



**10(a)(1)(A) Permit #
ESPER0011726 Annual Report -
2021**

Kings Point Wind Project and North
Fork Ridge Wind Project

Barton, Dade, Jasper, and Lawrence
Counties, Missouri

January 31, 2022

Prepared for:

Empire District Electric Company
602 S Joplin Avenue
Joplin, MO 64802

Prepared by:

Stantec Consulting Services Inc
6800 College Boulevard, Suite 750
Overland Park, KS 66211

10(A)(1)(A) PERMIT # ESPER0011726 ANNUAL REPORT - 2021

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Prepared by **Adam Rusk** CE, ABW, PSM

Approved by _____

(signature)

Josh Flinn Associate Wildlife Biologist/Project Manager

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Abbreviations

a_i	fraction of ground searched within each distance band
AIC	Akaike information criterion
control	3.0 m/s cut-in speed
CP	carcass persistence
DWP	density-weighted proportion
Empire	Empire District Electric Company
ft	feet
GenEst	Generalized Estimator
g-value	detection probability
I	search interval
k	SE decay
Kings Point	Kings Point Wind Project
m	meters
mph	miles per hour
m/s	meters per second
MW	megawatt
North Fork Ridge	North Fork Ridge Wind Project
p	Searcher efficiency
Permit	10(a)(1)(A) Permit # ESPER0011726
SE	searcher efficiency
TAL	Technical Assistance Letter
treatment	5.0 m/s cut-in speed
USFWS	U. S. Fish and Wildlife Service
v	temporal coverage
WTGs	Wind Turbine Generators
X_i	number of carcasses found within each distance band



Introduction
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1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION AND HISTORY

Empire District Electric Company (Empire) developed and is currently operating two wind power facilities in southwest Missouri. Kings Point Wind Project (Kings Point) in Barton, Dade, and Lawrence counties, Missouri consists of 69 Vestas wind turbine generators (WTGs; 12 Vestas V-110 2.0 megawatt [MW], 57 Vestas V-120 2.2-MW) with an approximate capacity of 149.4 MW. North Fork Ridge Wind Project (North Fork Ridge) in Barton County, Missouri has 69 Vestas WTGs (same composition of turbine models as Kings Point) with an approximate capacity of 149.4 MW. These two wind projects are collectively referred to as "the Projects" throughout this report. A map showing the location of the WTGs for the Projects is provided in Appendix A, Figure A-1.

Due to the potential risk of take of the federally endangered gray bat (*Myotis grisescens*) during operations, Empire applied for a Native Endangered Species Recovery Permit under Section 10(a)(1)(A) of the Endangered Species Act (Permit) to evaluate the effectiveness of smart curtailment on reducing gray bat fatality. The application included a study plan outlining a 4-year research study that was developed through coordination with the U.S Fish and Wildlife Service (USFWS) Columbia, Missouri Ecological Services Field Office and the Missouri Department of Conservation (Stantec 2021). The Permit (ESPER0011726) was issued on August 6, 2021. Prior to issuance of the Permit, the Projects operated in accordance with terms outlined in a Technical Assistance Letter (TAL) issued by the USFWS on May 10, 2019 for Kings Point and June 6, 2019 for North Fork Ridge. This report summarizes the operations and monitoring at the Project for 2021 and is intended to satisfy Condition L (Annual Reporting) of the Permit.

1.1.1 Spring and Summer 2021 - TAL

Operations and monitoring during the spring and summer of 2021 were in accordance with the TAL for the Projects. Conditions of the TAL required feathering of all turbine blades below 8.0 meters per second (m/s) when ambient temperature was above 50 degrees Fahrenheit during the gray bat active season (March 1 through November 15) from 30 minutes prior to sunset through 30 minutes after sunrise. Bat fatality monitoring began March 3, 2021 for North Fork Ridge and April 8, 2021 for Kings Point. Bat fatality monitoring included search efforts expected to achieve a detection probability (g-value) of 0.2 based on Evidence of Absence (EofA; Dalthorp et al. 2017). Fatality monitoring included twice weekly searches at all WTGs on graveled roads and pads and 60-m radius cleared plots around WTGs. Searcher efficiency and carcass persistence trials were completed in accordance with the TAL.



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1.1.2 Fall 2021 – 10(a)(1)(A)

After receiving the Permit, fatality monitoring and operational curtailment were adjusted, and acoustic monitoring was added at the Projects to begin collecting data to address the research objectives outlined in the study plan for the Permit. Fatality monitoring efforts included an expansion of search plots from 60-m radius cleared plots to 100-m radius cleared plots at 8 WTGs on August 23, 2021. Figures A-2 and A-3 (see Appendix A) show the search plot types for Kings Point and North Fork Ridge, respectively. On September 7, 2021 (Kings Point) and August 30, 2021 (North Fork Ridge) the Projects began operating half of their turbines at 3.0 m/s (control) and half at 5.0 m/s (treatment) cut-in speeds. Figures A-4 and A-5 (see Appendix A) show the control and treatment assignments for Kings Point and North Fork Ridge, respectively. Acoustic bat monitors were installed on WTGs the last 2 weeks of August. Purpose and Objectives of the Study

The goal of this study is to evaluate and understand gray bat fatality rates at wind facilities to develop and test an optimal curtailment strategy for reducing impacts. This will aid in the recovery of the gray bat by providing a basis of understanding for gray bat and wind energy interactions. The study will span 4 years and combines acoustic bat monitoring on WTG nacelles, fatality monitoring beneath WTGs, and operational curtailment treatments applied to WTGs to achieve 4 study objectives:

- Objective 1: Quantify turbine-related fatality rates for gray bats
- Objective 2: Quantify relationship between exposed gray bat activity and fatality
- Objective 3: Quantify effectiveness of blanket curtailment turbine operation (e.g., 5.0 m/s cut-in speed from April 1 – October 31 at temperatures above 50 degrees Celsius, 30 minutes before sunset through 30 minutes after sunrise) for reducing gray bat fatality
- Objective 4: Demonstrate use of nacelle-based acoustic and weather data to optimize turbine operation curtailment and evaluate its effectiveness at reducing gray bat fatality



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2.0 METHODS

Survey methods for carcass searches, searcher efficiency (SE) trials, carcass persistence (CP) trials, and acoustic monitoring followed those specified in the TAL, Permit conditions and as outlined in the study plan (Stantec 2021). Post-construction monitoring included the following components:

- Standardized carcass searches to systematically search plots at all WTGs for bat fatalities attributable to the WTGs
- SE trials to estimate the percentage of bat carcasses that were found by the searcher(s)
- CP trials to estimate the persistence time of carcasses on-site before scavengers removed them
- Acoustic monitoring to assess gray bat activity at nacelle height on WTGs and beneath the rotor-sweep

2.1 FIELD METHODS

2.1.1 Standardized Carcass Searches

Standardized carcass searches were completed at 100% of the Projects' WTGs between March 3 and October 29, 2021. Standardized carcass searches consisted of searching the graveled areas of turbine pads and access roads out to 100 m (road and pad searches) and within a 60-m radius of turbines (60-m cleared plot) during spring and summer. The distribution of the search plots during spring and summer was as follows:

- Kings Point – 45 WTGs with road and pad searches, 24 WTGs with 60-m cleared plot searches
- North Fork Ridge – 45 WTGs with road and pad searches, 24 WTGs with 60-m cleared plot searches

After issuance of the Permit, 8 of the 60-m cleared plots were expanded to cover a 100 m radius around the turbines (100-m cleared plots). Searches at the 100-m cleared plots began August 23, 2021. The distribution of the search plots during the fall was as follows:

- Kings Point – 45 WTGs with road and pad searches, 20 WTGs with 60-m cleared plot searches, 4 WTGs with 100-m cleared plot searches
- North Fork Ridge – 45 WTGs with road and pad searches, 20 WTGs with 60-m cleared plot searches, 4 WTGs with 100-m cleared plot searches



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Standardized carcass searches were conducted by qualified searchers trained in mortality search methods, including proper handling and reporting of carcasses. Searchers were familiar with and able to accurately identify bat species likely to be found at the Projects. Preliminary bat species identifications were made in the field by qualified staff. When carcass condition allowed, sex and age of the carcass were recorded. Forearm length was recorded to facilitate species identification. In addition to the carcass, photographs and data collected for each carcass were used to verify the species identification. Photos of any unknown bats discovered were sent to a Stantec permitted bat biologist with onsite knowledge and experience for all expected bat species at the Projects for positive identification, and carcasses were kept on-site. Any unknown bat or suspected *Myotis* was identified by a Stantec senior bat biologist who holds a USFWS permit for threatened and endangered bats, and/or sent to the Northern Arizona University's Bat Ecology and Genetics Lab¹ for genetic testing.

During searches, searchers walked at a rate of approximately 2 miles per hour (45 to 60 m per minute) while searching 3 m on either side. For each carcass found, the following data were recorded digitally within Survey123 (ESRI, Redlands, CA):

- Date and time
- Initial species identification (this information was updated as needed based on photos, dentition, or expert opinion)
- Sex, age, and reproductive condition (when applicable; sex was updated based on genetic testing)
- Global positioning system location
- Distance and bearing to turbine
- Condition (intact, scavenged, decomposed)
- Any notes on presumed cause of death

A digital photograph of each carcass next to a ruler for scale was taken before the carcass was handled and removed. All bat carcasses were labeled, bagged, and stored in onsite freezers at the Projects' Operations and Maintenance Buildings. Bat carcasses were collected and retained under Empire's Permit and Missouri Department of Conservation Wildlife Collector's Permit #s: 19236, 19275, 19280, 19278, 19171, 19158, 19247, 19228.

Bat carcasses found in non-search areas were coded as incidental finds and documented in a similar fashion to those found in standardized surveys when possible. These included carcasses found during non-search times or outside the monitoring plot. Incidental bat carcasses were collected and stored in the freezer with the carcasses found during standardized surveys. As per industry standard, incidental finds were not included in the fatality estimates.

¹ <https://in.nau.edu/bat-ecology-genetics/>



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2.1.2 Searcher Efficiency Trials

SE trials were used to estimate the probability of bat carcass detection by the searchers. There was a total of three SE trials, one per season. 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 dark mouse carcasses were used as trial carcasses to represent bats.

