FINAL HABITAT CONSERVATION PLAN FOR THE HIGH PRAIRIE RENEWABLE ENERGY CENTER

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Introduction

A Habitat Conservation Plan (HCP) has been developed for the High Prairie Renewable Energy Center (High Prairie Wind Farm or HPWF) in coordination with the U.S. Fish and Wildlife Service (USFWS) and the Missouri Department of Conservation (MDC). Ameren has determined that the operation of the HPWF may result in incidental take of bats, including mortality of the Indiana bat (*Myotis sodalis*), northern long-eared bat (*Myotis septentrionalis*), and little brown bat (*Myotis lucifugus*). The HCP has been prepared to manage risk associated with the following protected species:

- **Indiana bat**: The Project's location is within the range of the Indiana bat, a species listed as endangered under the Endangered Species Act (ESA) and the Wildlife Code of Missouri (3 CSR 10-4.111). In addition, this is considered a Species of Conservation Concern in Missouri.

- **Northern long-eared bat**: The Project's location is within the range of the northern long-eared bat, a species listed as threatened under the ESA and the Wildlife Code of Missouri (3 CSR 10-4.111). In addition, this is considered a Species of Conservation Concern in Missouri.

- **Little brown bat**: The Project's location is within the range of the little brown bat, a species that is not currently a federally- or state-listed, proposed, or candidate species; however, it is currently under a USFWS Discretionary Status Review on the National Listing Workplan. In addition, this is considered a Species of Conservation Concern in Missouri.

Below is a summary of the major elements of the HCP.

Take Estimation and Minimization Measures

Section 6.2 of the HCP outlines the methods used to calculate take, which include using regional data to determine an all-bat fatality estimate (Section 6.2.1), site-specific mist-net data on species composition (Section 6.2.3), and site-specific acoustic data from MET towers (Section 6.2.4), both applied to the overall all-bat fatality estimate, for an average take estimate of 42 little brown bats, 7 northern long-eared bats and 31 Indiana bats per year, before application of any minimization measures.

Operations will include **feathering turbine blades below a cut-in speed of 5.0 m/s at the HPWF from 45 minutes before sunset to 45 minutes after sunrise from April 1 – October 31 when air temperature is above 40ºF**, which is expected to yield an average mortality reduction of 62% for all bat species compared to no curtailment (see Section 7.2.1 and Table 7-1 of the HCP). Thus, the minimized take is expected to be:

- Little brown bat: 16 fatalities per year
- Northern long-eared bat: 3 fatalities per year
- Indiana bat: 12 fatalities per year

Over the 6-year permit term, the total direct take is estimated to be 72 Indiana bats, 96 little brown bats, and 18 northern long-eared bats.

Mitigation

Resource Equivalency Analysis (REA) models, which determine the biological impact to the species based on the taking of adult female bats, including the loss of the female bat and her lost reproductive potential, were used to determine the acres of mitigation (summer habitat protection) required to offset the take of 16 little brown bats, 3 northern long-eared bats, and 12 Indiana bats per year for 6 years. Due to the overlap in the covered species' habitat requirements, Ameren will use a mitigation bank that meets all three species requirements (and has documented presence on the site) and will thus "stack" the mitigation credits using the discount ratios published in the final MidAmerican Wind Energy HCP[1], which discounts each acre based on the number of species which will be mitigated by that acre. The stacking will apply to the three covered species. Mitigation that covers all 3 covered species will be increased by 20%, and mitigation that covers 2 species will be increased by 10%. The total mitigation requirement is 162.2 acres.

Post-construction Monitoring

Post-construction monitoring is described in Section 7.3 of the HCP and is the method by which Ameren will evaluate the effectiveness of the minimization measures and ensure that take of the covered species remains within the take limits set forth in the ITP. Because fatalities are expected to occur during the entire bat active season (April 1 – October 31), the post-construction monitoring will occur during this entire period as well.

The post-construction monitoring plan addresses all bat fatalities observed within the Permit Area due to operation of the HPWF. This includes the covered species, as well as any other bat species, including the tricolored bat. The monitoring plan is designed using the USGS Evidence of Absence (EofA) software designed by Dalthorp et al. (2017) to determine statistically whether Ameren has remained within given thresholds for take of the covered species.

Based upon a desired probability of detection (g) of above 0.2 for robust monitoring, the following monitoring plan will be implemented at the HPWF:

- A twice weekly search interval, and
- 60% road and pad searches (105 plots) and 40% cleared plot (60-meter circular cleared plots; 70 plots) searches.

This results in a projected overall probability of detection (g) of 0.213. This protocol will be implemented for the first year, and similar levels of detection probability will be targeted in years 2 and 3. Detection probability may be decreased in years 4 and 5 while maternity colony monitoring is being conducted (see below); however, an overall detection probability of at least 0.2 over the 6-year permit term will still be the goal.

Each year, the analysis of the post-construction monitoring data will include the following estimates:

- Annual take estimate (M_{YearX}; number estimated to have been killed that year)
- Cumulative take estimate ($M_{Cumulative}$; number estimated to have been killed to-date, sum of all previous years' monitoring results with the current year)

[1] https://ecos.fws.gov/docs/plan_documents/thcp/thcp_2970.pdf

- Annual take rate (λ)
- Projected take estimate ($M_{Projected}$; number estimated to have been killed to-date, plus the additional take likely to occur in the remaining years of the permit if the annual take rate continues)

Ameren will provide an annual mortality monitoring report to the USFWS and MDC within 45 days following the completion of each year of post-construction monitoring, as well as summaries 30 days after the end of each season (spring, summer and fall).

Maternity Colony Monitoring

Maternity colony monitoring for the covered species is described in Section 7.4 of the HCP and will be conducted either as part of adaptive management (see below), or in years 4 and 5. The persistence of maternity colonies within the Permit Area will be monitored utilizing mist-net surveys, with subsequent radio telemetry and emergence counts. The focus of maternity colony monitoring will be on the Indiana bat, but little brown bats will also be monitored if take is documented through post-construction monitoring. No northern long-eared bat maternity colonies were documented in 2016 or 2018, so tracking and emergence counts of northern long-eared bats will occur only if they are captured during monitoring for the other covered species.

Mist-net surveys will:

- Be conducted at a minimum of 20 mist-net site locations (based on sites surveyed in 2016 and 2018, see Section 3.4.2.4 of the HCP or based on habitat areas surveyed as part of adaptive management, see Section 7.5.1 of the HCP).
- Be conducted between May 15 and August 15
- Follow current USFWS guidelines.
- Target a minimum of two mist-net sites within each maternity colony identified in 2016 and 2018.
- Track up to three bats per species (if captured) for up to seven days, targeting a minimum of 14 roosting events (1 roosting event would be equivalent to 1 bat tracked for 1 calendar day) per maternity colony.
- Be coordinated with USFWS and MDC to ensure the study design is expected to yield significant results, and results will be comparable to off-site control studies and data.

If no mist-netting occurs due to adaptive management, then in one year (either year 4 or year 5 of the permit), mist-netting will be conducted at 10 sites within Schuyler County, and in the other year, mist-netting will be conducted at 10 sites within Adair County, spreading survey effort across the Permit Area (this level of effort may be decreased if mist-netting occurs during adaptive management).

Results of mist-netting will be compared to pre-construction survey results, as well as to control sites being monitored by the MDC at Rebel's Cove and Indian Hills (or other comparable sites found in coordination with USFWS and MDC). If capture rates or emergence counts have decreased significantly (≥30%) from pre-construction surveys, Ameren will compare the results to those seen at the MDC control sites to see if similar declines are occurring due to WNS and will also analyze the post-construction monitoring data to determine if take from the HPWF could have resulted in significant declines to any individual maternity colony.

This analysis will include fatalities during the summer maternity season (May 15 to August 15), spring migration (April 1 to May 14), and the beginning of fall migration (August 15 through September 30) at turbines within:

- 2.5 miles of an Indiana bat maternity colony,
- 1.5 miles of a northern long-eared bat maternity colony (if one is discovered), or
- 3.9 miles of a little brown bat maternity colony.

Adaptive Management

Adaptive management provides a measure to respond to changes in the fatality rates of the covered species, ensuring that ineffectiveness of minimization or changes in other conditions will not result in take above the permitted levels. Adaptive management is described in Section 7.5 of the HCP, and is based on the calculated level of take, after accounting for bats that may have been killed but missed during monitoring.

Adaptive Management for Maternity Colony Impacts

In addition to monitoring the maternity colonies (as described above), Ameren will look at the location of the fatalities that occurred during the summer maternity season (May 15 to August 15), spring migration (April 1 through May 14), and the first six weeks of fall migration (August 16 through September 30) to determine if any particular maternity colony may be experiencing take at a level higher than anticipated. This process is fully described in Appendix B of the HCP. In summary, Ameren will create a buffer around any turbine that had a documented take of an adult female of a covered species during the summer maternity season. This buffer will be based on known foraging distances and predicted home range sizes; specifically:

- 2.5-mile buffer for Indiana bats (based on a 2.5-mile foraging distance),
- 1.5-mile buffer for northern long-eared bats (based on a 1.5-mile foraging distance), and
- 3.9-mile buffer for little brown bats (based on a 3.9-mile foraging distance).

Adaptive management will be triggered if the adaptive management threshold for a covered species is triggered within a given buffer during the maternity season and the projected level of take within the buffer hits the thresholds described in Appendix B. Ameren will evaluate the suitable habitat that could contain a maternity colony where multiple bats originated from, and presence/absence surveys (i.e., acoustics, mist-netting) will be conducted if necessary. If adaptive management is triggered, Ameren will operate at avoidance (up to full turbine shutdown) during the summer period at affected turbines (those within the foraging distance of the maternity colony which caused the trigger) to avoid additional risk and continue post-construction monitoring (at operational turbines) to ensure additional take from that colony does not occur.

Adaptive Management for the Permitted Level of Take

The annual take rate (λ) and the projected take estimate ($M_{Projected}$) for each species (all ages and sexes) will be used to trigger adaptive management to prevent the cumulative take estimate ($M_{Cumulative}$) from reaching the take limits of any of the covered species (see Section 7.5). If the conservation measures are not producing the desired results, adjustments will be made to the operational protocols as necessary to achieve the biological objectives of this HCP.

Financial Assurances

If Ameren obtains an ITP from the USFWS, Ameren agrees to guarantee all funding obligations under this HCP (see Section 8.1.4). Funding assurance has been provided in the form of a Surety. The Surety is used to provide funding assurances for those portions of the conservation program that are not yet actually implemented. Ameren has provided funds required to implement mortality and maternity colony monitoring to comply with its obligations under this HCP and ITP. Ameren will be responsible for the continued implementation of the HCP throughout the 6-year ITP term.

Abbreviations

Ameren (Applicant)	Ameren Missouri
AWEA	American Wind Energy Association
BBCS	Bird and Bat Conservation Strategy
BCI	Bat Conservation International
BCID	Ball Call Identification
BO	Biological Opinion
CBD	Center for Biological Diversity
CFR	Code of Federal Regulations
DBH	Diameter at breast height
DW	Defenders of Wildlife
EA	Environmental Assessment
ECP	Eagle Conservation Plan
EIS	Environmental Impact Statement
EofA	Evidence of Absence
ESA	Endangered Species Act
ETP	Eagle Take Permit
EUs	Electric utilities
F	Fahrenheit
FAA	Federal Aviation Administration
FONSI	Finding of No Significant Impact
GIS	Geographic Information Systems
GPS	Global Positioning System
HCP	Habitat conservation plan
HDD	Horizontal directional drilling
HPWF (or Project)	High Prairie Wind Farm (i.e., High Prairie Renewable Energy Center)
IA	Implementation agreement
ITP	Incidental take permit
kV	Kilovolt
m/s	Meters per second
MDC	Missouri Department of Conservation
MET	Meteorological
MNHP	Missouri Natural Heritage Program
mph	Miles per hour
MSHCP	Multi-species Habitat Conservation Plan
MW	Megawatt
NEPA	National Environmental Policy Act
NLCD	National Land Cover Database
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
NRU	Northeast Recovery Unit
NYDEC	New York Department of Environmental Conservation
O&M	Operations and maintenance
OCRU	Ozark-Central Recovery Unit
REA	Resource Equivalency Model
ROD	Record of Decision
rpm	Revolutions per minute
T&E	Threatened and endangered
TG	Terra-Gen Development Company, LLC
TG High Prairie	TG High Prairie, LLC
UC – Santa Cruz	University of California – Santa Cruz
UEC	Underground electrical collector
USC	United States Code
USFS	U.S. Forest Service

USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UV	Ultraviolet
WDNR	Wisconsin Department of Natural Resources
WNS	White-nose syndrome
WTGs	Wind turbine generators

1.0 INTRODUCTION

1.1 APPLICANT INFORMATION

The High Prairie Renewable Energy Center (High Prairie Wind Farm or HPWF or Project), is owned and operated by Ameren Missouri, formerly known as Union Electric (Ameren or Applicant). The Project was built by TG High Prairie, LLC (TG High Prairie), a Delaware limited liability company and an indirect, wholly owned subsidiary of Terra-Gen Development Company, LLC (TG). The Applicant is headquartered in St. Louis, Missouri.

The Project was developed by TG High Prairie under the terms of a 'Build-Transfer Agreement' with Ameren. Upon completion of the Project TG High Prairie transferred all of its' assets and liabilities to Ameren who became the successor-in-interest and is responsible for all aspects of the Project. As the Applicant, Ameren is responsible for all outstanding and ongoing obligations set forth in any incidental take permit (ITP) issued to the Applicant for the Project, including those reflected in the associated Habitat Conservation Plan (HCP). Accordingly, the Applicant will comply with qualification, assurance, and mitigation requirements necessary to hold such permit and with all other requirements of the permit and HCP.

The Project is anticipated to operate for at least 30 years; however, the ITP and HCP is limited to a six-year term in order to collect data on site-specific impacts. While this HCP uses the best available science to predict the fatality rates for the Project, site-specific post-construction data will provide a more accurate representation of bat fatality rates at the Project. Ameren will apply for a separate long-term HCP (to support the remaining operating time of the wind facility) prior to the expiration of the 6-year permit, and the conservation program of the long-term HCP will be based off of the site-specific data collected during the initial short-term permit. The parties to the HCP fully acknowledge that the 6-year permit does not create the expectation for a subsequent long-term permit. In addition, the applicant and Ameren will accept any conditions of the 6-year ITP that would prohibit renewal of the short-term permit. If seamless transfer of operation from the 6-year ITP to a new, long-term ITP is desired, Ameren, or its duly authorized successor-in-interest acknowledge the obligation to submit a new ITP application at least 12 months prior to the expiration of the initial ITP to allow sufficient time for review by the USFWS, coordination with MDC, and public comment. In the event a new ITP has not been issued prior to the expiration of the initial 6-year permit, Ameren will operate the wind facility in a manner that avoids take of federally-listed bat species. Such measures may include, without limitation, raising cut-in speeds during night-time hours during the bat active season or other operating practices as may develop. Nothing herein shall obligate the USFWS to issue a permit for the remainder of the operating life for High Prairie project, or that such new permit contains substantially similar conditions to that of the initial, 6-year short-term permit.

1.2 BACKGROUND

In November 2008, Missouri enacted legislation known as the Missouri Clean Energy Act (via state statute 393.1020 R.S. Mo., et seq.) that established annual minimal benchmarks for renewable energy generation and energy efficiency. Under this program, electric utilities (EUs) in Missouri are required to provide at least 15% of their retail electric supply from renewable energy sources, including wind, by 2021. Given the legislative objectives of the state of Missouri for increased renewable energy generation, TG High Prairie developed the HPWF.

1.3 PURPOSE AND NEED

1.3.1 Purpose and Need of the Project

The purpose of the project is to maximize production of renewable energy at the HPWF in an environmentally responsible manner. The need for the project is to provide renewable energy in the state of Missouri as per the legislative objectives related to renewable energy described above in Section 1.2.

1.3.2 Purpose and Need of the Habitat Conservation Plan (HCP)

The purpose of this habitat conservation plan (HCP) is to support an Incidental Take Permit (ITP) application. This is needed because operating wind turbines may present a source of mortality to bats occurring within a wind energy project site. Ameren has determined that the operation of the Project may result in incidental take of bats, including mortality of the Indiana bat (*Myotis sodalis*), northern long-eared bat (*Myotis septentrionalis*), and little brown bat (*Myotis lucifugus*). Accordingly, Ameren is requesting the issuance of an incidental take permit (ITP) pursuant to section 10(a)(1)(B) of the Endangered Species Act (ESA).

Through the implementation of this HCP, Ameren seeks to minimize and mitigate the impacts of any incidental take of the Indiana bat, northern long-eared bat, and little brown bat due to the operation of the Project. This HCP has been developed to describe how Ameren will meet the issuance criteria for an ITP under section 10(a)(1)(B) of the ESA. That section authorizes the issuance of an ITP if the applicant implements an HCP which the USFWS finds meets the following criteria, as paraphrased:

- The taking will be incidental;
- Impacts of incidental take will be minimized and mitigated to the maximum extent practicable;
- Adequate funding for the HCP and procedures to deal with unforeseen circumstances will be provided;
- Take will not appreciably reduce the likelihood of the survival and recovery of the covered species in the wild;
- Other measures that the USFWS may require as being necessary or appropriate will be provided; and
- Other assurances as may be required that the HCP will be implemented have been received.

This HCP covers the first six years of operations at the HPWF (see Section 6.1.1) during which site-specific post-construction monitoring data will be collected (see Section 7.3) and used to inform take estimates for an anticipated longer-term HCP covering the rest of the project life.

1.4 HABITAT CONSERVATION PLAN CONTENTS

This HCP has been prepared in accordance with the requirements set forth under section 10(a)(1)(B) of the ESA, as amended, and applicable U.S. Fish and Wildlife Service (USFWS) guidance documents. This HCP has followed the Habitat Conservation Planning Handbook (USFWS and National Marine Fisheries Service [NMFS] 2016), which provides policy and guidance for section 10(a)(1)(B) procedures to promote efficiency and nationwide consistency within and between the USFWS and NMFS. However, all species covered in this HCP are under the sole jurisdiction of the USFWS. The HCP has been prepared to manage risk associated with the following protected species:

- **Indiana bat**: The Project's location is within the range of the Indiana bat, a species listed as endangered under the ESA and the Wildlife Code of Missouri (3 CSR 10-4.111). In addition, this is considered a Species of Conservation Concern in Missouri (MDC 2018d).
- **Northern long-eared bat**: The Project's location is within the range of the northern long-eared bat, a species listed as threatened under the ESA and the Wildlife Code of Missouri (3 CSR 10-4.111). In addition, this is considered a Species of Conservation Concern in Missouri (MDC 2018d).
- **Little brown bat**: The Project's location is within the range of the little brown bat, a species that is not currently a federally- or state-listed, proposed, or candidate species; however, it is currently under a USFWS Discretionary Status Review on the National Listing Workplan. In addition, this is considered a Species of Conservation Concern in Missouri (MDC 2018d).

Specifically, this HCP provides the following:

- An overview of the regulatory framework of wind projects as it relates to species protection;
- A description of the Permit Area and Plan Area;
- A description of the Project and definition of activities to be covered under the HCP;
- Alternatives considered;
- A discussion of the general environmental setting and biological resources within the Permit Area, and summary of survey conducted within the Permit Area;
- A discussion of the life history and presence in the Permit Area of the Indiana bat;
- A discussion of the life history and presence in the Permit Area of the northern long-eared bat;
- A discussion of the life history and presence in the Permit Area of the little brown bat;
- Potential effects of the proposed action;
- Estimates of the Project's take and a description of the impact of that take for each species';
- A Conservation Plan, outlining measures to avoid, minimize, and mitigate potential take, conduct post-construction monitoring for effectiveness, and implement adaptive management measures as appropriate; and
- An implementation plan.

Incidental take authorized within the scope of a section 10(a)(1)(B) permit issued to Ameren will include – under specific circumstances and limits – direct and indirect mortality from project operations.

As part of the requirements for the issuance of an ITP, Ameren has prepared this HCP to identify those actions that will minimize and mitigate the impacts of the potential take of the Indiana bat, northern long-eared bat, and little brown bat that may occur as a result of operation of the HPWF.

2.0 BACKGROUND

2.1 OVERVIEW

TG High Prairie developed the 400-MW wind farm in Adair and Schuyler counties, Missouri, near Queen City (Figure 1), which is now owned and operated by Ameren (the Applicant). Construction was completed and commercial operations began in December 2020. The requested ITP would cover operations during the bat active season following permit issuance. The final project layout consists of 175 wind turbine generators (WTGs; 163 2.2-MW and 12 3.45-MW turbines) and associated access roads, an underground electrical collection system, and overhead transmission lines. Two substations were constructed within the Permit Area (see Section 2.4), a northern and southern substation. An interconnection switchyard was also constructed adjacent to the 345-kilovolt (kV) Zachary to Appanoose Transmission Line through which the Project is interconnected to the Zachary to Appanoose Transmission Line.

2.2 PERMIT DURATION

Ameren is seeking a six-year ITP for the Indiana bat, northern long-eared bat, and little brown bat. This limited-term HCP covers the first six years of project operations. This HCP identifies the measures intended to assure that the effects of the incidental take will be minimized and mitigated to the maximum extent practicable. The results of the site-specific post-construction monitoring collected under the limited-term HCP could then be used, if appropriate, to estimate take for the development of a new, separate, life-of-project HCP to be implemented in year seven of operations.

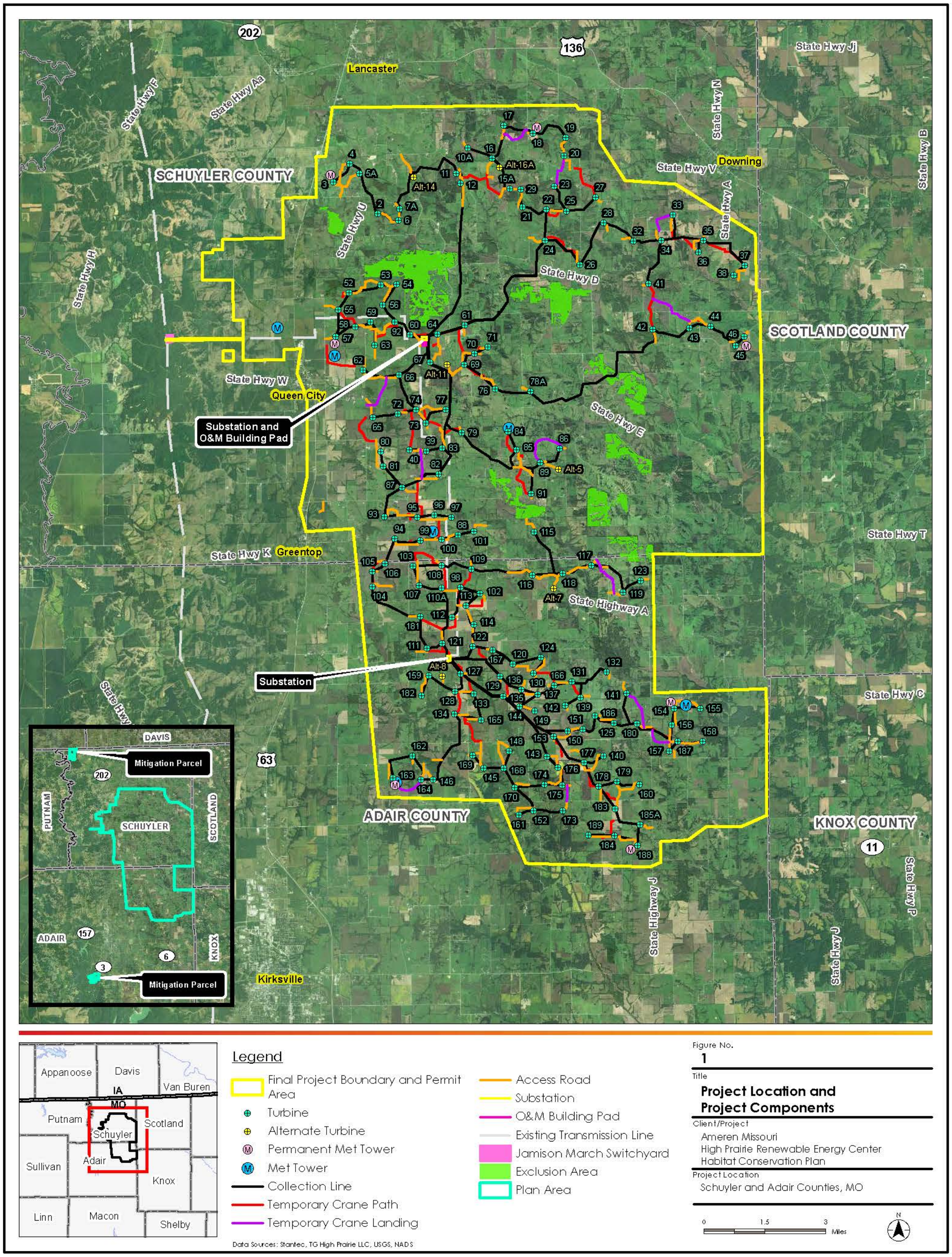

Figure 1. Project Location and Project Components

2.3 REGULATORY AND LEGAL FRAMEWORK

2.3.1 Endangered Species Act

Section 7(a)(2) of the ESA requires all federal agencies, in consultation with the USFWS, to ensure that any action "authorized, funded, or carried out" by any such agency "is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification" of critical habitat. Actions of federal agencies that are not likely to jeopardize the continued existence of listed species or result in destruction or adverse modification of their designated critical habitat, but that could adversely affect the species, or result in a take, must be addressed under section 7 of the ESA.

Section 9 of the ESA prohibits the "take" of any fish or wildlife species listed under the ESA, as endangered. Under federal regulation, take of fish or wildlife species listed as threatened is also prohibited, unless otherwise specifically authorized by regulation. Take, as defined by the ESA, means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect a listed species, or attempt to engage in any such conduct" [ESA §3(19)].

Section 9 of the ESA also prohibits the removal and reduction to possession of any listed plant species "under federal jurisdiction," as well as the removal, damage, or destruction of such plants on any other areas in knowing violation of any state law or regulation or in violation of state trespass law.

The USFWS' implementing regulations further define the term "harm" to mean "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering."

The 1982 amendments to the ESA established a provision in section 10 of the ESA that allows for "incidental take" of T&E species of wildlife by non-federal entities. Incidental take is defined by the ESA as take that is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity" [50 Code of Federal Regulations (CFR) §402.02].

Section 10 of the ESA establishes a program whereby persons seeking to pursue activities that otherwise could give rise to liability for unlawful "take" of federally protected species as defined in section 9 of the ESA, may receive an ITP, which exempts them from such liability. Under section 10 of the ESA, applicants may be authorized, through issuance of an ITP, to conduct activities that may result in take of a listed species, if the take is incidental to, and not the purpose of, otherwise lawful activities.

The USFWS is charged with regulating the incidental taking of listed species under its jurisdiction.

The submission of an ESA section 10(a)(1)(B) permit application requires the development of an HCP (16 United States Code [USC] §1539(a)(1)(B) and 1539(a)(2)(A)). The HCP must demonstrate that the impacts of incidental take have been minimized and mitigated to the maximum extent practicable. Incidental take may be permitted through the issuance of an ITP if the following six criteria of section 10(a)(2)(B) and 50 CFR 17.22(b)(2) and 50 CFR 17.32 (b)(2) are met (paraphrased below):

1. The take will be incidental to otherwise lawful activities.

2. The Applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking.

3. The Applicant will ensure that adequate funding for the HCP and procedures to deal with unforeseen circumstances will be provided.

4. The taking will not appreciably reduce the likelihood of the survival and recovery of the listed species in the wild.

5. The Applicant will ensure that other measures that the USFWS may require as being necessary or appropriate will be provided.

6. The USFWS has received such other assurances as may be required that the HCP will be implemented.

An ITP can only be issued if the HCP addresses all these requirements. To demonstrate that all six requirements have been adequately addressed, the HCP must document and describe:

1. Impacts likely to result from the proposed taking of the species for which permit coverage is requested;

2. Measures the project will undertake to monitor, minimize, and mitigate such impacts;

3. Funding that will be made available to undertake such measures;

4. Procedures to deal with unforeseen circumstances;

5. Alternatives that were considered that would not result in incidental take, and the reasons why such alternatives are not being utilized; and

6. Other necessary and appropriate measures the USFWS may require as necessary or appropriate for purposes of the plan.

The issuance of the ITP is a federal action and therefore the USFWS is required under section 7 of the ESA to evaluate the effects of the proposed action (i.e., issuance of an ITP) and establish an overall effect determination. The results of the section 7 evaluation will be a Biological Opinion (BO) that analyzes the HCP and other relevant information for the effects on the listed species and analyzes whether the proposed action will be likely to jeopardize the continued existence of the species or destroy or adversely modify designated critical habitat.

2.3.2 Wildlife Code of Missouri

The Wildlife Code of Missouri (3 CSR 10-4.111), published by the Missouri Secretary of State, extends special protection to endangered wildlife, and lists species considered to be threatened with extinction. The Code prohibits the importation, transportation, sale, purchase, taking, or possession of any endangered species of wildlife, or hides or other parts thereof, or the sale or possession with intent to sell of any article made in whole or in part from the skin, hide, or other parts of any endangered species of wildlife is prohibited without a permit from the Missouri Department of Conservation (MDC). The Code does not provide for the permitting of “incidental take” of state-listed species.

2.4 PERMIT AREA AND PLAN AREA

The HCP Handbook (USFWS and NMFS 2016) defines the “Plan Area” as where the HCP applies, and the “Permit Area” as where the incidental take authorization applies. Both the Plan Area and Permit Area are clearly geographically delineated as depicted in Figure 1. The data files used in Figure 1 include the precise boundaries of these areas and have been provided to the USFWS as part of the ITP application package.

The 114,090.2-acre Plan Area includes all areas that will be affected directly and indirectly by activities associated with operation of HPWF. This includes the entire Permit Area (explained below), as well as areas of mitigation. The areas of mitigation are the land credits purchased from the Chariton Hills Conservation Bank and includes 217 acres of mitigation, which are further described in Section 7.2.2 and shown on Figure 1.

The 113,873.2-acre Permit Area is the geographic area within the project boundary where the impacts of the activities occur for which ITP coverage is requested (Figure 1). The HPWF has direct control of the turbines and associated areas (e.g., access roads and turbine pads) within the Permit Area through land leases. Ameren has no control over landowner activities on these properties to the extent not covered in specific lease provisions.

2.5 PROJECT DESCRIPTION

The HPWF is a wind farm located in Adair and Schuyler counties in Missouri (Figure 1). Land use throughout the Permit Area is dominated by agricultural land (i.e., row crops and pasture) and woodlands. Both large and small tracts of forest, rural residences, and farmsteads are scattered throughout the Permit Area (see Section 3.2).

The final project layout consists of WTGs and associated access roads, an underground electrical collection system, substations, a switchyard, meteorological (MET) towers, an O&M building, and overhead transmission lines. During construction, a temporary laydown yard, temporary batch plants, and temporary crane paths were used (Figure 1). The temporary and permanent impacts associated with each of the project components are summarized in Table 2-1 and are further described in the sections below. All areas of temporary disturbance were restored to their original land use after construction, including grading to original contours and hydroseeding of an approved seed mix (or is farmed by the landowner if the disturbance is within a crop field).

Table 2-1. Temporary and permanent impacts associated with the construction and operation of the High Prairie Renewable Energy Center, Adair and Schuyler Counties, Missouri.

Project Component	Temporary Impacts (acres)	Permanent Impacts (acres)
Wind Turbines	386.5	7.9
Access Roads	313.2	125.3
Crane Paths	229.8	0
Laydown Areas	15.0	0
Underground Collection System	181.3	0
Substations (2)	11	11
MET Towers (max disturbance)	0.1	0.1
O&M Building	0.7	0.5
Generation Tie Line/Substation Line	129.9	116.9
Interconnection Switchyard/Legs	16.5	16.5

Project Component	Temporary Impacts (acres)	Permanent Impacts (acres)
Poles and Pull Sites	39.1	1.1
Batch Plants	6.0	0
Total	1,329.1	279.3

The Project also has a Bird and Bat Conservation Strategy (BBCS), which includes an Eagle Conservation Strategy, to address impacts to migratory birds, bats, and eagles and to outline avoidance and minimization measures and adaptive management strategies in place for these species.

2.5.1 Project

The HPWF was designed to generate approximately 400 MW with 163 2.2-MW and 12 3.45-MW WTGs. The Permit Area is located on land that has been purchased or leased as part of the development of the HPWF. As a leaseholder, Ameren's rights are limited to those outlined in the lease agreement to allow for safe and effective construction, operation, maintenance, and decommissioning of the HPWF. Ameren has no control over landowner activities on the property within which the HPWF is located to the extent not covered in specific lease provisions.

Additional detail of various project infrastructure components is provided in the following sections.

2.5.1.1 Turbines

There are two models (163 V120 2.2-MW and 12 V112 3.45-MW) of Vestas wind turbines in the Permit Area. Each wind turbine consists of three major components: the tower, the nacelle, and the rotor/blades. The height of the tower is known as the "hub height" which is the height from foundation to the center of the hub. The nacelle sits atop the tower, and the rotor hub is mounted to the front of the nacelle. The total turbine height equates to the height at the highest blade tip position to foundations (i.e., 12 o'clock position). Descriptions and specification of each of the turbine components are provided below.

Tower: The tubular towers used for the HPWF are conical steel structures manufactured in multiple sections. Each tower has an access door, internal lighting, and an internal ladder to access the nacelle. The towers are painted light gray to make the structure visible to aircraft (viewing against the ground) but decrease visibility against the sky. The Vestas V120 2.2-MW turbines have a hub height of approximately 302 feet, and the Vestas V112 3.45-MW turbines have a hub height of approximately 308 feet (Figure 2).

Nacelle: The main mechanical components of the wind turbine are housed in the nacelle. These components include the drive train, gearbox, and generator. The nacelle is housed in a steel reinforced fiberglass shell that protects internal machinery from the environment and dampens noise emissions. The housing is designed to allow for adequate ventilation to cool internal machinery. The nacelle is equipped with an external anemometer and a wind vane that signals wind speed and direction information to an electronic controller. The nacelle is mounted on a bearing that allows it to rotate (yaw) into the wind to maximize energy capture. A single, medium intensity aviation warning light is attached to the top of each nacelle for all turbines located within the Permit Area, per specifications of the Federal Aviation Administration (FAA). These lights are flashing red strobes (L-864) and operate only at night.

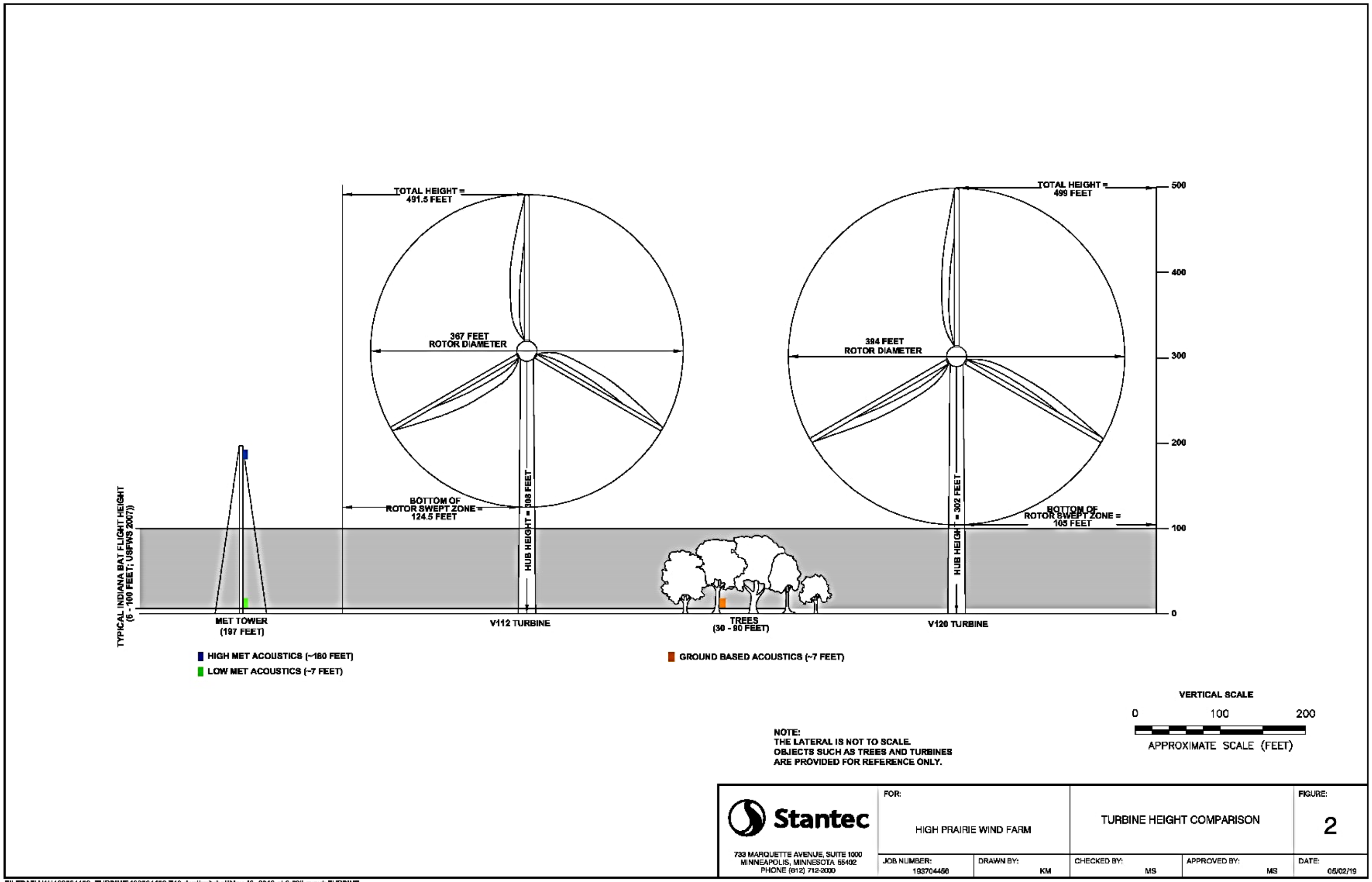

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Figure 2. Wind Turbine Height Comparison

Rotor/Blades: A rotor assembly is mounted to the nacelle to operate upwind of the tower. Each rotor consists of three composite blades. The rotor attaches to the drive train at the front of the nacelle. Hydraulic motors within the rotor hub feather (i.e., to reduce the blade angle to the wind to slow or stop the turbine rotor from spinning) each blade according to wind conditions, which enables the turbine to operate efficiently at varying wind speeds. The rotor can spin at varying speeds to operate more efficiently at lower wind speeds. The wind turbines begin generating energy (i.e., cut-ins) at wind speeds as low as 6.7 miles per hour (mph; cut-in speed; 3.0 meter per second [m/s]) and cut out when wind speeds reach 60 mph (25 m/s; cut-out speed). The Vestas V120 2.2-MW turbines have a rotor diameter of approximately 394 feet, while the Vestas V112 3.45-MW turbines have a rotor diameter of approximately 367 feet.

Steel reinforced concrete foundations were constructed to anchor each WTG. A pad mounted transformer was installed at the base of each WTG, which collects electricity generated by each turbine through cables routed down the inside of the tower. Approximately 386.5 total acres of temporary disturbance and 7.9 total acres of permanent disturbance occurred related to the construction and operation of the WTGs.

2.5.1.2 Access Roads and Crane Paths

Primary access to the Permit Area is from U.S. Route 63. Access roads were constructed within the Permit Area consisting of 64.6 miles of new roads and 80 miles of upgraded existing roads, designed to minimize impact. Initially, access roads were approximately 40 feet wide to accommodate safe operation of construction equipment and were later be reclaimed and narrowed to a permanent width of 16 feet or the width of the existing road, once construction was completed, to allow for regular access to turbines for maintenance. The pad around the turbine base extends out approximately 18 ft at each turbine. Approximately 313.2 acres of temporary disturbance and 125.3 acres of permanent disturbance occurred related to the access roads.

Temporary crane paths were constructed within the Permit Area totaling 47.4 miles with an average width of 40 feet. Approximately 229.8 acres of temporary disturbance occurred related to the crane paths, and no permanent impacts occurred. In addition, the Permit Area had one 15-acre laydown area, representing a temporary disturbance of 15 acres, where project components were stored prior to delivery to the turbine sites for erection. Also, three temporary concrete batch plants were installed within the Permit Area. Approximately six acres of temporary disturbance and no permanent impact occurred related to the laydown areas/concrete batch plants.

2.5.1.3 Buried Electrical Collector System

Power flows from the pad mounted transformers at each turbine through a 34.5-kV underground electrical collector (UEC) system, to one of two project substations. This UEC consists of 149.6 miles of cables (buried approximately 4 feet deep). Fiber optic communication lines were also installed alongside UEC cables to facilitate remote turbine operation and monitoring. Approximately 181.3 acres of temporary disturbance occurred as a result of the installation of the collector system.

2.5.1.4 Project Substations

There are two substations, one northern and one southern, that occupy a total of approximately six acres each; these are permanent impacts. To connect the northern and southern substations, a 9.15-mile 345-kV transmission line (Substation Line) was constructed.

2.5.1.5 Project Interconnection and Generation Tie-line

A new interconnection switchyard was constructed in Schuyler County to the west of the Permit Area, near the Zachary-Ottumwa 345-kV Transmission Line. Connecting the interconnection switchyard to the HPWF is a new 7.35-mile 345-kV transmission line (Generation Tie-line). The Generation Tie-line connects into the HPWF's northern substation. The interconnection switchyard and Generation Tie-line facilitate the delivery of electricity produced by the HPWF to the 'regional grid.'

The combined Substation Line and Generation Tie-Line resulted in 129.9 acres of temporary disturbance and 116.9 acres of permanent disturbance. In addition, 97 poles for the 16.5 miles of 345 kV transmission lines (Substation Line and Generation Tie-line) were needed. The poles resulted in 29.5 acres of temporary disturbance and 1.1 acres of permanent disturbance. Two pull sites were needed during construction for each turn in the transmission line to load the tractors and trailers with reels of conductors and the trucks with tensioning equipment. The pull sites resulted in 9.6 acres of temporary disturbance.

2.5.1.6 Meteorological Towers

Permanent MET towers were installed at the site and are used for performance testing of the wind turbines to ensure that they meet the manufacturer's guarantees. Six (309 feet tall) permanent (unguyed) MET towers were deployed within the Permit Area. Temporary and permanent disturbance resulting from the MET towers was 0.1 acre.

