2017 Post-Construction Bat Mortality Monitoring Report Pioneer Trail Wind Farm

Ford and Iroquois Counties, Illinois

Project #193705529

Prepared for:
Pioneer Trail Wind Farm, LLC
c/o E.ON Climate and Renewables
353 N. Clark, 30th Floor
Chicago, IL 60654

Prepared by:
Stantec Consulting Services, Inc.
2300 Swan Lake Boulevard Suite 202
Independence, Iowa 50644

December 22, 2017

CERTIFICATION

Under penalty of law, I certify that, to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of this report, the information submitted is true, accurate and complete in all material respects.

Signature: _____

Name: BRADFORD H. KING

Title: VP, MIDWEST/NORTHEAST DEVELOPMENT

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 5
2.1.4 Carcass Searches 5
2.1.5 Species Identification 6
2.2 SEARCHER EFFICIENCY TRIALS 6
2.3 CARCASS REMOVAL TRIALS 7
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 (p) 8
2.4.3 Estimation of Carcass Removal (t) 8
2.4.4 Estimation of the Probability of Carcass Availability and Detection (π) 8
2.4.5 Area Adjustment (A) 9
2.4.6 Estimation of Facility-Related Mortality (m) 9

3.0 RESULTS 10
3.1 SUMMARY OF SEARCHES 10
3.1.1 Species Composition 10
3.1.2 Sex 11
3.1.3 Temporal Patterns 11
3.1.4 Spatial Patterns 12
3.2 SEARCHER EFFICIENCY TRIALS 13
3.3 CARCASS REMOVAL TRIALS 13
3.4 ADJUSTED MORTALITY ESTIMATES 14
3.5 INCIDENTAL FINDS 15

4.0 SUMMARY AND CONCLUSIONS 15
4.1 COMPARISON TO PREVIOUS STUDIES 15
4.1.1 Extended State ITA Monitoring Period 15
4.1.2 Federal ITP Monitoring Period 16
4.2 SUMMARY 17
4.3 CONCLUSIONS 18

5.0 LITERATURE CITED 18

LIST OF TABLES

Table 1. Summary of all bat carcasses found during the 2017 standardized post-construction searches (July 15 through October 15) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois. 11
Table 2. Sex of all bat carcasses found during the 2017 standardized post-construction searches (July 15 through October 15) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois. 11
Table 3. Searcher efficiency by search type for the 2017 post-construction searches ... 13
Table 4. Carcass removal by plot type during the 2017 post-construction searches (July 15 to October 15) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois. 13
Table 5. Bat mortality estimates for the 2017 standardized post-construction searches . 14
Table 6. Bat mortality estimates by year for the extended state ITA monitoring period (July 15 – August 14) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois (Stantec Consulting Services 2017). 16
Table 7. Bat mortality estimates by year for the federal ITP monitoring period (August 15 – October 15) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois (ARCADIS 2013, 2014, Stantec Consulting Services 2015, 2017). 16

LIST OF FIGURES

Figure 1. Turbine and Survey Locations 3
Figure 2. Bat carcasses found by week during the 2017 standardized post-construction searches (July 15 through October 15) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois. Turbines were curtailed at 3.5 m/s for weeks 1 through 5 and at 5.0 m/s for weeks 6 through 13. 12

LIST OF APPENDICES

APPENDIX A SAMPLE DATA SHEETS

APPENDIX B REPRESENTATIVE CARCASS PHOTOS

APPENDIX C RAW DATA

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, operations and maintenance building, access roads, collector line system, and substation for a total capacity of approximately 150 MWs (Figure 1). 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. The federal ITP for the Project sets a take limit of 129 Indiana bats and 86 northern long-eared bats over the course of the 43-year permit term, or an estimated 3 Indiana bats and 2 northern long-eared bats per year.

1.2 PURPOSE AND OBJECTIVES OF THE STUDY

The HCP for the Project outlines the following measures required as a condition of the federal ITP and state 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.

The HCP and federal ITP require PTWF to perform post-construction monitoring during the fall season curtailment window (August 15 through October 15) for the first two years of operation post-ITP issuance, and every five years thereafter. The state ITA also requires PTWF to perform mortality monitoring for the first two years following ITA issuance during the fall curtailment window, plus an extended period prior to the curtailment window beginning on July 15. Therefore, PTWF conducted post-construction monitoring from 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 and every 10 years thereafter, unless the results of spring monitoring indicate a need for spring monitoring to be conducted every 5 years as well, as set forth in the HCP.

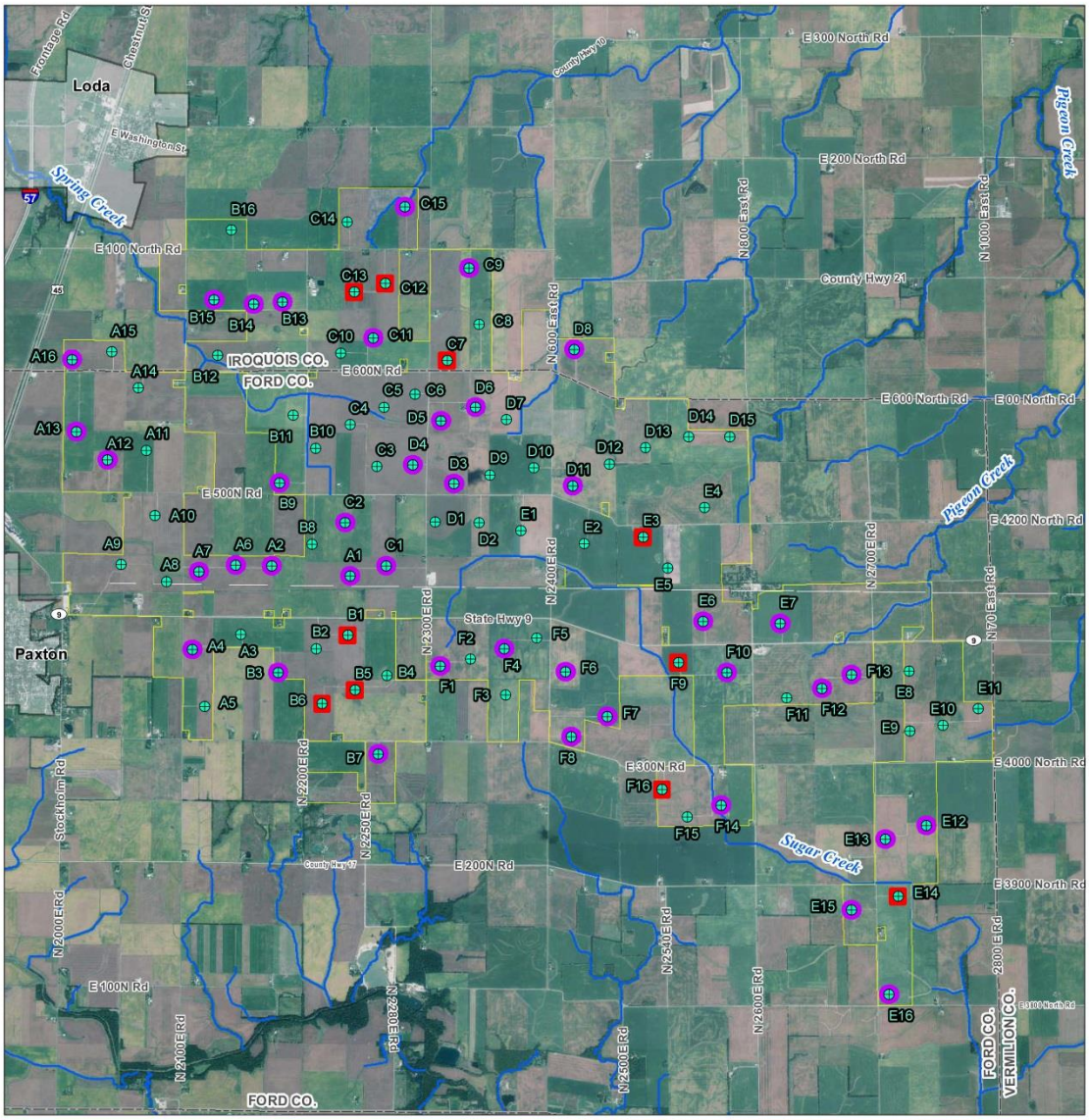
The HCP requires annual reporting to the USFWS of the results of the post-construction monitoring conducted at the Project. The state ITA requires that these results also be reported to the IDNR within 60 days of survey completion. This Post-Construction Bat Mortality Monitoring Report has been prepared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

