

**2015 Post-Construction Bat  
Mortality Monitoring Report  
Pioneer Trail Wind Farm**

**Ford and Iroquois Counties, Illinois**

**Project #193703901**



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**2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT  
PIONEER TRAIL WIND FARM  
FORD AND IROQUOIS COUNTIES, ILLINOIS**

**Table of Contents**

**1.0 INTRODUCTION ..... 1**

1.1 PROJECT DESCRIPTION..... 1

1.2 PURPOSE AND OBJECTIVES OF THE STUDY ..... 1

**2.0 METHODS..... 4**

2.1 MORTALITY STUDY..... 4

    2.1.1 Sample Size..... 4

    2.1.2 Search Plot Size ..... 4

    2.1.3 Search Schedule ..... 4

    2.1.4 Carcass Searches ..... 5

    2.1.5 Species Identification..... 6

2.2 SEARCHER EFFICIENCY TRIALS ..... 6

2.3 CARCASS REMOVAL TRIALS..... 6

2.4 STATISTICAL METHODS FOR MORTALITY ESTIMATES ..... 7

    2.4.1 Mean Observed Number of Casualties (c) ..... 7

    2.4.2 Estimation of Searcher Efficiency Rate (p) ..... 8

    2.4.3 Estimation of Carcass Removal Rate (t)..... 8

    2.4.4 Estimation of the Probability of Carcass Availability and  
    Detection ( $\pi$ )..... 8

    2.4.5 Area Adjustment (A) ..... 8

    2.4.6 Estimation of Facility-Related Mortality (m) ..... 9

**3.0 RESULTS ..... 9**

3.1 SUMMARY OF SEARCHES ..... 9

    3.1.1 Species Composition ..... 10

    3.1.2 Age and Sex..... 10

    3.1.3 Temporal Patterns..... 11

    3.1.4 Spatial Patterns ..... 11

3.2 SEARCHER EFFICIENCY TRIALS ..... 11

3.3 CARCASS REMOVAL TRIALS..... 12

3.4 ADJUSTED MORTALITY ESTIMATES ..... 12

3.5 INCIDENTAL FINDS ..... 13

**4.0 SUMMARY..... 13**

**5.0 LITERATURE CITED ..... 14**

**LIST OF TABLES**

Table 1. Summary of all bat carcasses found ..... 10

Table 2. Sex and age of all bat carcasses found ..... 10

Table 3. Searcher efficiency by search type..... 12

Table 4. Carcass removal by plot type ..... 12

Table 5. Bat mortality estimates for the 2015 post-construction monitoring study ..... 13

**2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT  
PIONEER TRAIL WIND FARM  
FORD AND IROQUOIS COUNTIES, ILLINOIS**

**LIST OF FIGURES**

Figure 1. Turbine and Survey Locations ..... 3  
Figure 2. Bat carcasses found by week..... 11

**LIST OF APPENDICES**

APPENDIX A SAMPLE DATA SHEETS

APPENDIX B REPRESENTATIVE CARCASS PHOTOS

**2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT  
PIONEER TRAIL WIND FARM  
FORD AND IROQUOIS COUNTIES, ILLINOIS**

## **1.0 Introduction**

### **1.1 PROJECT DESCRIPTION**

The Pioneer Trail Wind Farm (Project or Pioneer Trail), developed by Pioneer Trail Wind Farm, LLC (PTWF), is located in Ford and Iroquois counties, just east of the towns of Paxton and Loda, Illinois. The Project consists of 94 1.6 megawatt (MW) wind turbine generators and operations and maintenance building, access roads, collector line system, and substation for a total capacity of approximately 150 MWs (Figure 1). Each turbine is anchored in a steel reinforced concrete foundation. A pad mounted transformer is located at the base of each turbine, and collects electricity generated by each turbine through cables routed down the inside of the tower. The buried collection system connects the individual turbines to the substation, where the wind farm connects with the existing transmission line. The Project became operational in January 2012. The Project is located on lands leased from private landowners, who continue their existing use of the land. Land use in the area is predominantly agricultural.

Pioneer Trail is located within the range of both the federally and Illinois endangered Indiana bat (*Myotis sodalis*) and the federally and Illinois threatened northern long-eared bat (*Myotis septentrionalis*). PTWF developed a Habitat Conservation Plan (HCP) in accordance with the requirements set forth under Section 10(a)(1)(B) of the Endangered Species Act of 1973 (ESA), as amended, and applicable U.S. Fish and Wildlife Service (USFWS) guidance documents, in support of its application for an incidental take permit (ITP) for these species under Section 10(a)(1)(B) of the ESA. On June 26, 2015 the USFWS issued ITP No. TE66598B-0 to PTWF for the Project. On the basis of the HCP and certain additional information submitted to the Illinois Department of Natural Resources (IDNR), the IDNR issued an Incidental Take Authorization (ITA) to PTWF for the Project on October 8, 2015.

### **1.2 PURPOSE AND OBJECTIVES OF THE STUDY**

The HCP for the Project outlines the following measures required as a condition of the ITP and ITA:

- Avoidance measures to avoid take of listed species;
- Minimization measures to minimize take of listed species, as well as all bats;
- Mitigation to mitigate for unavoidable take of listed species;
- Post-construction monitoring protocols to measure effectiveness of avoidance and minimization measures; and
- Adaptive management to adjust minimization measures as necessary.

