Wisconsin Power and Light Company

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Madison, WI 53718

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March 23, 2011

Ms. Sandra J. Paske
Secretary to the Commission
Public Service Commission of Wisconsin
610 North Whitney Way
Madison Wisconsin 53707

RE: Wisconsin Power and Light Company **Docket No. 6680-CE-171**
Cedar Ridge Wind Farm, Order Points 14 & 15

Dear Ms. Paske:

Enclosed for filing is documentation provided in compliance with Order Points 14 and 15 of PSC Certificate and Order dated May 15, 2007.

Thank you.

/s/ Alan J. Arnold
Alan J. Arnold
Lead Environmental and Health Compliance Specialist
Wind Development Group

cc: Brian Dierksheide
Site Manager, Wind Generation Cedar Ridge

Attachment

February 2011

POST-CONSTRUCTION BIRD AND BAT MORTALITY STUDY
CEDAR RIDGE WIND FARM
FOND DU LAC COUNTY, WISCONSIN

Final Report

Prepared for:
Wisconsin Power and Light
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Madison, Wisconsin 53718-2148

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EXECUTIVE SUMMARY

BHE Environmental, Inc. was contracted by Wisconsin Power and Light Company (WPL) to conduct two years of post-construction bird and bat mortality surveys at its Cedar Ridge Wind Farm in Fond du Lac County, Wisconsin. Twenty of the 41 turbines were selected to be surveyed from March 15 to May 31, 2009, July 15 to November 15, 2009, March 15 to May 31, 2010, and July 15 to October 15, 2010. This report summarizes data collected during the 2009 and 2010 survey periods. Results are highlighted below:

- A total of 1,702 searches were conducted during the 200-day 2009 spring, fall, and late fall survey periods, and a total of 1,448 searches were conducted during the 166-day 2010 spring and fall survey periods.
- In 2009, 32 turbine-related bird carcasses were found during scheduled searches and an additional 14 were found incidental to non-search activities. In 2010, 24 turbine-related bird carcasses were found during scheduled searches and an additional four were found incidentally.
- No bird or bat species listed as threatened or endangered by the U.S. Fish and Wildlife Service or the state of Wisconsin were found as carcasses[1]. A single avian species found during the mortality surveys, the black-billed cuckoo (*Coccyzus erythropthalmus*), is listed by the State of Wisconsin as a "Special Concern" species and is protected by the federal Migratory Bird Treaty Act, as are all migratory birds.
- Perching birds (Passeriformes) were the most common (65 percent, 46 percent) order of birds found during both the 2009 and 2010 mortality surveys, respectively, followed by pigeons/doves (Columbiformes; 16 percent, 25 percent, respectively). The tree swallow (*Tachycineta bicolor*) and rock pigeon (*Columba livia*) were the two most common species of carcasses found in 2009, comprising 12.9 (n=4) and 9.7 percent (n=3) of the avian carcasses, respectively. The rock pigeon (not protected by Migratory Bird Treaty Act) was the most common species of carcass found in 2010, comprising 17 percent (n=4) of avian carcasses.
- Two raptor carcasses (red-tailed hawks [*Buteo jamaicensis*]) were found during the 2009 surveys. Two other red-tailed hawks and a single turkey vulture (*Cathartes aura*) were found as incidental finds in 2009. No raptor carcasses were found during the 2010 surveys; however, two red-tailed hawks were found as incidental finds in 2010.
- The bird carcasses found during the spring and fall searches were evaluated across seasons. In 2009, 14 of the 31 carcasses (45 percent) were found during the spring searches, while 17 (55 percent) were found during the fall searches. In 2010, 15 of the 24 carcasses (62.5 percent) were found during the spring searches, while 9 (37.5 percent) were found during the fall searches.
- In 2009, 84 bat carcasses were found during scheduled searches and an additional five were found incidentally. In 2010, 133 bat carcasses were found during scheduled searches and an additional 22 were found incidentally.
- Hoary bats (*Lasiurus cinereus*) were the most common (35 percent) bat species found in 2009. Four other species of bats were found in 2009: silver-haired bats

[1] Two bat species found during the mortality surveys, little brown bats (*Myotis lucifugus*) and big brown bats (*Eptesicus fuscus*), were recently listed as threatened by the State of Wisconsin; however, this listing and any associated reporting requirements did not go into effect until after the conclusion of the mortality surveys at Cedar Ridge.

(*Lasionycteris noctivagans*; 19 percent), big brown bats (18 percent), red bats (*Lasiurus borealis*; 14 percent), and little brown bats (14 percent). Red bats were the most common (33 percent) bat species found during the 2010 surveys, followed by hoary bats (27 percent), silver-haired bats (14 percent), big brown bats (13 percent), and little brown bats (11 percent). Tree bats, which migrate long distances and roost in trees year round, comprised 68 and 74 percent of the bat carcasses in 2009 and 2010, respectively.

- The bat carcasses found during the spring and fall searches were evaluated across seasons. In 2009, seven of the 84 carcasses (8 percent) were found during the spring searches, while 77 (92 percent) were found during the fall searches. In 2010, 11 of the 133 carcasses (8 percent) were found during the spring searches, while 122 (92 percent) were found during the fall searches.
- A total of 221 searcher efficiency trials were conducted for birds and bats during the 2009 spring and fall seasons. Searcher efficiency in 2009 was 51 percent for small and medium birds, 75 percent for large birds, and 27 percent for bats. A total of 50 searcher efficiency trials were conducted for large-bodied birds during the 2009 late fall season; searcher efficiency was 100 percent. A total of 218 searcher efficiency trials were conducted for birds and bats during the 2010 spring and fall seasons. Searcher efficiency was 80 percent for small and medium birds, 100 percent for large birds, and 69 percent for bats.
- A total of 128 scavenger removal trials were conducted during 2009, and a total of 100 scavenger removal trials were conducted during 2010. In 2009, the proportion of small and medium bird carcasses remaining after one day was 97 percent and decreased exponentially to 92.5 percent by day four for spring and fall. In 2010, the proportion of small and medium bird carcasses remaining after one day was 94 percent and decreased exponentially to 86 percent by day four for spring and fall. In 2009 and 2010, the proportion of bat carcasses remaining after one day was 94.5 percent and decreased exponentially to 87 percent by day four for spring and fall. Scavenger removal rates were not calculated for large birds for either year due to limited sample size.
- Mortality rates were calculated as average number per day, because data were not collected year round and assuming mortality remains at the same rate during the periods not surveyed may not be accurate. The mortality rate estimates calculated were 0.050 small birds, 0.014 medium-sized birds, and 0.299 bats per turbine per day for the 2009 spring and fall search periods (169 total days). The mortality rate estimates calculated were 0.022 small birds, 0.015 medium-sized birds, and 0.240 bats per turbine per day for the 2010 spring and fall search periods. (166 total days). Mortality rate estimates were not calculated for large-bodied birds for either year due to insufficient sample size.
- In 2009, mortality per turbine per 169 days (number of days in the 2009 spring and fall survey periods) would be an estimated 8.45 for small birds, 2.37 for medium birds for a combined small/medium bird estimate of 10.8, and 50.5 for bats. In 2010, mortality per turbine per 166 days (number of days in the 2010 spring and fall survey periods) would be an estimated 3.65 for small birds, 2.49 for medium birds for a combined small/medium bird estimate of 6.14, and 39.8 for bats.
- It be should be noted that the lack of standard methods for calculating rates complicates interpretation of the results when making comparisons of mortality data between wind farms.

1.0 INTRODUCTION

1.1 SITE DESCRIPTION

The Cedar Ridge Wind Farm is owned by Wisconsin Power and Light Company (WPL), a subsidiary of Alliant Energy Corporation. The wind farm is located approximately 16 kilometers (km; 10 miles [mi]) south of the city of Fond du Lac, near the towns of Eden and Empire. Eden and Empire are located in Fond du Lac County in southeastern Wisconsin (Figure 1).

Cedar Ridge consists of 41 wind turbines and related interconnection and ancillary facilities on approximately 3,160 hectares (ha; 7,808 acres [ac]; Figure 2). The Vestas V82 turbines utilize a horizontal axis, three-bladed rotor, and nacelle mounted on a tubular steel tower. Turbine and tower characteristics are as follows: 80-meter (m; 262.5 feet [ft]) hub height, 41-m (134.6 ft) blade length, 5,281-square meter (m^2; 56,844 square feet [ft^2]) rotor swept area, and 14.4-rotations per minute (rpm) rotor speed. The rotor swept area extends from 39 m (127.1 ft) above ground level (agl) to 121 m (396.1 ft) agl.

Nearly 80 percent of land in the project area is agricultural fields or vacant/open land; approximately 10 percent is forest; and the remainder is wetland, water, old fields, or other land uses (Figure 2; Table 1; and Photo 1 in Appendix A). Aerial photographs dating to 1941 indicate the project site has been used for agriculture, with some rural residential and recreational use, for at least 69 years. Construction on the Cedar Ridge Wind Farm was started in October 2007 and the facility began generating electricity in December 2008. The facility has the capacity to generate up to 68 megawatts (MW).

BHE Environmental, Inc. (BHE) was contracted to conduct two years of post-construction surveys to assess mortality of birds and bats for the Cedar Ridge Wind Farm as specified in the Wisconsin Public Service Commission (WPSC) Certificate of Authority (May 2007). In accordance with the WPSC order, methods for the post-construction survey were developed in coordination with the Wisconsin Department of Natural Resources (WDNR), the U.S. Fish and Wildlife Service (USFWS), and WPSC (Appendix B).

1.2 STUDY OBJECTIVES

The objectives of the proposed investigation were as follows:

- Conduct two years of mortality surveys at Cedar Ridge Wind Farm.
- Calculate estimates of collision mortality for birds and bats. Where sufficient data are collected, calculate estimated rates of mortality for species and/or species groups (e.g., passerines, "tree" bats).
- Collect data during the 2009 and 2010 spring and fall seasons on mortality, searcher efficiency, and scavenger removal.

2.0 METHODS

To assess bird and bat mortality, periodic and systematic searches below the turbines were conducted to locate birds and bats which collided with or assumed to have been impacted by the turbines due to the location of the find. Because searchers are not likely to locate all carcasses (e.g., buried in mud after heavy rain, buried in snow, or otherwise removed or

hidden from searchers) and because carcasses are often removed by scavengers, BHE also tested searcher efficiency and the rates of carcass removal. Rates of mortality of birds and bats at the Cedar Ridge Wind Farm were estimated by counting the number of carcasses found beneath a subset of turbines and by using standard statistical methods to correct for the rate of searcher efficiency and scavenger removal of carcasses. The approach for assessing avian and chiropteran mortality at Cedar Ridge was similar to methods used at the Blue Sky Green Field Facility in Fond du Lac County (approximately 19 km [12 mi] north of Cedar Ridge; Gruver et al 2008) and the Forward Energy Center (Forward) in Dodge and Fond du Lac counties (approximately 10 km [6 mi] southeast of Cedar Ridge; Drake 2008). Both of those wind generation projects are situated on larger areas than the Cedar Ridge Wind Farm and both projects have approximately twice the number of turbines as the Cedar Ridge Wind Farm.

The methods used were based upon the best data currently available and the best judgment of experienced professionals at the WDNR, USFWS, and WPSC. The approved study plan is provided in Appendix B. The methods presented herein were applied during 2009 and 2010.

2.1 ASSUMPTIONS

Mortality calculations for the Cedar Ridge Wind Farm were based on recommendations from a guidance document published by Kunz et al. (2007). A high number of turbines (20 of 41 turbines) were selected for the survey in order to more accurately extrapolate results across the entire project.

Previous studies have shown that most bird and bat mortalities occur during spring and fall migration events (Howe et al. 2002; Arnett et al. 2008); summer mortality is generally low. In order to maximize confidence in mortality estimates, field surveys for bird and bat carcasses took place during typical spring and fall migration periods. Additionally, crippling and mortality not associated with on-site wind turbines are assumed to be insignificant.

Carcasses found outside scheduled searches but located within search plots, and carcasses found outside search plots were documented according to procedures described below to the extent possible, and identified as incidental finds. No statistical analysis of incidental finds was conducted nor were incidental finds included in the estimates of mortality, as is consistent with the approved study plan.

2.2 FIELD SURVEYS

2.2.1 Sample Size

Following a study plan approved by the WDNR, 20 of 41 turbines in the project area were included and results were extrapolated across the site. WPL selected the turbines included in this study at the Cedar Ridge Wind Farm (Figure 1) based on the willingness of landowners to participate in the study. Twenty-one landowners agreed to participate and 20 of those 21 turbines were selected randomly by BHE. The turbines that were involved in the study were 1, 2, 6, 7, 9, 10, 11, 15, 16, 18, 19, 21, 22, 24, 26, 28, 29, 37, 38, 40, and 41R (Figure 2).

2.2.2 Search Plots

Plots were searched utilizing two separate methods. All of the search plots consisted of 2.56-ha (6.3 ac) square plots having 160-m (525 ft) long sides centered on the turbine. At two randomly selected turbines (Turbines 6 and 37/40), plots were searched in their entirety

(census plots); searchers walked twenty-six 6-m (19.7 ft) wide linear transects and two 2-m (6.6 ft) wide transects through the plot (Figure 3a), searching the entire 2.56-ha (6.3 ac) area. Census plots were selected by dividing the project area in half, and randomly selecting one plot in the southern half of the project area and one in the northern half of the project area.

The remaining 18 turbines (Turbines 1, 2, 7, 9, 10, 11, 15, 16, 18, 19, 21, 22, 24, 26, 28, 29, 38, and 41R) were sampled (sample plots) by searching six 6-m (19.7 ft) wide transects (Figure 3b). Two transects were centered on the turbine, perpendicular to each other. The other four transects intersected the plot at varying distances from the turbine, and in randomly selected directions (i.e., some transects were oriented north-south and some east-west). Transect centers were 10, 30, 50, and 70 m (approximately 33, 98, 164, and 230 ft) from the center of the turbine in half the plots, and 20, 40, 60, and 80 m (approximately 66, 131, 197, and 262 ft) from the turbine in remaining plots (Appendix C), distances which were selected randomly. The turbine pad and access road within the boundaries of the transects were searched. The search area at each of the 18 sample plot turbines was approximately 0.558 ha (1.4 ac).

2.2.3 Plot Condition

In an effort to increase searcher efficiency, plots were planted with either alfalfa by the land owners or grass by the hired mowing crew and maintained by mowing transects to a height of 10 centimeters (cm; 4 inches [in]), and 15 cm (6 in) within the rest of the plots throughout the study (Photo 2 in Appendix A). Landowners were instructed to remove all equipment and avoid plot areas. Fencerows were cleared of trees and shrubs shortly after the start of the study and herbaceous vegetation was controlled along the fencerows with herbicides. Understory vegetation within woodlots was also cleared and maintained (Photo 3 in Appendix A). To prevent carcasses from being removed or destroyed by mowers before searchers had a chance to locate them, mowing crews were instructed to mow plots after surveys were completed on that day. In 2010, plot transects were marked by spray painting a white line down the center of each transect. This marking process facilitated the mowing of straighter, more accurate lines by the mowing crew, and allowed for easier searches of transects by the field biologists.

2.2.4 Carcass Surveys

In 2009 and 2010, searches were conducted between March 15 and May 31, the typical period of spring migration for birds and bats, and again between July 15 and October 15, the typical period of fall migration for birds and bats. Between October 16 and November 15, 2009, hereafter called the "late fall" period, BHE personnel searched the 20 plots only looking for large-bodied birds, with a specific focus on finding sandhill cranes (*Grus canadensis*). Sandhill cranes inhabit the Horicon Marsh located 29 km (18 mi) southwest, have been observed on the Cedar Ridge site (Photos 4 and 5 in Appendix A), and often migrate through east-central Wisconsin in the fall later than other birds. Late fall surveys for large-bodied birds were not conducted in 2010 (WDNR approved elimination of the 2010 late fall surveys, due to a paucity of large bird data).

Prior to initiating the survey seasons in the spring of 2009 and 2010, and again prior to initiation of the 2009 and 2010 fall survey seasons (July 15), BHE conducted a clean sweep of all of the transects beneath each of the 20 turbines. Carcasses found during the clean sweeps were documented, removed from the site, and stored for potential use in searcher efficiency or scavenger removal trials.

Searches, conducted by trained personnel working in pairs, began at or shortly after sunrise. Searchers walked each transect at a rate of approximately 45 to 60 m per minute (m/min) along each transect.

The location of each carcass discovered was temporarily flagged (Photos 6 and 7 in Appendix A) and the distance and direction from the nearest turbine recorded with a rangefinder and compass, respectively. Each carcass was photographed as found in the field. When carcass condition allowed, data collected included the species, sex, age, reproductive condition, apparent cause of death (e.g., turbine collision or predator), presence of wing bars or other identifiers, and condition of the bird or bat carcass. Two types of carcass conditions were recorded. Condition 1 indicated how long the carcass had been present (i.e., fresh or decomposed). Condition 2 described how much of the carcass was remaining (i.e., whole, mostly whole, piece or pieces, or feather or fur spot). Searchers used the definitions below to determine conditions of each carcass.

- Fresh: little to no signs of decomposition; carcass likely fell within the past 24 to 48 hours (Photos 8 and 9 in Appendix A).
- Decomposed: signs of decomposition such as dehydration, strong odors, or missing flesh (Photo 10 in Appendix A).
- Whole: carcass is intact and in one piece with no body parts missing (Photos 8 and 9 in Appendix A).
- Mostly whole: carcass is mostly intact with a few minor body parts missing due to scavenging or decomposition (Photo 10 in Appendix A).
- Pieces: carcass is missing significant body parts or only a few body parts remain (Photos 11 and 12 in Appendix A).
- Feather or fur spot: carcass is missing, but fur or 10 or more feathers remain (Photos 6 and 13 in Appendix A).

Right forearm length was recorded for bats to facilitate identification. Carcasses were labeled with a unique identifier (Photo 11 in Appendix A), sealed in a plastic bag (Photo 14 in Appendix A), and stored frozen at the Cedar Ridge operations building (Photo 15 in Appendix A) at the site.

As a way of keeping track of which turbines to survey, the 20 turbines were grouped into five groups (Groups A through E) and two groups were surveyed each day during the spring and fall migration periods (Figure 4). The two census plots and three sample plots randomly selected at the beginning of the study were surveyed daily (Group A; Turbines 6, 10, 19, 22, and 37/40). The remaining 15 sample plots (Groups B through E; Turbines 1, 2, 7, 9, 11, 15, 16, 18, 21, 24, 26, 28, 29, 38, and 41R) were surveyed once every 4 days (Figure 4), rotating groups each day.

2009 Late Fall Survey Period Method: As noted above, the objective during the late fall survey period carried in 2009 was to find carcasses of large-bodied birds, specifically focusing on sandhill cranes. These relatively larger carcasses are likely to be more visible and less prone to decomposition and scavenging than smaller animals. Therefore, the frequency of searches was reduced and the pace increased during the late fall survey. All 20 turbines were searched every three days (Figure 5). Due to the large size and greater relative detectability of the bird species being surveyed, searchers walked only the center and perimeter of each plot (Figure 6 and Appendix D). If vegetation or topography blocked the view of any part of the plot, the searchers were instructed to walk to that portion to ensure the entire plot was

observed. All bird and bat carcasses identified during searches were collected and documented in the same manner as during the spring and fall periods; however, only large birds found were included in statistics. Small birds and bats found during this period were considered incidental finds because searchers were not employing standard search procedures designed to detect smaller carcasses. WDNR approved the Late Fall Field Procedure provided in Appendix D. In 2010 WDNR approved elimination of the late fall surveys, due to a paucity of large bird data.

2.2.5 Searcher Efficiency Trials

The ability of searchers to find a carcass must be considered when estimating mortality. Estimates solely based on carcasses found are likely to be significantly lower than actual mortality due to the low likelihood that searchers will find all carcasses. Searcher efficiency trials are conducted to develop a factor by which mortality estimates can be corrected. Trials were conducted during the spring and fall survey periods to estimate the percentage of carcasses found by searchers. Searcher efficiency trials were conducted by placing a mark of permanent red ink discreetly on carcasses (Photo 16 in Appendix A) and placing them throughout the 20 search plots with no more than three carcasses placed at a single turbine in one day. Carcasses of bats and birds of various sizes (i.e., small birds, medium birds, and large birds) and conditions (e.g., whole, partially decomposed) were used in the trials and placed throughout the transects in various levels of exposure. Bird carcass sizes for each species are defined in Appendix E. For the purposes of this study, species smaller than or equal to 10 inches in length and smaller than 4.0 oz in weight was considered a small bird, species greater than 10 inches in length or 4.0 to 15.99 oz in weight was considered a medium bird, and species greater than or equal to 1 pound (16.0 oz) in weight was considered a large bird. Levels of exposure are defined below.

- Exposed: carcasses not covered by vegetation or landscape features (Photos 7, 9, and 12 in Appendix A).
- Partially exposed: carcasses where at least part of the body is covered by vegetation or landscape features (Photos 17 and 18 in Appendix A).
- Hidden: carcasses where most or all of the body is covered by vegetation or landscape features (Photo 19 in Appendix A).

Searcher efficiency trials were conducted simultaneously with carcass searches; observers conducting carcass searches were not aware of the date or location where trial carcasses were placed. A person not conducting carcass searches placed trial carcasses during the evening or early morning prior to the start of carcass searches. Following carcass searches, trial carcasses were retrieved and the number and location of found trial carcasses were documented.

Carcasses used in trials came from a variety of sources. Bird carcasses were collected by harvesting non-native/non-protected birds in compliance with USFWS Migratory Bird Permits and WDNR Wildlife Collection Permits. Some bird carcasses that had been subject to mortality from automobile collisions were collected along roadsides. The Pineview Wildlife Rehabilitation Center in Ozaukee County, Wisconsin provided bird carcasses that resulted from mortality which occurred during the facility's attempts to rehabilitate the birds. Initially bat carcasses were used from WDNR and carcasses collected from a wind farm study in Tennessee. However, in May and June of 2009, landowners became concerned about the use of bat carcasses during the study. After a series of meetings and communications between WDNR, WPL, and the landowners, WDNR determined that only bat carcasses collected in Wisconsin, collected on-site as part of the Cedar Ridge study, or bat carcasses provided by

the Wisconsin Department of Health, Laboratory of Hygiene could be utilized. Bird carcasses from the wildlife rehabilitation center were also prohibited from use and were not used in the 2009 fall portion of the study or in 2010.

WDNR approved use of surrogates for the large-bodied bird carcasses during 2009 late fall searcher efficiency trials. As an alternative to carcasses, burlap bags filled with straw (Photo 20 in Appendix A) to approximate the size of sandhill cranes were used as surrogates during these searcher efficiency trials.

2.2.6 Scavenger Removal Trials

In addition to the efficiency of searchers, the rate at which scavengers remove carcasses also can affect the resulting mortality estimate. Scavenger removal trials are conducted to further correct mortality estimates based on scavenger activity and the probability of a carcass remaining from the time it fell to the ground to the time a searcher walks by. Trials were conducted during the spring and fall survey periods to estimate the rate of carcass removal by scavengers or other means (e.g., mowing or decomposition). Carcasses were placed at all 20 search plots, marked with an inconspicuous plastic plant stake (Photo 13 in Appendix A), and no more than two carcasses were placed in a single search plot during a survey period. Scavenger removal trials were conducted separately from searcher efficiency trials to avoid placing too many carcasses in one area.

Bird carcasses of various sizes, as well as bat carcasses, used in the trials were obtained from the same sources previously described. The observer conducting the daily carcass searches surveyed the carcasses over a period of 30 days. Carcasses were checked daily for the first five days, every three days between days 6 and 20, and on day 30. A photograph and condition of the carcass were recorded during each check. Conditions recorded were defined as described below.

- Intact: carcass with no body parts missing (Photos 8 and 9 in Appendix A).
- Scavenged: carcass with evidence of scavenging (Photo 12 in Appendix A).
- Feather or fur spot: only fur or 10 or more feathers remaining but no carcass remaining (Photos 6 and 13 in Appendix A).
- Missing: no carcass remaining or less than 10 feathers remaining.

Remaining trial carcasses, if any, were removed at the end of 30 days.

Scavenger removal trials in the late fall used larger carcasses, but it was agreed with WDNR that birds that approximate the size of sandhill cranes (i.e., domestic chickens and/or turkeys) should not be used. Large birds used during the late fall scavenger removal trials included ducks, great blue heron (*Ardea herodias*), rock pigeon (*Columba livia*), red-tailed hawk (*Buteo jamaicensis*), and great horned owl (*Bubo virginianus*). Due to the paucity of large-bodied bird mortality in the late fall period in 2009, WDNR approved elimination of the late fall monitoring in 2010.

2.3 CALCULATIONS AND ASSUMPTIONS

Estimated rates of mortality were calculated using methods typically applied to studies of wildlife mortality at wind farms. Improved calculations proposed in recent literature were incorporated (Smallwood 2007; Huso 2009). The following calculations were used to analyze data from the Cedar Ridge Wind Farm.

The estimated mean number of carcasses (M_u) observed per turbine per study period of interest (e.g., spring migration period, fall migration period, entire year):

$$M_u = \frac{\sum_{i=1}^{n} M_i}{k * A}$$

Where M_i is the number of carcasses found at plot *i* during the study period of interest, *A* is the proportion of the plot actually searched, and *k* is the number of turbines searched.

The proportion of carcasses remaining was calculated using the following equation (Smallwood 2007):

$$R_c = \frac{\sum_{I}^{i=1} R_i}{I \; x \; 100}$$

R_c is the cumulative proportion of carcasses remaining, *I* is the duration of a scavenger removal trial, R_i is the percent of carcasses remaining by the i^{th} day after initiation of the trial.

The R_i were estimated using an interval-censored exponential survival model. Two models were developed, one for small and medium birds combined and one for bats. Each model incorporated scavenger removal data from both the spring and fall study periods.

Estimated adjusted mortality (M_a) is:

$$M_a = \frac{M_u}{R_c \; x \; p}$$

Where *p* is the proportion of carcasses found by mortality searches during searcher detection trials.

Estimates of mortality were expressed per turbine per day. Estimates were calculated separately for both birds and bats.

All standard errors (SEs) were estimated using 5,000 bootstrap replications. Each of the 5,000 replicate samples provided an estimate for M_u, R_c, p, and M_a. The 90 percent confidence intervals (CIs) were constructed using the lower 5 percent and upper 95 percent of the distribution of 5,000 bootstrap estimates of M_a (Manly 1997).

The proportion of mortality for species or species groups (e.g., passerines, "tree" bats) was also calculated. Insufficient data were collected to quantitatively compare data from census plots with data from sample plots to identify variation attributed to the difference in area sampled.

Calculations were based upon the following assumptions:

- Rates of bird and bat mortality are similar among all turbines in the Cedar Ridge Wind Farm.
- Most mortality at the wind farm will occur during the migration periods for birds and bats (Howe et al. 2002; Arnett et al. 2008).

- Levels of background mortality (i.e., mortality not associated with turbines) and crippling bias (mortality of animals injured by turbines but that move away from the site and die at a later time) are insignificant (Smallwood 2007).

To eliminate false negatives in the dataset, WPL provided BHE information on any period(s) of three or more days where a study turbine was not operational. During the 2009 study period no study turbines were non-operational for three or more days. In 2010, Turbine 38 was non-operational for six days from September 3 to September 8, 2010 but this was considered to be insignificant and was not accounted for in the statistical analysis. Turbine 29 was non-operational for 26 days from September 13 to October 8, 2010. This was accounted for by removing all carcass search data from Turbine 29 for the 2010 study period from the mortality rate calculations.

Data on weather conditions during the survey periods was obtained from the National Climatic Data Center (NCDC) from the Fond du Lac Airport, approximately 16 km (10 mi) northwest of the project site. Weather conditions were evaluated qualitatively to estimate effects of weather on bird and/or bat mortality. For birds, the weather the day prior to any search day where two or more carcasses were found was considered. For bats, the weather the night prior to any search day where three or more carcasses were found was considered.

2.4 DISPOSITION OF CARCASSES

Carcasses found at Cedar Ridge were stored frozen on site. Frozen specimens in good condition were used during searcher efficiency or scavenger removal trials. At the end of the 2009 study period, specimens in good condition were frozen for use in the trials in 2010. When 2010 surveys were initiated, the condition of those remaining frozen carcasses were re-assessed to determine suitability for trial. Those in poor or extensively decomposed condition were incinerated at a nearby Fond du Lac County location in accordance with the requirements of our USFWS and WDNR wildlife collection permits.

Protocol required agencies to be notified immediately (within 24 hours) if an unusually large number of birds or bats were killed at one instance. A large mortality event was defined as five birds or bats found at a single turbine in a single day. No such event occurred during the 2009 or 2010 survey periods.

3.0 RESULTS

3.1 PLOTS

3.1.1 Description

Most landowners allowed full access to their property; however, the land owner in the northeastern corner of Turbine 41R's plot did not grant access (see Turbine 41R plot map in Appendix C). Consequently, BHE did not survey the northeastern corner of the plot surrounding Turbine 41R. During the 2009 and 2010 spring and fall surveys, only the end of Transect E was affected, which covers approximately 0.02 ha (0.04 ac) of the sampled area in the plot (3.1 percent). During the 2009 late fall surveys, the area not surveyed was approximately 0.01 ha (0.17 ac) of the plot (2.7 percent). In addition to Turbine 41R, in 2009 the land owner at Turbine 6 accidentally planted corn in the northern half of Transect A and the entire Transect AA (Photo 21 in Appendix A). Rather than remove the corn and compensate the land owner, BHE did not survey this 0.08-ha (0.2 ac) northern portion of the

plot (3.17 percent) during the 2009 fall survey period. By the start of the 2009 late fall surveys, the land owner had harvested the corn, allowing BHE to include that northern portion in the 2009 late fall surveys.

In early 2010, BHE coordinated with the WDNR to eliminate search areas where the ability to detect carcasses was greatly reduced; primarily this consisted of piles of cobbles and boulders along fencerows that intersected transects. In addition, one turbine plot had a trailer with a fire pit and other objects surrounding it and two turbine plots had stands of small pines that would prevent many carcasses from falling to the ground. In multiple locations, BHE recommended shifting of the search transect to allow searchers to search the entire transect without interference from identified obstacles. These changes decreased the total search area for the 2010 spring and fall surveys by less than one percent (0.125 ha [0.306 ac]) of the total area allowed, and were approved by the WDNR (Appendix F). All adjustments made in 2009 and 2010 were accounted for in the statistical analyses.

With the exceptions noted, plots were maintained to facilitate searches. Woodlots were cleared of understory vegetation and fencerows were cleared of trees, shrubs, and herbaceous vegetation. However, in 2009 the piled cobbles along fencerows remained part of some search areas, limiting the ability of searchers to detect carcasses that may have landed in those areas (Photo 22 in Appendix A). Near the beginning of the spring 2009 survey period, understory within woodlots had not yet been cleared and tall grass had not been mowed, particularly at Turbine 19 (Photo 23 in Appendix A), increasing the likelihood that small carcasses would become hidden from searchers.

Most plots have the turbine in the center of the plot, with each corner of the plot equidistant from the turbine. Due to property boundaries, plots at Turbines 16 and 40 are not centered on the turbines. Plot area and area searched remained the same as other turbines; however, distances searched from the turbine are slightly skewed.

Transects were oriented north/south or east/west on all turbines except Turbine 38. At this turbine, the plot and transects were rotated as a way to facilitate the land owner's ability to plow the surrounding terrain (see Turbine 38 plot map in Appendix C). Plot area, search area, and distances from the turbine remained unchanged.

3.1.2 Schedule

Approved procedures called for suspending field work during lightning storms, icy conditions, heavy snow and rain, and other weather conditions that create a safety hazard or conditions that preclude effective searching. Due to snow storms, searches were canceled on two days in spring 2009: March 29 and April 21, 2009. The March 29 search was not feasible to reschedule. Turbine 40 was searched April 21 before the remaining search effort was canceled, however the data were not included in the analysis because visibility during the search was poor (Photo 24 in Appendix A). Searches at Turbines 2, 9, 26, and 29 that were scheduled for April 21 were rescheduled and searched on April 22 along with the turbines scheduled to be searched that day. Searches were canceled due to snow or other severe weather on four days in spring and fall 2010: March 20, April 8, May 11, and September 6, 2010. Additionally, searches were not conducted on October 2, 2010 due to a lack of searchers. Searches were canceled at Turbine 6 and Turbine 40 on July 22, 2010 due to severe weather. Searches at Turbine 29 could not be conducted on October 1, 2010 due to turbine maintenance. None of the canceled searches in 2010 were rescheduled.

A total of 1,702 searches (one search is one turbine in one day) were conducted during the 200-day 2009 survey period: 669 searches during the 76 days in the spring, 813 searches during the 93 days in the fall, and 220 searches during the 31 days in the late fall. A total of 1,448 searches were conducted during the 166-day 2010 survey period: 656 searches during the 75 days in the spring and 792 searches during the 91 days in the fall. Field crews searched each turbine in Group A (daily searches) 180 times in 2009, and 165 or 166 times in 2010 depending on searches canceled due to reasons described above. Turbines scheduled to be searched every four days (Groups B through E) were searched 52 or 54 days in 2009 and 40, 41, or 43 days in 2010 depending on the turbine search rotation schedule and searches canceled due to reasons described above.

3.2 BIRD MORTALITY

3.2.1 Abundance and Species

A total of 31 individual bird carcasses of 17 species were found during the 2009 spring and fall plot searches and were considered turbine-related mortalities (Table 2 and Appendix G). A total of 24 individual bird carcasses of 13 species were found during the 2010 spring and fall plot searches (Table 3 and Appendix G). In addition to the 31 avian carcasses found during 2009 spring and fall searches, a wild turkey feather spot was found during searches and determined to be the result of predation or territorial fighting rather than a turbine-related mortality. Because the wild turkey was not considered a turbine-related mortality, it was not included in the statistical analysis. Five of the 31 avian carcasses found in 2009 and five of the 24 carcasses found in 2010 were unidentifiable due to the lack of sufficient plumage detail or due to an advanced state of decomposition. An additional 11 avian carcasses were found incidentally during the spring and fall of 2009 and an additional four carcasses were found incidentally in 2010; therefore, these carcasses were not included in the statistical analysis.

Tree swallow (*Tachycineta bicolor*) and rock pigeon were the two most common species for which carcasses were found during 2009 spring and fall searches, comprising 12.9 (n=4) and 9.7 percent (n=3) of the avian carcasses, respectively (Table 2). Rock pigeon was the most common species for which carcasses were found during 2010 spring and fall searches, comprising 16.7 percent (n=4) of the carcasses (Table 3). In 2009, four species each comprised 6.5 percent (n=2) of the individual carcasses: mourning dove (*Zenaida macroura*), magnolia warbler (*Dendroica magnolia*), golden-crowned kinglet (*Regulus satrapa*), and ruby-crowned kinglet (*Regulus calendula*); all other species were represented by one individual carcass comprising 3.2 percent each. In 2010, three species each comprised 8.3 percent (n=2) of the individual carcasses: mourning dove, tree swallow, and lapland longspur (*Calcarius lapponicus*); all other species were represented by one individual carcass comprising 4.1 percent each. Of the total 31 birds found in spring and fall of 2009, one (3.2 percent) was a large-bodied bird, a red-tailed hawk, and the remaining 96.8 percent were small to medium-bodied songbirds or doves. Of the total 24 birds found in spring and fall of 2010, one (4 percent) was a large-bodied bird, an American crow (*Corvus brachyrhynchos*), and the remaining 96 percent were small to medium songbirds, doves, cuckoos, or shorebirds.

In 2009, swallows (Hirundinidae), pigeons/doves (Columbidae), and kinglets (Regulidae) were the three most common families of birds found during spring and fall searches, comprising 23 (n=7), 16 (n=5), and 13 percent (n=4) of avian carcasses, respectively (Figure 7a). In 2010, pigeons/doves (Columbidae), sparrows/longspurs (Emberizidae), swallows (Hirundinidae), and kinglets (Regulidae) were the four most common families of birds found during spring and fall searches, comprising 25 (n=6), 17 (n=4), 8 (n=2), and 8 percent (n=2) of avian carcasses,

respectively (Figure 8a). Perching birds (Passeriformes) were the most common order of birds found during spring and fall searches in 2009 (65 percent, n=20) and in 2010 (46 percent, n=11) (Figure 7b and Figure 8b).

A single large-bodied bird, a red-tailed hawk, was found during the 2009 late fall study period. Due to this limited sample size, no statistical analysis was conducted for the 2009 late fall study period. An additional three avian carcasses were found incidentally during the 2009 late fall study period.

No avian species listed by the USFWS were found during the surveys. One species found during the surveys, the black-billed cuckoo (*Coccyzus erythropthalmus*), is listed by the State of Wisconsin as a "Special Concern" species and is protected by the Migratory Bird Treaty Act (WDNR 2011).