All SE trial carcasses were randomly placed by a field lead within the search plots. These were placed in the morning prior to the planned carcass searches for that day and checked after the SE trial to ensure they had not been scavenged. The number of trial carcasses found by the searcher in each plot was recorded and compared to the total number placed in the plots prior to the SE trial.

2.1.3 Carcass Persistence Trials

A CP trial was conducted to estimate the average length of time carcasses remained in the search plots before being removed by scavengers. Mouse carcasses used during the SE trials were left in place, and their locations were discretely marked (i.e., within Survey123). In addition, separate mouse carcasses were placed for the sole purpose of CP trials. Searchers monitored the placed carcasses for up to 28 days. During the CP trials, carcasses were checked every day for the first week, and then regularly checked until missing or 28 days had passed (i.e., 1, 2, 3, 4, 5, 6, 7, 10, 14, 21, and 28), or until no longer detectable).

The condition of each carcass was recorded during each CP 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

2.1.4 Acoustic Monitoring

Wildlife Acoustics (Model SM4BAT FS) acoustic bat detectors with SMM-U1 microphones were mounted on 30 WTG nacelles (height of 120 m) and on the turbine mast (20 m) of 10 WTGs in August. The detectors were set to record echolocation calls of bats that fly in proximity (within approximately 30 m) of the detector microphones from 30 minutes before sunset to 30 minutes after sunset each night. Detector locations are shown in Appendix A, Figures A-6 and A-7.

2.2 DATA ANALYSIS – GENEST

Results include summaries of the raw data, including counts of species, the number of searches conducted, and the average search interval (calculated as the sum of the number of visits to a turbine divided by the number of days within a season).



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The Generalized Estimator (GenEst; Dalthorp et al. 2018) was used for calculating bias correction factors (SE, CP, and area adjustment) and the overall fatality rate and fatality estimates for all bats at the Projects. Note that throughout the document some estimates may not correspond exactly with subsets of those estimates (e.g., fatality by species may not add up to total fatality). This is because GenEst generates all estimates as a result of 1,000's of iterations of a model (called "bootstraps"). As each iteration yields slightly different results, different repetitions of the analysis will yield slightly different results.

2.2.1 Searcher Efficiency (p)

Searcher efficiency (p) represents the average probability that a carcass was detected by the searcher. This rate was calculated using the data collected during SE trials (Section 2.1.6) by dividing the number of trial carcasses the observer found by the total number which remained available during the trial (i.e., non-scavenged). Analysis includes an evaluation of whether SE differed by searcher, season (spring, summer, fall), or plot type (roads and pads, cleared plots). SE decay (k) was fixed at 0.67. This value represents the decrease in searcher efficiency (p) on subsequent searches (i.e., if a carcass is missed the first time it is available, it is less likely to be found on subsequent searches than a "fresh" carcass).

GenEst returns numerous models depending on the number of variables included in the analysis, as well as Akaike information criterion (AIC) values for each model. The AIC value is a statistical score for the quality of a model fit, where smaller AIC values are considered better models. However, models within 3-4 Δ AIC (the difference between each models AIC and the AIC of the "best" model) are generally considered indistinguishable by this measure (Dalthorp et al. 2018). Therefore, the best model was chosen based on a manual review of models with the lowest AIC values, and a top model was chosen from the models within 3-4 Δ AIC of the top model based on AIC alone. Confidence intervals were generated using 1,000 bootstrapped iterations.

2.2.2 Carcass Persistence

CP times modeled in GenEst included using censored exponential, Weibull, lognormal, and loglogistic survival models of the data collected as part of the CP trial (Section 2.1.3). GenEst returns numerous models depending on the number of variables included in the analysis, as well as AIC values for each model. The best model was chosen based on a comparison of models with the lowest AIC values, though similar to SE, models were also graphically evaluated to ensure that they are logical, and the top model was chosen from the models within 3-4 Δ AIC of the top model based on AIC alone. Confidence intervals were generated using 1,000 bootstrapped iterations.

2.2.3 Density-weighted Proportion

The density-weighted proportion (DWP) was calculated based on several parameters, all of which were limited to road and pad plot types:

$$X_i = \text{number of carcasses found within distance band } i$$



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a_i = fraction of ground searched within distance band i

$$\hat{M}_i = \text{relative mortality rate in each ring} = \frac{X_i}{a_i}$$

$$\hat{p}(M_i) = \text{fraction of total in each ring} = \hat{M}_i / \sum_i \hat{M}_i$$

The number of carcasses found within each distance band (X_i) is a total of carcasses found at various distances. When each carcass was found, searchers recorded the location of the carcass using a sub-meter accuracy global positioning system in a digital datasheet (Collector for ArcGIS). The distance between these locations and the nearest turbine were calculated in GIS.

To determine the fraction of ground searched within each distance band (a_i), the turbine roads and pads were digitized, and the proportion of each distance band that included the road and pad was calculated for each of the 138 turbines out to 100 meters from the turbine base. These values were then averaged across all turbines to determine the percentage of each distance band that was searched on roads and pads. For cleared plot turbines, 100% of the area within 60 meters was searched, and 0% of the area beyond 60 meters was searched except for the 8 100-m cleared plot turbines that were searched beginning in the fall. Given that 35% of turbines had cleared plots and 65% were searched only on roads and pads, the weighted average of these values was calculated for each distance band. It was assumed that all carcasses fell within 100 meters of the turbine base.

Using the turbine-specific GIS data from the digitized roads and pads (since the road and pad configuration can vary by turbine), a turbine-specific DWP was then calculated by multiplying the fraction of each distance band searched at a particular turbine by the fraction of the total for that distance band. This varied by season for some turbines as cleared plots changed due to search protocols and land access.

2.2.4 Adjusted Fatality Estimates (GenEst)

GenEst was used to calculate overall fatality rates for the Projects (per turbine, per MW, for all 69 turbines at Kings Point, and for all 69 turbines at North Fork Ridge). All estimates include 90% confidence intervals. "Per turbine estimates" were calculated by dividing the GenEst estimate (and confidence intervals) by the number of turbines (69 turbines), and "per MW estimates" were calculated by dividing the GenEst estimate (and confidence intervals) by the total MW (149.4 MW).

Fatality estimates were split by season.

2.3 DATA ANALYSIS – EVIDENCE OF ABSENCE

Evidence of Absence (EofA; Dalthorp et al. 2017) was used for estimating the overall detection probability (g) and the estimated take of gray bats (M and λ).



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2.3.1 Estimation of Detection Probability (g)

For analysis of the 2021 data, Stantec used the “Multiple Class Module” to combine data from the two search classes (roads and pads and cleared plots) and across the three seasons (spring, summer, and fall). Site-specific monitoring data were used to calculate the g-value for each search class, including the following inputs:

- Search interval (I), calculated as the average time between searches per plot type
- Number of searches, calculated as the average number of times each turbine per plot type was visited
- Temporal coverage (v), set to 1 for the summer and 0.95 for spring and fall since monitoring occurred during the entire period of risk during the summer, and on-site pre-construction acoustic data suggests 95% of gray bat activity occurs after March in the spring and before November in the fall
- SE, calculated using the “carcasses removed after one search” option and inputting the total number of carcasses available and found per plot type and season across all searchers
- Factor by which SE changes with each search (k) was fixed at 0.67
- CP distribution, calculated using field trials to estimate the parameters, and the top model was selected based on results from within EofA.

This input was done for both road and pad searches and for cleared plots to calculate the detection probability (g) within those searched areas. Within the Multiple Class Module, the fraction of total carcasses arriving within each class needs to be assigned to the DWP column. This differs from the DWP calculated in Section 2.2.3, which is the proportion of bats expected to fall within the searched area at a particular turbine, whereas this DWP is the proportion of bats expected to fall within that class. The DWP was calculated for each of the plot types, as well as for an “unsearched” class to account for carcasses that fall outside of the searched area. The DWPs of these three classes (roads and pads, cleared plots and unsearched) must sum to one. The DWPs for roads and pads and cleared plots were calculated based on the DWPs calculated for the turbines within those plots (Section 2.2.3), using the average DWP for the plot type and multiplying it by the proportion of turbines within that plot type. The unsearched class was then calculated as one minus the sum of the DWPs for the searched areas.

Once these inputs were complete, the “Estimate overall detection probability (g)” option was chosen, and the overall detection probability for the survey period was calculated.



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3.0 RESULTS

Fatality monitoring was completed for both Kings Point and North Fork Ridge. From March 1 – September 7, 2021 (Kings Point) and March 1 – August 30, 2021 (North Fork Ridge) the WTGs were operating as specified in the TAL (cut-in >8.0 m/s). For the Fall season, both Projects operated under the conditions of the Permit with WTGs at either control cut-in speed (3.0 m/s) or treatment cut-in speed (5.0 m/s). Results for both Projects are presented individually below.

3.1 KINGS POINT

3.1.1 Carcass Searches

A total of 4,046 searches were conducted between April 8 and October 29, under TAL-level monitoring (April 8 – August 22, 2021; 24 60-m cleared plots and 45 road and pad plots) and Permit-level monitoring (August 23 – October 29, 2021; 20 cleared plots to 60 m, 4 cleared plots to 100 m, and 45 roads and pads). Prior to September 7, 2021, the turbines did not operate at night (30 min prior to sunset, 30 min after sunrise) when wind speeds were less than 8.0 m/sec and air temperature was above 50°F. A summary of search effort with total numbers of bats found is presented in Table 3-1.

Table 3-1. Summary of post-construction monitoring conducted between April 8 and October 29, 2021, at Kings Point Wind Project, Barton, Dade, and Lawrence counties, Missouri.

Season	Dates	Number of Searches Conducted	Average Search Interval ¹	Number of bats found in standardized searches	Number of bats found incidentally
Spring (TAL-level monitoring)	April 8 – May 31	1,020	3.65	19	5
Summer (TAL-level monitoring)	June 1 – August 31	1,863	3.40	19	0
Fall (Permit-level monitoring)	September 1 – October 29	1,163	3.62	27	0
Total	April 8 – October 29	4,046	3.53	65	5

A total of 65 bat carcasses were found during standardized carcass searches, and 5 bat carcasses were found incidentally.



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3.1.2 Species Composition

A summary of all bat carcasses found during the standardized carcass searches is shown in Table 3-2.