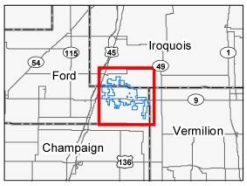
The primary objectives of the post-construction study were to:

1. Determine overall bat mortality rates from the Project;
2. Estimate Indiana and northern long-eared bat mortality at the species level to ensure compliance with the federal ITP and state ITA; and
3. Evaluate the circumstances under which fatalities occur.

The study included the following components:

1. Standardized carcass searches to systematically search plots at 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.





Legend

- Approximate Project Boundary
- As-Built Turbine Location
- Full Plot Survey Turbine
- Roads and Pads Search Turbine
- Perennial Stream

Notes
1. Coordinate System: NAD 1983 UTM Zone 16N
2. Data Sources Include: USGS, E. ON C&R, Stantec
3. Orthophotography: 2014 NAIP

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

Figure No.
1

Title
Turbines and Survey Locations

Client/Project
E. ON Climate & Renewables
Pioneer Trail Wind Farm

Project Location
Ford & Iroquois Co.
Illinois

193703901
Prepared by DJG on 2015-11-13
Technical Review by CP on 2015-11-13
Independent Review by MG on 2015-12-09

0 3,125 6,250 Feet
1:75,000 (at original document size of 8.5x11)

N

Stantec

Page 01 of 01

2.0 Methods

2.1 MORTALITY STUDY

Carcass searches were conducted during the following time periods:

1. Extended State ITA Monitoring Period – July 15 to August 14. This extended monitoring period was required by the IDNR as a condition of the state ITA. Turbine curtailment is not in effect during this period.

2. Federal ITP Monitoring Period – August 15 to October 15. This was identified in the Project's HCP as the period of risk for Indiana and northern long-eared bats, and is the monitoring period required by the federal ITP. It represents the period of turbine curtailment under both the federal ITP and the state ITA.

This year (2017) was the third year of Project operation under the federal ITP, but because the state ITA was not issued until late in 2015, it was the second full year that the Project operated at a cut-in speed of 5.0 m/s during the federal ITP monitoring period. In previous fall seasons prior to ITA issuance, PTWF continued to operate the Project with a cut-in speed of 6.9 m/s during the federal ITP monitoring period to avoid take of both the Indiana and northern long-eared bat that would not have been authorized under Illinois law.

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 meets the study objective 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% (n=40) of the 50 surveyed turbines, only the turbine pads and roads out to 328 feet (ft.; 100 meters[m]) from the turbine were searched. This method targets the areas with 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% (n=10) of the 50 surveyed turbines, 262-ft. x 262-ft. (80-m x 80-m) plots were cleared and searched using a full-coverage transect approach. Each 80-m x 80-m plot was centered on a turbine location, and vegetation was periodically mowed and cleared as needed to improve searcher efficiency.

Previous studies have indicated that the majority of bat carcasses typically fall within 100 ft. (30 m) of the turbine or within 50% of the maximum height of the turbine (Kerns and Kerlinger 2004, Arnett et al. 2005, Arnett et al. 2008, 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 ft. [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 road and pad search turbines. This mixed sampling approach is consistent with other post-construction monitoring studies being conducted and will enable comparison of study results.

2.1.3 Search Schedule

The search interval for all turbines was once weekly during the respective monitoring periods. An individual turbine was searched on the same day each week when conditions allowed. Within a day, the turbine search schedule and order were randomized, so that each turbine's search plot was sampled at differing periods during the day. A weekly search interval for mortality 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 biologists, operating under applicable state and federal permits and experienced and/or trained in post-construction monitoring search methods, including proper handling and reporting of carcasses. The biologist was familiar with and able to accurately identify the bat species likely to be found in the project area, and photos of any unknown bat discovered were sent to an expert for positive identification, and the carcasses were retained on-site. 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 biologist walked at a rate of approximately 2 miles per hour (45 to 60 m per minute) while searching 10 ft. (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); and
- Any notes on presumed cause of death.

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 the IDNR Permit Number NH17.5951, and listed species (Indiana bat and northern long-eared bats) under IDNR Permit Type S, Permit Number 15-052 (up to 3 of each listed species). Raw data for all bat carcasses found are included in Appendix C.

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. Bird carcasses were not collected, but left in place after data collection. 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 of the carcass. For bat carcasses, forearm length was recorded to facilitate 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 biologist. One searcher efficiency trial was conducted during the monitoring period, as only one biologist and one season are included in this monitoring study. The biologist did not know when during the monitoring period the trial was 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 prior to the carcass searches for that day. The number of trial carcasses found by the biologist 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 bat 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 biologist monitored the trial carcasses over a period of up to 35 days. During the carcass removal trial, carcasses were checked every day for the first week, and then on days 8, 14, 21, 28 and 35, 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.
- Fur spot – no carcass, but fur spot remaining.
- Missing – no carcass or fur remaining.

A sample data form is included in Appendix A. Any carcasses remaining at the end of the 35-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 methods 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_j 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

mortality rate. Mean number of observed casualties was calculated separately for each search type (roads and pads, full plots) and for both the federal ITP monitoring period and the extended state ITA monitoring period.

2.4.2 Estimation of Searcher Efficiency (p)

Searcher efficiency (p) represents the average probability that a carcass was detected by the biologist. The searcher efficiency 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), but was assumed to remain the same between the federal ITP monitoring period and the extended state ITA monitoring period.

2.4.3 Estimation of Carcass Removal (t)

Mean carcass removal times 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 trial 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_c is the number of carcasses remaining at day 35. 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 35 days were collected, yielding censored observations at 35 days. Carcass removal times were calculated separately for each search type (i.e., roads and pads, full plots) but was assumed to remain the same between the federal ITP monitoring period and the extended state ITA monitoring period.

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:

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

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 the area adjustment (A), which adjusts for areas 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 adjustment for the proportion of carcasses which likely fell outside of the search area 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, π_{RP} is the probability of carcass availability and detection on roads and pads, π_{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 were searched at 80% of the study turbines and full plot searches were 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-ft. x 262-ft. (80-m x 80-m) square plots. This number was calculated separately for the federal ITP monitoring period and the extended state ITA monitoring period due to the differences in cut-in speeds between the two periods, which may influence the distribution of carcasses around the turbine.

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 casualties/turbine/monitoring period (m) was calculated by dividing the mean observed number of bat casualties/turbine/monitoring period (c) by π, an estimate of the probability a carcass was not removed by scavengers and was detected by the biologist, and then multiplying by A, the adjustment for the area within which bats may have fallen but which was not searched.