**2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT  
PIONEER TRAIL WIND FARM  
FORD AND IROQUOIS COUNTIES, ILLINOIS**

The HCP requires PTWF to perform post-construction monitoring in the fall season (August 15 through October 15) for the first two years of operation post-ITP issuance, and every five years thereafter. The ITA requires PTWF to perform extended fall monitoring in the first two years following ITA issuance (July 15 through October 15). Due to the timing of the ITA issuance (near the end of the fall 2015 season), PTWF conducted fall monitoring from August 15 through October 15 in 2015 the first year of operation post-ITP issuance. PTWF will conduct extended fall monitoring (July 15 through October 15) in 2016 and 2017. Fall season monitoring will be repeated every 5 years beginning in 2021. Spring season monitoring (April 1 through May 15) will also occur in 2021 (year 7 of operation post-ITP issuance, year 6 post-ITA issuance) and every 10 years thereafter, unless the results of spring monitoring indicate that it must be conducted every 5 years as well, as set forth in the HCP.

The HCP requires annual reporting to the USFWS of the results of the post-construction monitoring conducted at the Project. The ITA requires that these results also be reported to the IDNR within 60 days of survey completion. This Post-Construction Bat Mortality Monitoring Report has been prepared to satisfy those requirements.

The primary objectives of the post-construction study were to:

1. Determine overall bat fatality rates from the Project;
2. Monitor for Indiana and northern long-eared bat mortality; and
3. Evaluate the circumstances under which fatalities occur.

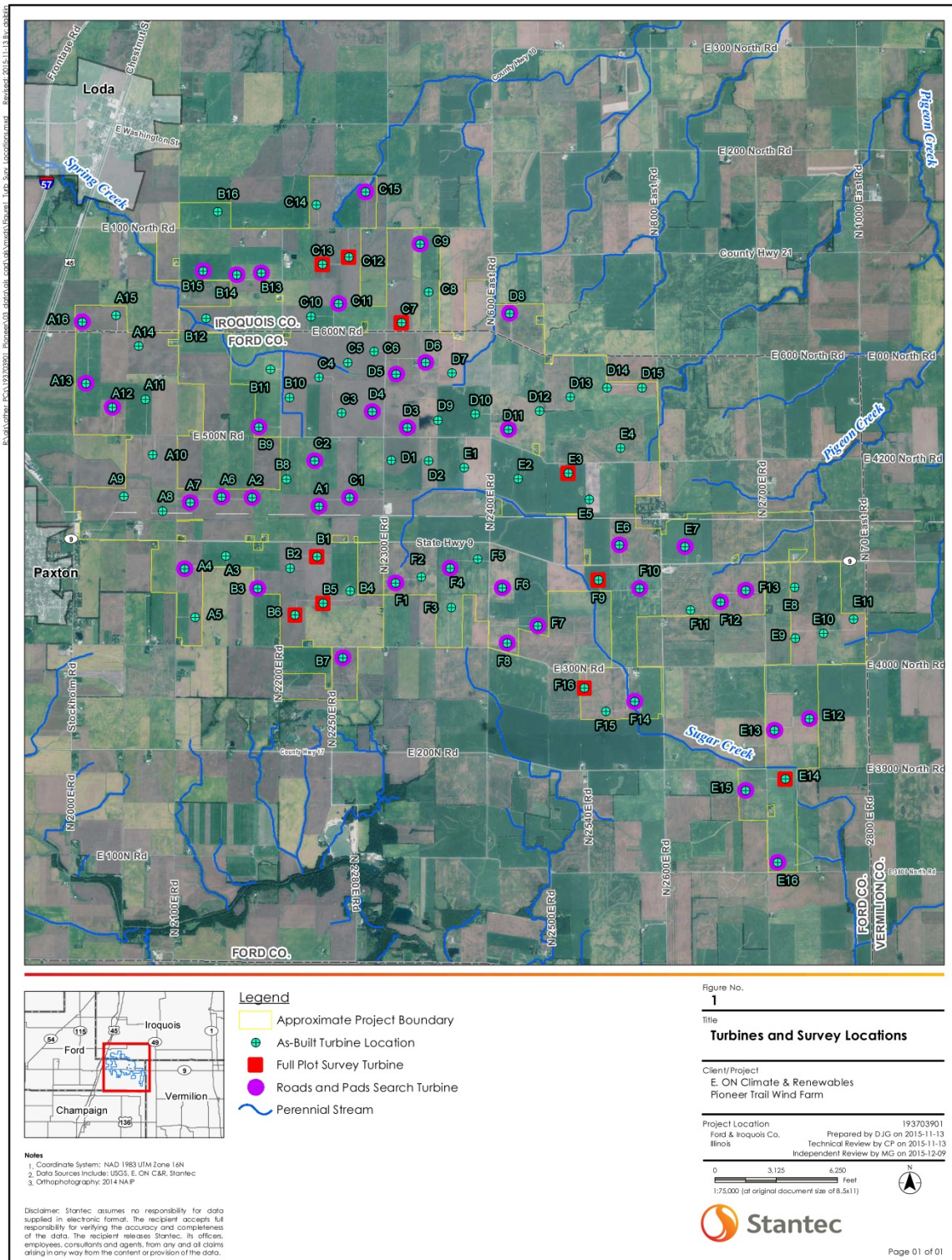
The study included the following components:

1. Standardized carcass searches to systematically search plots at all turbines for bat casualties attributable to the turbines;
2. Searcher efficiency trials to estimate the percentage of bat casualties that were found by the searcher(s); and
3. Carcass removal trials to estimate the persistence time of carcasses on-site before they were removed by scavengers.