Table 3-2. Summary of bat carcasses found during standardized carcass searches between April 8 and October 29, 2021, during post-construction monitoring at the Kings Point Wind Project, Barton, Dade, and Lawrence counties, Missouri.

	Count and Proportion			
	Season			
Species	Spring	Summer	Fall	Total
Eastern Red Bat <i>Lasiurus borealis</i>	11 57.9%	16 84.2%	17 63.0%	44 67.7%
Evening Bat <i>Nycticeius humeralis</i>	2 10.5%	0 0	0 0	2 3.1%
Gray Bat ^{1, 2} <i>Myotis grisescens</i>	0 0	1 5.3%	3 11.1%	4 6.2%
Hoary Bat ¹ <i>Lasiurus cinereus</i>	3 15.8%	2 10.5%	2 7.4%	7 10.8%
Silver-haired Bat ¹ <i>Lasionycteris noctivagans</i>	0 0	0 0	4 14.8%	4 6.2%
Tricolored Bat ¹ <i>Perimyotis subflavus</i>	0 0	0 0	1 3.7%	1 1.5%
Unknown (not Myotis)	3 15.8%	0 0	0 0	3 4.6%
Total	19 29.2%	19 29.2%	27 41.5%	65

¹Missouri Department of Conservation Species of Conservation Concern

²State and Federal listed Endangered

A total of 65 bat carcasses were found during standardized carcass searches, 62 of which were identified to the species level. The three unknown bats were determined to not be a *Myotis* species, and therefore were not genetically identified to the species level. Of the 65 bat carcasses, the most common species found was the eastern red bat (*Lasiurus borealis*; 44 individuals). The hoary bat (*Lasiurus cinereus*; 7) was the second most common species followed by gray bat and silver-haired bat (*Lasionycteris*



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noctivagans) with 4 carcasses each. Incidental finds included 5 bat carcasses during the spring monitoring period: 4 eastern red bats and 1 hoary bat.

3.1.3 Searcher Efficiency

SE trials were conducted during the post-construction monitoring during all three seasons (spring, summer, and fall). Data were analyzed in GenEst, with searcher, season, and plot type as the three predictor variables. The selected model included season, searcher, and plot type as the predictors (Table 3-3). Selected model is shown in bold. The model with the lowest AIC was not selected because it was not significantly different from a simpler model.

Table 3-3. Model comparison results from the top five models for searcher efficiency trials conducted between March 1 and October 31, 2021, at the Kings Point Wind Project, Barton, Dade, and Lawrence counties, Missouri. Selected model shown in bold.

Formula/Model	k	AIC _c	ΔAIC _c
p ~ searcher + plot_type + season + plot_type:season	0.67	226.24	0
p ~ searcher + plot_type + season	0.67	226.64	0.4
p ~ searcher + plot_type + season + searcher:plot_type + plot_type:season	0.67	229.42	3.18
p ~ searcher + plot_type + season + searcher:plot_type	0.67	230.68	4.44
p ~ searcher + season	0.67	232.18	5.94

Searcher efficiency was tested using a total of 141 trial carcasses. Based on the results of the top model, searcher efficiency ranged from 39.6% to 92.9% on cleared plots and ranged from 62.3% to 97.1% on roads and pads for all seasons (Table 3-4). There was variability among searchers, season, and plot type, but searcher efficiency was generally higher on road and pad plots than on cleared plots and higher during fall than the spring and summer seasons.



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Table 3-4. Searcher efficiency during 2021 post-construction monitoring at the Kings Point Wind Project, Barton, Dade, and Jasper counties, Missouri.

Season	Observer	Cleared Plots		Road and Pad Plots	
		Trial Carcasses	Searcher Efficiency (90% CI)	Trial Carcasses	Searcher Efficiency (90% CI)
Spring	1	10	0.558	10	0.761
			(0.394 - 0.709)		(0.615 - 0.864)
	2	10	0.396	10	0.623
			(0.256 - 0.555)		(0.463 - 0.760)
	3	10	0.929	10	0.971
			(0.705 - 0.986)		(0.853 - 0.995)
Summer	1	8	0.596	11	0.788
			(0.427 - 0.745)		(0.650 - 0.882)
	2	10	0.434	12	0.659
			(0.287 - 0.593)		(0.507 - 0.785)
Fall	1	10	0.818	10	0.919
			(0.679 - 0.905)		(0.834 - 0.963)
	2	10	0.700	10	0.855
			(0.536 - 0.826)		(0.735 - 0.926)

3.1.4 Carcass Persistence

The top five models for CP in GenEst included only lognormal distributions, with effects of season and/or plot type (Table 3-5). The five best models assumed a lognormal distribution. We selected the model with the lowest AIC which was both the best model and was also the most parsimonious. The selected model is highlighted below.



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Table 3-5. Model comparison results from the top five models for carcass persistence trials conducted between March 1 and October 31, 2021, at the Kings Point Wind Project, Barton, Dade, and Jasper counties, Missouri. Selected model is shown in bold.

Distribution	Location Formula	Scale Formula	AIC _c	ΔAIC _c
lognormal	l ~ season	s ~ season	475.4	0
lognormal	l ~ plot_type + season	s ~ season	477.12	1.72
lognormal	l ~ season	s ~ plot_type + season	477.48	2.08
lognormal	l ~ season	s ~ constant	478.66	3.26
lognormal	l ~ plot_type + season	s ~ plot_type + season	479.27	3.87

CP was tested using 122 carcasses across the three seasons. The shortest carcass persistence observed was in the summer, when carcass persistence averaged 2.5 days, compared to spring which averaged 5.5 days and fall which averaged 2.8 days (Table 3-6).

Table 3-6. Carcass persistence during 2021 post-construction monitoring at the Kings Point Wind Project, Barton, Dade, and Jasper counties, Missouri.

Season	Trial Carcasses	Carcass Persistence
		(90% CI)
Spring	40	5.49
		(4.62 - 6.52)
Summer	42	2.51
		(1.93 - 3.27)
Fall	40	2.83
		(2.36 - 3.40)

3.1.5 Density-weighted Proportion (DWP)

The 25 bat carcasses found during standardized road and pad searches during the full survey were used to calculate the DWP (Table 3-7).



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Table 3-7. Calculation of the Density-weighted Proportion (DWP) at the Kings Point Wind Project, Barton, Dade, and Jasper counties, Missouri based on bat carcasses found between April 8 and October 29, 2021.

Distance Band (meters)	Number of Carcasses	Fraction of Area Searched (%)	Relative Fatality Rate	Fraction of Total (%)	Cumulative Percent of Carcasses
0-10	1	45.3	2.2	0.3	0.3
10-20	1	7.8	12.9	2.0	2.3
20-30	2	7.8	25.7	3.9	6.2
30-40	6	6.0	99.9	15.2	21.4
40-50	4	4.2	94.8	14.4	35.8
50-60	3	3.3	91.2	13.9	49.7
60-70	3	2.6	113.8	17.3	67.0
70-80	5	2.3	216.6	33.0	100.0
80-90	0	2.0	0	0	100.0
90-100	0	1.7	0	0	100.0

Therefore, based on data from carcasses found, it is assumed that 49.7% of all bat carcasses fall within 60 meters of the turbine base and within the 60 m cleared plot searches, and 50.3% fall beyond the 60 m cleared plots.

Using the turbine-specific GIS data from the digitized roads and pads (since the road and pad configuration can vary by turbine), a turbine-specific DWP was then calculated by multiplying the fraction of each distance band searched at a particular turbine by the fraction of the total for that distance band. Therefore, all cleared plot turbines have a DWP of 49.7%, and the DWP for road and pad turbines ranges from 2.3% to 6.2%.

3.1.6 Adjusted Fatality Estimates

Fatality rate estimates were calculated based upon the carcasses found during the standardized carcass searches and did not include any incidental finds. Observed bat mortality estimates were adjusted to account for SE, CP, the search schedule, and the turbine-specific DWPs.

3.1.6.1 Seasonal Fatality Estimates

The total estimated fatality by season is summarized in Table 3-8 and detailed in the following sections.



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Table 3-8. Bat fatality rates by season from 2021 post-construction monitoring at the Kings Point Wind Project, Barton, Dade, and Jasper counties, Missouri.

Season	Dates	Facility-wide Estimated Fatalities (90% CI)	Per-turbine Estimated Fatalities (90% CI)	Per-MW Estimated Fatalities
Spring	March 1 – May 31	223.63 (99.83 - 409.17)	3.24 (1.45 - 5.93)	1.50 (0.67 - 2.74)
Summer	June 1 – August 31	541.31 (276.41 - 867.91)	7.85 (4.01 - 12.58)	3.62 (1.85 - 5.81)
Fall	September 1 – November 15	572.17 (307.55 - 919.68)	8.29 (4.46 - 13.33)	3.83 (2.06 - 6.16)
Annual	March 1 – November 15	1,364.95 (950.72 – 1,888.13)	19.78 (13.77 - 27.36)	9.14 (6.36 - 12.64)

A total of 19 bat carcasses were found during standard carcass searches in the spring monitoring period. Applying the SE rates, CP rates, turbine-specific DWPs, and the spring search schedule, results in an overall bat fatality estimate of 223.63 bats (90% CI: 99.83 – 409.17) across all 69 turbines between April 8 and May 31, 2021 – equivalent to 3.24 bats/turbine (90% CI: 1.45 – 5.93) or 1.50 bats/MW (90% CI: 0.67 – 2.74).

A total of 19 bat carcasses were found during standard carcass searches in the summer monitoring period. Applying the SE rates, CP rates, turbine-specific DWPs, and the summer search schedule, results in an overall bat fatality estimate of 541.31 bats (90% CI: 276.41 – 867.91) across all 69 turbines between June 1 and August 31, 2021 – equivalent to 7.85 bats/turbine (90% CI: 4.01 – 12.58) or 3.62 bats/MW (90% CI: 1.85 – 5.81).

At the beginning of the fall period until September 7, 2021, the turbines operated under TAL conditions. From September 7 through the end of the fall period, turbines operated at either 3.0 m/s or 5.0 m/s cut-in speeds as summarized in Appendix A, Figure A-4. A total of 27 bat carcasses were found during standard carcass searches in the fall monitoring period. Applying the SE rates, CP rates, turbine-specific DWPs, and the fall search schedule, results in an overall bat fatality estimate of 572.17 bats (90% CI: 307.55 – 919.68) across all 69 turbines between September 1 and October 31, 2021 – equivalent to 8.29 bats/turbine (90% CI: 4.46 – 13.33) or 3.83 bats/MW (90% CI: 2.06 – 6.16).