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

Where A is the area adjustment, C is the number of carcasses found per turbine, and π is the probability of carcass detection and availability (weighted average of π_{RP} and π_{FP} based on 80% of searches being roads and pads and 20% of searches being full plots). This number was calculated separately for the federal ITP monitoring period and the extended state ITA monitoring period.

3.0 Results

3.1 SUMMARY OF SEARCHES

A total of 638 carcass searches were conducted over 13 weeks in the fall. The average time between searches was 7.0 days. A total of 70 individual bat carcasses were found during standardized carcass searches, 20 during the extended state ITA monitoring period (July 15 – August 14) and 50 during the federal ITP monitoring period (August 15 – October 15). Eight additional bat carcasses were found incidentally, either outside of the search plot areas or on a non-scheduled search day during carcass removal checks. In total, 78 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 70 bat carcasses found during standardized searches, 35 were eastern red bats (*Lasiurus borealis*; 50.0%), 23 were silver-haired bats (*Lasionycteris noctivagans*; 32.9%), 8 were hoary bats (*Lasiurus cinereus*; 11.4%), 3 were big brown bats (*Eptesicus fuscus*; 4.3%) and 1 was a Seminole Bat[1] (*Lasiurus seminolus*; 1.4%). No bat species listed as threatened or endangered under the ESA, or by the State of Illinois were found during the searches.

Eastern red bats, big brown bats, and hoary bats were found during both the extended state ITA monitoring period (July 15 – August 14) as well as during the federal ITP monitoring period (August 15 – October 15). Silver-haired bats and the one Seminole bat was found only during the federal ITP monitoring period (August 15 – October 15).

[1] The project area is outside the known range of the Seminole bat, but the species identification was confirmed by a permitted bat biologist.

Table 1. Summary of all bat carcasses found during the 2017 standardized post-construction searches (July 15 through October 15) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois.

Species	Extended State ITA Monitoring Period (July 15 – August 14)	Federal ITP Monitoring Period (August 15 – October 15)	Total	Percent of All Bats Found
Eastern Red Bat	14	21	35	50.0%
Silver-Haired Bat	0	23	23	32.9%
Hoary Bat	5	3	8	11.4%
Big Brown Bat	1	2	3	4.3%
Seminole Bat	0	1	1	1.4%
Total	**20**	**50**	**70**	100%

3.1.2 Sex

A summary of the sex of all bat carcasses found during the standardized post-construction monitoring is shown in Table 2. Of the 70 bat carcasses found, there were 15 females (5 found prior to August 15), 21 males (4 found prior to August 15), and 34 bats of unknown sex (11 found prior to August 15; Table 2).

Table 2. Sex of all bat carcasses found during the 2017 standardized post-construction searches (July 15 through October 15) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois.

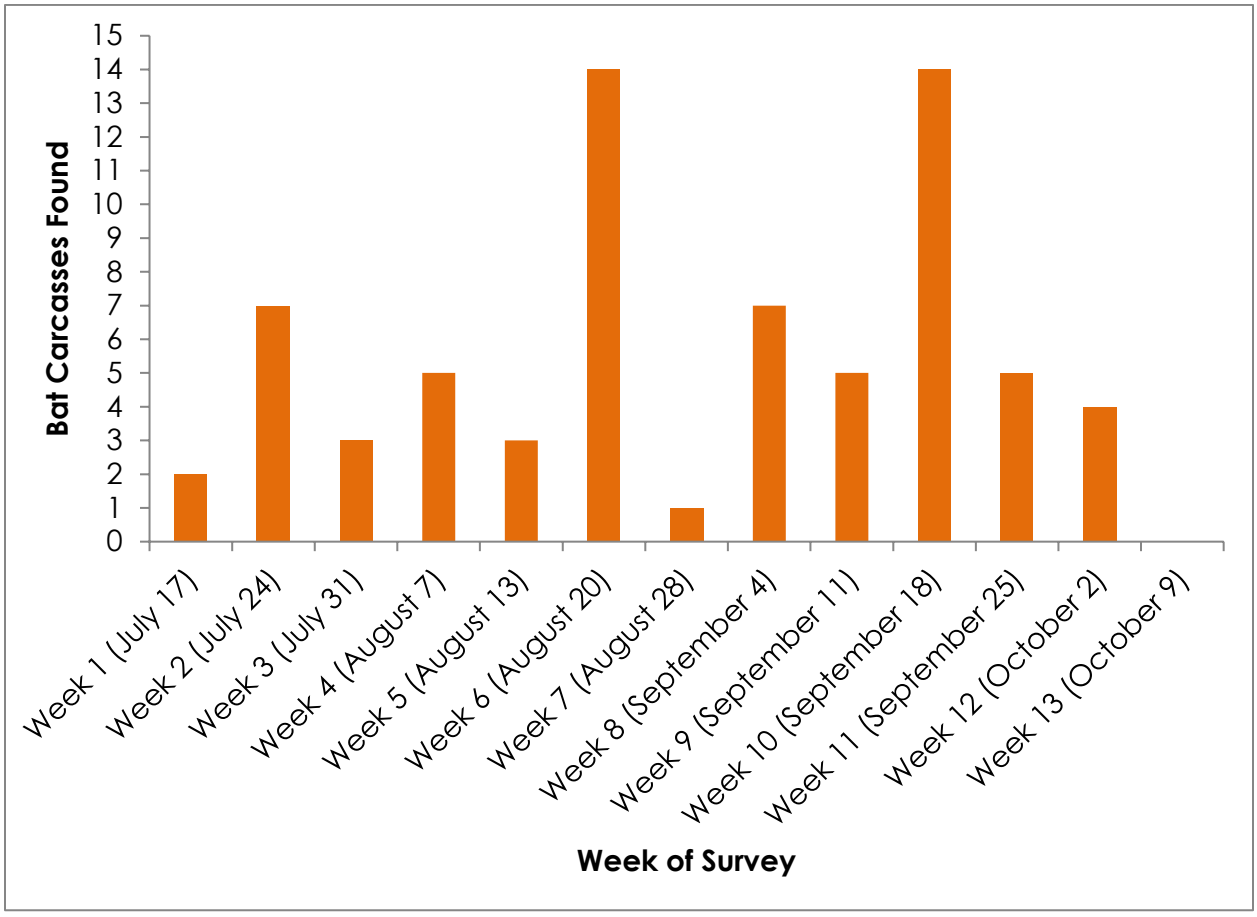
	Species	Female	Male	Unknown
Extended State ITA Monitoring Period (July 15 – August 14)	Eastern Red Bat	4	2	8
	Silver-Haired Bat	0	0	0
	Hoary Bat	1	1	3
	Big Brown Bat	0	1	0
	Seminole Bat	0	0	0
Federal ITP Monitoring Period (August 15 – October 15)	Eastern Red Bat	2	8	11
	Silver-Haired Bat	5	7	11
	Hoary Bat	3	0	0
	Big Brown Bat	0	1	1
	Seminole Bat	0	1	0
	Total	**15**	**21**	**34**

3.1.3 Temporal Patterns

Bat carcasses were found in 12 of the 13 survey weeks in 2017 (Figure 2). Week 6 and week 10 (weeks of August 20 and September 18) had the greatest number of bat carcasses (14) found in a single week, both of which occurred after curtailment going into effect on the night of August

15. On August 22, all turbines were turned off for maintenance and were turned back on between August 29 and September 1. This time period covered the time prior to and during the week 7 searches, and resulted in only one bat being found. During the last week of the monitoring period no carcasses were found. All other weeks had between two and seven bat carcasses found.