Of the 33 birds found during searches in 2009, surveyors were able to determine age class (adult versus juvenile) for 24 carcasses and were able to determine the sex of 11 carcasses (Table 4). In 2010, 9 of the 24 birds found during searches were able to be aged and 3 of the 24 were able to be sexed (Table 5). In 2009, adults comprised 71 percent (n=17) of the 24, while 29 percent (n=7) were juveniles. In 2010, adults comprised 78 percent (n=7) of the 9, while 22 percent (n=2) were juveniles. Sex ratios among the 11 bird carcasses found in 2009 were nearly even with 55 percent (n=6) females and 45 percent (n=5) males. In 2010, two of the three carcasses that could be sexed were females and one was a male.

The 2009 mortality rate estimate calculated for small-bodied birds was 0.050 birds per turbine per day (SE: 0.013; 90 percent CI: 0.031, 0.073) covering the spring and fall search periods (169 total days; Table 6). The 2010 mortality rate estimate calculated for small-bodied birds was 0.022 birds per turbine per day (SE: 0.005; 90 percent CI: 0.013, 0.031) covering the spring and fall search periods (166 total days; Table 7). The mortality rate estimate calculated for medium-bodied birds was 0.014 birds per turbine per day (SE: 0.006; 90 percent CI: 0.006, 0.024) for the 2009 spring and fall search periods (169 total days; Table 6). The mortality rate estimate calculated for medium-bodied birds was 0.015 birds per turbine per day (SE: 0.005; 90 percent CI: 0.008, 0.023) for the 2010 spring and fall search periods (166 total days; Table 6). Mortality rate estimates were not calculated for large-bodied birds for any season due to low sample size, due to detection of only one or two large-bodied bird carcasses during plot searches in each year.

One injured bird, a barn swallow (*Hirundo rustica*), was found during standard searches, which was carefully captured by the observer and humanely euthanized according to physical measures approved by the American Veterinary Medical Association (AVMA 2007). As required by the permit, details of the injury to the bird and euthanasia were reported to the USFWS Migratory Bird Regional Permit Office shortly after the incident.

3.2.2 Temporal Patterns

The bird carcass data from the 2009 and 2010 spring and fall searches were qualitatively evaluated across seasons. In 2009, 14 (45 percent) of the 31 carcasses were found during the spring searches, while 17 (55 percent) were found during the fall searches. In 2010, 15 (62.5 percent) of the 24 carcasses were found during the spring searches, while nine (37.5 percent) were found during the fall searches. Bird carcasses found during the spring and fall searches were also graphed by semi-monthly intervals (Figure 9 and Figure 10). The numbers of bird carcasses found were relatively evenly distributed over time, with possible slight increases shown in early August and late September of 2009, and an increase in March of 2010.

3.2.3 Spatial Patterns

In order to qualitatively evaluate differences in bird mortality across turbines, the number of carcasses found at each turbine was divided by the number of searches performed at that turbine, so that direct comparisons could be made between turbines that were searched daily and turbines that were searched every four days. The number of carcasses found at each turbine per search was then divided by the area (m^2) of each turbine plot that was searched so that direct comparisons could be made between turbines that were searched using a census approach and turbines where only a portion of the total plot was searched. This resulted in estimates of bird carcasses found per search per m^2 for each of the 20 turbines where searches were performed in 2009 and 2010 (Figure 11 and Figure 12).

In 2009 and again in 2010 there were few notable patterns of bird mortality across turbines for the spring season (Figure 11a and Figure 12a), the fall season (Figure 11b and Figure 12b), or the spring and fall seasons combined (Figure 11c and Figure 12c). Bird carcasses found per search per m^2 at Turbine 1 were slightly elevated in the 2009 fall season but this was attributed entirely to three tree swallow carcasses that were found at the turbine on August 13, 2009. The slight elevations in bird carcasses found per search per m^2 at Turbine 9 during the 2009 spring season, at Turbine 24 and Turbine 26 during the 2009 fall season, and at Turbine 2 and Turbine 41R during the 2010 spring season were each attributed to only two carcasses. In all five cases, the carcasses were of two different species found more than two weeks apart. The slight elevation in bird carcasses found per search per m^2 at Turbine 38 during the 2009 spring and fall seasons was attributed to four carcasses: two carcasses found in the 2009 spring season and two found in the 2009 fall season, with durations between carcass finds of over a month.

Bird carcasses found during the 2009 and 2010 spring and fall searches were also evaluated as a function of distance from the base of the search turbine (Table 8 and Table 9). Bird carcasses were found at a mean distance of 52 m (170.6 ft) from the turbines in 2009 and at a mean distance of 61 m (200 ft) from the turbines in 2010. The number of bird carcasses found was relatively evenly distributed across the ranges of distances from the turbine, except in 2010 no carcasses were found from 0 to 19 m from the turbines. The bird carcass found at the greatest distance from a search turbine was found at 101 m (331.4 ft) from the turbine. It should be noted that the maximum possible distance from the turbine in all search plots was approximately 113 m (370.7 ft).

3.3 BAT MORTALITY

3.3.1 Abundance and Species

A total of 84 and 133 individual bat carcasses of five species were found during the 2009 and 2010 plot searches, respectively (Table 10, Table 11, and Appendix H). Two of the 133 bat carcasses found in 2010 were unidentifiable due to the lack of identifying features or due to an advanced state of decomposition. An additional five bat carcasses were found incidentally in 2009 and an additional 22 were found incidentally in 2010; however these carcasses were not included in the analysis.

The hoary bat (*Lasiurus cinereus*) was the most common species of carcass found in 2009, comprising 34.5 percent (n=29) of the bat carcasses found during searches (Figure 13a). In 2009, distribution among the remaining species was relatively even with silver-haired bats (*Lasionycteris noctivagans*) comprising 19.0 percent (n=16), big brown bats (*Eptesicus fuscus*) comprising 17.9 percent (n=15), and red bats (*Lasiurus borealis*) and little brown bats (*Myotis*

lucifugus) each comprising 14.3 percent (n=12 each). The red bat was the most commonly found species of carcass in 2010, comprising 33 percent (n=44) of the bat carcasses found during searches (Figure 14a). In 2010, hoary bats comprised 27 percent (n=36) of carcasses, silver-haired bats comprised 14 percent (n=19), big brown bats comprised 13 percent (n=17), little brown bats comprised 11 percent (n=15), and bats of unknown species comprised the remaining two percent (n=2). Tree bat species (i.e., hoary, red, and silver-haired bats) comprised 68 percent (n=57) of the individual carcasses in 2009 (Figure 13b) and 74 percent (n=99) of the individual carcasses in 2010 (Figure 14b). The commonly occurring big brown and little brown bats comprised the remaining 32 percent (n=27) in 2009 and 24 percent (n=32) in 2010.

No bat species listed as threatened or endangered by the USFWS were found during the surveys. Two bat species found during the surveys, the little brown bat and big brown bat, were recently listed as threatened by the State of Wisconsin. The Wisconsin Natural Resources Board (WNRB) approved an emergency order on September 22, 2010 to list four species of cave bats (little brown bats, big brown bats, northern long-eared bats [*Myotis septentrionalis*], and eastern pipistrelles [*Perimyotis subflavus*]) as threatened within the state due to threat from white-nose syndrome (WNRB 2010). However, this emergency listing and any reporting requirements defined in the associated Broad Incidental Take Permit/Authorization for Cave Bats (WDNR 2010) which includes provisions for wind energy projects did not go into effect until after the conclusion of the mortality surveys at Cedar Ridge.

Of the 84 bats found during 2009 carcass searches, surveyors were able to determine the age class (adult versus juvenile) of 82 carcasses, and were able to determine the sex of 46 carcasses (Table 12). In 2010, 91 of the 133 bats found during searches were able to be aged and 97 of the 133 were able to be sexed (Table 13). In 2009, 87 percent (n=71) of the 82 bats were adults and 13 percent (n=11) were juveniles. In 2010, 91 percent (n=83) of the 91 bats were adults and nine percent (n=8) were juveniles. In 2009, 61 percent (n=28) of the 46 bats were female and 39 percent (n=18) were male. In 2010, 52 percent (n=50) of the 97 bats were female and 48 percent (n=47) were male.

The mortality rate estimate calculated for bats was 0.299 bats per turbine per day (SE: 0.063; 90 percent CI: 0.214, 0.416) for the 2009 spring and fall search periods (169 total days; Table 6). The mortality rate estimate calculated for bats was 0.240 bats per turbine per day (SE: 0.025; 90 percent CI: 0.201, 0.283) for the 2010 spring and fall search periods (166 total days; Table 7).

One injured bat, a little brown bat, was found during standard searches in 2009 and one injured bat, a hoary bat, was found during standard searches in 2010. The injured bats were carefully captured by the observer and humanely euthanized according to physical measures approved by the American Veterinary Medical Association (AVMA 2007).

3.3.2 Temporal Patterns

The bat carcasses found during the spring and fall searches were qualitatively evaluated across seasons. In 2009, seven (8 percent) of the 84 carcasses were found during the spring searches, while 77 (92 percent) were found during the fall searches. In 2010, 11 (8 percent) of the 133 carcasses were found during the spring searches, while 122 (92 percent) were found during the fall searches. Bat carcasses found during the spring and fall searches were also graphed by semi-monthly intervals (Figure 15 and Figure 16). The numbers of bat carcasses were found to be very low in the spring compared to the fall, with the peak of bat

carcasses found during August. In 2009, males were found as early as March 25 and females were found as early as May 8. In 2010, females were found as early as April 20 and males were found as early as May 19. The earliest juveniles were found on July 26, 2009 and August 9, 2010.

3.3.3 Spatial Patterns

In order to qualitatively evaluate differences in bat mortality across turbines, the same analytical procedure was used as previously described for birds in Section 3.2.3 of this report. This resulted in estimates of bat carcasses found per search per m^2 for each of the 20 turbines where searches were performed in 2009 and 2010 (Figure 17 and Figure 18).

In 2009 and again in 2010 there were few notable patterns of bat mortality across turbines for the spring season (Figure 17a and Figure 18a), the fall season (Figure 17b and Figure 18b), or the spring and fall seasons combined (Figure 17c and Figure 18c). Bat carcasses found per search per m^2 at Turbine 15 were elevated compared to other turbines in the 2009 spring and fall seasons. This was attributed to a total of eight bat carcasses (two found in the 2009 spring season, six found in the 2009 fall season) of four species all found on different search days. The elevated bat carcasses found per search per m^2 at Turbine 41R during the 2009 spring and fall seasons was attributed to a total of nine bat carcasses (one found in the 2009 spring season, eight found in the 2009 fall season) of four species. Two bat carcasses, a red bat and a hoary bat, were found at Turbine 41R on September 22, 2009; three bat carcasses, two silver-haired bats and one hoary bat, were found at Turbine 41R on October 12, 2009. Bat carcasses found per search per m^2 at Turbine 1 were elevated compared to other turbines in the 2010 fall season. This was attributed to ten bat carcasses of five species. Two hoary bats were found at Turbine 1 on July 20, 2010; two big brown bats were found at Turbine 1 on August 9, 2010. While these three turbines (15,41R, and 1)are close to wooded areas, no conclusions can be drawn to indicate proximity to trees increased mortality. Many turbines that were also close to trees showed little to no elevation in bat mortality (i.e., Turbines 2, 9 to 18, 21, 26 to 29, and 40).

Slight elevations in bat carcasses found per search per m^2 compared to other turbines were shown at Turbines 1, 2, 26, 29, and 38 during the 2009 fall season. These elevations were attributed to two to four bat carcasses of two to four different species at each turbine. Two bat carcasses, a big brown bat and a little brown bat, were found at Turbine 1 on August 17, 2009. Two hoary bat carcasses were found at Turbine 26 on August 14, 2009. No more than one bat carcass was found on any given search day at Turbines 2, 29, and 38 during the 2009 fall season. A very slight elevation in bat carcasses per search per m^2 compared to other turbines was shown at Turbine 7 during the 2010 spring season, and was attributed to two carcasses found over a month apart. Slight elevations in bat carcasses found per search per m^2 compared to other turbines were shown at Turbines 15, 24, 38, and 41R during the 2010 fall season. These elevations were attributed to five to eight bat carcasses of two to five different species at each turbine. Two bat carcasses, a big brown bat and a hoary bat, were found at Turbine 24 on August 23, 2010. Two bat carcasses, a red bat and a little brown bat, were found at Turbine 38 on August 3, 2010; two red bat carcasses were found at Turbine 38 on August 15, 2010. Three bat carcasses (a red bat, a hoary bat, and a little brown bat) were found at Turbine 41R on August 13, 2010. No more than one bat carcass was found on any given search day at Turbine 15 during the 2010 fall season.

Bat carcasses found during the 2009 and 2010 spring and fall searches were also evaluated as a function of distance from the search turbine (Table 14 and Table 15). Bat carcasses were found at a mean distance of 25 m (82 ft) from the turbines in 2009 and at a mean distance of

27 m (88.6 ft) from the turbines in 2010. The number of bat carcasses found was shown to generally decrease with increasing distance from the turbine. No bat carcasses were found at a distance of 80 m (262.5 ft) or more from any search turbine. Maximum distance searched was 113 m (370.7 ft) from the turbine.

3.4 SEARCHER EFFICIENCY TRIALS

A total of 271 searcher efficiency trials were conducted during 2009 using birds and bats of various sizes (Table 16). One trial is a placement of a single carcass for one day. Of the 271 total trials, 256 trial carcasses were determined to have been available for searchers to find. Available carcasses were carcasses not removed by wind, scavengers, or mowers and were available for searchers to find. A carcass was determined to have been not available for searchers to find if at the conclusion of the searcher efficiency trial that carcass could not be located by the biologist who had placed it. Trials were conducted during the 2009 spring (114 total, 103 available) and fall (107 total, 103 available) migratory periods. Fifty trials were conducted during the 2009 late fall large-bodied bird surveys.

A total of 218 searcher efficiency trials were conducted during 2010 (Table 17). Of the 218 total trials, 208 trial carcasses were determined to have been available for searchers to find. Trials were conducted during the 201 spring (119 total, 117 available) and fall (99 total, 91 available) migratory periods.

A total of 92 searcher efficiency trials, with 87 available carcasses, were conducted for small- and medium-bodied birds during the 2009 spring and fall seasons. Forty-four of the 87 available carcasses were found for a searcher efficiency of 51 percent. A total of eight searcher efficiency trials, with all eight carcasses available, were conducted for large-bodied birds during the 2009 spring and fall seasons; six of the eight available carcasses were found for a searcher efficiency of 75 percent. A total of 50 searcher efficiency trials, with all 50 surrogate carcasses available, were conducted for large-bodied birds during the 2009 late fall season. All 50 of the surrogate carcasses were found for a searcher efficiency of 100 percent.

A total of 104 searcher efficiency trials, with 100 available carcasses, were conducted for small- and medium-bodied birds during the 2010 spring and fall seasons. Eighty of the 100 available carcasses were found for a searcher efficiency of 80 percent. A total of three searcher efficiency trials, with all three carcasses available, were conducted for large-bodied birds during the 2010 fall season; all three of the available carcasses were found for a searcher efficiency of 100 percent.

A total of 121 searcher efficiency trials, with 111 available carcasses, were conducted for bats during the 2009 spring and fall seasons. Thirty of the 111 available carcasses were found for an overall searcher efficiency of 27 percent for bat carcasses. Sixty-six searcher efficiency trials, with 58 available carcasses, were conducted for bats during the 2009 spring season. Ten of the 58 available carcasses were found for a searcher efficiency of 17 percent. A total of 55 searcher efficiency trials, with 53 available carcasses, were conducted for bats during the 2009 fall season. Twenty of the 53 available carcasses were found for a searcher efficiency of 38 percent.

Searcher efficiency greatly improved in 2010. A total of 111 searcher efficiency trials, with 105 available carcasses, were conducted for bats during the 2010 spring and fall seasons. Seventy-two of the 105 available carcasses were found for a searcher efficiency of 69 percent.

3.5 SCAVENGER REMOVAL TRIALS

A total of 128 scavenger removal trials were conducted during 2009, and a total of 100 scavenger removal trials were conducted during 2010. Trials using birds and bats of various sizes were conducted during the spring (50 trials in 2009 and 50 trials in 2010) and fall (66 trials in 2009 and 50 trials in 2010) migratory periods. One trial is a placement of a single carcass for 30 days. During the 2009 late fall period BHE conducted 12 trials using only medium- to large-bodied birds. In 2009, the proportion of small and medium bird carcasses remaining after one day was 97 percent and decreased exponentially to 92.5 percent by day four (the longest interval between searches) for spring and fall (Figure 19). In 2010, the proportion of small and medium bird carcasses remaining after one day was 94 percent and decreased exponentially to 86 percent by day four for spring and fall (Figure 20). In 2009 and 2010, the proportion of bat carcasses remaining after one day was 94.5 percent and decreased exponentially to 87 percent by day four for spring and fall (Figure 21 and Figure 22). Scavenger removal rates were not calculated for large birds for any season due to insufficient sample size.

4.0 DISCUSSION

4.1 MORTALITY

4.1.1 Abundance and Species

Birds comprised 27 percent and 15 percent of the total carcasses found during the 2009 and 2010 searches, respectively. The proportion of bird species was nearly three times the proportion of bat species (17 and 13 bird species versus 5 bat species) in both 2009 and 2010. This was expected due to the much larger relative number of bird species recorded annually in Wisconsin (approximately 350 species) compared to only seven species of bats. Though proportions are not identical, other wind farms in Wisconsin have documented similar results. Gruver et al. (2009) found 14.1 percent of the carcasses at the Blue Sky Green Field Wind Farm were birds, while Drake et al. (2009) found only 7.2 percent were birds at the Forward Wind Farm. The lower proportions of birds at Blue Sky Green Field and Forward may be due to the lack of spring surveys at these two sites. Howe et al. (2002) documented bird proportions more similar to Cedar Ridge with 25.8 percent birds at a site in Kewaunee County, Wisconsin. Like Cedar Ridge, surveys at the Kewaunee site occurred during both spring and fall migration.

Swallows (Hirundinidae), pigeons/doves (Columbidae), and kinglets (Regulidae) were the three most common families of birds found during 2009 mortality surveys at Cedar Ridge. Similarly in 2010, pigeons/doves, sparrows/longspurs (Emberizidae), swallows, and kinglets were the most common families of birds found. Similar to other studies (National Academy of Sciences [NAS] 2007), perching birds (Passeriformes) were the most common order of birds in 2009 and 2010. Kinglets and swallows were also the most common at Blue Sky Green Field (Gruver et al. 2009) and swallows comprised four of the six birds found at Forward (Drake et al. 2009).

While the number of bat species found during mortality searches was far less than the number of bird species found, the number of individual bat carcasses was 2.7 and 5.5 times higher than the number of bird carcasses in 2009 and 2010, respectively. Like other studies (NAS 2007), mortality among bats found at Cedar Ridge was dominated by tree bats, which comprised 68 and 74 percent of all bats found during searches in 2009 and 2010, respectively.

Hoary bats composed about a third (35 percent in 2009 and 27 percent in 2010) of all bats found during searches. Though this is a common pattern at other wind farms across the Midwest (Osborn et al. 1999; Jain 2005; Kerlinger et al. 2007; Drake et al. 2009) and East (Jain et al. 2007; Fiedler et al. 2007; Arnett et al. 2005), only 17 percent of bats found at Blue Sky Green Field were hoary bats; less than half were tree bats. Cedar Ridge in 2009 and 2010, Blue Sky Green Field, and Top of Iowa found a relatively high proportion of the little brown bat (14, 11, 28.6, and 23.5 percent, respectively). These high proportions of little brown bats are unlike those found at Crescent Ridge, Illinois (Kerlinger et al. 2007) and Buffalo Ridge, Minnesota (Osborn et al. 1999) and may have contributed to higher overall bat mortality at Cedar Ridge and these other sites.

The qualitative evaluation of the effects of weather on bird and/or bat mortality at Cedar Ridge did not show any distinct correlation between weather conditions from 2000 to 0600 hours of the night prior to occasions when multiple carcasses were found (two or more carcasses for birds; three or more carcasses for bats) and mortality (Appendix I). Although there were many instances where multiple bird or bat carcasses were found on a search day following a precipitation event and/or high wind, there were also approximately as many instances where multiple carcasses were found on search days following unremarkable weather conditions. Qualitative analysis of higher mortality nights with weather is confounded by the fact that 18 turbines were searched every three days so it is not known if all carcasses were killed during the night time hours (2000-0600 hours) just prior to searches.

4.1.2 Temporal Patterns

Birds were found throughout the spring and fall survey periods with no distinct mortality patterns or peaks. Gruver et al. (2009) also noted bird carcasses were found throughout the survey period.

Bat carcasses at Cedar Ridge were uncommon during the spring, but increased in abundance through the fall with a peak during the month of August. Similar seasonality patterns have been documented in Wisconsin (Gruver et al. 2009; Drake et al. 2009), Tennessee (Fiedler et al. 2007), and New York (Jain et al. 2007), among others.

4.1.3 Spatial Patterns

Similar to temporal observations, distribution of bird carcasses at Cedar Ridge lacked distinct spatial patterns, which also may be due to small sample sizes. Birds were found at varying distances from the turbines and relatively evenly distributed among turbines. Drake et al. (2009) found bird carcasses at a mean distance of 30 m (98.4 ft) from the turbines, and Gruver et al. (2009) describes a bimodal distribution of bird carcasses with most carcasses found either closer than 20 m (65.6 ft) or further than 60 m (196.9 ft) from the turbines. However, like Cedar Ridge, relatively few birds were found at other Wisconsin sites.

Unlike birds, bat carcasses found at Cedar Ridge were usually closer (<40 m or 131 ft) to the turbines and were rarely found as far as the plot boundaries. This is consistent with other studies. Kerlinger et al. (2007) found that bats fell to the ground surface a mean distance of 18.4 m (60.4 ft) from the turbines at Crescent Ridge in Illinois. Johnson et al. (2004) found that nearly all of the bat carcasses were within 30 m (98.4 ft) of the turbines at Buffalo Ridge in Minnesota. Like birds, bats were relatively evenly dispersed among turbines, which is similar to patterns found at other wind farms (Johnson et al. 2004; Kerlinger et al. 2007; Arnett et al. 2008).

4.2 SEARCHER EFFICIENCY AND SCAVENGER REMOVAL ADJUSTMENTS

Searcher efficiency was calculated for small- and medium-bodied birds combined because no difference was found in searcher efficiency between these bird sizes. The searcher efficiency rate for small- and medium-bodied birds was 51 percent in 2009 and 80 percent in 2010.

Searcher efficiency was calculated separately for bats for the 2009 spring and fall seasons due to high seasonal differences in the data. The searcher efficiency rate for bats was 17 percent during spring 2009 and 38 percent during fall 2009. Combined, the searcher efficiency rate for bats was 27 percent in 2009. Searcher efficiency for bats was not found to vary by season in 2010; the searcher efficiency for bats was 69 percent in 2010.

During the 2009 spring surveys, prairie grasses at some turbines and understory vegetation within woodlots had not been cleared, impairing ground visibility. Mowing coordination caused problems in the spring of 2009 as mowing crews were often observed mowing plots before searchers arrived to survey, which would have resulted in the destruction or dispersion of carcasses. During the 2009 fall survey period, transects were sometimes mowed in a non-linear pattern causing searchers to wander off of the transect and may have caused them to avoid walking past trial carcasses on the transect. Early morning shadows and hard rains adversely affected efficiencies as well. Several rain events occurred in 2009, causing vegetation, particularly alfalfa, to grow rapidly, which could have made small carcasses difficult to detect. Alfalfa cover was present on most of the plots and comprised 25 to 75 percent of cover on many of the plot areas. Searchers reported that alfalfa fields were difficult to search due to its clumping growing habit, tendency to lay over when mowed, and rapid growth during 2009. As weather and procedures improved in 2009, searcher efficiency improved somewhat as illustrated by the 20 percent improvement in searcher efficiency for bats in the fall. Searcher efficiencies were greatly improved in 2010 over 2009 for both bird and bat carcasses. This is attributed to better weather conditions and to the improved marking of each transect centerline with white spray-paint; which helped the mowing crews to maintain straighter, more accurate lines, and allowed for easier searching by the field biologists.

Scavenger removal rates for small and medium bird carcasses were higher in 2010 than in 2009, with approximately three percent more carcasses removed after the first day and approximately 6.5 percent more carcasses removed after day four. The scavenger removal rates for bat carcasses were nearly identical in 2009 and 2010. Comparison of scavenger removal with other studies is difficult due to the different methods used for calculating these rates.

4.3 MORTALITY ESTIMATION

Estimates of mortality for small birds, medium birds, and bats were calculated separately because of the differences in numbers of carcasses, temporal patterns, searcher efficiencies, and scavenger removal rates. Mean mortality rates for birds during the 2009 and 2010 survey periods were calculated as 0.050 and 0.020 small birds and 0.014 and 0.014 medium birds per turbine per day, respectively. Bat mortality at Cedar Ridge, applicable during the monitored period of the year, had a mean rate of 0.299 bats per turbine per day for 2009, and a mean rate of 0.234 bats per turbine per day for 2010.

Many other studies describe bat mortality in terms of bats per turbine per year (Arnett et al. 2008). Because data were not collected year round, and existing data suggest a strong seasonal influence on mortality rates, it is not accurate to assume that mortality remains the

same rate during the periods when surveys were not conducted. For example, bat mortality during the summer months was assumed to be insignificant, but it could not be assumed to be zero. Therefore, total mean mortality per turbine was calculated based on the number of days of surveys. For 2009, mortality per turbine per 169 days (number of days in the 2009 spring and fall survey periods) would be an estimated 8.45 for small birds, 2.37 for medium birds, 10.8 for small and medium birds combined, and 50.5 for bats (Table 6). The confidence interval would indicate the bat mortality level for 2009 could have been as low as 0.214 bats per turbine per day, this rate calculates to a total of 36.2 bats. For 2010, mortality per turbine per 166 days (number of days in the 2010 spring and fall survey periods) would be an estimated 3.65 for small birds, 2.49 for medium birds, which equates to 6.14 for small and medium birds combined, and 39.8 for bats (Table 7). The confidence interval would indicate the bat mortality level for 2010 could have been as low as 0.201 bats per turbine per day, this rate calculates to 33.4 bats.

It should be noted that the lack of a standard method for calculating mortality rates and the lack of standardized survey methods complicates comparisons of data in a meaningful way. For example, rates for many studies do not always specify whether the rate estimated is for an entire 365-day year, for the typical activity period of a bat, or for the survey period. Differences in rotor swept areas between sites may also account for some differences in mortality that is not readily discernible. Standardization of data from the various studies may be useful to provide additional insight into a better understanding of how sites compare; however such analysis was beyond the scope of this study.

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TABLES

Table 1. Land cover at the Cedar Ridge Wind Farm, Fond du Lac County, Wisconsin.

Land Cover Type	Area (ha)	Area (ac)	Proportion of Total (percent)
Barren land	0.64	1.58	0.02
Evergreen forest	0.96	2.37	0.03
Developed, medium intensity	1.44	3.55	0.05
Open water	14.29	35.31	0.45
Herbaceous	21.87	54.05	0.70
Shrub/scrub	41.75	103.16	1.33
Developed, low intensity	50.37	124.46	1.60
Emergent herbaceous wetlands	53.80	132.94	1.71
Woody wetlands	60.27	148.92	1.92
Developed, open space	91.08	225.06	2.89
Deciduous forest	261.98	647.36	8.33
Cultivated crops	1,156.70	2,858.28	36.76
Hay/pasture	1,391.14	3,437.58	44.22
Total	**3,146.29**	**7,774.60**	**100.00**

Table 2. Summary of birds found during the 2009 mortality surveys at the Cedar Ridge Wind Farm.

Common Name	Species	Number Found During Searches	Number Found Incidentally[1]	Total Number	Proportion of All Birds Found[2] (percent)
Wild turkey[3]	*Meleagris gallopavo*	1	0	1	2.13
Turkey vulture	*Cathartes aura*	0	1	1	2.13
Red-tailed hawk[4]	*Buteo jamaicensis*	2	2	4	8.51
Killdeer	*Charadrius vociferus*	0	1	1	2.13
Rock pigeon	*Columba livia*	3	4	7	14.89
Mourning dove	*Zenaida macroura*	2	2	4	8.51
Chimney swift	*Chaetura pelagica*	0	1	1	2.13
Yellow-bellied flycatcher	*Empidonax flaviventris*	1	0	1	2.13
Blue jay	*Cyanocitta cristata*	0	1	1	2.13
Purple martin	*Progne subis*	1	0	1	2.13
Tree swallow	*Tachycineta bicolor*	4	0	4	8.51
Cliff swallow	*Petrochelidon pyrrhonota*	1	0	1	2.13
Barn swallow	*Hirundo rustica*	1	0	1	2.13
Brown creeper	*Certhia americana*	1	0	1	2.13
Golden-crowned kinglet	*Regulus satrapa*	2	1	3	6.38
Ruby-crowned kinglet	*Regulus calendula*	2	0	2	4.25
Cedar waxwing	*Bombycilla cedrorum*	1	0	1	2.13
Magnolia warbler	*Dendroica magnolia*	2	0	2	4.25
Savanna sparrow	*Passerculus sandwichensis*	1	0	1	2.13
Dark-eyed junco	*Junco hyemalis*	1	0	1	2.13
Red-winged blackbird	*Agelaius phoeniceus*	1	1	2	4.25
American goldfinch	*Spinus tristis*	1	0	1	2.13
Unknown	Unknown	5	0	5	10.63
Total		**33**	**14**	**47**	**100.00**

[1] Incidental finds were carcasses found outside of the searches scheduled and planned as part of the study design.
[2] Includes birds found during spring, fall, and late fall and includes incidental finds.
[3] Not considered a turbine-related mortality.
[4] One found during late fall searches.

Table 3. Summary of birds found during the 2010 mortality surveys at the Cedar Ridge Wind Farm.

Common Name	Species	Number Found During Searches	Number Found Incidentally[1]	Total Number	Proportion of All Birds Found[2] (percent)
Mallard	*Anas platyrhynchos*	0	1	1	3.6
Red-tailed hawk	*Buteo jamaicensis*	0	2	2	7.1
Killdeer	*Charadrius vociferus*	1	0	1	3.6
Rock pigeon	*Columba livia*	4	1	5	17.9
Mourning dove	*Zenaida macroura*	2	0	2	7.1
Black-billed cuckoo	*Coccyzus erythropthalmus*	1	0	1	3.6
American crow	*Corvus brachyrhynchos*	1	0	1	3.6
Tree swallow	*Tachycineta bicolor*	2	0	2	7.1
Golden-crowned kinglet	*Regulus satrapa*	1	0	1	3.6
Ruby-crowned kinglet	*Regulus calendula*	1	0	1	3.6
European starling	*Sturnus vulgaris*	1	0	1	3.6
Cedar waxwing	*Bombycilla cedrorum*	1	0	1	3.6
American tree sparrow	*Spizella arborea*	1	0	1	3.6
Swamp sparrow	*Melospiza georgiana*	1	0	1	3.6
Lapland longspur	*Calcarius lapponicus*	2	0	2	7.1
Unknown	Unknown	5	0	5	17.9
Total		**24**	**4**	**28**	**100.0**

[1] Incidental finds were carcasses found outside of the searches scheduled and planned as part of the study design.
[2] Includes birds found during spring, fall, and late fall and includes incidental finds.

Table 4. Summary of sexes and ages of bird orders found during the 2009 mortality surveys at the Cedar Ridge Wind Farm.

Type of Find	Common Name	Order	Female Adult	Female Juvenile	Male Adult	Male Juvenile	Unknown Adult	Unknown Juvenile	Unknown
Carcass Searches	Game birds	Galliformes	0	0	0	0	0	0	1
	Diurnal birds of prey	Falconiformes	0	0	0	0	2	0	0
	Pigeons and doves	Columbiformes	0	0	0	0	2	0	3
	Perching birds	Passeriformes	5	1	5	0	3	6	0
	Unknown	Unknown	0	0	0	0	0	0	5
	Total		**5**	**1**	**5**	**0**	**7**	**6**	**9**
Incidental Finds	Storks and relatives	Ciconiformes	0	0	0	0	0	0	1
	Diurnal birds of prey	Falconiformes	0	0	1	0	1	0	0
	Shorebirds and relatives	Charadriiformes	0	0	1	0	0	0	0
	Pigeons and doves	Columbiformes	0	0	1	0	1	0	4
	Hummingbirds and swifts	Apodiformes	0	0	0	0	0	0	1
	Perching birds	Passeriformes	0	0	2	0	1	0	0
	Total		**0**	**0**	**5**	**0**	**3**	**0**	**6**

Table 5. Summary of sexes and ages of bird orders found during the 2010 mortality surveys at the Cedar Ridge Wind Farm.

Type of Find	Common Name	Order	Female Adult	Female Juvenile	Male Adult	Male Juvenile	Unknown Adult	Unknown Juvenile	Unknown
Carcass Searches	Shorebirds and relatives	Charadriiformes	0	0	0	0	0	0	1
	Pigeons and doves	Columbiformes	0	0	0	0	1	0	5
	Cuckoos	Cuculiformes	0	0	0	0	1	0	0
	Perching birds	Passeriformes	2	0	1	0	2	2	4
	Unknown	Unknown	0	0	0	0	0	0	5
	Total		**2**	**0**	**1**	**0**	**4**	**2**	**15**
Incidental Finds	Waterfowl	Anseriformes	1	0	0	0	0	0	0
	Diurnal birds of prey	Falconiformes	0	0	0	0	2	0	0
	Pigeons and doves	Columbiformes	0	0	0	0	0	0	1
	Total		**1**	**0**	**0**	**0**	**2**	**0**	**1**

Table 6. Mortality estimates for birds and bats for the 2009 spring and fall mortality surveys at the Cedar Ridge Wind Farm.

Carcass Type	Mean Number of Mortalities per Turbine per Day	Number of Days in Spring and Fall Survey Period	Estimated Number of Mortalities per Turbine per Spring and Fall Study Period
Small birds	0.050	169	8.45
Medium birds	0.014	169	2.37
Combined small & medium birds	0.064	169	10.8
Bats	0.299	169	50.5

Table 7. Mortality estimates for birds and bats for the 2010 spring and fall mortality surveys at the Cedar Ridge Wind Farm.

Carcass Type	Mean Number of Mortalities per Turbine per Day	Number of Days in Spring and Fall Survey Period	Estimated Number of Mortalities per Turbine per Spring and Fall Study Period
Small birds	0.022	166	3.65
Medium birds	0.015	166	2.49
Combined small & medium birds	0.037	166	6.14
Bats	0.240	166	39.8

Table 8. Number of bird carcasses found at each range of distances from the turbine during the 2009 mortality surveys at the Cedar Ridge Wind Farm.

Distance to Turbine (m)	Number of Bird Carcasses	Proportion of Bird Carcasses (percent)
0 to 9	4	12.9
10 to 19	3	9.7
20 to 29	2	6.5
30 to 39	4	12.9
40 to 49	2	6.5
50 to 59	3	9.7
60 to 69	3	9.7
70 to 79	3	9.7
80 to 89	5	16.1
90 to 99	2	6.5

Table 9. Number of bird carcasses found at each range of distances from the turbine during the 2010 mortality surveys at the Cedar Ridge Wind Farm.

Distance to Turbine (m)	Number of Bird Carcasses	Proportion of Bird Carcasses (percent)
0 to 9	0	0.0
10 to 19	0	0.0
20 to 29	3	12.5
30 to 39	2	8.3
40 to 49	3	12.5
50 to 59	4	16.7
60 to 69	1	4.2
70 to 79	5	20.8
80 to 89	4	16.7
90 to 99	1	4.2
100 to 109	1	4.2

Table 10. Summary of bats found during the 2009 mortality surveys at the Cedar Ridge Wind Farm.

Common Name	Species	Number Found During Searches	Number Found Incidentally[1]	Total Number	Proportion of All Bats Found[2] (percent)
Big brown bat	*Eptesicus fuscus*	15	0	15	16.9
Silver-haired bat	*Lasionycteris noctivagans*	16	0	16	17.9
Red bat	*Lasiurus borealis*	12	1	13	14.6
Hoary bat	*Lasiurus cinereus*	29	1	30	33.7
Little brown bat	*Myotis lucifugus*	12	3	15	16.9
Total		**84**	**5**	**89**	**100.0**

[1] Incidental finds were carcasses found outside of the searches scheduled and planned as part of the study design.
[2] Includes bats found during spring, fall, and late fall and includes incidental finds.

Table 11. Summary of bats found during the 2010 mortality surveys at the Cedar Ridge Wind Farm.

Common Name	Species	Number Found During Searches	Number Found Incidentally[1]	Total Number	Proportion of All Bats Found[2] (percent)
Big brown bat	*Eptesicus fuscus*	17	2	19	12.3
Silver-haired bat	*Lasionycteris noctivagans*	19	1	20	12.9
Red bat	*Lasiurus borealis*	44	9	53	34.2
Hoary bat	*Lasiurus cinereus*	36	7	43	27.7
Little brown bat	*Myotis lucifugus*	15	3	18	11.6
Unknown	Unknown	2	0	2	1.3
Total		**133**	**22**	**155**	**100.0**

[1] Incidental finds were carcasses found outside of the searches scheduled and planned as part of the study design.
[2] Includes bats found during spring, fall, and late fall and includes incidental finds.

Table 12. Summary of sexes and ages of bats found during the 2009 mortality surveys at the Cedar Ridge Wind Farm.