Across all three survey seasons, 65 carcasses were found during standardized searches. Annual fatality estimates, combining all seasons, result in an overall bat fatality estimate of 1,364.95 bats (90% CI: 950.72 – 1,888.13) across all 69 turbines between March 1 and November 15, 2021 – equivalent to 19.78 bats/turbine (90% CI: 13.77 – 27.36) or 9.14 bats/MW (90% CI: 6.36 – 12.64).



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3.1.7 Gray Bat Fatality Estimates

3.1.7.1 In-hand Fatalities

Stantec found four gray bats during post-construction fatality monitoring at Kings Point. No other federal or state endangered species were found. The locations of these four gray bat fatalities are shown in **Error! Reference source not found.**A, Figure A-8. Sex of the gray bats found was confirmed through genetic analysis (see Appendix B). Female gray bats were found on 8/16, 9/23, and 9/24 and a male gray bat was found on 9/16.

3.1.7.2 Evidence of Absence

The “Multiple Classes” module was used in EofA. Because searcher efficiency and carcass persistence varied by season and plot type, the module was run four times: once for each season (with separate classes for each plot type plus an unsearched proportion), and once for the entire year (with separate classes for each season, and no unsearched portion since proportion of fatalities occurring outside of searched times was accounted for in each of the seasonal runs).

Detection Probability (g)

The detection probability for the post-construction monitoring season (March 1 – November 15, 2021) was 0.118 (95% CI: 0.100 to 0.137); however, this varied by season as summarized in Table 3-99.

Table 3-9. Summary of detection probability (g) by season and overall, during 2021 post-construction monitoring at the Kings Point Wind Project, Barton, Dade, and Jasper counties, Missouri.

Season	Detection Probability (g) and 95% CI
Spring	0.146 (0.120 – 0.173)
Summer	0.080 (0.050 – 0.113)
Fall	0.144 (0.112 – 0.179)
Total/Overall	0.118 (0.100 – 0.137)

3.1.7.3 Fatality Estimates (M^* and λ)

Analysis in the EofA “Multiple Years Module” included calculation of the following for gray bats:

- Annual Take Estimate (M_{2021})
- Annual take rate (λ)
- Number of Detected Fatalities (X)



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Results are summarized in Table 3-1010.

Table 3-10. Summary of EofA outputs for gray bats from 2021 post-construction monitoring at the Kings Point Wind Project, Barton, Dade, and Jasper counties, Missouri. Analysis done with $\alpha=0.5$.

Species	Number of detected fatalities (X)	Annual Take Estimate (M_{2021})	Annual Take Rate (λ) (95% CI)
Gray Bat	4	35	38.6 (11.40 – 82.62)

3.1.8 Acoustic Monitoring

Bat detectors were installed on the nacelles of 15 WTGs during the last two weeks of August, 2021 and 20 m up on the mast of 5 WTG's on August 4, 2021. Nacelle units were demobilized from November 15 through the first week of December, 2021. Mid-tower units were demobilized on December 20, 2021. Preliminary results suggest ~368,000 files were recorded across all units. Analysis of acoustic data is ongoing.

3.2 NORTH FORK RIDGE

3.2.1 Carcass Searches

A total of 4,750 searches were conducted between March 3 and October 29, under TAL-level monitoring (March 3 – August 22, 2021; 24 cleared plots out to 60 m and 45 roads and pads) and Permit-level monitoring (August 23 – October 29, 2021; 20 cleared plots to 60 m, 4 cleared plots to 100 m, and 45 roads and pads). Prior to August 30, 2021, the turbines did not operate at night (30 min prior to sunset, 30 min after sunrise) when wind speeds were less than 8.0 m/sec and air temperature was above 50°F. A summary of search effort with total numbers of bats found is presented in Table 3-1.

Table 3-11. Summary of post-construction monitoring conducted between March 3 and October 31, 2021, at North Fork Ridge Wind Project, Barton and Jasper Counties, Missouri.

Season	Dates	Number of Searches Conducted	Average Search Interval ¹	Number of bats found in standardized searches	Number of bats found incidentally
Spring (TAL-level monitoring)	March 3 – May 31	1,738	3.57	16	2
Summer (TAL-level monitoring)	June 1 – August 31	1,840	3.45	23	3
Fall (Permit-level monitoring)	September 1 – October 29	1,172	3.59	32	2



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Season	Dates	Number of Searches Conducted	Average Search Interval ¹	Number of bats found in standardized searches	Number of bats found incidentally
Total	March 3 – October 29	4,750	3.53	71	7

A total of 71 bat carcasses were found during standardized carcass searches, and 7 bat carcasses were found incidentally.

3.2.2 Species Composition

A summary of all bat carcasses found during the standardized carcass searches is shown in Table 3-2.

Table 3-12. Summary of bat carcasses found during standardized carcass searches between March 3 and October 29, 2021, during post-construction monitoring at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri.

	Count and Proportion			
	Season			
Species	Spring	Summer	Fall	Total
Big Brown Bat <i>Eptesicus fuscus</i>	0 0	1 4.3%	0 0	1 1.4%
Eastern Red Bat <i>Lasiurus borealis</i>	10 62.5%	16 69.6%	25 78.1%	51 71.8%
Evening Bat <i>Nycticeius humeralis</i>	3 18.8%	0 0	0 0	3 4.2%
Hoary Bat ¹ <i>Lasiurus cinereus</i>	3 18.8%	6 26.1%	4 12.5%	13 18.3%
Silver-haired Bat ¹ <i>Lasionycteris noctivagans</i>	0 0	0 0	3 9.4%	3 4.2%
Total	16 22.5%	23 33.4%	32 45.1%	71

¹Missouri Department of Conservation Species of Conservation Concern

²State and Federal listed Endangered



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A total of 71 bat carcasses were found during standardized carcass searches, all of which were identified to the species level. Of the 71 bat carcasses, the most common species found was the eastern red bat (*Lasiurus borealis*; 51 individuals). The hoary bat (*Lasiurus cinereus*; 13) was the second most common species. Next were the silver-haired bat (*Lasionycteris noctivagans*) and evening bat (*Nycticeius humeralis*) with 3 carcasses each. Lastly, one big brown bat (*Eptesicus fuscus*) was found during standard carcass searches. Incidental finds included 5 bat carcasses during the spring monitoring period: 4 eastern red bats and 1 hoary bat.

3.2.3 Searcher Efficiency

SE trials were conducted during the post-construction monitoring during all three seasons (spring, summer, and fall). Data were analyzed in GenEst, with searcher, season, and plot type as the three predictor variables. The selected model included season, searcher, and plot type as the predictors (Table 3-13). Selected model is shown in bold. The model with the lowest AIC was not selected for comparability with Kings Point, because searcher was artificially de-valued as a result of post-hoc calculated searcher efficiencies, and because the model types were not appreciably different.

Table 3-13. Model comparison results from the top five models for searcher efficiency trials conducted between March 1 and October 31, 2021, at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri. Selected model shown in bold.

Formula/Model	k	AIC _c	ΔAIC _c
p ~ plot_type + season	0.67	371.3	0
p ~ searcher + plot_type + season	0.67	372.86	1.56
p ~ plot_type + season + plot_type:season	0.67	374.62	3.32
p ~ searcher + plot_type + season + plot_type:season	0.67	376.28	4.98
p ~ searcher + plot_type + season + searcher:plot_type	0.67	383.51	12.21

Based on the results of the top model, searcher efficiency ranged from a low of 39.6% on cleared plots in the summer to a high of 97.1% on roads and pads in the spring (Table 3-14Table 3-4). Searcher efficiency was tested using a total of 141 trial carcasses.



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Table 3-14. Searcher efficiency during 2021 post-construction monitoring at North Fork Ridge Wind Project, Barton and Jasper counties, Missouri.

Season	Observer	Cleared Plots		Roads and Pads	
		Trial Carcasses	Searcher Efficiency (90% CI)	Trial Carcasses	Searcher Efficiency (90% CI)
Spring	1	10	0.783	10	0.963
			(0.645 – 0.878)		(0.921 – 0.983)
	2	10	0.703	9	0.944
			(0.552 – 0.820)		(0.888 – 0.943)
	3	10	0.384	10	0.816
			(0.210 – 0.595)		(0.647 – 0.915)
	4	10	0.373	9	0.808
			(0.199 – 0.586)		(0.632 – 0.912)
Summer	1	9	0.313	9	0.764
			(0.190 – 0.468)		(0.624 – 0.863)
	2	10	0.230	10	0.679
			(0.135 – 0.362)		(0.530 – 0.799)
Fall	1	10	0.579	10	0.907
			(0.420 – 0.723)		(0.827 – 0.952)
	2	10	0.474	10	0.865
			(0.327 – 0.625)		(0.765 – 0.926)

3.2.4 Carcass Persistence

The top five models for CP in GenEst included only lognormal distributions, with effects of season and/or plot type (Table 3-5). The five best models assumed a Weibull distribution. We selected the model with the lowest AIC which was both the best model and was also relatively parsimonious. The selected model is highlighted below.

Table 3-15. Model comparison results from the top five models for carcass persistence trials conducted between March 1 and October 31, 2021, at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri. Selected model is shown in bold.

Distribution	Location Formula	Scale Formula	AIC _c	ΔAIC _c
Weibull	<i>l ~ plot_type</i>	<i>s ~ season</i>	467.05	0
Weibull	<i>l ~ constant</i>	<i>s ~ season</i>	467.06	0.01



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Distribution	Location Formula	Scale Formula	AIC _c	ΔAIC _c
Weibull	$l \sim \text{season}$	$s \sim \text{season}$	468.86	1.81
Weibull	$l \sim \text{plot_type} + \text{season}$	$s \sim \text{season}$	468.97	1.92
Weibull	$l \sim \text{constant}$	$s \sim \text{plot_type} + \text{season}$	469	1.95

CP was tested using 119 carcasses across the three seasons. The shortest carcass persistence observed was in the fall on roads and pads when carcass persistence averaged 2.42 days (Table 3-16). Carcass persistence in the spring ranged from 2.81 days on roads and pads to 3.54 days on full cleared plots. Summer carcass persistence ranged from 2.84 days on roads and pads to 3.57 on full cleared plots.