2.5.1.7 Operations and Maintenance Building

An O&M building is located adjacent to the northern substation. This site houses operations personnel, tooling, equipment, and materials, and provides staff parking. The construction of this building resulted in 0.5 acre of permanent disturbance.

2.6 COVERED ACTIVITY - OPERATIONS

The requested ITP covers the initial six years of operations of the HPWF, starting in January 2021. It does not cover construction and commissioning and testing of turbines nor mitigation activities (which are delivered through Chariton Hills Conservation Bank). Avoidance measures for construction are described in Section 7.2.1.3 and avoidance measures for commissioning and testing are described in Section 7.2.1.4 under "Cut-in Speed During Commissioning and Testing". The potential for take of Indiana bats, northern long-eared bats, and little brown bats exists during operation of the turbines. The impacts of operations are fully described and evaluated in Section 5.1. To summarize, the covered species may be injured or killed due to collision with the rotating turbine blades during active periods (Table 2-2).

Table 2-2. Active periods and locations of risk for the covered species at the proposed High Prairie Renewable Energy Center, Adair and Schuyler counties, Missouri.

Season	Dates	Northern long-eared bat	Indiana bat and little brown bat
Spring migration	April 1 – May 14	All turbines	All turbines

Season	Dates	Northern long-eared bat	Indiana bat and little brown bat
Summer maternity season	May 15 – August 15	Turbines within 1,000 feet of suitable habitat	All turbines
Fall migration	August 16 – October 31	All turbines	All turbines

The primary method to minimize impacts to bats will be feathering turbine blades to slow the rotor below specific turbine cut-in speeds (i.e., the wind speed at which turbines begin rotating and producing power) based on time of year and temperature (see Section 7.2.1.4).

Post-construction mortality monitoring will occur during the life of the ITP to ensure compliance with the ITP (see Section 7.3) and to inform adaptive management responses (see Section 7.5). During mortality monitoring, injured or dead Indiana bats, northern long-eared bats, little brown bats, and unknown *Myotis* will be collected and turned over to the USFWS when encountered.

2.7 ALTERNATIVES TO TAKE

Section 10(a)(2)(A) of the ESA and 50 CFR 17.22(b)(1) and 17.32(b)(1) require an HCP to provide a description of alternative actions that were considered to reduce impacts to listed species, in this case, the Indiana and northern long-eared bats and non-listed covered species, the little brown bat. The Habitat Conservation Planning Handbook (USFWS and NMFS 2016) states that at least two types of alternatives are commonly included in HCPs:

- A No-Action Alternative, which means that the federal action (i.e., issuance of an ITP by the USFWS) will not occur because take of listed species will be avoided, and no HCP will be needed to minimize and mitigate impacts to the listed species; and
- Any alternative that will reduce incidental take below levels anticipated as a result of the Covered Activity.

Each of the alternatives that Ameren considered is discussed below.

2.7.1 No-action Alternative (Take Avoidance)

Under this alternative, take of the federally-endangered Indiana bat and federally-threatened northern long-eared bat, would be completely avoided by:

- From sunset to sunrise, raising cut-in speeds to 15.4 mph (6.9 m/s) for the period from March 15- October 31 each year for the life of the HPWF. The hub will not be locked, but blades will be feathered to the wind such that revolutions per minute (rpm) will be minimal during periods when wind speed is less than 15.4 mph (6.9 m/s).

The purpose of the HPWF is to maximize production of renewable energy in an environmentally responsible manner. This alternative would significantly reduce the amount of renewable electricity generated by the HPWF. As a result, this alternative was considered but rejected because it did not meet the purpose and need (see Section 1.3)

2.7.2 Reduced Take Alternative

An alternative involving reducing the requested take limit through an HCP with more significant restrictions on project operations, when compared to the proposed scenario, was considered. Specifically, this would include operating at a cut-in speed of 6.0 m/s for the period from April 1 to October 31. The hub would not be locked, but blades would be feathered to the wind such that the rpm will be minimal during periods when wind speed is less than 6.0 m/s. This operational protocol would be expected to result in an average bat mortality reduction of approximately 63%, when compared to operating with no curtailment (see Section 7.2.1.4). This alternative was considered but rejected because when compared to an average mortality reduction of 62% under the proposed scenario with a 5.0 m/s cut-in speed, the slight gain in mortality reduction does not outweigh the loss in electricity production that is expected with cut-in speed of 6.0 m/s, and thus does not meet the project's purpose and need of maximizing the production of renewable energy at the HPWF in an environmentally responsible manner.

2.8 PROPOSED ACTION/SUMMARY OF PROPOSED HCP

The details of this HCP are described in Section 7, and include operation of the HPWF at a 5.0 m/s cut-in speed, the result of the consideration of a range of cut-in speeds (see Section 7.2.1.4) and alternatives in order to select a project scenario that meets project goals while minimizing potential threats to the Indiana bat, northern long-eared bat, and little brown bat.

For the covered bat species, this HCP includes the following:

- Minimization: This includes operational adjustments that dictate when turbines are feathered (i.e., to reduce the blade angle to the wind to slow or stop the turbine rotor from spinning). Below the cut-in speed, turbine blades will be feathered so that the turbine rotors do not spin until a designated cut-in speed is reached. This type of curtailment has been shown to reduce bat mortality significantly (see Section 7.2.1.4). The turbines will be feathered below the cut-in speed from 45 minutes before sunset to 45 minutes after sunrise[2] during the entire bat active season (April 1 – October 31). If temperatures are below 40^0 Fahrenheit (F), the cut-in speed will be the manufacturer's cut-in speed (3.0 m/s). When air temperatures are above 40ºF, the cut-in speed will be raised to 5.0 m/s at all turbines. This operational protocol was developed based on the best available scientific information (see Section 7.2.1.4). The feathering/cut-in process will be computer-controlled on a real-time basis based on the 10-minute rolling average, as described in Section 7.2.1.4. Accordingly, turbines will cut-in or feather throughout the night as the wind speed fluctuates above and below the specified cut-in speed.
- Monitoring: Post-construction monitoring for bats will be conducted for the life of the permit (see Section 7.3). Robust monitoring will be conducted at 100% of the turbine sites from April 1 to October 31 during the 6-year permit term following issuance of the ITP. Robust monitoring will include twice-weekly road and pad searches at 60% of the turbines and twice-weekly full plot searches at 40% of the turbines. Monitoring of maternity colony persistence through mist-netting, radio-telemetry, and emergence counts (see Section 7.4).
- Adaptive Management: Based upon the results of the monitoring, adjustments may be made to increase cut-in speeds if current minimization techniques are proving ineffective. This change will occur in whichever

[2] Murray and Kurta (2004) found that Indiana bats begin feeding after sunset (20-30 minutes) and end before sunrise (10-40 minutes).

season(s) are resulting in higher-than-anticipated take. In addition, the geographic location and timing of fatalities will be used to determine which portion(s) of the HPWF should be included in the increased cut-in speeds.

- Mitigation: Mitigation measures have been incorporated into the Project to fully offset for the impacts of the permitted levels of take on the covered species. As more specifically described in Section 7.2.2, initial mitigation will include restoring and/or preserving 211.1 acres of summer roosting and foraging habitat.

The Project also has a BBCS, which includes an Eagle Conservation Strategy, to address impacts to migratory birds, bats, and eagles and to outline minimization measures and adaptive management strategies in place for migratory bird species and eagles.

2.9 PUBLIC PARTICIPATION

This HCP, and the associated NEPA documentation, had a 30-day public comment period, as outlined in the HCP handbook (USFWS and NMFS 2016). The High Prairie Public Comment Notice Publication was available from December 1, 2020 to December 31, 2020 under Agency Docket Numbers FWS-R3-ES-2020-0136 and FXES11140300000-201. Public comments received and Applicant responses can be found in Appendix G of the Service’s Environmental Assessment (EA).

In addition, TG High Prairie and Ameren have been in close contact with affected landowners, and all lease agreements are voluntary easements. An Open House was held at Schuyler High School in June 2018 to inform the public about the proposed project, and representatives from the HCP team were present to answer questions about wildlife-related and other environmental impacts.

2.10 COORDINATION WITH FEDERAL AND STATE AGENCIES

Representatives from TG High Prairie, LLC and Stantec first met with USFWS staff at the Columbia Field Office in Columbia, Missouri on May 3, 2016 to discuss the HPWF, the ITP process, and how best to proceed with preparation of an updated HCP[3]. At this meeting, discussion was held concerning additional, updated bat surveys (which led to the 2016 bat surveys), eagle use surveys (which began in May 2016), and that a new HCP needed to be developed. In addition, the USFWS recommended that TG High Prairie contact MDC and that MDC be involved in the development of the HCP as recommended by the HCP Handbook and the Interagency Cooperative Policy. TG High Prairie subsequently contacted MDC and MDC staff has been invited to every project meeting held since at the Columbia Field Office. TG High Prairie and representatives from Ameren have been consulting with USFWS and MDC regularly since the initial meeting regarding avian and bat surveys and development of the HCP, both through in-person meetings in Columbia, Missouri and regular email and phone communication between TG High Prairie, Ameren, USFWS, MDC, and Stantec.

[3] A draft HCP had been prepared for a much smaller project in the general location of the current project in 2010 by a previous developer.

Such coordination with USFWS and MDC has continued since publication of the draft HCP, and the final HCP incorporates edits based on public comments and coordination with MDC and USFWS (see Appendix C). Coordination with both USFWS and MDC will continue throughout the implementation of the HCP.

3.0 ENVIRONMENTAL SETTING AND BIOLOGICAL RESOURCES

The Permit Area is in the Glaciated Plains region, in the central lowland geomorphic province. This region is characterized by flat to gently rolling topography with some hills and valleys cut by glacial runoff (U.S. Forest Service [USFS] 1994). Adair and Schuyler counties include many small towns with residential, commercial, and agricultural activity, connected by a network of local and state roads and major and minor transmission lines. Schuyler County is largely comprised of agricultural lands interspersed with creeks, drainages, and small clusters of residential and agricultural development. Adair County is largely forest and agricultural lands interspersed with small clusters of residential and agricultural development, waterways, and roads, with one larger residential and business area (Kirksville) in the center of the county.

3.1 LAND USE

Land use within the Permit Area and surrounding counties is dominated by agricultural lands (i.e., crops, hay, herbaceous grassland). Approximately 75.2% of Adair County and 81.0% of Schuyler County lands are in agricultural production (U.S. Department of Agriculture [USDA] 2012a, 2012b). Pasture and row crops, primarily corn and soybeans, make up most of the agricultural operations. Other land uses within the Permit Area include residential, urban, manufacturing, commercial, transportation, recreational, and utility. Small towns within 20 miles of the Permit Area include: Queen City (population approx. 590), Downing (population approx. 334), Greentop (population approx. 438), Lancaster (population approx. 720), Glenwood (population approx. 197), and Memphis (population approx. 1,854), with the nearest city being Kirksville (population approx. 17,519). Major transportation routes that intersect the Permit Area include U.S. Route 63, U.S. Route 136, and State Highways D, A, and E.

3.2 LAND COVER

Before Euro-Americans arrived in substantial numbers, a large portion of Adair and Schuyler counties was covered in hardwood forests (USDA-Natural Resources Conservation Service [NRCS] 1996). Based on the National Land Cover Database (NLCD), the Permit Area is heavily used for agriculture, with 73.7% of land cover identified as pasture/hay and cultivated crops (Table 3-1). Forested areas, which cover 17.2% of the Permit Area, are found in small and large tracts, many of which are associated with streams within the Permit Area (Figure 3; Table 3-1). North Fork Salt River, Floyd Creek, North Fork South Fabius River, and South Fork Middle Fabius River, among others, run through the Permit Area (Figure 3). Several unnamed tributaries also intersect the Permit Area. Figure 3 shows the distribution of land cover within the Permit Area.

Table 3-1. National Land Cover Data within the High Prairie Wind Farm Project Boundary, Adair and Schuyler Counties, Missouri (NLCD 2011).

Land Cover Type	Total Acres	Percent of Total
Pasture/Hay	71,386.4	62.7%
Deciduous Forest	16,443.2	14.4%
Cultivated Crops	12,561.0	11.0%
Developed, Open Space	4,356.3	3.8%
Shrub/Scrub	3,170.4	2.8%
Mixed Forest	1,945.5	1.7%
Grassland/Herbaceous	1,797.9	1.6%
Wooded Wetlands	1,005.0	0.9%
Developed, Low Intensity	619.6	0.5%
Open Water	241.9	0.2%
Evergreen Forest	205.4	0.2%
Emergent Herbaceous Wetlands	106.7	0.1%
Developed, Medium Intensity	34.0	<0.1%
Total	113,873.2	100.0%

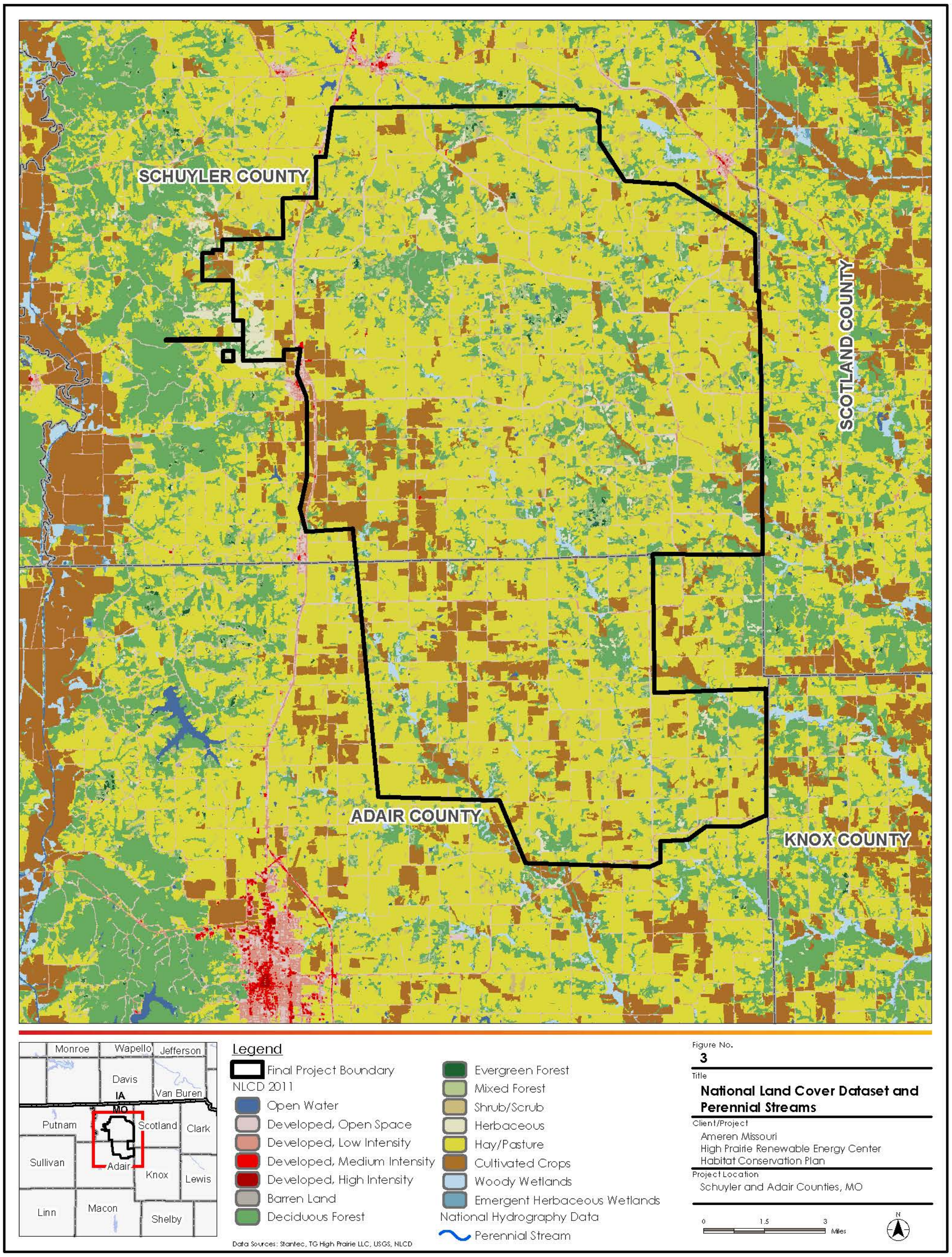


Figure 3. National Land Cover Dataset

3.3 WILDLIFE IN THE PERMIT AREA

Wildlife in the Permit Area and surrounding counties is likely comprised primarily of species adapted to a landscape dominated by agriculture, fragmented natural habitats (e.g., forest or prairie), and human disturbance. Disturbance-tolerant species, such as white-tailed deer (*Odocoileus virginianus*), raccoons (*Procyon lotor*), squirrels (*Sciurus* spp.), coyotes (*Canis latrans*), wild turkey (*Meleagris gallopavo*), hawks, owls, eagles, and various songbirds, are common and widespread and are expected to represent the majority of wildlife within the Permit Area. Many species of fish, amphibians, reptiles, and waterfowl may occur in and along the creeks and drainages of the Permit Area and surrounding landscapes.

3.3.1 Federally Threatened and Endangered Species

The Permit Area is within the range of three federally-listed wildlife species (USFWS 2018a):

- Gray bat (*Myotis grisescens*) – Endangered
- Indiana bat – Endangered
- Northern long-eared bat – Threatened

Gray bats roost in caves throughout the year (i.e., all seasons). No caves are known within or near the Permit Area. Adair County is the northern most county of the species' range in Missouri (i.e., Schuyler County is not considered a part of its range). There are no known publicly available records of a gray bat being captured in Adair County or anywhere north of Adair County (i.e., Schuyler County). No gray bats were recorded or captured in bat studies completed for the HPWF (see Section 3.4). In addition, the USFWS excluded the gray bat from 'covered species' status in the northern half of Missouri in a region-wide HCP because, "potential for take will be avoided because the species is not expected to occur within the Covered Lands" (USFWS 2016a). Therefore, no project-related impacts are expected to affect the gray bat. While the gray bat will not be covered by the ITP, it is considered in Section 8.2.2 (Changed Circumstances) and avoidance measure taken to protect the covered bat species will protect the gray bat in the unlikely event that the species occurs in the area.

The Permit Area is also within the range of two bat species that are not currently listed, but are being reviewed for listing:

- Little brown bat
- Tricolored bat (*Perimyotis subflavus*)

The little brown bat is currently undergoing a Discretionary Status Review on the National Listing Workplan. The USFWS anticipates determining if the species warrants listing under the ESA in 2023 (USFWS 2016b). The tricolored bat is currently under a status review after having been petitioned for listing as a threatened or endangered species under the ESA (Center for Biological Diversity [CBD] and Defenders of Wildlife [DW] 2016).

The biology, habitat requirements, and status within the Permit Area of the northern long-eared bat, Indiana bat, and little brown bat are discussed in detail in Section 4.0. Expected impacts from the proposed action and the conservation plan for these species are described in Section 5.0 and Section 7.0, respectively.

3.3.2 Bald and Golden Eagles

The bald eagle (*Haliaeetus leucocephalus*) was listed as an endangered species in 1966 under the Endangered Species Preservation Act. It was delisted in 2007 when recovery objectives were met (USFWS 2009). The bald eagle is still protected under the Bald and Golden Eagle Protection Act (BGEPA). The Missouri Natural Heritage Program (MNHP) notes that bald eagles are known from Adair and Schuyler counties, and the bald eagle is a species of conservation concern in those counties (MDC 2018b).

Golden eagles (*Aquila chrysaetos*) are not federally-listed or state-listed in Missouri, but they are protected under the BGEPA. They are mainly a western species that have never been common in the eastern U.S. and are not currently known to occur in Missouri, except as occasional transient visitors (MDC 2012).

Eagle use surveys for bald and golden eagles were initiated within the Permit Area in May 2016 and were completed in October 2019. Information from the surveys was used in the preparation of an Eagle Conservation Plan (ECP). High Prairie used the ECP to apply for an Eagle Take Permit on August 19, 2020.

3.4 BATS IN THE PERMIT AREA

Although the Indiana bat, northern long-eared bat, and little brown bat are the only bat species covered under this HCP, the avoidance and minimization measures implemented under this HCP are expected to reduce direct mortality of all bat species occurring in the Permit Area. Therefore, a brief overview of those species is provided in Section 3.4.1. In addition, many pre-construction surveys have been conducted within the Permit Area to document and characterize bat use at the HPWF, which are described in Section 3.4.2.

3.4.1 Bat Species

The MDC lists 14 bat species that occur in Missouri and 3 additional species may have potential occurrence but are unlikely due to species' range (MDC 2018a). Bat Conservation International (BCI) identifies 10 of these species that have geographic distributions that may include Adair and Schuyler counties, Missouri (BCI 2018; Table 3-2), though the gray bat is not expected to occur within the Permit Area (see Section 3.3.1). All 10 species use woodland habitat for feeding or roosting at some time during the year. Many species feed along stream corridors or over water. Some species, such as the little brown bat and big brown bat (*Eptesicus fuscus*), are known to roost in attics or the peaks of other large buildings (BCI 2018). Large outbuildings associated with farmsteads and rural residences within the Permit Area may provide suitable roosting locations for some bat species. Small and large tracts of woodland are found within the Permit Area, many of which are associated with streams and provide suitable foraging habitat for bats. Approximately 23,893 acres (21.0%) of the Permit Area is made up of suitable woodlands (see Section 3.4.2.1 and Figure 4).

Table 3-2. Bat species and their potential to occur within the state of Missouri and the High Prairie Wind Farm Permit Area, Adair and Schuyler counties, Missouri (BCI 2018, Stantec 2016, 2018).

Common Name	Scientific Name	Missouri Residency	Seasons in Permit Area	Confirmed Presence in Permit Area
Indiana Bat	*Myotis sodalis*	Year-Round	Summer, Migration	23 captured in 2016, 60 captured in 2018
Northern Long-eared Bat	*Myotis septentrionalis*	Year-Round	Summer, Migration	1 captured in 2016, Acoustic detections in 2016 and 2018
Little Brown Bat	*Myotis lucifugus*	Year-Round	Summer, Migration	7 captured in 2016, 2 captured in 2018
Tricolored bat	*Perimyotis subflavus*	Year-Round	Summer, Migration	Acoustic detections in 2016 and 2018, None captured
Big Brown Bat	*Eptesicus fuscus*	Year-Round	Summer, Migration	151 captured in 2016, 144 captured in 2018
Red Bat	*Lasiurus borealis*	Potentially Year-Round	Summer, Migration	116 captured in 2016, 73 captured in 2018
Silver-haired Bat	*Lasionycteris noctivagans*	Potentially Year-Round	Migration	4 captured in 2016, 1 captured in 2018
Evening Bat	*Nycticeius humeralis*	Summer	Summer, Migration	124 captured in 2016, 104 captured in 2018
Hoary Bat	*Lasiurus cinereus*	Summer	Summer, Migration	5 captured in 2016, 4 captured in 2018

Bats may migrate through the Permit Area during the spring and fall, although spring migration for *Myotis* species may be concentrated along river/wooded corridors (Hicks et al. 2012). There are no publicly available records of hibernacula in Adair and Schuyler counties for the bat species that could occur within the Permit Area. Based upon the geology and lack of caves in the HPWF vicinity, it is not anticipated that a natural bat hibernaculum is present within the Permit Area.

The tricolored bat has been petitioned for listing, and the USFWS 90-day finding found the listing may be warranted (82 FR 60362-60366). The USFWS has issued a Request for Information for the tricolored bat, seeking scientific and commercial data and other information regarding the species to inform a listing decision under the ESA. The tricolored bat was originally considered for coverage in this HCP; however, after discussions with the USFWS and MDC, it was determined that there was not enough information to include the species at this time. Data on impacts will be collected as part of post-construction monitoring (see Section 7.3), and coverage will be considered when a longer-term ITP is sought (see Section 8.3).

3.4.2 Pre-Construction Bat Surveys

3.4.2.1 Bat Habitat Assessment

A desktop review of recent aerial photography and Geographic Information Systems (GIS) data was performed to identify locations within the Permit Area and a 1,000-foot buffer containing suitable Indiana and northern long-eared bat habitat (Figure 4). For the purposes of assessing Indiana and northern long-eared bat summer habitat suitability (i.e., non-winter), woodlands within the Permit Area and a 1,000-foot buffer were digitized and then categorized into one of two classifications based on recent literature (Owen et al. 2003, Carter and Feldhamer 2005, Lacki et al. 2009, USFWS 2014a, 2019).

- Suitable habitat: This includes foraging/roosting habitat (woodlands 15 acres or more in size), and commuting/travel corridors (woodlands less than 15 acres in size, but within 1,000 feet of foraging/roosting areas)
- Unsuitable habitat: Woodlands less than 15 acres in size and not within 1,000 feet of foraging/roosting areas

Digitized woodlands were then reviewed, and the classification verified, by a qualified bat biologist who made any necessary revisions. Approximately 24,535 acres of woodland were digitized within the Permit Area, of which 23,893 acres were classified as suitable for Indiana and northern long-eared bat (Figure 4). Of the 113,873.2-acre Permit Area, approximately 21.0% is considered Indiana and northern long-eared bat suitable habitat.

Little brown bats are assumed to use both wooded and non-wooded areas and therefore, 100% of the 113,873.2-acre Permit Area is considered suitable little brown bat habitat.

3.4.2.2 Acoustic Presence/Probable Absence Surveys

Stantec conducted bat acoustic surveys (presence/probable absence) within the Permit Area in 2016 and 2018 using methods outlined in the USFWS 2016 and 2018 Indiana Bat Range-Wide Summer Survey Guidelines[4]. With the approval of the USFWS, the level of effort was kept consistent between the 2016 and 2018 surveys to allow for a direct comparison of results between years. Bat surveys were also conducted in 2011 by Robbins et al. (2012) and are summarized in Section 3.4.2.5.

A total of 70 acoustic sites were surveyed between June 6 and July 27, 2016 (Stantec 2016), and 65 acoustic sites were surveyed between May 16 and June 8, 2018 (Stantec 2018), both during the summer maternity season. The survey boundaries differed between the 2016 and 2018 studies, with all of the acoustic sites in 2016 located in Schuyler County and the majority of acoustic sites in 2018 located in Adair County (Stantec 2016, 2018). Survey locations were determined by proximity to other acoustic sites, presence of key habitat characteristics (e.g., canopy cover, presence of non-obstructed flyways, and forest condition), and site access. Two Wildlife Acoustics SongMeter SM3BAT and SM4BAT full-spectrum recorders[5] were used to record full spectrum WAV files at each identified site. Bat call analysis consisted of processing recorded calls through one of the USFWS accepted auto-identification programs, Kaleidoscope Pro. Sites with likely Indiana bat, northern long-eared bat, or little brown bat presence (p-value of equal to or less than

[4] 2016 Guidelines:
http://www.fws.gov/midwest/endangered/mammals/inba/surveys/pdf/2016IndianaBatSummerSurveyGuidelines11April2016.pdf
2018 Guidelines: https://www.fws.gov/midwest/endangered/mammals/inba/surveys/pdf/2018RangewideIBatSurveyGuidelines.pdf
[5] http://www.wildlifeacoustics.com/products/song-meter-sm4bat

0.05) for a particular night were then qualitatively analyzed by a Stantec bat biologist until the species was either confirmed present (at least one call positively identified to the species), or until all calls from that night at that detector had been analyzed, and probable absence could be assumed.

Acoustic surveys conducted at 70 sites in 2016 resulted in the detection of 73,955 bat calls, of which 68,150 were identified to the species level (92.2%). Nine bat species were identified, with the big brown bat being the most commonly identified species (18,370 calls). A total of 4,321 Indiana bat, 1,362 northern long-eared bat, and 6,337 little brown bat calls were identified by the program. Qualitative identification conducted on all detector nights with a p-value equal to or below 0.05 for one or more of the covered species resulted in confirming the presence of the Indiana bat at 60 sites, northern long-eared bat at 39 sites, and little brown bat at 59 sites (Table 3-3).

Surveys in 2018 at 65 acoustic sites detected 81,916 bat calls, of which, 60,688 were identified to the species level. All 9 bat species expected to occur within the Permit Area were identified (Table 3-2), with the big brown bat being the most commonly identified species (17,640 calls). A total of 3,289 Indiana bat, 1,016 northern long-eared bat, and 6,495 little brown bat calls were identified by the program. Qualitative identification conducted on all detector nights with a p-value equal to or below 0.05 for one or more of the covered species resulted in confirming the presence of the Indiana bat at 54 sites, northern long-eared bat at 30 sites, and little brown bat at 43 sites (Table 3-3).

Table 3-3. Qualitative analysis results at High Prairie Wind Farm for 2016 (n=70 sites) and 2018 (n=65 sites) acoustic presence/absence monitoring. Shows number of sites bat species were detected at (% of total sites; Stantec 2016, 2018).

Species Detected	**Qualitative Analysis**	
	2016	**2018**
All 3 *Myotis* species	33 sites (47.1%)	27 sites (41.5%)
Indiana bat and little brown bat, but no northern long-eared bat	18 sites (25.7%)	16 sites (24.6%)
Only Indiana bat	6 sites (8.6%)	8 sites (12.3%)
Indiana bat and northern long-eared bat, but no little brown bat	2 sites (2.9%)	3 sites (4.6%)
No *Myotis* species	5 sites (7.1%)	3 sites (4.6%)
Covered Species	**Confirmed Presence**	
Indiana Bat	60 sites (85.7%)	54 sites (83.1%)
Little brown bat	59 sites (84.3%)	43 sites (66.2%)
Northern long-eared bat	39 sites (55.7%)	30 sites (46.2%)

[1] Calls identified to the species level by Kaleidoscope Pro; confirmed presence determined by hand vetting by a Stantec bat biologist.

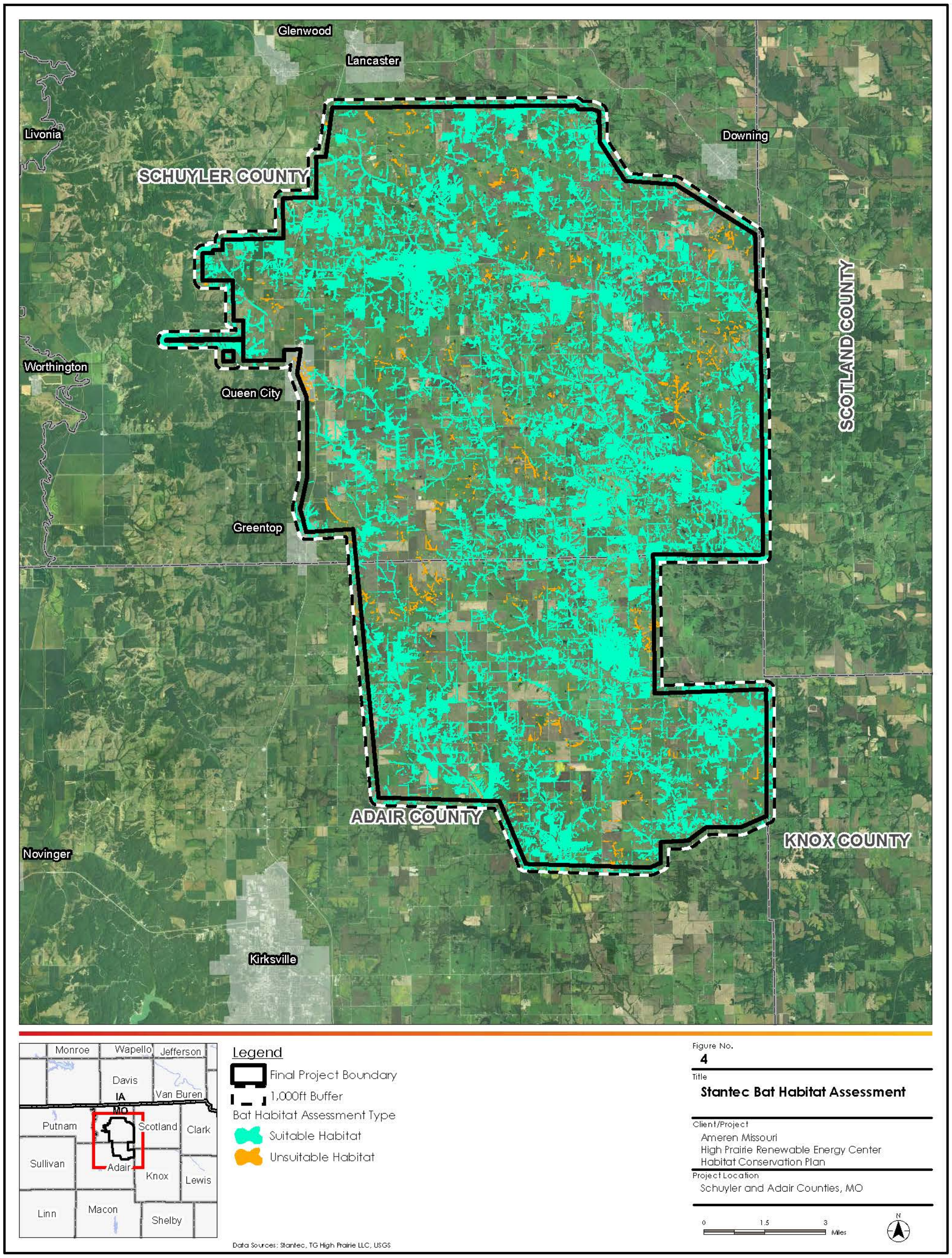


Figure 4. Bat Habitat Assessment

3.4.2.3 MET Tower Acoustic Survey

Acoustic detectors were deployed on five MET towers within the Permit Area on April 26, 2018. At each MET tower, a detector was placed at approximately 10 feet (low detector) and at 164 feet (high detector). Data were collected through November 7, 2018. Data were analyzed using Kaleidoscope Pro and the approved filters based on the 2018 USFWS Indiana Bat Survey Guidelines[6].

A total of 231,174 bat calls were recorded, of which 171,308 were identified to the species level by Kaleidoscope Pro. The remaining 59,866 bat calls (25.96% of all calls) were not of sufficient quality to be identified to a species. It is assumed that these unidentified calls are equally likely to be any of the nine species, and that no particular species is more likely to fall into the unidentified call category. As such, for this analysis, it is assumed that the species composition of the calls identified to the species level is comparable to the species composition of the unidentified calls. All nine species with the potential to occur within the HPWF were identified by Kaleidoscope Pro at a MET tower, with the following overall number of calls and species composition:

- Hoary bat – 52,946 calls (30.9% of all calls identified to the species level)
- Big brown bat - 35,895 calls (21.0%)
- Eastern red bat – 28,381 calls (16.6%)
- Silver-haired bat – 24,497 calls (14.3%)
- Evening bat – 14,749 calls (8.6%)
- Little brown bat – 11,566 calls (6.8%)
- Indiana bat – 1,609 calls (0.9%)
- Tricolored bat – 1,288 calls (0.8%)
- Northern long-eared bat – 377 calls (0.2%)

Breakdown by season and detector height are shown in Table 3-4.

[6] Bats of North America Version 4.2.0 set to the “0 Balanced (Neutral) auto ID setting. Species included big brown bat, eastern red bat, hoary bat, silver-haired bat, little brown bat, northern long-eared bat, Indiana bat, evening bat, and tricolored bat. Signal parameters were left at the default setting of 8-120 kHz, 2-500 maximum inter-syllable gap (ms) and a minimum of 2 pulses.

Table 3-4. MET tower species composition based on output from Kaleidoscope Pro (4.2.0). Includes data from spring (April 28 through May 14, 2018), summer (May 15 through August 15, 2018), and fall (August 16 through November 7, 2018). Percent composition (based on calls identified to the species level [i.e., excluding no identifications] within each season for a detector height) provided in parentheses.

Detector Location	Season	Species									No Identification (% of all calls)
		Big brown bat	Eastern red bat	Hoary bat	Silver-haired bat	Little brown bat	Northern long-eared bat	Indiana bat	Evening bat	Tricolored bat	
High MET Towers	Spring	139 (9.0%)	231 (14.9%)	786 (50.6%)	360 (23.2%)	15 (1.0%)	0 (0.0%)	2 (0.1%)	18 (1.2%)	2 (0.1%)	166 (9.7%)
	Summer	2,961 (13.2%)	4,053 (18.1%)	12,029 (53.6%)	2,619 (11.7%)	135 (0.6%)	0 (0.0%)	3 (<0.1%)	564 (2.5%)	66 (0.3%)	2,324 (9.4%)
	Fall	1,549 (11.4%)	2,492 (18.4%)	4,930 (36.4%)	3,904 (28.8%)	140 (1.0%)	2 (<0.1%)	8 (0.1%)	398 (2.9%)	113 (0.8%)	1,736 (11.4%)
Low MET Towers	Spring	796 (14.4%)	1,047 (18.9%)	2,740 (49.5%)	510 (9.2%)	74 (1.3%)	1 (<0.1%)	18 (0.3%)	316 (5.7%)	31 (0.6%)	1,062 (16.1%)
	Summer	5,763 (26.1%)	3,372 (15.3%)	8,321 (37.7%)	1,947 (8.8%)	497 (2.3%)	12 (0.1%)	68 (0.3%)	1,950 (8.8%)	154 (0.7%)	8,105 (26.8%)
	Fall	1,347 (28.6%)	499 (10.6%)	1,215 (25.8%)	853 (18.1%)	301 (6.4%)	4 (0.1%)	39 (0.8%)	368 (7.8%)	77 (1.6%)	1,317 (21.9%)

Qualitative Identification of Covered Species

Qualitative identification[7] was conducted on calls recorded at the high MET towers during the summer months for the covered species. Calls recorded at the high MET tower detectors were assumed to indicate the highest risk to individuals, as these bats are presumably flying within the rotor-swept zone and thus vulnerable to collision risk and mortality from operating wind turbines. Furthermore, while mortality of bats peaks during the fall (Arnett et al. 2008), the qualitative identification focused on the summer season (May 15 – August 15) to address concerns about impacts to local maternity colonies. Therefore, all calls of the covered species recorded at a high detector during the summer were evaluated. In addition, due to their listing under the ESA, any Indiana bat or northern long-eared bat call recorded at a high MET detector during the spring or fall was also evaluated.

Qualitative review confirmed the following:

- 73 of the 135 little brown bat calls had characteristics of *Myotis* or little brown bat calls.
- 0 of the 2 northern long-eared bat calls had characteristics of *Myotis* or northern long-eared bat calls.
- 7 of the 13 Indiana bat calls had characteristics of *Myotis* of Indiana bat calls. Of these 7 calls, 2 were during the spring migration period, 2 were during the summer maternity season (August 8 and August 9) and 3 were during the fall migration period.

Spatial Bat Activity

Bat activity was consistently higher at the ground-based detectors when compared to the low or high MET tower detectors (Figure 5). During the summer maternity season, bat activity at the high MET towers averaged 56.5 bat passes/detector night (for all species, including unidentified calls), whereas bat activity in bat habitat at the ground-based detectors averaged almost four times that amount at 217.0 bat passes/detector night (Figure 5).

[7] Evaluation of call characteristics using AnalookW (Titley Scientific) by a qualified bat biologist to confirm the auto identification.

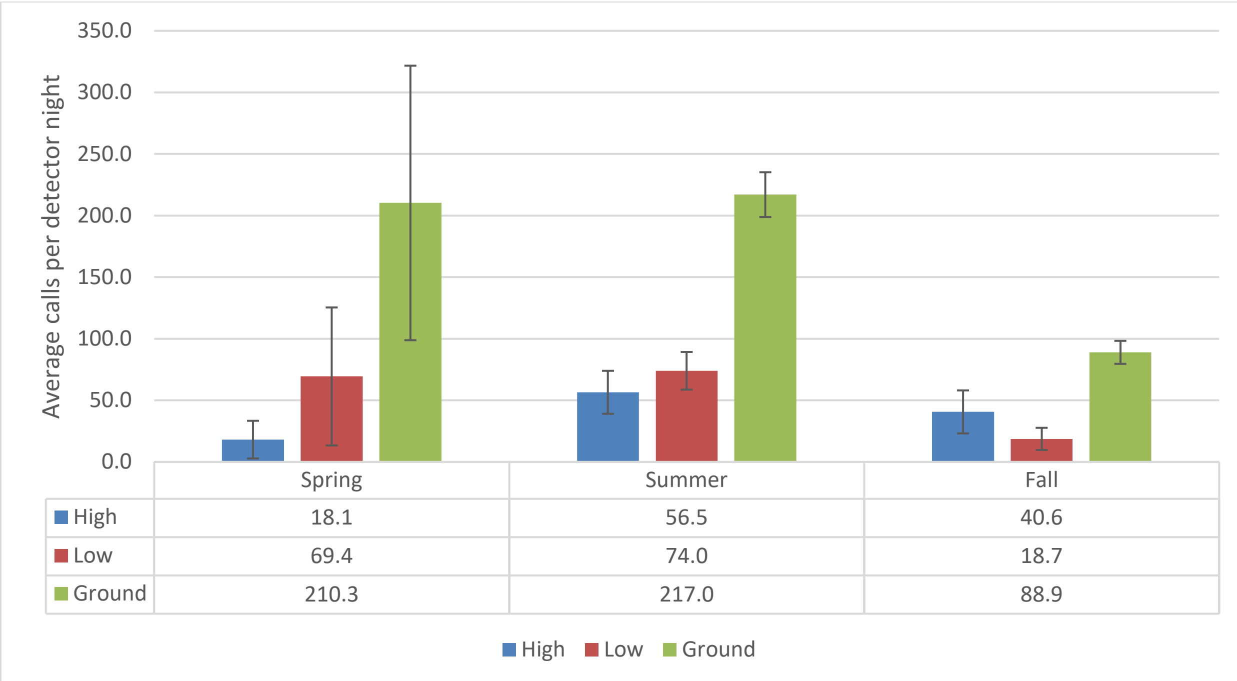
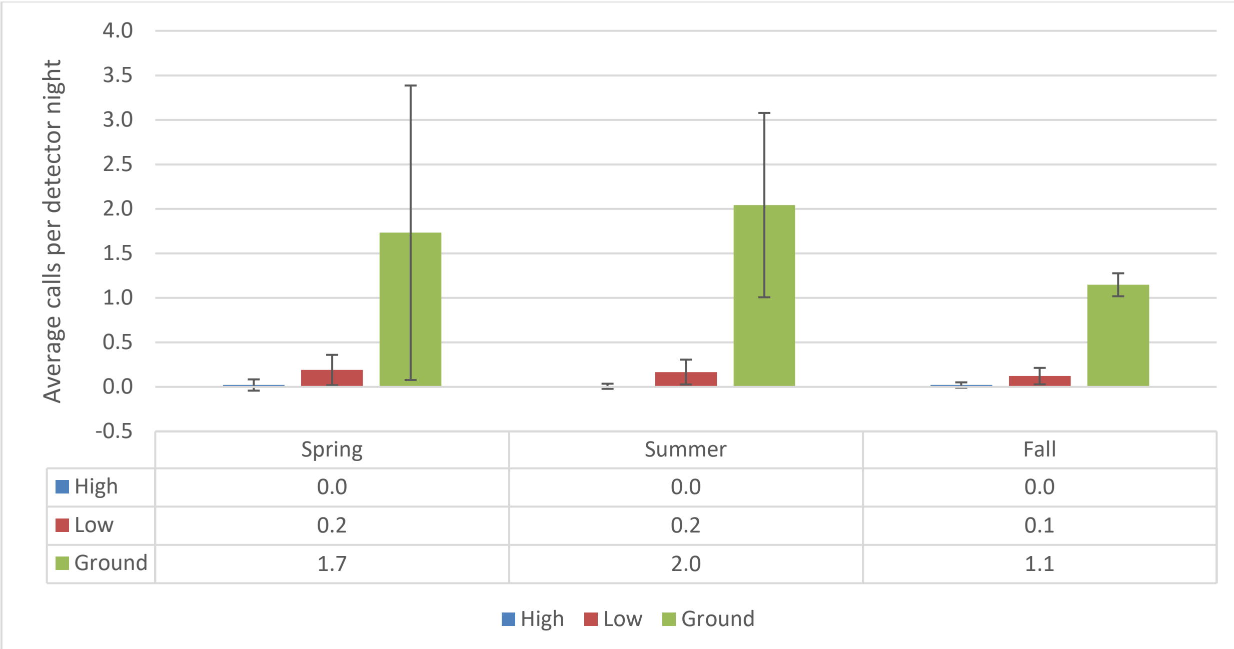


Figure 5. Average calls per detector night by season and detector at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri. Surveys were conducted during the spring (April 25-May14), summer (May 15 to August 15) and fall (August 16 to November 9) of 2018. Detectors were placed at 2 meters (10 feet) and 50 meters (164 feet) above ground level on five MET towers, and within bat habitat at 2 meters (10 feet) above ground level at five ground-based locations in suitable woodland or woodland edge habitat nearby.