Type of Find	Common Name	Species	Female Adult	Female Juvenile	Male Adult	Male Juvenile	Unknown Adult	Unknown Juvenile	Unknown
Carcass Searches	Big brown bat	*Eptesicus fuscus*	3	1	5	0	3	3	0
	Silver-haired bat	*Lasionycteris noctivagans*	5	1	3	0	6	0	1
	Red bat	*Lasiurus borealis*	3	0	1	0	7	1	0
	Hoary bat	*Lasiurus cinereus*	8	0	6	2	10	2	1
	Little brown bat	*Myotis lucifugus*	7	0	1	0	3	1	0
	Total		**26**	**2**	**16**	**2**	**29**	**7**	**2**
Incidental Finds	Big brown bat	*Eptesicus fuscus*	0	0	0	0	0	0	0
	Silver-haired bat	*Lasionycteris noctivagans*	0	0	0	0	0	0	0
	Red bat	*Lasiurus borealis*	0	0	0	0	1	0	0
	Hoary bat	*Lasiurus cinereus*	1	0	0	0	0	0	0
	Little brown bat	*Myotis lucifugus*	2	0	0	0	1	0	0
	Total		**3**	**0**	**0**	**0**	**2**	**0**	**0**

Table 13. Summary of sexes and ages of bats found during the 2010 mortality surveys at the Cedar Ridge Wind Farm.

Type of Find	Common Name	Species	Female Adult	Female Juvenile	Female Unknown	Male Adult	Male Juvenile	Male Unknown	Unknown Adult	Unknown Juvenile	Unknown
Carcass Searches	Big brown bat	*Eptesicus fuscus*	4	1	0	4	0	2	3	1	2
	Silver-haired bat	*Lasionycteris noctivagans*	9	0	2	3	0	1	0	0	4
	Red bat	*Lasiurus borealis*	10	2	4	14	3	2	3	0	6
	Hoary bat	*Lasiurus cinereus*	8	0	4	13	0	1	4	0	6
	Little brown bat	*Myotis lucifugus*	4	0	2	1	0	3	3	1	1
	Unknown	Unknown	0	0	0	0	0	0	0	0	2
	Total		**35**	**3**	**12**	**35**	**3**	**9**	**13**	**2**	**21**
Incidental Finds	Big brown bat	*Eptesicus fuscus*	0	1	0	0	0	0	0	0	1
	Silver-haired bat	*Lasionycteris noctivagans*	0	0	0	1	0	0	0	0	0
	Red bat	*Lasiurus borealis*	1	0	1	2	0	0	2	0	3
	Hoary bat	*Lasiurus cinereus*	2	0	1	1	0	1	0	0	2
	Little brown bat	*Myotis lucifugus*	1	0	0	0	1	1	0	0	0
	Total		**4**	**1**	**2**	**4**	**1**	**2**	**2**	**0**	**6**

Table 14. Number of bat carcasses found at each range of distances from the turbine during the 2009 mortality surveys at the Cedar Ridge Wind Farm.

Distance to Turbine (m)	Number of Bat Carcasses	Proportion of Bat Carcasses (percent)
0 to 9	15	17.9
10 to 19	19	22.6
20 to 29	21	25.0
30 to 39	14	16.7
40 to 49	10	11.9
50 to 59	3	3.6
60 to 69	0	0.0
70 to 79	2	2.4

Table 15. Number of bat carcasses found at each range of distances from the turbine during the 2010 mortality surveys at the Cedar Ridge Wind Farm.

Distance to Turbine (m)	Number of Bat Carcasses	Proportion of Bat Carcasses (percent)
0 to 9	28	21.1
10 to 19	22	16.5
20 to 29	27	20.3
30 to 39	22	16.5
40 to 49	15	11.3
50 to 59	10	7.5
60 to 69	6	4.5
70 to 79	3	2.3

Table 16. Searcher efficiency during the 2009 mortality surveys at the Cedar Ridge Wind Farm.

Carcass Type	Date	Number of Carcasses Placed	Number of Carcasses Available	Number of Carcasses Found	Carcasses Found (percent)
Small & medium birds -	4/1/2009	6	6	6	100
Spring & fall	4/7/2009	4	4	2	50
	4/22/2009	5	5	3	60
	4/30/2009	6	6	3	50
	5/4/2009	6	4	2	50
	5/20/2009	6	6	4	67
	5/21/2009	6	6	2	33
	5/26/2009	6	5	2	40
	7/23/2009	5	3	1	33
	7/29/2009	5	5	2	40
	8/26/2009	5	5	1	20
	9/4/2009	7	7	4	57
	9/10/2009	7	7	4	57
	9/15/2009	6	6	4	67
	9/24/2009	7	7	1	14
	9/29/2009	5	5	3	60
	OVERALL	**92**	**87**	**44**	**51**
Large birds -	5/20/2009	1	1	0	0
Spring & fall	5/21/2009	1	1	1	100
	5/26/2009	1	1	1	100
	7/23/2009	1	1	0	0
	7/29/2009	1	1	1	100
	8/26/2009	1	1	1	100
	9/4/2009	1	1	1	100
	9/10/2009	1	1	1	100
	OVERALL	**8**	**8**	**6**	**75**
Large bird surrogates -	10/22/2009	12	12	12	100
Late fall	11/3/2009	12	12	12	100
	11/6/2009	11	11	11	100
	11/12/2009	15	15	15	100
	OVERALL	**50**	**50**	**50**	**100**
Bats –	4/1/2009	8	8	1	13
Spring	4/7/2009	9	9	4	44
	4/22/2009	10	4	0	0
	4/30/2009	8	8	1	13
	5/4/2009	9	7	1	14
	5/20/2009	7	7	1	14
	5/21/2009	7	7	0	0
	5/26/2009	8	8	2	25
	OVERALL	**66**	**58**	**10**	**17**
Bats -	7/23/2009	8	7	2	29
Fall	7/29/2009	7	6	2	33
	8/26/2009	6	6	4	67
	9/4/2009	7	7	4	57
	9/10/2009	7	7	2	29
	9/15/2009	7	7	3	43
	9/24/2009	7	7	2	29
	9/29/2009	6	6	1	17
	OVERALL	**55**	**53**	**20**	**38**
Bats - Spring & fall	**OVERALL**	**121**	**111**	**30**	**27**

Table 17. Searcher efficiency during the 2010 mortality surveys at the Cedar Ridge Wind Farm.

Carcass Type	Date	Number of Carcasses Placed	Number of Carcasses Available	Number of Carcasses Found	Carcasses Found (percent)
Small & medium birds -	4/1/2010	6	6	4	67
Spring & fall	4/5/2010	7	7	5	71
	4/20/2010	6	6	3	50
	4/27/2010	6	6	4	67
	4/30/2010	7	7	6	86
	5/3/2010	7	7	5	71
	5/20/2010	8	7	7	100
	5/21/2010	6	6	6	100
	5/26/2010	8	8	7	88
	7/29/2010	6	6	5	83
	8/12/2010	6	6	3	50
	8/16/2010	5	5	5	100
	9/9/2010	5	5	4	80
	9/15/2010	5	4	3	75
	9/28/2010	6	5	5	100
	10/3/2010	5	4	4	100
	10/4/2010	5	5	4	100
	OVERALL	**104**	**100**	**80**	**80**
Large birds -	9/28/2010	1	1	1	100
Fall	10/3/2010	1	1	1	100
	10/4/2010	1	1	1	100
	OVERALL	**3**	**3**	**3**	**100**
Bats –	4/1/2010	7	7	5	71
Spring & fall	4/5/2010	8	8	6	75
	4/20/2010	7	7	4	57
	4/27/2010	5	5	3	60
	4/30/2010	7	7	5	71
	5/3/2010	7	6	3	50
	5/20/2010	7	7	6	86
	5/21/2010	5	5	5	100
	5/26/2010	5	5	4	80
	7/29/2010	7	6	5	83
	8/12/2010	8	6	2	33
	8/16/2010	6	6	4	67
	9/9/2010	6	6	3	50
	9/15/2010	8	7	5	71
	9/28/2010	7	7	5	71
	10/3/2010	5	4	2	50
	10/4/2010	6	6	5	83
	OVERALL	**111**	**105**	**72**	**69**

FIGURES

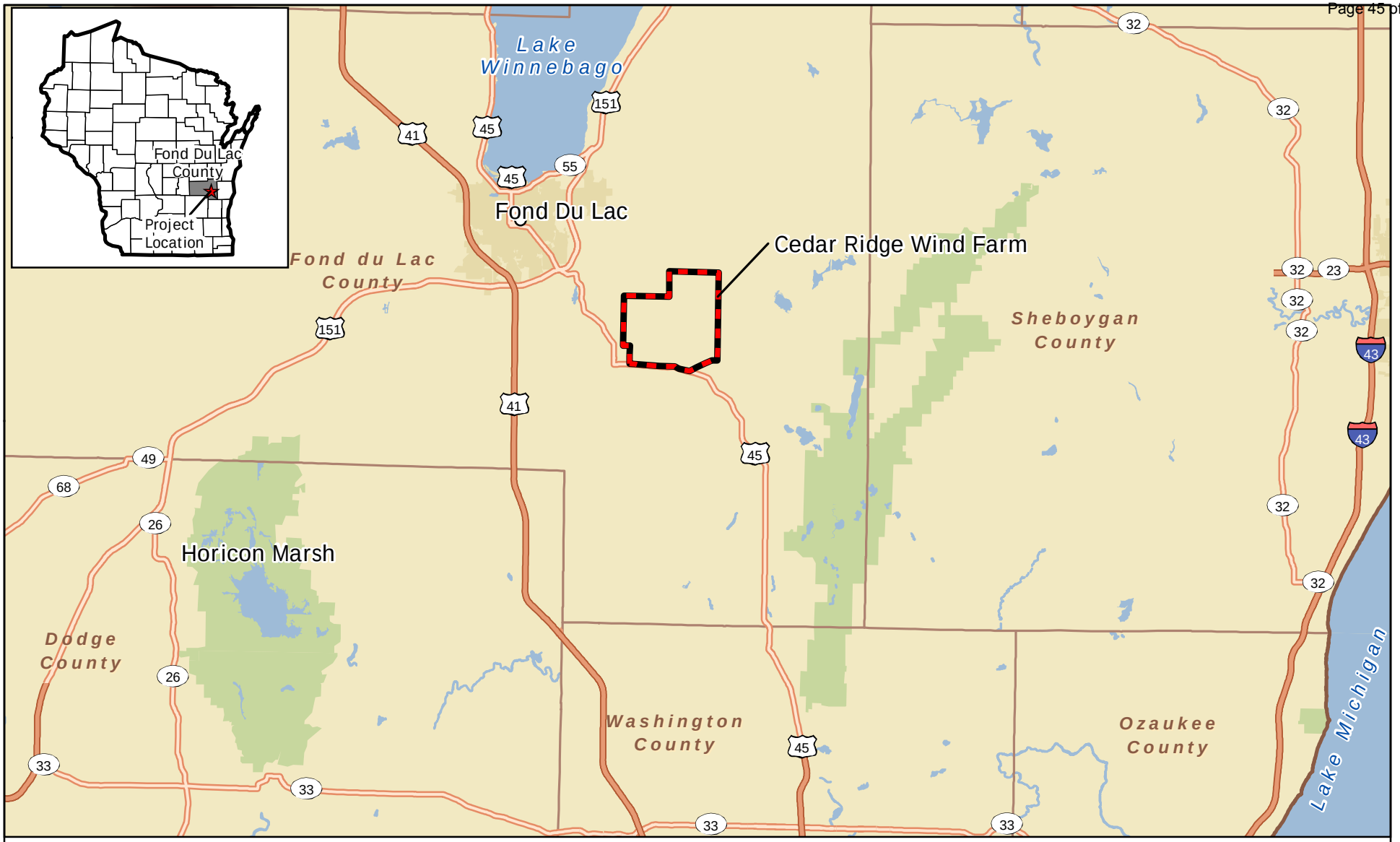


Figure 1. Location of the Cedar Ridge Wind Farm, Fond du Lac County, Wisconsin.

N W E S

Miles
5 0 5 10

January 2010

Project No. 1782.003

Basemap: ESRI StreetMap (2009)

BHE ENVIRONMENTAL

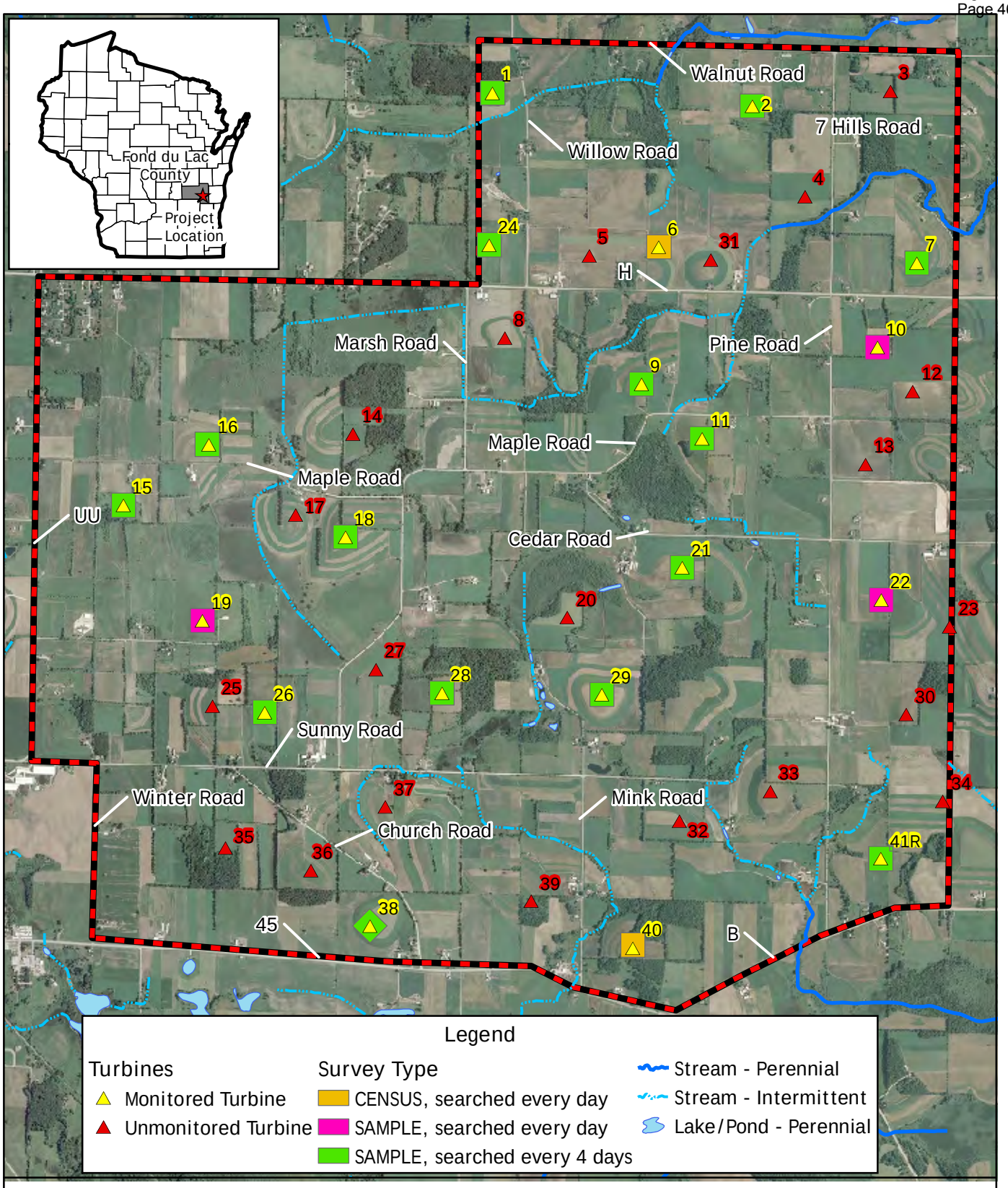
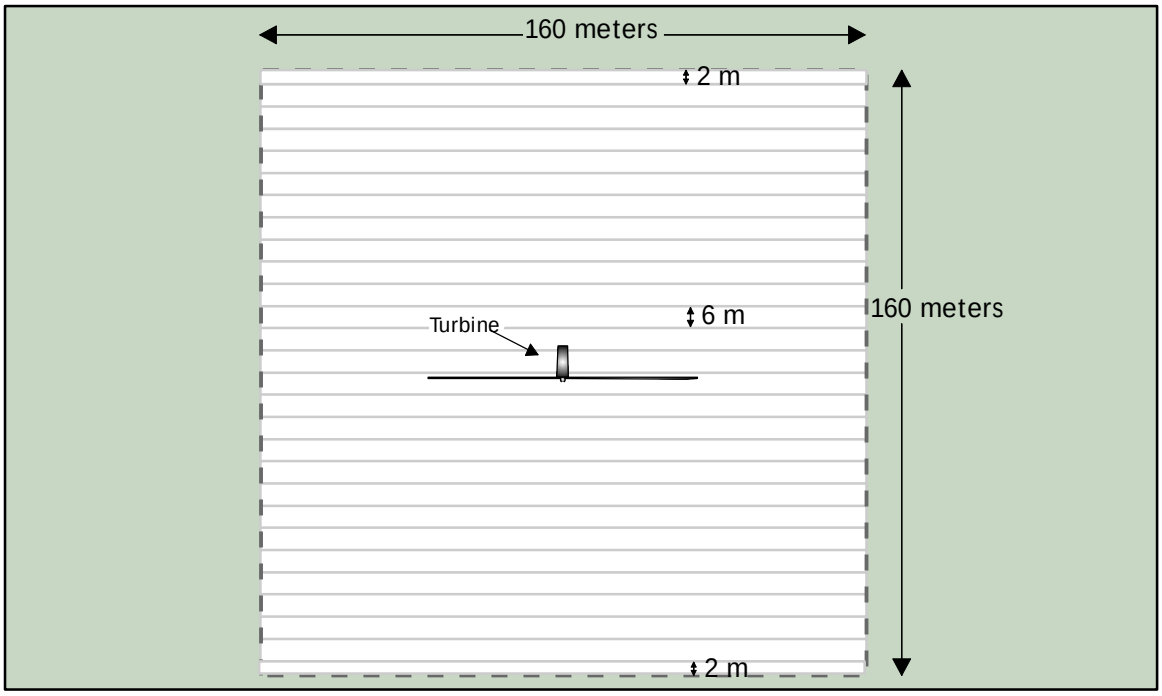
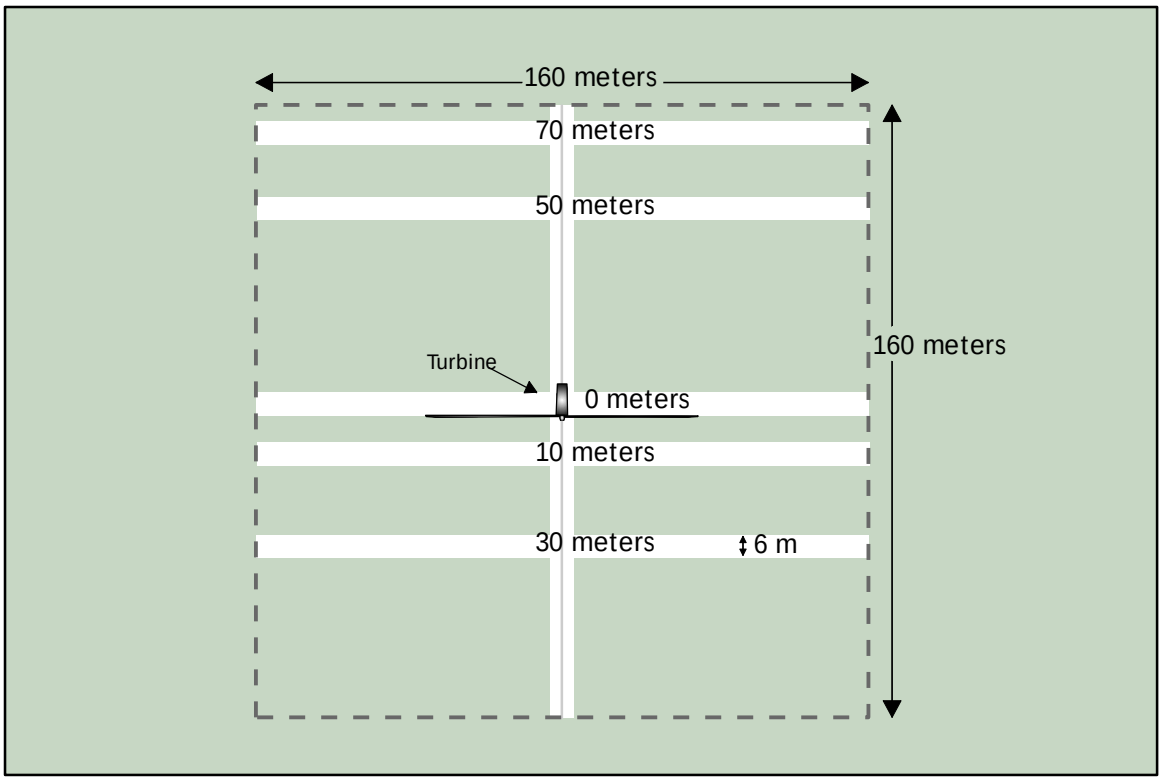


Figure 2. Turbines selected for monitoring bird and bat mortality at the Cedar Ridge Wind Farm, Fond du Lac County, Wisconsin.

N W E S	Feet 2,000 0 2,000 4,000	January 2010	BHE ENVIRONMENTAL
	Project No. 1782.003	Basemap: NAIP Imagery - 2006	



a. Census plot.



b. Sample plot.

Figure 3. Diagrams of the bird and bat mortality test plots used during the spring (March 15 to May 31) and fall (July 15 to October 15) surveys at the Cedar Ridge Wind Farm, Fond du Lac County, Wisconsin.

Figure 4. Example survey schedule during the 2009 and 2010 spring and fall survey periods at the Cedar Ridge Wind Farm.

Search Group	Turbine No.	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
A	6	■	■	■	■	■	■	■
	10	■	■	■	■	■	■	■
	19	■	■	■	■	■	■	■
	22	■	■	■	■	■	■	■
	37/40	■	■	■	■	■	■	■
B	1	■				■		
	7	■				■		
	18	■				■		
	41R	■				■		
C	2		■				■	
	9		■				■	
	26		■				■	
	29		■				■	
D	11			■				■
	15			■				■
	24			■				■
	38			■				■
E	16				■			
	21				■			
	28				■			

■ Turbine plot searched

Figure 5. Example survey schedule during the 2009 late fall survey period at the Cedar Ridge Wind Farm.

Search Group	Turbine No.	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
A	6	■			■			■
	10	■			■			■
	19	■			■			■
	22	■			■			■
	37/40	■			■			■
B	1	■			■			■
	7	■			■			■
	18	■			■			■
	41R	■			■			■
C	2	■			■			■
	9	■			■			■
	26	■			■			■
	29	■			■			■
D	11	■			■			■
	15	■			■			■
	24	■			■			■
	38	■			■			■
E	16	■			■			■
	21	■			■			■
	28	■			■			■

■ Turbine plot searched

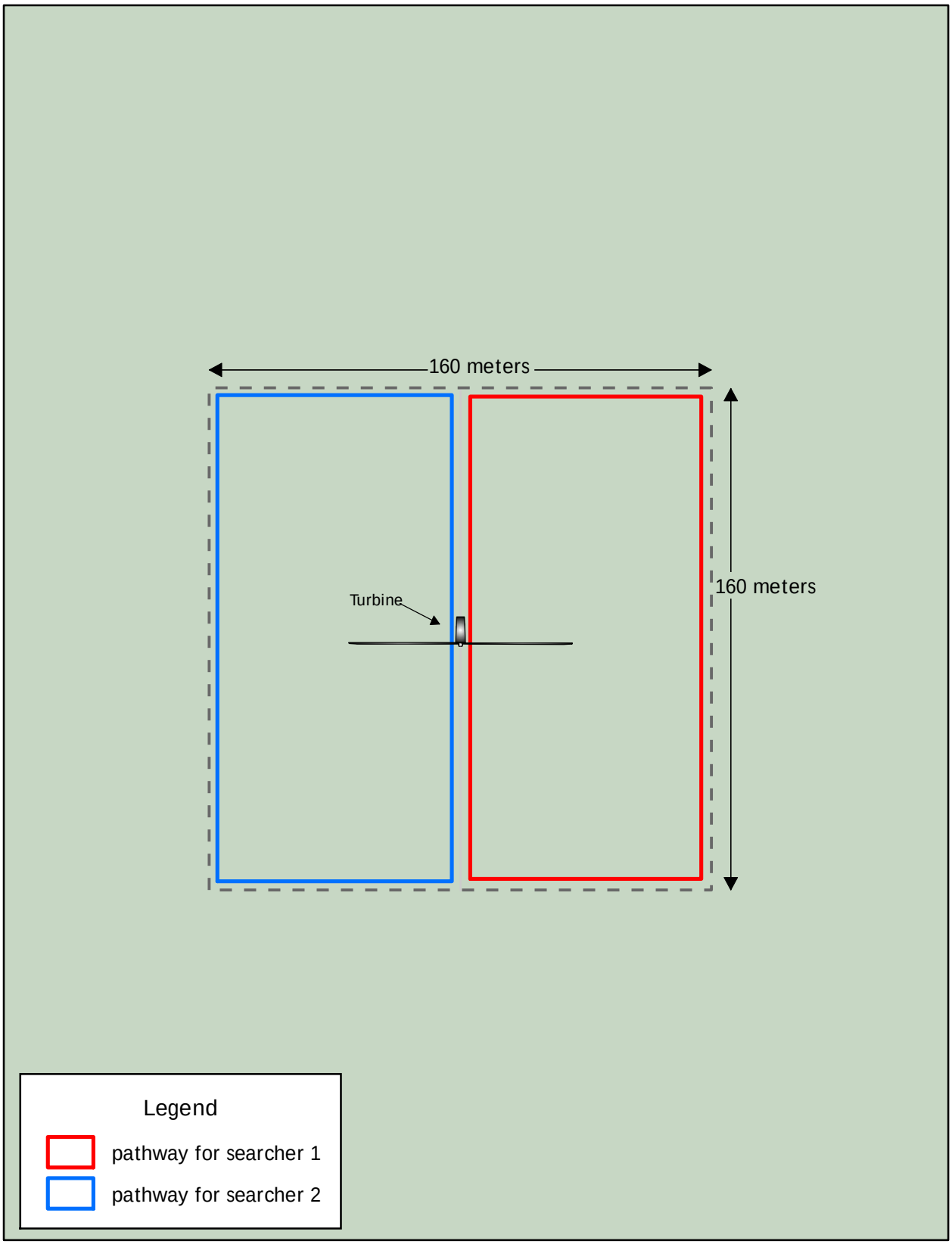
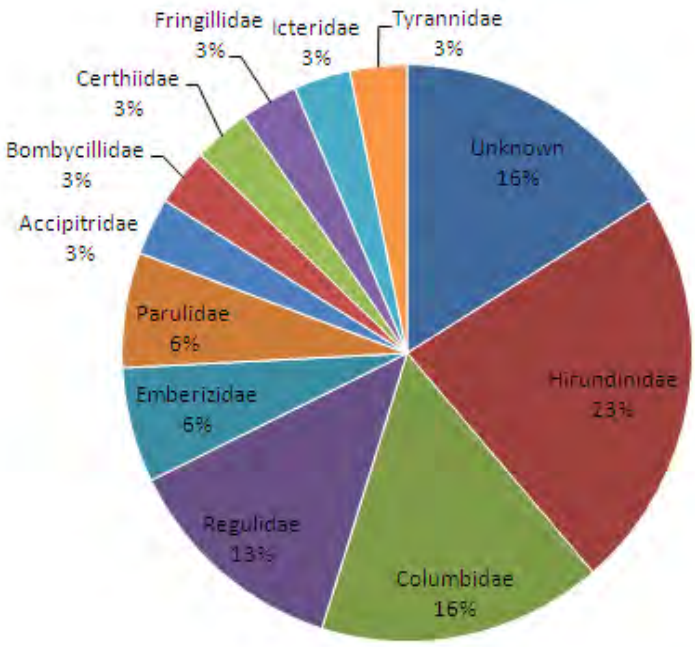
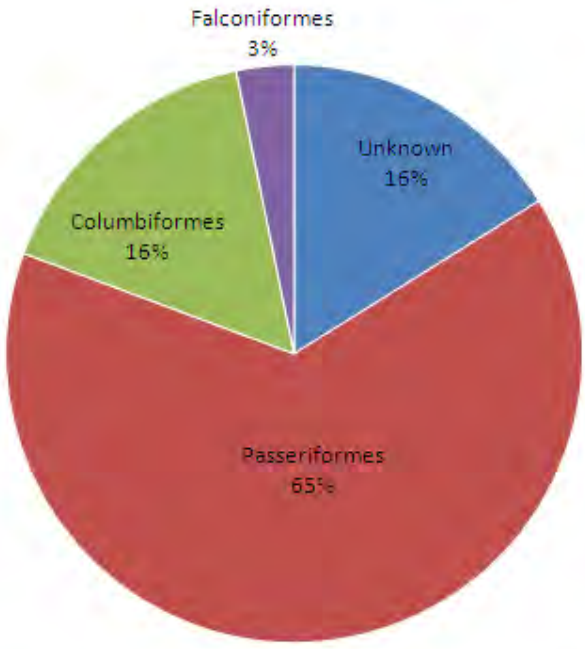


Figure 6. Diagram of the bird and bat mortality test plots used during the late fall (October 16 to November 15) surveys at the Cedar Ridge Wind Farm, Fond du Lac County, Wisconsin.

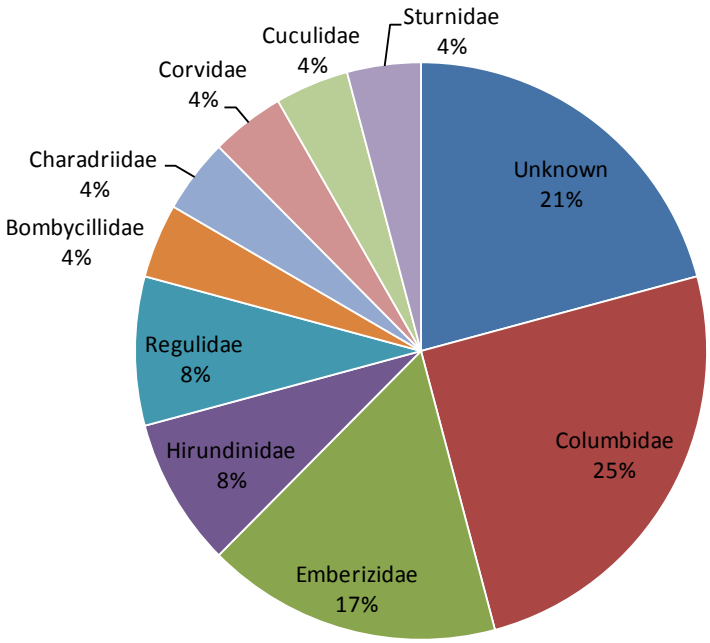


a. Bird carcasses by family.

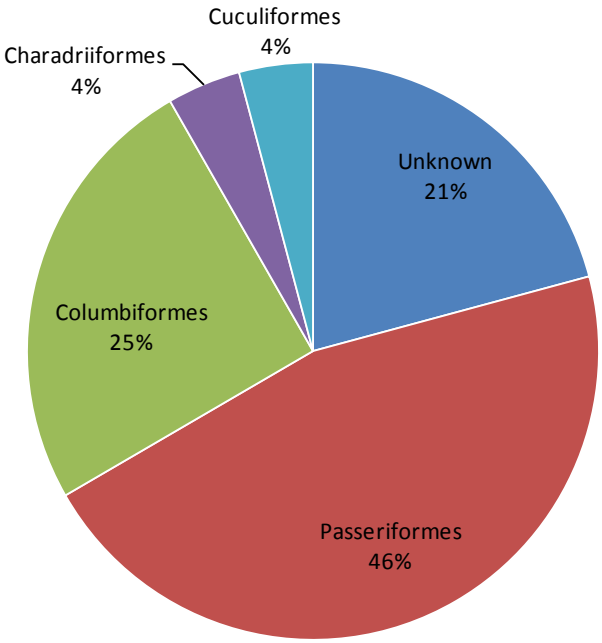


b. Bird carcasses by order.

Figure 7. Bird carcasses found during the 2009 spring and fall mortality surveys at the Cedar Ridge Wind Farm.



a. Bird carcasses by family.



b. Bird carcasses by order.

Figure 8. Bird carcasses found during the 2010 spring and fall mortality surveys at the Cedar Ridge Wind Farm.

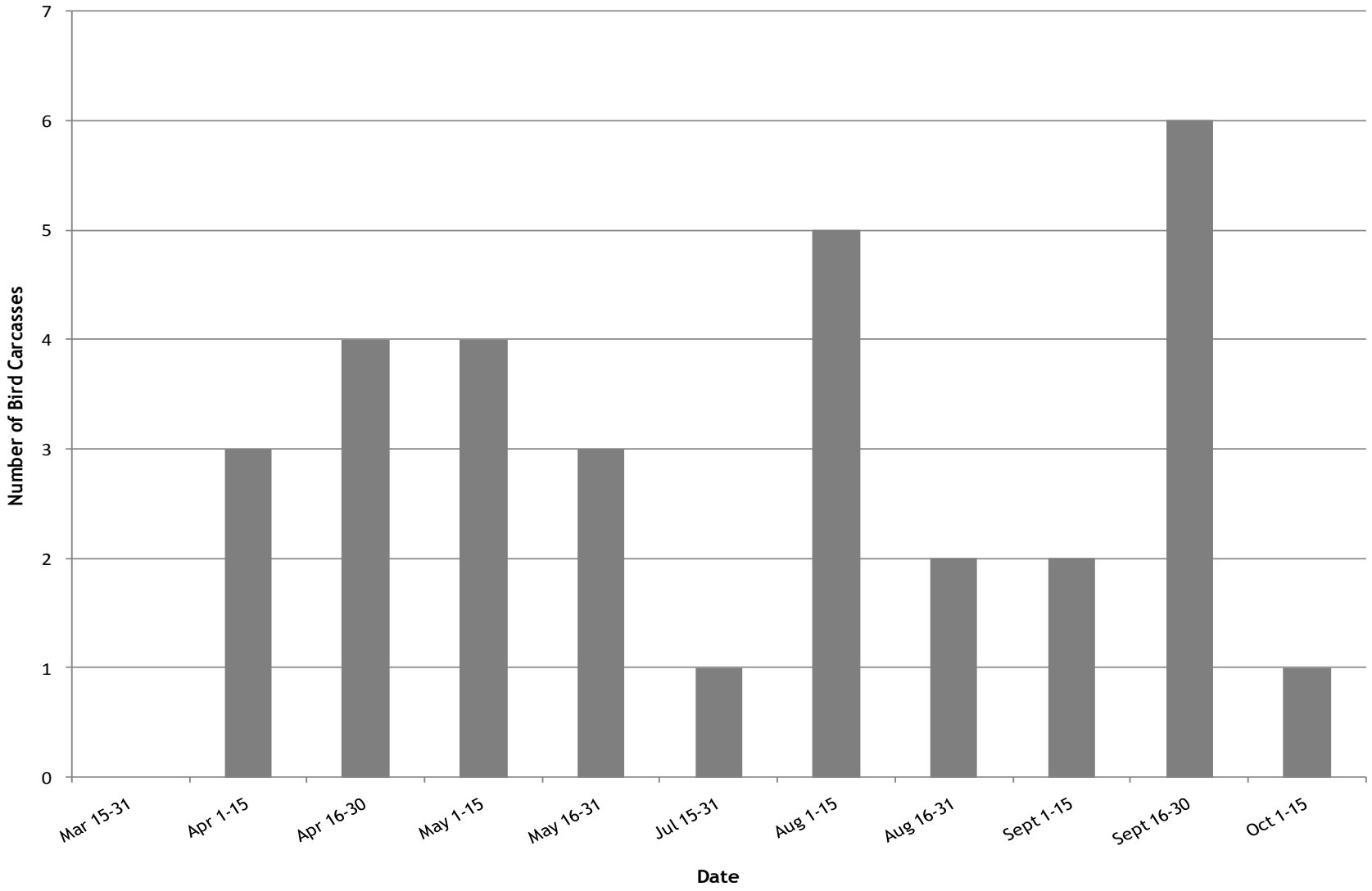


Figure 9. Temporal distribution of bird carcasses found during the 2009 spring and fall mortality surveys at the Cedar Ridge Wind Farm.