Figure 2. Bat carcasses found by week during the 2017 standardized post-construction searches (July 15 through October 15) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois. Turbines were curtailed at 3.5 m/s for weeks 1 through 5 and at 5.0 m/s for weeks 6 through 13.



3.1.4 Spatial Patterns

Bat carcasses were found at a total of 29 of 50 (58%) of the monitored turbines during the 2017 survey period. The greatest number of carcasses found at a single turbine (8) was at turbine F16 (full plot, Figure 1).

Over the entire monitoring period (July 15 – October 15), 32 bats were found at the road and pad turbines, and 38 bats were found at the full plot turbines. During the federal ITP monitoring period, when turbines were curtailed at 5.0 m/s, 23 bats were found at the road and pad turbines, and 27

bats were found at the full plot turbines, whereas for the extended state ITA monitoring period (July 15 – August 14), 9 bats were found at the road and pad turbines, and 11 bats were 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. Overall, the searcher efficiency ranged from 90% at full plots to 100% on roads and pads (Table 3). It was assumed that searcher efficiency did not differ between the federal ITP monitoring period and the extended state ITA monitoring period, as the same searcher and plots were used.

Table 3. Searcher efficiency by search type for the 2017 post-construction searches (July 15 to October 15) at the Pioneer Trail Wind Farm Ford and Iroquois counties, Illinois.

	Full Plots	Roads and Pads
# Carcasses Placed	10	20
# Carcasses Found	9	20
Mean Searcher Efficiency (90% CI)	**0.9** (0.7, 1.0)	**1.0** (1.0, 1.0)

3.3 CARCASS REMOVAL TRIALS

Mouse carcasses used in the searcher efficiency trials were left in place for up to 35 days, and checked on days 1-5, 8, 14, 21, 28 and 35 of the trial. Thirty (30) mouse carcasses were used during the monitoring period, 10 at full plot turbines, and 20 at roads and pads turbines. Carcasses persisted for an average of 6.4 days at roads and pads turbines and an average of 6.9 days at full plot turbines (Table 4). It was assumed that carcass persistence did not differ between the federal ITP monitoring period and the extended state ITA monitoring period.

Table 4. Carcass removal by plot type during the 2017 post-construction searches (July 15 to October 15) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois.

	Full Plots	Roads and Pads
# Carcasses Placed	10	20
# Carcasses Scavenged within 28 days	9	18
Mean Carcass Persistence time in days (90% CI)	**6.9** (2.5, 17.9)	**6.8** (2.5, 11.9)

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[2]. Results are summarized in Table 5.

Table 5. Bat mortality estimates for the 2017 standardized post-construction searches at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois.

	Extended State ITA Monitoring July 15 – August 14 (3.5 m/s cut-in)		**Federal ITP Monitoring August 15 – October 15 (5.0 m/s cut-in)**	
	Full Plots	**Roads and Pads**	**Full Plots**	**Roads and Pads**
(c) Observed bats/turbine/season	1.1	0.225	2.7	0.575
(π) Probability of Carcass Availability and Detection (90% CI)	0.6 (0.3, 0.8)	0.6 (0.3, 0.8)	0.6 (0.3, 0.8)	0.6 (0.3, 0.8)
(A) Area Adjustment	4.3		4.3	
(m) Estimated bats/turbine/monitoring period	3.1 (2.0, 5.3)		7.9 (5.2, 13.1)	
Estimated bats/MW/monitoring period	1.9 (1.3, 3.3)		4.9 (3.3, 8.2)	
Estimated bats/facility/monitoring period	291.4 (188.0, 498.2)		742.6 (488.8, 1,231.4)	
Estimated Indiana bats/facility/monitoring period[1]	NA		1.2 (0.8, 2.0)	
Estimated northern long-eared bats/facility/monitoring period[1]	NA		0.6 (0.4, 1.0)	

[1]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). Assumed to not be applicable (NA) for the extended state ITA monitoring period since that is prior to the established period of risk in the HCP for both species.

2

$A = \frac{\frac{C_{RP}}{\pi_{RP}*S_{RP}}+\frac{C_{FP}}{\pi_{FP}*S_{FP}}}{\frac{C_{RP}}{\pi_{RP}}+\frac{C_{FP}}{\pi_{FP}}} * A_{FP}; A = \frac{\frac{23}{0.6*0.8}+\frac{27}{0.6*0.2}}{\frac{23}{0.6}+\frac{27}{0.6}} * 1.305 = 4.3$ for the federal ITP monitoring period

$A = \frac{\frac{9}{0.6*0.8}+\frac{11}{0.6*0.2}}{\frac{9}{0.6}+\frac{11}{0.6}} * 1.305 = 4.3$ for the extended state ITA monitoring period

3.5 INCIDENTAL FINDS

A total of eight incidental bat carcasses were found during the 2017 standardized post-construction searches. Incidental bat finds included three hoary bats, three eastern red bats, and two silver-haired bats. Six of these bats were found in close proximity to the roads and pads. One bat was found on the road outside of the full plot. One bat was found on the road during the searcher efficiency trial.

Six bird carcasses were found during the 2017 post-construction searches. Species and locations are as follows:

- September 4, Ruby-throated Hummingbird (*Archilochus colubris*) on road and pad at B7
- September 19, Red-eyed Vireo (*Vireo olivaceus*) on road and pad at C9
- September 19, Bay-breasted Warbler (*Setophaga castanea*) just off of full plot at E14
- October 2, Red-tailed Hawk (*Buteo jamaicensis*) in bean field off of road and pad at B7
- October 3, Magnolia Warbler (*Setophaga magnolia*) on full plot at E3
- October 10, House Finch (*Haemorhous mexicanus*) on road and pad at A2

4.0 Summary and Conclusions

4.1 COMPARISON TO PREVIOUS STUDIES

Post-construction monitoring has been conducted in previous years at the Project. While the surveys differed in level of effort (search interval, search area) and bias correction factors (searcher efficiency, carcass persistence, area adjustments), all surveys had overall mortality estimates corrected for these differences, allowing for comparison of results. In addition, the Project operated under different cut-in speed adjustments between years based on the previous Technical Assistance Letters (TALs), federal ITP or state ITA requirements.

4.1.1 Extended State ITA Monitoring Period

Monitoring during the extended state ITA monitoring period (July 15 – August 14) has only been conducted in 2016 and 2017. Table 6 shows the comparison between these two years during that time period.

Table 6. Bat mortality estimates by year for the extended state ITA monitoring period (July 15 – August 14) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois (Stantec Consulting Services 2017).

	Year and Cut-in Speed	
	2016 (3.5 m/s)	**2017** (3.5 m/s)
(m) Estimated bats/turbine	4.6	3.1
Estimated bats/MW	2.9	1.9
Estimated bats/facility	432.4	291.4

4.1.2 Federal ITP Monitoring Period

The comparisons shown in Table 7 are only for the time period from August 15 to October 15 (the federal ITP monitoring period). For the first three years of Project operations the turbines operated under the terms of a TAL, with a cut-in speed of 6.9 m/s. In 2015, the Project operated under the terms of the TAL for the majority of the season, until October 9, when the state ITA was issued and the Project began operations under the federal ITP at 5.0 m/s. The Project operated at 5.0 m/s for the entire 2016 and 2017 federal ITP monitoring periods. The mean bat mortality estimate ranged from 71.4 to 256.6 bats during the fall period when operating at 6.9 m/s, compared to 244.4 to 742.6 bats when the project was operating at a cut-in speed of 5.0 m/s (Table 7).