This trend held true at the species level as well, with activity consistently being higher at the ground-based detectors when compared to either MET tower detector. Specifically, for the three covered species each species recorded significantly higher activity at the ground-based detectors compared to either MET tower detector during summer and fall while spring showed no significant differences for any species (Figures 6, 7, and 8). The little brown bat recorded significantly higher activity at the low MET tower compared to the high MET tower during summer and fall (Figure 8). Both Indiana bat and northern long-eared bat recorded <0.1 average call/detector night at the high MET tower across all seasons (Figures 6 and 7) and northern long-eared bat also recorded <0.1 average call/detector night at the low MET tower across all seasons (Figure 7).



	Spring	Summer	Fall
High	0.0	0.0	0.0
Low	0.2	0.2	0.1
Ground	1.7	2.0	1.1

Figure 6. Average calls per detector night for the Indiana bat by season and detector at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri. Surveys were conducted during the spring (April 25-May 14), summer (May 15 to August 15) and fall (August 16 to November 9) of 2018. Detectors were placed at 2 meters (10 feet) and 50 meters (164 feet) above ground level (agl) on five MET towers, and within bat habitat at 2 meters (10 feet) agl at five locations nearby.

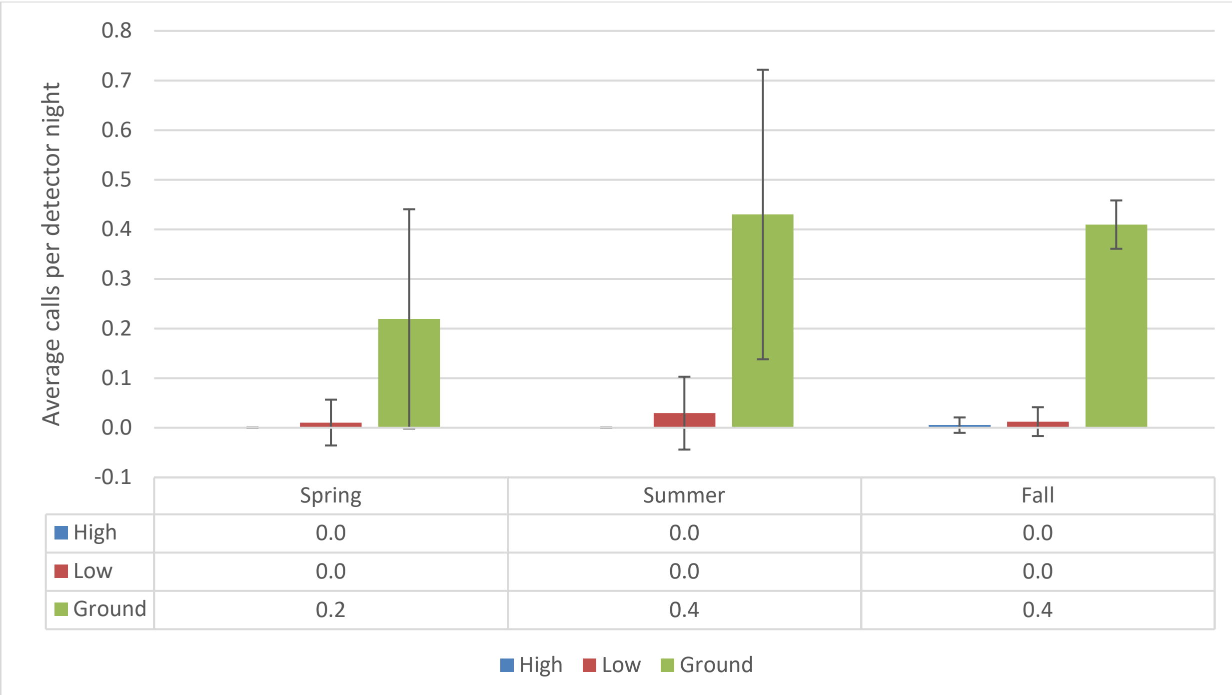


Figure 7. Average calls per detector night for the northern long-eared bat by season and detector at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri. Surveys were conducted during the spring (April 25-May 14), summer (May 15 to August 15) and fall (August 16 to November 9) of 2018. Detectors were placed at 2 meters (10 feet) and 50 meters (164 feet) above ground level (agl) on five MET towers, and within bat habitat at 2 meters (10 feet) agl at five locations nearby.

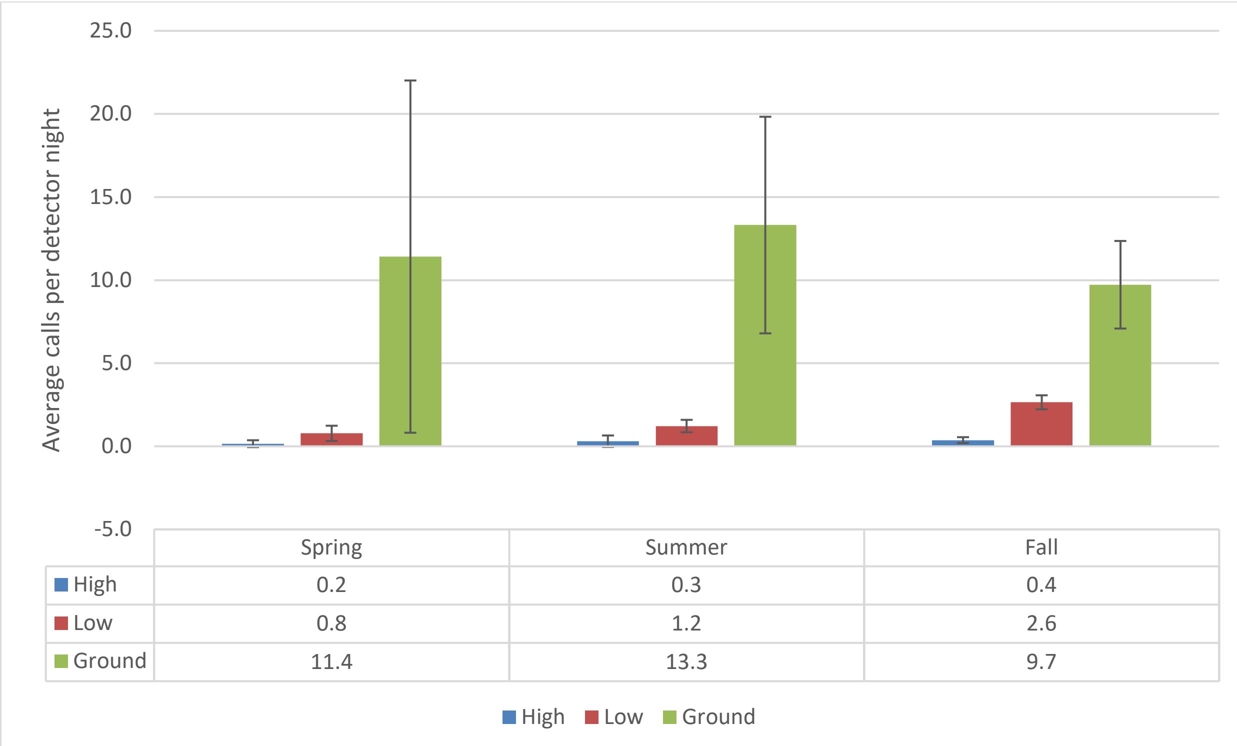


Figure 8. Average calls per detector night for the little brown bat by season and detector at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri. Surveys were conducted during the spring (April 25-May 14), summer (May 15 to August 15) and fall (August 16 to November 9) of 2018. Detectors were placed at 2 meters (10 feet) and 50 meters (164 feet) above ground level (agl) on five MET towers, and within bat habitat at 2 meters (10 feet) agl at five locations nearby.

3.4.2.4 Mist Net and Telemetry Surveys

Mist-net surveys were conducted at 33 sites in Schuyler County in 2016 between July 21 and August 5 targeting the northern long-eared bat, little brown bat, and Indiana bat. A total of 431 bats representing 8 species were captured including 151 big brown bats, 124 evening bats, 116 eastern red bats, 23 Indiana bats, 5 hoary bats, 7 little brown bats, 4 silver-haired bats, and 1 northern long-eared bat (Stantec 2016).

Stantec completed mist-net surveys for the Indiana bat, northern long-eared bat, and little brown bat in the Permit Area, primarily in Adair County, from June 18 to August 5, 2018. A total of 389 bats were captured at 33 sites, representing 7 species, including 144 big brown bats, 104 evening bats, 73 eastern red bats, 60 Indiana bats, 4 hoary bats, 2 little brown bats, 1 silver-haired bat, and 1 unidentified bat. No northern-long eared bats were captured (Stantec 2018). A summary of the age, sex, and reproductive status of covered bat species captured for the combined 2016 and 2018 mist-net surveys is provided in Table 3-5.

Table 3-5. Age, sex, and reproductive status of covered bat species captured during 2016 and 2018 mist-net surveys within the Permit Area (Stantec 2016, 2018).

Species	Adult						Juvenile			Unknown	Total
	Male		Female				Male		Female		
	Descended	Non-Reproductive	Pregnant	Lactating	Post-lactating	Non-Reproductive	Descended	Non-Reproductive	Non-Reproductive		
Indiana bat	10	22	0	17	7	3	0	12	12	0	**83**
Northern long-eared bat	0	0	0	0	0	0	0	0	0	1	**1**
Little brown bat	0	4	0	0	4	0	0	0	1	0	**9**

Radio-telemetry and emergence count surveys were conducted in 2016, with a total of 12 bats radio-tagged and tracked (9 Indiana bats and 3 little brown bats). Twenty-one roost locations were identified, as well as three estimated roosts and 7 triangulated roosts. A total of 65 emergence counts were completed at 42 different roosts (21 of which were roosts identified during previous studies). A total of 13 Indiana bat roosts and 10 little brown bat roosts were located during the survey in 2016[8]. The highest number of bats recorded emerging from a single roost tree was 147 bats on August 1, 2016 (Stantec 2016).

Recent telemetry surveys, from June 18 to August 5, 2018, tracked 12 radio-tagged female Indiana bats and identified12 roost trees. Ten roost trees occurred on accessible land parcels, and two occurred on inaccessible parcels. A total of 20 emergence counts were completed at 10 different roosts. The highest number of bats recorded emerging from a single roost tree on accessible parcels was 48 bats on July 17, 2018 (Stantec 2018).

3.4.2.5 Previous Field Studies

A bat study, similar to those of Stantec, was conducted in 2010 and 2011 by Robbins et al. (2010, 2012) for Normandeau Associates; however, the Permit Area has significantly changed in shape and size since the 2011 survey occurred. The 2011 study area did not include Adair County and was only approximately 4,500 acres in size. Survey methods were based on a standardized protocol in use at that time (USFWS 1999, USFWS 2007, Carroll et al. 2002, Robbins et al. 2008). Mist nets and ultrasonic bat detectors were used at 13 sites to document bat species in the area.

Acoustic data were collected and analyzed to species by comparing call structure to known calls using Analook software (Britzke et al. 2002, Murray et al. 1999) and Bat Call Identification (BCID) software (Allen et al. 2008). Surveys were

[8] Numbers do not add up to 42 roosts because one previous roost was also used by a tracked Indiana bat in 2016, and one roost located in 2016 was used by both a tracked Indiana bat and a tracked little brown bat.

conducted during fall migration in 2010 (Robbins et al. 2010) and during mist-netting surveys in 2011 (Robbins et al. 2012; Table 3-6).

Table 3-6. Results of acoustic surveys conducted at the previously proposed HPWF in Schulyer County, Missouri in 2010 (Robbins et al. 2010) and 2011 (Robbins et al. 2012).

Species	2011 Acoustic Results	2010 Acoustic Results
Big brown bat	11.0%	16.1%
Evening bat	16.0%	9.9%
Eastern red bat	24.0%	14.7%
Indiana bat	8.0%	1.4%
Little brown bat	8.0%	4.1%
Hoary bat	11.0%	11.1%
Silver-haired bat	15.0%	22.0%
Northern long-eared bat	2.0%	0.2%
Tricolored bat	3.0%	11.6%

Mist netting efforts occurred at 10 sites within the study area and 3 off-site locations associated with artificial roosts from May 19, 2011, to July 28, 2011 (71 available nights). A total of 460 individuals (7 species) were captured during 139 net nights. Within the study area (10 sites), 171 bats comprised of 7 species were captured during 128 net nights, including: 46 big brown bats, 45 eastern red bats, 37 Indiana bats (23 adult female, 2 juvenile female, and 12 adult male), 8 northern long-eared bats (5 adult female, 1 juvenile female, and 2 adult male), 18 evening bats, 14 little brown bats (3 adult female, 6 adult male, and 5 juvenile male), and 3 hoary bats. A total of 289 individuals (3 species) were captured outside of the study area (3 sites), including 258 little browns bats, 10 big brown bats, and 1 northern long-eared bat.

Telemetry surveys were conducted for 21 tagged bats (12 Indiana bats, 4 northern long-eared bats, and 5 little brown bats). Bats were tracked to roost trees and/or during foraging hours. Three tagged bats were not located after release. A total of 1,263 hours was spent collecting nighttime activity locations (n=1,141 total locations) and searching for roosts during the day. On average, 52.6 hours/bat resulted in 85 locations/bat. From the 12 tagged Indiana bats, 3 colonies were determined. Based on emergence counts, the 3 colonies had estimated Indiana bat colony sizes of 180, 132, and 69 bats. From the 4 northern long-eared bats tracked, one colony was identified which had an estimated size of 10 northern long-eared bats based on emergence counts. From the 5 little brown bats tracked, 3 colonies were found. Based on emergence counts, the 3 colonies had estimated sizes of 950, 183, and 80 bats; however, the larger colony had a 1 to 1 ratio of big brown bats to little brown bats.

4.0 COVERED SPECIES

4.1 INDIANA BAT

The range of the federally endangered Indiana bat includes the eastern and mid-western U.S., from Iowa, Oklahoma, and Wisconsin, northeast to Vermont, and south to northwestern Florida and northern Arkansas (USFWS 2007). The majority of Indiana bat wintering populations occur in the limestone cave regions of Indiana, Kentucky, and Missouri. The Indiana bat was originally listed on March 11, 1967, as being in danger of extinction under the Endangered Species Preservation Act of 1966 (32 FR 4001). The species is listed as endangered under the ESA of 1973, as amended. The Indiana bat is listed as state endangered in Missouri.

A USFWS Indiana Bat Recovery Plan was first developed and signed on October 14, 1983 (USFWS 1983). An agency draft of the Revised Recovery Plan was released in March 1999 (USFWS 1999) but was never finalized. The "Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision" (the "draft Revised Recovery Plan") was made available for public comment on April 16, 2007 (72 FR 19015-19016; USFWS 2007). The draft Revised Recovery Plan describes three recovery objectives for reclassification of the species as threatened (USFWS 2007):

1. Permanent protection of 80% of Priority 1 hibernacula.
2. A minimum overall population number equal to the 2005 estimate (457,000).
3. Documentation of a positive population growth rate over five sequential survey periods.

In addition, the draft Revised Recovery Plan describes three recovery objectives for delisting of the species (USFWS 2007):

1. Permanent protection of 50% of Priority 2 hibernacula.
2. A minimum overall population number equal to the 2005 estimate.
3. Continued documentation of a positive population growth rate over an additional five sequential survey periods.

Information regarding the species' characteristics, habitat requirements, range, and status within/near the HPWF is provided in the sections below.

4.1.1 Species Description

Indiana bats are medium-sized, grayish brown bats with a forearm length of 1.4 to 1.6 inches and a total length of 2.8 to 3.8 inches. The tragus (a fleshy projection arising from the base of the inner ear that directs sound into the ear) is short and blunt and measures slightly less than half the height of the ear. The tail is approximately 80% of the length of the head and body. The skull has a small sagittal crest and a small, narrow braincase. Indiana bats may be distinguished from the similar little brown bat and the northern long-eared bat by the presence of a keeled calcar and toe hairs on the hind feet that are shorter than the claws.

4.1.2 Habitat Description

Indiana bats require specific hibernacula conditions (e.g., stable temperature, humidity, and air movement) and typically hibernate in large, dense clusters that range from 300 individuals per square foot (Clawson et al. 1980) up to 100,000 individuals per cluster. Studies have found that over 98% of the range-wide population of Indiana bats hibernate in just five states: Indiana, Missouri, Kentucky, Illinois, and New York (USFWS 2017).

The summer habitat requirements of Indiana bats are not fully understood. Until recently, it was believed that floodplain and riparian forests were the preferred habitats for roosting and foraging (Humphrey et al. 1977); however, recent studies have shown that upland forests are also used by Indiana bats for roosting and that suitable foraging habitats may include upland forests, old fields (clearings with early successional vegetation), edges of croplands, wooded fencerows, and pastures with scattered trees and/or farm ponds (USFWS 2007).

The presence of Indiana bats in a particular area during the summer appears to be determined largely by the availability of suitable, natural roost structures. The suitability of a particular tree as a roost site is determined by its condition (live or dead), the amount of exfoliating bark, the tree's exposure to solar radiation, and its relative location to other trees, as well as a permanent water source and foraging areas (USFWS 2007).

Thirty-three species of trees have been documented as roosts for female Indiana bats and their young, with 87% of documented roosts located in various ash (*Fraxinus* spp.), elm (*Ulmus* spp.), hickory (*Carya* spp.), maple (*Acer* spp.), poplar (*Populus* spp.), and oak (*Quercus* spp.) species (USFWS 2007). However, the species of the roost tree appears to be a less crucial factor than the tree's structure (i.e., the availability of exfoliating bark with roost space underneath) and local availability, which can change from year to year as tree conditions change. Studies show that Indiana bats have strong site fidelity to summer habitats, and while individual roosts may change from year to year, females have been documented returning to the same roosts from one year to the next, though they will switch between roosts every two to three days on average (USFWS 2007).

4.1.3 Reproduction and Maternity Roost Habitat Requirements

Indiana bats mate during the fall, just prior to hibernation. Male and female bats congregate near the opening of a cave (usually their hibernaculum) and swarm, a behavior in which large numbers of bats fly in and out of cave entrances from dusk to dawn, while relatively few roost in the caves during the day (Cope and Humphrey 1977). Swarming lasts over a period of several weeks with mating occurring during the latter part of that period. Once females have mated, they enter the hibernacula and begin hibernation, whereas males will remain active longer, likely attempting to mate with additional females as they arrive at the hibernacula. Adult females store sperm during the winter with fertilization delayed until soon after they emerge from hibernation. Females emerge from the hibernacula ahead of the males, usually from mid- to late April, and migrate by the beginning of May to their summer roost habitats where they form small maternity colonies (Whitaker and Hamilton 1998). Maternity colonies generally have several separate roost areas located near one another that collectively provide the colony with the necessary roosting resources (including cover and correct temperature provided by exfoliating bark) needed during different environmental conditions. These colonies typically utilize one to a few primary roost trees (Callahan et al. 1997), which provide the proper roosting conditions most of the time, and are normally large, dead trees with exfoliating bark that are exposed to abundant sunlight (Miller et al. 2002, Whitaker and Brack 2002).

The habitat in which the primary roosts have been found varies considerably. Roost trees have been found in dense or open woods, strips of riparian forest, and small patches of woods, as well as open land; however, the roosts are normally located in open areas subjected to prolonged sunlight (Whitaker and Brack 2002, Miller et al. 2002). During extreme environmental conditions, such as rain, wind, or temperature extremes, the maternity colony may use alternate roost trees, which likely provide the bats with microclimate conditions that the primary roost trees cannot during times of sub-optimal environmental conditions. The locations of these alternate roosts vary from open areas to the interior of forest stands. A study of bats in northern Missouri revealed that usage of dead trees in the forest interior increased significantly in response to unusually warm temperatures, and the usage of both interior live and dead trees increased during periods of precipitation (Miller et al. 2002). The primary roosts are typically inhabited by many females and young throughout the summer, whereas alternate roost trees receive only intermittent use by individuals or a small number of bats (USFWS 2007). Females have one pup per year, generally in late May or early June, after they have arrived at their summer roost habitat.

4.1.4 Diet and Feeding Behavior

Indiana bats are nocturnal insectivores that feed exclusively on flying insects, consuming both terrestrial and aquatic insects. Diet varies seasonally, and variation is seen between different ages, sexes, reproductive status groups, and geographic regions (USFWS 2007). A number of studies conducted on the diet of Indiana bats have found the major prey groups include: moths (Lepidoptera); caddisflies (*Trichoptera* spp.); flies, mosquitoes, and midges (*Diptera* spp.); bees, wasps, and flying ants (*Hymenoptera* spp.); beetles (*Coleoptera* spp.); stoneflies (*Plecoptera* spp.); leafhoppers and treehoppers (*Hemiptera* spp.); and lacewings (*Neuroptera* spp.; USFWS 1999), with Coleoptera, Diptera, Lepidoptera, and Trichoptera contributing most to the diet (USFWS 2007).

Studies indicate that Indiana bats typically forage from 6 to 100 feet above the ground and hunt primarily around, not within, the canopy of trees (USFWS 2007). Foraging areas are most often located in closed to semi-open forested habitats and forest edges, with radio-telemetry data consistently indicating that wooded areas are preferred as foraging sites, although open habitats such as old fields and agricultural areas may also be used (USFWS 2007). Sparks et al. (2005) found that woodlands were used by foraging Indiana bats nearly twice as often as availability alone would suggest, supporting the idea that Indiana bats preferentially forage in woodlands.

4.1.5 Migration

The timing of spring emergence from hibernacula varies across the range of the species, but in general, females emerge first, from mid- to late April, and males emerge later, from late April to mid-May (USFWS 2007). Females may leave for summer habitat immediately after emerging or shortly thereafter and often travel quickly to where they will spend the summer. Some individuals may travel several hundred miles from their hibernacula, but studies in Indiana and New York have also found Indiana bats using summer habitat only 30 to 50 miles from their hibernacula (USFWS 2007). Maternity colonies begin breaking up in early August, at which time females head back to their hibernacula (USFWS 2007).

4.1.6 Range-wide Status

A population decrease of 28% over the Indiana bat's total range was reported from 1960 to 1975 (Thomson 1982). The range-wide population estimate dropped 57% from 1965 to 2001 (USFWS 2007). As of 2006, the USFWS had records of extant winter populations at approximately 281 hibernacula in 19 states and 269 maternity colonies in 16 states (USFWS 2007). The estimated range-wide Indiana bat population in 2017 was 559,781 bats (USFWS 2017). The closest known hibernaculum to the HPWF is in Marion County, Missouri, approximately 35 miles southeast of the site (USFWS 2007). As of 2007, this hibernaculum was considered a Priority 4[9] site containing a population of less than 50 Indiana bats. A previously unknown Indiana bat hibernaculum, classified as a Priority 1[10] site, was discovered in Missouri in 2012. It is located approximately 65 miles southeast of the HPWF and contained approximately 197,719 bats in 2017 (USFWS 2017).

A relatively recent, and potentially devastating, threat to Indiana bats is a disease known as white-nose syndrome (WNS). WNS is a fungal infection that was first identified in eastern New York during the winter of 2006-2007. It was named for the visible presence of a white fungus around the muzzles, ears, and wing membranes of affected bats. A previously unreported species of cold-loving fungus (*Pseudogymnoascus destructans*), which thrives in the darkness, low temperatures (40-50ºF), and high levels of humidity (>90%) characteristic of bat hibernacula, is now known to be the primary pathogen (U.S. Geological Survey [USGS] 2018). Bats afflicted with WNS wake more frequently from hibernation, causing them to lose fat reserves that are needed to survive hibernation (USGS 2018). It is thought that WNS is transmitted primarily from bat to bat; however, the possibility exists that it may also be transmitted by humans inadvertently carrying the fungus from cave to cave on their clothing and gear.

Since first being reported in New York, WNS has been confirmed to be present in 33 states. WNS has been confirmed present in 48 counties in Missouri to date, including: Marion, Ralls, Pike, Lincoln, Warren, Franklin, St. Louis, Jefferson, Ste. Genevieve, Perry, St. Francois, Iron, Washington, Crawford, Phelps, Dent, Shannon, Carter, Oregon, Howell, Texas, Pulaski, Miller, Cole, Callaway, Boone, Cooper, Moniteau, Camden, Laclede, Wright, Douglas, Ozark, Searcy, Dallas, Greene, Christian, Taney, Stone, Barry, McDonald, Newton, Dade, Cedar, St. Clair, Jackson, Clay, and Buchanan counties (USFWS 2019a). Most species of cave hibernating bats in the East have been affected, with the little brown bat, northern long-eared bat, and Indiana bat particularly hard hit (USGS 2018). The USFWS estimates the Indiana bat population in the USFWS Appalachian Mountain Recovery Unit, where WNS has more recently spread, dropped 53.8% from 2015 to 2017 based on the 2017 count of Indiana bats (USFWS 2017). Previously, between 2013 and 2015, this region dropped 69%.

Additional threats to the Indiana bat include: modifications to hibernacula that change airflow and alter the microclimate; human disturbance and vandalism during hibernation, resulting in direct mortality; natural events during winter affecting large numbers of individuals; disease; and habitat degradation and loss (USFWS 2007).

In addition, mortality of Indiana bats from operating wind turbines has been documented, with 13 fatalities to-date (USFWS 2018b, see Section 5.1). Thirteen ITPs have been issued for incidental take of Indiana bats from wind energy, which are summarized in Table 4-1 below.

[9] Priority 4 hibernacula are least important to recovery and long-term conservation of Indiana bats. These hibernacula typically have current or observed historic populations of fewer than 50 bats (USFWS 2007).
[10] Priority 1 hibernacula are essential to the recovery and long-term conservation of Indiana bats. These hibernacula typically have current and/or historically observed winter populations greater than 10,000 Indiana bats and currently have suitable and stable microclimates (USFWS 2007).

Table 4-1. Summary of Incidental Take Permits issued to wind facilities for Indiana bats to-date.

Project and Location	Indiana bats per year	Project Size (MW)	Indiana bats per MW per year	Total permitted take
Buckeye Wind (Ohio) (project not yet built)	5.2	250	0.02	130
Beech Ridge (West Virginia)	1.8 to 4.5	100.5 to 186	Up to 0.04 (first 3 years)	53
Criterion (Maryland)	0.7	70	0.01	14
Fowler Ridge (Indiana)	2 to 11	150.4 to 750	0.01	193
Pioneer Trail (Illinois)	3	150	0.02	129
Wildcat (Indiana)	6	200	0.03	162
Hoopeston (Illinois)	2	98	0.2	60
Headwaters (Ohio)	9.55	200	0.05	258
MidAmerican (Iowa)	25	866[1] (based on turbines within the range of Indiana bat)	0.03	750
North Allegheny (Pennsylvania)	0.16	70	<0.01	4
Blue Creek (Ohio)	4.39	304	0.01	154
Timber Road (Ohio)	2.49 to 10.77	Up to 224	0.04	276
Hog Creek (Ohio)	3.23	66	0.05	97

While many of these HCPs are for facilities with migratory risk, rather than summer risk due to the presence of maternity colonies, the Buckeye Wind Farm in Ohio has documented maternity colonies within the project area and an estimated summer population of 10.1 to 2,271.4 Indiana bats spread across 4 to 45 maternity colonies[11]. In addition, 3 of the 13 Indiana bat fatalities at wind farms to-date have occurred during the summer maternity season (1 each in Indiana, West Virginia, and Iowa), clearly demonstrating that there are operating wind farms with summer risk to Indiana bats.

4.1.7 Ozark-Central Recovery Unit Status

The draft Revised Recovery Plan for the Indiana bat divides the species' range into four recovery units based on several factors, such as traditional taxonomic studies, banding returns, and genetic variation (USFWS 2007). The Permit Area is located within the Ozark-Central Recovery Unit (OCRU), which includes the range of the Indiana bat within the states of Illinois, Missouri, Arkansas, and Oklahoma (USFWS 2007). According to the 2019 Range-wide Population Estimate (USFWS 2019b), the overall Indiana bat population in Missouri was approximately 195,157 in 2019 (Table 4-2). This represents approximately 70.1% of the overall 2019 population estimate for the Indiana bat population in the OCRU

[11] See Page 71 of the Buckeye Wind HCP (https://www.fws.gov/midwest/Endangered/permits/hcp/buckeyewind/pdf/finalhcpeis/BuckeyeFinalHCP25March2013.pdf)

(276,317; USFWS 2019b). The total population estimate for the OCRU decreased by approximately 8% between 2017 and 2019 (Table 4-2; USFWS 2017, 2019b).

Table 4-2. Indiana Bat Population Estimates for the Ozark-Central Recovery Unit (USFWS 2019b).

State	2011	2013	2015	2017	2019
Missouri[1]	212,942	214,453	216,289	217,884	195,157
Illinois	57,212	66,817	69,924	81,143	78,403
Arkansas	1,206	856	1,398	1,722	2,749
Oklahoma	13	5	5	8	8
Total	271,373	282,131	287,616	300,757	276,317

[1]A previously unknown Indiana bat hibernaculum was discovered in Missouri in 2012, which contained 123,000 bats when surveyed in January 2013, which has been added to each previous survey year due to first-hand accounts of large clusters/numbers of hibernating bats for the past several decades prior to discovery by bat biologists. Source: USFWS 2017

4.1.8 State Status

The Indiana bat is listed as state endangered in Missouri. State-listed species are protected under the Wildlife Code of Missouri as S1 ranked species (critically imperiled) in the Missouri Wildlife Action Plan (MDC 2015). Maternity roosts have been identified in 21 counties, with 39 counties having probable maternity use (MDC, personal communication).

As of 2019, the state of Missouri had the largest hibernating population of Indiana bats at 195,157 individuals (USFWS 2019b, Table 4-2). Historically, size estimates of hibernating populations of the Indiana bat across the state of Missouri have ranged from 399,000 in 1965 to 72,983 in 2001 (USFWS 2007). Recorded maternity colonies are known from 21 counties (USFWS personal communication 2019). Historically, known hibernacula in Missouri included:

- 6 – Priority 1 (current and/or observed historic winter populations of ≥10,000 bats and currently have suitable and stable microclimates)
- 10 – Priority 2 (current or observed historic population of 1,000 – 10,000 bats)
- 24 – Priority 3 (current or observed historic population of 50 – 1,000 bats)
- 26 – Priority 4 (current or observed historic population of <50 bats)
- 1 – Ecological Trap (defined as having a history of repeated flooding or severe freezing events that have resulted in mortality of most Indiana bats)

Of these 67 previously recorded hibernacula, 40 sites recorded at least one bat between 1995 and 2007 (USFWS 2007), and recent 2016/2017 surveys documents Indiana bats at 32 sites in Missouri (Colatskie 2017), though it is unclear whether these surveys included all known hibernacula.

A long-term study conducted by MDC from 2011 to 2017 surveyed over 800 unique sites in 66 counties in Missouri. Visible WNS has been documented in 48 counties (240 hibernacula) since 2012. An additional continental WNS study conducted by The University of California – Santa Cruz (UC – Santa Cruz) swabbed bats at eight hibernacula in Missouri and discovered the positive detection of *P. destructans* in bats prior to any visual expression of WNS (Colatskie 2017).

Population counts during winter periods from 2012 to 2017 were conducted by MDC at 183 hibernacula in Missouri. When counts first began (2012/2013 winter period), 138,554 Indiana bats were found. The Indiana bat populations showed a 55.3% increase at surveyed hibernacula, with recent counts (2016/2017 winter period) equating to 215,107 individuals in total (Colatskie 2017; this increase is likely due to increased level of effort in surveying, rather than population growth). All hibernacula in Missouri are considered WNS affected. In 2019, the Indiana bat population at Sodalis Nature Preserve exhibited the first indication of a declining population trajectory since surveys were initiated here in 2013 (USFWS 2019b). Smaller hibernacula also showed indications of a decline, with 21 surveyed hibernacula declining from 13,165 in 2017 to 12,993 in 2019 (USFWS, personal communication).

4.1.9 Status within the Permit Area

As described in Section 3.4.1, approximately 21.0% of the Permit Area provides suitable summer habitat for the Indiana bat. Acoustic surveys conducted in 2016 at 70 sites resulted in the detection of 73,955 bat calls, of which 4,321 were identified as Indiana bat calls. Qualitative identification confirmed the presence of Indiana bats at 60 sites (see Section 3.4.2). Recent surveys conducted by Stantec (2018) at 65 acoustic sites, outlined in Section 3.4, detected 81,946 bat calls, of which 3,289 were identified as Indiana bat calls. Presence of this species was confirmed through qualitative acoustic identification (detection at 54 sites) and mist net surveys (i.e., captures). Additionally, acoustic detectors deployed on five MET towers within the Permit Area in 2018 identified 138 Indiana bat calls (see Section 3.4.2.3).

Mist-net surveys conducted in 2016 at 33 sites resulted in 431 bat captures, including 23 Indiana bats (Stantec 2016; see Section 3.4.4). Nine Indiana bats were radio-tagged and tracked in 2016, resulting in the identification of 13 Indiana bat roosts. Mist-net surveys in 2018 resulted in 389 bat captures, including 60 Indiana bat captures, 12 of which were fitted with radio transmitters and tracked during telemetry efforts. Ten roost locations were confirmed within the Permit Area with an average emergence count of 13.75 bats per night (Stantec 2018). There is no designated critical habitat located within or near the Permit Area for the species (USFWS 2007).

4.1.9.1 Maternity Colonies within the Permit Area

During 2016 and 2018 mist-net surveys, a total of 83 Indiana bats were captured, of which 66 were adult females or juvenile bats, and, therefore, presumably associated with maternity colonies (Stantec 2016, 2018). Of these 66 bats, 21 were fit with radio-transmitters, and 14 were tracked to 33 different roost locations, including 23 specific roost trees, 5 estimated roost trees (could be viewed from afar, but did not have access to the land) and 5 triangulated locations.

Research has found that foraging areas for Indiana bats can range from 0.3 to 5.2 miles, although most distances are less than half of the maximum distance (Murray and Kurta 2004, Sparks et al. 2005). At the HPWF, radio tracking in 2016 and 2018 of 14 bats found that they roosted up to 2.5 miles from the capture locations.

Size of Maternity Colonies within the Permit Area

Kurta (2005) found that the mean maximum number of bats emerging from a colony, after juveniles have become volant, is approximately 119 bats, suggesting that 60 to 70 adult females are present during the breeding season.

Emergence counts at the 23 Indiana bat roosts averaged 21.9 bats/night, with a maximum of 147 bats (Stantec 2016, 2018). Because colonies are distributed through multiple roosts, exit counts provide limited information on colony size (Silvis et al. 2014). On any given day, a single maternity colony is dispersed among numerous roosts, with many bats occupying one or more primary roosts, while other individuals or small groups may be occupying other alternate roosts (Kurta et al. 2004). Primary roosts can be defined by the number of bats using them (>30 individuals; Callahan 1993). Carter (2003) found that a maternity colony used a minimum of 8 roosts on any given day, while maternity colonies in general use a minimum of 8 to 25 roosts during a maternity season (Callahan et al. 1997, Carter 2003, Kurta et al. 2002, Sparks 2003).

Given this information, without tracking every single bat within a maternity colony, and then conducting simultaneous emergence counts on all known roost trees used by the colony, it can be difficult to determine the size of a maternity colony. During 2016 and 2018, 43 emergence counts (with a count greater than 0) were conducted at 23 known Indiana bat roosts within the Permit Area over 25 calendar nights. Roosts were placed into seven distinct groups (representing a potential maternity colony) based on their location and proximity to other roosts (within 2.5 miles). Emergence counts conducted prior to mid-July[12] (when Indiana bat pups start to become volant in Missouri; USFWS 2017) were multiplied by 1.582 (assuming a fecundity rate of 0.582 for adult female Indiana bats; see Section 6.3.2) and rounded to the nearest whole bat to account for non-volant pups.

Seven of the 23 roosts were identified as primary roosts based on an exit count of greater than 30 bats (average of 66 bats). The remaining 16 roosts had an average emergence count of 10 bats. Using the emergence counts conducted on a calendar night within a maternity group, and then adjusting for other roosts (assuming 10 bats per alternate roost, and a minimum of 8 roosts per maternity colony on a given night), a total of 29 colony counts were calculated (Table 4-3). For example:

- A night with a single emergence count would be adjusted by an additional 70 bats to account for 7 additional alternate roosts with an average of 10 bats each.
- A night with two emergence counts within 2.5 miles of each other would have a colony count calculated as the sum of the two emergence counts, plus 60 additional bats to account for 6 additional alternate roosts with an average of 10 bats each.

Eleven of the counts included at least one emergence count at a primary roost (>30 bats), and these colony estimates averaged 138 bats, compared to an average of 101 bats for nights where no primary roost was included in an emergence count. Therefore, using an average maternity colony size of 120 bats (60 adult females, as found by Kurta [2005]) appears appropriate.

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[12] Defined as July 15th for this analysis

Table 4-3. Emergence count data from 2016 and 2018 (Stantec 2016, 2018) within the Permit Area and associated maternity colony calculations.

Maternity Group	Roost	Date	Emergence Count	Actual Size adjusted for non-volant pups	Colony count for that night	Colony count adjusted for other roosts[1]
1	R-11	7/24/2016	8	8	8	78
	R-11	7/25/2016	9	9	9	79
	R-11	7/26/2016	8	8	15	75
	R-44	7/26/2016	7	7		
	R-46	7/29/2016	11	11	33	93
	R-54	7/29/2016	21	21		
	R-46	7/30/2016	6	6	8	68
	R-54	7/30/2016	2	2		
	R-44	7/31/2016	3	3	3	73
2	R-47	7/27/2016	8	8	8	78
	R-47	7/28/2016	82	82	82	152
3	R-48	7/27/2016	35	35	99	159
	R-49	7/27/2016	64	64		
	R-48	7/28/2016	82	82	165	225
	R-49	7/28/2016	83	83		
	R-58	8/1/2016	7	7	7	77
4	R-60	8/1/2016	147	147	154	214
	R-61	8/1/2016	7	7		
	R-60	8/2/2016	29	29	52	92
	R-61	8/2/2016	3	3		
	R-63	8/2/2016	15	15		
	R-64	8/2/2016	5	5		
	R-62	8/3/2016	20	20	34	84
	R-63	8/3/2016	12	12		
	R-64	8/3/2016	2	2		
	R-62	8/4/2016	22	22	22	92
5	R-2	6/26/2018	27	43	43	113
	R-2	6/27/2018	42	66	66	136
6	R-3	6/27/2018	2	3	3	73
	R-4	6/29/2018	1	2	5	65
	R-5	6/29/2018	2	3		

Maternity Group	Roost	Date	Emergence Count	Actual Size adjusted for non-volant pups	Colony count for that night	Colony count adjusted for other roosts[1]
	R-5	6/30/2018	2	3	5	65
	R-6	6/30/2018	1	2		
	R-6	7/1/2018	4	6	27	87
	R-7	7/1/2018	13	21		
	R-7	7/2/2018	6	9	9	79
	R-10	7/17/2018	48	48	48	118
	2R-11	7/31/2018	14	14	14	84
	2R-11	8/1/2018	9	9	9	79
	R-12	8/3/2018	34	34	34	104
	R-12	8/4/2018	39	39	39	109
7	R-8	7/12/2018	16	25	25	95
	R-8	7/13/2018	15	24	24	94

[1]Assuming a minimum of 8 roosts are used by a maternity colony on a given night and using the site-specific average of 10 bats per alternate roost. For example, if a night had a single emergence count, that number would be adjusted by 63 bats (7 additional alternate roosts of 10 bats each). If a night had two emergence counts, then the sum of those emergence counts would be adjusted by 60 bats (6 additional alternate roosts of 10 bats each). To be conservative, additional primary roosts were not added, even for maternity colonies where no primary roost was found.

Number of Maternity Colonies within the Permit Area

The number of maternity colonies at the site was calculated adapting methods used in the final BO for the northern long-eared bat listing decision (USFWS 2016d) using the following inputs:

- **Site Occupancy**: Acoustic surveys (see Section 3.4.2.2) determined that 84% of acoustic sites had occupancy by Indiana bats.
- **Colony Size:** An average colony size of 120 bats, of which 60 are adult females and the remainder are primarily volant juveniles and sympatric adult males, was used for this analysis (see "Size of Maternity Colonies within the Permit Area" above for explanation). While WNS may decrease this population size over time, the impacts of WNS are only just starting to be seen on Indiana bat populations in Missouri as of 2019, and future declines are built into the population projection matrices (see Appendix A).
- **Area a Colony Uses**: Assuming that each adult female requires 46 acres of suitable bat habitat (USFWS 2016c) and using the lower estimate of 60 adult females per maternity colony, each maternity colony would require approximately 2,760 acres of habitat (60 adult females multiplied by 46 acres per female).
- **Overlap**: Lacking information regarding the degree of spatial overlap between neighboring maternity colonies, we conservatively assumed that the colonies do not overlap (e.g., 2,760 acres of occupied habitat supports 1 colony). If this assumption is incorrect, it would result in an underestimation of the population size (i.e., if 2,760

acres supports more than one colony). We calculated the overlap between summer home range of reproductive females and males and non-reproductive females in the same way as USFWS (2016d), and since all Indiana bat mist-net captures were either females or juveniles (indicative of a maternity colony), or were males that were captured within 5 miles of females or juveniles, we assumed 100% overlap of maternity colonies and male presence within the Permit Area.