# 2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT

## PIONEER TRAIL WIND FARM

### FORD AND IROQUOIS COUNTIES, ILLINOIS





**2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT  
PIONEER TRAIL WIND FARM  
FORD AND IROQUOIS COUNTIES, ILLINOIS**

## **2.0 Methods**

### **2.1 MORTALITY STUDY**

Carcass searches were conducted in fall (August 18 to October 13) during the 2015 year of Project operation. This was the first year of Project operation under the ITP; however, the Project continued to operate at 6.9 m/s (avoidance) until October 9, 2015, when PTWF received the Illinois state ITA. Starting the evening of October 9, 2015, the Project lowered the cut-in speed to 5.0 m/s as outlined in the HCP and ITA until October 15, 2015. In 2016, operation of the Project will be at 5.0 m/s from August 15 through October 15.

#### **2.1.1 Sample Size**

Post-construction monitoring was conducted at 50 of the 94 turbines (53%). This sample size optimizes field survey effort while maximizing expected confidence in the data and associated results. This approach will meet the study goal of detecting and analyzing overall bat fatalities at the facility by providing sufficient sample size to support reliable data analysis and related interpretations and conclusions.

#### **2.1.2 Search Plot Size**

At 80% of the surveyed turbines (n=40), only the turbine pads and roads out to 328 feet (100 meters[m]) from the turbine were searched. This method targets the areas shown to support the highest searcher efficiency while greatly reducing the financial and logistical constraints associated with clearing and searching large study plots, enabling much broader coverage of the facility. At the remaining 20% of turbines (n=10), 262-foot x 262-foot (80-m x 80-m) plots were cleared and searched using a full-coverage transect methodology. Each 80-m x 80-m plot was centered on a turbine location, and vegetation was periodically mowed as needed to improve searcher efficiency.

Previous studies have indicated that the majority of bat carcasses typically fall within 100 feet (30 m) of the turbine or within 50% of the maximum height of the turbine (Kerns and Kerlinger 2004, Arnett et al. 2005, Young et al. 2009, Jain et al. 2007, Piorkowski and O'Connell 2010, USFWS 2012). The plot size used for this study exceeds one-half the maximum turbine rotor height of the Project turbines (246 feet [75 m]). The subset of full-coverage plots provided a reference for estimating the number of fatalities which may have fallen outside of the search area at the roads and pads search turbines. This mixed sampling methodology is consistent with other post-construction monitoring studies being conducted (e.g., Good et al. 2011) and will enable comparison of study results.

#### **2.1.3 Search Schedule**

The search interval for all turbines was once weekly. An individual turbine was searched on the same day each week when conditions allowed. Within a day, the turbine search schedule and

**2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT  
PIONEER TRAIL WIND FARM  
FORD AND IROQUOIS COUNTIES, ILLINOIS**

order were randomized, so that each turbine's search plot was sampled at differing periods during the day. A weekly search interval for fatality monitoring was deemed adequate by Kunz et al. (2007) and studies have demonstrated that a weekly search interval provides effective mortality monitoring and adequately estimates impacts from wind energy facilities (Gruver et al. 2009, Young et al. 2009), such that the added effort associated with more frequent intervals is not warranted.

**2.1.4 Carcass Searches**

Carcass searches were conducted by qualified biologists, operating under applicable permits and experienced and/or trained in fatality search methods, including proper handling and reporting of carcasses. The searcher was familiar with and able to accurately identify the bat species likely to be found in the Project area, and any unknown bat discovered was sent to an expert for positive identification. Bird carcasses were identified in the field. Digital photographs and location information of all bird carcasses were taken and used for confirming identification when necessary. Carcasses (birds and bats) were photographed from several angles to provide the best chance of photographic identification. During searches, the searchers walked at a rate of approximately 2 mph (45 to 60 m per minute) while searching 10 feet (3 m) on either side of each transect.

For each carcass found, the following data were recorded (a sample data form is included in Appendix A):

- Date and time;
- Initial species identification;
- Sex, age, and reproductive condition (when possible);
- Global positioning system (GPS) location;
- Distance and bearing to turbine;
- Substrate/ground cover conditions;
- Condition (intact, scavenged);
- Any notes on presumed cause of death; and
- Wind speeds and direction and general weather conditions for nights preceding search.

A digital photograph of each detected carcass was taken before the carcass was handled and removed. Representative digital photographs are included in Appendix B. All bat carcasses were labeled with a unique number, bagged, and stored frozen (with a copy of the original data sheet) at the Project Operations and Maintenance Building. Bat carcasses were collected and retained under Illinois Department of Natural Resources (DNR) Permit Number NH15.5951,



**2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT  
PIONEER TRAIL WIND FARM  
FORD AND IROQUOIS COUNTIES, ILLINOIS**

and listed species (Indiana bat and northern long-eared bats) under Illinois DNR Permit Type S, Permit Number 15-052 (up to 3 of each listed species).