Table 7. Bat mortality estimates by year for the federal ITP monitoring period (August 15 – October 15) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois (ARCADIS 2013, 2014, Stantec Consulting Services 2015, 2017).

	Year[1] and Cut-in Speed				
	2012[2] (6.9 m/s)	**2013[2]** (6.9 m/s)	**2015** (6.9 m/s until October 9, then 5.0 m/s)	**2016** (5.0 m/s)	**2017** (5.0 m/s)
(m) Estimated bats/turbine	0.76	2.73	1.1	2.6	7.9
Estimated bats/MW	0.48	1.71	0.7	1.6	4.9

	Year[1] and Cut-in Speed				
	2012[2] (6.9 m/s)	**2013[2]** (6.9 m/s)	**2015** (6.9 m/s until October 9, then 5.0 m/s)	**2016** (5.0 m/s)	**2017** (5.0 m/s)
Estimated bats/facility	71.4	256.6	103.4	244.4	742.6

[1]Post-construction monitoring was not required or conducted in 2014.

[2]The estimated bats/facility was adjusted for these years, as the published reports had only multiplied the bats/turbine rate by the number of turbines sampled (50) rather than the facility size of 94 turbines

4.2 SUMMARY

- A total of 638 carcass searches were conducted over 13 weeks from July 15 to October 15.
- A total of 70 bat carcasses were found during standardized searches, with an additional 8 incidental carcasses found. Of these 70 carcasses, 20 were found during the extended ITA monitoring period (July 15 – August 14) and 50 were found during the federal ITP monitoring period (August 15 – October 15).
- 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 during standardized searches included eastern red bats (35), hoary bats (8), silver-haired bats (23), big brown bats (3), and a Seminole bat (1). In addition, three hoary bats, three eastern red bats, and two silver-haired bats were found incidentally.
- Six bird carcasses were found during the searches, including a red-tailed hawk, ruby-throated hummingbird, red-eyed vireo, bay-breasted warbler, magnolia warbler, and a house finch.
- Estimated bat mortality between July 15 and August 14 was 291.4 bats (90% CI: 188.0 to 498.2), compared to an estimated bat mortality between August 15 and October 15 of 742.6 bats (90% CI: 488.8 to 1,231.4). Turbines operated at a cut-in speed of 3.5 m/s for the period from July 15 to August 14, and at a cut-in speed of 5.0 m/s starting on August 15.
- No Indiana bat carcasses were found during the 2017 study. Estimated mortality of the federally and state endangered Indiana bat was 1.2 Indiana bats during the federal ITP monitoring period.

- No northern long-eared bat carcasses were found during the 2017 study. Estimated mortality of the federally and state threatened northern long-eared bat was 0.4 northern long-eared bat during the federal ITP monitoring period.

4.3 CONCLUSIONS

Estimated Indiana bat and northern long-eared bat fatalities were below the annual take limits set forth in both the federal ITP and state ITA. Because estimated Indiana bat mortality was less than 2 and estimated northern long-eared bat mortality was less than 1 in each of the two years of baseline monitoring, the federal ITP and state ITA provide PTWF the option to lower cut-in speeds by 1.1 mph (0.5 m/s) in future years. A reduction in cut-in speeds would be accompanied by two additional years of baseline monitoring. PTWF will provide written notice to the USFWS and IDNR if it elects to implement this adaptive management change.

5.0 Literature Cited

ARCADIS. 2013. Fall 2012 and spring 2013 avian and bat post-construction mortality monitoring report, Pioneer Trail Wind Farm. Prepared for E.ON Climate & Renewables, North America. ARCADIS U.S., Inc. Milwaukee, Wisconsin. 14 August.

ARCADIS. 2014. Fall 2013 and spring 2014 avian and bat post-construction mortality monitoring report, Pioneer Trail Wind Farm. Prepared for E.ON Climate & Renewables, North America. ARCADIS U.S., Inc. Milwaukee, Wisconsin. July.

Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships Between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines. Final Report prepared for the Bats and Wind Energy Cooperative. Bat Conservation International, Austin, Texas. June 2005.

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, and R.D. Tankersley. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72: 61-78.

Erickson, W.P., Gritski, B., and K. Kronner. 2003. Nine Canyon Wind Power Project Avian and Bat Monitoring Report, August 2003. Technical report submitted to energy Northwest and the Nine Canyon Technical Advisory Committee.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual Report for the Maple Ridge Wind Power Project: Post-Construction Bird and Bat Fatality Study – 2006. Final report. Prepared for PPM Energy and Horizon Energy and Technical Advisory Committee (TAC) for the Maple Ridge Project Study.

Good, R. E., Erickson, W., Merrill, A., Simon, S., Murray, K., Bay, K., & Fritchman, C. 2011. Bat monitoring studies at the Fowler Ridge Wind Energy Facility, Benton County, Indiana, April 13–October 15, 2010. Prepared for Fowler Ridge Wind Farm, by Western EcoSystems Technology, Inc. Cheyenne, WY, USA.

Gruver, J., K. Bay, and W. Erickson. 2009. Post-construction bat and bird fatality study, Blue Sky Green Field Wind Resource Area, Fond du Lac County, Wisconsin. Interim Report prepared for We Energies, Milwaukee, Wisconsin.

Kerns, J., and P. Kerlinger. 2004. A Study of Bird and Bat Collisions at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003. Prepared for FPL Energy and the Mountaineer Wind Energy Center Technical Review Committee. Technical report prepared by Curry and Kerlinger, LLC. February 14, 2004. 39 pp. http://www.wvhighlands.org/Birds/MountaineerFinalAvianRpt-%203-15-04PKJK.pdf

Kunz, T.H., E.B. Arnett, B.M. Cooper, W.P. Erickson, R.P. Larkin, T. Mabee, M.L. Morrison, M.D. Strickland, and J.M. Szewczak. 2007. Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document. Journal of Wildlife Management 71:2449-2486.

Manly, B.F.J. 1997. Randomization, Bootstrap, and Monte Carlo Methods in Biology. Second edition. Chapman and Hall, New York. 399 pp.

Piorkowski, M.D., and T. J. O'Connell. 2010. Spatial Pattern of Summer Bat Mortality from Collisions with Wind Turbines in Mixed-grass Prairie. Am. Midl. Nat. 164:260-269.

Stantec Consulting Services Inc. 2015. 2015 Post-construction Bat Mortality Monitoring Report Pioneer Trail Wind Farm, Ford and Iroquois Counties, Illinois. Prepared for Pioneer Trail Wind Farm, LLC. December 9, 2015.

Stantec Consulting Services Inc. 2017. 2016 Post-construction Bat Mortality Monitoring Report Pioneer Trail Wind Farm, Ford and Iroquois Counties, Illinois. Prepared for Pioneer Trail Wind Farm, LLC. January 6, 2017.

US Fish and Wildlife Service (USFWS). 2012. Land-based Wind Energy Guidelines. March 2012. 71 pp.

Western Ecosystems Technology, Inc. 2013. Fowler Ridge Wind Farm, Benton County, Indiana: Indiana Bat Habitat Conservation Plan. Prepared for Fowler Ridge Wind Farm LLC, Fowler Ridge II Wind Farm LLC, Fowler Ridge III Wind Farm LLC, Fowler Ridge IV Wind Farm LLC. November 2013.