Table 3-16. Carcass persistence during 2021 post-construction monitoring at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri.

Season	Cleared Plots		Roads and Pads	
	Trial Carcasses	Carcass Persistence (days; 90% CI)	Trial Carcasses	Carcass Persistence (days; 90% CI)
Spring	20	3.54	19	2.81
		(2.90 – 4.32)		(2.28 – 3.46)
Summer	20	3.57	20	2.84
		(2.87 – 4.39)		(2.32 – 3.46)
Fall	20	3.04	20	2.42
		(2.44 – 3.73)		(1.92 – 2.99)

3.2.5 Density-weighted Proportion (DWP)

The 27 bat carcasses found during standardized road and pad searches during the full survey were used to calculate the DWP (Table 3-7).



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Table 3-17. Calculation of the Density-weighted Proportion (DWP) at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri based on bat carcasses found between March 3 and October 29, 2021.

Distance Band (meters)	Number of Carcasses	Fraction of Area Searched (%)	Relative Fatality Rate	Fraction of Total (%)	Cumulative Percent of Carcasses
0-10	0	45.3	0.0	0.0	0.0
10-20	4	8.7	46.2	5.2	5.2
20-30	1	6.5	15.4	1.7	6.9
30-40	2	5.1	39.3	4.4	11.4
40-50	4	3.6	112.4	12.7	24.0
50-60	6	3.1	196.3	22.1	46.2
60-70	2	2.4	84.0	9.5	55.7
70-80	5	2.1	238.8	26.9	82.6
80-90	3	1.9	154.3	17.4	100.0
90-100	0	1.6	0.0	0.0	100.0

Therefore, based on data from carcasses found in summer 2021, it is assumed that 46.2% of all bat carcasses fall within 60 meters of the turbine base and within the 60 m cleared plot searches, and 53.8% fall beyond the 60 m cleared plots.

Using the turbine-specific GIS data from the digitized roads and pads (since the road and pad configuration can vary by turbine), a turbine-specific DWP was then calculated by multiplying the fraction of each distance band searched at a particular turbine by the fraction of the total for that distance band. Therefore, all cleared plot turbines have a DWP of 55.6%, and the DWP for road and pad turbines ranges from 2.1% to 6.0%.

3.2.6 Adjusted Fatality Estimates

Fatality rate estimates were calculated based upon the carcasses found during the standardized carcass searches and did not include any incidental finds. Observed bat mortality estimates were adjusted to account for SE, CP, the search schedule, and the turbine-specific DWPs.

3.2.6.1 Seasonal Fatality Estimates

The total estimated fatality by season is summarized in Table 3-8 and detailed in the following sections.



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Table 3-18. Bat fatality rates by season from 2021 post-construction monitoring at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri.

Season	Dates	Facility-wide Estimated Fatalities (90% CI)	Per-turbine Estimated Fatalities (90% CI)	Per-MW Estimated Fatalities
Spring	March 1 – May 31	401.59 (205.03 – 657.59)	5.82 (2.97 – 9.53)	2.69 (1.37 – 4.40)
Summer	June 1 – August 31	809.51 (459.03 – 1,271.58)	11.73 (6.65 – 18.43)	5.42 (3.07 – 8.51)
Fall	September 1 – November 15	566.32 (317.46 – 931.64)	8.21 (4.60 – 13.50)	3.79 (2.12 – 6.24)
Annual	March 1 – November 15	1826.1 (1296.99 – 2,446.17)	26.47 (18.8 - 35.45)	12.22 (8.68 - 16.37)

A total of 16 bat carcasses were found during standard carcass searches in the spring monitoring period. Applying the SE rates, CP rates, turbine-specific DWPs, and the spring search schedule, results in an overall bat fatality estimate of 401.59 bats (90% CI: 205.03 – 657.59) across all 69 turbines between March 3 and May 31, 2021 – equivalent to 5.82 bat/turbine (90% CI: 2.97 – 9.53) or 2.69 bat/MW (90% CI: 1.37 – 4.40).

A total of 23 bat carcasses were found during standard carcass searches in the summer monitoring period. Applying the SE rates, CP rates, turbine-specific DWPs, and the summer search schedule, results in an overall bat fatality estimate of 809.51 bats (90% CI: 459.03 – 1,271.58) across all 69 turbines between June 1 and August 31, 2021 – equivalent to 11.73 bats/turbine (90% CI: 6.65 – 18.46) or 5.42 bats/MW (90% CI: 3.07 – 8.51).

At the end of the summer period on August 30, 2021, the turbines switched from operating under TAL conditions to operating at either 3.0 m/s or 5.0 m/s cut-in speeds as specified in the Permit. A total of 32 bat carcasses were found during standard carcass searches in the fall monitoring period. Applying the SE rates, CP rates, turbine-specific DWPs, and the fall search schedule, results in an overall bat fatality estimate of 566.32 bats (90% CI: 317.46 – 931.64) across all 69 turbines between September 1 and October 31, 2021 – equivalent to 8.21 bats/turbine (90% CI: 4.60 – 13.50) or 3.79 bat/MW (90% CI: 2.12 – 6.24).

Across all three survey seasons, 71 carcasses were found during standardized searches. Annual fatality estimates, combining all seasons, result in an overall bat fatality estimate of 1,826.10 bats (90% CI: 1,296.99 – 2,446.17) across all 69 turbines between March 1 and November 15, 2021 – equivalent to 26.47 bats/turbine (90% CI: 18.80 – 35.45) or 12.22 bats/MW (90% CI: 8.68 – 16.37).



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3.2.7 Gray Bat Fatality Estimates

3.2.7.1 In-hand Fatalities

Stantec found no gray bats during post-construction fatality monitoring at North Fork Ridge. No other federal or state endangered species were found.

3.2.7.2 Evidence of Absence

The “Multiple Classes” module was used in EofA. Because searcher efficiency and carcass persistence varied by season and plot type, the module was run four times: once for each season (with separate classes for each plot type plus an unsearched proportion), and once for the entire year (with separate classes for each season, and no unsearched portion since proportion of fatalities occurring outside of searched times was accounted for in each of the seasonal runs).

Detection Probability (g)

The detection probability for the post-construction monitoring season (March 1 through November 15, 2021) was 0.067 (95% CI: 0.050 to 0.086); however, this varied by season as summarized in Table 3-19.

Table 3-19. Summary of detection probability (g) by season and overall, during 2021 post-construction monitoring at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri.

Season	Detection Probability (g) and 95% CI
Spring	0.121 (0.100 – 0.143)
Summer	0.047 (0.022 – 0.080)
Fall	0.074 (0.048 – 0.105)
Total/Overall	0.067 (0.050 – 0.086)

3.2.7.3 Fatality Estimates (M^* and λ)

Analysis in the EofA “Multiple Years Module” included calculation of the following for gray bats:

- Annual Take Estimate (M_{2021})
- Annual take rate (λ)
- Number of Detected Fatalities (X)

Results are summarized in Table 3-20.



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Table 3-20. Summary of EofA outputs for gray bats from 2021 post-construction monitoring at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri. Analysis done with $\alpha=0.5$.

Species	Number of detected fatalities (X)	Annual Take Estimate (M_{2021})	Annual Take Rate (λ) (95% CI)
gray bat	0	3	7.66 (0.01 – 38.88)

3.2.8 Acoustic Monitoring

Bat detectors were installed on the nacelles of 15 WTGs during the last two weeks of August, 2021 and 20 m up on the mast of 5 WTG's on August 4, 2021. Nacelle units have yet to be demobilized as of the submission of this report. Mid-tower units were demobilized on December 20, 2021. Acoustic data have not yet been processed.



Discussion
January 31, 2022

4.0 DISCUSSION

The results of this first year of bat fatality monitoring for the Projects were presented by season and provide insight into how future monitoring may need to be adjusted to achieve the study goals. The Permit was not issued until late in the summer, therefore only the fall season of monitoring includes data collection methods that will contribute to the study objectives. The spring and summer seasons do, however, provide useful information, particularly carcass persistence and distributions of carcasses around turbines (i.e., DWP), which should be assessed to adjust monitoring methods for the 2022 surveys.

Total bat mortality (all species combined) was higher at North Fork Ridge than at Kings Point; however, gray bat fatalities were only observed at Kings Point. Although no gray bat fatalities were recorded at North Fork Ridge, the EofA annual take estimate was 3 gray bats which is much lower than the annual take estimate of 35 gray bats at Kings Point. This was expected since higher gray bat activity was recorded at Kings Point during pre-construction surveys. Annual take estimates for the Projects are within the limits covered by the Permit.

The Projects' predicted g-values were below the estimated 0.2 target, possibly for a variety of reasons. Searcher efficiency was less than anticipated, carcass persistence times were shorter than expected, and the DWP value was lower than expected based on assumptions made in the study plan (Stantec 2021). The WTGs at the Projects are taller than at other projects where studies have occurred, which may explain the differences measured for DWP. Adjusting the total search area could increase DWP values and adjusting the search interval such that it is less than the average carcass persistence times will result in an increased g-value.

The acoustic data recorded from the WTGs have not yet been analyzed, but when paired with weather data will be useful in understanding gray bat exposure at the Projects. Those analyses are ongoing and results will be presented in the 2022 annual report along with the first full-year of Permit-level monitoring results.



References
January 31, 2022

5.0 REFERENCES

Dalthorp, D.H., J. Simonis, L. Madsen, M.M. Huso, P. Rabie, J.M. Mintz, R. Wolpert, J. Studyvin, F. Korner-Nievergelt. 2018. Generalized Mortality Estimator (GenEst) - R code & GUI: U.S. Geological Survey Software Release. Available at <https://doi.org/10.5066/P9O9BATL>.

Stantec. 2021. 10(a)(1)(A) Permit Application Study Plan - Kings Point & North Fork Ridge Wind Projects. *Activity-based Informed Curtailment Study*. Prepared for: Kings Point Wind Project, LLC, North Fork Ridge Wind Project, LLC. February 2, 2021.