Bat carcasses found in non-search areas and any bird carcasses found were coded as incidental finds, and documented as much as possible in a similar fashion to those found in standardized searches. Maintenance personnel were informed of the standardized searches, and were trained in collision event reporting protocol in the case of an incidental find. Incidental finds are not included in the mortality estimates because the lack of standardized search effort and search area as well as the lack of searcher efficiency and carcass removal trials prohibits calculations to account for bias and extrapolate incidental carcasses found to estimated fatalities.

### **2.1.5 Species Identification**

Preliminary bird and bat species identifications were made in the field by qualified staff. When carcass condition allowed, data collected also included the sex, age, and reproductive condition of the carcass. For bat carcasses, forearm length was recorded to facilitate in identification. Any unknown bat, or potential Indiana or northern long-eared bat, was identified by a Stantec bat biologist. In addition to the carcass, photographs and data collected for each carcass were used to verify the species identification.

## **2.2 SEARCHER EFFICIENCY TRIALS**

Searcher efficiency trials were used to estimate the probability of bat carcass detection by the searchers. One searcher efficiency trial was conducted during the monitoring period, as only one searcher and one season are included in this monitoring study. The searchers did not know when during the monitoring periods the trials were being conducted, at which turbines trial carcasses were placed, or the location or number of trial carcasses placed in any given search plot. Commercially-available brown mouse carcasses were used as trial carcasses to represent bats.

All searcher efficiency trial carcasses were randomly placed by the field lead within the search plots the morning of the search prior to the carcass searches for that day. The number of trial carcasses found by the searcher during the mortality searches in each plot was recorded and compared to the total number of trial carcasses placed in the plot and not scavenged prior to the mortality search. A sample data form is included in Appendix A.

## **2.3 CARCASS REMOVAL TRIALS**

Carcass removal trials were conducted to estimate the average length of time carcasses remained in the search plots (i.e., were available to find) before being removed by scavengers. The carcass removal trial was conducted following the searcher efficiency trial. Mouse carcasses used during the searcher efficiency trials were left in place and their locations were discretely marked. The searcher monitored the trial carcasses over a period of up to 30 days.

**2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT  
PIONEER TRAIL WIND FARM  
FORD AND IROQUOIS COUNTIES, ILLINOIS**

During each carcass removal trial, carcasses were checked every day for the first week, and then on days 10, 14, 20 and 30, when possible.

The condition of each carcass was recorded during each trial check. The conditions recorded were defined as follows:

- Intact – complete carcass with no body parts missing.
- Scavenged – carcass with some evidence or signs of scavenging.
- Feather or fur spot – no carcass, but 10 or more feathers or fur spot remaining.
- Missing – no carcass or fur remaining or fewer than 10 feathers.

A sample data form is included in Appendix A. Any carcasses remaining at the end of the 30-day trial period were removed from the field.

## **2.4 STATISTICAL METHODS FOR MORTALITY ESTIMATES**

In an effort to make results comparable with other post-construction mortality studies, the methodology used to calculate the mortality estimates largely followed the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). The estimate of the total number of turbine-related casualties was based on three components: (1) observed number of casualties, (2) searcher efficiency, and (3) carcass removal rates. The 90% confidence intervals were calculated using bootstrapping methods (Erickson et al. 2003 and Manly 1997 as presented in Young et al. 2009).

### **2.4.1 Mean Observed Number of Casualties (c)**

The estimated mean observed number of casualties (c) per turbine per monitoring period was calculated as:

$$c = \frac{\sum_{j=1}^n c_j}{n}$$

where n is the number of turbines searched, and c<sub>j</sub> is the number of casualties found during mortality searches. Incidental carcass finds (those found outside of the searched areas or at times other than during mortality searches) were not included in this calculation, or in the estimated fatality rate. Mean number of observed casualties was calculated separately for each search type (roads and pads, full plots).

**2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT  
PIONEER TRAIL WIND FARM  
FORD AND IROQUOIS COUNTIES, ILLINOIS**

**2.4.2 Estimation of Searcher Efficiency Rate (p)**

Searcher efficiency (p) represents the average probability that a carcass was detected by searchers. The searcher efficiency rate was calculated by dividing the number of trial carcasses observers found by the total number which remained available during the trial (non-scavenged). Searcher efficiency was calculated separately for each search type (roads and pads, full plots).

**2.4.3 Estimation of Carcass Removal Rate (t)**

Carcass removal rates were estimated to adjust the observed number of casualties to account for scavenger activity at the site. Mean carcass removal time (t) represents the average length of time a planted carcass remained at the site before it was removed by scavengers. Mean carcass removal time was calculated as:

$$t = \frac{\sum_{i=1}^S t_i}{S - S_c}$$

where s is the number of carcasses placed in the carcass removal trials and s<sub>c</sub> is the number of carcasses censored. This estimator is the maximum likelihood (conservative) estimator assuming the removal times follow an exponential distribution, and there is right-censoring of the data. Any trial carcasses still remaining at 30 days were collected, yielding censored observations at 30 days. Carcass removal rates were calculated separately for each search type (roads and pads, full plots).