To calculate the number of maternity colonies that may be at risk of take during the summer maternity season (as well as during migration, though additional non-local maternity colonies will also be at risk), the Applicant used the above information, along with site-specific habitat information. Within the current Permit Area and a 1,000-foot buffer (in order to include individuals outside of the Permit Area that may also be at risk during the maternity season), there are approximately 26,050 acres of suitable bat habitat. The number of maternity colonies is then calculated as:

$$26{,}050\ acres * 0.84\ occupancy\ rate = 21{,}882\ occupied\ acres$$

$$21{,}882\ occupied\ acres * 1.0\ overlap\ with\ males = 21{,}882\ colony\ occupied\ acres$$

$$\frac{21{,}882\ acres}{2{,}760\ acres\ per\ colony} = 8\ maternity\ colonies$$

The result is approximately 8 Indiana bat maternity colonies within the Permit Area and a 1,000-foot buffer that could be impacted by take during the summer maternity season as well as the spring and fall migratory seasons.

Using an estimate of 60 adult females per maternity colony (see "Size of Maternity Colonies within the Permit Area" above for explanation), and the conservative estimate of 8 maternity colonies within the Permit Area and a 1,000-foot buffer, it is estimated that 480 adult female Indiana bats use maternity colonies that may be at the highest risk of take from the proposed project turbines. These values are used for evaluating the impact of the take on local maternity colonies (see Section 6.3), and by being conservative (low) with the number of maternity colonies and the size of maternity colonies, this results in a "worst case" for the analysis of the impact of the take (i.e., if there are actually more colonies present, and/or if each colony present is larger than predicted, then the impact of the take will represent a smaller proportion of local maternity colonies than what is estimated in this HCP).

4.1.9.2 Population Size within the Permit Area

As described above, there are an estimated 480 adult females within the Permit Area and a 1,000-foot buffer during the summer maternity season. Assuming a fecundity rate of 0.582 (the midpoint between a stable and declining population, see Table 6-7 in Section 6.3.2), there are approximately 279 pups born each year within the Permit Area and a 1,000-foot buffer. Based on site-specific sex ratios from mist-net surveys (see Section 6.3.1), approximately 53% of the captures within the Permit Area were female. Therefore, the total number of adult Indiana bats would be approximately 906 (480 bats divided by 0.53), for a total summer population size of 1,185 Indiana bats (906 adults plus 279 pups).

4.2 NORTHERN LONG-EARED BAT

The northern long-eared bat ranges throughout much of the eastern and north central U.S., from Maine to North Carolina westward to eastern Oklahoma, Wyoming, and Montana, as well as all Canadian provinces from the Atlantic

Ocean west to the southern Yukon Territory and eastern British Columbia. Northern long-eared bats have historically been found in greater abundance in the Northeast and portions of the Midwest and Southeast (USFWS 2014a). Though widespread, their distribution may be patchy or irregular (Amelon and Burhans 2006). On April 2, 2015, the USFWS published a final rule in the Federal Register (80 FR 17974) designating the northern long-eared bat as a threatened species under the ESA throughout its geographic range. The listing became effective on May 4, 2015, and a final 4(d) rule became effective on January 14, 2015. The final 4(d) rule exempts incidental take occurring at wind projects from ESA section 9 take prohibitions with minor exceptions (81 FR 1900).

4.2.1 Species Description

Northern long-eared bats are medium-sized yellowish-brown bats with a forearm length of 1.3 to 1.5 inches and a total length of 3.0 to 3.4 inches. The tragus is long, pointed, and measures more than one-half the height of the ear and is not obviously curved. Northern long-eared bats may be distinguished from the similar little brown bat and Indiana bat by longer ears and a longer, pointed tragus. The calcar is usually slightly keeled, and the toe hairs are medium long and sparse.

4.2.2 Habitat Description

Suitable summer habitat for northern-long eared bats is quite variable. During summer, northern long-eared bats roost singly or in colonies in cavities, underneath bark, crevices, or hollows of both live and dead trees and/or snags (typically ≥3 inches diameter at breast height [DBH]). They will utilize a wide variety of forested habitats for roosting, foraging, and traveling, and they may also utilize some adjacent and interspersed non-forested habitat, such as emergent wetlands and edges of fields. Males and non-reproductive females may utilize cooler roost spots, such as caves or mines.

Winter habitat includes underground caves and cave-like structures, such as mines and railroad tunnels. These hibernacula typically have high humidity, minimal air current, large passages with cracks and crevices for roosting, and maintain a relatively cool temperature (USFWS 2014b). Additional landscape features being used by northern long-eared bats during the winter may still be undocumented (USFWS 2014a).

4.2.3 Reproduction and Maternity Roost Habitat Requirements

Roosting habitat includes forested areas with live trees and/or snags with a DBH of at least 3 inches with exfoliating bark, cracks, crevices, and/or other cavities. Trees are considered suitable if they meet those requirements and are located within 1,000 feet of the nearest suitable roost tree, woodlot, or wooded fencerow (USFWS 2014b). Maternity habitat is defined as suitable summer habitat that is used by juveniles and reproductive females and is generally similar to Indiana bat habitat, though northern long-eared bats will use smaller trees (USFWS 2014b). The maternity colonies generally consist of 30-60 individuals (USFWS 2014b).

4.2.4 Diet and Feeding Behavior

Northern long-eared bats begin foraging at dusk, focusing on upland and lowland woodlots and tree-lined corridors, catching insects in flight. They will also feed by gleaning insects from vegetation and water surfaces (USFWS 2014b). Prey includes moths, flies, leafhoppers, caddisflies, and beetles.

4.2.5 Migration

Northern long-eared bats migrate between their winter hibernacula and summer habitat, typically between mid-March and mid-May in the spring and mid-August and mid-October in the fall. They are considered a short-distance migrant, with migration distances documented between 35 and 55 miles (USFWS 2015).

4.2.6 Range-wide Status

The northern-long eared bat is a commonly encountered species throughout the majority of the Midwest and was historically commonly captured in mist-net surveys (USFWS 2013b). However, their distribution among hibernacula in the Midwest is not very well known. The northern long-eared bat is less common in the southern and western portions of its range than in the north, though they are considered abundant in the Black Hills National Forest of South Dakota. In Canada, the species occurs throughout the majority of forested regions, though similar to the U.S., it is more commonly encountered in the eastern portions of its range (USFWS 2013b).

Disease is the principle factor currently affecting the population status of northern long-eared bats throughout their range in the U.S. and Canada (Frick et al. 2010, USFWS 2013b). Of the 39 states with northern long-eared bat populations, 22 have confirmed cases of WNS (USFWS 2013b). Within four years of initial WNS detection, northern long-eared bats have been documented to experience up to 100% decline at some hibernacula (Turner et al. 2011). Other factors, such as habitat loss and modification, wind farm and urban development, and disturbance at hibernacula, likely also impact this species, but no other single factor has had the profoundly devastating impact to northern long-eared bat populations as WNS. The USFWS (2013b) estimates that WNS will eventually spread throughout the entire known North American population of northern long-eared bats, and they estimate that impacts from WNS could lead to extinction of this species by 2026.

As of 2015, 43 northern long-eared bat fatalities had been recorded from wind-energy facilities located in North America, representing 0.3% of the total bat mortality at wind-energy facilities (Gruver and Bishop-Boros 2015). The majority (79.1%) of these northern long-eared bat fatalities occurred in the fall (Gruver and Bishop-Boros 2015). In the Midwest, all 3 of the known northern long-eared bat fatalities occurred in the fall, as is common with *Myotis* species (Gruver and Bishop-Boros 2015). The northern long-eared bat was not listed or proposed for listing when these fatalities occurred; however, these records do provide information on the rarity of northern long-eared bat fatalities, given the relatively large number of wind energy facilities operating within the species' range.

Eight ITPs have been issued for incidental take of northern long-eared bats from wind energy, which are summarized in Table 4-4 below.

Table 4-4. Summary of Incidental Take Permits issued to wind facilities for northern long-eared bats to-date.

Project and Location	Northern long-eared bats per year	Project Size (MW)	Northern long-eared bats bats per MW per year	Total permitted take
Pioneer Trail (Illinois)	2	150	0.01	86
Wildcat (Indiana)	3	200	0.02	81

Project and Location	Northern long-eared bats per year	Project Size (MW)	Northern long-eared bats bats per MW per year	Total permitted take
Hoopeston (Illinois)	2	98	0.02	60
Headwaters (Ohio)	2.53	200	0.01	68
MidAmerican (Iowa)	21	4,048.3	<0.01	637
Blue Creek (Ohio)	2.96	304	<0.01	103
Timber Road (Ohio)	0.57 to 2.48	Up to 224	0.01	64
Hog Creek (Ohio)	1	66	0.02	30

4.2.7 State Status

The northern long-eared bat is currently listed as endangered in the state of Missouri and is a S1 ranked species (vulnerable) in the Missouri Wildlife Action Plan (MDC 2019).

Per a review of the USFWS' WNS Zone map, Adair and Schuyler counties are located within 150 miles of a location with known WNS infected hibernacula (USFWS 2018c). Therefore, the HPWF falls within the WNS buffer zone per the final 4(d) rule under the ESA; however, take due to operation of a wind farm is still an exempt activity.

Because the northern long-eared bat has only recently been federally-listed, public records of captures are limited. As of 2014, there were 58 known occupied maternity trees, and there were an estimated 285,948 adult northern long-eared bats summering in Missouri each year (USFWS 2016d). Northern long eared bats have been documented in approximately 70 hibernacula across Missouri; however, none have been documented further north in Missouri than Sodalis Nature Preserve in Marion County (approximately 65 miles southeast of the Permit Area; USFWS 2016e); however, northern long-eared bat hibernacula have been documented north of Missouri, including records in Iowa (USFWS, personal communication).

A long-term study conducted by MDC from 2011-2017 surveyed over 800 unique sites in 66 counties in Missouri. Visible WNS has been documented in 48 counties (240 hibernacula) since 2012. An additional continental WNS study, conducted by UC-Santa Cruz, swabbed bats at eight hibernacula in Missouri and discovered the positive detection of *P. destructans* in bats prior to any visual expression of WNS (Colatskie 2017).

Population counts during winter periods from 2012 to 2017 were conducted by MDC at 183 hibernacula in Missouri. Results showed an extreme decline (99.9%) in northern long-eared bat populations at surveyed hibernacula, starting at 4,591 individuals (2012/2013 winter period) and ending with recent counts (2016/2017 winter period) of 2 individuals (Colatskie 2017).

4.2.8 Status within the Permit Area

As described in Section 3.4.1, approximately 21.0% of the Permit Area provides suitable summer habitat for the northern long-eared bat. During acoustic surveys conducted in 2016 at 70 sites, a total of 73,955 bat calls were detected, 1,362 of which were identified as northern long-eared bat calls (Stantec 2016; see Section 3.4.2). Acoustic surveys in 2018 detected 81,916 bat calls, including 1,016 northern long-eared bat calls (Stantec 2018). The species was also confirmed present through qualitative acoustic identification (detection at 39 sites in 2016 and 30 sites in 2018) and mist net surveys (i.e., captures). Eight northern long-eared bats were captured in 2011 (Robbins et al. 2012), and one individual was captured in 2016 (Stantec 2016). During the 2018 mist net survey, no northern long-eared bats were captured (Stantec 2018). Four northern long-eared bats were tagged and tracked successfully in 2011 to a colony with an estimated size of 10 bats, based on the largest emergence count observed (Robbins et al. 2012). No northern long-eared bat hibernacula are known within or near (within 55 miles) the Permit Area (USFWS 2016e).

4.2.8.1 Maternity Colonies within the Permit Area

During 2016 and 2018 mist-net surveys, only one northern long-eared bat was captured, which escaped the net prior to being sexed or aged (Stantec 2016, 2018). Home ranges for northern long-eared bats, consisting of maternity, foraging, roosting, and commuting habitat, typically occur within three miles of a documented capture or positive acoustic identification (USFWS 2014a). The number of maternity colonies at the site was calculated using the methods used in the final BO for the northern long-eared bat listing decision (USFWS 2016d) with the following inputs:

- **Site Occupancy**: Acoustic surveys (see Section 3.4.2.2) determined that 51% of acoustic sites had occupancy by northern long-eared bats.
- **Colony Size:** USFWS (2014) reported that maternity colonies can range in size from 7 to 100 individuals, though 30 to 60 may be more common. USFWS (2016d) reported that, in areas impacted by WNS prior to 2010/2011, a maternity colony of 20 adult females (and the same number of sympatric adult males and juveniles following parturition) should be assumed.
- **Area a Colony Uses**: USFWS (2016d) reported that northern long-eared bat maternity colonies use approximately 1,000 acres per colony.
- **Overlap**: USFWS (2016d) assumed no overlap between maternity colonies (which is conservative, as it would underestimate the population size if 1,000 acres actually supports more than 1 colony). Additionally, overlap with males was estimated at 90.43% (USFWS 2016d).

To calculate the number of maternity colonies that may be at risk of take during the summer maternity season (as well as during migration), the Applicant used the above information, along with site-specific habitat information. Within the current Permit Area and a 1,000-foot buffer (in order to include individuals outside of the Permit Area that may also be at risk during the maternity season), there are approximately 26,050 acres of suitable bat habitat. The number of maternity colonies is then calculated as:

$$26{,}050\ acres * 0.51\ occupancy\ rate = 13{,}286\ occupied\ acres$$

$$13{,}286\ occupied\ acres * 0.9043\ overlap\ with\ males = 12{,}015\ colony\ occupied\ acres$$

$$\frac{12{,}015\ acres}{1{,}000\ acres\ per\ colony} = 12\ maternity\ colonies$$

The result is approximately 12 northern long-eared bat maternity colonies within the Permit Area and a 1,000-foot buffer that could be impacted by take during the summer maternity season as well as the spring and fall migratory seasons.

Using the assumption of 20 adult females per maternity colony (the value USFWS assumed for populations affected by WNS prior to the winter of 2010/2011; USFWS 2016d), and applying this number to the conservative estimate of 12 maternity colonies within the Permit Area and a 1,000-ft buffer, it is estimated that 240 adult female northern long-eared bats use maternity colonies that may be at the highest risk of take from the proposed project turbines.

4.2.8.2 Population Size within the Permit Area

As described in Section 4.2.8.1, there are an estimated 240 adult females within the Permit Area and a 1,000-foot buffer during the summer maternity season. Assuming a fecundity rate of 0.562 (a declining population, see Table 6-7 in Section 6.3.2), there are approximately 135 pups born each year within the Permit Area and a 1,000-foot buffer. Approximately 50% of the northern long-eared bats within the Permit Area are assumed to be female (see Section 6.3.1). Therefore, the total number of adult northern long-eared bats would be approximately 480 (240 adult female bats and 240 adult male bats), for a total summer population size of 615 northern long-eared bats (480 adults plus 135 pups).

4.3 LITTLE BROWN BAT

The little brown bat is not a federally-listed, proposed, or candidate species, but it is currently undergoing a Discretionary Status Review on the National Listing Workplan. The USFWS anticipates determining if the species warrants listing under the ESA in 2023 (USFWS 2016b). Currently, no federal critical habitat, conservation plans, or recovery plans exist for this species. The species is listed as a species of conservation concern by Missouri.

4.3.1 Species Description

The little brown bat is 3.0-3.8 inches in length (tail length is 1.3-1.8 inches) and weighs approximately 0.3 ounce. Overall, they are dark brown in color with individual hairs appearing black/gray at the base, brown shaft, and yellowish-brown to olive brown glossy tips that give the appearance of a metallic sheen. Ears are small and bluntly rounded at the tip (MDC 2018c). Long toe hairs extend to the tips of the toes (Wisconsin Department of Natural Resources [WDNR] 2017).

4.3.2 Habitat Description

Little brown bats hibernate in caves and mines with high humidity and ambient temperatures above freezing (Fenton and Barclay 1980). Little brown bats often share hibernacula with other bat species, such as the tricolored bat, northern long-eared bat, Indiana bat, and big brown bat, but they rarely, if ever, will form hibernating clusters with other species (WDNR 2017). In summer, most females form maternity colonies in anthropogenic structures, such as buildings, bat boxes, and expansion cracks on bridges; however, some maternity colonies occur in large dead trees where the bats make extensive use of cracks, crevices, and under exfoliating bark (Humphrey and Cope 1976, Kunz et al. 1998). These colonies typically equate to approximately 300-1,200 bats (adults and offspring) but may reach up to 3,000 individuals (Humphrey and Cope 1976). Little brown bats forage above wetlands, waterways, and along the edges of agricultural fields.

4.3.3 Reproduction

Mating begins in fall, prior to hibernation, throughout winter when awakened from hibernation, and in spring, immediately following hibernation (MDC 2018c). Females produce a single pup in June or early July, born after a gestation period between 50 and 60 days. Young mature after one month, and once volant (able to fly), travel to the hibernacula but do not mate until the following year (WDNR 2017).

4.3.4 Diet and Feeding Behavior

Little brown bats are insectivores and forage above wetlands, waterways, and between open areas and denser cover where there are flying insects. Foraging behavior may range from singly along the edge habitat early in the evening and to hunting groups above open water later in the evening (Fenton and Barclay 1980). Their diet consists of aquatic or soft-bodied insects, such as wasps, moths, mosquitoes, gnats, and crane flies (Barbour and Davis 1969). They may consume up to half of their body weight in a single night (MDC 2018c).

4.3.5 Migration

In fall, little brown bats migrate to caves and mines with constant temperatures where they will hibernate during the winter. In spring, they migrate both short and long distances to summer roosting and foraging grounds (Barbour and Davis 1969). Migration distances of up to 282 miles have been documented (as cited in USFWS 2016a).

4.3.6 Range-wide Status

Until the arrival of WNS, little brown bats were one of the most common bat species in North America and abundant throughout most of their range. Their geographic distribution ranges from Alaska to northern Florida and into southern California. They are absent from the middle plains region (e.g., New Mexico, Texas, southern Florida). Little brown bats are extremely vulnerable to WNS, which has resulted in sharps declines in populations, especially along their eastern range. As the disease spreads geographically and regionally, population collapse has been observed and, in some cases, local species extinction has been predicted, suggesting that even limited take may have the potential for population-level effects (MidAmerican Energy Company [MEC] 2018, Frick et al. 2010, Ingersoll et al. 2013).

Die-offs of little brown bats at hibernacula have been associated with declines in summer activity (Dzal et al. 2011). Research has shown that severe declines in populations which cause population bottlenecks can trigger a rapid evolutionary response, and it has been predicted that little brown bat populations affected by WNS will stabilize due to this response within 11 years of WNS exposure (Maslo and Fefferman 2015). Empirical research has also shown increasing survival rates after exposure to WNS, and that stabilization in populations may be due to increasing survival rather than immigration (Maslo et al. 2015). Colatski (2017) found evidence of stabilization in Missouri as well. Additionally, even individuals affected by WNS have shown recovery from wing damage and infection (Dobony et al. 2011, Fuller et al. 2011).

4.3.7 State Status

The little brown bat, once commonly found statewide in Missouri, was recently reassigned a state conservation status rank of S2 (imperiled species) due to steep declines in populations in response to the impact of WNS (MDC 2018d). A long-term study conducted by MDC from 2011 to 2017 surveyed over 800 unique sites in 66 counties in Missouri. Visible WNS has been documented in 48 counties (240 hibernacula) since 2012. An additional continental WNS study conducted by UC – Santa Cruz swabbed bats at eight hibernacula in Missouri and discovered the positive detection of *P. destructans* in bats prior to any visual expression of WNS (Colatskie 2017).

Population counts during winter periods from 2012 to 2017 were conducted by MDC at 183 hibernacula in Missouri. Results revealed a decline (86.7%) in little brown bat populations at surveyed hibernacula, starting at 5,624 individuals (2012/2013 winter period) and ending with recent counts (2016/2017 winter period) equating to 748 individuals in total (Colatskie 2017).

4.3.8 Status within Permit Area

As described in Section 3.4.2.1, 100% of the Permit Area provides suitable summer habitat for the little brown bat. Acoustic surveys in 2016 at 70 sites detected 73,955 bat calls, including 6,337 little brown bat calls (Stantec 2016; see Section 3.4.2). In 2018, acoustic surveys at 65 sites detected 81,916 bat calls, including 6,495 little brown bat calls (Stantec 2018). Additionally, acoustic detectors deployed at five MET towers within the Permit Area in 2018 identified 1,162 little brown bat calls. Recent surveys conducted by Stantec (2016, 2018), outlined in Section 3.4, confirmed presence of this species through qualitative acoustic identification (detection at 59 sites in 2016 and 43 sites in 2018) and mist net surveys (i.e., captures). Five little brown bats were tagged and tracked in 2012; however, all roosts were identified outside of the original study area (Robbins et. al 2012). Four of the 5 tagged little brown bats either roosted alone or at 1 of 3 colonies of 80 to over 950 individuals based on emergence counts, though some of these colonies may have included big brown bats or been bachelor colonies. All three of the colonies were within manmade structures (barns, garage, house; Robbins et al. 2012). Three little brown bats were tagged and tracked to 10 roosts located within the Permit Area by Stantec in 2016, with an average emergence count of 10.8 bats per night (Stantec 2016). Mist net surveys in 2018 resulted in two little brown bat captures that consisted of one post lactating female and one non-reproductive male. Transmitters were not placed on captured little brown bats, and therefore, no roost tree locations were documented (Stantec 2018). No little brown bat hibernacula are known within or near the Permit Area.

4.3.8.1 Maternity Colonies within the Permit Area

During 2016 and 2018 mist-net surveys, a total of 9 little brown bats were captured, of which 5 were adult females or juvenile bats, and, therefore, presumably associated with maternity colonies (Stantec 2016, 2018). Of these 5 bats, 2 were fitted with radio-transmitters and were tracked to 5 different roost trees up to 10,870 ft from the capture location (approximately 2.0 miles; Stantec 2016). Data indicate that little brown bats may forage even further from their roost location, with records of over 3 miles (Randall et al. 2014). Female or juvenile little brown bats were captured at 3 of the 33 mist-net sites in 2016 and at 1 of the 33 mist-net sites in 2018 (Stantec 2016, 2018). The number of maternity colonies at the site was calculated adapting methods used in the final BO for the northern long-eared bat listing decision (USFWS 2016d) using the following inputs:

- **Site Occupancy**: Acoustic surveys (see Section 3.4.2.2) determined that 75.5% of acoustic sites had occupancy by little brown bats. While occupancy is calculated based on the forested habitat (and acoustic sites chosen for Indiana bats), it is acknowledged that little brown bats may also occupy non-forested areas within the Permit Area, and MET tower acoustic surveys (Section 3.4.2.3) confirm little brown bat use of non-forested areas. In addition, previous mist-net surveys found little brown bat colonies utilizing barns and structures in the vicinity of the Permit Area (Section 3.2.2.5).

- **Colony Size:** Maternity colonies can range in size from tens to hundreds of individuals (Kunz and Reichard 2010), and up to 3,000 adult females and young have been recorded at a single emergence count, though most populations range from 300 to 1,200 bats (Humphrey and Cope 1976). Emergence counts in 2016 averaged 10.8 bats per roost per night for roosts used by the radio-tagged little brown bats (Stantec 2016), whereas emergence counts in 2011 included a colony of over 950 individuals, though this population was found in a house rather than at a roost tree (Robbins et al. 2012). Given the small sample size of site-specific emergence counts for little brown bats, and the fact that multiple roost trees can be used by a single colony, published data were the best available science on maternity colony size. However, in addition, WNS has decreased hibernating populations in Missouri by 86.7% (Colatskie 2017, see Section 4.3.7). Assuming a similar decline in maternity colony size, it is assumed that populations in Missouri now average 40 to 160 individuals (13.3% of the 300 to 1,200 range). Assuming that, similar to Indiana bats, half of these individuals are adult females, approximately 20 to 80 adult females and 20 to 80 volant juveniles, may be present in each maternity colony. For this analysis, it is assumed that pre-WNS there were an average of 750 little brown bats per maternity colony (375 adult females), and that post-WNS there will be an average of 100 little brown bats per maternity colony (50 adult females).

- **Area a Colony Uses**: Assuming that each adult female requires 46 acres of suitable bat habitat (USFWS 2016f) and using the estimate of 375 adult females per maternity colony (pre-WNS), each maternity colony would require approximately 17,250 acres of habitat (375 adult females multiplied by 46 acres per female).

- **Overlap**: Lacking information regarding the degree of spatial overlap between neighboring maternity colonies, we conservatively assumed that the colonies do not overlap (e.g., 17,250 acres of occupied habitat supports 1 colony). If this assumption is incorrect, it would result in an underestimation of the population size (i.e., if 17,250 acres supports more than one colony). We calculated the overlap between summer home range of reproductive females and males and non-reproductive females in the same way as USFWS (2016d). Little brown bats were captured at six mist-net locations. Four of these locations had reproductive females or juveniles (indicative of a maternity colony) and one of the other two captures was within 3.9 miles of a female capture. Therefore, the Applicant assumed 83.3% overlap between maternity colonies and males (five of the six sites were used by a maternity colony or were within foraging distance of a maternity colony).

To calculate the number of maternity colonies that may be at risk of take during the summer maternity season (as well as during migration), the Applicant used the above information, along with site-specific habitat information. The current Permit Area is approximately 113,873 acres in size, and little brown bats are assumed to use both wooded and non-wooded areas. The number of maternity colonies is then calculated as:

$$113{,}873\ acres * 0.755\ occupancy\ rate = 85{,}974\ occupied\ acres$$

$$85{,}974\ occupied\ acres * 0.833\ overlap\ with\ males = 71{,}616\ colony\ occupied\ acres$$

$$\frac{71{,}616\ acres}{17{,}250\ acres\ per\ colony} = 4\ maternity\ colonies$$

Within the current Permit Area, there are approximately 4 little brown bat maternity colonies which could be impacted by take during the summer maternity season as well as the spring and fall migratory seasons. Assuming post-WNS populations of 50 adult females per maternity colony and applying this number to the conservative estimate of 4 maternity colonies within the Permit Area, it is estimated that 200 adult female little brown bats use maternity colonies that may be at the highest risk of take from the proposed project turbines. Since WNS arrived in Missouri in 2012 (Colatski 2017), and several studies have shown stabilization of little brown bat colonies after WNS exposure (see Section 4.3.6), the impacts of WNS on local maternity colonies may have already been realized, and populations may stabilize going forward.

4.3.8.2 Population Size within the Permit Area

As described in Section 4.3.8.1, there are an estimated 200 adult females within the Permit Area during the summer maternity season. Assuming a fecundity rate of 0.900 (see Table 6-10 in Section 6.3.4), there are approximately 180 pups born each year within the Permit Area. Within the Permit Area, it is assumed there is a 50:50 ratio of males to males (see Section 6.3.1). Therefore, the total number of adult little brown bats would be approximately 400 (200 adult females and 200 adult males), for a total summer population size of 580 little brown bats (400 adults plus 180 pups).

5.0 EFFECTS OF THE COVERED ACTIVITIES

Effects of the covered activities are described in the sections below; measures to minimize these impacts are described in Section 7.2.

5.1 DIRECT EFFECTS

Bat mortality has been documented at wind energy facilities worldwide (Arnett et al. 2008). The primary bat species affected by wind facilities are migratory, foliage- and tree-roosting lasiurine species that undergo long distance migrations and do not hibernate (i.e., eastern red bat, silver-haired bat, and hoary bat). Arnett et al. (2008) compiled data from 21 studies at 19 wind facilities in the U.S. and Canada and found that mortality has been reported for 11 of the 45 bat species known to occur north of Mexico. Of the 11 species, the hoary bat, eastern red bat, and silver haired bat have the highest mortality rates, with the hoary bat making up 61.7% of all fatalities (Arnett et al. 2008).

Prior to September 2009, no mortality of species listed as threatened or endangered under the ESA had been reported in connection with wind energy facilities, including the Indiana bat (Arnett et al. 2008). In September 2009, the first documented take of an endangered Indiana bat occurred at BP Wind Energy's Fowler Ridge wind farm located in Benton County, Indiana (Good et al. 2016).

As of 2015, 1,146 little brown bat, 43 northern long-eared bat, and 7 Indiana bat fatalities had been recorded from wind-energy facilities located in North America, representing 8.1%, 0.3%, and 0.1% of the total bat mortality at wind-energy facilities, respectively (Gruver and Bishop-Boros 2015). The majority of fatalities occurred in the fall: 62.2% of little brown bat fatalities, 79.1% of northern long-eared bat fatalities, and 71.4% of Indiana bat fatalities (Gruver and Bishop-Boros 2015). In the Midwest, all 3 of the known northern long-eared bat and 145 of 225 recorded little brown bat fatalities (64.4%) occurred in the fall, as is common with *Myotis* species (Gruver and Bishop-Boros 2015). The northern long-eared bat was not listed or proposed for listing when these fatalities occurred; however, these records do provide information on the rarity of northern long-eared bat fatalities, given the relatively large number of wind energy facilities operating within the species' range.

Bat mortality at wind facilities has been reported from direct impact with a spinning turbine blade or from barotrauma. Barotrauma involves tissue damage to air-containing structures (e.g., lungs) caused by rapid or excessive pressure change (Baerwald et al. 2008). As turbine blades spin, the blades create areas of low pressure. Bats flying through these areas may suffer barotrauma in as high as 90% of cases (Baerwald et al. 2008); however, more recent studies have concluded that direct collision is still the leading cause of death (Rollins et al. 2012, Grodsky et al. 2011).

Indiana bats, little brown bats, and northern long-eared bats have been confirmed present in the Permit Area (see Sections 4.1.9, 4.2.8, 4.3.8), and all three species may be present during migration as they pass through the Permit Area.

The mitigation associated with the HPWF (increased restoration and protection of summer habitat) is not anticipated to result in any direct negative effect to the covered species but is intended to preserve, protect, enhance, and/or restore summer maternity habitat for the covered species.

5.2 INDIRECT EFFECTS

Indirect effects are those effects that are caused by or will result from the proposed action and are later in time but are still reasonably certain to occur. For the purposes of an HCP, the indirect effects in question must be reasonably foreseeable, a proximate consequence of the covered activities proposed under the HCP and must rise to the level of take (USFWS and NMFS 2016) if they are to be included as a covered activity.

Indiana bats, northern long-eared bats, and little brown bats have been confirmed present within the Permit Area during the active season, and all three covered species may be impacted while migrating through the Permit Area. A potential indirect effect to these species would be disturbance/displacement due to the presence of the turbines or some aspect of their operations. Limited information is available regarding the disturbance/displacement of bats at wind facilities (Kunz et al. 2007). However, based on the number and frequency of documented deaths of bat species observed at wind energy facilities throughout North America, there appears to be no active avoidance of wind facilities by bat species (USFWS 2011).

Indirect effects to the Covered Species also include lost future reproduction when a female is killed prematurely. These impacts are covered in detail in Section 6.3.

A potentially positive indirect effect on Indiana bats, northern long-eared bats, and little brown bats is the addition of the HPWF as a renewable energy source, offsetting the potential operation of fossil fuel-fired generating sources and with the potential to slow the effects of climate change on the covered species However, the specific level of such benefit attributable to the HPWF is not readily quantifiable.

The mitigation associated with the HPWF (increased restoration and protection of summer habitat) is not anticipated to result in any indirect negative effect to the covered species but is intended to preserve, protect, enhance, and/or restore summer maternity habitat for the covered species.

5.3 EFFECTS ON CRITICAL HABITAT

A final rule designating critical habitat for the Indiana bat was published on September 24, 1976 (41 FR 41914). The critical habitat consists of 11 caves and 2 mines in 6 states:

- Illinois – Blackball Mine (LaSalle County)
- Indiana – Big Wyandotte Cave (Crawford County) and Ray's Cave (Greene County)
- Kentucky – Bat Cave (Carter County) and Coach Cave (Edmonson County)
- Missouri – Cave 021 (Crawford County), Caves 009 and 017 (Franklin County), Pilot Knob Mine (Iron County), Bat Cave (Shannon County), and Cave 029 (Washington County)
- Tennessee – White Oak Blowhole Cave (Blount County)
- West Virginia – Hellhole Cave (Pendleton County)

No critical habitat has been designated for the northern long-eared bat or little brown bat to date.

The nearest Indiana bat critical habitat is more than 119 miles away in Franklin County. The HPWF Plan Area does not occur within or near, nor will it directly affect, designated Indiana bat critical habitat; therefore, none will be affected.

5.3.1 Other Important Habitat Areas

While not designated critical habitat, the Sodalis Nature Preserve in Hannibal, Missouri (approximately 65 mi from the Permit Area) is the world's largest known hibernation site for the species. The 185-acre site was protected after the discovery of over 168,000 hibernating Indiana bats, who utilize an abandoned mine that is now protected by bat-friendly gates at 33 mine entrances. The last count in 2017 was over 200,000 Indiana bats, and it is estimated that this hibernaculum supports over a third of all Indiana bats (USFWS 2019c).

The HPWF Permit Area is located over 60 miles away from Hannibal and will not physically affect the Sodalis Nature Preserve.

6.0 INCIDENTAL TAKE PERMIT

The USFWS shall issue an ITP upon a finding that this HCP meets the permit issuance criteria set forth in 50 CFR Part 17, including that the actions proposed by Ameren will not appreciably reduce the likelihood of the survival and recovery of the covered species in the wild and that Ameren has minimized and mitigated the effects of its activities to the maximum extent practicable (see Section 1.3). The minimization and mitigation measures that Ameren will implement to meet this standard are described in the Conservation Plan in Section 7.0 of this HCP.

6.1 SCOPE OF THE INCIDENTAL TAKE PERMIT

6.1.1 Permit Period

Ameren is seeking a six-year ITP for the Indiana bat, northern long-eared bat, and little brown bat.

6.1.2 Type of Take

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in such activity [ESA §3(19)]. Harm is defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt behavior patterns which include, but are not limited to, breeding, feeding, or sheltering [50 CFR §17.3]. Incidental take is defined by the ESA as take that is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity" [50 CFR §402.02].

The HPWF has the potential to result in the incidental take of the Indiana bat, the northern long-eared bat, and little brown bat during operation of the HPWF through mortality due to collision with turbine blades or as a result of barotrauma. Accordingly, the ITP will cover potential incidental take occurring in connection with the otherwise lawful activities related to the operations of the HPWF. Indirect impacts to bats (measured as lost reproductive potential) are evaluated in Section 6.3 and included in the calculation of mitigation needs.

6.2 TAKE ESTIMATE FOR THE COVERED BAT SPECIES

Because the HPWF is not yet constructed or operational, site-specific mortality data are not available; therefore, take estimation must be based on the best available science, which includes other facilities' published fatality rates combined with High Prairie site-specific pre-construction data. It is understood that take estimation is not an exact science, and that High Prairie may pose a greater or lower risk to the covered species than the sites used in the take estimation analysis in this section. However, for the purpose of estimating take for the covered species, it was necessary to start with the best available data (including data from sites with similar habitats, as well as regional data). Due to the need for site-specific data, High Prairie is requesting a 6-year permit, during which site-specific post-construction monitoring data will be collected (see Section 7.3) and used to inform take estimates for an anticipated longer-term HCP covering the rest of the project life. Adaptive management measures (see Section 7.5) have also been developed to help protect the local maternity colonies and ensure the HPWF stays within the permitted level of take.

An overall fatality estimate for all bats is described in Section 6.2.1, the species composition for the covered species is described in Section 6.2.2, and the take estimates for the covered species are described in Section 6.2.3 and Section 6.2.4. Two methods were used to estimate take of the covered species, and these estimates were then averaged, as described in Section 6.2.5.

6.2.1 All-Bat Fatality Estimation

Post-construction monitoring data from the state of Missouri are limited (i.e., no publicly available studies), and no Missouri-specific post-construction monitoring data fulfilled the requirements for use in the draft Midwest Wind Multi-

Species Habitat Conservation Plan (MSHCP; USFWS 2016a). Therefore, data from within the range of the northern long-eared bat and within the Midwest were used to estimate overall bat fatalities at the HPWF. This includes projects that are geographically closer to the HPWF due to their location in the Midwest, as well as projects with more similar habitat such as facilities in the eastern United States where turbines are placed in closer proximity to suitable or occupied habitat. The final BO for the northern long-eared bat reported that bat fatalities from wind energy within the species' range averaged 17.55 bats/MW/year, ranging from 1.42 bats/MW/year to 38.25 bats/MW/year (USFWS 2016d). The draft MSHCP used similar data to determine that, within the range of the Indiana bat in the Midwest, fatalities average 18.13 bats/MW/year, ranging from 12.16 bats/MW/year to 38.22 bats/MW/year (USFWS 2016a).

Since publication of the draft MSHCP, the USFWS has continued to compile and summarize post-construction monitoring data, and provided the Applicant with summary information from 89 studies from USFWS Region 3 which operated at no cut-in speed, and had an average fatality rate of 15.34 bats/MW/year (95% confidence interval of 10.37 to 20.31 bats/MW).

Based upon these newer data, High Prairie conservatively used the upper 95% confidence interval of 20.31 bats/MW/year. Use of this value is conservative as it errs on the side of higher take, rather than utilizing the average take which would result in a lower overall take estimate. For the 400 MW size of the proposed HPWF, it is estimated that approximately 8,124 bats will be killed each year at the HPWF prior to any minimization.

6.2.2 Species Composition

High Prairie is located within the range of nine bat species (BCI 2018), including three species of bats that use trees year-round and six species of cave-hibernating bats that alternate between trees and caves, or use caves year-round (see Table 3-2 and Section 3.3.2).

Pre-construction *Myotis* Composition at the HPWF

Pre-construction acoustic and mist-net surveys were conducted at the HPWF in 2016 and 2018. Site-specific surveys conducted at the HPWF during the summer maternity season in 2016 and 2018 confirmed the presence of Indiana bats, northern long-eared bats, and little brown bats within the Permit Area. Table 6-1 summarizes the results of the acoustic and mist-net surveys from 2016 and 2018. While mist-net surveys were also conducted in 2010 and 2011 (see Section 3.4.2.5), those surveys were not included in this analysis due to the amount of time that has passed, and arrival of WNS, and as such, densities and species composition from 8-9 years ago were not considered relevant for take estimation at this time.

All bat survey methods have their own biases and the potential to detect a species using mist nets or acoustic detectors varies from species to species. Whereas mist net surveys can be biased toward those species that fly beneath the forest canopy, such as some North American *Myotis* species (Hayes and Gruver 2000, Kalcounis et al. 1999, Weller and Lee 2007), some species are more likely to be detected acoustically because of relatively low capture success. Certain species, such as hoary bats, are known to fly at heights that make their capture difficult, and other species are more adept at avoiding nets (e.g., *Myotis* and tri-colored bats) (Ministry of Environment, Lands and Parks 1998). Alternatively, juveniles may be more susceptible to capture than older age classes, creating a bias in the population composition (Ministry of Environment, Lands and Parks 1998). Acoustic surveys have their own set of biases. The maximum detection distance from the detector differs among species and flight and foraging behavior of bats in cluttered environments can make recording clean, identifiable calls difficult (Thomas and West 1989, as cited in Ministry of Environment, Lands and Parks 1998).

Table 6-1. Species composition from acoustic presence-absence surveys and mist-netting surveys conducted within the proposed High Prairie Renewable Energy Center Permit Area in 2016 (Stantec 2016, 2018).

Species	2016				2018			
	Mist-Net		Acoustic Bat Passes		Mist-Net		Acoustic Bat Passes	
	Number captured	Percent of total captures	Number files recorded	Percent of total files	Number Captured	Percent of total captures	Number files recorded	Percent of total files
Eastern red bat	116	26.9%	12,550	17.0%	73	37.0%	16,062	26.5%
Hoary bat	5	1.2%	7,235	9.8%	4	1.0%	13,569	22.4%
Silver-haired bat	4	0.9%	13,573	18.4%	1	0.3%	2,787	4.6%
Big brown bat	151	35.0%	18,370	24.8%	144	37.0%	17,640	29.1%
Evening bat	124	28.8%	3,651	4.9%	104	26.7%	8,285	13.7%
Little brown bat	7	1.6%	6,337	8.6%	2	0.5%	6,495	10.7%
Indiana bat	23	5.3%	4,321	5.8%	60	15.4%	3,289	5.4%
Northern long-eared bat	1	0.2%	1,362	1.8%	0	0.0%	1,016	1.7%
Tricolored bat	0	0.0%	235	0.3%	0	0.0%	220	0.4%
Total	431	100.0%	67,634	100.0%	389[1]	100.0%	60,688	100.0%

[1]One unidentified bat (either an Indiana bat or little brown bat) was captured but was not able to be identified before its escape.

Comparing Pre-construction Mist-net Data with Post-Construction Fatalities

Post-construction fatalities of bats at wind farms are higher for certain species, particularly migratory tree bats (eastern red, hoary, and silver-haired), which constitute over 75% of all fatalities nation-wide (Arnett et al. 2008). This pattern is also evident in USFWS Region 3 (Minnesota, Iowa, Missouri, Wisconsin, Illinois, Indiana, Michigan, Ohio) and within the State of Missouri (see Table 6-2).

Table 6-2. Species composition from post-construction mortality studies within the USFWS Region 3 (USFWS 2016a). This included 73 studies at approximately 54 facilities within Region 3, and 3 studies at 2 facilities within Missouri.