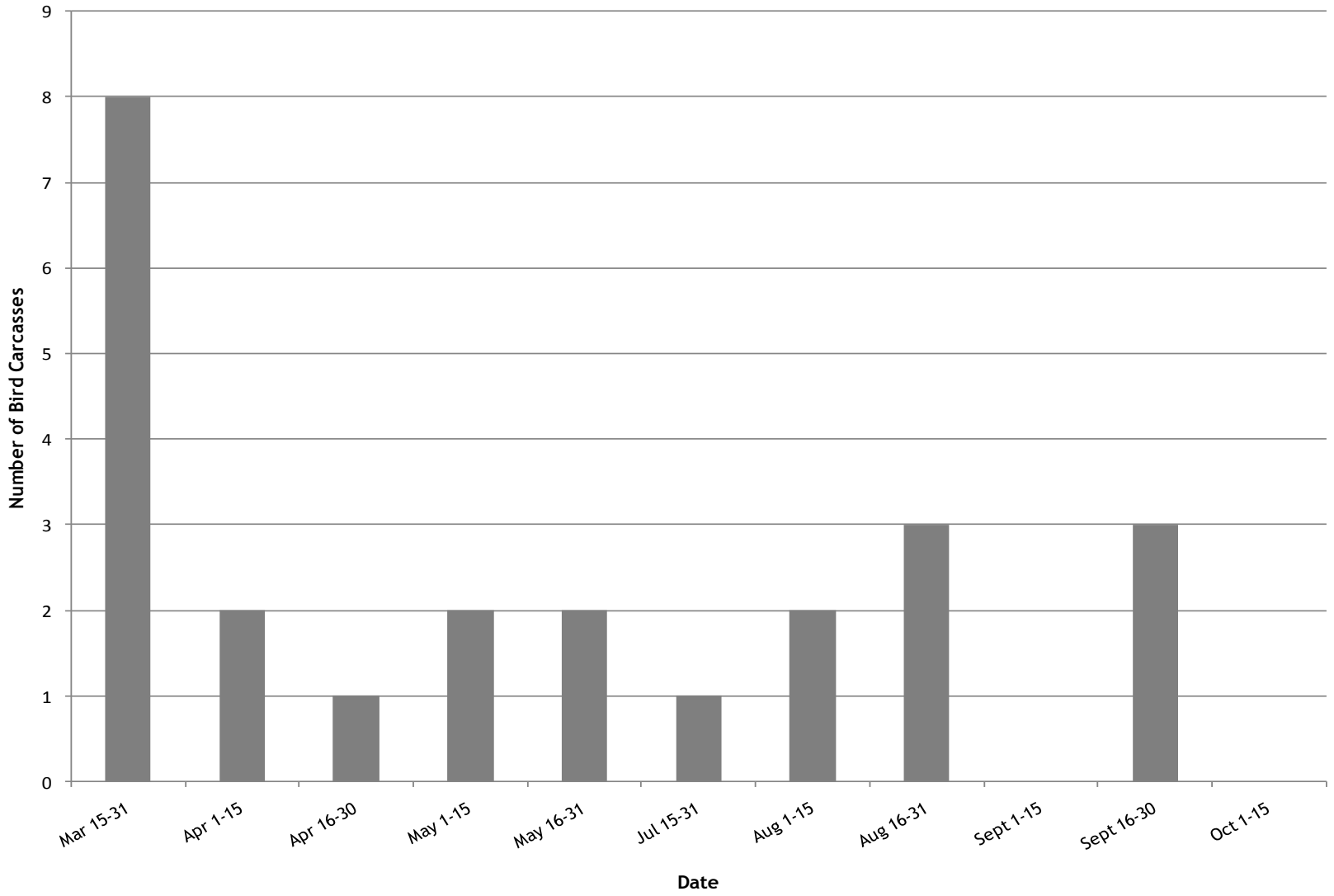
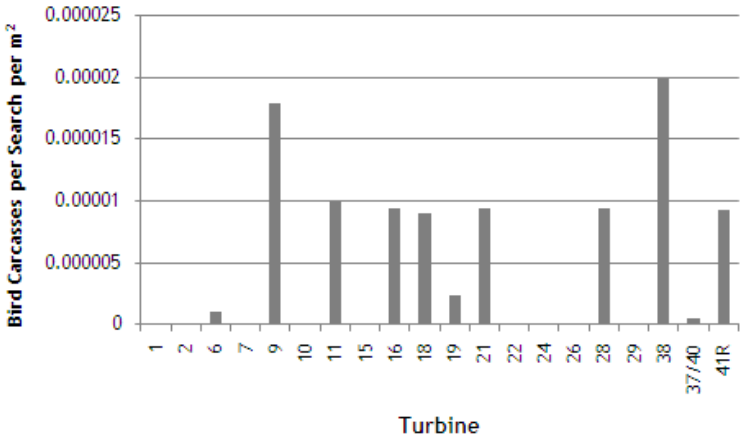
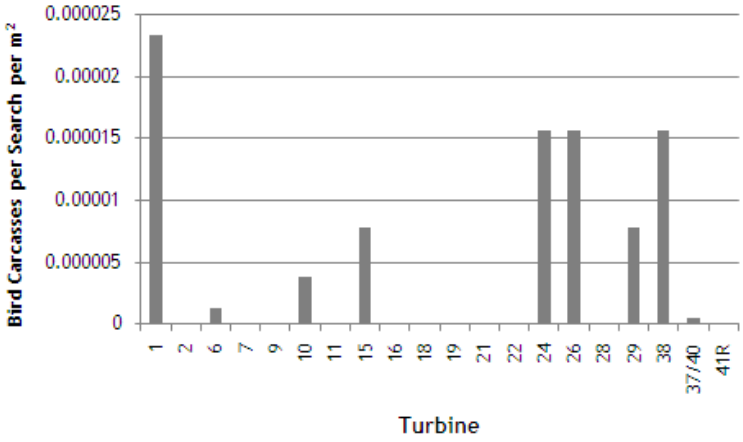


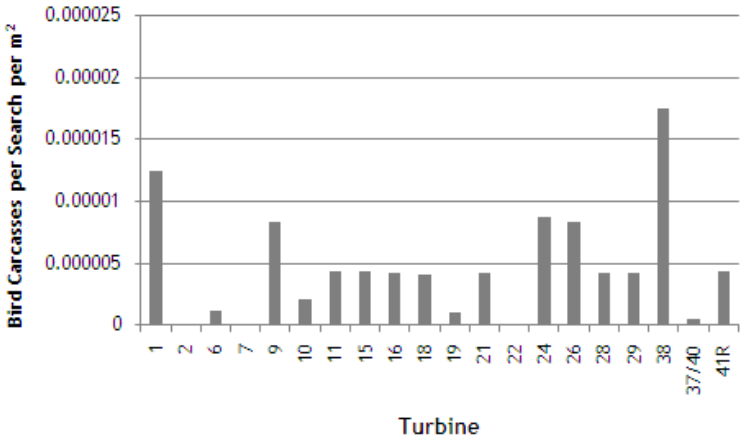
Figure 10. Temporal distribution of bird carcasses found during the 2010 spring and fall mortality surveys at the Cedar Ridge Wind Farm.



a. Bird carcasses per search per unit area for the 2009 spring surveys.

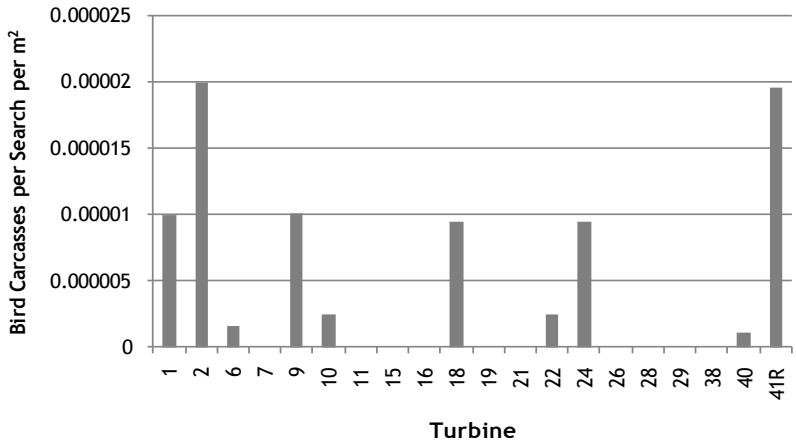


b. Bird carcasses per search per unit area for the 2009 fall surveys.

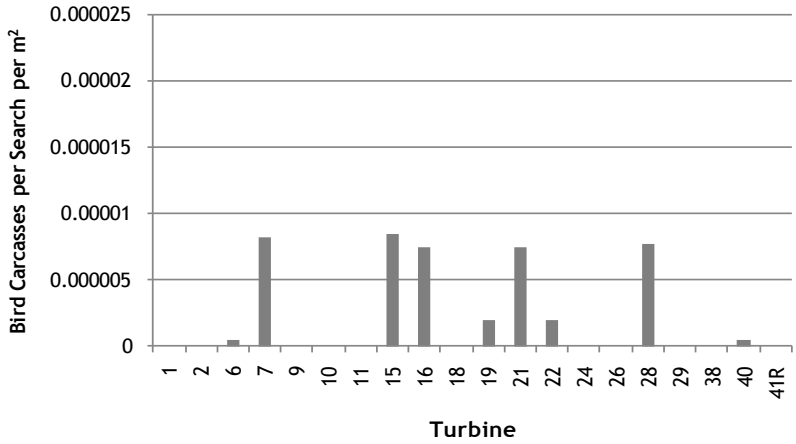


c. Bird carcasses per search per unit area for the 2009 spring and fall surveys.

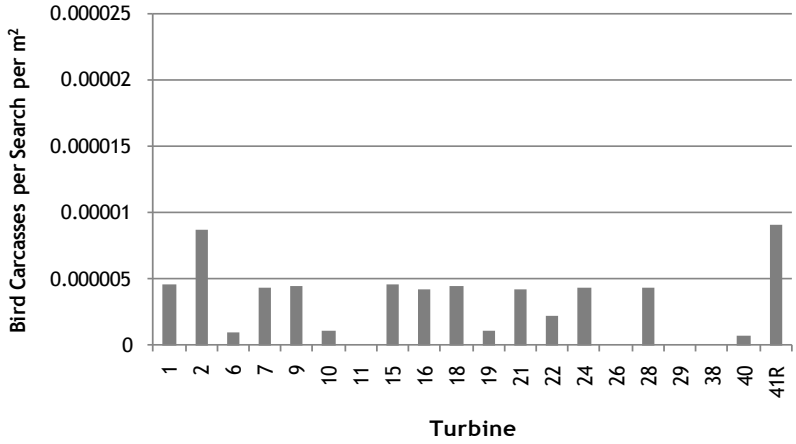
Figure 11. Bird carcasses per search per unit area for each turbine surveyed during the 2009 mortality surveys at the Cedar Ridge Wind Farm.



a. Bird carcasses per search per unit area for the 2010 spring surveys.

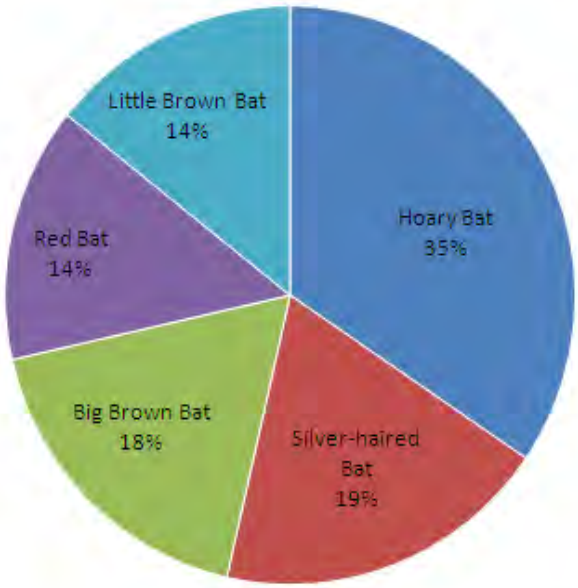


b. Bird carcasses per search per unit area for the 2010 fall surveys.

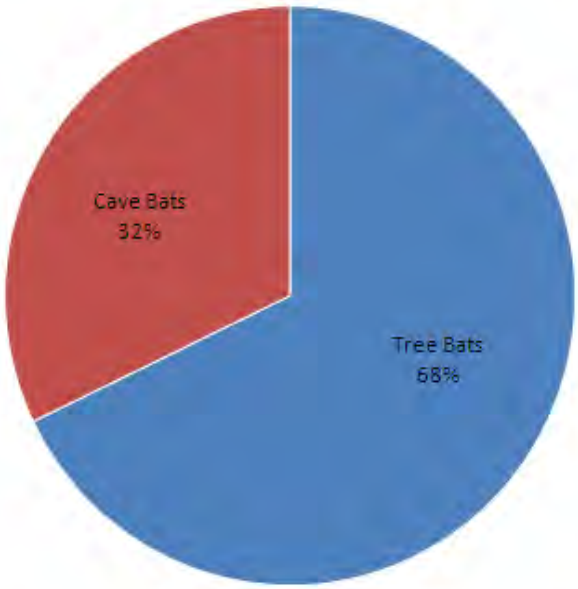


c. Bird carcasses per search per unit area for the 2010 spring and fall surveys.

Figure 12. Bird carcasses per search per unit area for each turbine surveyed during the 2010 mortality surveys at the Cedar Ridge Wind Farm.

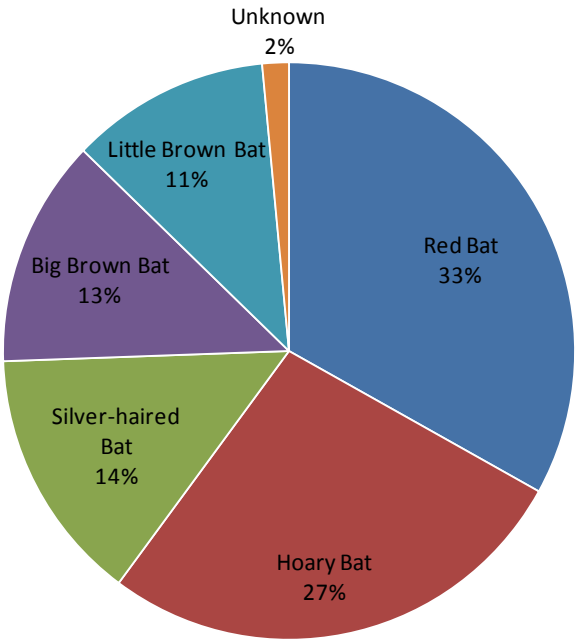


a. Bat carcasses by species.

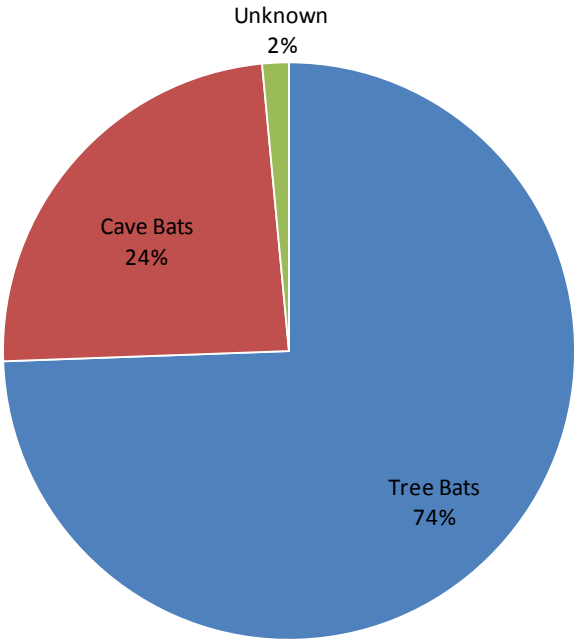


b. Bat carcasses by type.

Figure 13. Bat carcasses found during the 2009 mortality surveys at the Cedar Ridge Wind Farm.



a. Bat carcasses by species.



b. Bat carcasses by type.

Figure 14. Bat carcasses found during the 2010 mortality surveys at the Cedar Ridge Wind Farm.

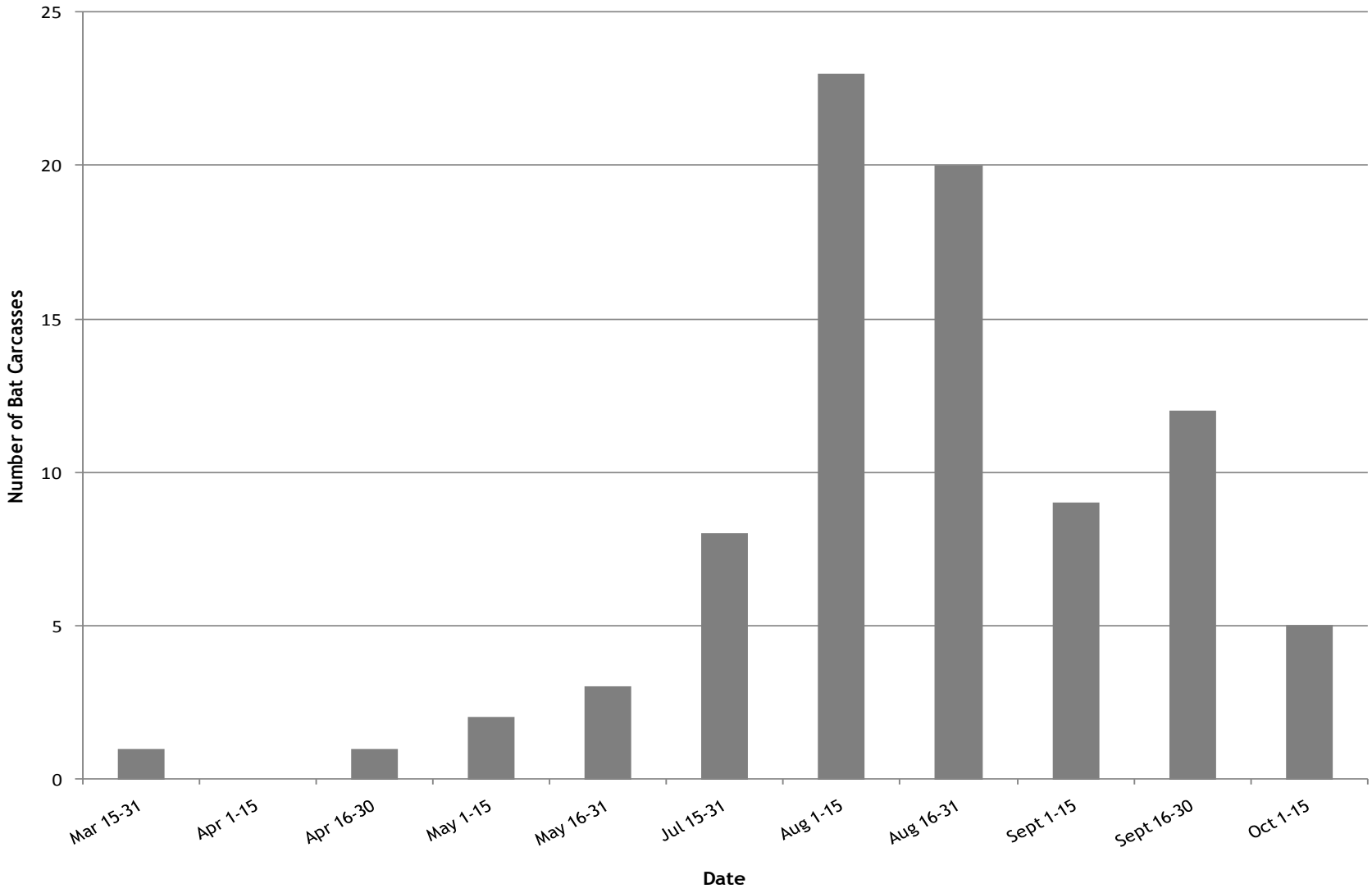


Figure 15. Temporal distribution of bat carcasses found during the 2009 mortality surveys at the Cedar Ridge Wind Farm.

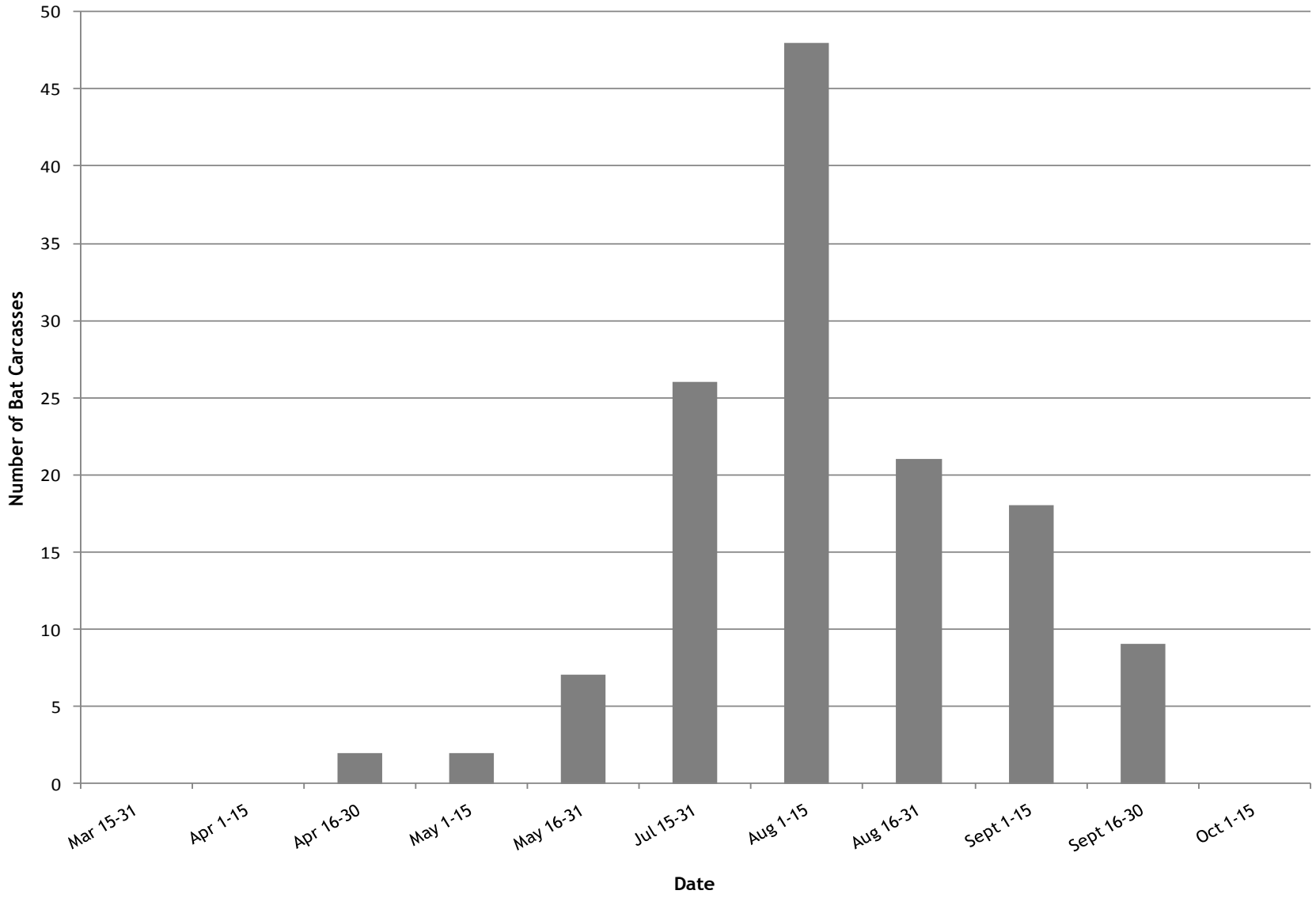
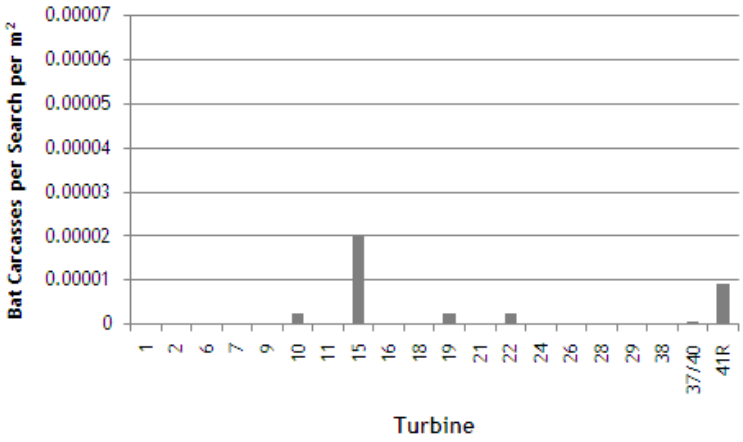
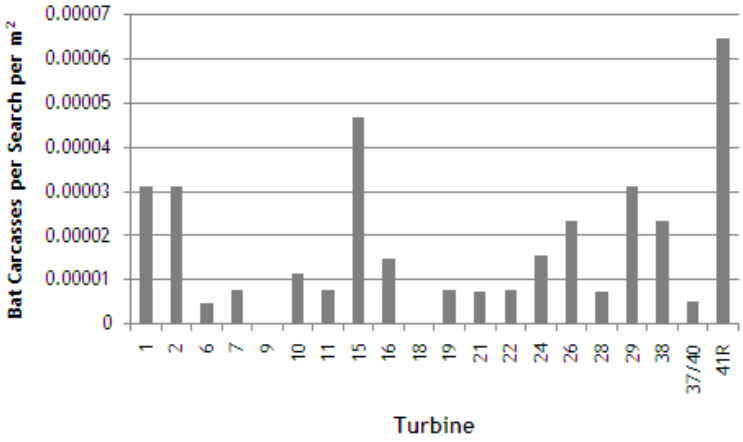


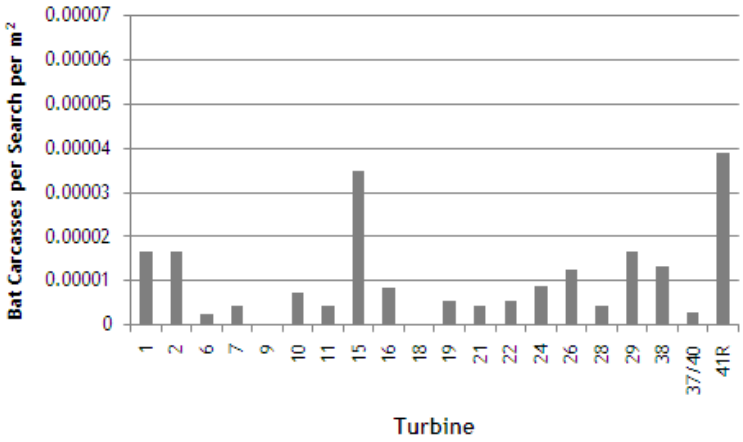
Figure 16. Temporal distribution of bat carcasses found during the 2010 mortality surveys at the Cedar Ridge Wind Farm.



a. Bat carcasses per search per unit area for the 2009 spring surveys.

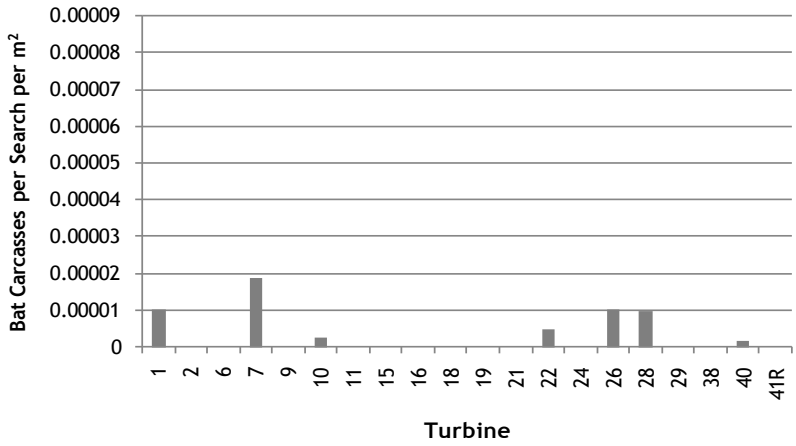


b. Bat carcasses per search per unit area for the 2009 fall surveys.

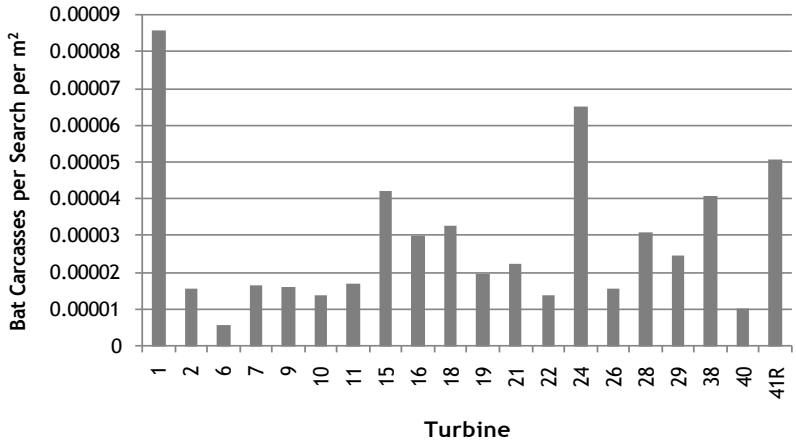


c. Bat carcasses per search per unit area for the 2009 spring and fall surveys.

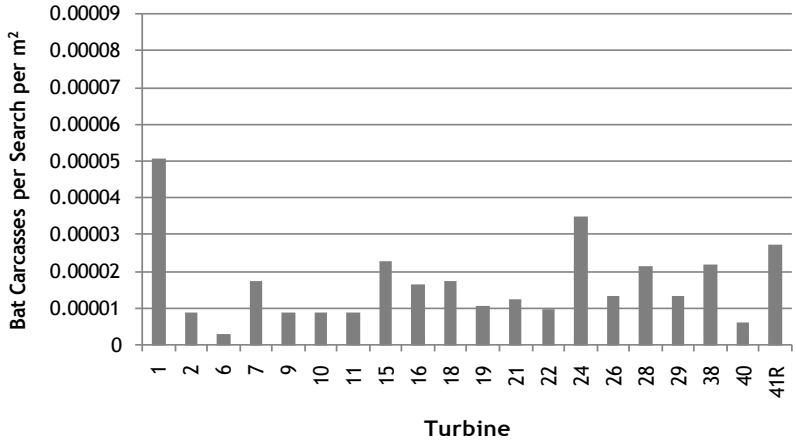
Figure 17. Bat carcasses per search per unit area for each turbine surveyed during the 2009 mortality surveys at the Cedar Ridge Wind Farm.



a. Bat carcasses per search per unit area for the 2010 spring surveys.



b. Bat carcasses per search per unit area for the 2010 fall surveys.



c. Bat carcasses per search per unit area for the 2010 spring and fall surveys.

Figure 18. Bat carcasses per search per unit area for each turbine surveyed during the 2010 mortality surveys at the Cedar Ridge Wind Farm.

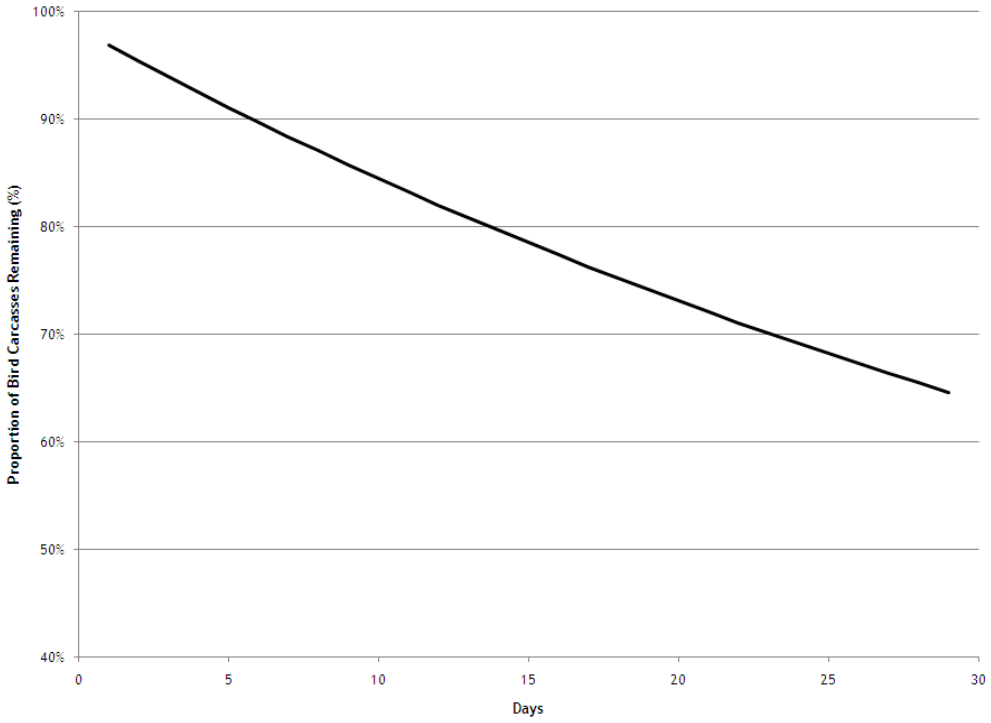


Figure 19. Proportion of bird carcasses remaining over time during the 2009 scavenger removal trials at the Cedar Ridge Wind Farm.

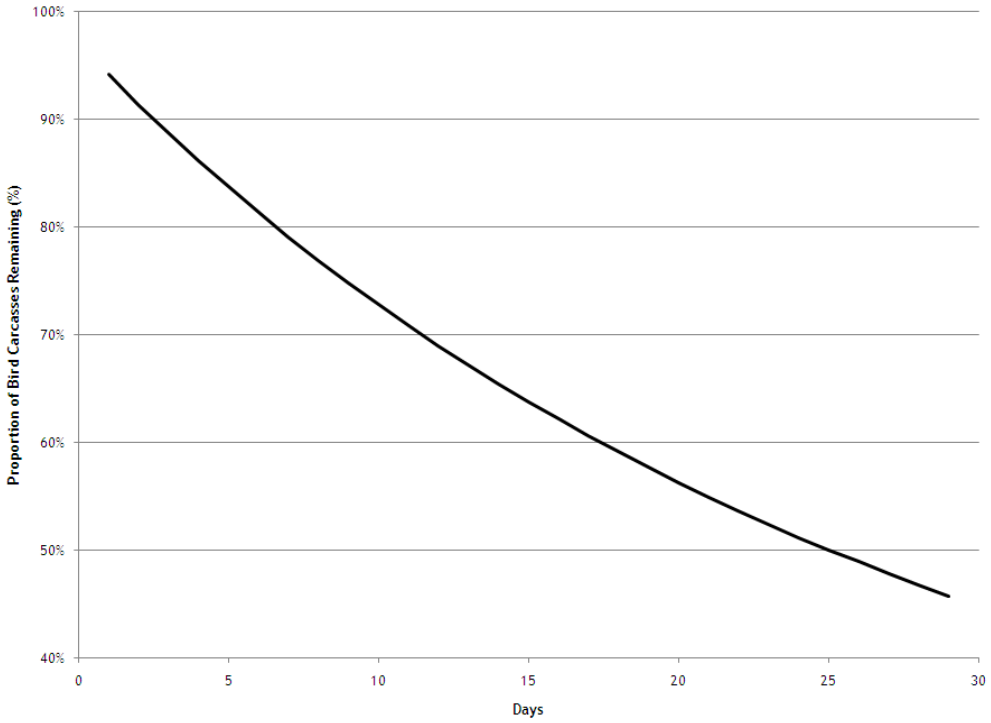


Figure 20. Proportion of bird carcasses remaining over time during the 2010 scavenger removal trials at the Cedar Ridge Wind Farm.

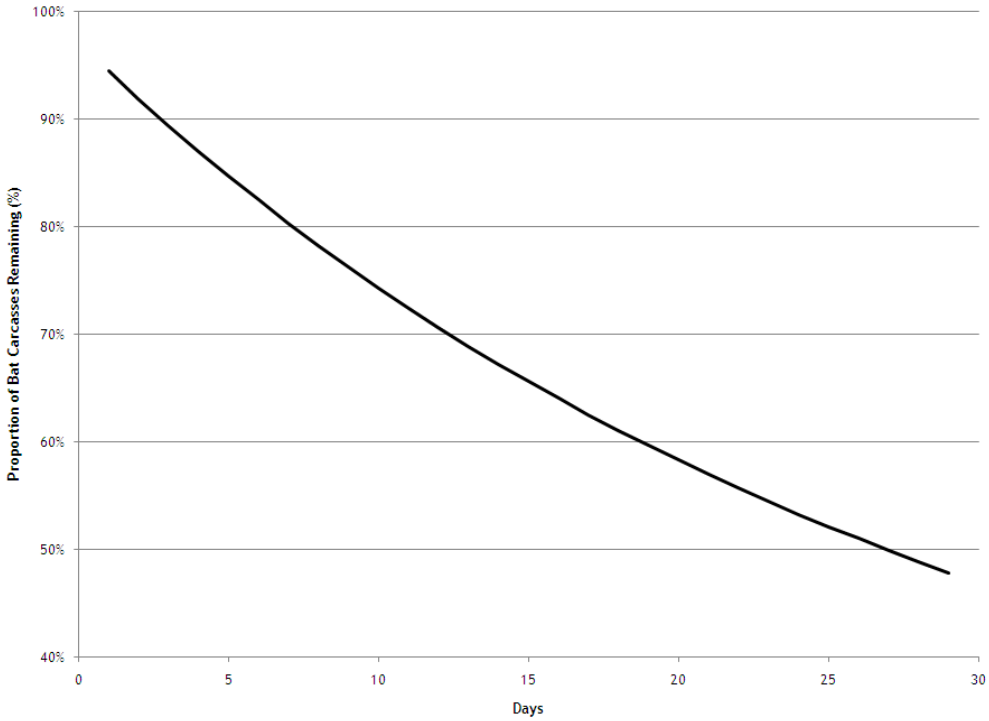


Figure 21. Proportion of bat carcasses remaining over time during the 2009 scavenger removal trials at the Cedar Ridge Wind Farm.