**2.4.4 Estimation of the Probability of Carcass Availability and Detection (π)**

Searcher efficiency and carcass removal rates were combined to represent the overall probability (π) that a casualty incurred at a turbine was reflected in the mortality search results. This probability was calculated as:

$$\pi = \frac{t \cdot p}{I} \cdot \left[ \frac{\exp(I/t) - 1}{\exp(I/t) - 1 + p} \right]$$

where I is the interval between searches. The estimation of the probability of carcass availability and detection was calculated separately for each search type (roads and pads, full plots), and then averaged for the study using a weighted average as:

$$\pi = (0.8 * \pi_{RP}) + (0.2 * \pi_{FP})$$

**2.4.5 Area Adjustment (A)**

Approximation of A, the adjustment for areas which were not searched, was calculated following methods and data collected during post-construction monitoring studies at Fowler Ridge Wind Farm in Indiana (Good et al. 2011). For this study, A was calculated to represent the

**2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT  
PIONEER TRAIL WIND FARM  
FORD AND IROQUOIS COUNTIES, ILLINOIS**

adjustment for the proportion of carcasses which likely fell outside of the area searched at surveyed turbines. The value for A was approximated using the following equation:

$$A = \frac{\frac{C_{RP}}{\pi_{RP} * S_{RP}} + \frac{C_{FP}}{\pi_{FP} * S_{FP}}}{\frac{C_{RP}}{\pi_{RP}} + \frac{C_{FP}}{\pi_{FP}}} * A_{FP}$$

where  $C_{RP}$  is the number of observed casualties on roads and pads,  $C_{FP}$  is the number of observed casualties on full plots,  $\pi_{RP}$  is the probability of carcass availability and detection on roads and pads,  $\pi_{FP}$  is the probability of carcass availability and detection on full plots,  $S_{RP}$  is the proportion of roads and pads searched across all study turbines, and  $S_{FP}$  is the proportion of full plots searched across all study turbines. For this study,  $S_{RP} = 0.8$  and  $S_{FP} = 0.2$ , as only roads and pads will be searched at 80% of the study turbines and full plot searches will be conducted at the remaining 20% of the study turbines.

The value for  $A_{FP}$  used was equal to the correction factor calculated for the Fowler study ( $A_{FP}=1.305$ ) as the Fowler study estimated that 23.4% of fatalities fall outside of the 262-foot x 262-foot (80-m x 80-m) square plots.

#### **2.4.6 Estimation of Facility-Related Mortality (m)**

Mortality estimates were calculated using the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). The estimated mean number of bat and bird casualties/turbine/monitoring period (m) was calculated by dividing the mean observed number of bat and bird casualties/turbine/monitoring period (c) by  $\pi$ , an estimate of the probability a carcass was not removed by scavengers and was detected by searchers, and then multiplying by A, the adjustment for the area within which bats may have fallen but which was not searched.

$$m = A * \frac{c}{\pi}$$

Where A is the area adjustment, C is the number of carcasses found per turbine, and  $\pi$  is the probability of carcass detection and availability (weighted average of  $\pi_{RP}$  and  $\pi_{FP}$  based on 80% of searches being roads and pads and 20% of searches being full plots).

### **3.0 Results**

#### **3.1 SUMMARY OF SEARCHES**

A total of 447 carcass searches were conducted over 9 weeks in the fall. Due to schedule, weather and maintenance, the average time between searches was 6.9 days. A total of 12 individual bat carcasses were found during standardized carcass searches. Five additional bat carcasses were found incidentally, either outside of the search plot areas, killed prior to the start

**2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT  
PIONEER TRAIL WIND FARM  
FORD AND IROQUOIS COUNTIES, ILLINOIS**

of fall monitoring (determined by carcass condition the first week of searches) or on a non-scheduled search day during carcass removal checks. In total, 17 bat carcasses were found during the study period.

**3.1.1 Species Composition**

A summary of all bat carcasses found during standardized post-construction searches is shown in Table 1. Of the 12 bat carcasses found during searches, 6 were eastern red bats (*Lasiurus borealis*; 50%), 3 were silver-haired bats (*Lasionycteris noctivagans*; 25%), 2 were big brown bats (*Eptesicus fuscus*; 16.7%) and 1 was an unknown bat (8.3%). The unknown bat was only a partial wing, but the forearm length (at least 41.8 mm) indicates that it is not a *Myotis* and the forearm length and color of the pelage indicate that it was likely a silver-haired bat or big brown bat. No bat species listed as threatened or endangered under the ESA, as amended, or by the State of Illinois were found during the searches.

**Table 1.** Summary of all bat carcasses found during the 2015 post-construction monitoring study (August 18 through October 13) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois.