Species	# fatalities within USFWS Region 3 (percent)	# fatalities within Missouri (percent)
Eastern red bat	3,893 (44.4%)	33 (45.2%)
Hoary bat	2,328 (26.6%)	25 (34.2%)
Silver-haired bat	1,621 (18.5%)	7 (9.6%)
Big brown bat	519 (5.9%)	4 (5.5%)
Evening bat	28 (0.3%))	3 (4.1%)
Little brown bat	339 (3.9%)	0 (0.0%)
Indiana bat	6 (0.1%)	0 (0.0%)
Northern long-eared bat	8 (0.1%)	1 (1.4%)
Tricolored bat	24 (0.3%)	0 (0.0%)
Total	8,766	73

To better understand these patterns, High Prairie evaluated nine wind energy projects which had publicly-available pre-construction mist-net data and one to three years of post-construction monitoring data. The projects were located in Maryland (n=1) and Pennsylvania (n=8)[13] (Young and Gruver 2011, Criterion Power Partners 2014, Young et al. 2012a, Taucher et al. 2012). These nine sites were chosen because of the data they had publicly available pre-construction mist-net data and post-construction fatality data; no other sites had these data available. These sites were all surveyed between 2004 and 2011, around the timeframe when WNS was first spreading through Maryland and Pennsylvania (but prior to the full impacts of WNS). This is similar to the HPWF, which was surveyed in 2016 and 2018 as WNS spread into Missouri. While these studies are the closest representatives available, they do not represent the specific Indiana bat maternity colony use that has been documented on-site. Tree bat species present at these projects included

[13] While these studies were not conducted within Missouri or the Midwestern United States, they were conducted at sites that are representative of the conditions found at High Prairie, (i.e., suitable bat habitat present within the project boundary and near turbine locations), as opposed to Midwestern wind farms, which are typically located in cropfields away from bat habitat (i.e., woodland).

eastern red bat, hoary bat, and silver-haired bat. Data on tricolored bats indicate that their behavior may be more similar to migratory tree bats (CBD and DW 2016), and for this reason they were included with tree bats in our analysis. Cave-hibernating bat species present at these projects included big brown bat, little brown bat, northern long-eared bat, and eastern small-footed bat (*Myotis leibii*). All projects evaluated were within the range of the eastern small footed bat, which is not present at High Prairie, but was included in our analysis as it was assumed that they are representative of other cave-hibernating bats. In addition, none of the projects was within the range of the evening bat, which is present at the HPWF, but the Applicant assumed that the data from other cave-hibernating bat species would be representative of this species as well. Species were categorized as "tree bats" or "cave-hibernating bats" for our analysis to increase the sample size, since captures and fatalities of certain species are rare events.

Overall, tree bats (eastern red bats, hoary bats, and silver-haired bats, plus the tricolored bat[14]) made up just 11.1% of mist-net captures (range: 2.8% to 27.3%), but 84.4% of fatalities (range: 69.5% to 91.0%). Cave-hibernating bats (big brown bats, little brown bats, northern long-eared bats, and eastern small-footed bats [excluding tricolored-bats[15]]) made up 88.9% of mist-net captures (range: 72.7% to 97.2%), but only 12.7% of fatalities (range: 8.5% to 17.5%). Therefore, while cave-hibernating bats make up a much larger proportion of mist-net captures, they make up a small fraction of the observed fatalities, suggesting that they are less susceptible to fatality from wind energy. See Table 6-3 for an analysis by species (the remaining 2.6% of fatalities were either unknown or the Seminole bat [*Lasiurus seminolus*]).

Table 6-3. Species composition from pre-construction mist-net surveys and post-construction fatality surveys from 9 projects with publicly-available data for both surveys (Young and Gruver 2011, Criterion Power Partners 2014, Young et al. 2012a, Taucher et al. 2012).

Species	Average Percent of Mist-net Captures	Average Percent of Fatalities
Eastern red bat	8.5%	28.6%
Hoary bat	1.1%	33.5%
Silver-haired bat	0.1%	16.8%
Big brown bat	27.2%	5.3%
Evening bat[1]	n/a	n/a
Little brown bat	33.2%	7.2%
Indiana bat	0.0%	0.0%
Northern long-eared bat	28.3%	0.2%
Tricolored bat	1.3%	5.4%
Eastern small-footed bat[2]	0.2%	0.0%

[1]All projects were either outside of the range of the evening bat or did not have captures or fatality records.
[2]The range of the eastern small-footed bat included all 9 projects, but this species is not found at the HPWF.

All nine sites had documented northern long-eared bat presence during mist-net surveys, yet only 1 of the 9 sites had documented northern long-eared bat fatalities (a single September fatality in Pennsylvania, Taucher et al. 2012), That

[14] Data on tricolored bats indicate that their behavior may be more similar to migratory tree bats (CBD and DW 2016)
[15] Ibid.

suggests while present in the summer, northern long-eared bats do not appear to be particularly susceptible to collision mortality, though additional fatalities may have occurred and gone undetected. Little brown bats made up 18.2% to 47.9% of mist-net captures at the 9 sites, and 2.0% to 15.0% of fatalities, indicating they are at moderate risk of collision mortality.

Met Tower Acoustic Data

Acoustic detectors were deployed on five MET towers within the Permit Area on April 26, 2018. At each MET tower, a detector was placed at approximately 3 meters (10 feet; low detector) and at 50 meters (164 feet; high detector). Data were collected through November 7, 2018 (see Table 3-4 and Section 3.4.2.3). A total of 231,174 bat calls were recorded, of which 171,308 were identified to the species level by Kaleidoscope Pro. The remaining 59,866 bat calls (25.96% of all calls) were determined by the software not to be of sufficient quality to be identified to a species. It is assumed that these unidentified calls are equally likely to be any of the nine species, and that no particular species is more likely to fall into the unidentified call category. As such, for this analysis, it is assumed that the species composition of the calls identified to the species level is comparable to the species composition of the unidentified calls. Nine species were identified by Kaleidoscope Pro, with the following overall number of calls and species composition of calls:

- Hoary bat – 52,946 calls (30.9% of all calls identified to the species level)
- Big brown bat - 35,895 calls (21.0%)
- Eastern red bat – 28,381 calls (16.6%)
- Silver-haired bat – 24,497 calls (14.3%)
- Evening bat – 14,749 calls (8.6%)
- Little brown bat – 11,566 calls (6.8%)
- Indiana bat – 1,609 calls (0.9%)
- Tricolored bat – 1,288 calls (0.8%)
- Northern long-eared bat – 377 calls (0.2%)

6.2.3 Take Estimation for the Covered Species Using Mist-net Data

Cave-hibernating bats made up 70.9% of mist-net captures at the HPWF (see Section 3.4.2.4), a value that falls within the range of the mist-net captures at the 9 sites with pre-construction mist-net data and post-construction fatality data (see Section 6.2.2). Based upon post-construction fatality monitoring at those sites (which had similarly high cave-hibernating bat captures during summer mist-netting), it is anticipated that approximately 12.7% of fatalities at High Prairie will be cave-hibernating bats, while the remaining 87.3% will be tree bats (plus the tricolored bat). The Applicant assumed that fatalities at High Prairie will follow a similar pattern to the sites included in our analysis, which will be verified via post-construction monitoring (see Section 7.3).

Of the 8,124 bats that are estimated will be killed each year at High Prairie, approximately 1,032 will be cave-hibernating bats[16]. Within the cave-hibernating bat species, data from the nine pre-construction mist-net and post-construction fatality surveys indicate that fatalities do not occur proportionally to captures (Table 6-3). Big brown bats and little brown bats are killed at slightly higher rates than they are caught, but northern long-eared bats are killed far less frequently than they are captured in mist-net survey (Table 6-3). Thus, adjustment ratios (calculated as the percent of total cave-

[16] 8,124 * 0.127 = 1,032

hibernating bat fatalities divided by the percent of total cave-hibernating bat captures) were calculated for each species (Table 6-4), and then applied to the pre-construction mist-net data collected at the HPWF to predict post-construction fatalities. The Applicant assumes that fatalities at High Prairie will follow a similar pattern as occurred at the nine sites with pre-construction mist-net data and post-construction fatality data, and that species composition during pre-construction mist-net surveys can be used to predict post-construction fatalities. This assumption is based on those sites having a similar landscape to HPWF, with suitable habitat and maternity colonies present in woodlands within the operating wind farm. Post-construction monitoring (see Section 7.3) and Adaptive Management (see Section 7.5) will be used to evaluate the actual post-construction fatalities at the HPWF and keep the HPWF within the permitted levels of take of the covered species. The 6-year permit term will allow for collection of site-specific post-construction fatality data to better inform take estimates for a longer-term HCP.

Data on evening bats and Indiana bats were not available for this analysis; however, based on their behavior, the Applicant assumed that evening bats would behave similarly to the big brown bat and little brown (foraging in open areas), and therefore the adjustment ratios for big brown bats and little brown bats were averaged for the evening bat. The Applicant assumed that Indiana bats would be more similar to the northern long-eared bat (i.e., foraging within and near woodlands). However, to be conservative, yet still weight the data towards the northern long-eared bat data, the adjustment ratios for northern long-eared bats and little brown bats were averaged but weighted towards the northern long-eared bat at a 3:1 ratio[17] (Table 6-4) to account for the fact that Indiana bats are not as much of an interior woodland species as the northern long-eared bat, but also do not utilize open areas to the same extent as the little brown bat.

Table 6-4. Calculation of adjustment ratios for cave-hibernating bats.

Species	Site-specific mist-net data (Stantec 2016, 2018)		Mist-net and fatality data (see Table 6-3)		Adjustment ratio (percent fatalities divided by percent captures)	Adjustment ratio * percent of total cave-hibernating bat captures at High	Adjustment ratio scaled to 100%[1]
	Number captured	Percent of total cave-hibernating bat captures	Average Percent of total cave-hibernating bat captures	Average Percent of total cave-hibernating bat fatalities			
Big brown bat	295	47.9%	31.5%	42.7%	1.36	0.65	51%
Evening bat	228	37.0%	n/a		1.44	0.53	42%
Little brown bat	9	1.4%	37.2%	56.2%	1.51	0.02	2%
Indiana bat	83	13.5%	n/a		0.41	0.06	5%
Northern long-eared bat	1	0.2%	31.2%	1.1%	0.04	<0.01	1%
Total	616	100.0%				1.27	

[1]Adjustment ratio divided by the sum of the adjustment ratios (1.27). This was done to determine the percent of cave-hibernating bat fatalities anticipated by species for the HPWF. Does not add to 100 due to rounding.

[17] (1.51 * 0.25) + (0.04*0.75) = 0.41

Thus, of the estimated 1,032 annual cave-hibernating bat fatalities, estimated fatality by species include:

- Big brown bat – 526 (51% of cave-hibernating bat fatalities)
- Evening bat – 433 (42% of cave-hibernating bat fatalities)
- Little brown bat – 21 (2% of cave-hibernating bat fatalities)
- Indiana bat – 52 (5% of cave-hibernating bat fatalities)
- Northern long-eared bat – 10 (1% of cave-hibernating bat fatalities)

These are the unminimized take estimates (i.e., what would be expected to occur if no curtailment were put into place) and were based off of post-construction monitoring data from nine facilities that were not known to be operating under any curtailment. The minimized take estimates are outlined in Section 6.2.6.

6.2.4 Take Estimation for the Covered Species Using MET Tower Acoustic Data

Site-specific acoustic data from the upper MET towers (see Section 3.4.2.3) recorded a total of 41,745 bat passes between April 28 and November 7, 2018. Of these calls, the seasonal breakdown was:

- 1,719 passes during the spring (4.1%)
- 24,754 passes during the summer (59.3%)
- 15,272 passes during the fall (36.6%)

Assuming these activity levels correlate with risk, and that the overall take estimate of 8,124 bats per year (see Section 6.2.1) is accurate, the following overall bat fatalities by season are anticipated:

- Spring: 333
- Summer: 4,818
- Fall: 2,973

Based upon these seasonal breakdowns of fatalities, and the seasonal species composition of bat passes of the covered species[18] from the high MET tower (Table 3-4), the following fatalities are estimated (Table 6-5):

- Little brown bat: 63 fatalities per year (1.0% of the 333 spring fatalities, 0.6% of the 4,818 summer fatalities, and 1.0% of the 2,973 fall fatalities)
- Northern long-eared bat: 3 fatalities per year (0% of the 333 spring fatalities, 0% of the 4,818 summer fatalities, and 0.1% of the 2,973 fall fatalities)
- Indiana bat: 9 fatalities per year (0.1% of the 333 spring fatalities, 0.1% of the 4,818 summer fatalities, and 0.1% of the 2,973 fall fatalities)

[18] Conservatively using the quantitative identification from Kaleidoscope, and not the qualitative identification, in case some unidentified passes could have been the covered species.

Table 6-5. Fatality estimates for the covered species based on species composition of acoustic calls from the upper MET towers (see Table 3-4). Numbers rounded up to the nearest whole bat.

	Little brown bat	Northern long-eared bat	Indiana bat
Spring	4	0	1
Summer	29	0	5
Fall	30	3	3
Total	63	3	9

6.2.5 Averaged Take Estimates for the Covered Species

Since take estimation for a site like High Prairie is based on data from other facilities, in combination with site-specific pre-construction survey data, the two take estimation methods described above (see Sections 6.2.3 and 6.2.4) were averaged to best predict take at the HPWF. Actual take at the HPWF will be monitored using post-construction monitoring (Section 7.3), and adaptive management (Section 7.5) will be used to keep the HPWF within permitted levels of take. The following is the average estimated take if no curtailment were put into place (rounded to the nearest whole bat):

- Little brown bat: 42 fatalities per year
- Northern long-eared bat: 7 fatalities per year
- Indiana bat: 31 fatalities per year

The minimized take estimates are outlined in Section 6.2.6.

6.2.6 Take Estimate Adjusted for Minimization Measures

Operations will include feathering turbine blades below a cut-in speed of 5.0 m/s at the HPWF from 45 minutes before sunset to 45 minutes after sunrise from April 1 – October 31 when air temperature is above 40ºF, which is expected to yield an average mortality reduction of 62% for all bat species compared to no curtailment (see Table 7-1 and Section 7.2.1). This reduction is likely even higher for *Myotis* species, which are adapted for foraging over water or near vegetation, rather than the open-air aerial hawking used by migratory tree bats (Norberg and Rayner 1987), and thus are less likely to fly at higher wind speeds. Curtailment above even 4.0 m/s has been shown to reduce *Myotis* fatalities by over 90% (Gruver and Bishop-Boros 2015), and it is assumed that curtailment at 5.0 m/s would be even more protective than 4.0 m/s (i.e., reductions may actually be greater than 90%). However, it should be noted that the sample size of Myotis fatalities to compare fatality rate with or without curtailment is much smaller than when looking at all bat fatalities. Thus, to be conservative, High Prairie proposed to use the observed average 62% mortality reduction for all bat species in developing take estimates, despite the potential for the actual reductions likely being higher for the covered species.

A 62% reduction in fatalities is anticipated for all bat species, thus the take estimates for the covered species after being adjusted for minimization are in Table 6-6.

Table 6-6. Summary of annual unminimized and minimized direct take (mortality) estimations, rounded up to the nearest whole bat.

	Take Estimation using Mist-net Data (see Section 6.2.3)	Take Estimation Using Upper Met Tower Data (see Section 6.2.4)	Average (see Section 6.2.5)	After Minimization (62% Reduction)
Little brown bat	21	63	42	16
Northern long-eared bat	10	3	7	3
Indiana bat	52	9	31	12

Over the 6-year permit term, the total direct take is estimated to be 72 Indiana bats, 96 little brown bats, and 18 northern long-eared bats. The 62% reduction used for these calculations is likely conservative, as *Myotis* species likely see even greater reductions in fatalities from curtailment (see Section 7.2.1.4).

Section 4.1.6 and Section 4.2.6 discuss other HCPs that have been issued to-date for the Indiana bat and northern long-eared bat, respectively. While the annual estimated take of 12 Indiana bats at this Project is higher than most other permitted projects (due in part to the size of the project at 400 MW), the per-MW take rate of 0.03 Indiana bat per MW is equivalent to or lower than other recently permitted projects (e.g., Headwaters = 0.05 Indiana bat per MW per year; Hog Creek = 0.05 Indiana bat per MW per year; MidAmerican = 0.03 Indiana bat per MW per year; Timber Road = 0.04 Indiana bat per MW per year). Therefore, on a per-MW annual basis, this Project's requested permitted take is in line with other permitted projects.

6.3 IMPACTS OF ESTIMATED TAKE

6.3.1 Sex Ratios

Predicted sex ratios are needed to analyze the impact of the estimated take, however, actual sex ratios will be analyzed based on post-construction monitored data (Section 7.3) and the HPWF will use adaptive management (Section 7.5) to alter operations if needed if impacts to local maternity colonies are higher than anticipated. Bats directly taken by the HPWF may include non-reproductive juveniles as well as adult female and male bats. Mortality statistics are skewed toward males of the four most commonly killed species at wind energy facilities: the hoary bat, eastern red bat, silver-haired bat, and tricolored bat (Arnett et al. 2008). Behavioral-based risk factors have been hypothesized to increase the exposure potential for male tree bats at turbines (Cryan 2008). However, there are no data that suggest that male *Myotis* bats may be more vulnerable to wind turbine mortality (USFWS 2011). Gruver et al. (2009) recorded an equal number of male and female *Myotis* fatalities at a wind energy facility in Wisconsin, and BHE Environmental (2011) recorded more female *Myotis* fatalities than male *Myotis* fatalities at another wind energy facility in Wisconsin. The draft MSHCP evaluated 50 publicly available mortality monitoring studies from the eastern and midwestern United States and Canada, and found that 18% of *Myotis* fatalities were females, 40% were male, and 42% were of unknown sex; if unidentified bats were divided equally among the sexes, the ratio of females to males would have been roughly equal but skewed towards males (39% female and 61% male; USFWS 2016a).

Site-specific mist-netting in 2011, 2016, and 2018 captured both male and female *Myotis (*Stantec 2016, 2018, Robbins et al. 2012):

- Little brown bats – 35% females (23 captures total)
- Indiana bats – 53% females (120 captures total)
- Northern long-eared bats - 75% females (8 captures total, all in 2011)

Little brown bat and northern long-eared bat fatalities may come from local maternity colonies, where adult females are likely to be more common, or from solitary males, as well as from migrating individuals which could be either sex. Thus, while the site-specific sex ratio for little brown bats was skewed towards males (only 35% of captures were female), it is conservatively assumed that fatalities will have a 50:50 sex ratio of males to females since migratory individuals are likely to be either sex, and the sample size of individuals captured on site (n=23) is small. For northern long-eared bats, while 75% of captures were females, that data is from 2011, the sample size is small (n=8), and only 1 northern long-eared bat has been captured since then, suggesting that migratory risk may be greater than summer risk for this species, and a 50:50 sex ratio of males to females is also assumed for this species. This approach is considered conservative for both little brown bats and northern long-eared bats, in that it likely overestimates the percentage of females being taken based on the best available information (e.g., site-specific data).

Indiana bats typically segregate between the sexes during the summer maternity season, with males remaining close to hibernacula, and females migrating an average of 76.7 miles, and up to 375 miles (USFWS 2016a). Therefore, it is assumed that most Indiana bats encountering wind turbines at High Prairie will be adult females from the local maternity colonies, as well as adult females migrating through the Permit Area. In addition, of the six Indiana bat fatalities at wind facilities with known sex, five have been females (83%; USFWS 2018b). Although the exact proportion of females to males is unknown, it is assumed for this analysis that approximately 75% of the Indiana bats taken at the HPWF will be females.

Thus, the following number of females are estimated to be taken each year at the HPWF:

- Little brown bat – 8 females (50% of the minimized take of 16 bats per year)
- Indiana bat – 9 females (75% of the minimized take of 12 bats per year)
- Northern long-eared bat – 1.5 females (50% of the minimized take of 3 bats per year)

Impacts to the three covered species are analyzed at two levels in the following sections. First, the impact is analyzed using species-specific Resource Equivalency Analysis (REA) models, which determine the biological impact to the species based on the taking of adult female bats, which includes the loss of the female bat and her lost reproductive potential (see Section 7.2.2 for a more in-depth discussion of REA models). Secondly, the impact to local maternity colonies is evaluated based on the maternity colonies assumed to be present in the vicinity (see Section 4.1.9.1, Section 4.2.8.1 and Section 4.3.8.1) and the projected take of females that may originate from those colonies.

6.3.2 Indiana Bat

Based on the estimated annual take of 12 Indiana bats (see Section 6.2.6), and the assumed sex ratio of 75% females, an estimated 9 female Indiana bats will be taken each year at the HPWF, or a total of 54 females over the 6-year permit term.

The USFWS REA model for Indiana bats includes parameters for three different population trends – increasing populations (λ = 1.02 – 1.03), stationary populations (λ = 0.99 – 1.01), and declining populations (λ = 0.97 – 0.98). It is assumed that the state of Missouri is currently in a declining population (see Section 4.1.8), so the declining population parameters were used for the 6-year permit term (Table 6-7).

Table 6-7. Indiana bat REA model parameters (USFWS 2016c).

	Declining Population Value
Adult female breeding rate (pups/female/year)	0.562
Juvenile female breeding rate (pups/female/year)	0.130
Pup survival to juvenile (annual rate)	0.585
Juvenile survival (annual rate)	0.674
Adult survival (annual rate)	0.857

The direct take of 54 adult female Indiana bats over the 6-year permit term will also result in the loss of 86 female pups (total impact of 140 female Indiana bats; Table 6-8). The mitigation required[19] (in acres of protected summer roosting and foraging habitat) would be 149 acres, which would fully offset the impact of take (Table 6-8).

[19] The Chariton Hills Conservation Bank provides a program by which credits are calculated in the REA model using the maximum term (52 years) to represent protection, management, and monitoring that will occur in perpetuity. This is the year at which the REA model credits max out, even though the protection of the bank is in perpetuity.

Table 6-8. Indiana bat REA model outputs. Mitigation will utilize the USFWS-approved Chariton Hills Conservation Bank.

		Declining Population Value
Debits	Direct Take (female adults)	54
	Total Lost Reproduction (female pups)	86
	Total Debits Accrued (female bats)	140
Mitigation Required (acres of summer habitat protection)		149
Credits	Direct females added (adult females)	47
	Total reproduction gained (female pups)	93
	Total Mitigation Credit Accrued (female bats)	140

Impact on Maternity Colonies

Not all fatalities would occur during the maternity season, as most bat mortality peaks during fall migration, even at sites with maternity colonies present nearby (Taucher et al. 2012). Fatalities in the Midwestern U.S average 6.5% in the spring, 25.5% during summer, and 68.0% during fall (USFWS 2016a), while site-specific acoustic data of the three covered species from the high MET towers (see Section 3.4.2.3) showed activity at 5.6% in the spring, 45.3% in the summer and 49.2% in the fall (when looking at only the passes of the three covered species). The annual take of 9 female Indiana bats (see Section 6.3.1) will likely be spread across multiple maternity colonies (including the 10 within and near the HPWF), and bats taken during the fall migratory period (when the majority of bat fatalities occur) may be from more distant maternity colonies, and not all from within the local populations. For this analysis, we assume that all summer take and half of the migratory take occur from local maternity colonies. Indiana bats are thought to fly between 6.6 feet and 98.41 feet agl while foraging (LaVal et al. 1976, Humphrey et al. 1977, Russell et al. 2008), such that risks to Indiana bats during the summer are likely very low. Site-specific acoustic data at the MET towers (n=5; see Section 3.4.3) support this, with only 13 Indiana bat calls recorded at the upper MET tower detectors, of which only 7 were qualitatively identified as Indiana bats. Of these 7 calls, 2 were during the spring migration period, 2 were during the summer maternity season (August 8 and August 9) and 3 were during the fall migration period.

To be conservative, we assume that fatalities of the covered species will follow the pattern of activity from the site-specific acoustic data collected on these three species. This is conservative because we are using the quantitative data, rather than the bat passes that were qualitatively identified, and because this method results in the assumption that more of the fatalities will occur during the summer than if we were to use the pattern seen in the Midwest based on actual post-construction fatality data.

- 5.6% of the 9 female Indiana bat fatalities occur during the spring (0.5 female Indiana bats), of which 50% are from the local maternity colonies (0.3 female Indiana bats)

- 45.3% of the 9 female Indiana bat fatalities occur during the summer (4.1 female Indiana bats), of which 100% are from the local maternity colonies (4.1 female Indiana bats)
- 49.2% of the 9 female Indiana bat fatalities occur during the fall (4.4 female Indiana bats), of which 50% are from the local maternity colonies (2.4 female Indiana bats)

This results in an annual loss of 7.1 adult female Indiana bats from the local maternity colonies. This would represent less than 1.5% of the estimated adult female population size of 480 adult females. To determine the impact of take on the maternity colonies, we must first divide the population into different classes. For an Indiana bat maternity colony of 119 individuals, it was assumed that 60 of these individuals are adult females, leaving 59 juvenile bats. Of these 59 juvenile bats, it is assumed that there is a 1:1 sex ratio of females to males, or approximately 30 juvenile female bats. For this population analysis, it was assumed that half of these juvenile females are pups born that year (n=15), and half are juvenile females from the previous breeding season (n=15).

This starting population of 60 adult females, 15 juvenile females, and 15 female pups was used as the basis for population projections over the 6-year permit term, using the parameters from the REA model's declining population (see Table 6-7) for the population vital rates (i.e., birth and survival). The population projection calculations are explained in detail in Appendix A.

With a predicted take of 7.1 adult females per year, spread across 8 maternity colonies, it is assumed that each maternity colony will lose approximately 1 adult female per year (rounded up to the nearest whole bat to be conservative given this species' endangered status). Applying this take to the modeled population projections results in a population of 49 adult females, 9 juvenile females, and 15 female pups at the end of the 6-year permit term.

For comparison purposes, projections were also run for a take that is double what is expected (2 bats per year from a maternity colony, for all 6 years, resulting in a population size of 44 adult females, 9 juvenile females, and 14 female pups at the end of the 6-year permit term) and for a maternity colony of 50% of the anticipated size (30 adult females, 7 juvenile females and 7 female pups, resulting in a population size of 23 adult females, 4 juvenile females, and 7 female pups at the end of the 6-year permit term). While minimum sustainable maternity colony sizes are not known at this time, all three projections result in persisting populations at the end of the 6-year permit term.

The actual impact of take to the local maternity colonies is likely to be lower, as risk to bats from wind energy peaks during fall migration, spreading the risk of take between local and non-local maternity colonies. The adaptive management protocols (Section 7.5) include triggers to alter operations if post-construction monitoring indicates that any particular maternity colony is having a higher-than-anticipated level of take that could result in greater than anticipated losses at a maternity colony. In addition, maternity colony persistence will be monitored during the permit term (see Section 7.4).

6.3.3 Northern long-eared Bat

Based on the estimated annual take of 3 northern long-eared bats, and the assumed sex ratio of 50% females, an estimated 1.5 female northern long-eared bats will be taken each year at the HPWF, or a total of 9 females over the 6-year permit term.

The USFWS REA model for northern long-eared bats includes the same parameters as Indiana bats for the three different population trends– increasing populations (λ = 1.02 – 1.03), stationary populations (λ = 0.99 – 1.01), and declining populations (λ = 0.97 – 0.98). Given the threats faced by the species, including WNS, and the status of the species in Missouri (see Section 4.2.6), a declining population was used (Table 6-7).

The direct take of 9 adult female northern long-eared bats over the 6-year permit term, would result in the loss of 14 female pups in a declining population (total impact of 23 female northern long-eared bats) (Table 6-9). The mitigation required[20] (in acres of protected summer roosting and foraging habitat) would be 24 acres, which would fully offset the impact of take under each scenario (Table 6-9).

Table 6-9. Northern long-eared bat REA model outputs (USFWS 2016g). Mitigation will utilize the USFWS-approved Chariton Hills Conservation Bank.

		Declining Population Value
Debits	Direct Take (female adults)	9
	Total Lost Reproduction (female pups)	14
	Total Debits Accrued (female bats)	23
Mitigation Required (acres of summer habitat protection)		24[1]
Credits	Direct females added (adult females)	8
	Total reproduction gained (female pups)	15
	Total Mitigation Credit Accrued (female bats)	23

[1]The USFWS REA model requires a minimum mitigation size of 46 acres. Due to stacking, any mitigation implemented as part of this HCP will be greater than 46 acres.

Impact on Maternity Colonies

As discussed above in Section 6.3.2, not all fatalities would occur during the maternity season. The annual take of 1.5 female northern long-eared bats (see Section 6.3.1) will likely be spread across multiple maternity colonies (including the 12 within and near the HPWF), and bats taken during the fall migratory period (when the majority of bat fatalities occur) may be from more distant maternity colonies, and not from within the local populations. For this analysis, we assume that all summer take and half of the migratory take occur from local maternity colonies.

To be conservative, we assume that fatalities of the covered species will follow the pattern of activity from the site-specific acoustic data collected on these three species. This is conservative because we are using the quantitative data, rather than the bat passes that were qualitatively identified, and because this method results in the assumption

[20] The Chariton Hills Conservation Bank provides a program by which credits are calculated in the REA model using the maximum term (52 years) to represent protection, management, and monitoring that will occur in perpetuity. This is the year at which the REA model credits max out, even though the protection of the bank is in perpetuity.

that more of the fatalities will occur during the summer than if we were to use the pattern seen in the Midwest based on actual post-construction fatality data.

Utilizing the same assumptions that were used for the Indiana bat (i.e., following site-specific activity data based on quantitative analysis), the breakdown of female northern long-eared bat fatalities is thus:

- 5.6% of the 1.5 female northern long-eared bat fatalities occur during the spring (0.1 female northern long-eared bats), of which 50% are from the local maternity colonies (0.05 female northern long-eared bats)
- 45.3% of the 1.5 female northern long-eared bat fatalities occur during the summer (0.7 female northern long-eared bats), of which 100% are from the local maternity colonies (0.7 female northern long-eared bats)
- 49.2% of the 1.5 female northern long-eared bat fatalities occur during the fall (0.7 female northern long-eared bats), of which 50% are from the local maternity colonies (0.35 female northern long-eared bats)

This results in an annual loss of 1.1 adult female northern long-eared bats from the local maternity colonies. This would represent less than 0.5% of the estimated adult female population size of 240 adult females. To determine the impact of take on the maternity colonies, we must first divide the population into different classes. For a northern long-eared bat maternity colony with 20 adult females, it was assumed there were 20 juvenile bats, of which there is a 1:1 sex ratio of females to males, or approximately 10 juvenile female bats. For this population analysis, it was assumed that half of these juvenile females are pups born that year (n=5), and half are juvenile females from the previous breeding season (n=5).

This starting population of 20 adult females, 5 juvenile females, and 5 female pups was used as the basis for population projections over the 6-year permit term, using the parameters from the REA model's declining population (see Table 6-7) for the population vital rates (i.e., birth and survival). The population projection calculations are explained in detail in Appendix A.

With a predicted take of 1.1 adult females per year, spread across 12 maternity colonies, it is assumed that each maternity colony will lose an average of 0.1 adult female per year. Applying this take to the modeled population projections results in a population of approximately 17 adult females, 3 juvenile females, and 5 female pups at the end of the 6-year permit term, indicating that the level of requested take is sustainable for the local maternity colonies.

For comparison purposes, projections were also run for a take that is double what is expected (0.2 bats per year from a maternity colony, for all 6 years, resulting in a population size of approximately 17 adult females, 3 juvenile females, and 5 female pups at the end of the 6-year permit term) and for a maternity colony of 50% of the anticipated size (10 adult females, 2 juvenile females and 2 female pups, resulting in a population size of 8 adult females, 1 juvenile females, and 2 female pups at the end of the 6-year permit term). While minimum sustainable maternity colony sizes are not known at this time, all three projections result in persisting populations at the end of the 6-year permit term.

The actual impact of take to the local maternity colonies is likely to be lower, as risk to bats from wind energy peaks during fall migration, spreading the risk of take between local and non-local maternity colonies. The adaptive management protocols (Section 7.5) include triggers to alter operations if post-construction monitoring indicates that any particular maternity colony is having a higher-than-anticipated level of take that could result in greater than anticipated losses at a particular maternity colony.

6.3.4 Little Brown Bat

Based on the estimated annual take of 16 little brown bats, and the assumed sex ratio of 50% females, an estimated 8 female little brown bats will be taken each year at the HPWF, or a total of 48 females over the 6-year permit term.

The USFWS REA model for little brown bats includes parameters for three different population trends – increasing populations, stationary populations, and declining populations. While WNS has been present in Missouri since 2012 and populations may be showing signs of stabilization (see Section 4.3.7), it is conservatively assumed that the populations impacted by the HPWF will be between a declining and stationary population (Table 6-10).

Table 6-10. Little brown bat REA model parameters (USFWS 2016f).

	Declining Population	Stationary Population	Average
Adult female breeding rate (pups/female/year)	0.600	0.900	0.75
Juvenile female breeding rate (pups/female/year)	0.300	0.560	0.43
Pup survival to juvenile (annual rate)	0.200	0.550	0.375
Juvenile survival (annual rate)	0.700	0.865	0.7825
Adult survival (annual rate)	0.700	0.865	0.7825

With a direct take of 48 adult female little brown bats over the 6-year permit term, the impact of the take would include the loss of between 46.1 and 171.3 female pups (total impact of 94.1 to 219.3 female little brown bats, Table 6-11), under the declining and stationary population models, respectively. The mitigation required[21] (in acres of protected summer roosting and foraging habitat), when averaging the stationary and declining models, would be 108 acres, which would fully offset the impact of take (Table 6-11).

Table 6-11. Little brown bat REA model outputs

		Declining Population	Stationary Population	Average[1]
Debits	Direct Take (female adults)	48	48	48
	Total Lost Reproduction (female pups)	46.1	171.3	108.7
	Total Debits Accrued (female bats)	94.1	219.3	156.7
Mitigation Required (acres of protection)		136	80	108
Cred	Direct females added	46.1	40.7	43.4

[21] The Chariton Hills Conservation Bank provides a program by which credits are calculated in the REA model using the maximum term (52 years) to represent protection, management, and monitoring that will occur in perpetuity. This is the year at which the REA model credits max out, even though the protection of the bank is in perpetuity.

	(adult females)			
	Total reproduction gained (female pups)	48.8	179.5	114.2
	Total Mitigation Credit Accrued (female bats)	95.0	220.0	157.6

[1]There is evidence to suggest that little brown bat populations stabilize after exposure to WNS (see Section 4.3.6), and that this stabilization may already be occurring in Missouri (see Section 4.3.7). To be conservative, the average of a stationary and declining population was used, in case populations are still declining over part of the 6-year permit term. This evidence is not yet available for Indiana or northern long-eared bats, which is why declining population models were used for those species.

Impact on Maternity Colonies

As discussed above in Section 6.3.2, not all fatalities would occur during the maternity season. The annual take of 8 female little brown bats (see Section 6.3.1) will likely be spread across multiple maternity colonies (including the 4 within the HPWF), and bats taken during the fall migratory period (when the majority of bat fatalities occur) may be from more distant maternity colonies, and not from within the local populations. For this analysis, we assume that all summer take and half of the migratory take occur from local maternity colonies.

To be conservative, we assume that fatalities of the covered species will follow the pattern of activity from the site-specific acoustic data collected on these three species. This is conservative because we are using the quantitative data, rather than the bat passes that were qualitatively identified, and because this method results in the assumption that more of the fatalities will occur during the summer than if we were to use the pattern seen in the Midwest based on actual post-construction fatality data.

Utilizing the same assumptions that were used for the Indiana bat (i.e., following site-specific activity data based on quantitative analysis), the breakdown of female little brown bat fatalities is thus:

- 5.6% of the 8 female little brown bat fatalities occur during the spring (0.4 female little brown bats), of which 50% are from the local maternity colonies (0.2 female little brown bats)
- 45.3% of the 8 female little brown bat fatalities occur during the summer (3.6 female little brown bats), of which 100% are from the local maternity colonies (3.6 female little brown bats)
- 49.2% of the 8 female little brown bat fatalities occur during the fall (3.9 female little brown bats), of which 50% are from the local maternity colonies (2.0 female little brown bats)

This results in an annual loss of 5.8 adult female little brown bats from the local maternity colonies. This would represent 2.9% of the estimated adult female population size of 200 adult females. To determine the impact of take on the maternity colonies, we must first divide the population into different classes. For a little brown bat maternity colony of 100 individuals, it was assumed that 50 of these individuals are adult females, leaving 50 juvenile bats. Of these 50 juvenile bats, it is assumed that there is a 1:1 sex ratio of females to males, or approximately 25 juvenile female bats. For this population analysis, it was assumed that half of these juvenile females are pups born that year (n=12), and half are juvenile females from the previous breeding season (n=12).

This starting population of 50 adult females, 12 juvenile females, and 12 female pups was used as the basis for population projections over the 6-year permit term, using the parameters from the REA model's stationary population (see Table 6-10) for the population vital rates (i.e., birth and survival). The population projection calculations are explained in detail in Appendix A.

With a predicted take of 5.8 adult females per year, spread across 4 maternity colonies, it is assumed that each maternity colony will lose an average of approximately 1.45 adult females per year. Applying this take to the modeled population projections (using the average of the declining and stationary population parameters) results in a population of approximately 25 adult females, 5 juvenile females, and 11 female pups at the end of the 6-year permit term.

For comparison purposes, projections were also run for a take that is double what is expected (2.9 bats per year from a maternity colony, for all 6 years, resulting in a population size of 19 adult females, 4 juvenile females, and 10 female pups at the end of the 6-year permit term) and for a maternity colony of 50% of the anticipated size (25 adult females, 6 juvenile females and 6 female pups, resulting in a population size of 10 adult females, 2 juvenile females, and 5 female pups at the end of the 6-year permit term). While minimum sustainable maternity colony sizes are not known at this time, all three projections result in persisting populations at the end of the 6-year permit term.

The actual impact of take to the local maternity colonies is likely to be lower, as risk to bats from wind energy peaks during fall migration, spreading the risk of take between local and non-local maternity colonies. The adaptive management protocols (Section 7.5) include triggers to alter operations if post-construction monitoring indicates that any particular maternity colony is having a higher-than-anticipated level of take that could result in greater than anticipated losses at a particular maternity colony. In addition, maternity colony persistence will be monitored during the permit term (see Section 7.4).

7.0 CONSERVATION PLAN

7.1 BIOLOGICAL GOALS AND OBJECTIVES

The biological goals define the expected outcome of this conservation plan. These goals are broad, representing the guiding principles for operation of the conservation program described in this HCP and form the basis for the minimization and mitigation strategies employed. The biological objectives represent the steps through which the biological goals will be achieved and provide a basis for measuring progress towards and achievement of those goals.

The biological goals and objectives of this conservation plan for the covered bat species are:

1. **Goal #1**: To better understand the risk of the covered species at the HPWF.
    a. **Objective**: To collect annual site-specific post-construction mortality data to statistically estimate annual take of the covered species during the 6-year permit term to inform take estimates for a long-term HCP that will cover the remaining life of the HPWF.
2. **Goal #2**: To minimize Indiana bat, northern long-eared bat, and little brown bat mortality in the Permit Area, including minimizing take from local maternity colonies to ensure their continued existence.

a. **Objective**: Implement an operational strategy that will decrease bat mortality by approximately 62% (and potentially more for the covered species) from predicted uncurtailed levels, thereby decreasing actual mortality of all bats, and specifically keeping mortality of Indiana bats, northern long-eared bats, and little brown bats at or below permitted levels.

3. **Goal #3**: To support survival and reproductive capacity of Indiana bats, northern long-eared bats, and little brown bats in their summer range, thereby promoting population growth of maternity colonies.

    a. **Objective**: Implement a mitigation project that will protect summer maternity habitat at sites known to be occupied by Indiana bats, northern long-eared bats, and little brown bats.

7.2 MEASURES TO ACHIEVE BIOLOGICAL GOALS AND OBJECTIVES

7.2.1 Minimization of Direct Bat Mortality

7.2.1.1 Turbine Siting

A total of 23,893 acres of suitable summer bat habitat is present within the Permit Area (see Section 3.4.2.1, Figure 4). In an effort to minimize the effect of the HPWF on the covered species, TG High Prairie established turbine exclusion areas in portions of the Permit Area containing some of the largest tracts of woodland, shown in green on Figure 1. As a result, 3,952.6 acres of suitable habitat were excluded from turbine placement (i.e., no turbines sited within suitable woodlands in the exclusion area or within 1,000 feet of suitable woodlands located in an exclusion area) within the Permit Area.

Where possible, turbines are sited greater than 1,000 ft from bat habitat, though this was often not feasible given the landscape within the Permit Area. Turbines sited more than 1,000 ft from bat habitat is considered minimization of summer risk for little brown bats, northern long-eared bats, and Indiana bats (USFWS 2016a). In addition, foraging of Indiana bats has been found to decrease by 6% for every 100 m (328 ft) away from the forest edge (Jachowski et al. 2014), indicating that the further a turbine is sited from the woodlands, the less risk it will pose to foraging Indiana bats.

7.2.1.2 Turbine Design

Analysis of bat activity at various heights and locations (see Section 3.4.2.3) showed that all bat activity, as well as *Myotis* activity, was decreased at 50 m (200 ft) above ground level when compared to ground level activity or activity within the woodlands. Recent research has shown that bats with a predisposition to fly at heights near the rotor-swept zone are more prone to collision mortality, and thus pre-construction bat activity within the rotor swept zone can be correlated with collision risk (Roemer et al. 2017).

The turbines used at the HPWF (see Section 2.5.1.1) have a rotor swept zone that is a minimum of 105 feet above ground level. This could lower the risk to the Covered Species, since the lower end of the rotor-swept-zone would be above the elevations typically flown by *Myotis* species (see Figure 2). As described previously, Indiana bats are thought to fly between 6.6 feet and 98.41 feet while foraging (LaVal et al. 1976, Humphrey et al. 1977, Russell et al. 2008), northern long-eared bats likely spend more time even closer to the ground than Indiana bats (3.3 to 9.8 feet above ground; USFWS 2014a), and other Myotis are likely similar. The use of taller turbines may shift the risk to bat species which utilize high-height aerial hunting and commuting strategies (Wellig et al. 2018).

In addition, the use of larger turbines with a higher energy capacity (i.e., higher MW output per turbine) results in the need for fewer turbines to produce the same amount of energy, decreasing the number of turbines on the landscape. This decreases direct habitat impacts, as fewer access roads and collector lines are needed, and also decreases the number of potential collision areas by reducing the number of turbines. While the rotor-swept zone of a single turbine may be larger due to longer blades, the overall area of collision risk within the wind farm is still minimized by decreasing the number of turbines.

7.2.1.3 Tree Clearing

Impacts to bat habitat were avoided when possible during project siting. As discussed above, TG High Prairie took measures to avoid wooded areas of bat habitat through the establishment of turbine exclusion areas in portions of the Permit Area containing some of the largest tracts of woodland (shown in green on Figure 1). In addition, during project development, the gen-tie line running from the substations to the existing transmission line was rerouted, reducing potential woodland impacts from 61.3 acres to 39.5 acres. Both substations have been located in areas that will not require any clearing of potential bat habitat.

Based on the final layout, 93.61 acres of bat habitat (wooded areas) were removed during construction for access roads, crane pads/erection areas, the collection system, the transmission line between the substations, and the interconnection transmission line. Most areas of clearing were less than 5 acres in size, and were spread throughout the Permit Area, representing less than 0.4% of the available bat habitat (23,893 acres).