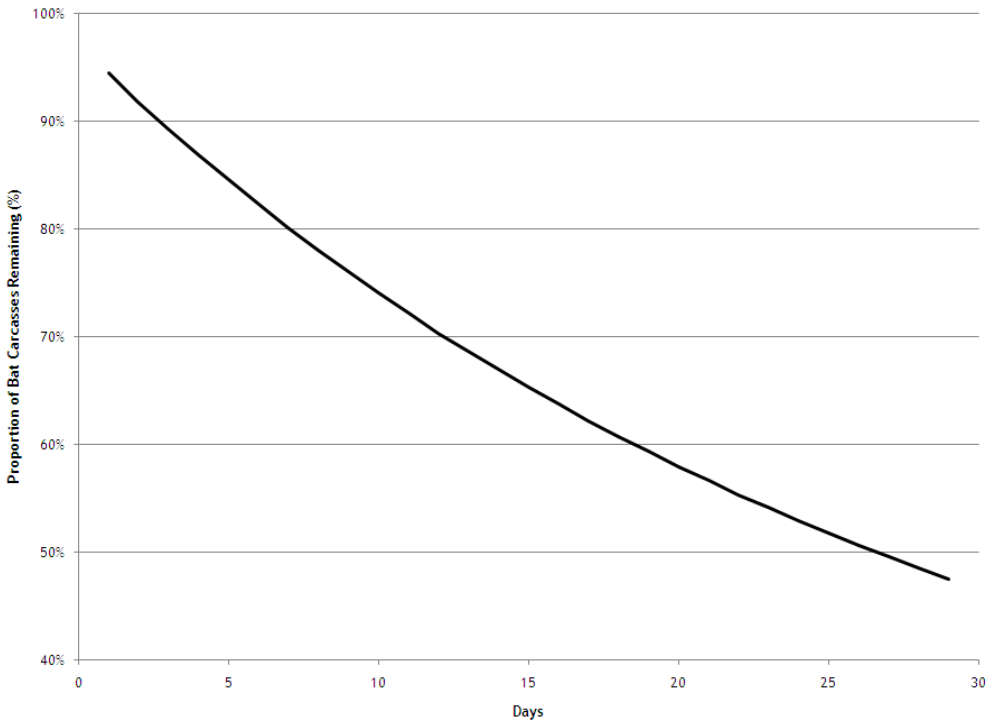


Figure 22. Proportion of bat carcasses remaining over time during the 2010 scavenger removal trials at the Cedar Ridge Wind Farm.

APPENDIX A

Representative Photos

Appendix A

Photographs taken by BHE Environmental, Inc.
2009

Photo 1. Typical landscape at the Cedar Ridge Wind Farm.

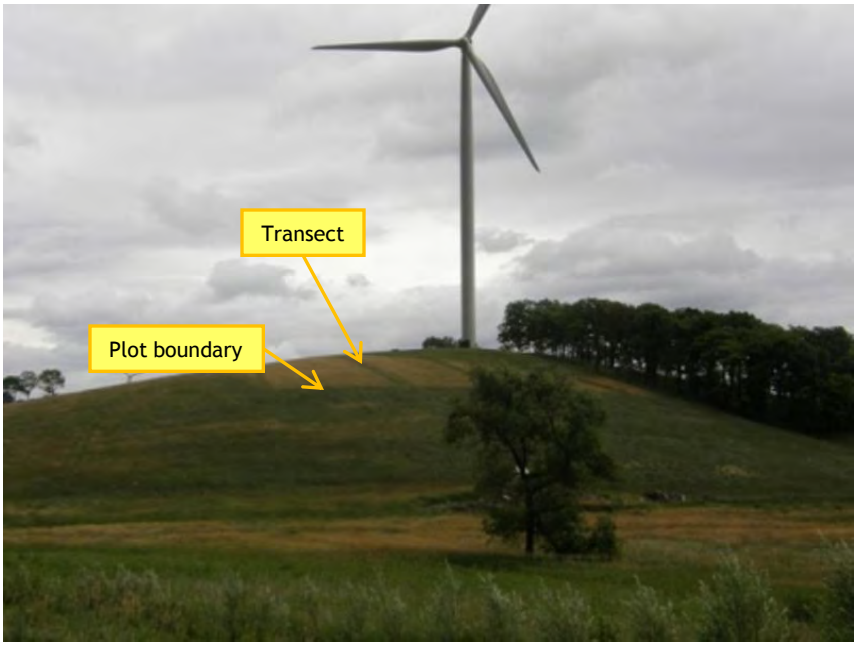


Photo 2. Mowed survey plot and mowed and mulched transects at Turbine 11.

Photo 3. Woodlot at Turbine 40 cleared from understory vegetation.

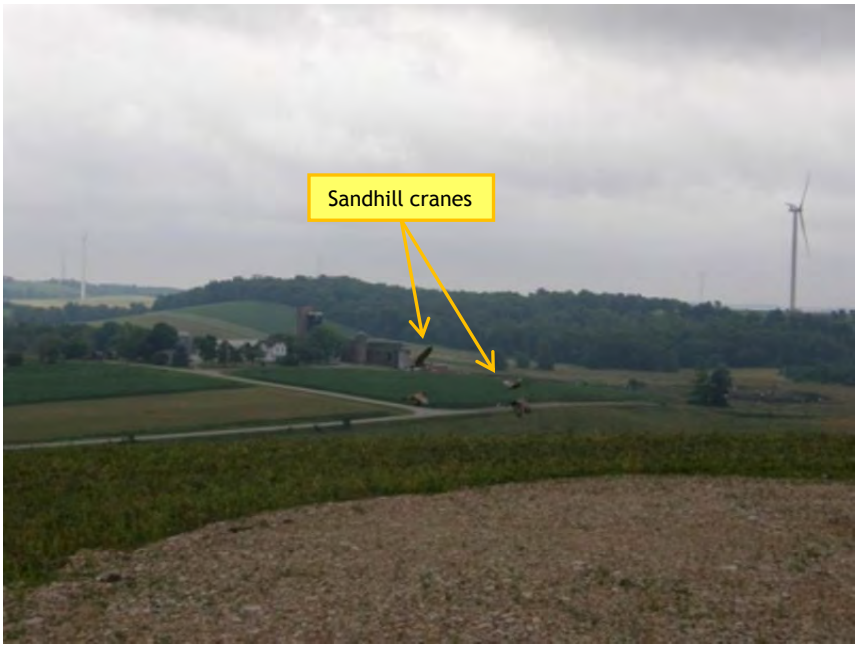


Photo 4. Sandhill cranes at the Cedar Ridge Wind Farm. Gravel in the foreground is the turbine pad for Turbine 18.

Photo 5. Sandhill crane chicks observed near Turbine 26.

Photo 6. Feather spot located at Turbine 22 and temporarily marked with a pin flag until feathers were collected.

Photo 7. Searcher efficiency carcass found exposed and temporarily flagged by searchers.

Photo 8. Fresh, whole (intact) hoary bat carcass found by searchers.

Photo 9. Fresh, whole (intact) red-winged blackbird exposed on bare soil.

Photo 10. Decomposed, mostly whole little brown bat carcass.

Photo 11. Posterior end (piece) of a tree swallow found and labeled with an ID tag before collecting.

Photo 12. Remaining pieces of a rock pigeon after one night of scavenging (scavenger removal trial carcass).

Photo 13. Feather spot remaining after three nights of scavenging. Note the plastic plant stake used to help searchers find the scavenger removal trial carcasses.

Photo 14. Searcher placing a carcass in a plastic bag after collecting data.

Photo 15. Operations building at the Cedar Ridge Wind Farm. Carcasses were stored in a freezer in the warehouse.

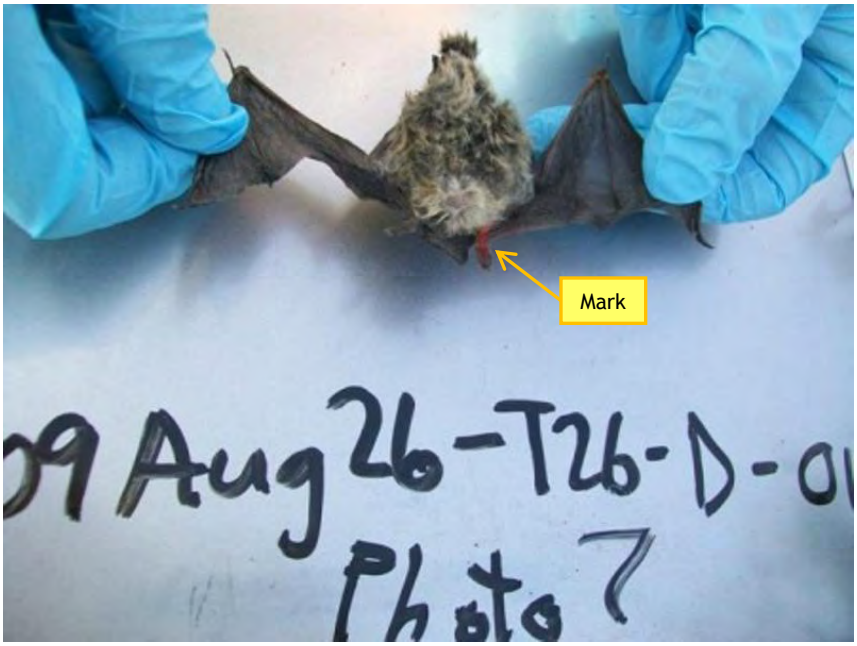


Photo 16. Permanent, red ink on the left, hind foot of this little brown bat used in a searcher efficiency trial.

Photo 17. Silver-haired bat partially exposed in the grass for a scavenger removal trial.

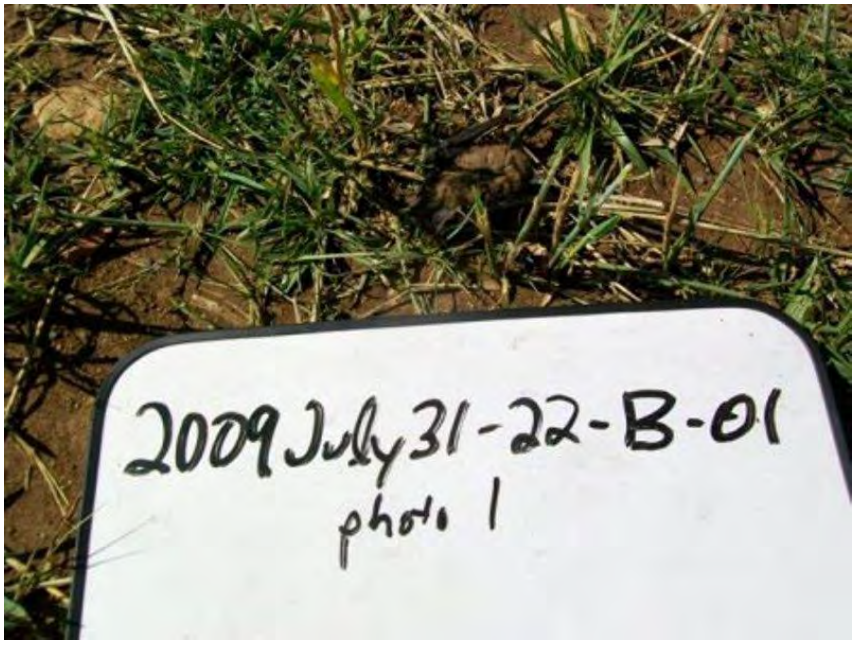


Photo 18. Little brown bat found partially exposed in the grass.

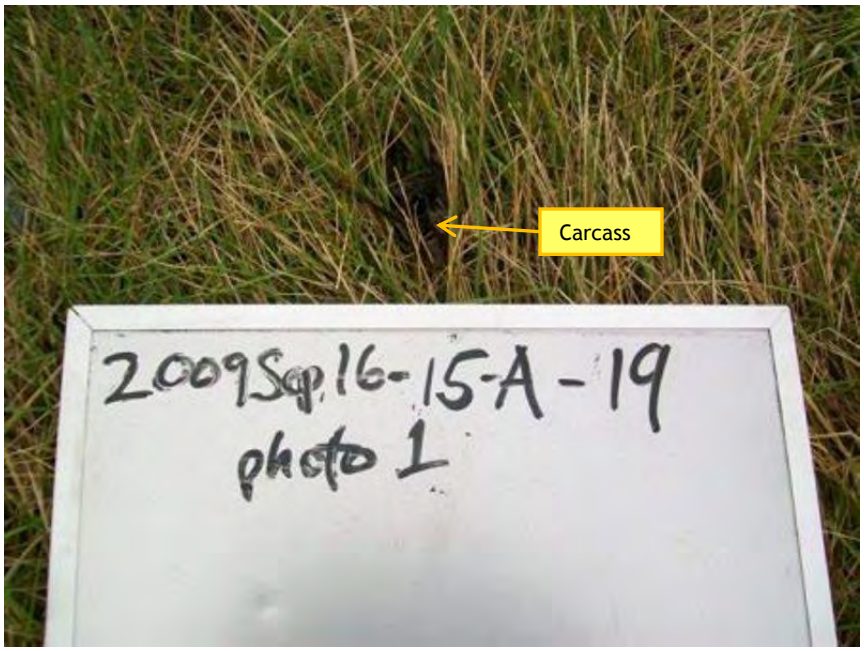


Photo 19. Scavenger removal trial carcass hidden in the tall grass at Turbine 15.

Photo 20. Burlap bag placed for a searcher efficiency trial during the late fall survey period.

Photo 21. Corn planted during the fall survey period in Transect AA and the northern half of Transect A at Turbine 6.

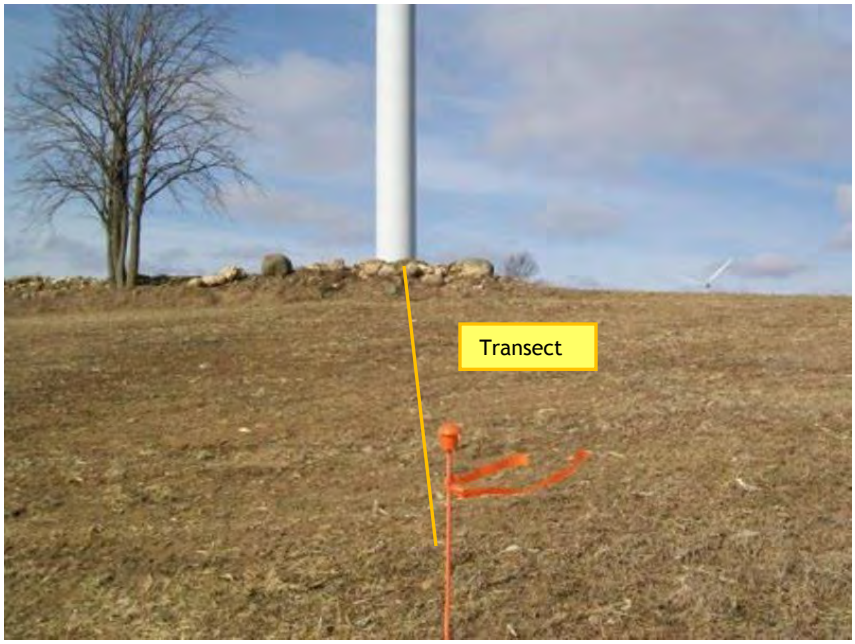


Photo 22. Cobbles piled along a fencerow which intersects Transect F at Turbine 9.

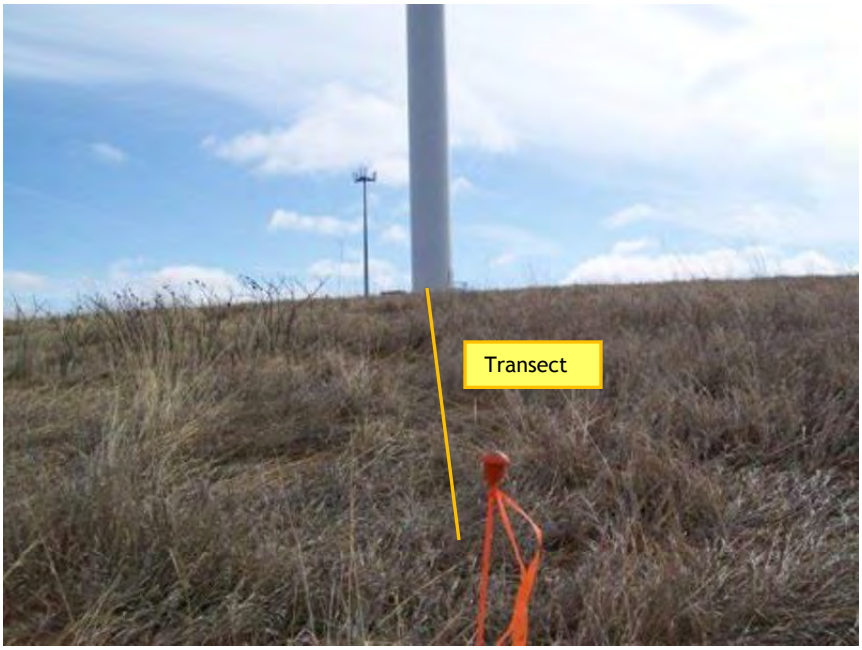


Photo 23. Tall, prairie grass along Transect F at Turbine 19. This grass was removed during the spring survey period.

Photo 24. Low visibility during a snow storm on April 21. Surveys were canceled this day.

APPENDIX B

Study Plan

Study Plan
Post-Construction Bird and Bat Mortality Study
Cedar Ridge Wind Farm
Fond du Lac County, Wisconsin

Introduction

The Cedar Ridge Wind Farm is owned by Wisconsin Power and Light Company (WPL), a subsidiary of Alliant Energy Corporation, and is located approximately ten miles south of the city of Fond du Lac, in the towns of Eden and Empire in Fond du Lac County, in southeastern Wisconsin (Figure 1).

Cedar Ridge consists of 41 wind turbines and related interconnection and ancillary facilities on approximately 7,808 acres (Figure 1). The Vestas V82 turbines utilize a horizontal axis, three-bladed rotor, and nacelle mounted on a tubular steel tower. Turbine and tower characteristics are as follows: 41-meter (m) (134.6-foot [ft]) blade length, 5,281-square meter (m^2) rotor swept area, 80-m (262.5-ft) hub height, and 14.4-rotations per minute (rpm) rotor speed. The rotor swept area extends from 39 m (127.1 ft) above ground level (agl) to 121 m (396.1 ft) agl.

Nearly 70% of land in the project area is agricultural fields or vacant/open land; about 10% is forest, and the remainder is wetland, water, old fields, or other land uses (Figure 1). Aerial photographs dating to 1941 indicate the project site has been used for agriculture, with some rural residential and recreational use. Construction initiated in October 2007 and the facility began generating electricity in December 2008. The facility has the capacity to generate up to 68 megawatts.

Two years of post-construction monitoring to assess mortality of birds and bats was specified in the Wisconsin Public Service Commission (WPSC) Certificate of Authority for the Cedar Ridge Wind Farm (May 2007). In accordance with the WPSC order, methods for the post-construction monitoring study have been developed in coordination with the Wisconsin Department of Natural Resources (WDNR), the U.S. Fish and Wildlife Service (USFWS), and WPSC.

Study Objectives

The objectives of the proposed investigation are as follows:

- Conduct two years of mortality surveys at Cedar Ridge Wind Farm.
- Calculate annual estimates of collision fatalities for bats and birds. If sufficient data are collected, we will calculate estimated rates of mortality for species and/or guilds (e.g., songbirds, waterfowl, nocturnal migrants, “tree” bats).
- Compare 2009 and 2010 data on mortality, searcher efficiency, and scavenger removal.

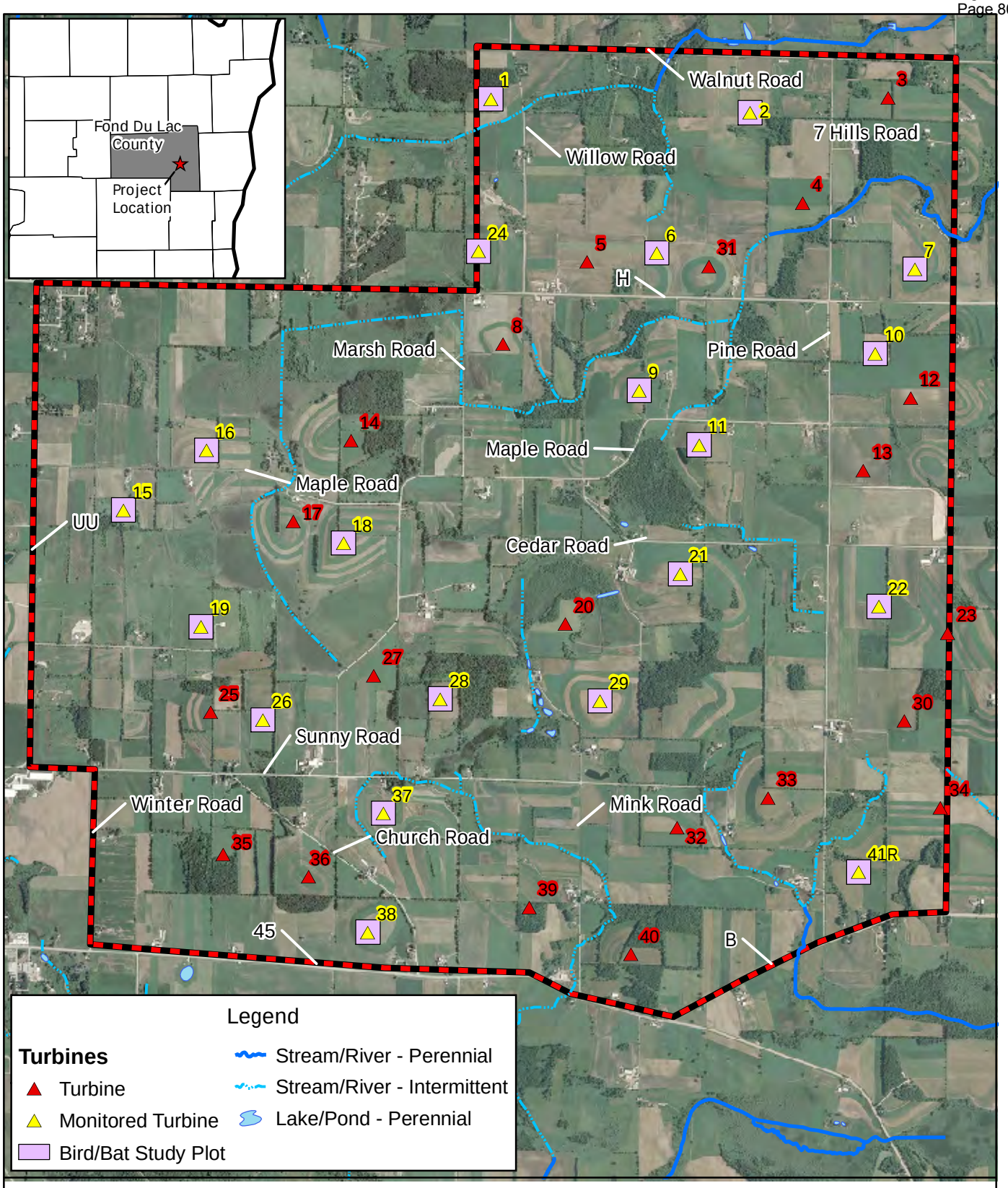


Figure 1. Turbines selected for monitoring bird/bat mortality at the Cedar Ridge Wind Farm, Fond du Lac County, Wisconsin

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S

Feet
2,000 0 2,000 4,000

February 2009

Project No. 1782.003

Basemap: NAIP Imagery - 2006

BHE ENVIRONMENTAL

Methods

Rates of mortality of birds and bats at the Cedar Ridge Wind Farm will be estimated by counting the number of carcasses found beneath a subset of turbines and by using standard statistical methods to correct for the rate of searcher efficiency and scavenger removal of carcasses. The approach for assessing avian and chiropteran mortality at Cedar Ridge is similar to methods used at the Blue Sky Green Field (BSGF) Facility in Fond du Lac County (12 miles north of Cedar Ridge; Gruver et al 2008) and the Forward Energy Center (Forward) in Dodge and Fond du Lac counties (6 miles southeast of Cedar Ridge; Drake 2008). Both of those wind generation projects are situated on larger areas than the Cedar Ridge Wind Farm, and both projects have approximately twice the number of turbines as Cedar Ridge Wind Farm.

The methods proposed herein are based upon the best data currently available, including the best judgment of experienced professionals at the WDNR, USFWS, and WPSC. Data from the BSGF and Forward projects (if available), as well as the first year of post-construction monitoring at Cedar Ridge, may provide new insight about the most effective methods for estimating mortality. Therefore, methods proposed herein will be applied during 2009. Following the 2009 field season, WPL will coordinate with the WDNR, USFWS, and WPSC to evaluate any appropriate changes to monitoring methods.

Field Surveys

BHE will conduct field studies at 20 of the 41 turbines at the Cedar Ridge Wind Farm. In coordination with the WNDR, WPL selected the 20 turbines included in this study (Figure 1).

A square plot having 160-meter long sides (6.3 acres) will be searched at each of the 20 turbines. Field studies will consist of carcass surveys, searcher efficiency trials, and scavenger removal trials.

Carcass Surveys

Each of the 20 plots will be systematically searched to identify the carcasses of birds and bats killed by collision with turbines. Using a similar approach as studies at BSGF and Forward, transects will be established to either census or sample each plot. Transects will be mowed regularly throughout the study to facilitate searches. The WDNR will be notified if portions of any of the 20 search plots are unsearchable.

At two plots, the survey will census the entire plot; all searchable areas within the 6.3 acres will be searched. Searchers will walk 26 6-meter wide linear transects through the plot (Figure 2a), searching the entire area. Census plots will be selected by dividing the project area in half, and randomly selecting one plot in the southern half of the project area, and one in the northern half.

In the 18 sample plots, six 6-meter wide transects will be established (Figure 2b). Two transects will be centered on the turbine, perpendicular to each other. The other four transects will intersect the plot at varying distances from the turbine, and in varying directions (e.g., some transects will be oriented north-south and some east-west). Transects will be 10, 30, 50 and 70 m from the turbine in half the plots, and 20, 40, 60 and 80 m from

the turbine in remaining plots. In addition to the six transects, the turbine pad and access road within the plot be searched. The search area at each of the 18 sample turbines will be approximately 1.4 acres.

Figure 2a. Diagram of a census plot.

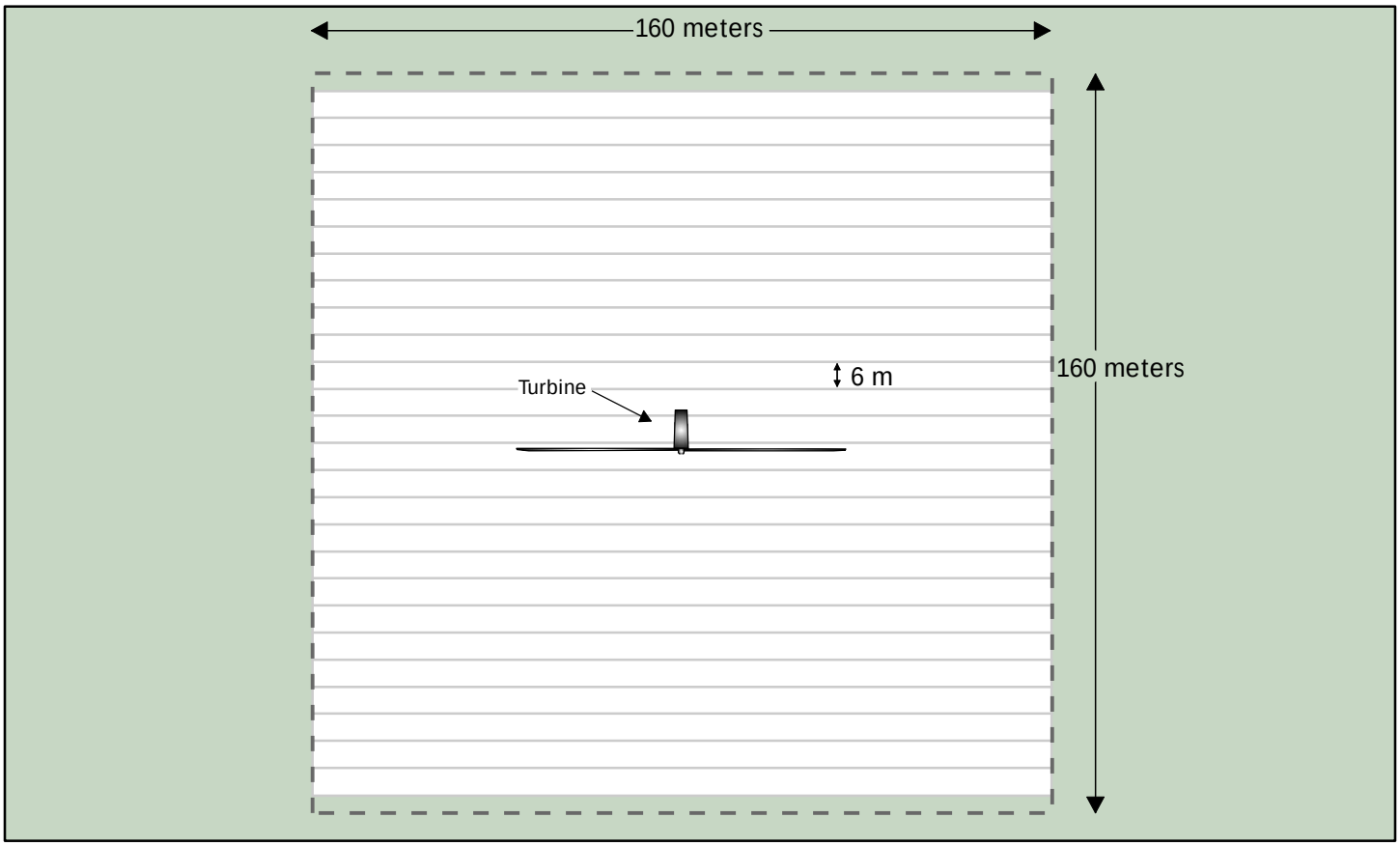
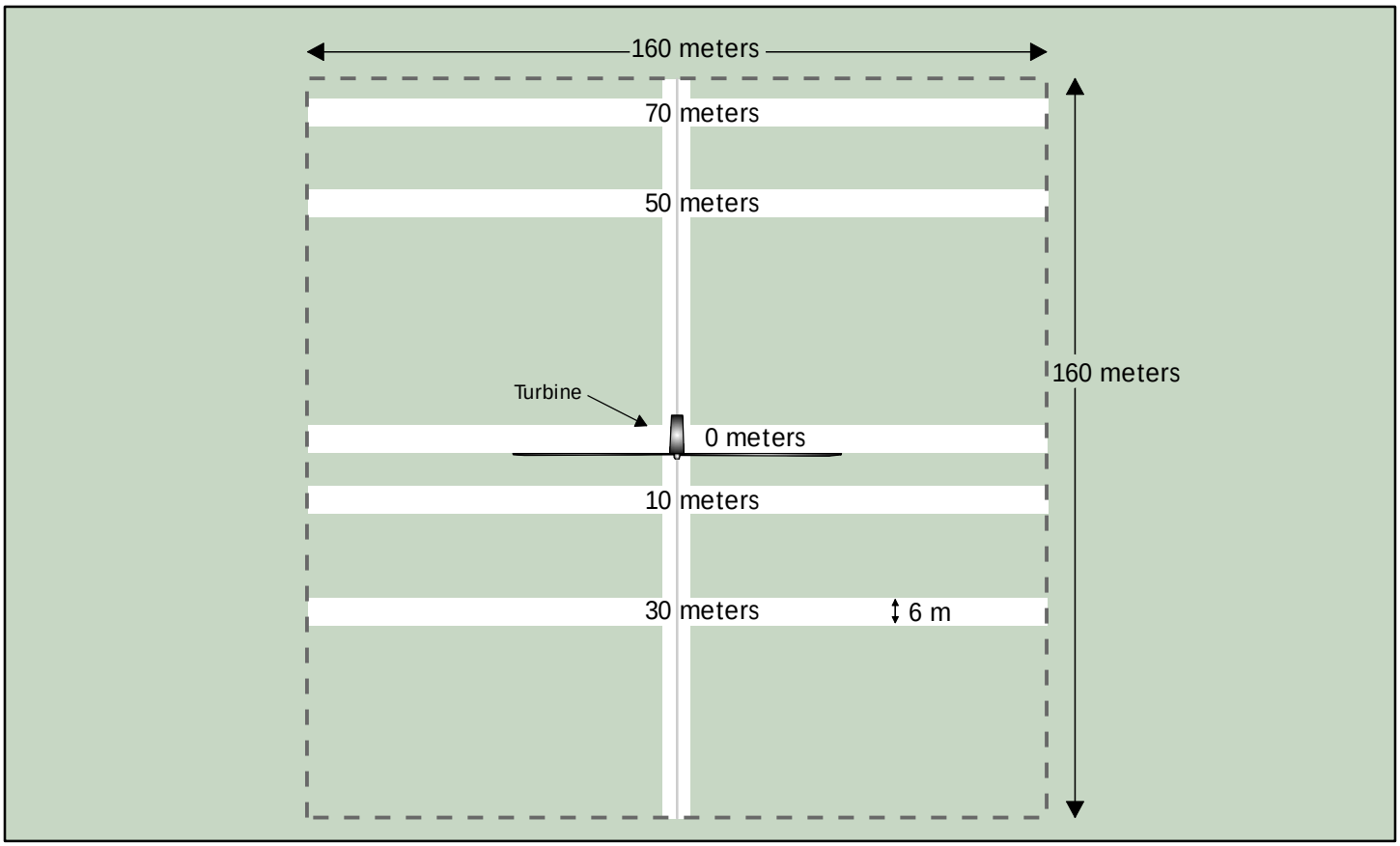


Figure 2b. Diagram of a sample plot.



Searches will be conducted between March 15 and June 1, the typical period of spring migration for birds and bats, and again between July 15 and October 15, the typical period of autumn migration for birds and bats. Between October 16 and November 15, hereafter called the "late autumn" period we will search the 20 plots for sandhill cranes (*Grus canadensis*). Sandhill cranes inhabit the Horicon Marsh (18 miles southwest) and often migrate in the late autumn.

During the spring and autumn migration periods, five of the 20 turbines will be randomly selected and monitored daily. The remaining 15 turbines will be monitored once every 4 days (Figure 3). Between October 16 and November 15, all 20 turbines will be searched every three days. Field work will be suspended during lightning storms, icy conditions, heavy snow and rain, and other weather conditions that create a safety hazard. Searches that cannot be completed during bad weather will be completed as soon as is practicable.

During the late autumn period, the objective is to detect relatively large bodied birds that are likely to be more visible and less prone to decomposition and scavenging than smaller animals. Therefore, we believe the frequency of searches will be reduced and the pace increased without compromising thoroughness of the search. During the late autumn period, all 20 turbines will be searched every three days. All birds and bats identified during searches will be collected and document in the same manner as during the spring and autumn periods.

Prior to initiating the monitoring season in the spring of 2009 and 2010, BHE will conduct a clean sweep of the plots beneath each of the 20 turbines, including roads and the turbine pad. Carcasses found during the clean sweep will be documented, removed from the site, and stored for potential use in searcher efficiency or scavenger removal trials.

Figure 3. Example monitoring schedule.

Turbine No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Monday	■	■	■	■	■	■	■	■	■											
Tuesday	■	■	■	■	■					■	■	■	■							
Wednesday	■	■	■	■	■									■	■	■	■			
Thursday	■	■	■	■	■													■	■	■
Friday						■	■	■	■											
Saturday										■	■	■	■							
Sunday														■	■	■	■			

■ Turbine plot searched

Searches will be conducted by trained personnel working in pairs. Searchers will walk at a rate of approximately 45-60 meters per minute along each transect. The rate may be adjusted based upon results of the first searcher efficiency trial.

The location of each carcass we discover will be flagged and the distance and direction (compass bearing) from the nearest turbine recorded. Each fatality will be photographed as found in the field. Data collected will include the species, sex, age, reproductive condition (when identifiable), apparent cause of death, presence of wing bands or other identifiers, and condition of the bat or bird carcass (e.g., intact, scavenged). Recent weather conditions will be recorded for each search day. Feather spots (10 or more feathers found together) will be recorded as a fatality; feathers will be identified to the extent possible. Injured bats and birds observed in search plots will be recorded as a fatality.

Carcasses will be labeled with a unique identifier, sealed in a plastic bag, and stored frozen at the Cedar Ridge operations building.