Young, D. P., Erickson, W.P., Bay, K., Nomani, S., and W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase I Post-Construction Avian and Bat Monitoring, July-October 2008. Prepared for NedPower Mount Storm, LLC, by Western EcoSystems Technology, Inc. 40pp.

APPENDIX A

Sample Data Sheets

CARCASS SEARCH SUMMARY SHEET

PIONEER TRAIL WIND FARM (193705529)

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	

Page____of_____

SCAVENGER REMOVAL TRIAL
LOG Pioneer Trail Wind Farm (193705529)

Trial (spring, fall)_____ **Start Date_____**

Carcasses are labeled with date-turbine- carcass number as they were originally found (e.g., 2009Apr01-T04-C07, to describe carcass #7 found at turbine 4 on April 1, 2009).

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

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

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

Comments:_____
_____
_____
_____
_____
_____

More data on back? Yes No

SEARCHER EFFICIENCY TRIAL
LOG Pioneer Trail Wind
Farm (193705529)

Trial (spring, fall)_____ **Trial Date_____**

Carcasses are labeled with date-turbine- carcass number as they were originally found (e.g., 2009Apr01-T04-C07, to describe carcass #7 found at turbine 4 on April 1, 2009).

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

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

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

_____
_____
_____
_____
_____
_____

[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] Placed By – Initials of the person who placed the carcass.
[4] Found By – Record the initials of the person who found the carcass.

More data on back? Yes No

CARCASS SEARCH DATA SHEET

PIONEER TRAIL WIND FARM (193705529)

DATE: _____ BIOLOGIST: _____

LABEL CARCASSES AND PHOTO WITH DATE-TURBINE -CARCASS NUMBER (e.g., 2009Apr01-T04-C07, to describe carcass #7 found at turbine 4 on April 1, 2009).

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

Turbine No.[1]	Plot Type [2]	Carcass No. [3]	From Turbine		On Road/Pad?	GPS Coordinates	Species (scientific name, spell out)[4]	Forearm length of bat (mm)	Age[5]	Sex[6]	Cause of Death [7]	Condition[8]	Check if Comments (write on back)[9]
			Distance (m)	Azimuth (degrees)									
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	

[1] Turbine – Enter Number of Turbine. Also search the turbine pad and access road in addition to the Study Plot.

[2] Plot Type – R=Roads and Pads, F=Full Plot

[3] Carcass No. – Number carcasses in the order they are found.

[4] Species – If Unknown, specify unknown bat or unknown bird.

[5] Age – If identifiable: Adult = A; Juvenile = J; Unknown = U

[6] Sex – If identifiable: Female = F; male = M, Unknown = U

[7] Cause of Death – Collision with turbine = T; Predation = P; Unknown = U (add explanation in comments if necessary).

[8] Condition – enter F=Fresh or D=decomposed <u>AND</u> Whole =W; Most of body with some missing = M; Pieces = P (e.g., wing only); Feather spot = F (example: F/W)

[9] 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.**

<u>PHOTOS:</u> 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 winds (for raptors).

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

_____

_____

_____

APPENDIX B

Representative Carcass Photos

Photo 1. Representative example of a red bat (*Lasiurus borealis*) found during road and pad surveys at turbine F14 at the Pioneer Trail Wind Farm. (September 19, 2017)

Photo 2. Representative hoary bat (*Lasiurus cinerus*) found at turbine D4 during road and pad surveys at the Pioneer Trail Wind Farm. (September 19, 2017)

Photo 3. Representative big brown bat (Eptesicus fuscus) and calipers found during roads and pads surveys at turbine F7 at the Pioneer Trail Wind Farm. (September 4, 2017)

Photo 4. Representative example of a Seminole Bat (*Lasiurus seminolus*) found during roads and pads surveys at turbine A7 at the Pioneer Trail Wind Farm. (August 21, 2017)

Photo 5. Representative example of a silver-haired bat (*Lasionycteris noctivagans*) found during roads and pads surveys at turbine A7 at the Pioneer Trail Wind Farm. (September 4, 2017)

Photo 6. Photo of a Magnolia warbler (*Setophaga magnolia*) found at turbine E3 at the Pioneer Trail Wind Farm. (October 3, 2017)

Photo 7. Photo of a Red-tailed hawk (*Buteo jamaicensis*) found at turbine B7 at the Pioneer Trail Wind Farm. (October 2, 2017)

APPENDIX C

Raw Data

Date	Turbine	Search Type (Full, R/P, Incidental)	On Road/Pad? (Y or N)	Carcass Type	Latitude	Longitude	Distance	Azimuth	Common Name	Species	Forearm Length	Age	Sex	Cause of Death	Condition	Incidental	Comments
7/18/2017	F10	Incidental	N	Bat	40.453048	-87.974872	12	220	Hoary Bat	*Lasiurus cinerus*	56.5	A	M	T	F/W	Yes	fresh dead, probably night before
7/18/2017	F6	R/P	Y	Bat	40.45307	-88.00007	18	265	Eastern Red Bat	*Lasiurus borealis*	40.5	A	M	T	F/W	No	fresh dead, probably night before
7/18/2017	F9	Full	N	Bat	40.454186	-87.982647	26	260	Hoary Bat	*Lasiurus cinerus*	57.6	A	F	T	F/W	No	fresh dead, probably night before
7/24/2017	A13	R/P	Y	Bat	40.481019	-88.07666	18	0	Hoary Bat	*Lasiurus cinerus*	NA	U	U	T	D/P	No	Just wings. Scavenged by predator
7/24/2017	C13	Full	Y	Bat	40.498116	-88.033796	41	340	Eastern Red Bat	*Lasiurus borealis*	39.2	U	U	T	D/W	No	
7/25/2017	B1	Full	N	Bat	40.457287	-88.034179	36	320	Eastern Red Bat	*Lasiurus borealis*	38.1	U	M	T	D/W	No	
7/25/2017	B1	Full	Y	Bat	40.457254	-88.033956	24	350	Eastern Red Bat	*Lasiurus borealis*	40.5	U	U	T	D/W	No	
7/25/2017	D3	R/P	N	Bat	40.474864	-88.017721	35	185	Eastern Red Bat	*Lasiurus borealis*	39.2	U	U	T	D/W	No	only slightly decomposed
7/25/2017	E12	R/P	Y	Bat	40.435414	-87.943724	27	315	Eastern Red Bat	*Lasiurus borealis*	40.8	U	U	T	D/W	No	
7/25/2017	E16	Incidental	N	Bat	40.41511	-87.94921	14	275	Hoary Bat	*Lasiurus cinerus*	54.3	U	U	T	D/W	Yes	very decomposed
7/26/2017	B6	Full	N	Bat	40.4491	-88.038245	41	315	Hoary Bat	*Lasiurus cinerus*	52.5	U	M	T	F/W	No	fresh dead, probably night before
7/26/2017	F7	Incidental	N	Bat	40.447743	-87.993576	14	270	Eastern Red Bat	*Lasiurus borealis*	39.8	U	F	T	F/W	Yes	fresh dead, probably night before
7/31/2017	A16	R/P	Y	Bat	40.489488	-88.077543	6	280	Eastern Red Bat	*Lasiurus borealis*	39.1	U	U	T	D/W	No	
7/31/2017	B15	R/P	Y	Bat	40.496511	-88.055475	26	180	Eastern Red Bat	*Lasiurus borealis*	NA	U	U	T	D/P	No	Just a chunk of skin and hair
8/1/2017	F16	Full	Y	Bat	40.439116	-87.984634	2	105	Big Brown Bat	*Eptesicus fuscus*	47.5	U	F	T	F/W	No	fresh dead, probably night before
8/7/2017	D11	R/P	Y	Bat	40.475173	-87.999153	8	0	Eastern Red Bat	*Lasiurus borealis*	37.6	U	F	T	D/W	No	slightly decomposed with bugs on it
8/7/2017	F9	Full	N	Bat	40.45444	-87.982593	32	320	Hoary Bat	*Lasiurus cinerus*	53.1	U	U	T	D/W	No	likely for previous week when plot was skipped