Appendix A FIGURES



\\Corps\ads\data\Virtual_Workspace\workgroup\1937\Active\193708398_northforkridge\03_data\gis_cad\gis\mxd\NorthForkRidge_PCM_Pro.aprx
Revised: 2022-01-28 By: slperry

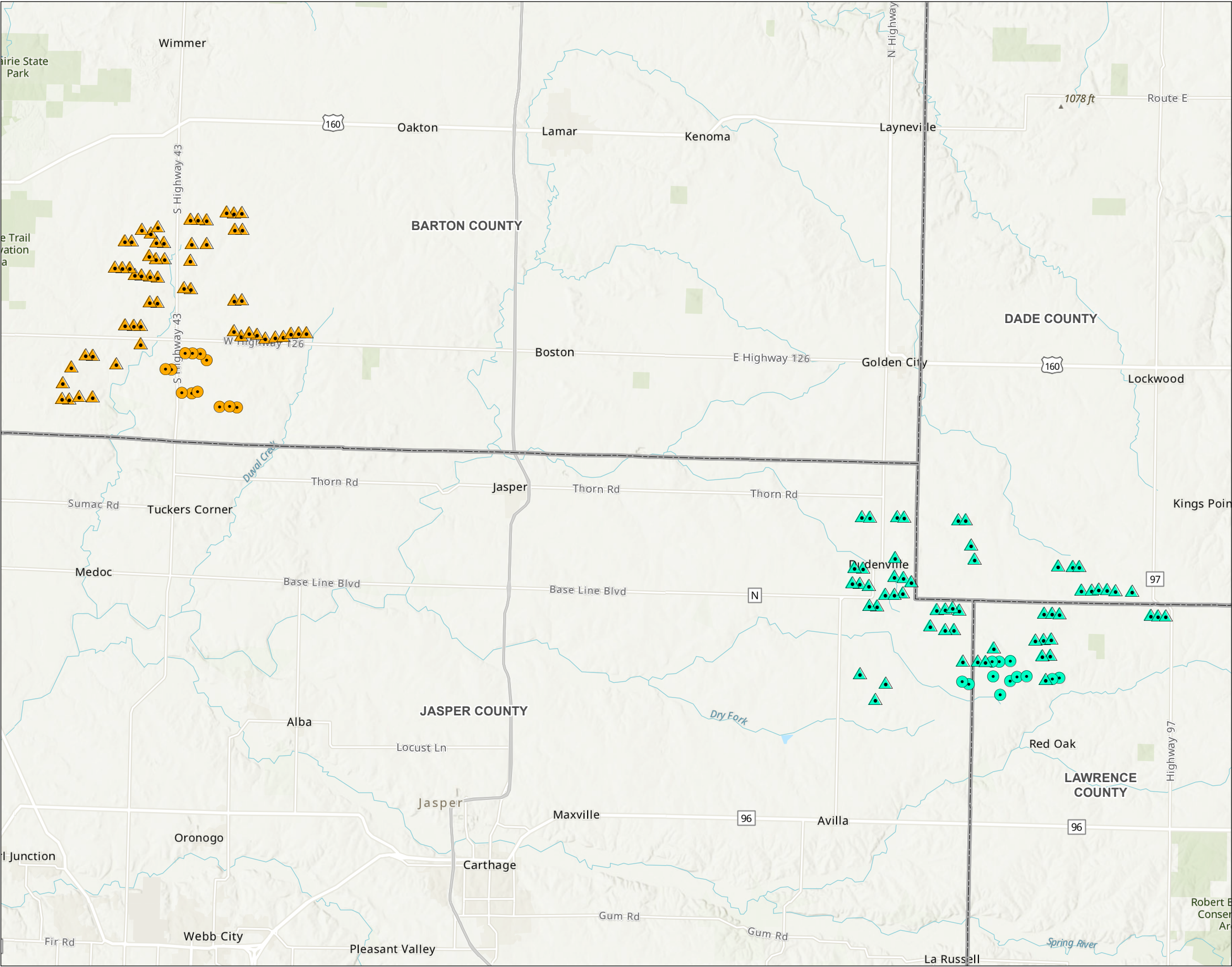


Figure No. **A-1**

Title
Kings Point and North Fork Ridge Wind Project Locations

Client/Project
Empire District Electric Company
Kings Point Wind Project
North Fork Ridge Wind Project

Project Location
Barton, Dade, Jasper,
and Lawrence Co., MO

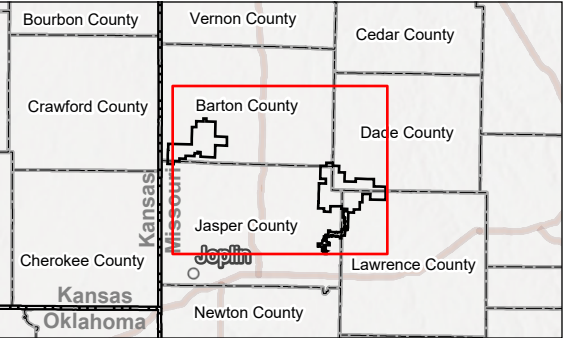
193708398

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 1.5 3 Miles
(At original document size of 11x17)
1:190,080

- Legend
- Kings Point Wind Turbine
- Vestas 110 2.0 MW
 - Vestas 120 2.2 MW
- North Fork Ridge Wind Turbine
- Vestas 110 2.0 MW
 - Vestas 120 2.2 MW



- Notes
- Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
 - Data Sources: Empire, Stantec, Esri, NADS
 - Background: Esri Topographic



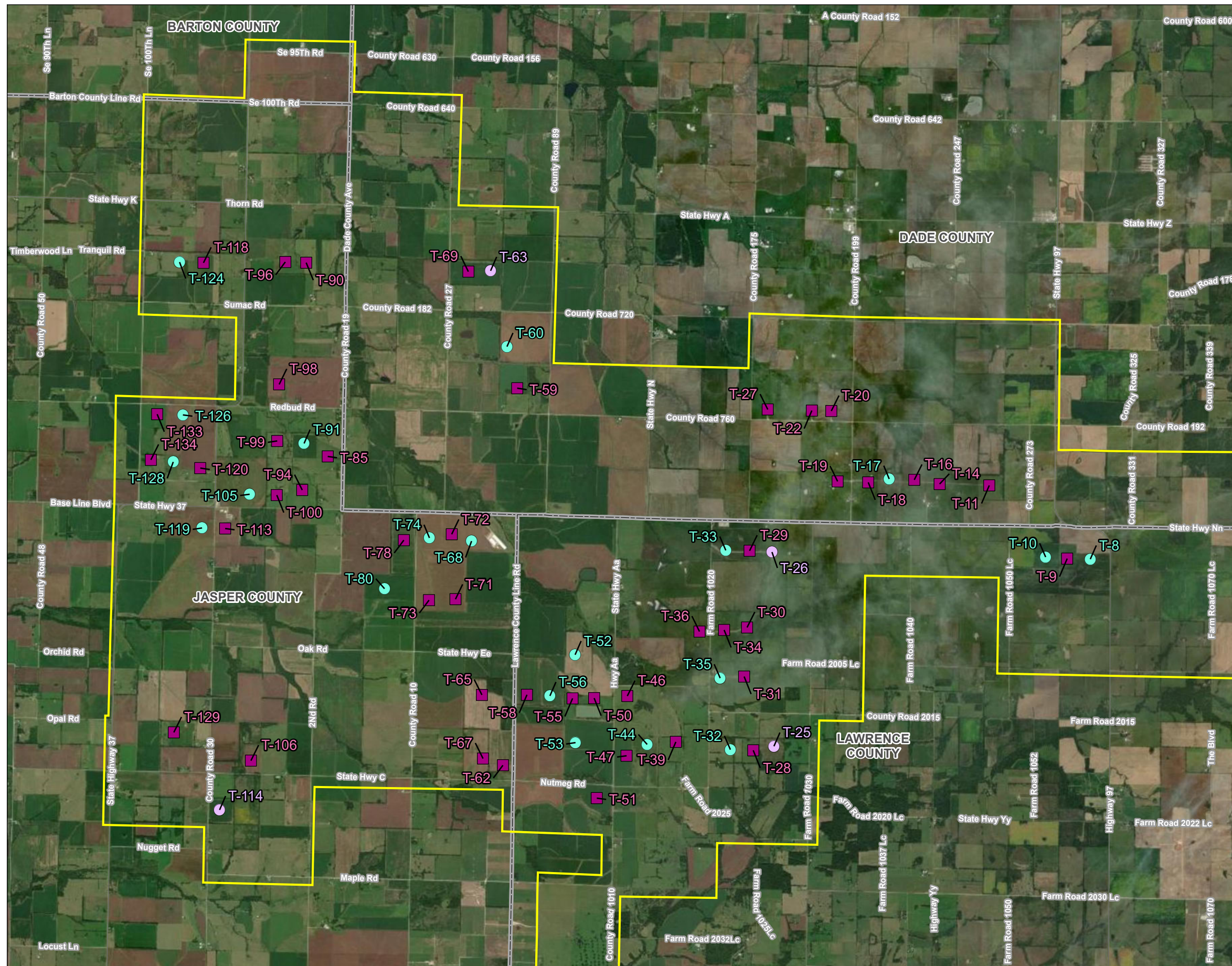


Figure No.