Carcasses found outside scheduled searches but located within search plots, and carcasses found outside search plots will be documented according to procedures described above to the extent possible, and identified as an incidental find. Incidental carcasses may be used during field bias trials.

Searcher Efficiency Trials

Trials will be conducted during the spring and autumn monitoring periods to estimate the percentage of carcasses found by searchers. Searcher efficiency trials will be conducted by planting discreetly marked carcasses throughout the 20 search plots. Carcasses of bats and birds of various sizes and conditions (e.g., whole, partially decomposed) will be used in the trials. Searcher efficiency trials will be conducted simultaneously with carcass searches; observers conducting carcass searches will not be aware of the date or location where trial carcasses are planted. A person not conducting carcass searches will plant trial carcasses during the evening or early morning prior to the start of carcass searches. Following carcass searches, trial carcasses will be retrieved and the number and location of detected trial carcasses will be documented.

Approximately 100 trials (one trial = placement of a single carcass for one day) using bats and birds of various sizes will be conducted during the spring and again during the autumn migratory periods. During the late autumn period, we will conduct about 50 trials using birds only, and including larger bodied birds if available. Therefore, a total of approximately 250 searcher efficiency trials will be conducted during the year. Carcasses will be placed at all 20 search plots, and no more than three carcasses will be placed in a single search plot during one day.

Carcasses used in trials will consist of non-native/non-protected or commercially available species. Bird and bat carcasses salvaged from the project area will be used, and we will request carcasses from the WDNR and similar sources. Carcasses will be used in trials in accordance with our USFWS Migratory Bird Permit and WDNR Wildlife Collection Permit.

Scavenger Removal Trials

Trials will be conducted during the spring and autumn monitoring periods to estimate the rate of carcass removal by scavengers or other means (mowing, decomposition). Carcass removal trials will be conducted by planting discreetly marked carcasses throughout the 20 search plots.

Bird carcasses of various sizes, as well as bat carcasses will be used in the trials. The observer(s) conducting the trials will monitor the trial carcasses over a period of up to 30 days. Carcasses will be checked daily for the first five days, every three days between days 6 and 20, and on day 30. A photograph and written description of the carcass will be recorded during each check. Remaining trial carcasses, if any, will be removed at the end of 30 days.

Approximately 50 trials (one trial = placement of a single carcass for 30 days) using bats and birds of various sizes will be conducted during the spring and again during the autumn migratory periods. During the late autumn period, we will conduct about 20 trials using birds only, and including larger bodied birds if available. Therefore a total of approximately 120 scavenger removal trials will be conducted during the year. Carcasses will be placed at all 20 search plots, and no more than two carcasses will be placed in a single search plot during a monitoring period. Scavenger removal trials will be conducted separately from searcher efficiency trials, to avoid placing too many carcasses in one area.

Carcasses used in trials will consist of non-native/non-protected or commercially available species. Bird and bat carcasses salvaged from the project area will be used. We will request carcasses from the WDNR and similar sources. Carcasses will be used in trials in accordance with our USFWS Migratory Bird Permit and WDNR wildlife collection permit.

Calculations and Assumptions

Bird and bat carcasses identified during searches will be plotted on a detailed map of the study area showing the location of the wind turbines and associated facilities (i.e., overhead power lines and met towers).

Estimated rates of mortality will be calculated using methods typically applied to studies of wildlife mortality at wind farms. To the extent practicable, we will incorporate improved calculations proposed in recent literature (Smallwood 2007, Huso 2008). The following calculations, or similar, will be used to analyze data from the Cedar Ridge Wind Farm.

The estimated average number of carcasses (M_u) observed per turbine per monitoring year is:

$$M_u = \frac{\sum_{i=1}^{n} Mi}{k * A}$$

Where Mi is the number of carcasses detected at plot i during the study period of interest (e.g. spring migration period, entire year). A is the proportion of the plot actually searched. k is the number of turbines searched.

The proportion of carcasses remaining will be calculated using the following equation (Smallwood 2007) or an appropriate equivalent.

$$R_c = \frac{\sum_I^{i=1} R_i}{I \, x \, 100}$$

R_c is the cumulative proportion of carcasses remaining, where I is the duration of a scavenger removal trial, R_i is the percent of carcasses remaining by the i^{th} day after initiation of the trial.

Estimated adjusted mortality (M_a) is:

$$Ma = \frac{M_u}{R \, x \, p}$$

Where *p* is the proportion of carcasses found by fatality searches during searcher detection trials.

Estimates of mortality will be expressed per turbine per year. Estimates will be calculated for birds and bats. If sufficient data are collected, estimated rates of mortality for species or guilds (e.g., songbirds, waterfowl, "tree bats") will also be calculated. Data from census plots will be compared with sample plots to identify variation attributed to the difference in area sampled.

Calculations will be based upon the following assumptions.

- Rates of bird and bat mortality are similar among all turbines in the Cedar Ridge Wind Farm.
- Most fatalities at the wind farm will occur during the migration periods for birds and bats (Howe et al. 2002, Arnett et al. 2008).
- Levels of background mortality (i.e., mortality not associated with turbines) and crippling bias (mortality of animals injured by turbines but move away from the site and die at a later time) are small.

Data on weather conditions during the survey periods will be collected from the Cedar Ridge site and/or National Climatic Data Center (NCDC) from the Fond du Lac Airport, approximately 10 miles northeast of the project site. Weather conditions will be evaluated qualitatively to estimate effects of weather on bird/bat mortality.

Disposition of Carcasses and Injured Wildlife

Carcasses found at Cedar Ridge will be stored frozen on site. Frozen specimens may be used during searcher efficiency or scavenger removal trials. At the end of the study in 2010, frozen specimens will be transported to the WDNR, or other location in accordance with requirements of our USFWS and WDNR wildlife salvage permits.

In the unexpected event that a state or federally threatened or endangered is discovered, we will notify the WDNR, USFWS, and WPSC by email and/or phone within 24 hours. Disposition of those carcasses will be at the direction of the agencies. Likewise, those agencies will be notified immediately (within 24 hours) if an unusually large number of birds or bats are killed at once.

Injured bats and native birds found during standard searches will be carefully captured by the observer and humanely euthanized according to physical measures approved by the American Veterinary Medical Association (June 2007) or transported to a local wildlife rehabilitation center in a timely fashion. If we encounter an injured animal that cannot be approached safely, we will notify the Wisconsin DNR, Oshkosh Office.

Reporting

Following the autumn 2009 monitoring period, BHE will prepare an interim report summarizing the first year of field studies. A final report of the two-year study will be prepared following the autumn 2010 monitoring period. Reports will describe site conditions, survey methods, results, and estimated mortality rates. Printed versions of reports will include representative photographs, and the complete photographic log will be provided digitally. Datasheets also will be provided digitally.

Literature Cited

American Veterinary Medical Associatio. 2007. AVMA Guidelines on Euthanasia. http://www.avma.org/issues/animal_welfare/euthanasia.pdf 25pp + appendices.

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Gruver, J., G.D. Johnson, W.P. Erickson, and N.J. Cutright. 2008. Post-construction bat and bird fatality monitoring plan, Blue Sky Green Field Wind Project, Fond du Lac County, Wisconsin. Study Plan prepared for We Energies, Milwaukee, Wisconsin.

Howe, R.W., W. Evans, and A.T. Wolf. 2002. Effects of wind turbines on birds and bats in northeastern Wisconsin: a report submitted to Wisconsin Public Service Commission and Madison Gas and Electric Company.

Huso, M. 2008. A comparison of estimators of bat (and bird) mortality at wind power generation facilities. Presented at *Bats and Wind Energy Cooperative (BWEC) Workshop 2008*, January 8-10, 2008, Austin, TX.

Smallwood, K.S. 2007. Estimating wind turbine–caused bird mortality. Journal Of Wildlife Management 71: 781-2791.

Datasheets

SCAVENGER REMOVAL TRIAL LOG

Project Name: _____ **Project Number:** _____

Comments:

_____

_____

Carcasses are labeled with date-turbine-transect-carcass number as they were originally found (e.g., 2009Apr01-04-B-07, to describe carcass #7 found on transect B of turbine 4 on April 1, 2009).

Carcass ID[1]	Placement						Check One		Species (scientific name)	Condition[6] When Checked											Checked by[7]
	Date	Time (Military)	Turbine[2]	Transect[3]	Exposure[4]	Placed By[5]	Bat	Bird		Day 1	Day 2	Day 3	Day 4	Day 5	Day 8	Day 11	Day 14	Day 17	Day 20	Day 30	

[1] **Carcass ID** – Identification number marked inside carcass.
[2] **Turbine** – Turbine number where carcass placed.
[3] **Transect** – Letter of transect. Also use the turbine pad (Enter PAD) and access road (Enter RD) in addition to the transects.
[4] **Exposure** - Exposed = E, Partially hidden = P, Hidden = H
[5] **Placed By** -Initials of the person who placed the carcass.
[6] **Condition** - Record the condition the carcass was in when checked. Intact = I, Signs of scavenging = S, Feather/Fur Spot = F, Missing or < 10 feathers = 0
[7] **Checked by** - Record the initials of the person who checked on the carcass.

More data on back? Yes No

Carcass ID[1]	Placement						Check One		Species (scientific name)	Condition[6] When Checked											Checked by[7]
	Date	Time (Military)	Turbine[2]	Transect[3]	Exposure[4]	Placed By[5]	Bat	Bird		Day 1	Day 2	Day 3	Day 4	Day 5	Day 8	Day 11	Day 14	Day 17	Day 20	Day 30	

Additional comments (record carcass number next to associated comment, include any identifiers other than bands, if present):

Turbine Number: _____ Page ___ of ___

CARCASS SEARCH DATA SHEET

Date: _____ Biologists: _____

Project Name: _____ Project Number: _____

Survey Type (circle one): Census Sample

Weather: % Cloud Cover_____ Temperature (˚F) _____ Precipitation _____

Site Description/Comments: _____
_____
_____

Label carcasses and photos with date-turbine-transect-carcass number (e.g., 2009Apr01-04-B-07, to describe carcass #7 found on transect B of turbine 4 on April 1, 2009).

Start Time (military): End Time (military) :

Transect [1]	Carcass No. [2]	From Turbine		Check one [3]		Species (scientific name, spell out)	Forearm length of bat (mm)	Age [4]	Sex [5]	Repro. Cond. [6]	Cause of Death [7]	Condition [8]	Band Color /No. [9]	Check if Comments and Write Them on the Back
		Distance (m)	Azimuth (degrees)	Bat	Bird									
												/		
												/		
												/		
												/		
												/		
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												/		
												/		

See back for footnotes. **More data on back? Yes No**

Turbine Number: _____ Page ___ of ___

Transect [1]	Carcass No.[2]	From Turbine		Check one[3]		Species (scientific name, spell out)	Forearm length of bat (mm)	Age [4]	Sex[5]	Repro. Cond.[6]	Cause of Death[7]	Condition[8]	Band Color /No.[9]	Check if Comments and Write Them on the Back
		Distance (m)	Azimuth (degrees)	Bat	Bird							/		
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[1] **Transect** – Enter letter of transect. Also search the turbine pad (Enter PAD) and access road (Enter RD) in addition to the transects.
[2] **Carcass No**.- Number carcasses in the order they are found. Begin at 01 for each turbine each day (do not start over at 01 for every transect).
[3] **Check one** -If not a bat or bird, leave these 2 columns blank and complete the rest of the data.
[4] **Age** – If identifiable, Adult = A, Juvenile = J, Unknown = U
[5] **Sex** – If identifiable, Female = F, Male = M, Unknown = U
[6] **Reproductive Condition** – If identifiable, Pregnant = P, Lactating = L, Post-Lactating = PL, Non-reproductive = NR, Testes descended = T, Unkown = U, B= breeding (birds).
[7] **Cause of Death** - Collision with turbine = T, Predation = P, Unknown = U (add explaination in comments if necessary)
[8] **Condition** – enter F=fresh or D=decomposed AND Whole = W, Most of body with some missing = M, Pieces = P (e.g., wings only), Feather spot = F (example: F/W)
[9] **Band Color/No.** - If banded, record color of band (or metal), and number.

Additional comments (record carcass number next to associated comment, include any identifiers other than bands, if present):

_____

_____

_____

SEARCHER EFFICIENCY TRIAL LOG

Project Name: _____ **Project Number:** _____

Comments:

_____

_____

Carcasses are labeled with date-turbine-transect-carcass number as they were originally found (e.g., 2009Apr01-04-B-07, to describe carcass #7 found on transect B of turbine 4 on April 1, 2009).

	Placement						From Turbine		Check one[6]			Weather When Found				
Carcass ID[1]	Date	Time (military)	Turbine[2]	Transect[3]	Exposure[4]	Placed By[5]	Distance (m)	Azimuth (degrees)	Bat	Bird	Species (scientific name spell out)	Temp (F)	% Cloud Cover	Precip[7]	Found by[8]	Retrieved[9]

[1] **Carcass ID -** Use carcass ID from when it was originally found. If no ID, just number.
[2] **Turbine -** Turbine should be labeled with the turbine number where it was placed.
[3] **Transect -** Transects should be labeled with the transect letter where it was placed. Also use the turbine pad (Enter PAD) and access road (Enter RD) in addition to the transects.
[4] **Exposure -** Exposed = E, Partially hidden = P, Hidden = H
[5] **Placed by -** Record the initials of the person who placed the carcass.
[6] **Check one -** If not a bat or bird, leave these 2 columns blank and complete the rest of the data. Add what it is in the comments.
[7] **Precip** - Rain = R, Snow = S, Fog = F, None = 0
[8] **Found by -** Record the initials of the person who found the carcass.
[9] **Retrieved -** Was the carcass retrieved once found? Yes = Y, No = N

More data on back? Yes No

Page ___ of ___

Carcass ID[1]	Placement						From Turbine		Check one[6]		Species (scientific name spell out)	Weather When Found			Found by[8]	Retrieved[9]
	Date	Time (military)	Turbine[2]	Transect[3]	Exposure[4]	Placed By[5]	Distance (m)	Azimuth (degrees)	Bat	Bird		Temp (F)	% Cloud Cover	Precip[7]		

Additional comments (record carcass number next to associated comment, include any identifiers other than bands, if present):

APPENDIX C

Maps of Turbine Plots and Transects

Turbine # 1 (Survey Group B)
Sample plot, search every 4 days
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

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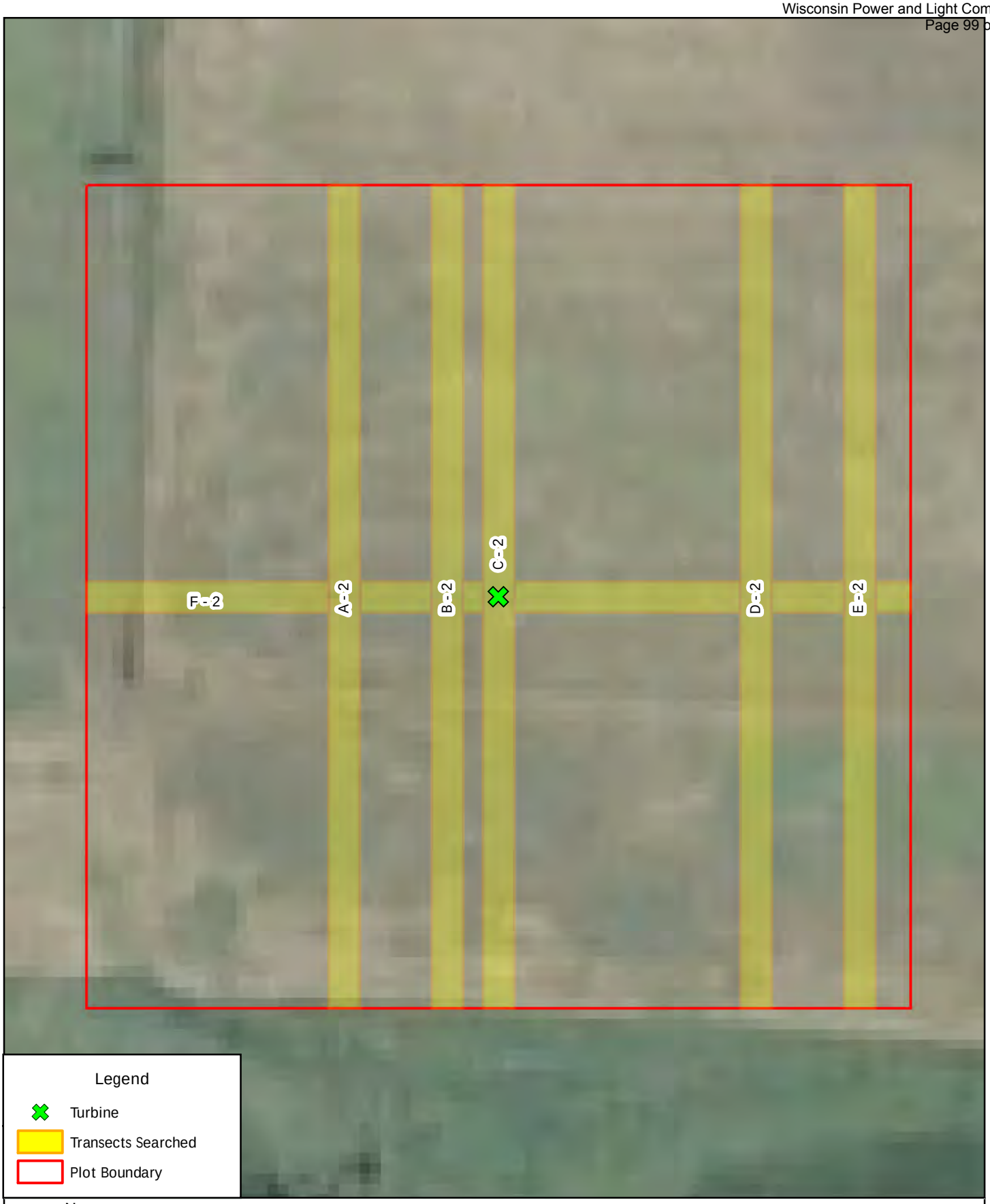
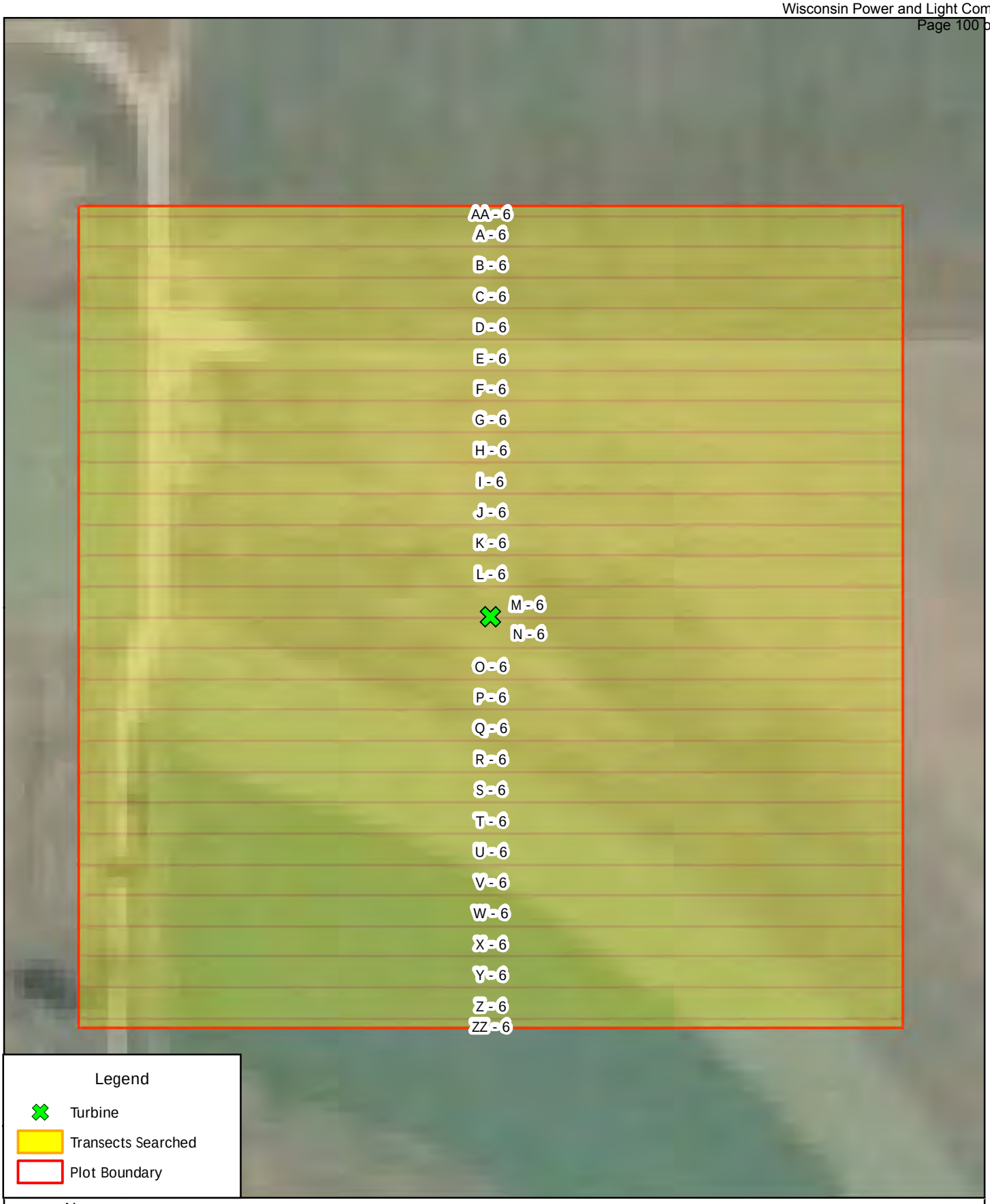


Turbine # 2 (Survey Group C)
Sample plot, search every 4 days
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

BHE ENVIRONMENTAL



Turbine # 6 (Survey Group A)
Census plot, search every day
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

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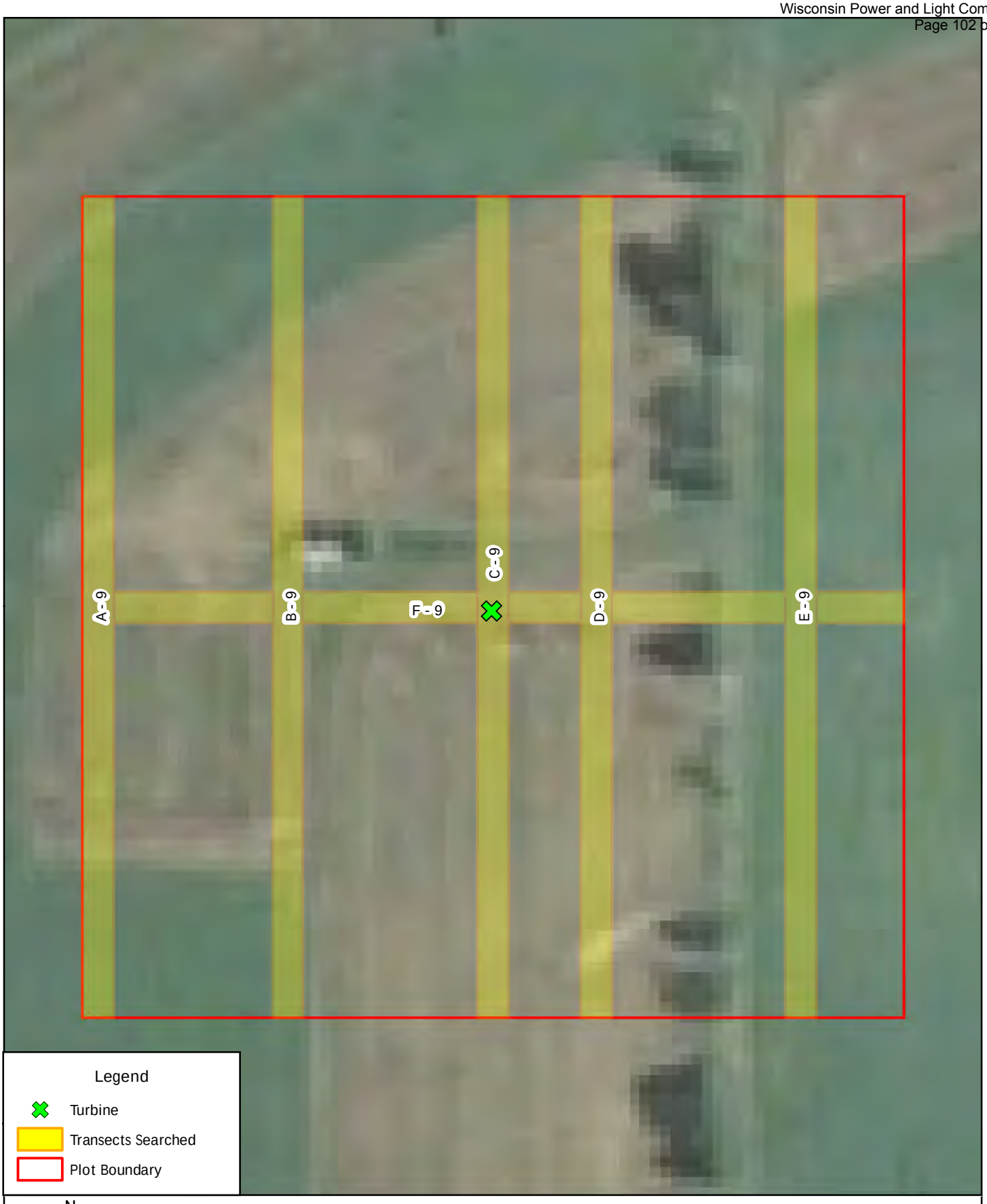
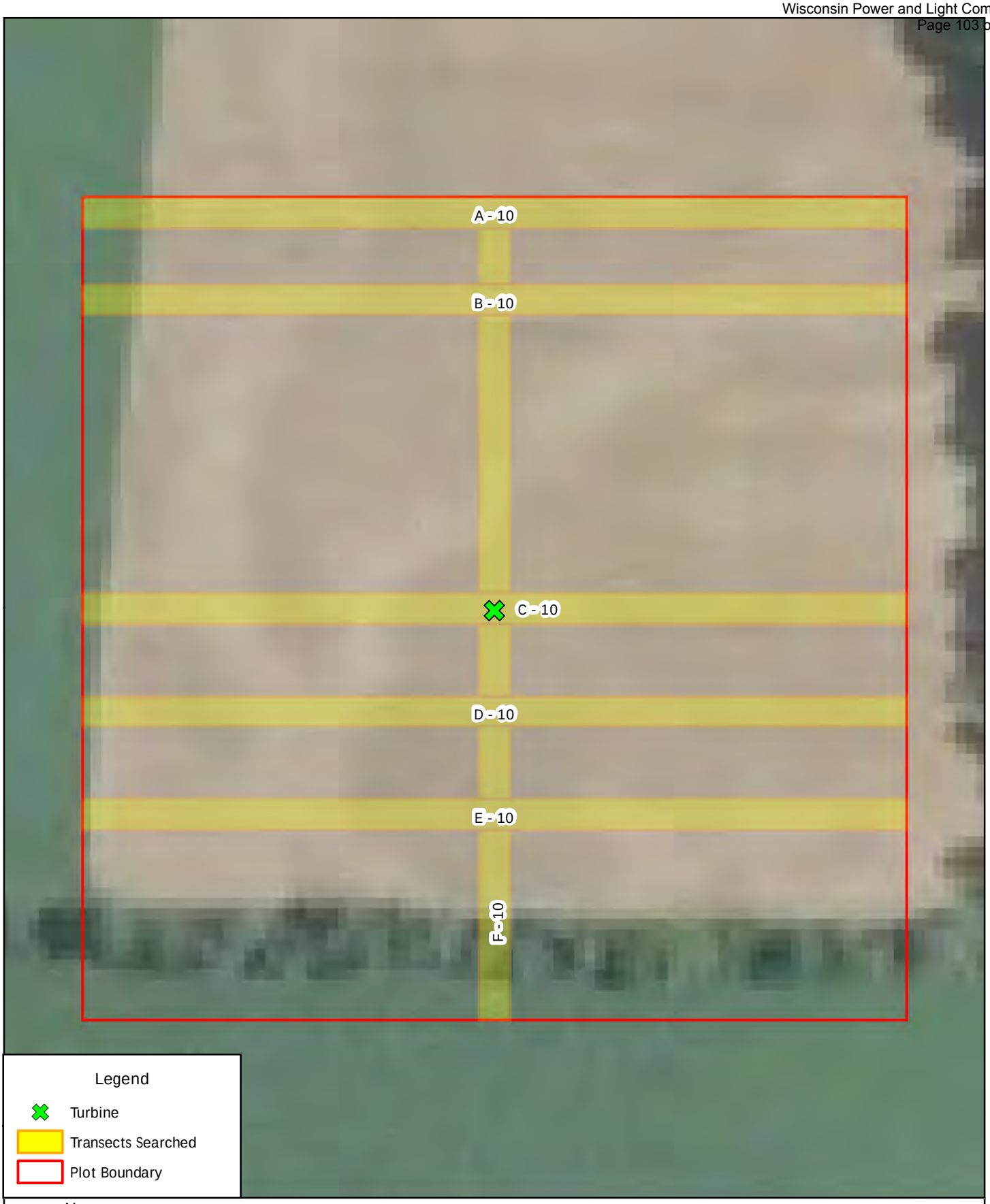
Turbine # 7 (Survey Group B)
Sample plot, search every 4 days
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

BHE ENVIRONMENTAL



Turbine # 9 (Survey Group C)
Sample plot, search every 4 days
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

BHE ENVIRONMENTAL



Turbine # 10 (Survey Group A)
Sample plot, search every day
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

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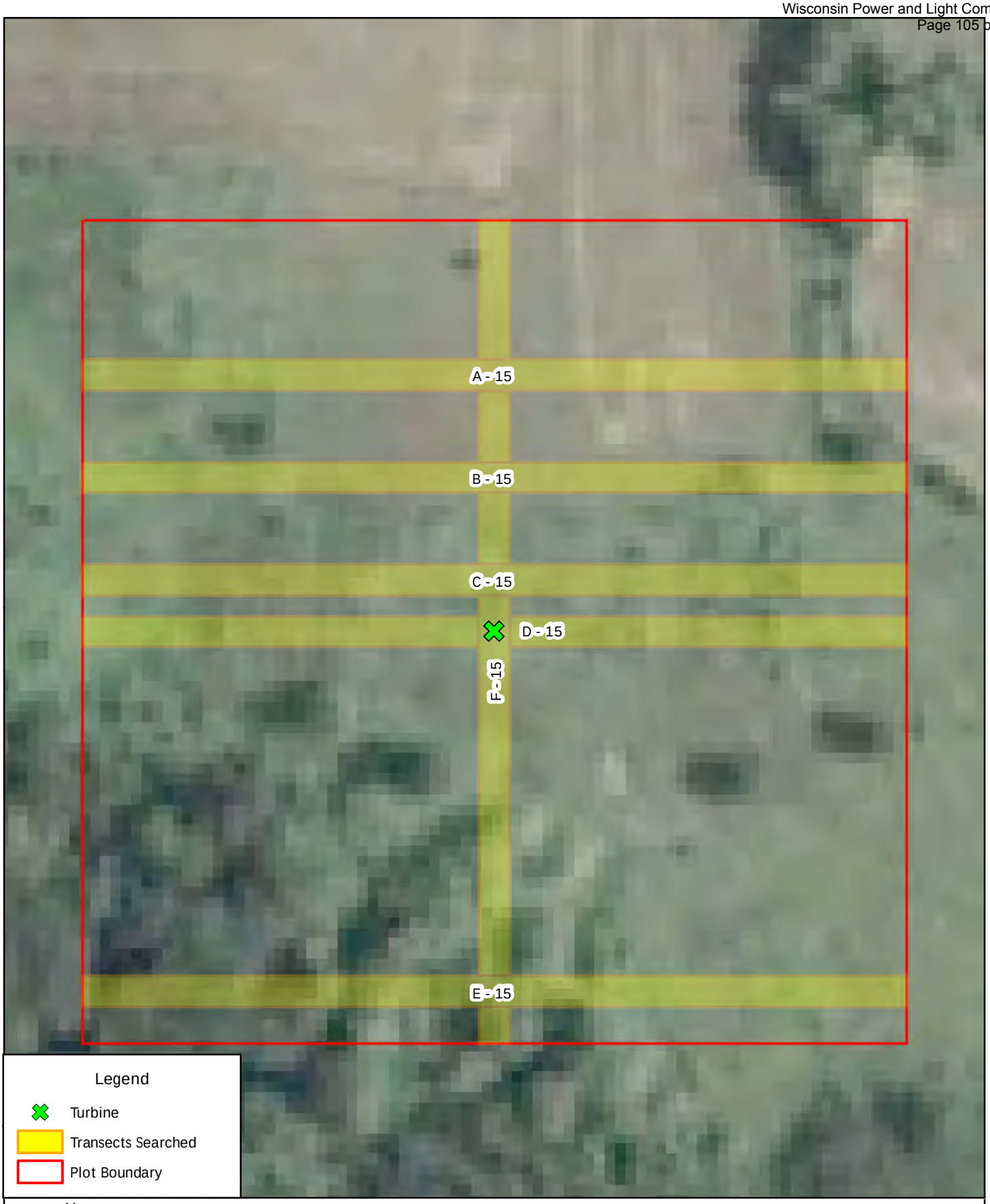
Turbine # 11 (Survey Group D)
Sample plot, search every 4 days
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

BHE ENVIRONMENTAL

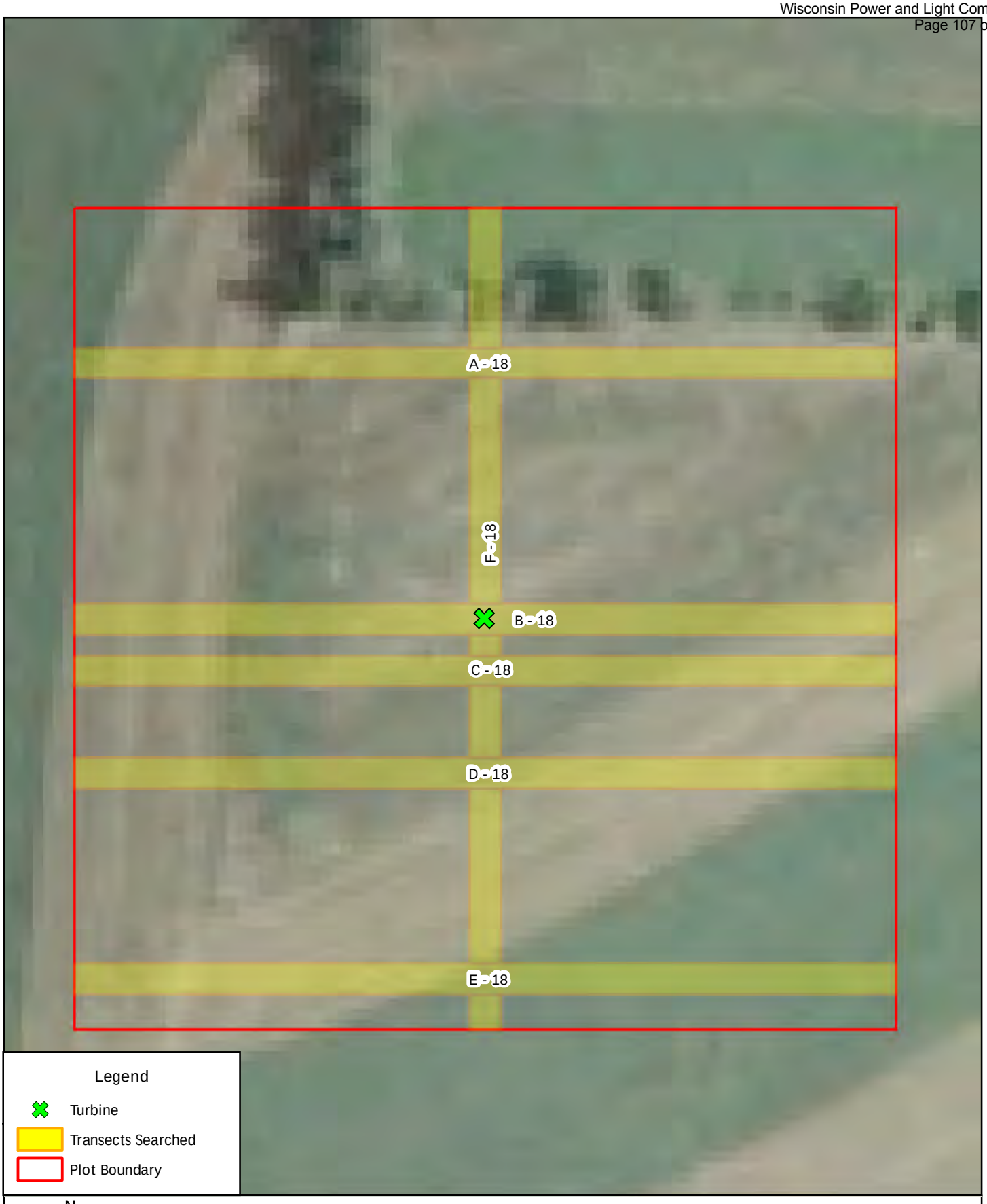


Turbine # 15 (Survey Group D)
Sample plot, search every 4 days
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