Date	Turbine	Search Type (Full, R/P, Incidental)	On Road/Pad? (Y or N)	Carcass Type	Latitude	Longitude	Distance	Azimuth	Common Name	Species	Forearm Length	Age	Sex	Cause of Death	Condition	Incidental	Comments
8/7/2017	F9	Full	N	Bat	40.454468	-87.982555	32	330	Eastern Red Bat	*Lasiurus borealis*	42.4	U	U	T	D/W	No	likely for previous week when plot was skipped
8/8/2017	A6	R/P	Y	Bat	40.464894	-88.051305	59	125	Eastern Red Bat	*Lasiurus borealis*	40.2	U	F	T	F/W	No	
8/8/2017	E15	R/P	Y	Bat	40.425073	-87.954023	85	90	Hoary Bat	*Lasiurus cinerus*	52	U	U	T	D/W	No	
8/13/2017	E14	Full	N	Bat	40.426557	-87.947686	17	175	Eastern Red Bat	*Lasiurus borealis*	43.2	U	F	T	F/W	No	
8/13/2017	E3	Full	N	Bat	40.469296	-87.987935	19	40	Eastern Red Bat	*Lasiurus borealis*	38	U	U	T	D/W	No	
8/14/2017	C12	Full	N	Bat	40.498632	-88.28622	37	165	Eastern Red Bat	*Lasiurus borealis*	40	U	F	T	D/W	No	somewhat fresh but dried out
8/20/2017	A16	R/P	Y	Bat	40.489392	-88.07756	9	220	Eastern Red Bat	*Lasiurus borealis*	40.8	U	U	T	D/W	No	
8/20/2017	B6	Full	N	Bat	40.449077	-88.037532	34	45	Big Brown Bat	*Eptesicus fuscus*	46	U	U	T	D/W	No	
8/20/2017	C1	R/P	Y	Bat	40.465353	-88.028091	5	120	Eastern Red Bat	*Lasiurus borealis*	NA	U	U	T	D/P	No	likely red bat based on small amount of fur
8/20/2017	C12	Full	N	Bat	40.499169	-88.028779	17	5	Eastern Red Bat	*Lasiurus borealis*	NA	U	U	T	D/P	No	
8/20/2017	C13	Full	N	Bat	40.498167	-88.033173	49	50	Eastern Red Bat	*Lasiurus borealis*	42.6	U	U	T	D/W	No	
8/20/2017	C13	Full	N	Bat	40.498104	-88.033257	40	50	Eastern Red Bat	*Lasiurus borealis*	NA	U	U	T	D/P	No	
8/21/2017	A7	R/P	Y	Bat	40.464894	-88.057002	56	25	Seminole Bat	*Lasiurus seminolus*	39.3	U	M	T	F/W	No	maybe 2 days old
8/21/2017	B1	Full	N	Bat	40.457169	-88.033873	11	15	Eastern Red Bat	*Lasiurus borealis*	40.4	U	U	T	D/W	No	
8/21/2017	B9	R/P	Y	Bat	40.47507	-88.044844	6	100	Eastern Red Bat	*Lasiurus borealis*	39.2	U	U	T	D/P	No	
8/21/2017	E13	R/P	Y	Bat	40.433774	-87.94985	23	0	Eastern Red Bat	*Lasiurus borealis*	41.3	U	F	T	F/W	No	probably last night
8/21/2017	E14	Full	N	Bat	40.426734	-87.94725	40	90	Hoary Bat	*Lasiurus cinerus*	55.3	U	F	T	F/W	No	on the very edge of plot
8/21/2017	F16	Full	N	Bat	40.439269	-87.9849	23	315	Eastern Red Bat	*Lasiurus borealis*	39	U	M	T	F/W	No	slightly decayed
8/21/2017	F16	Full	Y	Bat	40.43914	-87.984763	5	300	Eastern Red Bat	*Lasiurus borealis*	38.9	U	M	T	D/W	No	
8/21/2017	F6	R/P	Y	Bat	40.453046	-87.999992	6	280	Eastern Red Bat	*Lasiurus borealis*	40.5	U	M	T	F/W	No	

Date	Turbine	Search Type (Full, R/P, Incidental)	On Road/Pad? (Y or N)	Carcass Type	Latitude	Longitude	Distance	Azimuth	Common Name	Species	Forearm Length	Age	Sex	Cause of Death	Condition	Incidental	Comments
8/28/2017	F16	Full	N	Bat	40.439489	-87.98517	47	315	Eastern Red Bat	*Lasiurus borealis*	40.7	U	U	T	D/W	No	fairly decayed. Either from last Monday or missed from last week.
9/1/2017	C11	Incidental	Y	Bat	40.492451	-88.031059	39	270	Eastern Red Bat	*Lasiurus borealis*	40.5	U	M	T	F/W	Yes	confirmed kill last night. Found during carcass removal trials and left for next week. Bat was gone on Monday.
9/4/2017	A7	R/P	Y	Bat	40.464895	-88.056982	55	20	Silver-haired Bat	*Lasionycteris noctivagans*	40.7	U	M	T	F/W	No	killed last night
9/4/2017	B6	Full	N	Bat	40.449225	-88.037482	46	35	Silver-haired Bat	*Lasionycteris noctivagans*	40.2	U	U	T	D/W	No	scavenged by bugs but not very old
9/4/2017	B7	R/P	Y	Bird	40.442928	-88.029252	<1	300	Ruby-Throated Hummingbird	*Archilochus colubris*	NA	U	U	T	D/M	No	head missing
9/4/2017	F4	R/P	Y	Bat	40.455881	-88.009525	26	10	Hoary Bat	*Lasiurus cinerus*	55.1	U	F	T	F/W	No	probably last night
9/4/2017	F7	R/P	Y	Bat	40.447755	-87.993514	10	265	Big Brown Bat	*Eptesicus fuscus*	45.5	U	M	T	F/W	No	couple days old. Stiff
9/5/2017	B5	Full	N	Bat	40.450741	-88.032299	36	50	Silver-haired Bat	*Lasionycteris noctivagans*	43	U	F	T	F/W	No	maybe night before last
9/5/2017	C9	R/P	Y	Bat	40.501457	-88.015777	63	0	Eastern Red Bat	*Lasiurus borealis*	39.1	U	M	T	F/W	No	maybe night before last
9/6/2017	E3	Full	N	Bat	40.468964	-87.988539	38	230	Eastern Red Bat	*Lasiurus borealis*	37.2	U	U	T	D/W	No	
9/11/2017	B6	Full	N	Bat	40.448911	-88.037549	25	85	Silver-haired Bat	*Lasionycteris noctivagans*	39.8	U	U	T	D/W	No	
9/11/2017	F16	Full	N	Bat	40.439098	-87.985123	35	270	Eastern Red Bat	*Lasiurus borealis*	40.7	U	M	T	F/W	No	couple days old.
9/11/2017	F16	Full	N	Bat	40.43922	-87.985072	31	295	Eastern Red Bat	*Lasiurus borealis*	39.8	U	U	T	D/W	No	maybe night before last
9/12/2017	C12	Full	N	Bat	40.499115	-88.028491	28	45	Silver-haired Bat	*Lasionycteris noctivagans*	39.8	U	U	T	D/W	No	
9/12/2017	C12	Full	Y	Bat	40.498972	-88.02894	14	275	Eastern Red Bat	*Lasiurus borealis*	39.6	U	U	T	D/W	No	
9/18/2017	B7	R/P	Y	Bat	40.442866	-88.029225	3	180	Silver-haired Bat	*Lasionycteris noctivagans*	41.4	U	F	T	F/W	No	
9/18/2017	F14	R/P	Y	Bat	40.437307	-87.975564	12	255	Silver-haired Bat	*Lasionycteris noctivagans*	43.5	U	M	T	F/W	No	couple days old
9/18/2017	F14	R/P	Y	Bat	40.437324	-87.975965	44	270	Eastern Red Bat	*Lasiurus borealis*	40.1	U	F	T	F/W	No	couple days old