Species	Total	Percent of All Bats Found
Eastern Red Bat	6	50.0%
Silver-haired Bat	3	25.0%
Big Brown Bat	2	16.7%
Unknown, not <i>Myotis</i>	1	8.3%
<b>Total</b>	<b>12</b>	<b>100%</b>

**3.1.2 Age and Sex**

A summary of the age and sex of all bat carcasses found during the post-construction monitoring is shown in Table 2. Of the 12 bat carcasses found, there was 1 adult female, 1 adult male, 2 adults of unknown sex, and 8 bats of unknown age and unknown sex (Table 2).

**Table 2.** Sex and age of all bat carcasses found during the 2015 post-construction monitoring study (August 18 through October 13) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois. Ages include adults (A), juveniles (J) and unknown (U).

Species	Female			Male			Unknown		
	A	J	U	A	J	U	A	J	U
Eastern Red Bat	1	0	0	1	0	0	1	0	3
Silver-haired Bat	0	0	0	0	0	0	0	0	3
Big Brown Bat	0	0	0	0	0	0	1	0	1

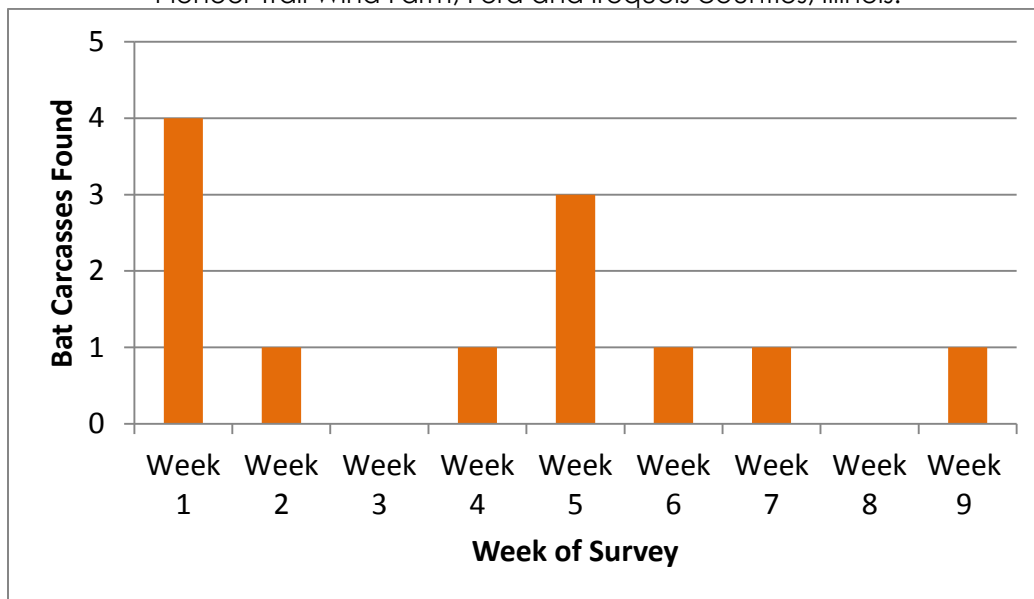
**2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT  
PIONEER TRAIL WIND FARM  
FORD AND IROQUOIS COUNTIES, ILLINOIS**

Unknown, not <i>Myotis</i>	0	0	0	0	0	0	0	0	1
<b>Total</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>8</b>

**3.1.3 Temporal Patterns**

Bat carcasses were found in seven of the nine survey weeks in 2015 (Figure 2). The first week of survey had the largest number of bat carcasses (4) found in a single week, followed by the fifth week (September 14) with three carcasses. All other weeks had only one or zero carcasses found (Figure 2).

**Figure 2.** Bat carcasses found by week during the 2015 post-construction monitoring study (August 18 through October 13) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois.



**3.1.4 Spatial Patterns**

Bat carcasses were found at a total of 11 of 50 (22%) of the monitored turbines during the 2015 survey period. The largest number of carcasses found at a single turbine (2) was turbine E15 (road and pad; Figure 1). The remainder of turbines had either zero or one carcass found over the nine weeks of fatality monitoring.

During the monitoring period, 11 bats were found at the road and pad turbines, and only 1 bat was found at the full plot turbines.

**3.2 SEARCHER EFFICIENCY TRIALS**

A total of 30 mouse carcasses were placed for searcher efficiency trials during the monitoring period. Scavengers removed one trial carcass prior to the searcher efficiency trial. Overall, the searcher efficiency ranged from 20% at full plots to 89% on roads and pads (Table 3).



**2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT  
PIONEER TRAIL WIND FARM  
FORD AND IROQUOIS COUNTIES, ILLINOIS**

**Table 3.** Searcher efficiency by search type  
For the 2015 post-construction monitoring study  
(August 18 to October 13) at the Pioneer Trail Wind Farm  
Ford and Iroquois counties, Illinois.

	Full Plots	Roads and Pads
# Carcasses Placed	11	18
# Carcasses Found	2	16
<b>Mean Searcher Efficiency (90% CI)</b>	<b>0.2</b> (0, 0.4)	<b>0.89</b> (0.78, 1.0)

### 3.3 CARCASS REMOVAL TRIALS

Mouse carcasses used in the searcher efficiency trials were left for up to 30 days, and checked each day for the first week and then on days 10, 14, 21, and 30 of the trial. Thirty (30) mouse carcasses were used during the monitoring period. Carcasses persisted for an average of 7 to 16 days (Table 4).