BHE ENVIRONMENTAL

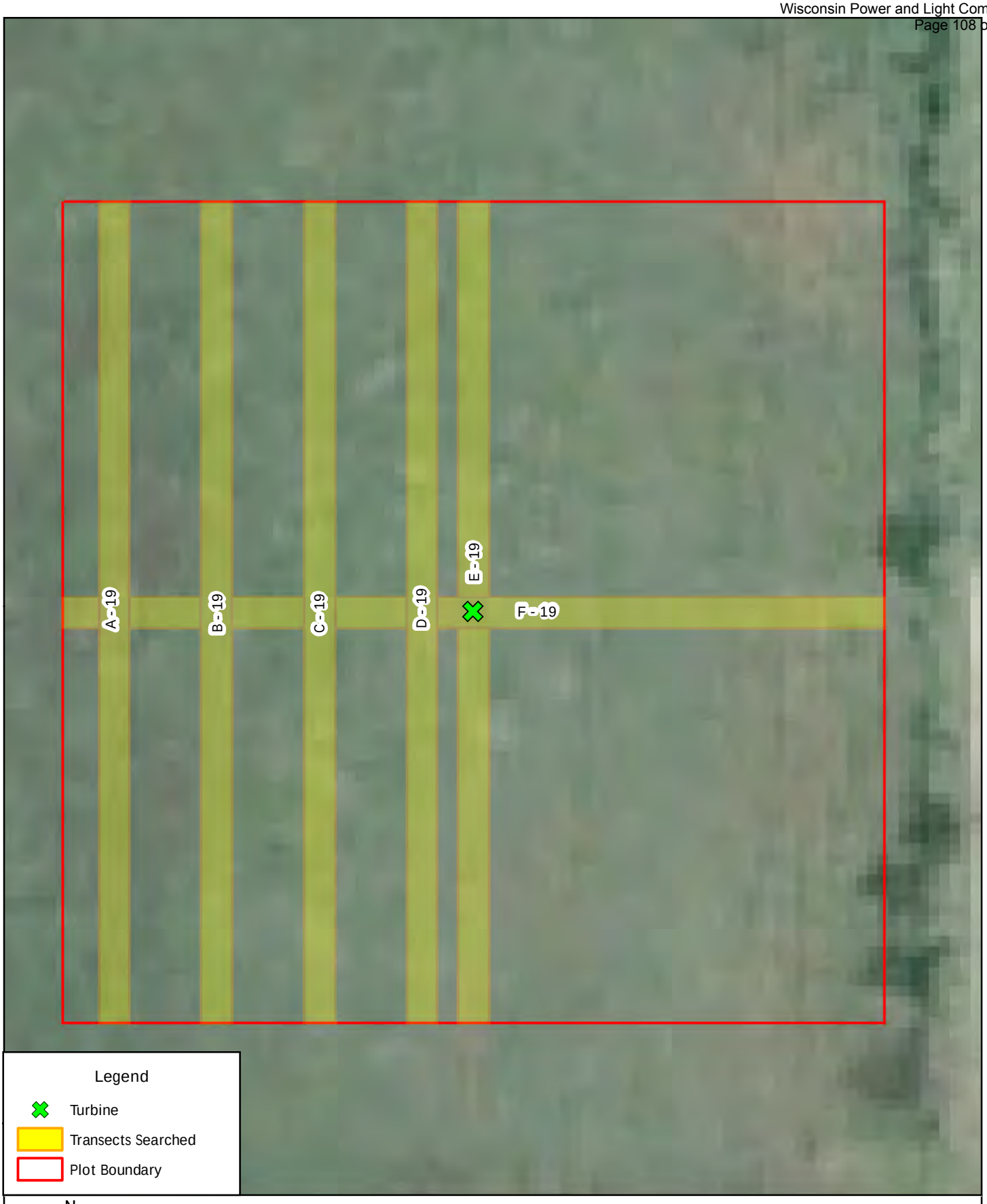
Turbine # 16 (Survey Group E)
Sample plot, search every 4 days
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

BHE ENVIRONMENTAL



Turbine # 18 (Survey Group B)
Sample plot, search every 4 days
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

BHE ENVIRONMENTAL



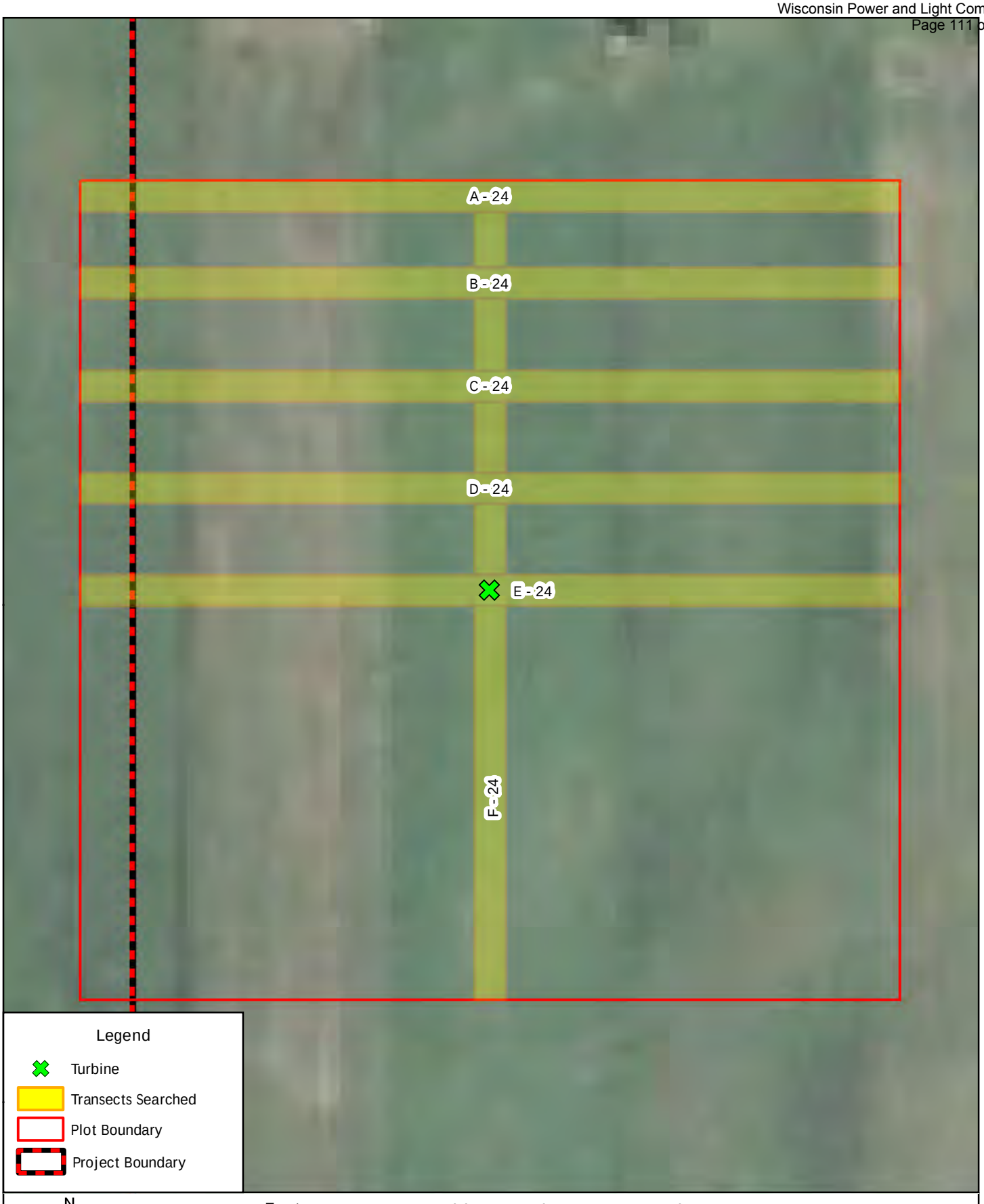
Turbine # 19 (Survey Group A)
Sample plot, search every day
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

Turbine # 21 (Survey Group E)
Sample plot, search every 4 days
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

BHE ENVIRONMENTAL

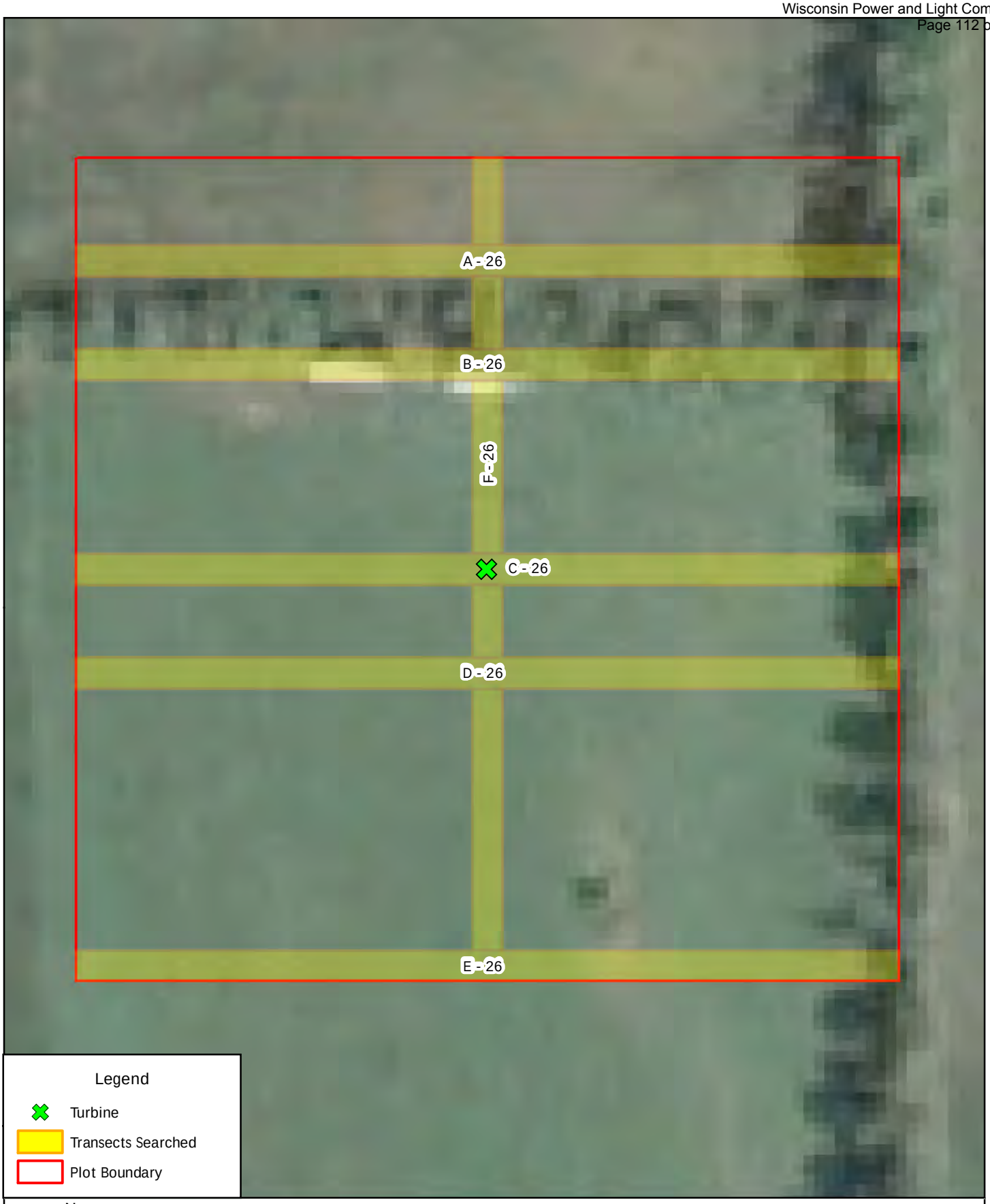
Turbine # 22 (Survey Group A)
Sample plot, search every day
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

BHE ENVIRONMENTAL



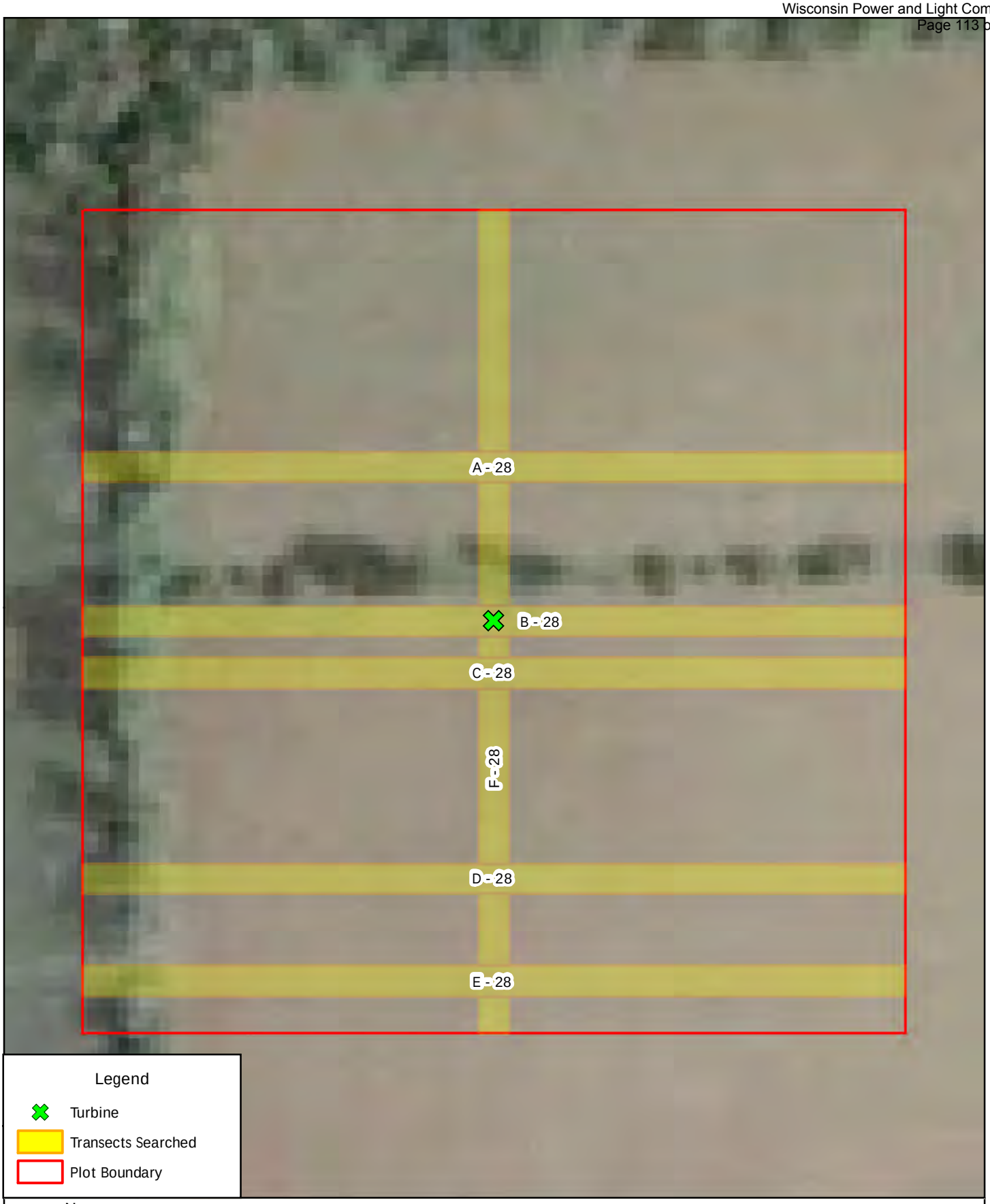
Turbine # 24 (Survey Group D)
Sample plot, search every 4 days
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

BHE ENVIRONMENTAL



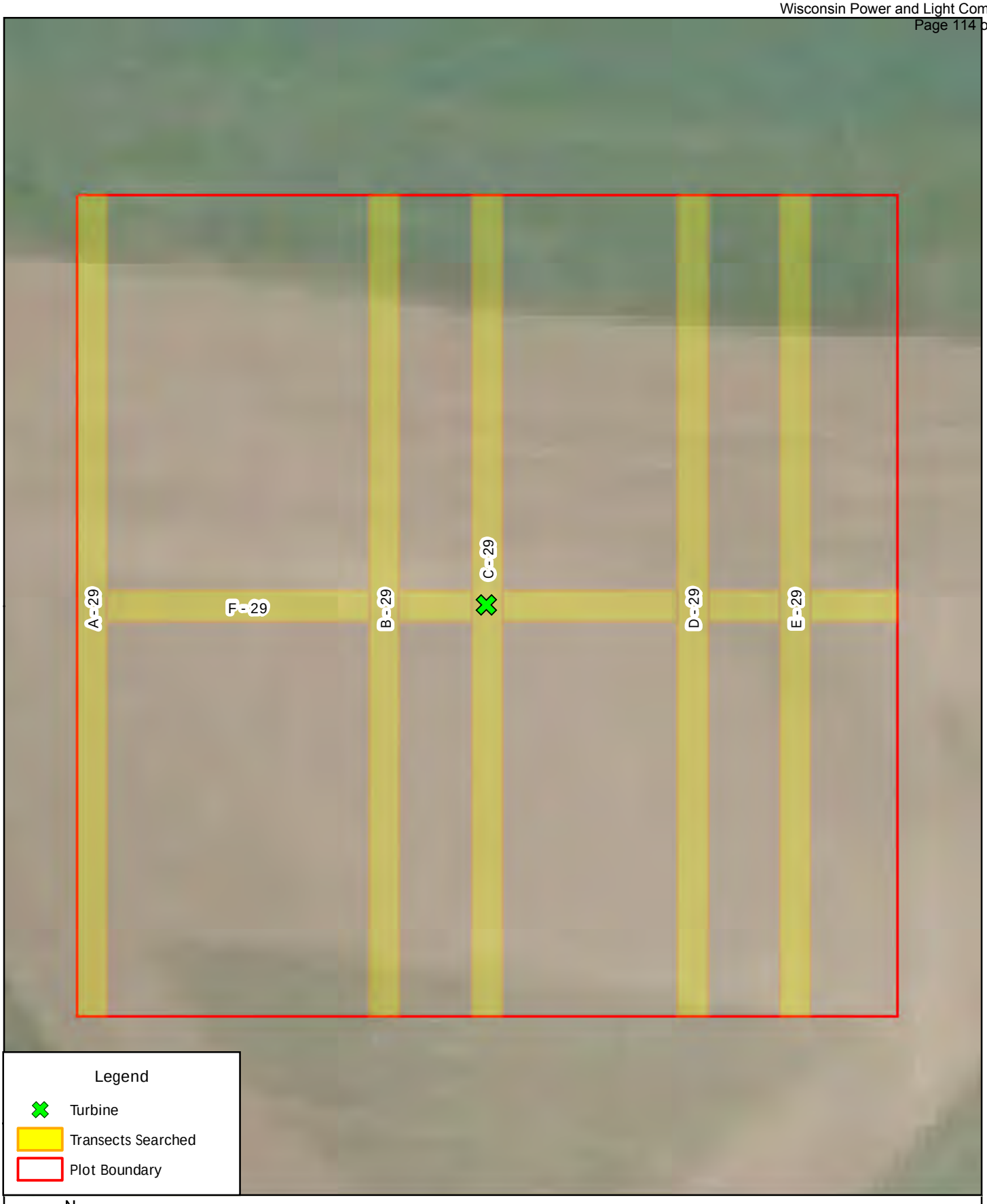
Turbine # 26 (Survey Group C)
Sample plot, search every 4 days
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

BHE ENVIRONMENTAL



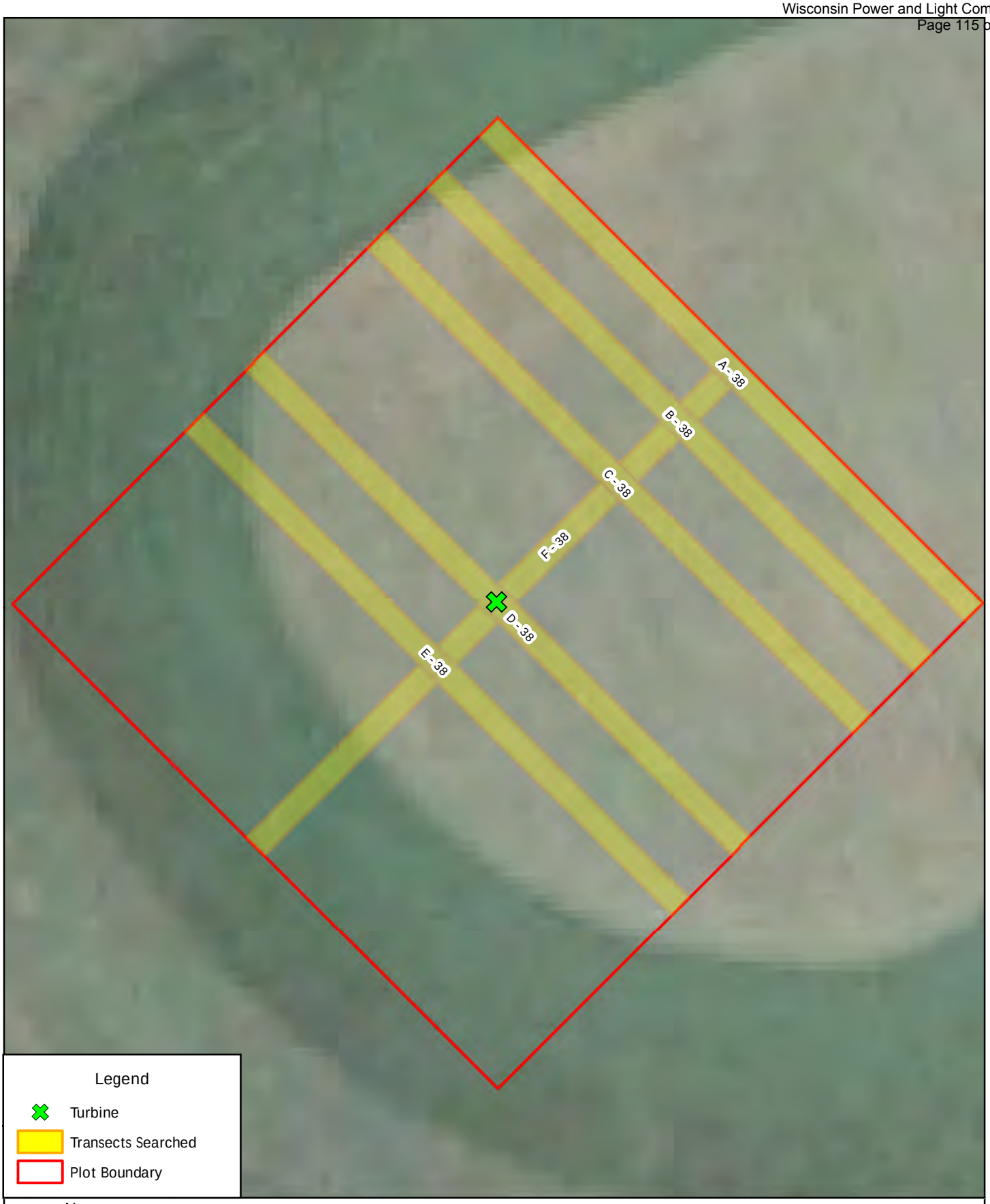
Turbine # 28 (Survey Group E)
Sample plot, search every 4 days
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

BHE ENVIRONMENTAL



Turbine # 29 (Survey Group C)
Sample plot, search every 4 days
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

BHE ENVIRONMENTAL



Turbine # 38 (Survey Group D)
Sample plot, search every 4 days
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

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Turbine # 40 (Survey Group A)
Census plot, search every day
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

BHE ENVIRONMENTAL

Turbine # 41R (Survey Group B)
Sample plot, search every 4 days
Cedar Ridge Wind Farm
Post-construction bird-bat mortality monitoring
Project No. 1782.003

BHE ENVIRONMENTAL

APPENDIX D

Late Fall Field Procedure and WDNR Approval

Mike Sponsler

From: Koslowsky, Shari - DNR [Shari.Koslowsky@Wisconsin.gov]
Sent: Wednesday, October 14, 2009 1:59 PM
To: Mike Sponsler
Cc: 'Stevens, Jill'; Lovenduski, Rick; Lisa Winhold; 'Bill Mueller'; 'Ginny Plumeau'; Russ Romme; Fannucchi, William - PSC; Weiss, Marilyn - PSC; jill_utrup@fws.gov
Subject: RE: Cedar Ridge Late Autumn, Large-bodied Bird Post Construction Mortality Monitoring.

Mike,

Thanks for summarizing our conversation – each site has its particular adjustments.

Shari

From: Mike Sponsler [mailto:msponsler@bheenvironmental.com]
Sent: Monday, October 12, 2009 3:04 PM
To: Koslowsky, Shari - DNR
Cc: 'Stevens, Jill'; Lovenduski, Rick; Lisa Winhold; 'Bill Mueller'; 'Ginny Plumeau'; Russ Romme
Subject: Cedar Ridge Late Autumn, Large-bodied Bird Post Construction Mortality Monitoring.

Hi Shari,
This note is to acknowledge our call on October 8, 2009 regarding the late autumn phase of the post-construction mortality study at Alliant's Cedar Ridge Wind Farm near Eden, WI.

The late autumn survey (October 16-November 15) calls for a focus upon sandhill crane mortality by searching 100% of the plot areas. We agreed that a protocol that calls for walking the center transect of each test plot and the plot perimeter is sufficient to detect mortality for these large bodied birds provided that any "blind spots" caused by vegetation or topography are also searched (see attached field instruction to search crew).

For searcher efficiency trials, we agreed surrogates for large carcasses are acceptable such as goose or duck decoys or burlap bags filled with straw. We will likely use burlap bags.
For the scavenger removal trials, it was agreed it would be unwise to use large bodied bird carcasses such as chickens or turkeys due to the landowner concern with carcass placement at this site. Instead you advised using the largest birds we could collect such as rock pigeons.
You also asked me to review the Invenergy Forward plan for the late autumn search protocol. I reviewed their plans and could not find documentation of a change in plot search protocol other than a focus on large birds. I could also not find documentation on the types of carcasses used for searcher efficiency or scavenger removal trials after October 15.

Given the conditions at the Cedar Ridge site and the focus on large bodied birds such as sandhill cranes, we believe the approach we have outlined is appropriate. Thanks you for your advise.
Mike

BHE Environmental, Inc.
Mike Sponsler
Technical Director
5300 East Main St., Ste 101

Columbus, Ohio 43213
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Cellular: 614.743.9977
Email: msponsler@bheenvironmental.com
Web Address: www.bheenvironmental.com

Late Autumn Field Procedure

- The late autumn sampling period is October 16 – November 15.
- All 20 turbines are to be searched in one day and repeated every 3 days.
- The focus of the searches during this time period will be on sand hill cranes and large-bodied birds that tend to migrate later in the season.
- Each searcher shall have a pair of binoculars in addition to all other standard equipment that has been used during the project to this point. Let us know if you do not have binoculars.
- The entire plot will be searched for sand hill cranes, not just the area you walk. While walking the path described below, stop occasionally and use your binoculars to search the turbine plot. Heads Up! You will have to have your head up more than you are accustomed to on this part of the project so that you are scanning the entire plot rather than a narrow transect.
- However all birds and bats that are found when walking the designated pathway shall be identified, recovered and documented using the standard procedures we have utilized to date for the project.
- Start at the turbine and walk together 15 feet apart down Transect F (See Figure).
- Split up going opposite directions along the perimeter. Walk 15 feet inside the perimeter.
- Meet back at Transect F and walk back towards the turbine 15 feet apart.
- If a plot has some blind spots that can not be observed by walking the previous paths, walk to those blind spots and make observations over the remaining plot area. We will continue with the searcher efficiency trials, so don't miss areas of the plots. Remember the goal is to search the entire plot for the large bodied birds.
- All other procedures are the same for documentation, identification, collection, and photography.
- Scavenger removal trials will continue with the same procedures as before.
- All safety procedures remain the same.

Field testing of this procedure showed each turbine can be completed in about 10-15 minutes, when no fatalities are discovered that require collection of data. So be thorough, but be efficient too.

Figure 2a. Diagram of a census plot.

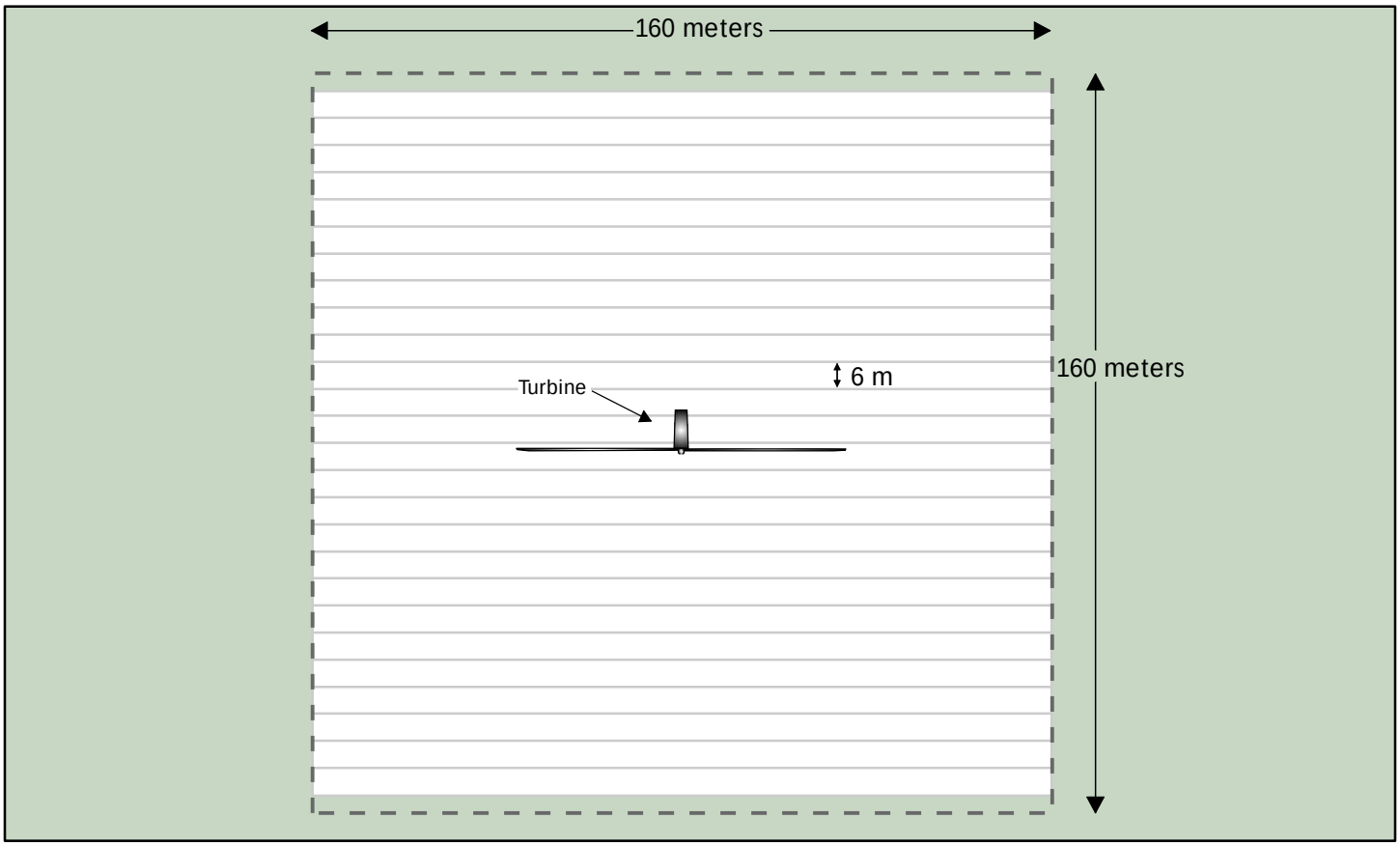
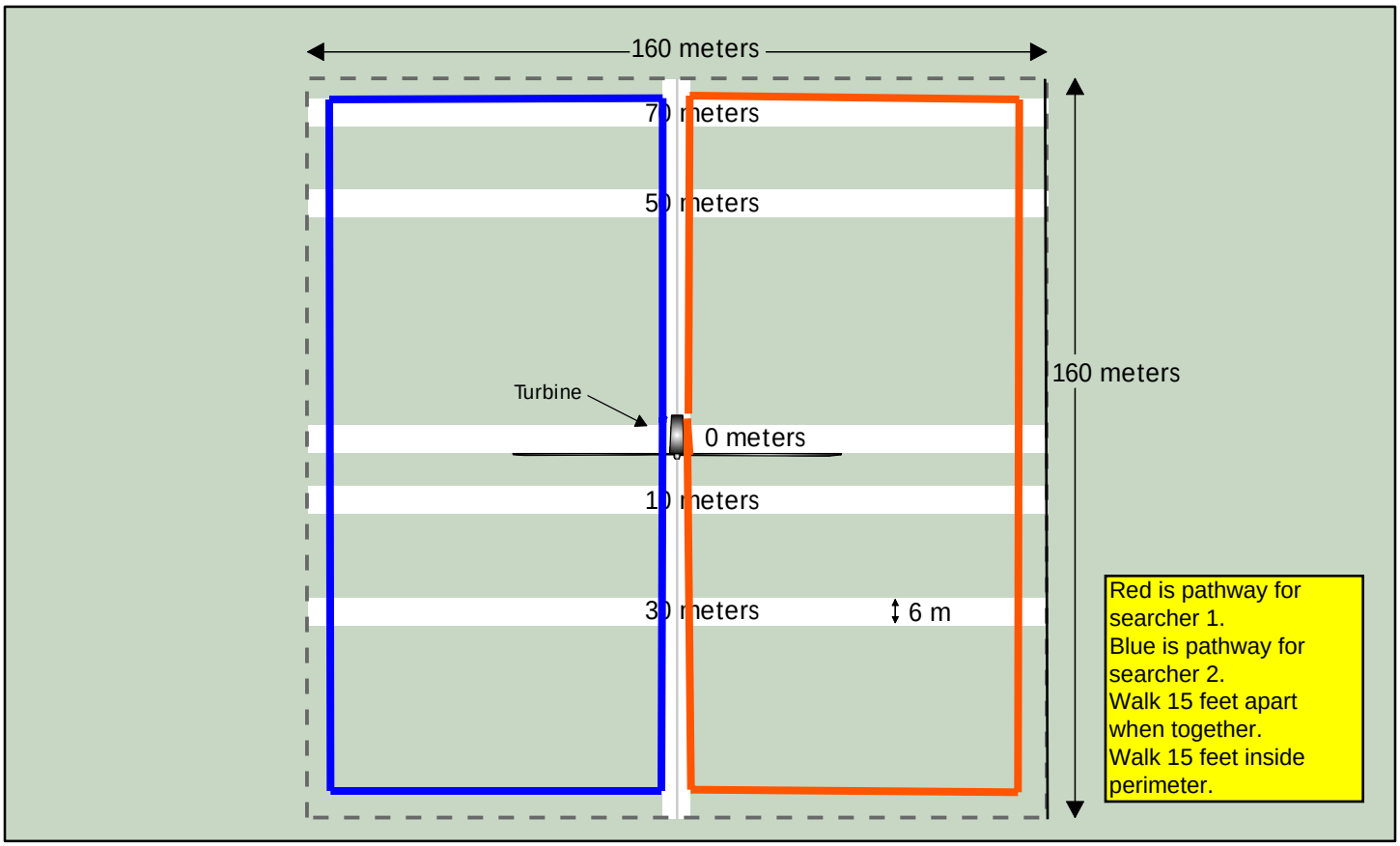


Figure 2b. Diagram of a sample plot.



APPENDIX E

Size Classes of Bird Carcasses Found and Used in Trials in 2009 and 2010 at the Cedar Ridge Wind Farm

Appendix E. Size classes of bird carcasses found and used in trials in 2009 and 2010 at the Cedar Ridge Wind Farm.