Date	Turbine	Search Type (Full, R/P, Incidental)	On Road/Pad? (Y or N)	Carcass Type	Latitude	Longitude	Distance	Azimuth	Common Name	Species	Forearm Length	Age	Sex	Cause of Death	Condition	Incidental	Comments
9/18/2017	F16	Full	N	Bat	40.438959	-87.984487	26	135	Silver-haired Bat	*Lasionycteris noctivagans*	40.9	U	F	T	F/W	No	couple days old. Tiny maggots
9/18/2017	F16	Full	Y	Bat	40.439124	-87.984649	1	95	Silver-haired Bat	*Lasionycteris noctivagans*	41.8	U	F	T	F/W	No	maybe last night. On platform for turbine door
9/19/2017	A16	R/P	Y	Bat	40.489334	-88.077467	15	180	Silver-haired Bat	*Lasionycteris noctivagans*	41.8	U	U	T	D/W	No	slightly decomposing
9/19/2017	C12	Full	Y	Bat	40.498801	-88.029198	39	240	Silver-haired Bat	*Lasionycteris noctivagans*	39.8	U	M	T	F/W	No	
9/19/2017	C12	Full	N	Bat	40.498668	-88.028833	30	190	Silver-haired Bat	*Lasionycteris noctivagans*	39.1	U	U	T	D/W	No	
9/19/2017	C12	Full	Y	Bat	40.499323	-88.029217	53	315	Silver-haired Bat	*Lasionycteris noctivagans*	41.3	U	M	T	D/W	No	
9/19/2017	C9	R/P	Y	Bird	40.50082	-88.015803	9	185	Red-eyed Vireo	*Vireo olivaceus*	NA	U	U	T		No	looks fresh but hit hard and torn up
9/19/2017	D4	R/P	Y	Bat	40.477473	-88.024164	5	310	Hoary Bat	*Lasiurus cinerus*	59.2	U	F	T	F/W	No	
9/19/2017	D5	R/P	Y	Bat	40.483017	-88.019882	40	0	Eastern Red Bat	*Lasiurus borealis*	37.4	U	M	T	D/W	No	
9/19/2017	E12	R/P	Y	Bat	40.435387	-87.943729	30	315	Silver-haired Bat	*Lasionycteris noctivagans*	39.3	U	U	T	D/W	No	
9/19/2017	E14	Incidental	N	Bird	40.426367	-87.948096	50	220	Bay-Breasted Warbler	*Setophaga castanea*	NA	U	U	T	D/W	Yes	8 inches outside of 40m plot
9/20/2017	B1	Full	N	Bat	40.457224	-88.034288	40	305	Silver-haired Bat	*Lasionycteris noctivagans*	39.4	U	M	T	F/W	No	probably last night
9/20/2017	B1	Full	N	Bat	40.457374	-88.033946	32	0	Silver-haired Bat	*Lasionycteris noctivagans*	42.2	U	U	T	F/W	No	looks fresh but hit hard and torn up
9/25/2017	E12	R/P	Y	Bat	40.435398	-87.943905	58	58	Silver-haired Bat	*Lasionycteris noctivagans*	41.2	U	M	T	D/W	No	
9/25/2017	E13	R/P	Y	Bat	40.433544	-87.949796	<1	90	Eastern Red Bat	*Lasiurus borealis*	39.1	U	M	T	F/W	No	on platform for turbine door
9/25/2017	F7	R/P	Y	Bat	40.447757	-87.993509	12	270	Silver-haired Bat	*Lasionycteris noctivagans*	U	U	U	T	D/P	No	hindparts only. ID based on fur color
9/26/2017	C9	R/P	Y	Bat	40.501323	-88.015759	38	5	Silver-haired Bat	*Lasionycteris noctivagans*	41.1	U	U	T	D/P	No	just part of wing. ID based on fur color
9/26/2017	E14	Full	N	Bat	40.42661	-87.947654	16	165	Silver-haired Bat	*Lasionycteris noctivagans*	40.6	U	U	T	D/W	No	missed from last week. Fur and bones
9/26/2017	E16	Incidental	N	Bat	40.415044	-87.949333	24	265	Silver-haired Bat	*Lasionycteris noctivagans*	40.8	U	U	T	D/W	Yes	
10/2/2017	A6	R/P	Y	Bat	40.464875	-88.052056	42	205	Silver-haired Bat	*Lasionycteris noctivagans*	41.1	U	M	T	D/W	No	tiny maggots started
10/2/2017	B1	Full	N	Bat	40.456931	-88.033575	28	110	Silver-haired Bat	*Lasionycteris noctivagans*	41.7	U	F	T	D/W	No	

Date	Turbine	Search Type (Full, R/P, Incidental)	On Road/Pad? (Y or N)	Carcass Type	Latitude	Longitude	Distance	Azimuth	Common Name	Species	Forearm Length	Age	Sex	Cause of Death	Condition	Incidental	Comments
10/2/2017	B7	Incidental	N	Bird	40.443148	-88.029118	30	20	Red-Tailed Hawk	*Buteo jamaicensis*	NA	U	U	T	D/W	Yes	Found in bean field after it was cut
10/2/2017	F16	Incidental	Y	Bat	40.439756	-87.984714	71	0	Eastern Red Bat	*Lasiurus borealis*	38.7	U	M	T	F/W	Yes	looks fresh but hit hard and torn up
10/3/2017	D11	R/P	Y	Bat	40.475465	-87.999126	37	5	Eastern Red Bat	*Lasiurus borealis*	38.1	U	M	T	F/W	No	
10/3/2017	E13	Incidental	N	Bat	40.433678	-87.949783	12	10	Silver-haired Bat	*Lasionycteris noctivagans*	41.1	U	U	T	D/W	Yes	
10/3/2017	E14	Full	N	Bat	40.426649	-87.947948	19	235	Silver-haired Bat	*Lasionycteris noctivagans*	39.8	U	U	T	D/W	No	
10/3/2017	E3	Full	N	Bird	40.468893	-87.988366	37	220	Magnolia Warbler	*Setophaga magnolia*	NA	U		T	D/W	No	
10/10/2017	A2	R/P	Y	Bird	40.464896	-88.046264	43	210	House Finch	*Haemorhous mexicanus*	NA	U	U	T	D/W	No	missed from last week. Likely killed 2-3 weeks ago when plot was skipped
10/10/2017	F10	Incidental	N	Bat	40.453166	-87.974869	9	315	Hoary Bat	*Lasiurus cinerus*	51.8	U	F	T	D/W	Yes	1 foot off of pad