A-2

**Kings Point Post Construction Fatality
Monitoring Turbine Search Plot Type**

Client/Project
Empire District Electric Company
Kings Point Wind Project

93708398

Project Location
Barton, Dade, Jasper,
and Lawrence Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28



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(At original document size of 11x17)
1:63,360

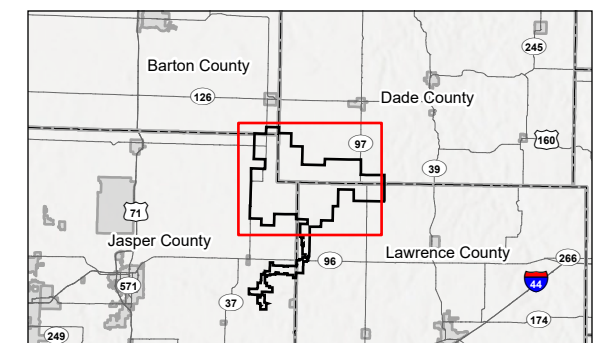
Legend

 Project Boundary

Turbine

Search Plot Type

- 100 m Cleared Plot
- 60 m Cleared Plot
- Road & Pad



Notes

- Notes**
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
 2. Data Sources: Empire, Stantec, Esri, NADS
 3. Background: 2020 NAIP



10Corpus data/Virtual_Workspace/workgroup1937/Active193708398_northforkridge103_data\gis_cad\gis\mxds\NorthForkRidge_PCM_Pro.aprx Revised: 2022-01-31 By: slpenry

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

\\Corp.acs\data\Virtual_Workspace\workgroup\1937\Active\193708398_northforkridge\03_data\gis_cad\gis\mxds\NorthForkRidge_PCM_Pro.aprx
Revised: 2022-01-28 By: slperry



Figure No. **A-3**

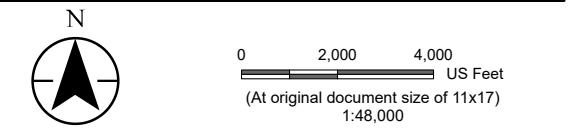
Title
**North Fork Ridge Post Construction
Fatality Monitoring Turbine Search Plot
Type**

Client/Project
Empire District Electric Company
North Fork Ridge Wind Project

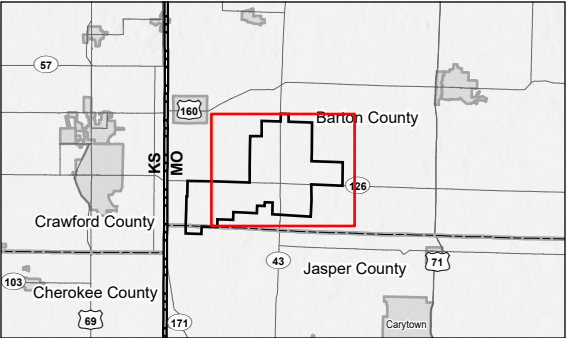
193708398

Project Location
Barton and Jasper Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28



- Legend
- Project Boundary
 - Turbine
 - Search Plot Type
 - 100 m Cleared Plot
 - 60 m Cleared Plot
 - Road & Pad



- Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
 2. Data Sources: Empire, Stantec, Esri, NADS
 3. Background: 2020 NAIP



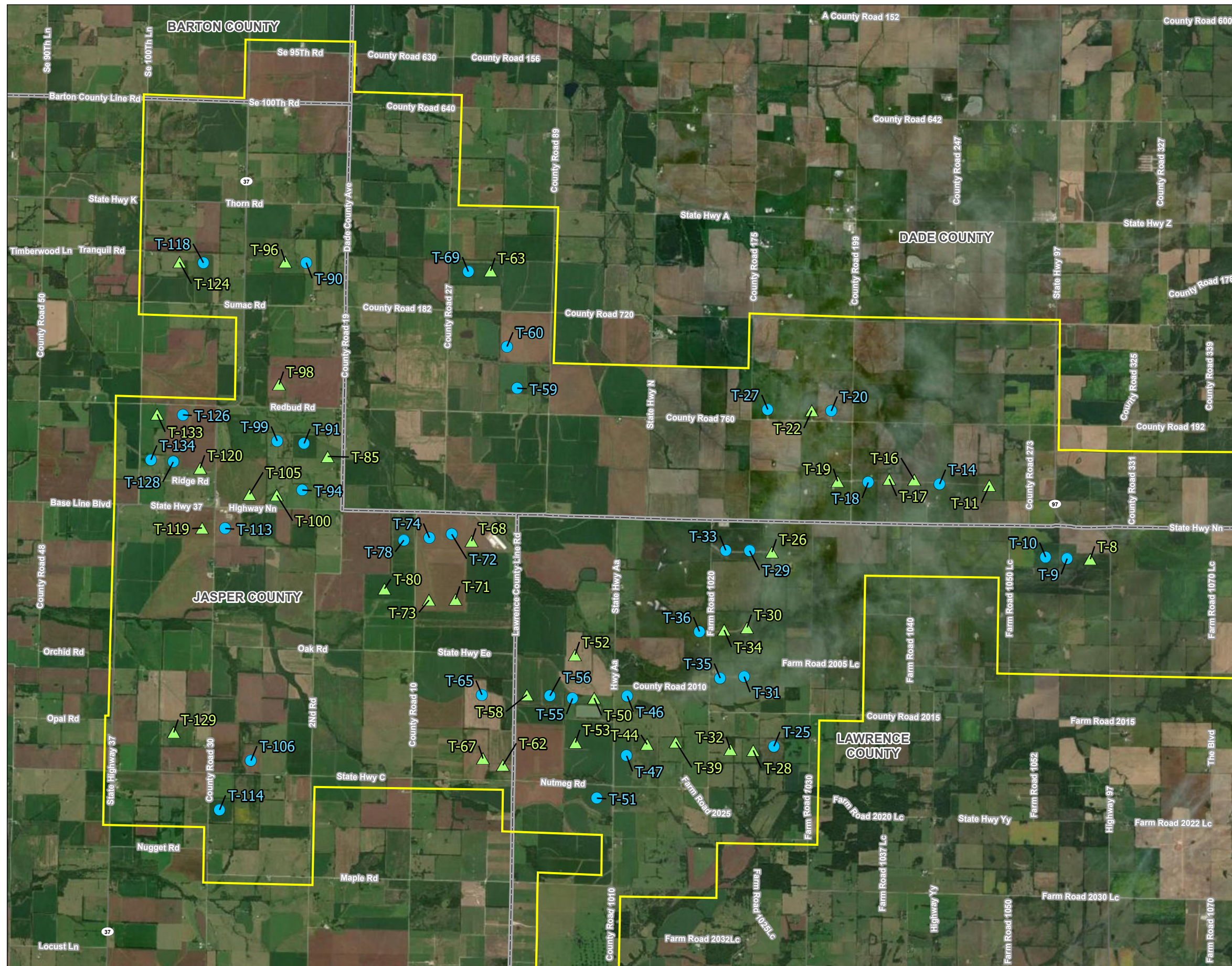


Figure No.

A-4

Title
Kings Point Turbine Operational Curtailment

Client/Project
Empire District Electric Company
Kings Point Wind Project

193708398




Project Location
Barton, Dade, Jasper,
and Lawrence Co., MO

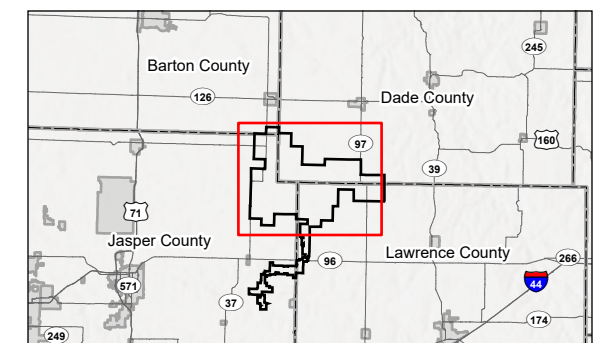
Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28



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(At original document size of 11x17)
1:63,360

Legend

-  Project Boundary
 Turbine
 Cut-in Speed
 Control (3 m/s)
 Treatment (5 m/s)



Notes

- Notes**
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
 2. Data Sources: Empire, Stantec, Esri, NADS
 3. Background: 2020 NAIP





Figure No.

A-5

Title
North Fork Ridge Turbine Operational Curtailment

Client/Project
Empire District Electric Company
North Fork Ridge Wind Project

93708398

Project Location
Barton and Jasper Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28



0 2,000 4,000 US Feet
(At original document size of 11x17)
1:48,000


Legend

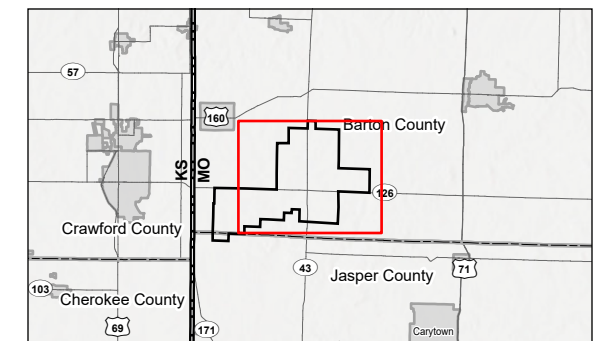
 Project Boundary

Turbine

Cut-in Speed

Control (3 m/s)

 Treatment (5 m/s)



Notes

- NOTES**
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
 2. Data Sources: Empire, Stantec, Esri, NADS
 3. Background: 2020 NAIP