Common Name	Order	Family	Species	Length (inches)[1]	Weight (oz)[1]	Size Class[2]
Golden-crowned kinglet	Passeriformes	Regulidae	*Regulus satrapa*	4.00	0.16	Small
Ruby-crowned kinglet	Passeriformes	Regulidae	*Regulus calendula*	4.25	0.16	Small
American goldfinch	Passeriformes	Fringillidae	*Spinus tristis*	4.50	0.32	Small
Magnolia warbler	Passeriformes	Parulidae	*Dendroica magnolia*	5.00	0.32	Small
Common yellowthroat	Passeriformes	Parulidae	*Geothlypis trichas*	5.00	0.32	Small
Brown creeper	Passeriformes	Certhiidae	*Certhia americana*	5.25	0.32	Small
House wren	Passeriformes	Troglodytidae	*Troglodytes aedon*	4.75	0.39	Small
Yellow-bellied flycatcher	Passeriformes	Tyrannidae	*Empidonax flaviventris*	5.50	0.48	Small
Indigo bunting	Passeriformes	Cardinalidae	*Passerina cyanea*	5.50	0.51	Small
Swamp sparrow	Passeriformes	Emberizidae	*Melospiza georgiana*	5.75	0.60	Small
Savannah sparrow	Passeriformes	Emberizidae	*Passerculus sandwichensis*	5.50	0.64	Small
Tree swallow	Passeriformes	Hirundinidae	*Tachycineta bicolor*	5.75	0.64	Small
Ovenbird	Passeriformes	Parulidae	*Seiurus aurocappilla*	6.00	0.64	Small
Dark-eyed junco	Passeriformes	Emberizidae	*Junco hyemalis*	6.25	0.64	Small
Barn swallow	Passeriformes	Hirundinidae	*Hirundo rustica*	6.75	0.64	Small
Song sparrow	Passeriformes	Emberizidae	*Melospiza melodia*	6.25	0.70	Small
American tree sparrow	Passeriformes	Emberizidae	*Spizella arborea*	6.25	0.70	Small
White-breasted nuthatch	Passeriformes	Sittidae	*Sitta carolinensis*	5.75	0.74	Small
Cliff swallow	Passeriformes	Hirundinidae	*Petrochelidon pyrrhonota*	5.50	0.80	Small
House finch	Passeriformes	Fringillidae	*Carpodacus mexicanus*	6.00	0.80	Small
Chimney swift	Apodiformes	Apodidae	*Chaetura pelagica*	5.25	0.81	Small
Lapland longspur	Passeriformes	Emberizidae	*Calcarius lapponicus*	6.25	0.95	Small

Appendix E. Size classes of bird carcasses found and used in trials in 2009 and 2010 at the Cedar Ridge Wind Farm.

Common Name	Order	Family	Species	Length (inches)[1]	Weight (oz)[1]	Size Class[2]
House sparrow	Passeriformes	Passeridae	*Passer domesticus* (NP)	6.25	0.96	Small
Downy woodpecker	Piciformes	Picidae	*Picoides pubescens*	6.75	0.96	Small
Swainson's thrush	Passeriformes	Turdidae	*Catharus ustulatus*	7.00	1.10	Small
Eastern kingbird	Passeriformes	Tyrannidae	*Tyrannus tyrannus*	8.50	1.40	Small
Rose-breasted grosbeak	Passeriformes	Cardinalidae	*Pheucticus ludovicianus*	8.00	1.60	Small
Northern cardinal	Passeriformes	Cardinalidae	*Cardinalis cardinalis*	8.75	1.60	Small
Red-winged blackbird	Passeriformes	Icteridae	*Agelaius phoeniceus*	8.75	1.76	Small
Cedar waxwing	Passeriformes	Bombycillidae	*Bombycilla cedrorum*	8.25	2.00	Small
Purple martin	Passeriformes	Hirundinidae	*Progne subis*	8.00	2.08	Small
Red-bellied woodpecker	Piciformes	Picidae	*Melanerpes carolinus*	9.25	2.24	Small
Red-headed woodpecker	Piciformes	Picidae	*Melanerpes erythrocephalus*	9.25	2.56	Small
American robin	Passeriformes	Turdidae	*Turdus migratorius*	10.00	2.72	Small
European starling	Passeriformes	Sturnidae	*Sturnus vulgaris* (NP)	8.50	2.88	Small
Eastern meadowlark	Passeriformes	Icteridae	*Sturnella magna*	9.50	3.20	Small
Black-billed cuckoo	Cuculiformes	Cuculidae	*Coccyzus erthropthalmus*	12.00	1.80	Medium
Blue jay	Passeriformes	Corvidae	*Cyanocitta cristata*	11.00	3.00	Medium
Killdeer	Chraradriiformes	Charadriidae	*Charadrius vociferus*	10.50	3.36	Medium
Common grackle	Passeriformes	Icteridae	*Quiscalus quiscula*	12.50	4.00	Medium
Mourning dove	Columbiformes	Columbidae	*Zenaida macroura*	12.00	4.16	Medium
Northern flicker	Piciformes	Picidae	*Colaptes auratus*	12.50	4.64	Medium
Sharp-shinned hawk	Falconiformes	Accipitridae	*Accipiter striatus*	11.00	4.96	Medium
Eastern screech owl	Strigiformes	Strigidae	*Megascops asio*	8.50	6.08	Medium

Appendix E. Size classes of bird carcasses found and used in trials in 2009 and 2010 at the Cedar Ridge Wind Farm.

Common Name	Order	Family	Species	Length (inches)[1]	Weight (oz)[1]	Size Class[2]
American woodcock	Chraradriiformes	Scolopacidae	*Scolopax minor*	11.00	6.88	Medium
Rock pigeon	Columbiformes	Columbidae	*Columba livia* (NP)	12.50	8.96	Medium
Baltimore oriole	Passeriformes	Icteridae	*Icterus galbula*	8.75	11.50	Medium
Cooper's hawk	Falconiformes	Accipitridae	*Accipiter cooperii*	16.50	16.00	Large
American crow	Passeriformes	Corvidae	*Corvus brachyrhynchos*	17.50	16.00	Large
Barred owl	Strigiformes	Strigidae	*Strix varia*	21.00	25.60	Large
Lesser scaup	Anseriformes	Anatidae	*Aythya affinis*	16.50	28.80	Large
Common goldeneye	Anseriformes	Anatidae	*Bucephala clangula*	18.50	30.40	Large
Red-tailed hawk	Falconiformes	Accipitridae	*Buteo jamaicensis*	19.00	38.40	Large
Mallard	Anseriformes	Anatidae	*Anas platyrhynchos*	23.00	38.40	Large
Great-horned owl	Strigiformes	Strigidae	*Bubo virginianus*	22.00	49.60	Large
Turkey vulture	Ciconiiformes	Cathartidae	*Cathartes aura*	26.00	64.00	Large
Great blue heron	Ciconiiformes	Ardeidae	*Ardea herodias*	46.00	84.80	Large
Wild turkey	Galliformes	Phasianidae	*Meleagris gallopavo*	46.00	259.20	Large

NP = non-protected species

[1] Source: Sibley, D.A. 2000. The Sibley Guide to Birds. Alfred A. Knopf, New York.

[2] Species ≤ 10 inches in length **AND** < 4.0 oz in weight is considered a small bird for the purposes of this study.
Species > 10 inches in length **OR** 4.0-15.99 oz in weight is considered a medium bird for the purposes of this study.
Species ≥ 1 pound (16.0 oz) in weight is considered a large bird for the purposes of this study.

APPENDIX F

2010 Cedar Ridge Sampling Change Request and WDNR Approval

From: Koslowsky, Shari - DNR [mailto:Shari.Koslowsky@Wisconsin.gov]
Sent: Thursday, April 08, 2010 1:34 PM
To: Mike Sponsler
Subject: RE: Cedar Ridge Sampling Change Request

Go ahead with the changes.

From: Mike Sponsler [mailto:msponsler@bheenvironmental.com]
Sent: Thursday, April 08, 2010 11:08 AM
To: Koslowsky, Shari - DNR
Subject: FW: Cedar Ridge Sampling Change Request

Use this email. The other was a draft from Lisa to me. Thanks
Mike

From: Mike Sponsler
Sent: Monday, March 29, 2010 2:51 PM
To: 'Koslowsky, Shari - DNR'
Cc: 'Stevens, Jill'; 'Lovenduski, Rick'; Lisa Winhold; 'Bill Mueller'
Subject: Cedar Ridge Sampling Change Request

Good Afternoon Shari,

BHE recently commenced the 2010 bird and bat mortality surveys at the Cedar Ridge Wind Farm in Fond du Lac County, WI. In an effort to improve our searcher efficiency, we have reviewed the 2009 efforts and protocols and believe eliminating searches in areas where the ability to detect small carcasses is greatly reduced (see attached maps and photos). Such areas are primarily piles of cobbles and boulders along fencerows that intersect transects. In addition, Turbine 9 has a trailer with a fire pit and other objects surrounding it and Turbines 15 and 19 have stands of small pines that would prevent many carcasses from falling to the ground. For Turbine 19, BHE recommends shifting Transect F northward slightly to allow us to search the entire transect without the pines interfering. Likewise, for Turbine 26, BHE recommends shifting Transect B southward.

Total search area described in our study plan was 37.47 acres. As mentioned last year, one landowner at Turbine 41 chose to exclude his property in this study. This decreased our total area to 37.273 acres that we are allowed to search. If we shift the transects mentioned above and eliminate the remaining areas with low detectability (0.306 acres), BHE would search 36.967 acres (99.2% of the total area allowed). The difference in search area will be taken into account during statistical analysis.

Please let me know if this is an acceptable change in search methods or if you have any questions or concerns.

Thanks.
Mike

BHE Environmental, Inc.
Mike Sponsler
Technical Director
5300 East Main St., Ste 101
Columbus, Ohio 43213
Office: 614.856.4680 ext. 4681
Direct Line: 856-4681
Fax: 614.856.4685
Cellular: 614.743.9977
Email: msponsler@bheenvironmental.com
Web Address: www.bheenvironmental.com

APPENDIX G

Bird Carcasses Found During the 2009 and 2010 Survey Periods at the Cedar Ridge Wind Farm

Appendix G. Bird carcasses found during the 2009 and 2010 survey periods at the Cedar Ridge Wind Farm.

Date	Turbine	Common Name	Order	Family	Species	Size Class	Type of Find	Comments
3/14/2009	07	Red-tailed hawk	Falconiformes	Accipitridae	*Buteo jamaicensis*	Large	Incidental	Found during clean sweeps.
3/16/2009	15	Rock pigeon	Columbiformes	Columbidae	*Columba livia*	Medium	Incidental	Found during clean sweeps.
3/16/2009	15	Blue jay	Passeriformes	Corvidae	*Cyanocitta cristata*	Medium	Incidental	Found during clean sweeps.
3/28/2009	22	Rock pigeon	Columbiformes	Columbidae	*Columba livia*	Medium	Incidental	Missed during clean sweeps. Old feathers and decayed bones.
4/3/2009	28	Rock pigeon	Columbiformes	Columbidae	*Columba livia*	Medium	Search	
4/5/2009	19	Red-tailed hawk	Falconiformes	Accipitridae	*Buteo jamaicensis*	Large	Search	
4/15/2009	16	Golden-crowned kinglet	Passeriformes	Regulidae	*Regulus satrapa*	Small	Search	
4/18/2009	06	Tree swallow	Passeriformes	Hirundinidae	*Tachycineta bicolor*	Small	Search	
4/18/2009	38	Brown creeper	Passeriformes	Certhiidae	*Certhia americana*	Small	Search	
4/22/2009	09	Dark-eyed junco	Passeriformes	Emberizidae	*Junco hyemalis*	Small	Search	
4/22/2009	11	Savannah sparrow	Passeriformes	Emberizidae	*Passerculus sandwichensis*	Small	Search	
4/30/2009	15	Wild turkey	Galliformes	Phasianidae	*Meleagris gallopavo*	Large	Search	Wild Turkey feathers only; no carcass. Abundance of turkey tracks. This is not considered a turbine-related mortality.
4/30/2009	09	Red-tailed hawk	Falconiformes	Accipitridae	*Buteo jamaicensis*	Large	Incidental	Found outside search transects.
5/1/2009	21	Golden-crowned kinglet	Passeriformes	Regulidae	*Regulus satrapa*	Small	Search	
5/2/2009	41R	Ruby-crowned kinglet	Passeriformes	Regulidae	*Regulus calendula*	Small	Search	
5/6/2009	06	Ruby-crowned kinglet	Passeriformes	Regulidae	*Regulus calendula*	Small	Search	
5/7/2009	09	Mourning dove	Columbiformes	Columbidae	*Zenaida macroura*	Medium	Search	
5/20/2009	38	American goldfinch	Passeriformes	Fringillidae	*Spinus tristis*	Small	Search	
5/20/2009	11	Red-winged blackbird	Passeriformes	Icteridae	*Agelaius phoeniceus*	Small	Incidental	Found outside search transects.
5/26/2009	18	Unknown	Unknown	Unknown	Unknown	Unknown	Search	Carcass was too decayed to identify.
5/27/2009	40	Yellow-bellied flycatcher	Passeriformes	Tyrannidae	*Empidonax flaviventris*	Small	Search	
7/14/2009	06	Killdeer	Charadriiformes	Charadriidae	*Charadrius vociferus*	Medium	Incidental	Found during clean sweeps.
7/14/2009	22	Rock pigeon	Columbiformes	Columbidae	*Columba livia*	Medium	Incidental	Found during clean sweeps.
7/22/2009	06	Unknown	Unknown	Unknown	Unknown	Unknown	Search	Not enough carcass remained to identify.
8/7/2009	15	Barn swallow	Passeriformes	Hirundinidae	*Hirundo rustica*	Small	Search	The bird was found alive, but due to injuries sustained, was euthanized.
8/11/2009	24	Mourning dove	Columbiformes	Columbidae	*Zenaida macroura*	Medium	Search	
8/13/2009	01	Tree swallow	Passeriformes	Hirundinidae	*Tachycineta bicolor*	Small	Search	
8/13/2009	01	Tree swallow	Passeriformes	Hirundinidae	*Tachycineta bicolor*	Small	Search	
8/13/2009	01	Tree swallow	Passeriformes	Hirundinidae	*Tachycineta bicolor*	Small	Search	
8/14/2009	09	Mourning dove	Columbiformes	Columbidae	*Zenaida macroura*	Medium	Incidental	Found outside search transects.
8/29/2009	06	Unknown	Unknown	Unknown	Unknown	Unknown	Search	Feather spot only.
8/31/2009	38	Red-winged blackbird	Passeriformes	Icteridae	*Agelaius phoeniceus*	Small	Search	

Appendix G. Bird carcasses found during the 2009 and 2010 survey periods at the Cedar Ridge Wind Farm.

Date	Turbine	Common Name	Order	Family	Species	Size Class	Type of Find	Comments
9/7/2009	26	Cliff swallow	Passeriformes	Hirundinidae	*Petrochelidon pyrrhonota*	Small	Search	
9/14/2009	10	Purple martin	Passeriformes	Hirundinidae	*Progne subis*	Small	Search	
9/17/2009	06	Unknown	Unknown	Unknown	Unknown	Unknown	Search	Feather spot only.
9/18/2009	40	Unknown	Unknown	Unknown	Unknown	Unknown	Search	Feather spot only.
9/19/2009	16	Chimney swift	Apodiformes	Apodidae	*Chaetura pelagica*	Small	Incidental	Found outside search transects.
9/23/2009	10	Magnolia warbler	Passeriformes	Parulidae	*Dendroica magnolia*	Small	Search	
9/23/2009	26	Magnolia warbler	Passeriformes	Parulidae	*Dendroica magnolia*	Small	Search	
9/24/2009	24	Rock pigeon	Columbiformes	Columbidae	*Columba livia*	Medium	Search	
9/27/2009	29	Rock pigeon	Columbiformes	Columbidae	*Columba livia*	Medium	Search	
10/6/2009	38	Cedar waxwing	Passeriformes	Bombycillidae	*Bombycilla cedrorum*	Small	Search	
10/7/2009	20	Turkey vulture	Ciconiiformes	Cathartidae	*Cathartes aura*	Large	Incidental	Found at a turbine not searched as part of this study.
10/25/2009	06	Red-tailed hawk	Falconiformes	Accipitridae	*Buteo jamaicensis*	Large	Search	
11/3/2009	38	Rock pigeon	Columbiformes	Columbidae	*Columba livia*	Medium	Incidental	Non "large bird" found during late fall season.
11/9/2009	21	Golden-crowned kinglet	Passeriformes	Regulidae	*Regulus satrapa*	Small	Incidental	Non "large bird" found during late fall season.
11/12/2009	02	Mourning dove	Columbiformes	Columbidae	*Zenaida macroura*	Medium	Incidental	Non "large bird" found during late fall season.
3/19/2010	18	American tree sparrow	Passeriformes	Emberizidae	*Spizella arborea*	Small	Search	
3/19/2010	18	Red-tailed hawk	Falconiformes	Accipitridae	*Buteo jamaicensis*	Large	Incidental	Found outside search plot.
3/24/2010	06	Lapland longspur	Passeriformes	Emberizidae	*Calcarius lapponicus*	Small	Search	
3/24/2010	06	Rock pigeon	Columbiformes	Columbidae	*Columba livia*	Medium	Search	
3/24/2010	09	Rock pigeon	Columbiformes	Columbidae	*Columba livia*	Medium	Search	
3/25/2010	24	Rock pigeon	Columbiformes	Columbidae	*Columba livia*	Medium	Search	
3/27/2010	06	Unknown	Unknown	Unknown	Unknown	Unknown	Search	
3/27/2010	19	Red-tailed hawk	Falconiformes	Accipitridae	*Buteo jamaicensis*	Large	Incidental	Found during SR trial carcass check; carcass was not present during scheduled plot search earlier that day.
3/31/2010	01	Mourning dove	Columbiformes	Columbidae	*Zenaida macroura*	Medium	Search	
3/31/2010	10	Lapland longspur	Passeriformes	Emberizidae	*Calcarius lapponicus*	Small	Search	
4/5/2010	02	Unknown	Unknown	Unknown	Unknown	Unknown	Search	
4/12/2010	40	Golden-crowned kinglet	Passeriformes	Regulidae	*Regulus satrapa*	Small	Search	
4/21/2010	40	Swamp sparrow	Passeriformes	Emberizidae	*Melospiza georgiana*	Small	Search	
5/2/2010	41R	Unknown	Unknown	Unknown	Unknown	Unknown	Search	
5/3/2010	09	Mallard	Anseriformes	Anatidae	*Anas platyrhynchos*	Large	Incidental	Found outside search transects.
5/9/2010	22	Unknown	Unknown	Unknown	Unknown	Unknown	Search	
5/22/2010	41R	American crow	Passeriformes	Corvidae	*Corvus brachyrhynchos*	Large	Search	

Appendix G. Bird carcasses found during the 2009 and 2010 survey periods at the Cedar Ridge Wind Farm.

Date	Turbine	Common Name	Order	Family	Species	Size Class	Type of Find	Comments
5/31/2010	02	Mourning dove	Columbiformes	Columbidae	*Zenaida macroura*	Medium	Search	
7/27/2010	19	Black-billed cuckoo	Cuculiformes	Cuculidae	*Coccyzus erythropthalmus*	Medium	Search	
8/13/2010	06	Tree swallow	Passeriformes	Hirundinidae	*Tachycineta bicolor*	Small	Search	
8/15/2010	15	Unknown	Unknown	Unknown	Unknown	Unknown	Search	
8/18/2010	22	Killdeer	Charadriiformes	Charadriidae	*Charadrius vociferus*	Medium	Search	
8/24/2010	16	Tree swallow	Passeriformes	Hirundinidae	*Tachycineta bicolor*	Small	Search	
8/25/2010	07	European starling	Passeriformes	Sturnidae	*Sturnus vulgaris*	Small	Search	
8/27/2010	22	Rock pigeon	Columbiformes	Columbidae	*Columba livia*	Medium	Incidental	Found outside search transects; possible SR trial carcass that had been moved.
9/17/2010	21	Rock pigeon	Columbiformes	Columbidae	*Columba livia*	Medium	Search	
9/17/2010	40	Cedar waxwing	Passeriformes	Bombycillidae	*Bombycilla cedrorum*	Small	Search	
9/25/2010	28	Ruby-crowned kinglet	Passeriformes	Regulidae	*Regulus calendula*	Small	Search	

APPENDIX H

Bat Carcasses Found During the 2009 and 2010 Survey Periods at the Cedar Ridge Wind Farm

Appendix H. Bat carcasses found during the 2009 and 2010 survey periods at the Cedar Ridge Wind Farm.

Date	Turbine	Common Name	Species	Type	Type of Find	Comments
3/25/2009	15	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
4/30/2009	15	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
5/8/2009	40	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
5/14/2009	41R	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
5/22/2009	10	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
5/25/2009	19	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
5/30/2009	22	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
7/15/2009	41R	Little brown bat	*Myotis lucifugus*	Cave bats	Incidental	Found during clean sweeps.
7/15/2009	41R	Little brown bat	*Myotis lucifugus*	Cave bats	Incidental	Found during clean sweeps.
7/21/2009	40	Little brown bat	*Myotis lucifugus*	Cave bats	Search	The bat was found alive, but due to injuries sustained, was euthanized.
7/24/2009	01	Red bat	*Lasiurus borealis*	Tree bats	Search	
7/24/2009	10	Red bat	*Lasiurus borealis*	Tree bats	Search	
7/26/2009	06	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
7/26/2009	24	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
7/26/2009	38	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
7/30/2009	15	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
7/31/2009	22	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
8/1/2009	06	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/1/2009	40	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/6/2009	22	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
8/7/2009	06	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
8/7/2009	11	Little brown bat	*Myotis lucifugus*	Cave bats	Incidental	Found outside search transects.
8/8/2009	06	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/9/2009	22	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/9/2009	40	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	

Appendix H. Bat carcasses found during the 2009 and 2010 survey periods at the Cedar Ridge Wind Farm.

Date	Turbine	Common Name	Species	Type	Type of Find	Comments
8/11/2009	22	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/11/2009	38	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
8/11/2009	40	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/12/2009	10	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/12/2009	40	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/13/2009	06	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/13/2009	19	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
8/13/2009	40	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/13/2009	41R	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/14/2009	26	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/14/2009	26	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/14/2009	29	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
8/14/2009	29	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/15/2009	11	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/15/2009	15	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
8/15/2009	40	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
8/16/2009	21	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/17/2009	01	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/17/2009	01	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
8/18/2009	02	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/19/2009	15	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/20/2009	16	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/21/2009	40	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/21/2009	41R	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/22/2009	02	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/22/2009	19	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	

Appendix H. Bat carcasses found during the 2009 and 2010 survey periods at the Cedar Ridge Wind Farm.

Date	Turbine	Common Name	Species	Type	Type of Find	Comments
8/23/2009	24	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/23/2009	40	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/24/2009	10	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/25/2009	01	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/25/2009	06	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/25/2009	07	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
8/26/2009	10	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
8/26/2009	19	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
8/26/2009	22	Red bat	*Lasiurus borealis*	Tree bats	Incidental	Found outside of search transects.
8/27/2009	06	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/31/2009	15	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
9/1/2009	06	Red bat	*Lasiurus borealis*	Tree bats	Search	
9/5/2009	10	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
9/6/2009	29	Hoary bat	*Lasiurus cinereus*	Tree bats	Incidental	Found outside of search transects.
9/9/2009	16	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
9/11/2009	40	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
9/12/2009	06	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/14/2009	06	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
9/14/2009	41R	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/15/2009	02	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
9/15/2009	26	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
9/16/2009	19	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
9/17/2009	40	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/19/2009	02	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
9/20/2009	15	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/21/2009	28	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	

Appendix H. Bat carcasses found during the 2009 and 2010 survey periods at the Cedar Ridge Wind Farm.

Date	Turbine	Common Name	Species	Type	Type of Find	Comments
9/22/2009	41R	Red bat	*Lasiurus borealis*	Tree bats	Search	
9/22/2009	41R	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/23/2009	40	Red bat	*Lasiurus borealis*	Tree bats	Search	
9/24/2009	15	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/25/2009	06	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/27/2009	29	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/28/2009	38	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
10/5/2009	29	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
10/10/2009	10	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
10/12/2009	41R	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
10/12/2009	41R	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
10/12/2009	41R	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
4/20/2010	07	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
4/30/2010	40	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
5/1/2010	22	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
5/2/2010	16	Hoary bat	*Lasiurus cinereus*	Tree bats	Incidental	Found during SR trial carcass check; Turbine 16 was not in search group for this day.
5/15/2010	40	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
5/18/2010	01	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
5/19/2010	26	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
5/21/2010	28	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
5/24/2010	40	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
5/26/2010	10	Red bat	*Lasiurus borealis*	Tree bats	Search	
5/30/2010	07	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
5/30/2010	22	Little brown bat	*Myotis lucifugus*	Cave bats	Search	

Appendix H. Bat carcasses found during the 2009 and 2010 survey periods at the Cedar Ridge Wind Farm.

Date	Turbine	Common Name	Species	Type	Type of Find	Comments
7/14/2010	16	Little brown bat	*Myotis lucifugus*	Cave bats	Incidental	Found during clean sweeps.
7/14/2010	19	Hoary bat	*Lasiurus cinereus*	Tree bats	Incidental	Found during clean sweeps.
7/14/2010	22	Red bat	*Lasiurus borealis*	Tree bats	Incidental	Found during clean sweeps.
7/14/2010	22	Hoary bat	*Lasiurus cinereus*	Tree bats	Incidental	Found during clean sweeps.
7/14/2010	22	Little brown bat	*Myotis lucifugus*	Cave bats	Incidental	Found during clean sweeps.
7/14/2010	28	Hoary bat	*Lasiurus cinereus*	Tree bats	Incidental	Found during clean sweeps.
7/15/2010	19	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
7/15/2010	40	Unknown	Unknown	Unknown	Search	
7/15/2010	29	Red bat	*Lasiurus borealis*	Tree bats	Incidental	Turbine 29 was not in search group for this day.
7/16/2010	06	Red bat	*Lasiurus borealis*	Tree bats	Search	
7/20/2010	01	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
7/20/2010	01	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
7/20/2010	19	Red bat	*Lasiurus borealis*	Tree bats	Search	
7/20/2010	19	Red bat	*Lasiurus borealis*	Tree bats	Search	
7/21/2010	02	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
7/21/2010	19	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
7/21/2010	26	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
7/21/2010	01	Little brown bat	*Myotis lucifugus*	Cave bats	Incidental	Found during SR trial carcass check; found outside search transects.
7/21/2010	15	Red bat	*Lasiurus borealis*	Tree bats	Incidental	Found during SR trial carcass check; Turbine 15 was not in search group for this day.
7/23/2010	06	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
7/23/2010	10	Red bat	*Lasiurus borealis*	Tree bats	Search	
7/23/2010	28	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	The bat was found alive, but due to injuries sustained, was euthanized.

Appendix H. Bat carcasses found during the 2009 and 2010 survey periods at the Cedar Ridge Wind Farm.

Date	Turbine	Common Name	Species	Type	Type of Find	Comments
7/24/2010	06	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
7/24/2010	07	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
7/24/2010	40	Red bat	*Lasiurus borealis*	Tree bats	Search	
7/26/2010	15	Red bat	*Lasiurus borealis*	Tree bats	Search	
7/27/2010	06	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
7/27/2010	10	Red bat	*Lasiurus borealis*	Tree bats	Search	
7/27/2010	40	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
7/27/2010	26	Red bat	*Lasiurus borealis*	Tree bats	Incidental	Turbine 26 was not in search group for this day.
7/27/2010	41R	Hoary bat	*Lasiurus cinereus*	Tree bats	Incidental	Turbine 41R was not in search group for this day.
7/28/2010	01	Big brown bat	*Eptesicus fuscus*	Cave bats	Incidental	Found outside search transects.
7/29/2010	02	Red bat	*Lasiurus borealis*	Tree bats	Search	
7/29/2010	10	Red bat	*Lasiurus borealis*	Tree bats	Search	
7/29/2010	22	Red bat	*Lasiurus borealis*	Tree bats	Search	
7/29/2010	22	Red bat	*Lasiurus borealis*	Tree bats	Search	
7/29/2010	40	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/1/2010	01	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/1/2010	18	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/1/2010	41R	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/2/2010	19	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/2/2010	29	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/2/2010	29	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
8/3/2010	06	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/3/2010	06	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/3/2010	24	Little brown bat	*Myotis lucifugus*	Cave bats	Search	

Appendix H. Bat carcasses found during the 2009 and 2010 survey periods at the Cedar Ridge Wind Farm.

Date	Turbine	Common Name	Species	Type	Type of Find	Comments
8/3/2010	38	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/3/2010	38	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
8/3/2010	40	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/4/2010	28	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
8/7/2010	06	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/7/2010	15	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/7/2010	24	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/9/2010	01	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/9/2010	01	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/9/2010	06	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/9/2010	07	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
8/9/2010	19	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/9/2010	41R	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/10/2010	06	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/10/2010	06	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/10/2010	26	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/11/2010	11	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
8/11/2010	24	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/12/2010	16	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/12/2010	21	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/12/2010	22	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
8/12/2010	28	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/12/2010	40	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/12/2010	40	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/13/2010	01	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
8/13/2010	10	Red bat	*Lasiurus borealis*	Tree bats	Search	

Appendix H. Bat carcasses found during the 2009 and 2010 survey periods at the Cedar Ridge Wind Farm.

Date	Turbine	Common Name	Species	Type	Type of Find	Comments
8/13/2010	18	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/13/2010	18	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/13/2010	41R	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/13/2010	41R	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/13/2010	41R	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
8/14/2010	09	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/14/2010	19	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/14/2010	22	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/14/2010	40	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/15/2010	11	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/15/2010	15	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/15/2010	38	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/15/2010	38	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/16/2010	28	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/20/2010	16	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/20/2010	21	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/20/2010	22	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/20/2010	29	Big brown bat	*Eptesicus fuscus*	Cave bats	Incidental	Found during SR trial carcass check; Turbine 29 was not in search group for this day.
8/21/2010	19	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
8/21/2010	40	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/21/2010	21	Red bat	*Lasiurus borealis*	Tree bats	Incidental	Found during SR trial carcass check; Turbine 21 was not in search group for this day.
8/22/2010	29	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/23/2010	10	Little brown bat	*Myotis lucifugus*	Cave bats	Search	

Appendix H. Bat carcasses found during the 2009 and 2010 survey periods at the Cedar Ridge Wind Farm.

Date	Turbine	Common Name	Species	Type	Type of Find	Comments
8/23/2010	24	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/23/2010	24	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/23/2010	38	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/24/2010	28	Hoary bat	*Lasiurus cinereus*	Tree bats	Incidental	Found outside search transects.
8/25/2010	06	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/25/2010	41R	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/26/2010	40	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/27/2010	15	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
8/27/2010	40	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
8/27/2010	40	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
8/28/2010	16	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/29/2010	01	Red bat	*Lasiurus borealis*	Tree bats	Search	
8/31/2010	15	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
8/31/2010	40	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
9/1/2010	19	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
9/2/2010	01	Big brown bat	*Eptesicus fuscus*	Cave bats	Search	
9/2/2010	40	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/2/2010	01	Red bat	*Lasiurus borealis*	Tree bats	Incidental	Found outside search transects.
9/3/2010	19	Hoary bat	*Lasiurus cinereus*	Tree bats	Incidental	Found outside search transects.
9/4/2010	24	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/4/2010	40	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/5/2010	40	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/7/2010	09	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
9/7/2010	40	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
9/7/2010	40	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/8/2010	06	Red bat	*Lasiurus borealis*	Tree bats	Search	

Appendix H. Bat carcasses found during the 2009 and 2010 survey periods at the Cedar Ridge Wind Farm.

Date	Turbine	Common Name	Species	Type	Type of Find	Comments
9/9/2010	10	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/9/2010	21	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/9/2010	40	Red bat	*Lasiurus borealis*	Tree bats	Search	
9/10/2010	01	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
9/14/2010	01	Red bat	*Lasiurus borealis*	Tree bats	Search	
9/14/2010	10	Red bat	*Lasiurus borealis*	Tree bats	Search	
9/14/2010	18	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
9/15/2010	22	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
9/16/2010	40	Little brown bat	*Myotis lucifugus*	Cave bats	Search	
9/17/2010	16	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
9/18/2010	01	Red bat	*Lasiurus borealis*	Tree bats	Incidental	Found outside search transects.
9/19/2010	19	Hoary bat	*Lasiurus cinereus*	Tree bats	Search	
9/19/2010	22	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
9/19/2010	18	Red bat	*Lasiurus borealis*	Tree bats	Incidental	Found during SR trial carcass check; Turbine 18 was not in search group for this day.
9/24/2010	24	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Search	
9/25/2010	40	Red bat	*Lasiurus borealis*	Tree bats	Search	
9/25/2010	40	Unknown	Unknown	Unknown	Search	
9/26/2010	22	Silver-haired bat	*Lasionycteris noctivagans*	Tree bats	Incidental	Found outside search transects.
9/28/2010	24	Red bat	*Lasiurus borealis*	Tree bats	Search	
9/28/2010	40	Red bat	*Lasiurus borealis*	Tree bats	Search	
10/14/2010	22	Red bat	*Lasiurus borealis*	Tree bats	Incidental	Found outside search transects.

APPENDIX I

Qualitative Evaluation of the Effect of Weather on Bird and Bat Mortality

Appendix I-1. Mean hourly weather values from 2000-0600 hours measured at the Fond du Lac Airport located 16 km (10 mi) northwest of the Cedar Ridge Wind Farm on nights when bat carcasses were totaled 3 or more.

Bat Carcasses	Date	Dry Bulb Fahrenheit	Dry Bulb Celsius	Dew Point Fahrenheit	Dew Point Celsius	Relative Humidity	Wind Speed	Wind Direction	Station Pressure	Precipt
3	7/26/2009	62.50	16.93	59.00	15.00	88.50	8.08	280.83	28.91	None
3	8/11/2009	65.73	18.70	62.60	16.99	89.80	5.22	294.44	29.12	None
4	8/13/2009	63.09	17.28	58.55	14.74	85.36	3.63	173.75	29.23	None
4	8/14/2009	68.82	20.46	61.18	16.24	76.91	7.00	172.73	29.21	None
3	8/15/2009	69.55	20.86	64.45	18.02	84.18	6.10	199.00	29.18	None
3	8/25/2009	64.18	17.87	58.64	14.79	82.73	8.82	196.36	29.17	None
3	10/12/2009	34.91	1.61	28.45	-1.96	77.73	3.50	167.50	29.43	None
4	7/20/2010	66.10	18.94	62.95	17.17	89.81	5.57	125.71	29.04	0.06
3	7/21/2010	68.82	20.45	64.45	18.04	86.09	5.86	212.86	29.09	None
3	7/23/2010	74.05	23.43	71.26	21.73	90.79	8.72	217.78	28.89	0.02
3	7/24/2010	73.27	22.95	70.77	21.44	91.83	7.88	209.23	29.00	0.30
3	7/27/2010	66.18	18.98	61.82	16.58	86.00	5.20	180.00	29.19	None
5	7/29/2010	64.00	17.78	58.73	14.85	83.91	4.67	305.00	29.21	Trace
3	8/1/2010	62.55	16.87	60.58	15.83	93.26	3.00	190.00	29.08	Trace
3	8/2/2010	70.36	21.31	66.27	19.03	86.82	5.36	189.09	29.08	None
6	8/3/2010	72.36	22.41	67.18	19.53	83.82	5.10	214.00	29.08	None
3	8/7/2010	62.64	17.05	59.36	15.20	89.18	4.67	173.33	29.08	None
6	8/9/2010	73.60	23.14	70.25	21.19	89.15	9.82	217.27	28.99	0.18
3	8/10/2010	70.67	21.43	68.04	20.06	91.25	3.00	174.00	29.10	None
6	8/12/2010	71.47	21.85	69.72	20.91	93.94	3.53	190.00	29.00	0.01
7	8/13/2010	74.18	23.43	69.27	20.70	84.45	5.36	177.27	28.96	0.02
4	8/14/2010	69.45	20.83	66.00	18.88	88.73	5.20	240.00	28.91	0.02
4	8/15/2010	71.18	21.75	66.82	19.35	86.09	5.18	233.64	28.99	None
3	8/20/2010	68.35	20.20	64.50	18.05	87.45	7.75	143.50	29.03	0.02
4	8/23/2010	61.00	16.09	58.19	14.60	90.57	3.00	170.00	29.25	None
3	8/27/2010	58.00	14.45	52.00	11.14	80.64	6.09	181.82	29.24	Trace
3	9/7/2010	67.82	19.88	55.64	13.12	0.00	14.00	200.91	0.00	0.01
3	9/9/2010	49.00	9.43	43.83	6.58	83.08	4.00	340.00	29.27	None
3	9/14/2010	49.73	9.85	43.73	6.52	81.00	5.20	246.00	29.21	None

Appendix I-2. Mean hourly weather values from 2000-0600 hours measured at the Fond du Lac Airport located 16 km (10 mi) northwest of the Cedar Ridge Wind Farm on nights when bird carcasses were totaled 2 or more.

Bird Carcasses	Date	Dry Bulb Fahrenheit	Dry Bulb Celsius	Dew Point Fahrenheit	Dew Point Celsius	Relative Humidity	Wind Speed	Wind Direction	Station Pressure	Precipt
2	4/17/2009	49.18	9.55	30.64	-0.78	49.45	5.00	196.36	29.28	None
2	4/21/2009	36.09	2.27	27.82	-2.33	72.18	5.27	258.18	28.85	0.23
3	8/12/2009	63.09	17.28	58.55	14.74	85.36	3.63	173.75	29.23	None
2	9/22/2009	63.37	17.46	62.43	16.77	97.03	6.25	220.00	29.17	None
3	3/23/2010	30.55	-0.82	16.82	-8.45	57.18	7.27	169.09	29.22	None
2	3/30/2010	54.18	12.33	38.82	3.79	56.36	15.27	187.27	28.83	None
2	9/16/2010	51.08	10.63	48.54	9.18	91.31	5.00	205.00	29.19	0.20