TG High Prairie limited the timing of tree clearing to time periods when the bats were not present (November 1 – March 31) and avoided clearing of known roost trees (based on locations in Stantec 2018, which include identified roosts from 2011, 2016, and 2018 surveys within the Permit Area). Should any future tree clearing be required outside of these dates, Ameren will confer with the USFWS and contract with a qualified bat biologist to evaluate the suitability of trees to serve as maternity roosts and conduct emergence counts, if deemed necessary by USFWS, at any suitable roost tree to determine if the tree is occupied by bats. Ameren will seek approval of an emergence counts study plan from USFWS prior to completing the survey(s).

Given the large amount of suitable habitat present within the Permit Area (23,893 acres), of which, less than 94 acres (representing 0.4% of the available habitat in the Permit Area) were cleared, no significant modification of habitat occurred as a result of the construction of the HPWF. The study area has had a high density of bat studies conducted (see Section 3.4.2), and all known roost trees from surveys conducted on-site were avoided (based on locations in Stantec 2018, which include identified roosts from 2011, 2016, and 2018 surveys within the Permit Area), and while there was the potential that an unknown roost tree was present in a tree clearing area, only 0.4% of the suitable habitat was taken, and all tree clearing occurred during the winter (November 1 – March 31), and thus no direct killing or injury to any of the covered species occurred. In addition, the small amount of modification that occurred (most areas were less than 5 acres spread across the Permit Area) did not significantly impair the essential behavior patterns of any of the covered species, and should a roost tree have been removed, the remaining 99.6% of the suitable bat habitat within the Permit Area still remains. Therefore, no harm in the form of take through habitat modification occurred (i.e., did not result in any actual injury or killing of bats), and it is not anticipated that the relatively small loss of habitat resulted in the loss of maternity colonies.

7.2.1.4 Cut-in Speed Adjustments

Cut-in speed adjustments will be implemented as a minimization measure (below the cut-in speed, turbine blades will be feathered so that they do not spin, however, the blades may pinwheel slowly) based on the 10-minute rolling average wind speed. All curtailment studies to-date show a generally consistent inverse relationship between cut-in speeds and bat mortality (Table 7-1). Curtailment actions effective at reducing risk of collision for all bat species are assumed to also be effective for the Indiana bat, northern long-eared bat, and little brown bat.

Table 7-1. Summary of publicly available curtailment studies on bats conducted to-date in North America.

Project	Year	State/Province	Cut-in Speed	Reduction	Average Reduction	Citation
Fowler Ridge	2011	Indiana	3.5	36%	36%	Good et al. 2012
Laurel Mountain	2011	West Virginia		35%		Stantec 2015
Summerview	2007	Alberta	4	57%	34%	Baerwald et al. 2009
Mount Storm	2010	West Virginia		22-47%		Young et al. 2011[1]
Mount Storm	2011	West Virginia		12%		Young et al. 2012b
Anonymous 2	2012	USFWS Region 8		20%		Arnett et al. 2013a[2,3]
Fowler Ridge	2011	Indiana	4.5	57%	59%	Good et al. 2012
Wolfe Island	2011	Ontario		48%		Stantec 2012
Anonymous 1	2010	USFWS Region 3		47%		Arnett et al. 2013a[2]
Laurel Mountain	2011	West Virginia		73%		Stantec 2015
Laurel Mountain	2012	West Virginia		71%		Stantec 2015
Casselman	2008	Pennsylvania	5	87%	55% (62% when Region 8 studies excluded)	Arnett et al. 2011
Casselman	2009	Pennsylvania		68%		Arnett et al. 2011
Fowler Ridge	2010	Indiana		50%		Good et al. 2011[4]
Pinnacle	2012	West Virginia		47%		Hein et al. 2013[2]
Pinnacle	2013	West Virginia		58%		Hein et al, 2014
Criterion	2012	Maryland		62%		Young et al. 2013
Anonymous 2	2012	USFWS Region 8		35%		Arnett et al. 2013a[2,3]
Anonymous 2	2012	USFWS Region 8		32%		Arnett et al. 2013a[2,3]
Summerview	2007	Alberta	5.5	60%	66%	Baerwald et al. 2009
Fowler Ridge	2011	Indiana		73%		Good et al. 2012
Wolfe Island	2011	Ontario		60%		Stantec 2012
Anonymous 1	2010	USFWS Region 3		72%		Arnett et al. 2013a[2]
Sheffield	2012	Vermont	6	63%	51% (63% when Region 8	Martin et al. 2013
Anonymous 2	2012	USFWS Region 8		38%		Arnett et al. 2013a

Project	Year	State/Province	Cut-in Speed	Reduction	Average Reduction	Citation
					studies excluded)	
Casselman	2008	Pennsylvania	6.5	74%	76%	Arnett et al. 2011
Casselman	2009	Pennsylvania		76%		Arnett et al. 2011
Fowler Ridge	2010	Indiana		78%		Good et al. 2011[4]
Pinnacle	2013	West Virginia		75%		Hein et al. 2014
Beech Ridge	2012	West Virginia	6.9	73-89%	81%	Tidhar et al. 2013[5]

[1]This study looked at curtailment for the first half of the night (47% reduction) versus the second half of the night (22% reduction). It was assumed for this analysis that curtailing for the full night would result in at least a 47% reduction.
[2]These studies used modelled differences, not calculated reductions based on fatality estimates.
[3]This reduction is likely lower due to the high proportion of Brazilian free-tailed bats (*Tadarida brasiliensis*), a species known to be active in higher wind speeds compared to the typical suite of species in Missouri.
[4]These studies did not include feathering below cut-in speed.
[5]This study did not have control turbines, so this is the reduction from the West Virginia average (73%) and from the average in the Northeastern United States (83%).

A cut-in speed of 5.0 m/s is proposed for the HPWF from 45 minutes before sunset to 45 minutes after sunrise from April 1 – October 31 when air temperature is above 40ºF, which is expected to yield an average reduction of 62% for all bat species (Table 7-1). This reduction is likely even higher for *Myotis* species, which are adapted for foraging over water or near vegetation, rather than the open-air aerial hawking used by migratory tree bats (Norberg and Rayner 1987). Curtailment above even 4.0 m/s has been shown to reduce *Myotis* fatalities by over 90% (Gruver and Bishop-Boros 2015), and it is assumed that curtailment at 5.0 m/s would be even more protective. To be conservative, the Applicant proposed to use the observed average 62% mortality reduction for all bat species in developing take estimates, despite the potential for the actual reductions likely being higher for the covered species. Thus, the expected take may be lower than estimated.

Notwithstanding any other provision of this HCP, the timeframe for curtailment (45 minutes before sunset to 45 minutes after sunrise) and temperature threshold of 40°F may be refined in consultation with USFWS and MDC based on site-specific acoustic data collected at the turbine nacelles, though a minimum curtailment will be in place for 30 minutes before sunset to 30 minutes after sunrise and when temperatures are above 50°F. Any refinement to the proposed minimization would need to be approved in writing by USFWS and would include a temperature threshold between 40°F and 50°F in place 30-45 minutes before sunset to 30-45 minutes after sunrise.

Cut-in Speed Adjustments for Full Avoidance

High Prairie commissioned and tested turbines starting in July 2020. During this time, turbines operated in accordance with a Technical Assistance Letter (TAL) provided by the USFWS. The letter memorialized High Prairie's commitments to feather turbines below a cut-in speed of 6.9 m/s from sunset to sunrise during from March 15- October 31st. The USFWS has recommended these turbine operating parameters to avoid take of Indiana bat and northern long-eared bats throughout the Region, and these parameters have shown to be successful for migrating bats. Throughout the Midwest Region, the USFWS has agreed when turbines are feathered below wind speeds of 6.9 m/s during the times of year in which listed bats migrate, from dusk through dawn, it is unlikely for operations to result in take of listed bats.

However, High Prairie has maternity colonies on-site, and this makes the project unique to the Midwest Region. While other Midwest permitted wind facilities risk impacts to migrating bats, no other facility is contextually similar to High Prairie. The amount of summer suitable habitat in the Permit Area, and the configuration of this habitat could alter bat flight behavior such that traditional avoidance parameters are less effective than demonstrated at other facilities. This hypothesis is supported by a late September fatality of a male Indiana bat (based on preliminary identification, currently awaiting genetic testing to confirm species identification) at High Prairie while turbines were operating in accordance with the TAL. This fatality indicates traditional avoidance parameters may need to be adjusted for this project. Therefore, if adaptive management thresholds are triggered such that avoidance is warranted, High Prairie will confer with the USFWS and MDC and evaluate new information to identify operating parameters and turbines to avoid take. As an outcome, the USFWS and MDC will provide operating parameters to avoid take in writing, to High Prairie. If no other effective parameters are identified, avoidance will, at a maximum, include measures such as fully feathering any affected turbines (see Section 7.5) 45 minutes before sunset through 45 minutes after sunrise during the bat active season.

7.2.1.5 Other Avoidance and Minimization Measures Considered

The Applicant considered the use of smart curtailment strategies, which use real-time bat activity and weather data to determine turbine curtailment and operation to reduce bat fatalities. These technologies show promise as a strategy for reducing bat mortality at wind energy facilities, with an 83% reduction in bat fatalities reported (Sutter and Schumacher 2017). However, they are not yet commercially available. Specifically, their effectiveness for protecting species of the *Myotis* genus is, as of yet, untested. Another limiting factor is that insufficient data has been produced regarding the density and configuration of their deployment to guide optimal performance. Thus, they are considered in Changed Circumstances (Section 8.2.2).

7.2.2 Mitigation for Direct Bat Mortality

For the purpose of calculating required mitigation, REAs are typically denominated in units of resource services, which account for more than simply bodies. For the covered bat species, the resource of primary interest is reproductive services, and specifically female bat reproductive potential. When an adult female bat is prematurely killed at a wind energy facility, she and her future offspring's reproductive potential are lost. The mitigation debits are thus measured in the number of female bats killed at the HPWF and their lost reproductive potential, and the mitigation credits are the female bats gained from the mitigation, as females limit the reproductive potential of the species. The HPWF will also kill male bats, but the mitigation will also gain male bats, and these are not considered in the debits or credits (USFWS 2016c, 2016f, 2016g).

Due to the overlap in the covered species' habitat requirements, TG High Prairie calculated mitigation needs based on locating mitigation sites that meet all three species requirements (and have documented presence on or immediately adjacent to the site) and thus "stacked" the mitigation credits. TG High Prairie used the discount ratios published in the final MidAmerican Wind Energy HCP[22], which discounts each acre based on the number of species which will be mitigated by that acre. TG High Prairie applied the stacking to the three covered species. Mitigation that covers all 3 covered species was increased by 20%, and mitigation that covers 2 species was increased by 10%.

[22] https://ecos.fws.gov/docs/plan_documents/thcp/thcp_2970.pdf

The REA model outputs and required mitigation are described in detail for each species in Section 6.3 and are summarized below in Table 7-2.

Table 7-2. Summary of mitigation requirements (in acres) and mitigation stacking.

Species	Mitigation Requirement (acres)
Little brown bat	108
Indiana bat	149
Northern long-eared bat	24
Total (Stacking)[1]	162.2
[1]Calculated as Total Acres = (NLEB acres * 1.2) + ([LBB acres-NLEB acres] * 1.1) + ([IBAT acres-(LBB acres)]). Thus, the smallest mitigation requirement (NLEB) is increased by 20% to account for the stacking of IBAT and LBB which would also be mitigated by those acres. The next argument in the equation is for acres that are mitigating for IBAT and LBB and is increased by 10% to account for the stacking of IBAT. The final argument in the equation is for acres that are mitigating for IBAT only.	

To fulfill the mitigation requirements calculated above, the Applicant will utilize the Chariton Hills Conservation Bank[23], which was authorized by the USFWS pursuant to a Conservation Bank Enabling Instrument on July 11, 2018. To fulfill the requirement, 217 credits (which is above the required mitigation outlined above) have been reserved from Chariton Hills Conservation Bank and will be allocated to the Project upon issuance of a FONSI.

7.3 MORTALITY MONITORING AND REPORTING

Post-construction monitoring is the method by which the Applicant will evaluate the effectiveness of the minimization measures and ensure that take of the covered species remains within the take limits set forth in the ITP. Because fatalities are expected to occur during the entire bat active season (April 1 – October 31), the post-construction monitoring will occur during this entire period as well. Because the purpose of the limited-term HCP is to provide site-specific post-construction monitoring data informing the development of a potential longer, life-of-project HCP, the Applicant proposes to conduct 6 years of robust monitoring.

The robust monitoring is designed to monitor for fatalities at the HPWF, to ensure initial permit compliance over the first 6 years, and then to be used to better inform the take estimation for a longer-term life-of-project HCP.

7.3.1 Species to be Monitored

The post-construction monitoring plan will address all bat fatalities observed within the Permit Area due to operation of the HPWF. This will include the covered species, as well as any other bat species, including the tricolored bat. The monitoring plan is designed using the USGS Evidence of Absence (EofA) software designed by Dalthorp et al. (2017) to determine statistically whether Ameren has remained within given adaptive management and take thresholds (see Section 7.5) for the covered species.

[23] https://info.burnsmcd.com/mitigationbankingusa/chariton-hills-conservation-bank

7.3.2 Permits and Wildlife Handling Procedures

All necessary state wildlife salvage/collection permits will be obtained from MDC to facilitate legal transport of injured animals and/or carcasses.

All bat carcasses found will be labeled with a unique number, individually bagged, and retained in a freezer at the HPWF O&M building. A copy of the original data sheet for each carcass will be placed in the bag with each frozen carcass. The carcasses may be used in searcher efficiency and carcass removal trials; however, mice purchased through a commercial source may be used as a surrogate. If a carcass of an ESA- or state-listed species is found, the Applicant will arrange to submit the carcass to the USFWS or tissue samples to the MDC. Tissue samples from all bats (including all *Myotis* species) will be submitted for genetics analysis. If an injured bat is found, the animal will be sent to a local wildlife rehabilitator, when possible.

7.3.3 Monitoring Protocols

The Applicant used the EofA Software (Dalthorp et al. 2017) to evaluate post-construction monitoring protocols for the HPWF. EofA relies upon observed carcasses of rare species (such as the covered species) to determine the likelihood that actual mortality of those species has remained below the authorized amount. The model can also be used to develop post-construction monitoring plans to increase the likelihood of detecting a rare event, such as the carcass of a threatened or endangered species.

The “Design Tradeoffs” tool within EofA was used to help design a monitoring scheme, with the following assumptions:

- Area adjustment of 0.80 for full plots, and 0.23 for roads and pads (80% of carcasses fall within 60 meters of a turbine and would be within the full plot[24], while 23% of carcasses fall on the turbine road and pad)
- Searcher efficiency of 0.7 for full plots and 0.9 for roads and pads (a trained searcher or dog team will find 70% of carcasses on full plots and 90% of carcasses on roads and pads)
- Carcass persistence of 3.5 days, with a Weibull distribution[25]
- Uniform arrival function (EofA default)
- Factor by which searcher efficiency changes with each search (k) of 0.67 (EofA default)
- Search period of 30 weeks (April 1 through October 31; temporal coverage of 100% of the period of risk[26])

The two design elements that were then adjusted were the area searched (ratio of full plot turbines to road and pad turbines) and the search interval (how often the plots are searched). The EofA program then outputs a probability of

[24] This is based on data provided by USFWS from confidential projects in Ohio
[25] The carcass persistence will be analyzed throughout each year of monitoring during each season (spring, summer, fall), and the search interval will be adjusted as needed to achieve the desired overall detection probability.
[26] While bats may be active prior to April 1 or after October 31, this period includes the time frame within which all Myotis mortalities have been documented at all wind facilities within the range of the Covered Species (USFWS 2016a)

detection (g). This value represents the probability of detecting a carcass of a rare species that occurs at the site based on the post-construction monitoring effort.

Based upon a desired probability of detection (g) of at least 0.2 for robust monitoring (based on the point estimate), a twice-weekly search interval with 60% of the turbines being searched on the roads and pads and 40% of the turbines having 60-meter circular cleared plots was chosen, which results in a probability of detection (g) of 0.213. This protocol will be implemented for the first year, and similar levels of detection probability (i.e., a detection probability above 0.2) will be targeted in years 2 and 3. Detection probability may be decreased in years 4 and 5 while maternity colony monitoring is being conducted (see Section 7.4) due to the increased effort of maternity colony monitoring; however, an overall detection probability of at least 0.2 over the 6-year permit term will still be the goal (i.e., the post-construction monitoring plan for each year will include a projected g-value point estimate based on previous bias correction factors sufficient to maintain an average above 0.2). The Applicant will use the results of bias correction trials to inform monitoring in subsequent years, and this monitoring plan (and the associated detection probability it would achieve) will be included in the Annual Monitoring Report. Additionally, analysis in GenEst (see Section 7.3.3.4) may be used to stratify the Permit Area, focusing searches in areas of higher risk, and achieving a greater overall detection probability for the same (or lower) level of effort. This analysis cannot be conducted until actual data are collected onsite, but will include an analysis of whether proximity to suitable bat habitat or certain areas of the Project have higher levels of overall bat fatality rates, as well as a temporal analysis to determine if searching harder at certain times of year would yield higher detection probabilities. Additionally, other tools to increase detection probability may be implemented, if available (e.g., dogs may be used to assist human searchers to increase the searcher efficiency).

7.3.3.1 Standardized Carcass Searches

Carcass searches will be completed by third party contractors. As described above, a total of 70 full plots and 105 road and pad plots will be established. Turbines will be randomly assigned to the full plot or road and pad group; however, preference will be given for full plots to be placed in fields where crops are not currently grown (e.g., pasture). In addition, 1 of the full plots will be established at the 1 turbine that is located within 1,000 ft of a known Indiana bat capture or roost, to more closely monitor fatalities at that turbine.

At 197-foot (60 m) radius cleared-plot turbines, 23 transects will be spaced at approximately 16.4-foot intervals. Observers will walk at a rate of approximately 2 mph, scanning the ground for carcasses within 8.2 feet of each transect. The observer will start at one side of the circular plot and systematically search in a north/south or east/west direction, switching the search pattern on a weekly basis. At road/pad turbines, the observer will walk the access road starting at 312 feet from the turbine and walk towards the turbine, around the turbine, and back towards the starting point, searching out 8.2 feet on each side until the entire road/access pad is searched, or start at the turbine and walk out.

Carcass searches will be conducted under applicable permits using searchers experienced and/or trained in conducting fatality search methods, including proper handling, and reporting of carcasses. Searchers may be assisted by trained canines. Searchers will be familiar with and able to accurately identify bat species likely to be found in the Permit Area. Any unknown bats or suspected individuals of the covered species discovered during fatality searches will be sent to a qualified USFWS-approved bat expert for positive identification or may be sent for genetic testing to determine species and/or sex.

For each carcass found (including avian species per the BBCS) data recorded will include:

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

A digital picture of each detected carcass (all species, not just the covered species) will be taken before the carcass is handled and removed. As previously mentioned, all bat carcasses will be labeled with a unique number, bagged, and stored frozen as needed for future studies at the HPWF O&M building. The Applicant will also collect a tissue sample from each bat carcass for submission to the USFWS and/or MDC.

Bat carcasses found in non-search areas will be coded as “incidental finds” and documented as much as possible in a similar fashion to those found during standard searches. Maintenance personnel will be informed of the timing of standardized searches, and in the event that maintenance personnel find a carcass or injured animal, these personnel will be trained on the collision event reporting protocol. In order to allow for these finds to be included in the statistical analysis, maintenance personnel will be given contact information for the post-construction monitoring supervisor (or some other contact designated by the third-party contractor), who will have someone verify the identification of the bat, but leave the carcass in place so that it can be found during the standardized search. Any carcasses found by maintenance personnel that are not then found by the searcher during the standardized search will be considered an incidental find. Incidental finds will be included in survey summary totals but will not be 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.

7.3.3.2 Searcher Efficiency and Carcass Removal Trials

To assess carcass persistence, approximately 40 bat carcasses will be randomly placed within survey plots at varying times during the search seasons (spring, summer and fall). Ameren’s contractors will rely on contacts with veterinary labs that can provide bat carcasses and/or use of bat carcasses collected onsite during monitoring studies; however, in the event that 40 are not available, brown mice or small black rats will be used as surrogates for bat carcasses. The carcasses will be placed at least once during each season, thereby spreading the trials throughout the survey period to incorporate the effects of varying weather, climatic and vegetation conditions, and scavenger types and densities. Carcasses will be dropped from waist high or higher and allowed to land in a random posture. Each trial carcass will be discreetly marked (with tape or thread) prior to placement so that it can be identified as a study carcass if it is found by observers or wind facility personnel or moved by a scavenger.

Observers conducting carcass searches will monitor the trial bats over a 30-day period according to the following schedule as closely as possible. Carcasses will be checked every day for the first week, and then on days 10, 14, 21, and 30. This schedule may vary slightly depending on weather and coordination with the other survey work. At each visit, the observer will note the condition of the carcass (e.g., intact, scavenged, complete). Trial carcasses will be left at the location until the end of the 30-day trial or until the carcass is removed entirely by scavengers. After 30 days, any remaining evidence of the carcasses will be removed.

Searcher efficiency trials will be completed concurrent with scavenger trials using the same test subjects as used in carcass persistence trials. Searchers will be unaware of the placement of the test subjects done on the morning of turbine searches. Test subjects will be checked after searcher efficiency trials to ensure the subjects were present at the time of the trial. These carcass removal and searcher efficiency trials will be used to adjust estimates of bat fatalities using contemporary equations for estimating fatality.

7.3.3.3 Statistical Methods for Estimating Bias Correction Factors

The Applicant will utilize the Generalized Estimator (GenEst; Dalthorp et al. 2018) for calculating bias correction factors and the overall fatality estimates for all bats. The bias correction factors and overall detection probabilities calculated in GenEst will then be used in EofA to evaluate impacts to the covered species and to determine whether changes to the monitoring protocol are needed in subsequent season and/or years (i.e., if the overall detection probability is falling below target values).

Estimation of Searcher Efficiency Rate (p)

Searcher efficiency (p) will represent the average probability that a carcass was detected by searchers. The searcher efficiency rates will be calculated by using the number of trial carcasses observers found and the total number that remained available during the trial (non-scavenged). Analysis will include an evaluation of whether searcher efficiency varied by searcher, season, and/or search method (i.e., roads and pads, full plots).

Estimation of Carcass Persistence

Carcass persistence times will be modeled in GenEst using censored exponential, Weibull, lognormal, and loglogistic survival models. Categorical covariates such as visibility class, season, carcass size, or other factors may be used to determine the location and scale parameters (Dalthorp et al. 2018). Analysis will include an evaluation of whether carcass persistence varied by season.

Search Area Adjustment

GenEst does not currently have a module for estimating the area adjustment, but it may become available during the permit term. Meanwhile, the area adjustment will be calculated using density-weighted proportions, placing each carcass found into a 10-meter distance band, and calculating the percent of each distance band that was searched site-wide, and the weighted searcher efficiency for that distance band.

7.3.3.4 Generalized Estimator (GenEst)

The estimate of the total number of wind turbine-related casualties will be modeled based on four components: (1) observed casualties, (2) searcher efficiency, (3) carcass persistence, and (4) area adjustment (estimated percent of casualties that likely fall in non-searched areas, based on percent of area searched around each turbine). GenEst will be used to calculate point estimates as well as confidence intervals.

7.3.3.5 Evidence of Absence (EofA)

To evaluate compliance with the ITP, post-construction mortality monitoring of the covered species will be conducted based on EofA. Using the bias correction factors calculated from the post-construction monitoring (see Section 7.3.3.3), the "Design Tradeoffs" module will be used to calculate the overall detection probability (g) for each year of monitoring. Each year, the analysis of the post-construction monitoring data will include the following estimates:

- Annual take estimate (M_{YearX}; number estimated to have been killed that year)
- Cumulative take estimate ($M_{Cumulative}$; number estimated to have been killed to-date, sum of all previous years' monitoring results with the current year)
- Annual take rate (λ)
- Projected take estimate ($M_{Projected}$; number estimated to have been killed to-date, plus the additional take likely to occur in the remaining years of the permit if the annual take rate continues)

7.3.4 Reporting and Consultation

7.3.4.1 Reporting

Ameren will provide an Annual Mortality Monitoring Report (Report) to the USFWS and MDC within 45 days following the completion of each year of post-construction monitoring, as well as summaries 30 days after the end of each season (spring, summer and fall) (Seasonal Summaries). The Report will include data summaries, EofA parameters, and the results of the EofA analysis for the covered species (see Section 7.3.3.5), while the Seasonal Summaries will include raw data and the results of bias correction trials (searcher efficiency and carcass persistence, if available). An excel file (either the MDC bat reporting form or the USFWS Region 3 Indiana bat reporting form) will be submitted to MDC annually, at a minimum.

The report will also include all bat fatality estimates. Fatalities will be expressed both in terms of fatalities/turbine/season and in terms of fatalities/MW/season, as recommended by the USFWS's Land-Based Wind Energy Guidelines (USFWS 2012b) to facilitate comparison with other studies. The reports will include all data analyses, including overall fatality estimates and EofA outputs for the covered species, and a discussion of monitoring results and their implications.

In addition to the Annual Mortality Monitoring Reports, Ameren will promptly report fatalities of ESA- or state-listed species to the USFWS and will also report fatalities of species of conservation concern to the MDC. Ameren will report the discovery of any Indiana bat, northern long-eared bat, or little brown bat fatalities to the USFWS and MDC within 48 hours of discovery. Bat fatalities of unknown species that are suspected to be *Myotis* will be sent for genetic testing.

Fatalities of species of conservation concern will be reported to MDC within 24 hours. In the event that estimated covered species mortality approaches the thresholds set forth in Section 6.2.6, adaptive management measures will be implemented as specified in Section 7.5, informed by the relevant variables identified in the Annual Mortality Monitoring Report. Any adaptive management measures implemented shall be described in the annual fatality monitoring report.

7.4 MATERNITY COLONY MONITORING

Maternity colony monitoring for the covered species will be conducted either as part of adaptive management (see Appendix B), or in years 4 and 5. The persistence of maternity colonies within the Permit Area will be monitored utilizing mist-net surveys, with subsequent radio telemetry and emergence counts. The focus of maternity colony monitoring will be on the Indiana bat, but little brown bats will also be monitored if take is documented through post-construction monitoring. No northern long-eared bat maternity colonies were documented in 2016 or 2018 (see Section 3.4.2.4), so tracking and emergence counts of northern long-eared bats will occur only if they are captured during monitoring for the other covered species.

Mist-net surveys will be conducted at a minimum of 20 mist-net site locations (based on sites surveyed in 2016 and 2018, see Section 3.4.2.4 or based on habitat areas surveyed as part of adaptive management, see Section 7.5.1). Surveys will be conducted between May 15 and August 15 (based on 2019 Range-wide Indiana Bat Survey Guidelines; USFWS 2019d) and will follow the then current USFWS guidelines. The Applicant will coordinate with USFWS and MDC to ensure the study design is expected to yield significant results, and results will be comparable to off-site control studies and data. If adaptive management for maternity colonies is not triggered prior to year 4 (see Appendix B), then in one year (either year 4 or year 5 of the permit), mist-netting will be conducted at 10 sites within Schuyler County, and in the other year, mist-netting will be conducted at 10 sites within Adair County, spreading survey effort across the Permit Area (this level of effort may be decreased if mist-netting occurs during adaptive management, see Section 7.5.1). The Applicant will target a minimum of two mist-net sites within each maternity colony identified in 2016 and 2018, and will track up to three bats per species (if captured) for up to seven days, targeting a minimum of 14 roosting events (1 roosting event would be equivalent to 1 bat tracked for 1 calendar day) per maternity colony. Foraging ranges of Indiana bat and little brown bat maternity colonies may overlap, so a single mist-net site may be used to capture both Indiana and little brown bats from separate maternity colonies.

Results of mist-netting will be compared to pre-construction survey results (see Section 3.4.2.4), as well as to control sites being monitored by the MDC at Rebel's Cove and Indian Hills (or other comparable public data found in coordination with USFWS and MDC). If capture rates or emergence counts have decreased significantly (≥30%; Niver et al. 2014) from pre-construction surveys, the Applicant will compare the results to those seen at the MDC control sites to see if similar declines are occurring due to WNS and will also analyze the post-construction monitoring data to determine if take from the HPWF could have resulted in significant declines to any individual maternity colony. This analysis will include fatalities during the summer maternity season (May 15 to August 15) at turbines within 2.5 miles of an Indiana bat maternity colony, 1.5 miles of a northern long-eared bat maternity colony (if one is discovered), or 3.9 miles of a little brown bat maternity colony and will also analyze fatalities that occur during spring migration (April 1 through May 14) and the first six weeks of fall migration (August 16 through September 30).

7.5 ADAPTIVE MANAGEMENT

Post-construction monitoring will provide a measure of the effectiveness of the minimization measures implemented, as well as a measure of whether the HPWF is operating in compliance with the ITP take limits. Adaptive management (based on a calculate level of take, after accounting for bats that may have been killed but missed during monitoring) provides a measure to respond to changes in the fatality rates of the covered species, ensuring that ineffectiveness of minimization or changes in other conditions will not result in take above the permitted levels. Two adaptive management strategies are provided for in the HCP and are additive, as explained below. Covered Species fatalities are incorporated into the adaptive management strategy for permitted level of take, and if the fatality occurred between April 1 and September 30th, then the adaptive management strategy for maternity colonies also applies.

7.5.1 Adaptive Management for Maternity Colony Impacts

Because of the assumptions used to analyze the impact of the projected take on local maternity colonies, it is vital that High Prairie use post-construction monitoring estimates to confirm whether these assumptions were correct, and adaptively manage if they were not. Thus, in addition to monitoring the maternity colonies (as described in Section 7.4), the Applicant will analyze the location of the fatalities that occurred during the summer maternity season (May 15 to August 15) as well as during spring migration (April 1 through May 14) and the beginning of fall migration (August 15 through September 30) to determine if any particular maternity colony may be experiencing take at a level higher than anticipated. This time span is longer than the generalized maternity season in USFWS 2007 to be protective of early spring arrivals, and to individuals that may still be using the permit area after resident colonies begin disbanding in the fall (prior to fall migration). Onsite mist-netting data (explained below) suggests that colonies begin to disband prior to August 15th, however individuals from resident maternity colony populations may still be using habitat near and around maternity roost trees and the September 30th date is more protective of those individuals.

The conclusion that local maternity colonies begin disbanding prior to August 15 is supported by on-site mist-netting data from 2018 which included 22 adult female captures over 24 nights (3 nets per night) prior to August 1 (capture rate of 0.92 adult female Indiana bat per night) compared to 1 capture over 10 nights (3 nets per night) after August 1 (capture rate of 0.10 adult female Indiana bat per night, and this was the only non-reproductive female captured). Additionally, in 2016, while only 5 adult female Indiana bats were captured at the Project, with 4 captures over 27 nights prior to August 1 (capture rate of 0.15 adult female Indiana bat per night) compared to 1 capture over 6 nights after August 1 (capture rate of 0.17 female Indiana bat per night), all 3 reproductively active females were caught prior to August 1. Further support is provided by mist-netting data from a nearby project (Ameren, unpublished confidential data) which show captures of adult female Indiana bats (both reproductive and non-reproductive) averaging 1.2 adult female per night between May 17 and July 31 (over 28 nights of netting, with 2 nets per night), compared to 0.1 adult female per night between August 1 and August 14 (over 10 nights of netting). These datasets support the idea that local maternity colonies have disbanded prior to August 15. Swarming activity at caves has also been shown to have an increase in female ratios by late July (Cope and Humphrey 1977).

Nevertheless, year to year variation in temperature, wind, and precipitation, can impact the actual dates bats arrive at, and leave the Project (e.g., Pettit and O'Keefe 2017). The USFWS additionally has data from Lime Kiln Mine showing that Indiana bats begin to arrive in mid-September and peak activity in mid-October. Since there is the possibility that female bats from local maternity colonies may persist on the landscape beyond August 15, High Prairie is including adult female fatalities through September 30 as part of the adaptive management strategy, though in reality some of these fatalities may be from non-local maternity colonies due to migration.

To analyze the location of potential maternity colony take, the Applicant will create a buffer around any turbine that had a documented take of an adult female of a covered species between April 1 and September 30. This buffer will be based on known foraging distances and predicted home range sizes; specifically, a 5-mile buffer for Indiana bats (based on a 2.5-mile foraging distance), 3-mile buffer for northern long-eared bats (based on a 1.5-mile foraging distance)), and a 7.8-mile buffer for little brown bats (based on a 3.9-mile foraging distance) will be used.

The Applicant estimated that an average of 1 Indiana bat, 0.1 northern long-eared bat, and 0.7 little brown bat may be taken from each maternity colony in a given year (see Section 6.3.2, Section 6.3.3 and Section 6.3.4). However, in reality take will only occur in whole bats (e.g., 0, 1, 2, 3, etc.). If a single individual is taken from a maternity colony in a year, there will be a 20% chance that the carcass will be found during post-construction monitoring (based on an overall detection probability of at least 0.2). Adaptive management will be triggered if more than one reproductively active female of a single covered species is found within a given buffer (see Appendix B – Adaptive Management for Maternity Colonies) and/or the projected level of take within the buffer hits thresholds described in Appendix B. If adaptive management is triggered, the Applicant will avoid take (in consultation with the USFWS and MDC, see Section 7.2.1.4) during the summer period at the turbines within the buffer (2.5 miles for Indiana bats, 1.5 miles for northern long-eared bats, and 3.9 miles for little brown bats), and continue post-construction monitoring to ensure take decreases below the permitted values. In addition, the Applicant may choose (at their discretion) to operate certain turbines at higher cut-in speeds prior to reaching an adaptive management trigger, depending on information discovered about bat habitat use and the risk level of individual turbines or areas of the Project.

If cut-in speeds were raised or other avoidance measures implemented due to triggering the maternity colony adaptive management strategy, turbines will return to 5.0 m/s from 45 minutes before sunset to 45 minutes after sunrise when air temperature is above 40ºF after the maternity colony period of risk (April 1 to September 30) is over, unless more protective operations are currently prescribed under the Adaptive Management for Permitted Level of Take Strategy (explained below). The following year, avoidance measures would remain in place for the remainder of the 6-year permit term if presence of a maternity colony is determined to exist within the suitable habitat. In addition, the Applicant could use the changed circumstance for deployment of bat deterrent technology or smart curtailment technology, should either of those options become commercially available during the permit term, and implement them according to the process outlined in Changed Circumstances (see Section 8.2.2.3). If appropriate and approved by USFWS, one or both of these technologies may be used in place of or in addition to increased cut-in speeds to decrease bat fatalities if needed based on adaptive management triggers (see Section 8.2.2.3).

If, at some point, the cumulative take estimate ($M_{Cumulative}$) across all seasons and years reaches the permitted level of take for a covered species, the Applicant will implement avoidance measures to avoid any future take.

7.5.2 Adaptive Management for Permitted Level of Take

The Applicant will utilize adaptive management to ensure that the Project's bat conservation program is effective in meeting the biological goals and objectives of this HCP and that the take of Covered Species at the Project does not exceed the permitted level of take (Table 7-3). Each year, the analysis of the post-construction monitoring will include the following estimates for each covered species (including any age or sex):

- Annual take estimate (M_{YearX}; number estimated to have been killed that year)
- Cumulative take estimate ($M_{Cumulative}$; number estimated to have been killed to-date, sum of all previous years' monitoring results with the current year)
- Annual take rate (λ)
- Projected take estimate ($M_{Projected}$; number estimated to have been killed to-date, plus the additional take likely to occur in the remaining years of the permit if the annual take rate continues)
- Number of detected fatalities (X)

The number of detected fatalities (X) and the cumulative annual take rate (λ) for each species will be used to trigger adaptive management to prevent the cumulative take estimate ($M_{Cumulative}$) from reaching the take limits of any of the covered species. If the number of detected fatalities (X) reaches an adaptive management threshold all turbines will immediately respond accordingly (Table 7-3). At the end of each year, the average annual take rate will be evaluated, and turbine operations may be further refined based on spatial and seasonal data, in consultation with MDC and FWS, and approved by USFWS annually. In summary, this provides an annual within-season trigger based on number of detected fatalities (X), as well as a cumulative trigger based on annual take rate (λ) to keep annual fatalities within the permitted levels, however the response may be refined spatially and seasonally based on coordination with FWS and MDC, and written concurrence from FWS. Adaptive management will allow the Applicant to protect local maternity colonies and ensure that the Project remains within permitted take levels. Monitoring data will be analyzed in EofA (Dalthorp et al. 2017; α = 0.5). If the conservation measures are not producing the desired results, adjustments will be made to the operational protocols (i.e., cut-in speeds) as outlined below to achieve the biological objectives of this HCP.

Two "bat in hand" trigger levels were created; one based on the number of bats of a given species that would trigger adaptive management within a single year to keep annual take rates within permitted levels, and one based on the cumulative number of bats found that would trigger adaptive management to keep the overall take level within permitted levels. The number of detected fatalities (X) needed to trigger adaptive management were calculated using the "Multiple Years Module" in EofA, the "Estimate M" function (α=0.5) for the cumulative trigger and the "Short Term Rate" function (α=0.5, term of 1 year) for the annual trigger.

(1) The annual "bat in hand" trigger is the number of carcasses (X) that would need to be found within a single year to indicate that take may be exceeding that annual estimate (λ) for a given species[27]. If triggered, cut-in speeds would be raised site-wide by 0.5 m/s, and additional carcasses of that species would trigger additional 0.5 m/s cut-in speed increases.

[27] Estimated take of northern long-eared bats is lower than the other Covered Species, and at the projected detection probability (g) of 0.2, it is estimated that 3-4 northern long-eared bats will be found over the 6-year Permit Term. Therefore, a bat in hand trigger for the annual take rate does not work for this species, though northern long-eared bats are already protected within any single year by the maternity colony adaptive management (Section 7.5.1 and Appendix B), which triggers adaptive management if a single adult female northern long-eared bat is found during the summer maternity season, and annual take rate (λ) triggers would also still apply to this species at the end of the season.

(2) The cumulative “bat in hand” trigger is the number of carcasses (X) that would need to be found cumulatively over the permit term to indicate that take may reach the limit of total permitted number for a given species. If triggered, avoidance measures would be implemented.

The Applicant may work with the USFWS and MDC to further refine when and where these cut-in speed adjustments apply (i.e., it may be that only turbines in the southern portion of the project area are at increased risk, or only during spring migration), but any refinement will need to be approved in writing by USFWS. In addition, these “bat in hand” triggers are based off the assumed detection probability (g) of 0.2, which as explained, is a minimum goal. Given that actual detection probability (g) may be higher, the seasonal summaries or annual report may include refined triggers based on actual site-specific detection probabilities for a given year. In summary, adaptive management will be triggered if one or more of the following occurs:

- $\lambda_{IBAT} \geq 12$; 3 bats in hand during a single monitoring year (X=3)
- $\lambda_{NLEB} \geq 3$
- $\lambda_{LBB} \geq 16$; 4 bats in hand during a single monitoring year (X=4)

In response, the Applicant will increase the cut-in speed of turbines at night (45 minutes before sunset to 45 minutes after sunrise) when temperatures are above 4^0F (Table 7-3).

This change will initially occur site-wide, however, the Applicant will work with USFWS and MDC to determine if a certain subset of turbines, season(s) or month(s) is resulting in higher-than-anticipated take. If take is higher than anticipated during the maternity season (May 15 – August 15), adaptive management will be implemented during that entire period. If take is higher than anticipated during migration, the timing of fatalities will be used to determine if specific portions of the migratory period could be the focus of adaptive management change to keep take within permitted levels without increasing minimization during the entire time period (e.g., if 80% of fatalities occur between two dates, it would be assumed that going to avoidance during that period would decrease fatalities by 80%). In addition, the geographic location and timing of fatalities will be used to determine which portion(s) of the HPWF should be included in the increased cut-in speed. If this take is occurring during the summer, then adaptive management will take place at turbines within 1.5 to 3.9 miles of maternity colonies with high levels of documented take, depending on the species which triggered the adaptive management change (1.5 miles for northern long-eared bats, 2.5 miles for Indiana bats or 3.9 miles for little brown bats). See Appendix B for an outline of the summer adaptive management strategy. If this take is occurring during the fall or spring migratory periods, then adaptive management will take place at turbines within any turbine group(s) (shown on Figure 9) with documented migratory take of the covered species that triggered the adaptive management change. These turbine groups were developed using the HUC-8 watersheds within the Permit Area. A turbine group straddles the “ridge” that typically divides two watersheds and includes the turbines along that ridge and then down into the “valley” of each watershed (Figure 9). Any refinement to the adaptive management approach (i.e., spatial or temporal targeting of the increased cut-in speed) will be determined in coordination with USFWS and MDC and will require written concurrence from USFWS prior to implementation (e.g., prior to decreasing the cut-in speed back to 5.0 m/s during certain times of year or at certain turbines).

In the event that the actual calculated take to-date reaches the permitted level of take, avoidance measures will be implemented (Table 7-3).

Table 7-3. Adaptive management triggers and responses for the High Prairie Renewable Energy Center, Adair and Schuyler counties, Missouri.

	Species	Trigger Type	EofA Trigger (calculated at end of season)	Bat in hand trigger[2]	Response
Short-term Trigger	Indiana bat[1]	The annual take rate is above the permitted take	$\lambda_{IBAT} \geq 12$	3 Indiana bats found during a monitoring year	Raise cut-in speeds by 0.5 m/s site-wide as soon as bat-in-hand trigger is met, and cut-in speed will continue to increase by 0.5 m/s for each additional carcass of that species found. If triggered due to EofA calculation, cut-in speed increase would take place the following year starting on April 1. May refine cut-in speed increase to target a specific season or location(s) within the project area in coordination with USFWS and MDC.
	Northern long-eared bat		$\lambda_{NLEB} \geq 3$	n/a	
	Little brown bat		$\lambda_{LBB} \geq 16$	4 little brown bats found during a monitoring year	
Avoidance Trigger	Indiana bat[1]	The actual calculated take to-date reaches the permitted take.	$M_{IBAT} \geq 72$	15 Indiana bats found	Implement avoidance measures (in consultation with USFWS and MDC, up to full turbine shut down from 45 minutes before sunset to 45 minutes after sunrise) during the identified period of risk throughout the permit area.
	Northern long-eared bat		$M_{NLEB} \geq 18$	4 northern long-eared bats found	
	Little brown bat		$M_{LBB} \geq 96$	20 little brown bats found	

[1] An Indiana bat killed prior to permit issuance in April 2021 and monitoring occurring at the time of that fatality will be included in all applicable adaptive management thresholds going forward (i.e., the bat in hand trigger for the first year, the annual take rate for the first year, and for the calculation of M_{IBAT} for the life of the permit).
[2]This is based on a detection probability (g) of 0.2 (point estimate); if the projected detection probability (g) for the year is estimated to be above 0.2 in a seasonal summary or end of year report, a revised table of bat in hand triggers for that year will be provided to USFWS and MDC. Any changes to the bat in hand trigger would need to be approved in writing by USFWS.