**Table 4.** Carcass removal by plot type  
during the 2015 post-construction monitoring study  
(August 18 to October 13) at the Pioneer Trail Wind Farm,  
Ford and Iroquois counties, Illinois.

	Full Plots	Roads and Pads
# Carcasses Placed	12	18
# Carcasses Scavenged within 30 days	10	18
<b>Mean Carcass Persistence time in days (90% CI)</b>	<b>16.0</b> (10.1, 26.5)	<b>7.0</b> (4.5, 10.0)

### 3.4 ADJUSTED MORTALITY ESTIMATES

Mortality rate estimates were calculated based upon the carcasses found during the mortality searches, and did not include any incidental finds. Observed bat mortality estimates were adjusted to account for searcher efficiency, carcass removal, and an area adjustment using the methods described in Section 2.4<sup>1</sup>. Results are summarized in Table 5.

$$A = \frac{\frac{C_{RP}}{\pi_{RP} \cdot S_{RP}} + \frac{C_{FP}}{\pi_{FP} \cdot S_{FP}}}{\frac{C_{RP}}{\pi_{RP}} + \frac{C_{FP}}{\pi_{FP}}} * A_{FP}; A = \frac{\frac{11}{0.6 \cdot 0.8} + \frac{1}{0.3 \cdot 0.2}}{\frac{11}{0.6} + \frac{1}{0.3}} * 1.305 = 2.39$$

**2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT  
PIONEER TRAIL WIND FARM  
FORD AND IROQUOIS COUNTIES, ILLINOIS**

**Table 5.** Bat mortality estimates for the 2015 post-construction monitoring study (August 18 to October 13) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois.

	<b>Full Plots</b>	<b>Roads and Pads</b>
(c) Observed bats/turbine/season	<b>0.10</b>	<b>0.28</b>
(π) Probability of Carcass Availability and Detection (90% CI)	<b>0.3</b> (0, 0.6)	<b>0.6</b> (0.5, 0.7)
(A) Area Adjustment	<b>2.39</b>	
(m) Estimated bats/turbine/season	<b>1.1</b> (0.6, 1.7)	
Estimated Bats/MW/Season	<b>0.7</b> (0.4, 1.1)	
Estimated Bats/Facility/Season	<b>103.4</b> (56.4, 159.8)	
Estimated Indiana Bats/Facility/Season <sup>1</sup>	<b>0.17</b> (0.09, 0.26)	
Estimated northern long-eared bats/Facility/Season <sup>1</sup>	<b>0.08</b> (0.05, 0.13)	

<sup>1</sup>Calculated based upon percentage of Indiana and northern long-eared bats to all bat carcasses found (0.16% and 0.08%, respectively), based upon research done at Fowler Ridge Wind Farm (Western Ecosystems Technology, Inc. 2013). Actual mortality is expected to be essentially zero for both species given that fatalities are expected to occur only in the fall, and the Project was curtailed at 6.9 m/s during the majority of fall migration.

### 3.5 INCIDENTAL FINDS

A total of five incidental bat carcasses were found, all during the first week of searches (August 18 and 19). Incidental bat finds included three hoary bats (*Lasiurus borealis*) and two eastern red bats.

Only one bird carcass was found, which was identified as a sparrow of unknown species due to carcass degradation.

## 4.0 Summary

- A total of 447 carcass searches were conducted over 9 weeks from 18 August to 13 October.
- A total of 12 bat carcasses were found during standardized searches, with an additional 5 incidental carcasses found.
- Only one incidental bird carcass was found, of unknown species.

**2015 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT  
PIONEER TRAIL WIND FARM  
FORD AND IROQUOIS COUNTIES, ILLINOIS**

- No bird or bat species listed as threatened or endangered under the ESA or by the State of Illinois were found during the study.
- Bat species found included eastern red bats (6), silver-haired bats (3) and big brown bats (2). There was one unidentified carcass, which was likely a silver-haired or big brown bat based on the color of the pelage and forearm length. In addition, hoary bats (3) and eastern red bats (2) were found incidentally.
- Estimated bat mortality was 103.4 bats/facility/season (90% CI: 56.4 to 159.8) during the fall migration period (August 15 – October 15).
- No Indiana bat or northern long-eared bat carcasses were found during the 2015 study. Estimated mortality of the endangered Indiana bat was 0.17 Indiana bat, and estimated mortality of the threatened northern long-eared bat was 0.08 northern long-eared bat.
- The monitoring took place while the turbines were curtailed at 6.9 m/s until October 9, 2015, and likely does not represent mortality estimates under the minimization measures outlined in the HCP. Only 1 bat carcass was found after cut-in speeds were lowered to 5.0 m/s (minimization under the HCP).