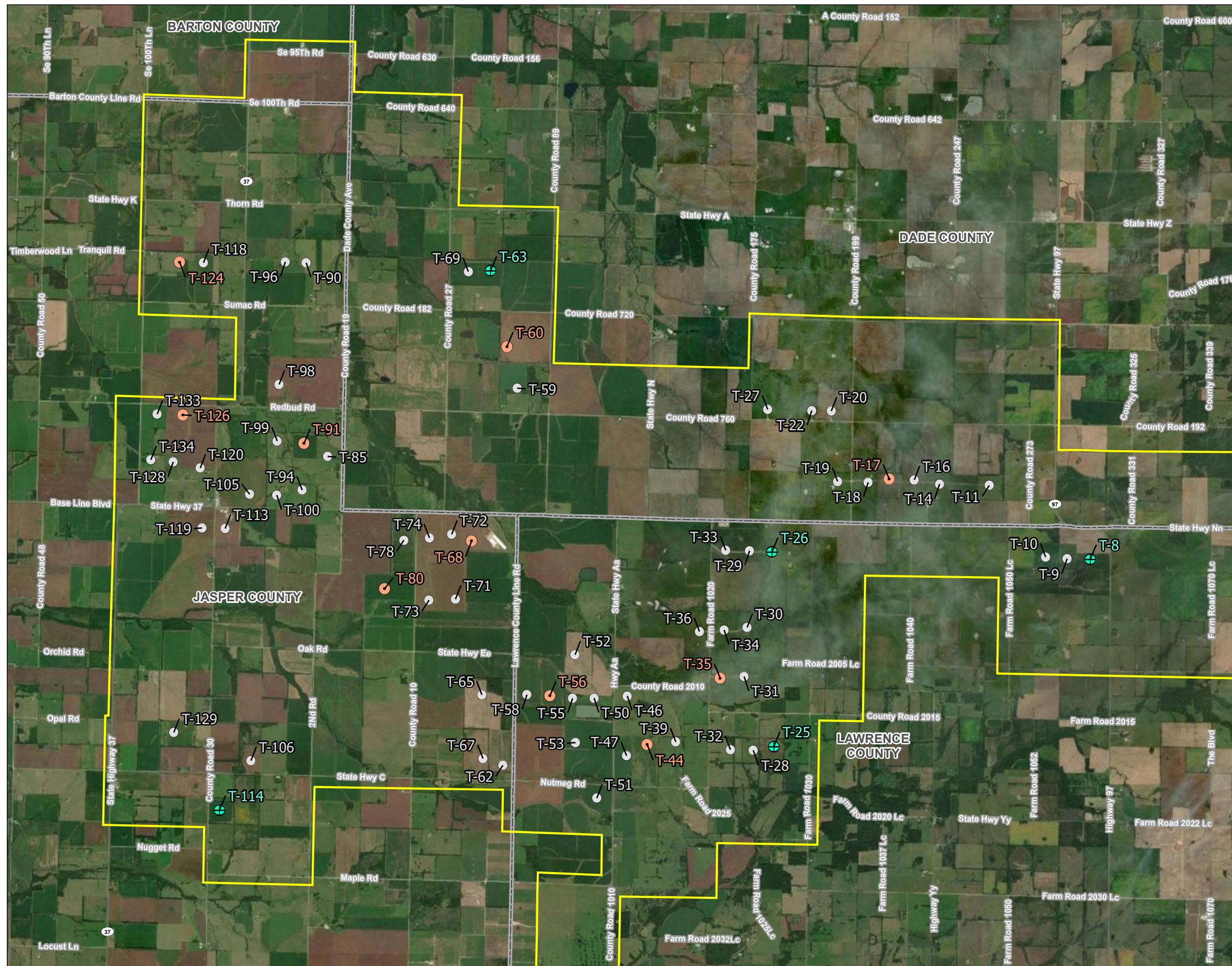


Figure No.

A-6

Title
**Kings Point Post Construction Fatality
Monitoring Turbine Bat Detector Type**

Client/Project
Empire District Electric Company
Kings Point Wind Project

93708398

Project Location
Barton, Dade, Jasper,
and Lawrence Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28






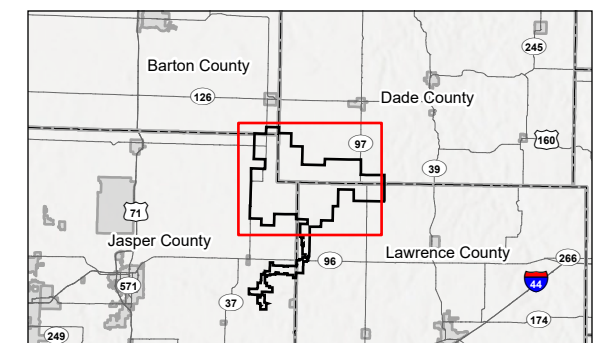
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(At original document size of 11x17)
1:63,360

Legend

-  Project Boundary

Turbine

- Detector Type
-  Nacelle
 -  Nacelle and Mid-Tower
 -  No Detector



Notes

- Notes**
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
 2. Data Sources: Empire, Stantec, Esri, NADS
 3. Background: 2020 NAIP





Figure No.

A-7

Title
North Fork Ridge Post Construction
Fatality Monitoring Turbine Bat Detector
Type

Client/Project
Empire District Electric Company
North Fork Ridge Wind Project

93708398

Project Location
Barton and Jasper Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28




0 2,000 4,000
US Feet
(At original document size of 11x17)
1:48,000


Legend

 Project Boundary

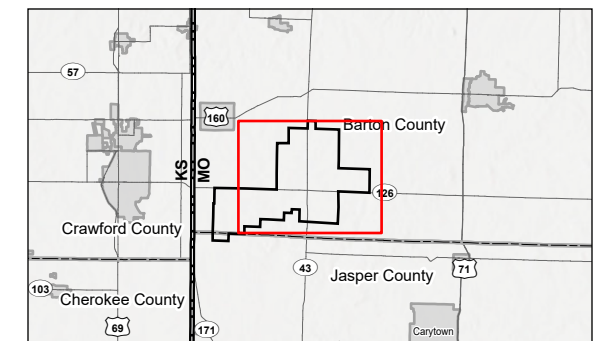
Turbine

Detector Type

 Nacelle

 Nacelle and Mid-Tower

☐ No Detector



Notes

Notes

1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP



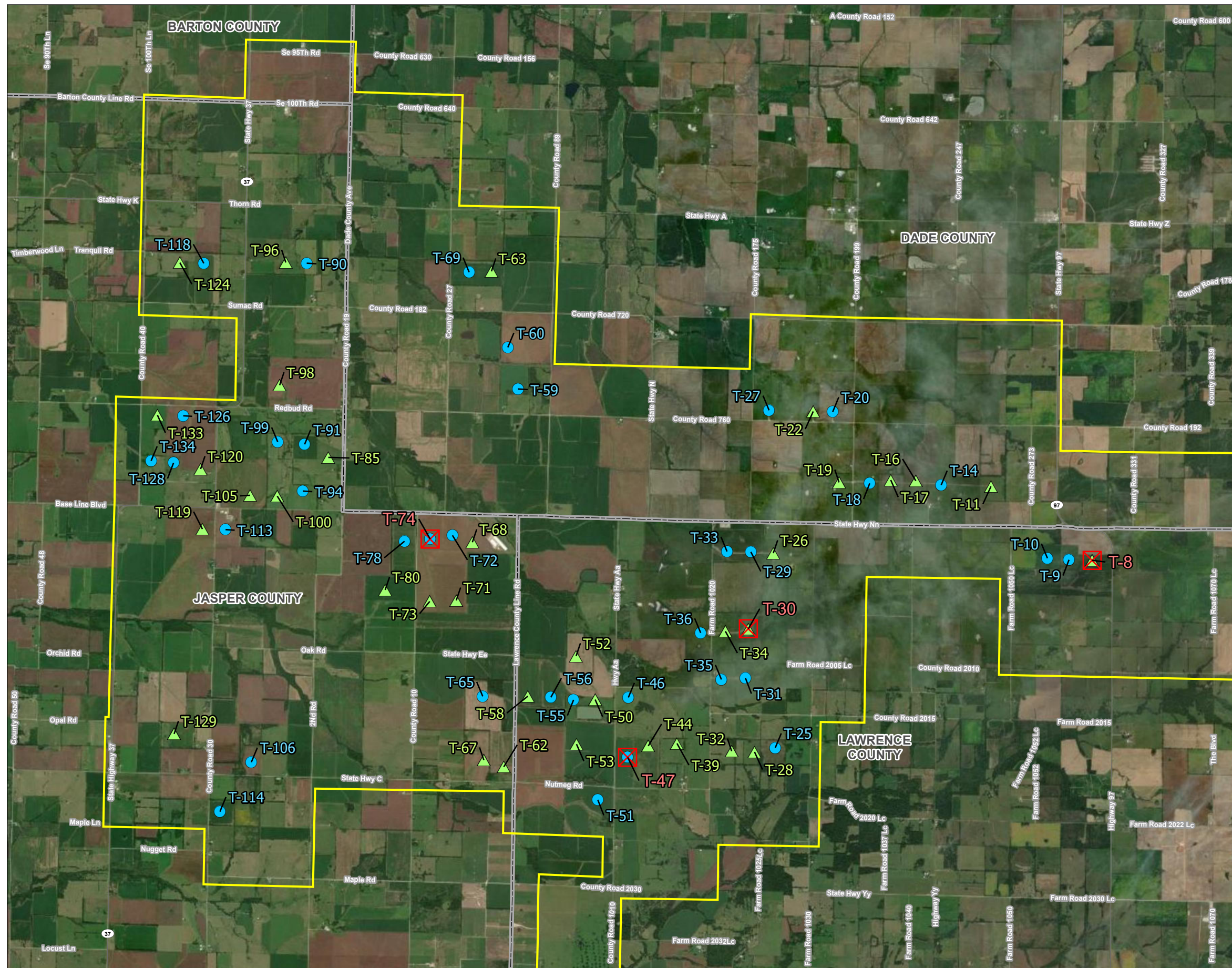


Figure No.

A-8

Title
**Kings Point Post Construction Fatality
Monitoring Gray Bat Observations**

Client/Project
Empire District Electric Company
Kings Point Wind Project

93708398



Project Location
Barton, Dade, Jasper,
and Lawrence Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28



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(At original document size of 11x17)
1:63,360

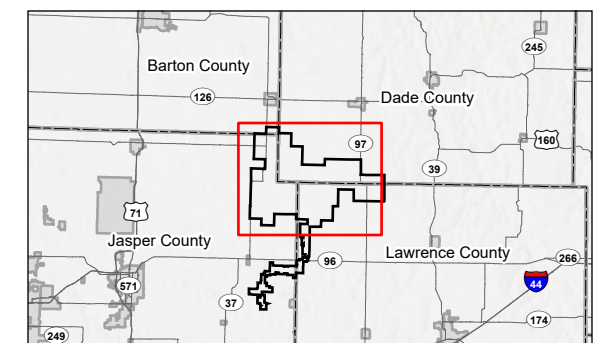
Legend

-  Project Boundary
-  Gray Bat Observation

Turbine

Cut-in Speed

- Control (3 m/s)
▲ Treatment (5 m/s)



Notes

- Notes**
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
 2. Data Sources: Empire, Stantec, Esri, NADS
 3. Background: 2020 NAIP



Appendix B GENETICS RESULTS





NORTHERN
ARIZONA
UNIVERSITY

School of Forestry



Genetic ID of Bat Sex

Client: Adam Rusk (Adam.Rusk@stantec.com), Stantec;
Invoice number 20211213_2.

Samples: We received four bat carcasses. After DNA extraction, we tested the sex of the individuals using the methods of Korstian et al. 2013. All non-template controls were negative for amplification and the positives controls amplified correctly.

Test date: 01/21/2022

Report date: 01/25/2022

Sample ID	Sex
T-030	Female
T-074	Male
8	Female
47	Female