Additionally, the Applicant may decide to make operational adjustments or take other actions (e.g., investigate bat deterrent technology) prior to triggering an adaptive management threshold as a preemptive measure. The above adaptive management triggers are established checkpoints that require operational adjustments, however, it is at the Applicant’s discretion to implement operational or other changes prior to them being necessitated by this HCP. Any operational changes would be made in consultation with USFWS and MDC.

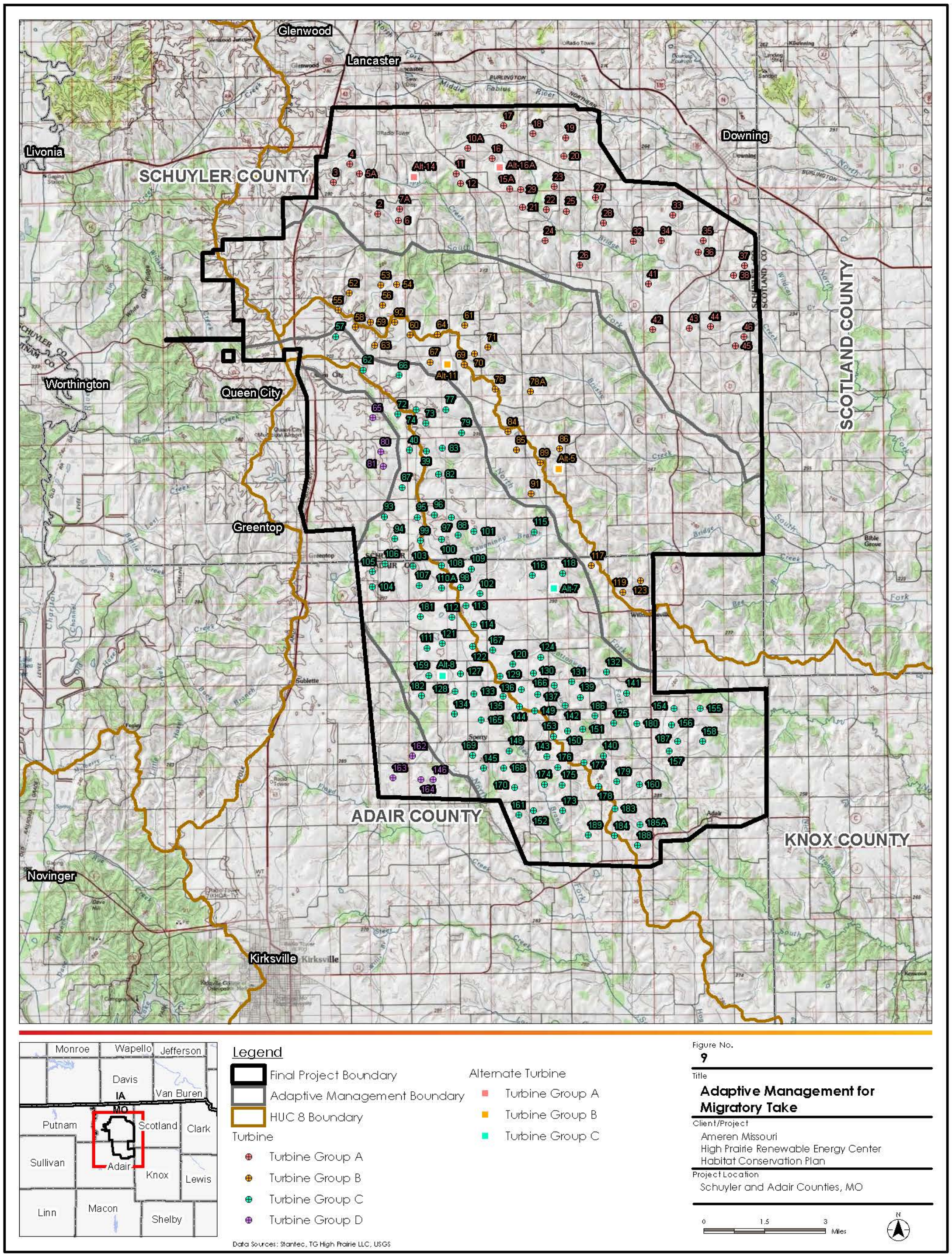

Figure 9. Adaptive Management for Migratory Take

8.0 IMPLEMENTATION OF THE HCP

This chapter provides a discussion of the costs to implement the HCP and the financial mechanisms that Ameren will utilize to assure funding.

The processes for addressing changed and unforeseen circumstances, amending the HCP, reviewing implementation of the HCP, and funding of the conservation measures included in the HCP are included in the HCP.

8.1 HIGH PRAIRIE COMMITMENTS

For the duration of the ITP, Ameren will provide sufficient staff members and resources to ensure effective implementation of the HCP, as described below.

8.1.1 HCP Administration

The HPWF Plant Manager, in coordination with USFWS, will designate a field technician or a site/regional environmental employee as the HCP coordinator with the task of overseeing the implementation of the HCP, including all reporting requirements, prior to the beginning of each bat active season. This information will be provided to USFWS by March 1 of each year.

8.1.2 Implementation Schedule

Table 8-1 outlines a schedule for implementation of the various conservation and mitigation measures. Additional conservation measures, including mitigation, may be implemented, or measures may be modified through adaptive management as described in Section 7.5.

Table 8-1. Implementation schedule for conservation measures and mitigation.

Conservation Measure	Implementation Schedule
Pre-construction surveys	Already implemented
Turbine layout modifications and turbine design	Already implemented
Summer bat habitat mitigation	Reservation of 217 mitigation credits (above the required 162.2 credits) from the Chariton Hills Conservation Bank has occurred.
Robust Post-construction Monitoring	April 1 through October 31 during years 1-6 of operations post-ITP issuance. Specifically, it is assumed this will occur between permit issuance and October 31, 2026.
Post-construction Monitoring Reporting	Summaries provided to the USFWS and MDC within 30 days of each season ending (i.e., by June 15 for Spring, by September 15 for Summer, and November 31 for Fall).

Conservation Measure	Implementation Schedule
	Annual Mortality Monitoring Report submitted to the USFWS and MDC by December 15 following each monitoring year
Maternity Colony Monitoring	During a minimum of 2 years between years 1-6 of operations post-ITP issuance. This is preliminary planned for years 4 and 5 (2024 and 2025), but may occur prior to that or in additional years if triggered by adaptive management.
Maternity Colony Monitoring Report	Submitted annually to the USFWS by December 15 following each monitoring year (may be combined with Annual Mortality Monitoring Report)

8.1.3 Implementation Costs

The avoidance, minimization, monitoring, and mitigation measures proposed in this HCP require financial assurances by Ameren to ensure that adequate funding exists for their implementation and maintenance. These funding assurances are described in the following sections.

8.1.3.1 Minimization Measures

Minimization measures implemented at the HPWF will consist of implementing a cut-in speed of 5.0 m/s from April 1 through October 31 from sunset to sunrise when the air temperature is above 40ºF. This increase in cut-in speed will reduce the annual energy production at the HPWF, which effects the economic viability of the Project. Wind projects generate revenue in relation to how much energy is generated and the cost of that energy and the renewable energy credits (RECs):

$$Revenue = Energy\ Generated\ X\ Price\ of\ Energy\ X\ Price\ of\ RECs\ X\ Cost\ of\ Production\ Tax\ Credits$$

And the energy generated is based on the amount of power hitting the turbine:

$$Power = \frac{1}{2}\ X\ Rotor\ Swept\ Area\ X\ Air\ Density\ X\ Wind\ Speed^3$$

This means the power available to be turned into energy increases by the wind speed cubed and thus, each increase in power lost at higher wind speeds is exponentially larger than that lost at lower wind speeds. So, the amount of revenue generated by a wind project declines exponentially as the cut-in speed increases.

Using this, the estimated costs associated with implementation of the minimization measures outlined in this HCP can be calculated based on assumptions about Project operation (lost production due to feathering), energy costs, and RECs cost. The estimated costs are:

i. 0.84% less clean energy generated (lost production due to feathering);

ii. $649,000 per year in lost annual revenues (lost production due to feathering multiplied by the assumed price of energy and price of RECs)

This results in approximately $3,894,000 in costs due to implementation of minimization measures over the six-year ITP Term. However, this initial minimization cost (that would be incurred over the six-year ITP term) is not an out-of-pocket expenditure by the Applicant, and the economic models for the HPWF have been adjusted to account for these losses. All other minimization measures (i.e., project siting, turbine design) have already been incorporated into the project design and financials and will not increase out-of-pocket costs to Ameren.

8.1.3.2 Monitoring

Post-construction Monitoring

Post-construction mortality monitoring will be conducted annually for the 6-year permit term, as described in Section 7.3 of this HCP. Costs of mortality monitoring will be funded through the annual operating budget of the HPWF and will be contracted via a time and materials contract to allow for any changes deemed necessary to maintain the desired detection probability of at least 0.2 (e.g., changes to plot size or search frequency). Annual operating expenses associated with monitoring and reporting requirements of the HCP are estimated to be approximately $650k or less. Applicant's current credit rating from Standard & Poor's is BBB+ and Baa1 from Moody's. Applicant's tangible net worth is approximately $4.9B. Revenues from the sale of energy generated from the project or other energy centers may be used to pay for operating costs including compliance costs associated with the HCP. It is important to note that if the HPWF has insufficient funds for operations, the HPWF will not be operational and therefore will not pose risk to the covered species. Since mitigation measures will be funded prior to any take occurring (see Section 8.1.3.4), all take associated with the HPWF would be mitigated if the HPWF suffered from insufficient funds. As a further assurance that funds will be in place to conduct monitoring, Ameren has established a Surety which includes funding sufficient to cover the costs of the post-construction monitoring for the first year of monitoring and will be updated annually to include costs for the upcoming monitoring year (i.e., at ITP issuance the Surety would cover Year 1 of monitoring, after the first year of operations the Surety would cover Year 2 of monitoring, etc.). The Conservation Fund is the third-party beneficiary of the Surety bond, which has been written to authorize the USFWS to call the bond and prepay the necessary funds to The Conservation Fund to implement any portion of the requirements of this HCP which the USFWS deems have not been implemented or have been inadequately implemented.

At the end of each season of monitoring, the end-of-season report will include a description of the post-construction monitoring required for the upcoming monitoring year, based on the results of the prior year’s monitoring. The Applicant will also provide as part of its annual report a proposal from an independent consultant for the monitoring work for the upcoming year. The Surety will be updated as necessary to reflect the amount set forth in the independent consultant’s proposal. Evidence of the Surety has been provided to the USFWS and will be provided annually by March 1 of each year of the ITP term, which is 30 days prior to the start of the bat monitoring season (April 1).

The post-construction monitoring for Year 1 is described in Section 7.3. The estimated annual cost is $557,832 based on the following scope:

- Monitoring 70 full plot turbines twice weekly from April 1 to October 31;
- Monitoring 105 roads and pads twice weekly from April 1 to October 31;
- Performing searcher efficiency and carcass removal trials according to the specification in this HCP a minimum of three times during each monitoring year (spring, summer and fall);

- Calculating the bias correction factors based on the searcher efficiency and carcass removal trials, as well as observed mortality;
- Preparing Seasonal Summaries;
- Producing an Annual Mortality Monitoring Report; and
- Conducting plot maintenance (i.e., mowing and herbicide application).

Maternity Colony Monitoring

Maternity colony monitoring will be conducted at a minimum of 20 mist-net sites, as described in Section 7.4 of this HCP. Costs of maternity colony monitoring will be self-funded through the annual operating budget of the HPWF. Annual operating expenses associated with monitoring and reporting requirements of the HCP are estimated to be approximately $650k or less. Applicant's current credit rating from Standard & Poor's is BBB+ and Baa1 from Moody's. Applicant's tangible net worth is approximately $4.9B. Revenues from the sale of energy generated from the project or other energy centers may be used to pay for operating costs including compliance costs associated with the HCP.

It is important to note that if the HPWF has insufficient funds for operations, the HPWF will not be operational and therefore will not pose risk to the covered species. As a further assurance that funds will be in place to conduct monitoring, the Applicant has established a Surety sufficient to cover the costs of maternity colony monitoring if adaptive management is triggered during the first year of operations and will update this Surety annually for the upcoming monitoring year (i.e., at ITP issuance the Surety will cover Year 1 of monitoring, after the first year of operations the Surety would cover Year 2 of monitoring, etc.). The Conservation Fund is the third-party beneficiary of the Surety bond, which has been written to authorize the USFWS to call the bond and prepay the necessary funds to The Conservation Fund to implement any portion of the requirements of this HCP which the USFWS deems have not been implemented or have been inadequately implemented, including maternity colony monitoring.

At the end of each season of monitoring, the end-of-season report will include a proposal from an independent consultant for the monitoring work for the upcoming year, including maternity colony monitoring if planned. The Surety will be updated as necessary to reflect the amount set forth in the independent consultant’s proposal. Evidence of the Surety has been provided to the USFWS and will be provided annually by March 1 of each year of the ITP term, which is 30 days prior to the start of the post-construction monitoring season (April 1).

The estimated annual cost for the first year (based on a single adaptive management trigger requiring monitoring) is $29,300.

8.1.3.3 Adaptive Management

While adaptive management measures could have substantial costs related to lost revenue due to changes in operations, there are no “out of pocket” expenses and the costs will be accounted for in the annual operating budget. Calculations of lost revenue would be done similarly to that described in Section 8.1.3.1 but scaled to whatever turbines or season the adaptive management was occurring during.

8.1.3.4 Mitigation Measures

For the mitigation of at least 162.2 acres of bat habitat, the Applicant has reserved 217 credits (more than the 162.2 credits required) from the Chariton Hills Conservation Bank, a USFWS-approved conservation bank. the Applicant has provided the USFWS with evidence that this amount has been paid to the conservation bank via a signed purchase agreement, and all credits have been purchased to offset the permitted levels of take of the covered species.

The mitigation has been reserved prior to ITP issuance and will be fully implemented upon ITP issuance and will thus not require any additional funding after ITP issuance.

8.1.3.5 Changed Circumstances

Reasonably foreseeable circumstances described in Section 8.2.2 (Changed Circumstances) could result in changes to the covered species (e.g., listing of a new species, change in risk to listed species not currently covered) or to the minimization measures (e.g., deployment of new technologies). Application of changed circumstances funds towards corrective measures will occur when a changed circumstances trigger has been met. Because it is difficult to know exactly what the cost of covering changed circumstances could be, the Applicant has obtained a $58,713 contingency Surety, equaling 10% of the total amount bonded (post-construction monitoring and maternity colony monitoring), which would cover the costs of additional data analysis, risk evaluation, and coordination with USFWS and MDC. This Surety assures that there is a contingency fund available to cover any unexpected cost resulting from changed circumstances, which would essentially be the analysis of existing data and an evaluation of risk. Corrective measures that could be funded (in whole or part) by the contingency fund are identified for each changed circumstance in Section 8.2.2 and would generally include the evaluation of the existing post-construction monitoring data, pre-construction data on species, publicly-available data on species, and/or publicly available data on new technologies, as well as coordination with USFWS. If a changed circumstance triggers a response and the Surety is used to fund the response, the Surety will be maintained or replenished to the appropriate value within 6 months of the Surety being depleted to fully fund any future changed circumstances events that may occur during the ITP Term. This amount is subject to adjustment for inflation.

Changed circumstances for mitigation have been dealt with as part of the contract with the conservation bank and are included in the price of mitigation.

8.1.3.6 Administrative Costs

Many of the costs associated with this HCP are described in the previous sections; however, there will be costs associated with the administration of this ITP, including a portion of the time for senior operations staff and environmental and permit compliance staff at Ameren to be dedicated to ITP administration, as well as the HCP Coordinator's time (see Section 8.1.1). This time will include maintaining lines of communication with the USFWS and the MDC, managing consultants' work (monitoring, reports), attending annual meetings with the USFWS and MDC as required, and other tasks necessary to ensure successful implementation of the HCP. It is anticipated that these costs will be absorbed within the annual salaries of such managers and will consist of less than 5% of the total responsibilities for 2-3 appropriate staff members. Because this is not an additional cost to the Applicant and is already accounted for in their annual operating budget, this cost will be funded out of the annual operating budget. The HCP Coordinator will be noted by March 1 of each year when the Surety(s) for Post-construction Monitoring and Maternity Colony Monitoring are provided.

8.1.3.7 Contingency Fund

The purpose of this contingency amount is to provide a reasonable "buffer" if actual costs estimated in this section are higher than anticipated. This total will change from year to year as the assured funding is revised based on the year-ahead monitoring estimates. Given that the Surety for the post-construction monitoring and maternity colony monitoring have been based off of an executed contract, it is assumed that 5% is adequate to cover any additional unforeseen costs, as this value will not need to take into account any inflation.

The Contingency Fund takes 5% of the base costs that have been placed in a Surety to provide funding assurance. Costs were provided for Year 1 Post-construction Monitoring ($557,832) and for Year 1 Maternity Colony Monitoring ($29,300), for a total base cost of $587,132. Five percent of $587,132 equals $29,357. This total will change in subsequent years based on the proposed monitoring effort and estimates.

8.1.4 Funding

Under section 10(a)(2)(A)(ii) and 10(a)(2)(B)(iii) of the ESA, an HCP submitted in support of an ITP must establish the funding that will be available to implement such steps the applicant will take to monitor, minimize, and mitigate the impacts from the proposed taking (50 C.F.R. § 17.22(b)(1) and 50 C.F.R. § 17.32(b)(1)). The ITP approval could be denied and is subject to full or partial suspension, or revocation, should Ameren fail to ensure funding for mitigation and conservation measures outlined in this HCP. If Ameren obtains an ITP from the USFWS, Ameren agrees to guarantee all funding obligations under this HCP. Unless otherwise noted, all amounts described in this chapter are based on 2019 dollars and are therefore required to be adjusted annually for inflation in the future. However, since all funding assurances will be renewed on an annual basis, this will occur naturally as Ameren secures contractors to conduct the required monitoring, and assurances will be provided by March 1 of each year as described above.

The Applicant has provided funding to implement the conservation program outlined in Section 7.0. Funding or implementation of specific portions of the conservation program has been provided prior to the beginning of project operations, unless otherwise indicated, as provided in Table 8-2, and additional portions of funding will be provided as the project progresses. Funding assurance has been provided in the form of a Surety in the name of Ameren Missouri. The Surety will be used to provide funding assurances for those portions of the conservation program that are not yet actually implemented. The Surety totals $675,202, which is equal to the sum of all needed funding assurances (i.e., post-construction monitoring, maternity colony monitoring, changed circumstances and contingency). Ameren will be responsible for the continued implementation of the HCP throughout the 6-year ITP term.

Table 8-2. Habitat Conservation Plan Implementation Budget for HPWF.

Conservation Measure	Year 1 Cost	Total over ITP Term	Funding Source	Timing of Conservation Measure	Timing of Funding
Post-construction Mortality Monitoring	$557,832	$3,000,000	Annual operating budget, with 1 year ahead surety	Annually, April 1 – October 31	By March 1 of each year

Conservation Measure	Year 1 Cost	Total over ITP Term	Funding Source	Timing of Conservation Measure	Timing of Funding
Maternity Colony Monitoring	$29,300	$200,000	Annual operating budget, with 1 year ahead surety	As needed (minimum of two years), May 15-August 15	By March 1 of each year
Mitigation (>162.2 acres of summer habitat protection)	n/a	217 Credits	Demonstration that mitigation credits have been purchased from USFWS-approved mitigation bank (e.g., signed purchase agreement)	30 days prior to ITP issuance	30 days prior to ITP issuance
Changed circumstances funding	n/a	$58,713	Deposited in a Surety	Conditional on occurrence of Changed Circumstance	Prior to project operations
Contingency fund	$29,357 for first year, to be adjusted annually	n/a	Deposited in a Surety		By March 1 of each year

8.2 UNFORESEEN AND CHANGED CIRCUMSTANCES

The HCP Assurances (No Surprises) Final Rule defined and clarified unforeseen circumstances and changed circumstances (63 FR 8859-8873). These two types of circumstances are key elements of the USFWS and NMFS No Surprises Rule developed to provide ITP applicants with long-term economic and regulatory certainty. The differentiation between unforeseen and changed circumstances is important, because depending on the type of event that occurs, Ameren may or may not be responsible for implementing additional conservation measures.

8.2.1 Unforeseen Circumstances

Unforeseen circumstances are changes in circumstances affecting a species or geographic area covered by a conservation plan that could not reasonably have been anticipated by plan developers and the USFWS at the time of the conservation plan’s negotiation and development, which result in a substantial and adverse change in the status of a covered species (63 FR 8870-8871).

Under ESA regulations, if unforeseen circumstances arise during the term of the permit, the USFWS will “not require the commitment of additional land, water, or financial compensation, or additional restrictions on the use of land, water, or other natural resources beyond the level agreed upon the species covered by the conservation plan” unless the Permittee consents. See, 50 CFR 17.22(b)(1)(5)(iii). If additional conservation and mitigation measures are deemed necessary to respond to unforeseen circumstances, the USFWS may require additional measures under the following conditions. If additional conservation and mitigation measures are deemed necessary to respond to unforeseen circumstances, the Director may require additional measures of the permittee where the conservation plan is being properly implemented, but only if such measures are limited to modifications within conserved habitat areas, if any, or to the conservation plan's operating conservation program for the affected species, and maintains the original terms of the conservation plan to the maximum extent possible. Additional conservation and mitigation measures will not involve the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources otherwise available for development or use under the original terms of the conservation plan without the consent of the permittee. 50 CFR 17.22(b)(5)(iii)(B).

8.2.2 Changed Circumstances

Changed circumstances are changes in circumstances affecting a species or geographic area covered by a conservation plan that can reasonably be anticipated by plan developers and the USFWS and that can be planned for (e.g., the listing of new species, or a fire or other natural catastrophic event in areas prone to such events; 63 FR 8870).

Ameren and the USFWS anticipate that circumstances may change during the term of the ITP and those changes could affect the ability of Ameren to properly implement the HCP. Events that could occur during the term of the HCP that are identified as changed circumstances are addressed below. This list differs from other published HCPs for bats and wind energy in Region 3 due to the shorter length of the permit term (6 years versus 30 years) and the use of a mitigation bank.

8.2.2.1 Listing of a New Species or Critical Habitat Designation

Trigger: Proposal to list a currently unlisted species (excluding the little brown bat, which is included as covered species in this HCP despite not currently being listed) as federally endangered or threatened pursuant to the ESA after ITP issuance.

Response: Ameren will request that the USFWS make a determination as to whether there is a potential for incidental take of the newly listed species due to the covered activity outlined in this HCP. If no, then no further action will be needed. If incidental take may occur, Ameren, in coordination with the USFWS, will identify measures necessary to avoid take, adverse modification of the critical habitat, and/or appreciable reduction in the likelihood of the survival and recovery of the newly listed species. These measures would be implemented once the species was listed and would remain in place until the permit is amended to include the species, or the USFWS notifies Ameren that such measures are no longer needed.

If Ameren would like to pursue take coverage for the newly listed (or proposed) species, Ameren will confer with the USFWS to determine if the avoidance and minimization measures outlined in this HCP are adequate for the newly listed species. If so, Ameren may request addition of the newly listed species to the ITP, and any additional funding needs would be determined in the permit amendment for that species. If the conservation measures in this HCP are not adequate for the newly listed species, then Ameren may coordinate with the USFWS to amend the HCP or create a supplementary HCP, including additional conservation measures and funding assurances as necessary to support an ITP. After changes, if necessary, have been made to the HCP, additional NEPA and ESA section 7 consultation shall be undertaken by the USFWS as necessary to amend and/or reissue the ITP. Ameren will also coordinate such changes with the MDC.

8.2.2.2 Change in Risk to Gray Bats

As described in Section 3.3.1, the gray bat is not currently expected to occur within the HPWF Permit Area and take coverage for this species is not being sought.

> **Trigger:** Documented change in the risk to gray bats, such that gray bat use of the Permit Area is documented or observed, and/or finding a gray bat as a fatality at the HPWEF.
>
> **Response:** Ameren will consult with the USFWS to determine if a permit amendment (see Section 8.3.2) is needed. If incidental take may occur, Ameren, in coordination with the USFWS and MDC, will identify measures necessary to avoid take. These measures would be implemented as necessary to avoid take until a permit amendment was completed.

If Ameren would like to pursue take coverage for the gray bat, Ameren will confer with the USFWS to determine if the avoidance and minimization measures outlined in this HCP are adequate for the species. If so, Ameren may request addition of the gray bat to the ITP, and any additional funding needs would be determined in the permit amendment. If the conservation measures in this HCP are not adequate for the gray bat, then Ameren may coordinate with the USFWS to amend the HCP or create a supplementary HCP, including additional conservation measures and funding assurances as necessary to support an ITP. After changes, if necessary, have been made to the HCP, additional NEPA and ESA section 7 consultation shall be undertaken by the USFWS as necessary to amend and/or reissue the ITP. Ameren will also coordinate such changes with the MDC.

8.2.2.3 Changed Technologies/Techniques

Over the permit term, new technology and information pertaining to the covered species may become available. New information on the covered species and their interactions with wind energy facilities, refined mortality and monitoring methods, and additional minimization measures to reduce wildlife mortality are likely to be developed or become available.

> **Trigger:** Ameren notifies the USFWS of the intent to utilize alternative monitoring, mortality estimation, or minimization methods. Ameren will consult with the USFWS and MDC at least 90 days prior to implementation of any new monitoring, mortality estimating, or take minimizing measures to inform them of the new methods and how they will be implemented. Any funding needed to assure proposed measures will need to be provided prior to approval.
>
> **Response:** Any new method, information or technology will only be considered if it has been demonstrated to be as effective as or more effective than the methods described in the HCP and has been approved in writing by the USFWS field office administering the HCP and will not require an increase in the take authorization. Ameren will work with USFWS to ensure that any new measures are compatible with the biological goals and objectives of this HCP and monitor the effectiveness of the methods via post-construction monitoring.

Any changes in techniques or technologies will only be considered if scientific evidence supports that the use of such techniques or technologies will not require an increase in the authorized take for the HPWF and will only be implemented if agreed upon by the USFWS. In addition, it would need to be as good or better for operations (e.g., not result in additional economic losses), and will only be implemented if the funding for such technology can be assured at that time.

New methods, procedures, or analysis for monitoring studies may be developed during the course of the ITP that provide more accurate results for determining the appropriate management actions for the Projects (e.g., adjusting the turbine operations) to minimize impacts. For example, improvements to the EofA method using covariate analyses and additional monitoring data from the HPWF and other projects in Missouri may improve the take estimation method and then further allow targeted measures to minimize take of the covered species.

Studies are ongoing on the influence of weather conditions and other factors on bat mortality, which may help inform improved turbine operations and minimization measures to meet the HCP conservation objectives in the future. Additional information on the location, timing, and periods of elevated risk could also inform mortality estimates and effective curtailment strategies to minimize take of the covered species at the HPWF. For example, focused monitoring using thermal infrared cameras at problem turbines could inform tailored curtailment strategies. Deterrent technologies (e.g., acoustic deterrents, visual deterrents) are being researched and developed, with growing scientific evidence that may support their commercial use in the future. Acoustic deterrents may reduce bat fatalities, though their effectiveness is often limited by the distance and area that the ultrasound can be broadcast (Arnett et al. 2013b). Observed decreases in bat activity with dim ultraviolet (UV) illumination has been reported, justifying additional research on UV light and other visual deterrents as a means to reduce bat fatalities at wind energy facilities (Gorresen et al. 2015). Smart curtailment strategies, which use real-time bat activity and weather data to determine turbine curtailment and operation, also show promise as a strategy for reducing bat mortality at wind energy facilities, with an 83% reduction in bat fatalities reported (Sutter and Schumacher 2017).

8.3 PERMIT RENEWAL AND AMENDMENTS

8.3.1 Permit Extension/Renewal

When the ITP expires or when all authorized take has occurred, Ameren will no longer be protected from ESA violations that may occur as a result of operation of the HPWF (provided species listing status has not changed and/or species have been delisted at the expiration of the permit). At that time, Ameren may apply for a new, longer-term ITP (as described in Section 2.2) but the short-term ITP cannot be renewed or extended because it is limited to a six-year term to collect data on site-specific impacts. Section 1.1 of the HCP outlines Ameren's plan for permitting going forward, and avoidance measures that will be implemented if needed.

Nothing herein shall obligate the USFWS to issue a permit for the remainder of the operating life for the High Prairie project, or that such new permit contains substantially similar conditions to that of the initial, six-year short-term permit.

8.3.2 Amendments

Ameren or the USFWS may request an amendment to this HCP or the ITP through an exchange of formal correspondence, addenda to the HCP, revisions to the HCP, or permit amendments. Any amendment will also be made in consultation with MDC. The USFWS shall process the amendment request in the same manner as the original HCP, provided that additional NEPA review shall be necessary only if and to the extent that the amendment involves an issue or action that was not addressed in the original NEPA analysis, respectively. If the circumstances necessitating the amendment were addressed in the original documents, then only amendment of the ITP itself shall be necessary.

Examples of amendments include (USFWS and NMFS 2016):

- Correcting insignificant mapping errors,
- Slightly modifying avoidance and minimization measures,
- Modifying annual reporting protocols,
- Making small changes to monitoring protocols,
- Making changes to funding assurances, and
- Changing the names or addresses of responsible officials.
- Addition of new species, either listed or unlisted,
- Increased level, or different form of take for covered species,
- Changes to funding that affect the ability of the permittee to implement the HCP,
- Changes to covered activities not previously addressed,
- Changes to covered lands, and
- Significant changes to the conservation strategy, including changes to the mitigation measures.

8.4 ENFORCEMENT

The provisions of this HCP are enforceable under the terms and conditions set forth in the ITP issued by the USFWS.

8.5 SUSPENSION/REVOCATION/TRANSFER

The USFWS may suspend or revoke all or part of the privileges authorized by the ITP if the permittee does not comply with the conditions of the permit or with applicable laws and regulations governing the permitted activity. Suspension or revocation of the ITP, in whole or in part, by the USFWS shall be in accordance with 50 CFR 13.27-29, as may be amended over time.

Assignment or other transfer of the ITP shall be governed by the federal regulations located at 50 C.F.R. Part 13. In accordance with 50 C.F.R. § 13.25, the Parties agree that the ITP may be transferred in whole or in part to a new party through a joint submission by Ameren and the new party to the USFWS field office responsible for administering the ITP describing: (1) each party's role and responsibility in implementing the HCP, (2) each party's role in funding the implementation of the HCP, and (3) any proposed changes to the HCP reasonably necessary to effectuate the transfer and implement the ITP. The USFWS may approve a proposed transfer of the ITP in whole or in part to a new party, which approval shall not be unreasonably withheld or delayed, provided that the USFWS field office responsible for administering the ITP determines that the proposed transferee meets the certification requirements of 50 C.F.R. § 13.25 by: (1) meeting all of the qualifications to hold an ITP under 50 C.F.R. § 13.21; (2) providing adequate written assurances that it will provide sufficient funding for the HCP, and that the proposed transferee will implement the terms and conditions of the ITP, including any outstanding minimization or mitigation requirements; and (3) the proposed transferee has provided such other information that the USFWS determines is relevant to the processing of the submission. No new conditions will be added to the HCP or the ITP by the USFWS if the proposed transferee meets these conditions for transfer.

9.0 LIST OF PREPARERS

This document was prepared in consultation with the USFWS and MDC. The following companies and key individuals contributed to its preparation.

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10.0 LITERATURE CITED

Allen, C.R, J.R. Flinn, J.T. Layne, and L.W. Robbins. 2008. Efficient repeatable approach to quantitative call identification. North American Symposium on Bat Research. Scranton, PA.

Amelon, S., and D. Burhans. 2006. Conservation assessment: *Myotis septentrionalis* (northern long-eared bat) in the eastern United States. Pages 69-82 in Conservation assessments for five forest bat species in the eastern United States, Thompson, F.R., III, editor. U.S. Department of Agriculture, Forest Service, North Central Research Station, General Technical Report NC-260. St. Paul, Minnesota. 82 pp.

American Wind Energy Association (AWEA). 2018. Missouri Wind Energy. Fact Sheet. Available at: http://awea.files.cms-plus.com/FileDownloads/pdfs/Missouri.pdf. Accessed on October 9, 2018.

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 Wildlife Management 72:61–78.

Arnett, E.B., M.M.P. Huso, M.R. Schirmacher, and J.P. Hayes. 2011. Altering turbine speed reduces vat mortality at wind-energy faciltiies. Frontiers in Ecology and the Environment. 9(4): 209-214.

Arnett, E.B., G.D. Johnson, W.P. Erickson, and C.D. Hein. 2013a. A Synthesis of Operational Mitigation Studies to Reduce Bat Fatalities at Wind Energy Facilities in North America. A report submitted to The National Renewable Energy Laboratory. Prepared by Theodore Roosevely Conservation Partnership, Western EcoSystems Technology, Inc., and Bat Conservation International. March 2013.

Arnett, E.B., C.D. Hein, M.R. Schirmacher, M.M.P. Huso, and J.M. Szewczak. 2013b. Evaluating the Effectiveness of an Ultrasonic Acoustic Deterrent for Reducing Bat Fatalities at Wind Turbines. PloS One 8(6):e65794.

Baerwald, E.F., G.H. D'Amours, B.J. Klug, and R.M.R. Barclay. 2008. Barotrauma is a significant cause of bat fatalities at wind turbines. Current Biology 18(16):R695-R696.

Baerwald, E.F., J. Edworthy, M. Holder, and R.M.R. Barclay. 2009. A Large-Scale Mitigation Experiment to Reduce Bat Fatalities at Wind Energy Facilities. Journal of Wildlife Management 73(7):1077-1081.

Barbour, R.W, and W.H. Davis. 1969. Bats of America. The University Press of Kentucky. Lexinton, KY.

Bat Conservation International, Inc. (BCI). 2018. Species Profiles, Missouri. Available at: http://www.batcon.org/resources/media-education/species-profiles. Accessed September 26, 2018.

BHE Environmental. 2011. Post-Construction Bird and Bat Mortality Study, Cedar Ridge Wind Farm, Fond du Lac County, Wisconsin. Prepared for Wisconsin Power and Light. February 2011. 143 pp.

Britzke, E.R., K.L. Murray, J.E. Heywood, and L.W. Robbins. 2002. Acoustic Identification. In The Indiana Bat: Biology and Management of an Endangered Species (A. Kurta and J. Kennedy, eds). Bat Conservation International, Austin, TX.

Callahan, E.V. 1993. Indiana bat summer habiat requirements. Dissertation, University of Missouri – Columbia.

Callahan, E.V., R.D. Drobney, and R.L. Clawson. 1997. Selection of summer roosting sites by Indiana bats (*Myotis sodalis*) in Missouri. Journal of Mammology 78:818-825.

Carroll, S.K., T.C. Carter, and G.A. Feldhamer. 2002. Placement of nets for bats: Effects on perceived fauna. Southeastern Naturalist 1:193-198.

Carter, T.C., and G.A. Feldhammer. 2005. Roost tree use by maternity colonies of Indiana bats and northern long-eared bats in southern Illinois. Forest Ecology and Management 219:259-268.

Center for Biological Diversity (CBD) and Defenders of Wildlife (DW). 2016. Petition to list the Tricolored Bat *Perimyotis subflavus* as Threatened or Endangered Under the Endangered Species Act. Prepared for Secretary of Interior, U.S. Fish and Wildlife Service. June 14, 2016. 76 pp.

Clawson, R.L., R.K. LaVal, M.L. LaVal, and W. Caire. 1980. Clustering behavior of hibernating *Myotis sodalis* in Missouri. Journal Mammology 61:245-253.

Colatskie, S. 2017. Missouri Bat Hibernacula Survey Results from 2011-2017, Following White-nose Syndrome Arrival. Missouri Department of Conservation, Technical Brief.

Cope, J.B., and S.R. Humphrey. 1977. Spring and autumn swarming behavior in the Indiana bat, *Myotis sodalis*. Journal of Mammology 58:93-95.

Criterion Power Partners. 2014. Criterion Wind Project, Garrett County, Maryland Indiana Bat Habitat Conservation Plan. January 21, 2014.

Cryan, P.M. 2008. Mating Behavior as a Possible Cause of Bat Fatalities at Wind Turbines. Journal of Wildlife Management 72(3):845-850.

Dalthorp, D., M. Huso, and D. Dail. 2017. Evidence of Absence (v2.0) software user guide. Data Series 1055. U.S. Department of the Interior, U.S. Geological Survey in cooperation with the U.S. Fish and Wildlife Service. 109 pp. Available at: https://pubs.er.usgs.gov/publication/ds1055.

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

Dames, H. R., and D. J. Neuswanger. 1999. Stream Fishery Resources in the Fabius River Watershed of Northeastern Missouri: Assessment of Status and Conservation Opportunities. Missouri Department of Conservation. https://mdc.mo.gov/sites/default/files/watersheds/FabiusWatershed110.pdf

Dobony, C.A., A.C. Hicks, K.E. Langwig, R.I. con Linden, J.C. Okoniewski, and R.E. Rainbolt. 2011. Little brown Myotis persist despite exposure to white-nose syndrome. Journal of Fish and Wildlife Management. 2(2):190-195.

Dzal, Y., L.P. McGuire, N. Veselka, M.B. Fenton. 2011. Going, going, gone: the impact of white-nose syndrome on the summer activity of the little brown bat (Myotis lucifugus). Biology Letters. 7(3):392-394.

Erickson, R.A., W.E. Thogmartin, J.E. Diffendorfer, R.E. Russell, and J.A. Szymanski. 2016. Effects of wind energy generation and white-nose syndrome on the viability of the Indiana bat. PeerJ 4:e2830. https://doi.org/10.7717/peerj.2830.

Erickson, W.P., B. Gritski, 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.

Fenton, M., and R. Barclay. 1980. *Myotis lucifugus*. Mammalian Species 142: 1-8. doi:10.2307/3503792.

Fowler Ridge Wind Farm. 2013. Fowler Ridge Wind Farm, Benton County, Indiana, Indiana bat Habitat Conservation Plan. Available at: https://www.fws.gov/midwest/endangered/permits/hcp/FowlerRidge/pdf/FowlerRidgeWindFarmFinalHCP120913.pdf.

Frick, W.F., D.S. Reynolds, and T. H. Kunz. 2009. Influence of climate and reproductive timing on demography of little brown myotis *Myotis lucifugus*. Journal of Animal Ecology. pp 1-9.

Frick, W.F., J.F. Pollock, A.C. Hicks, K.E. Langwig, D.S. Reynolds, G.G. Turner, C.M. Butchkoshi, and T.H. Kuntz. 2010. An emerging disease causes regional population collapse of a common North American bat species. Science 329:679.

Fuller, N.W., J.D. Reichard, M.L. Nabhan, S.R. Fellows, L.C. Pepin, and T.H. Kunz. 2011. Free-ranging Little Brown Myotis (*Myotis lucifugus*) Heal from Wing Damage Associated with White-Nose Syndrome. EcoHealth 8(2):154-162.

Good, R.E., W. Erickson, A. Merrill, S. Simon, K. Murray, K. Bay, and C. Fritchman. 2011. Bat Monitoring Studies at Fowler Ridge Wind Energy Facility, Benton County, Indiana, April 13 – October 15, 2010. Prepared for Fowler Ridge Wind Farm. Prepared by Western EcoSystems Technology, Inc. January 28, 2011.

Good, R.E., A. Merrill, S. Simon, K. Murray and K. Bay. 2012. Bat Monitoring Studies at the Fowler Ridge Wind Farm, Benton County, Indiana, April 1 – October 31, 2011. Prepared for Fowler Ridge Wind Farm. Prepared by Western EcoSystems Technology, Inc. January 31, 2012.

Good, R.E., G. Iskali, and K. Nasman. 2016. Bat Evaluation Monitoring Studies at Fowler Ridge Wind Farm, Benton County, Indiana: August 3 – October 14, 2015. Prepared for Fowler Ridge Wind Farm. Prepared by Western EcoSystems Technology, Inc. January 28, 2016.

Gorresen, P.M., P.M. Cryan, D.C. Dalton, S. Wolf, J.A. Johnson, C.M. Todd, and F.J. Bonaccorso. 2015. Dim ultraviolet light as a means of deterring activity by the Hawaiian hoary bat *Lasiurus cinereus semotus*. Endangered Species Research 28(3):249-257.

Grodsky, S.M., M.J. Behr, A. Gendler, D. Drake, B.D. Dieterle, R.J. Rudd, and N.L. Walrath. 2011. Investigating the causes of death for wind turbine-associated bat fatalities. Journal of Mammalogy 92(5):917-925.

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. Prepared for We Energies. Prepared by Western EcoSystems Technology, Inc. June 3, 2009.

Gruver, J., and L. Bishop-Boros. 2015. Summary and Synthesis of *Myotis* Fatalities at Wind Facilities with a Focus on Northeastern North America. Prepared for EDP Renewables. Prepared by Western EcoSystems Technology, Inc. April 13, 2015.

Hayes, J.P., and J.C. Gruver. 2000. Vertical stratification of activity of bats in an old-growth forest in western

Washington. Northwest Science 74:102-108.

Hein, C.D., A. Prichard, T. Mabee, and M.R. Schirmacher. 2013. Effectiveness of an Operational Mitigation Experiment to Reduce Bat Fatalities at the Pinnacle Wind Farm, Mineral County, West Virginia, 2012. An annual report submitted to Edison Mission Energy and the Bats and Wind Energy Wind Cooperative. Bat Conservation International, Austin, Texas.

Hein, C.D., A. Prichard, T. Mabee, and M.R. Shirmacher. 2014. Efficacy of an operational minimization experiment to reduce bat fatalities at the Pinnacle Wind Farm, Mineral County, West Virginia, 2013. An annual report submitted to Edison Mission Energy and the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas.

Hicks, A.C., M. Cooper, W. Skinner, R. von Linden, A. Bailey, J.A. Kath, and M. Sailor. 2012. Spring Migratory Behavior of Female Indiana Bats (*Myotis sodalis*) from the Blackball Mine Complex, LaSalle County, Illinois. Final Report. Prepared for Invenergy LLC. Prepared by Vesper Environmental LLC, USFWS, and the IDNR. December 18, 2012.