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# APPENDIX A

Sample Data Sheets

# CARCASS SEARCH SUMMARY SHEET

PIONEER TRAIL WIND FARM (193703901)

DATE: \_\_\_\_\_ BIOLOGIST: \_\_\_\_\_

WEATHER: % CLOUD COVER \_\_\_\_\_ TEMPERATURE (° F) \_\_\_\_\_

PRECIPITATION \_\_\_\_\_ WIND \_\_\_\_\_

SITE DESCRIPTION/COMMENTS: \_\_\_\_\_

TURBINE NUMBER	PLOT TYPE (Full or Roads/Pads)	SURVEY TIME (MILITARY)		CARCASSES FOUND (#BIRD, #BAT, NONE)
		START	END	





Carcass ID <sup>1</sup>	Placement				GPS Coordinates	From Turbine		Species (scientific name)	Trial Result		
	Time (Military)	Turbine <sup>2</sup>	Placed By <sup>3</sup>	On Road/Pad?		Distance (m)	Azimuth (degrees)		Found By <sup>4</sup>	Not Found	Scavenged Prior to Search

**Comments (record carcass number next to associated comment, include any identifiers and bands, if present):**

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<sup>1</sup> Carcass ID – Use carcass ID from when it was originally found. If no ID, just number.  
<sup>2</sup> Turbine – Turbine should be labeled with the turbine number where it was placed.  
<sup>3</sup> Placed By – Initials of the person who placed the carcass.  
<sup>4</sup> Found By – Record the initials of the person who found the carcass.

**More data on back? Yes No**



TURBINE NO. <sup>1</sup>	PLOT TYPE <sup>2</sup>	CARCASS NO. <sup>3</sup>	FROM TURBINE		ON ROAD/PAD?	GPS COORDINATES	SPECIES (scientific name, spell out) <sup>4</sup>	FOREARM LENGTH OF BAT (mm)	AGE <sup>5</sup>	SEX <sup>6</sup>	CAUSE OF DEATH <sup>7</sup>	CONDITION <sup>8</sup>	CHECK IF COMMENTS (write on back) <sup>9</sup>
			DISTANCE (m)	AZIMUTH (DEGREES)									
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	

<sup>1</sup> TURBINE – ENTER NUMBER OF TURBINE. ALSO SEARCH THE TURBINE PAD AND ACCESS ROAD IN ADDITION TO THE STUDY PLOT.

<sup>2</sup> PLOT TYPE – R=ROADS AND PADS, F=FULL PLOT

<sup>3</sup> CARCASS NO. – NUMBER CARCASSES IN THE ORDER THEY ARE FOUND.

<sup>4</sup> SPECIES – IF UNKNOWN, SPECIFY UNKNOWN BAT OR UNKNOWN BIRD.

<sup>5</sup> AGE – IF IDENTIFIABLE: ADULT = A; JUVENILE = J; UNKNOWN = U

<sup>6</sup> SEX – IF IDENTIFIABLE: FEMALE = F; MALE = M, UNKNOWN = U

<sup>7</sup> CAUSE OF DEATH – COLLISION WITH TURBINE = T; PREDATION = P; UNKNOWN = U (ADD EXPLANATION IN COMMENTS IF NECESSARY).

<sup>8</sup> CONDITION – ENTER F=FRESH OR D=DECOMPOSED AND WHOLE =W; MOST OF BODY WITH SOME MISSING = M; PIECES = P (E.G., WING ONLY); FEATHER SPOT = F (EXAMPLE: F/W)

<sup>9</sup> COMMENTS – INCLUDING: REPRODUCTIVE CONDITION, IF IDENTIFIABLE: PREGNANT = P; LACTATING = L; POST-LACTATING = PL; NON-REPRODUCTIVE = NR; TESTES DESCENDED = T; UNKNOWN = U; B= BREEDING (BIRDS).

BAND COLOR/No. – IF BANDED, RECORD COLOR OF BAND (OR METAL), AND NUMBER.

OTHER COMMENTS. INCLUDE CARCASS NUMBER NEXT TO ALL COMMENTS.

**PHOTOS:** WHERE POSSIBLE, PHOTOGRAPH FOR BATS: BACK, BREAST, MUZZLE, TRAGUS, RULER BEHIND EAR, RULER NEXT TO FOREARM, FOOT, TOEHAIRS, CALCAR (IF EXPOSED).

FOR BIRDS: BACK, BREAST, HEAD, FEET, UNDERSIDE OF WINGS (FOR RAPTORS).

**ADDITIONAL COMMENTS (record carcass number next to associated comment; include any identifiers and bands, if present):**

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Carcass ID <sup>1</sup>	Placement				Species (scientific name)	Condition <sup>4</sup> When Checked, Checked By <sup>5</sup>										
	GPS Coordinates	Time (Military)	Turbine <sup>2</sup>	Placed By <sup>3</sup>		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 10	Day 14	Day 20	Day 30

<sup>1</sup> Carcass ID – Identification number marked inside carcass.  
<sup>2</sup> Turbine – Turbine number where carcass placed.  
<sup>3</sup> Placed By – Initials of the person who placed the carcass.  
<sup>4</sup> 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  
<sup>5</sup> Checked by – Record the initials of the person who checked on the carcass.

**Comments:** \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

More data on back? Yes No



# APPENDIX B

## Representative Carcass Photos



Photo 1. Big brown bat found at turbine A1 on 8/18/2015 with calipers for size comparison.



Photo 2. Eastern-red bat found at turbine D11 on 9/21/2015.



Photo 3. Silver-haired bat found at turbine C1 on 9/15/2015.



Photo 4. Unknown sparrow found at turbine C7 on 8/18/2015.