Hull, C.L., and S. Muir. 2010. Search areas for monitoring bird and bat carcasses at wind farms using a Monte-Carlo model. Australasian Journal of Environmental Management 17(2):77-87.

Humphrey, S.R., and J.B. Cope. 1976. Population Ecology of the Little Brown Bat (*Myotis lucifugus*), in Indiana and North-central Kentucky. The American Society of Mammalogists. Special Publication No. 4. January 30, 1976.

Humphrey, S.R., A.R. Richter, and J.B. Cope. 1977. Summer habitat and ecology of the Indiana bat, *Myotis sodalist.* Journal Mammology 58:334-346.

Ingersoll T.E., B.J. Sewall, and S.K. Amelon. 2013. Improved Analysis of Long-Term Monitoring Data Demonstrates Marked Regional Declines of Bat Populations in the Eastern United States. PLoS ONE 8(6):e65907. https://doi.org/10.1371/journal.pone.0065907.

Jackowski, D.S., J.B. Johnson, C.A. Dobony, J.W. Edwards, and W.M. Ford. 2014. Space use and resource selection by foraging Indiana bats at the northern edge of their distribution. Endangered Species Research. 24: 149-157.

Kalcounis, M.C., K.A. Hobson, R.M. Brigham, and K.R. Hecker. 1999. Bat activity in the boreal forest: importance of stand type and vertical strata. Journal of Mammalogy 80:673-682.

Kunz, T.H., J.A. Wrazen, and C.D. Burnett. 1998. Changes in body mass and fat reserves in prehibernating little brown bats (*Myotis lucifugus*). Ecoscience. 5(1): 8-17.

Kunz, T.H., E.B. Arnett, W.P. Erickson, A.R. Hoar, G.D. Johnson, R.P. Larkin, M.D. Strickland, R.W. Thresher, and M.D. Tuttle. 2007. Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. Frontiers in Ecology and the Environment 5(6):315-324.

Kunz, T.H., and J.D. Reichard. 2010. Status review of the little brown Myotis (*Myotis lucifugus*) and determination that immediate listing under the Endangered Species Act is scientifically and legally warranted. Status review conducted by Boston University's Center for Ecology and Conservation Biology, in collaboration with Friends of Blackwater Canyon, Wildlife Advocacy Project, Bat Conservation International, Center for Biological Diversity, Meyer Glitzenstein and Crystal.

Kurta, A. 2005. Roosting Ecology and Behavior of Indiana Bats (*Myotis sodalis*) in Summer. Pp. 29-42 in K.C. Vories and A. Harrington (eds.), Proceedings of the Indiana Bat and Coal Mining: A Technical Interactive Forum. Office of Surface Mining, U.S. Department of the Interior, Alton, IL.

Lacki, M.J., D.R. Cox, L.E. Dodd, and M.B. Dickinson. 2009. Response of Northern Bats (*Myotis septentrionalis*) to Prescribed Fires in Eastern Kentucky Forests. Journal of Mammalogy 90(5):1165-1175.

Langwig, K.E., J.R. Hoyt, K.L. Parise, W.F. Frick, J.T. Foster, and A.M. Kilpatrick. 2017. Resistance in persisting bat populations after white-nose syndrome invasion. Philos Trans R Soc Lond B Biol Sci 372(1712):20160011.

LaVal, R.K., R.L. Clawson, W. Caire, L.R. Wingate, and M.L. LaVal. 1976. An evaluation of the status of myotine bats in the proposed Meramec Park Lake and Union Lake project areas, Missouri. U.S. Army Corps of Engineers, St. Louis, Missouri.

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

Martin, C., E. Arnett, and M. Wallace. 2013. Evaluating Bird and Bat Post-Construction Impacts at the Sheffield Wind Facility, Vermont, 2012 Annual Report. Prepared for Bat Conservation International and First Wind. March 25, 2013.

Martin, J.E., M.S. Politano, S. Prakash, P.M. Carrica, and C.D. Markfort. 2017. Optimizing Bat Carcass Search Areas Using a CFD-Lagrangian Modeling Approach. Submitted to MidAmerican Energy Company. January 5, 2017. https://www.fws.gov/midwest/endangered/permits/hcp/pdf/MidAmericanDraftHCP_AppxE_ParticleDistributionModel.pdf.

Maslo, B., M. Valent, J.F. Gumbs, W.F. Frick. 2015. Conservation implications of ameliorating survival of little brown bats with white-nose syndrome. Ecological Applications. 25(7): 1832-1840.

Maslo, B. and N.H. Fefferman. 2015. A case study of bats and white-nose syndrome demonstrating how to model population viability with evolutionary effects. Conservation Biology. 29(4): 1176-1185.

MidAmerican Energy Company (MEC). 2018. Draft Environmental Impact Statement for Proposed Habitat Conservation Plan and Incidental Take Permit. U.S. Department of the Interior, Fish and Wildlife Service.

Miller, N.E., R.D. Drobney, R.L. Clawson, and E.V. Callahan. 2002. Summer habitat in northern Missouri. Pp. 165-171 *In* The Indiana Bat: Biology and Management of an Endangered Species (A. Kurta and J. Kennedy, Eds.). Bat Conservation International, Austin, Texas.

Miller-Butterworth, C.M., M.J. Vonhof, J. Rosenstern, G.C. Turner, A.L. Russell. 2014. Genetic structure of little brown bats (Myotis lucifugus) corresponds with spread of white-nose syndrome among hibernacula. Journal of Heredity. 105(3): 354-364.

Ministry of Environment, Lands and Parks. 1998. Inventory Methods for Bats – Standards for Components of British Columbia's Biodiversity No. 20. Prepared by the Ministry of Environment, Lands and Parks Resources Inventory Branch for the Terrestrial Ecosystems Task Force Resources Inventory Committee. March 13, 1998,. Version 2.0. https://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/bats/assets/bats.pdf.

Missouri Department of Conservation (MDC). 2012. *The Bald Eagle in Missouri* (pp. 4). Jefferson City, MO. Retrieved from https://nature.mdc.mo.gov/sites/default/files/downloads/baldeaglemo2012.pdf. Accessed September 25, 2018.

MDC. 2015. Missouri State Wildlife Action Plan. Conserving healthy fish, forests, and wildlife. Columbia, Missouri.

MDC. 2018a. Field Guide, Bats. Retrieved from https://nature.mdc.mo.gov/discover-nature/field-guide/bats.

MDC. 2018b. Missouri Natural Heritage Program. Missouri Department of Conservation. Retrieved from https://mdc.mo.gov/property/responsible-construction/missouri-natural-heritage-program.

MDC. 2018c. Field Guide: A-Z. Retrieved from https://nature.mdc.mo.gov/discover-nature/field-guide/search

MDC. 2018d. Missouri species and communities of conservation concern checklist. Missouri Natural Heritage Program Jefferson City, Missouri. pp. 56.

Murray, K.L., E.R. Britzke, B.M. Hadley, and L.W. Robbins. 1999. Surveying bat communities: a comparison between mist nets and the Anabat II bat detector system. Acta Chiropterologica 1:105-112.

Murray, S.W., and A. Kurta. 2004. Nocturnal activity of the endangered Indiana bat (*Myotis sodalis*). Journal of Zoology. 262(2):197-206.

National Land Cover Database (NLCD). 2011. https://www.mrlc.gov/nlcd11_data.php.

New York State Department of Environmental Conservation (NYSDEC). 2012. DEC Reports: 2012 Winter Bat Survey Results. April 19, 2012. https://www.dec.ny.gov/press/81767.html.

Niver, R.A., R.A. King, M.P. Armstrong, and W.M. Ford. 2014. Methods to evaluate and develop minimum recommended summer survey effort for Indiana bats: white paper. January 13, 2014.

Norberg, U.M., and J.M. Rayner. 1987. Ecological morphology and flight in bats (Mammalia: Chiroptera): wind adaptations, flight performance, foraging strategy and echolocation. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 316(1179):335-427.

Owen, S.F., M.A. Menzel, W.M. Ford, B.R Chapman, K.V. Miller, J.W. Edwards, and P.B. Wood. 2003. Home-range size and habitat used by the Northern Myotis (*Myotis septentrionalis*). American Midland Naturalist 150:352-359.

Parmesan, C. and G. Yohe. 2003. A globally coherent fingerprint of climate change impacts across natural systems. Nature 421:37-42. January 2003.

Pettit, J.L. and O'Keefe, J.M., 2017. Day of year, temperature, wind, and precipitation predict timing of bat migration. Journal of Mammalogy, 98(5), pp.1236-1248.

Powers, K.E., R.J. Reynolds, W. Orndorf, W.M. Ford, and C.S. Hobson. 2015. Post-white-nose syndrome trends in Virginia's cave bats, 2008–2013. Journal of Ecology and the Natural Environment 7(4):113-124. https://doi.org/10.5897/jene2015.0507.

Randall, L.A., T.S. Jung, and R.M.R. Barclay. 2014. Roost-Site Selection and Movements of Little Brown Bats (*Myotis lucifugus*) in Southwestern Yukon. Northwestern Naturalist 95(3).

Reichard, J.D., N.W. Fuller, A.B. Bennett, S.R. Darling, M.A. Moore, K.E. Langwig, E.D. Preston, S. von Oettingen, C.S. Richardson, and D.S. Reynolds. 2014. Inerannual survival of *Myotis lucifugus* (Chiroptera: Vespertilonidae) near the epicenter of white-nose syndrome. Northeastern Naturalist 21(4):N56-N59.

Robbins, L. W., K. L. Murray, and P. McKenzie. 2008. Evaluating the Effectiveness of the Standard Mist Netting Protocol for the Endangered Indiana Bat (*Myotis sodalis*). Northeastern Naturalist 15:275-282.

Robbins, L.W., C.R. Allen, B.T. Hale, J. Bowcock, J.R. Lemen and S. Romeling. 2010. Bat Activity during the fall migratory period at the proposed wind power facility in Schuyler County, Missouri (Final Report). Prepared for Ecology and Environment, Inc. December 14, 2010.

Robbins, L.W., B.T. Hale, S. Romeling, and J.R. Lemen. 2012. Evaluation of *Myotis* Activity: Capture, telemetry, and acoustic analysis of potential interactions at a wind energy facility. Prepared for Normandeau Associates. March 7, 2012.

Roemer, C., Disca, T., Coulon, A. and Bas, Y., 2017. Bat flight height monitored from wind masts predicts mortality risk at wind farms. *Biological Conservation*, *215*, pp.116-122.

Rollins, K.E., D.K. Meyerholz, G.D. Johnson, A.P. Capparella, and S.S. Loew. 2012. A forensic investigation into the etiology of bat mortality at a wind farm: barotrauma or traumatic injury?. Veterinary Pathology 49(2):362-371.

Russell, A.L., C.M. Butchkoski, L. Saidak, and G.F. McCracken. 2008. Road-killed bats, highway design and the commuting ecology of bats. Endangered Species Research 8(1):49-60. DOI: 10.3354/esr00121.

Silvis, A., A.B. Kniowski, S.D. Gehrt, and W.M. Ford. 2014. Roosting and foraging social structure of the endangered Indiana bat (Myotis sodalist). PLos One. 9(5):e96937.

Sparks, D.W., C.M. Ritzi, J.E. Duchamp and J.O. Whitaker, Jr. 2005. Foraging habitat of the Indiana bat (*Myotis sodalis*) at an urban-rural interface. Journal of Mammology 84(4):713-718.

Stantec Consulting Ltd. 2012. Wolfe Island Wind Plant, Post-Construction Follow-up Plan, Bird and Bat Resources, Monitoring Report No. 6, July – December 2011. Prepared for TransAleta Corporation's wholly owned subsidiary, Canadian Renewable Energy Corporation. July 2012.

Stantec Consulting Services Inc (Stantec). 2015. 2014 Bird and Bat Post-Construction Monitoring Report – Laurel Mountain Wind Energy Project, Randolph and Barbour Counties, West Virginia. Prepared for AES Laurel Mountain Wind, LLC. January 2015.

Stantec. 2016. 2016 Acoustic and Mist Netting Report. TG High Prairie, LLC. Prepared by Stantec Consulting Services Inc, Independence, Iowa. November 2016.Stantec. 2018. 2018 Acoustic and Mist Netting Report. TG High Prairie, LLC. Prepared by Stantec Consulting Services Inc, Independence, Iowa. November 2018.

Sutter, C., and S. Schumacher. 2017. Bat Detection and Shutdown System for Utility-Scale Wind Turbines. Prepared for Electric Power Research Institute (EPRI). Prepared by Normandeau Associates, Inc.

Taucher, J., T. Librandi Mumma, and W. Capouillez. 2012. Pennsylvania Game Commission Wind Energy Voluntary Cooperation Agreement, Third Summary Report. December 27, 2012.

Thomson, C. 1982. *Myotis sodalis*. Mammalian Species 163:1-5.

Tidhar, D., M. Sonnenberg, and D. Young. 2013. 2012 Post-Construction Carcass Monitoring Study for the Beech Ridge Wind Farm, Greenbrier County, West Virginia – Final Report, April 1- October 28, 2012. Prepared for Beech Ridge Wind Farm, Beech Ridge Energy, LLC. January 18, 2013.

Turner, G.G., D.M. Reeder, and J.T.H. Coleman. 2011. A five-year assessment of mortality and geographic spread of white-nose syndrome in North American bats and a look to the future. Bat Research News 52:13-27.

U.S. Department of Agriculture (USDA). 2012a. *Adair County*. Retrieved from https://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Missouri/cp29001.pdf

USDA. 2012b. *Schuyler County*. Retrieved from https://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Missouri/cp29197.pdf

U.S. Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS). 1996. Soil Survey of Schuyler County, Missouri. 155 pp.

U.S. Fish and Wildlife Service (USFWS). 1983. Recovery Plan for the Indiana Bat. U.S. Department of the Interior, Fish and Wildlife Service, Region 3, Fort Snelling, Minnesota. 80 pp.

USFWS. 1999. Indiana Bat (*Myotis sodalis*) Revised Recovery Plan. U.S. Department of the Interior, Fish and Wildlife Service, Region 3, Fort Snelling, Minnesota. 53 pp.

USFWS. 2007. Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. U.S. Department of the Interior, Fish and Wildlife Service, Region 3, Fort Snelling, Minnesota. 258 pp.

USFWS. 2009. Final Environmental Assessment, Proposal to Permit Take as Provided Under the Bald and Golden Eagle Protection Act. Division of Migratory Bird Management, U.S. Fish and Wildlife Service, Washington, D.C. April 2009.

USFWS. 2011. Indiana bat Section 7 and Section 10 Guidance for Wind Energy Projects. U.S. Department of the Interior, Fish and Wildlife Service. Revised 26 October 2011.

USFWS. 2012a. 2011 Rangewide Population Estimate for the Indiana Bat (*Myotis sodalis*) by USFWS Region. U.S. Department of the Interior, Fish and Wildlife Service. January 4, 2012.

USFWS. 2012b. Land-based Wind Energy Guidelines. U.S. Department of the Interior, Fish and Wildlife Service. March 23, 2012

USFWS. 2013a. 2013 Rangewide Population Estimate for the Indiana Bat (*Myotis sodalis*) by USFWS Region. U.S. Department of the Interior, Fish and Wildlife Service. Revised August 26, 2013. 6pp.

USFWS. 2013b. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to List the Eastern Small-Footed Bat and the Northern Long-Eared Bat as Endangered or Threatened Species; Listing the Northern Long-Eared Bat as an Endangered Species. U.S. Department of the Interior, Fish and Wildlife Service. October 2, 2013.

USFWS. 2014a. Northern Long-Eared Bat Interim Conference and Planning Guidance. USFWS Regions 2, 3, 4, 5, & 6. U.S. Department of the Interior, Fish and Wildlife Service. January 6, 2014. 67pp.

USFWS. 2014b. Correspondence from Richard Nelson of USFWS to Dave Phillips, Hoopeston Wind, LLC. March 4, 2014.

USFWS. 2015. Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Northern Long-Eared Bat With 4(d) Rule; Final Rule and Interim Rule. Federal Register: 80:17974-18033. U.S. Department of the Interior, Fish and Wildlife Service. April 2, 2015.

USFWS. 2016a. Midwest Wind Energy Multi-Species Habitat Conservation Plan. Public Review Draft. USFWS Midwest Region, in collaboration with the States of Iowa, Illinois, Indiana, Michigan, Minnesota, Missouri, and Wisconsin and the AWEA. U.S. Department of the Interior, Fish and Wildlife Service. April 2016.

USFWS. 2016b. https://www.fws.gov/endangered/improving_ESA/pdf/Listing%207-Year%20Workplan%20Sept%202016.pdf [Accessed 11 September 2018].

USFWS. 2016c.R3 Ibat REA Model v7.user. Created by Jennifer Szymanski and Forest Clark and programmed by Drew Laughland.

USFWS. 2016d. Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-eared Bat and Activities Excepted from Take Prohibitions. U.S. Fish and Wildlife Service, Regions 2, 3, 4, 5, and 6. U.S. Department of the Interior, Fish and Wildlife Service. January 5, 2016.

USFWS. 2016e. Known Northern Long-eared Bat Hibernacula and Maternity Roost Trees in Missouri. Missouri Ecological Services Field Office. Available at: https://www.fws.gov/midwest/endangered/mammals/nleb/pdf/MO_NLEBHibMatRoostTreeMap24March2016.pdf. Updated March 24, 2016.

USFWS. 2016f. R3 LBB REA Model v1.user. Created by Jennifer Szymanski, Forest Clark, and Erik Olson and programmed by Drew Laughland.

USFWS. 2016g. R3 NLEB REA Model v1.user. Created by Jennifer Szymanski and Forest Clark and programmed by Drew Laughland.

USFWS. 2017. 2017 Rangewide Population Estimate for the Indiana Bat (*Myotis sodalis*) by USFWS Region. U.S. Department of the Interior, Fish and Wildlife Service. https://www.fws.gov/MIDWEST/endangered/mammals/inba/pdf/2017_Population_Stats_Indiana_Bat_Revised_%2013Nov2018.pdf Revised November 13, 2018. 6pp.

USFWS. 2018a. Information for Planning and Consultation website. U.S. Department of the Interior, Fish and Wildlife Service. https://ecos.fws.gov/ipac/. Accessed September 26, 2018.

USFWS. 2018b. Indiana Bat Fatalities at Wind Energy Facilities. U.S. Department of Interior, Fish and Wildlife Service. https://www.fws.gov/midwest/wind/wildlifeimpacts/inbafatalities.html. Revised April 12, 2018.

USFWS. 2018c. Northern Long-Eared Bat Final 4(d) Rule, White-Nose Syndrome Zone Around WNS/PD Positive Counties/Districts. U.S. Department of the Interior, Fish and Wildlife Service. October 1, 2018. http://www.fws.gov/Midwest/endangered/mammals/nleb/pdf/WNSZone.pdf. Accessed May 1, 2019.

U.S. Fish and Wildlife Service. April 26, 2018. *Guidance on trigger for an incidental take permit under Section 10(a)(1)(B) of the Endangered Species Act where occupied habitat or potentially occupied habitat is being modified* [Memorandum]. Washington DC: United States Department of the Interior. Retrieved from https://www.fws.gov/endangered/esa-library/pdf/Guidance-on-When-to-Seek-an-Incidental-Take-Permit.pdf

USFWS. 2019a. 4/23/2019 Bat White Nose Syndrome (WNS) Occurrence by County/District (or portions thereof). http://whitenosesyndrome.org/resources/map

USFWS. 2019b. 2019 Indiana Bat (Myotis sodalis) Population Status Update. Department of the Interior, Fish and Wildlife Service. Indiana Ecological Services Field Office. Revised 27 June, 2019. 9 pp.

USFWS. 2019c. From abandoned mine to bat haven: Missouri's Sodalis Nature Preserve. https://www.fws.gov/midwest/news/BatHaven.html. Originally published on October 28, 2017. Last updated March 5, 2019.

USFWS. 2019d. 2019 Range-wide Indiana Bat Survey Guidelines. U.S. Fish and Wildlife Service. https://www.fws.gov/midwest/endangered/mammals/inba/surveys/pdf/2019_Rangewide_IBat_Survey_Guidelines.pdf

USFWS and National Marine Fisheries Service (NMFS). 2016. Habitat Conservation Planning and Incidental Take Permit Processing Handbook. U.S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce, National Marine Fisheries Service. December 21, 2016.

U.S. Forest Service (USFS). 1994. Ecological Subregions of the United States. Compiled by W. Henry McNab and Peter E. Avers. U.S. Department of Agriculture, Forest Service. Retrieved from https://www.fs.fed.us/land/pubs/ecoregions/ch28.html#251C.

U.S. Geological Survey (USGS). 2018. White-Nose Syndrome Threatens the Survival of Hibernating Bats in North America. U.S. Department of the Interior, Geological Survey. https://www.usgs.gov/centers/fort/science/white-nose-syndrome-threatens-survival-hibernating-bats-north-america?qt-science_center_objects=0#qt-science_center_objects. Accessed November 26, 2018.

Weller, T.J., and D.C. Lee. 2007. Mist net effort required to inventory a forest bat species assemblage. Journal of Wildlife Management 71:251–257.

Wellig, S.D., Nusslé, S., Miltner, D., Kohle, O., Glaizot, O., Braunisch, V., Obrist, M.K. and Arlettaz, R., 2018. Mitigating the negative impacts of tall wind turbines on bats: Vertical activity profiles and relationships to wind speed. *PloS one*, *13*(3), p.e0192493.

Whitaker, J.O., Jr., and V. Brack, Jr. 2002. Distribution and summer ecology in Indiana. Pp. 48-54 *In* The Indiana Bat: Biology and Management of an Endangered Species (A. Kurta and J. Kennedy, Eds.). Bat Conservation International, Austin, Texas.

Whitaker, J.O., and W.J. Hamilton, Jr. 1998. Mammals of the eastern United States. Cornell University Press. Ithaca, New York. Third Edition.

Wisconsin Department of Natural Resources (WDNR). 2017. Wisconsin Little Brown Bat Species Guidance. Bureau of Natural Heritage Conservation, Wisconsin Department of Natural Resources, Madison, Wisconsin. PUB-ER-705

Young, D., and J. Gruver. 2011. Bat Mist Netting and Acoustic Surveys Beech Ridge Wind Energy Project GreenBrier and Nicholas Counties, West Virginia. Prepared for Beech Ridge Energy LLC. Prepared by Western EcoSystems Technology, Inc. Revised June 27, 2011.

Young, D.P., W.P. Erickson, K. Bay, S. Nomani., and W. Tidbar. 2009. Mount Storm Wind Energy Facility, Phase 1 Post-Construction Avian and Bat Monitoring, July-October 2008. Prepared for NedPower Mount Storm, LLC. Prepared by Western EcoSystem Technology, Inc.

Young, D., M. Lout, Z. Courage, S. Nomani, and K. Bay. 2012a. 2011 Post-construction Monitoring Study Criterion Wind Project Garrett County, Maryland, April 2011 – November 2011. Prepared for Criterion Power Partners, LLC. Prepared by Western EcoSystems Technology, Inc. April 20, 2012.

Young, D.P., S. Nomani, Z. Courage, and K. Bay. 2012b. NedPower Mount Storm Wind Energy Facility Post-Construction Avian and Bat Monitoring, July-October 2011. Prepared for NedPower Mount Storm, LLC. Prepared by Western EcoSystems Technology, Inc. February 27, 2012.

Young, D., C. Nations, M. Lout, and K. Bay. 2013. 2012 Post-Construction Monitoring Study, Criterion Wind Project, Garret County, Maryland, April – November 2012. Prepared for Criterion Power Partners, LLC. Prepared by Western EcoSystems Technology, Inc. January 15, 2013.

Appendix A. Population Projection Matrices

Appendix A. Population Projection Matrices for Maternity Colonies

Introduction

A Leslie Matrix is a discrete, age-structured model used to describe the growth of a population and its projected age distribution. Three major assumptions with this model is that it is appropriate to classify individuals by age (i.e., age is what determines survival and fecundity rates, not size or developmental stage), that fecundity and survival rates are constant (i.e., environment is constant and density effects are unimportant), and that it is a closed population (i.e., no immigration or emigration into or out of the population). For the three covered bat species, this analysis focuses on female bats, with three possible age classes that an individual female can fall into:

- Pup - period from birth until first hibernation
- Juvenile - period from first hibernation to second hibernation
- Adult - period beginning with second hibernation and beyond

The population matrix takes the following form:

$$N_t = \begin{bmatrix} n_1 \\ n_2 \\ n_3 \end{bmatrix}$$

Where the population at time *t* is the sum of the populations of the three age classes. Specifically,

$$N_t = \begin{bmatrix} n_{pups} \\ n_{juveniles} \\ n_{adults} \end{bmatrix}$$

In addition to a matrix establishing the starting population size, as described above, survival and reproductive rates describing the transitions between different stages are included, as outlined below:

To Stage	From Stage: Pup	From Stage: Juvenile	From Stage: Adult
Pup	0	Juvenile Reproductive Rate	Adult Reproductive Rate
Juvenile	Pup to Juvenile Survival	0	0
Adult	0	Juvenile Survival Rate	Adult Survival Rate

Therefore, the Leslie Matrix (L) (which includes these survival and reproductive rates) for this analysis takes the following form:

$$L = \begin{bmatrix} 0 & F_2 & F_3 \\ S_1 & 0 & 0 \\ 0 & S_2 & S_3 \end{bmatrix}$$

Where F_x represents the fecundity rate for age class *X*, and *S* represents the probability of an individual surviving from age class *X* to the next age class. All other entries in the matrix are zero.

These two matrices can then be used to project the future population over time as follows:

$$N_{t+1} = L \times N_t$$

Where N_{t+1} is the future population, N_t is the starting population size, and **L** is the Leslie Matrix.

Covered Bat Species

For the three covered species, population parameters (i.e., reproductive and survival rates) are found in the USFWS Resource Equivalency Analysis (REA) models specific to each species (USFWS 2016a, 2016b, 2016c). Based on data from Missouri, it was assumed that the Indiana bat populations and northern long-eared bat populations are declining, but that little brown bat populations are between stationary and declining (and thus an average of these population parameters is used). Population parameters from the REA models by species are shown below in Table 1.

Table 1. Population parameters by species based on the Resource Equivalency Analysis (REA) models (USFWS 2016a, 2016b, 2016c).

Parameter	Indiana Bat	Northern Long-eared Bat	Little Brown Bat
Population Condition	Declining	Declining	Average of Declining and Stationary
Adult Reproductive Rate (female pups/female/year)	0.281	0.281	0.375
Juvenile Reproductive Rate (female pups/female/year)	0.065	0.065	0.215
Pup to Juvenile Survival Rate	0.585	0.585	0.375
Juvenile Survival Rate (annual)	0.674	0.674	0.7825
Adult survival rate (annual)	0.857	0.857	0.7825

Indiana Bats

As described in Section 4.1.9.1 of the HCP, Kurta (2005) found that the mean maximum number of bats emerging from a colony, after juveniles have become volant, is approximately 119 bats, suggesting that

60 to 70 adult females are present during the breeding season. The remaining 59 bats would be composed of juveniles and pups and would be a mix of males and females. Assuming that the sex ratio of pups and juveniles is 50:50 (which may be conservative, as juvenile males may be less likely to return to the maternity colony, in which case the number of juvenile females may be higher), and that half of the remaining bats are pups and half are juveniles, the following would be the starting matrix for an Indiana bat maternity colony:

$$N_0 = \begin{bmatrix} 15 \\ 15 \\ 60 \end{bmatrix}$$

Using the parameters described in Table 1 results in the following Leslie Matrix:

$$L = \begin{bmatrix} 0 & 0.065 & 0.281 \\ 0.585 & 0 & 0 \\ 0 & 0.674 & 0.857 \end{bmatrix}$$

Thus, in the absence of any additional mortality, the following scenario would occur:

$$N_{t+1} = L \times N_t$$

$$N_{t+1} = \begin{bmatrix} 0 & 0.065 & 0.281 \\ 0.585 & 0 & 0 \\ 0 & 0.674 & 0.857 \end{bmatrix} \times \begin{bmatrix} 15 \\ 15 \\ 60 \end{bmatrix}$$

$$N_{t+1} = \begin{bmatrix} (15 * 0.065) + (60 * 0.281) \\ (15 * 0.585) \\ (15 * 0.674) + (60 * 0.857) \end{bmatrix}$$

$$N_{t+1} = \begin{bmatrix} 17.84 \\ 8.78 \\ 61.53 \end{bmatrix}$$

In order to evaluate the impact of the HPWF on a maternity colony, the estimated take of female bats was added to the mortality of adult female bats. Based on the analysis provided in Section 6.3.2 of the HCP, it is estimated that up to 7.1 adult female Indiana bats may be taken by the Project each year from local maternity colonies. With a predicted take of 7.1 adult females per year, spread across 8 maternity colonies (see HCP Section 4.1.9.1), it is assumed that each maternity colony will lose an average of approximately 1 adult female per year (rounded up to the nearest whole bat to be conservative given this species' endangered status). In addition, take of an adult female bat during the pup season could also result in the loss of her pup. Based on the adult reproductive rate of 0.281 female pups per adult female, and the assumption that 45.3% of the female Indiana bat take will occur during the summer (see Section 6.3.2 of the HCP), approximately 0.127 female pups may also be lost annually from any given maternity colony. The impact of this take can therefore be modelled by adding mortality of 1 adult female per year and 0.127 female pups per year to the above calculation as follows:

$$N_{t+1} = \begin{bmatrix} (15 * 0.065) + (60 * 0.281) - 0.127 \\ (15 * 0.545) \\ (15 * 0.674) + (60 * 0.857) - 1 \end{bmatrix}$$

$$N_{t+1} = \begin{bmatrix} 17.71 \\ 8.78 \\ 60.53 \end{bmatrix}$$

The resulting population matrix is then used in the calculation for the following year during each year for the life of the Project. For this analysis, we projected populations for the six years of the permit with the take of 1 adult Indiana bat female per year (Table 2).

Table 2. Population projection for a single Indiana bat maternity colony (including females only) over the six-year permit term (including take from the HPWF).

	Starting Population	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Pups	15	17.71	17.45	16.50	15.89	15.31	14.72
Juveniles	15	8.78	10.36	10.21	9.65	9.30	8.96
Adults	60	60.53	56.79	54.65	52.72	50.69	48.71
Total	90	87.02	84.60	81.36	78.26	75.30	72.39

Northern Long-eared Bats

As described in Section 4.2.8.1 of the HCP, the USFWS (2016d) reported that maternity colonies that have been impacted by white nose syndrome (WNS) should be assumed to have 20 adult females. Similar to the Indiana bat, adult females represent half of the maternity colony, with the other half split between juveniles and pups (though only half of these would be females), resulting in the following starting matrix for a northern long-eared bat maternity colony:

$$N_0 = \begin{bmatrix} 5 \\ 5 \\ 20 \end{bmatrix}$$

Using the population parameters described in Table 1 results in the following Leslie Matrix:

$$L = \begin{bmatrix} 0 & 0.065 & 0.281 \\ 0.585 & 0 & 0 \\ 0 & 0.674 & 0.857 \end{bmatrix}$$

Thus, in the absence of any additional mortality, the following scenario would occur:

$$N_{t+1} = L \times N_t$$

$$N_{t+1} = \begin{bmatrix} 0 & 0.065 & 0.281 \\ 0.585 & 0 & 0 \\ 0 & 0.674 & 0.857 \end{bmatrix} \times \begin{bmatrix} 5 \\ 5 \\ 20 \end{bmatrix}$$

$$N_{t+1} = \begin{bmatrix} (5 * 0.065) + (20 * 0.281) \\ (5 * 0.585) \\ (5 * 0.674) + (20 * 0.857) \end{bmatrix}$$

$$N_{t+1} = \begin{bmatrix} 5.95 \\ 2.93 \\ 20.51 \end{bmatrix}$$

In order to evaluate the impact of the HPWF on a maternity colony, the estimated take of female bats was added to the mortality of adult female bats. Based on the analysis provided in Section 6.3.3 of the HCP, it is estimated that up to 1.1 adult female northern long-eared bats may be taken by the Project each year from local maternity colonies. With a predicted take of 1.1 adult females per year, spread across 12 maternity colonies (see HCP Section 4.2.8.1), it is assumed that each maternity colony will lose an average of 0.1 adult female per year. In addition, take of an adult female bat during the pup season could also result in the loss of her pup. Based on the adult reproductive rate of 0.281 female pups per adult female, take of 0.1 adult females per year, and the assumption that 45.3% of the female northern long-eared bat take will occur during the summer (see Section 6.3.3 of the HCP), approximately 0.01 female pups may also be lost annually from any given maternity colony. The impact of this take can therefore be modelled by adding mortality of 0.1 adult northern long-eared bat female per year and 0.01 northern long-eared bat pup to the above calculation as follows:

$$N_{t+1} = \begin{bmatrix} (5 * 0.065) + (20 * 0.281) - 0.01 \\ (5 * 0.585) \\ (5 * 0.674) + (20 * 0.857) - 0.1 \end{bmatrix}$$

$$N_{t+1} = \begin{bmatrix} 5.94 \\ 2.93 \\ 20.41 \end{bmatrix}$$

The resulting population matrix is then be used in the calculation for the following year during each year for the life of the Project. For this analysis, we projected populations for the six years of the permit with the take of 0.1 adult northern long-eared bat female per year (Table 3).

Table 3. Population projection for a single northern long-eared bat maternity colony (including females only) over the six-year permit term (including take from the HPWF).

	Starting Population	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Pups	5	5.94	5.92	5.66	5.51	5.37	5.22
Juveniles	5	2.93	3.47	3.46	3.31	3.22	3.14
Adults	20	20.41	19.37	18.84	18.38	17.88	17.39
Total	30	29.28	28.70	27.96	27.20	26.47	25.75

Little Brown Bats

As described in Section 4.3.8.1 of the HCP, most little brown bat colonies range from 300 to 1,000 individuals (Humphrey and Cope 1976); however, due to an 86.7% decline in Missouri (see Section 4.3.7), it is assumed that populations in Missouri now average 40 to 160 individuals. Using the average of 100 little brown bats per colony, and assuming that, similar to the Indiana bat, half of these individuals would be adult females with the remaining split between juveniles and pups (though only half of these would be females), the following would be the starting matrix for a little brown bat maternity colony:

$$N_0 = \begin{bmatrix} 12 \\ 12 \\ 50 \end{bmatrix}$$

Using the population parameters described in Table 1 results in the following Leslie Matrix:

$$L = \begin{bmatrix} 0 & 0.215 & 0.375 \\ 0.375 & 0 & 0 \\ 0 & 0.7825 & 0.7825 \end{bmatrix}$$

Thus, in the absence of any additional mortality, the following scenario would occur:

$$N_{t+1} = L \times N_t$$

$$N_{t+1} = \begin{bmatrix} 0 & 0.215 & 0.375 \\ 0.375 & 0 & 0 \\ 0 & 0.7825 & 0.7825 \end{bmatrix} \times \begin{bmatrix} 12 \\ 12 \\ 50 \end{bmatrix}$$

$$N_{t+1} = \begin{bmatrix} (12 * 0.215) + (50 * 0.375) \\ (12 * 0.375) \\ (12 * 0.7825) + (150 * 0.7825) \end{bmatrix}$$

$$N_{t+1} = \begin{bmatrix} 21.33 \\ 4.50 \\ 48.52 \end{bmatrix}$$

In order to evaluate the impact of the HPWF on a maternity colony, the estimated take of female bats was added to the mortality of adult female bats. Based on the analysis provided in Section 6.3.4 of the HCP, it is estimated that up to 5.8 adult female little brown bats may be taken by the Project each year from local maternity colonies. With a predicted take of 5.8 adult females per year, spread across 4 maternity colonies (see HCP Section 4.3.8.1), it is assumed that each maternity colony will lose an average of 1.45 adult females per year. In addition, take of an adult female bat during the pup season could also result in the loss of her pup. Based on the adult reproductive rate of 0.375 female pup per adult female, the take of 1.45 adult females per year, and the assumption that 45.3% of the female little brown bat take will occur during the summer (see Section 6.3.4 of the HCP), approximately 0.25 female pups may also be lost annually from any given maternity colony. The impact of this take can therefore be modelled by adding mortality of 2 adult little brown bat females per year and 0.34 female little brown bat pups to the above calculation as follows:

$$N_{t+1} = \begin{bmatrix} (12 * 0.215) + (50 * 0.375) - 0.25 \\ (12 * 0.375) \\ (12 * 0.7825) + (150 * 0.7825) - 1.45 \end{bmatrix}$$

$$N_{t+1} = \begin{bmatrix} 21.08 \\ 4.50 \\ 47.07 \end{bmatrix}$$

The resulting population matrix is then be used in the calculation for the following year during each year of the life of the Project. For this analysis, we projected populations for the six years of the permit with the take of 1.45 adult little brown bat females per year (Table 4).

Table 4. Population projection for a single little brown bat maternity colony (including females only) over the six-year permit term (including take from the HPWF).

	Starting Population	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Pups	12	21.08	18.37	16.04	14.42	12.85	11.37
Juveniles	12	4.50	7.91	6.89	6.02	5.41	4.82
Adults	50	47.07	38.90	35.18	31.47	27.89	24.61
Total	74	72.65	65.18	58.11	51.91	46.15	40.80

Discussion

As stated previously, the Indiana and northern long-eared bat populations are considered to be declining, and the little brown bat population is considered to be between declining and stable for the six-year permit term regardless of whether or not the HPWF is constructed and operating. Therefore, using the population parameters described above, but not including the additional mortality of 1 Indiana bat, 0.1 northern long-eared bat or 1.45 little brown bats per maternity colony taken by the HPWF, projected maternity colony size over the six-year period is shown in Table 5.

Table 5. Population projection for the Indiana, northern long-eared and little brown bat maternity colonies over a six-year period without any take from the wind farm.

Species	**Age Class**	**Starting Population**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**
Indiana bat	Pups	15	17.84	17.86	17.16	16.78	16.43	16.06
	Juveniles	15	8.78	10.44	10.45	10.04	9.82	9.61
	Adults	60	61.53	58.65	57.30	56.15	54.89	53.66
	Total	90	88.15	86.95	84.91	82.97	81.14	79.33
Northern long-	Pups	5	5.94	5.92	5.66	5.51	5.37	5.22
	Juveniles	5	2.93	3.47	3.46	3.31	3.22	3.14
	Adults	20	20.41	19.37	18.84	18.38	17.88	17.39

eared bat	Total	30	29.28	28.70	27.96	27.20	26.47	25.75
Little brown bat	Pups	12	21.08	18.37	16.04	14.42	12.85	11.37
	Juveniles	12	4.50	7.91	6.89	6.02	5.41	4.82
	Adults	50	47.07	38.90	35.18	31.47	27.89	24.61
	Total	74	72.65	65.18	58.11	51.91	46.15	40.80

Even without mortality from the wind farm, it is projected that an Indiana bat maternity colony would exhibit a 11.9% decline, a northern long-eared bat maternity colony would exhibit a 11.9% decline, and a little brown bat maternity colony would exhibit a 32.4% decline over the six-year. With estimated take from the wind farm, these projected declines are expected to potentially be 19.6% for Indiana bats, 14.2% for the northern long-eared bat, and 44.9% for little brown bats. The additional 7.7% projected decline in an Indiana bat maternity colony (which is approximately 7 bats), 2.3% projected decline in a northern long-eared bat maternity colony (which is less than 1 bat), and 12.5% projected decline for little brown bats (which is less than 9 bats) would be more than offset by the mitigation implemented for the Project (which is adding approximately 140 Indiana bats, 23 northern long-eared bats, and 158 little brown bats). Actual gains from mitigation may be greater than anticipated, as the gains above are based only on the mitigation requirement for each species, and not the aggregate mitigation that will be implemented for all three species (e.g., for the northern long-eared bat, the mitigation credits is based only off of the 31 acres that are needed for that species, and not the entire 211.1 acre mitigation that will be implemented).

Additionally, these population projections assume declining populations over the entire 6-year Permit Term; however, studies have shown that little brown bat populations may start to stabilize after exposure to WNS (Dobony et al. 2011, Reichard et al. 2014), and the same may be true of other *Myotis* species, including the Indiana and northern long-eared bat. In addition, the projection does not take into account that declines in the local population are assumed to lead to declines in the predicted take (USFWS 2016a). Lastly, the projected take includes the loss of pups for females taken during the summer, but pups are non-volant for only a portion of the summer period, and thus not all summer take would also result in the loss of the pup.

Post-construction monitoring data (see Section 7.3 of the HCP) and maternity colony monitoring data (see Section 7.4 of the HCP) will be collected to better understand the impact of the Project on local maternity colonies during the six-year permit term and to inform adaptive management. In addition, it is assumed that other research on populations will occur during the interim that will be incorporated into any longer-term plans for the Project.

<u>Literature Cited:</u>

Dobony, C.A., A.C. Hicks, K.E. Langwig, R.I. von Linden, J.C. Okoniewski, and R.E. Rainbolt. 2011. Little brown myotis persist despite exposure to white-nose syndrome. Journal of Fish and Wildlife Management. 2(2):190-195.

Reichard, J.D., N.W. Fuller, A.B. Bennett, S.R. Darling, M.A. Moore, K.E. Langwig, E.D. Preston, S. von Oettingen, C.S. Richardson and D.S. Reynolds. 2014. Inerannual survival of Myotis lucifugus (Chiroptera: Vespertilonidae) near the epicenter of white-nose syndreom. Northeastern Naturalist. 21(4):N56-N59.

USFWS. 2016a.R3 Ibat REA Model v7.user. Created by Jennifer Szymanski and Forest Clark and programmed by Drew Laughland.

USFWS. 2016b. R3 LBB REA Model v1.user. Created by Jennifer Szymanski, Forest Clark, and Erik Olson and programmed by Drew Laughland.

USFWS. 2016c. R3 NLEB REA Model v1.user. Created by Jennifer Szymanski and Forest Clark and programmed by Drew Laughland.

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Appendix B. Adaptive Management for Maternity Colonies

Appendix B. Adaptive Management for Maternity Colonies

An adaptive management protocol will be implemented for the maternity colonies present within the Project Area to minimize impacts to any one maternity colony. Carcass survey data collected by observers on-site is used to generate estimates of bat fatalities through the Evidence of Absence (EofA) software. Specific fatality levels estimated by the model then provide the basis for triggers to initiate changes in turbine operations and minimize impacts to on-site bat populations. The post-construction monitoring is detailed in Section 7.3 of the HCP, and the application of EofA is explained in Section 7.3.3.5 of the HCP. Below, we outline how adaptive management triggers for maternity colonies were developed and the operational responses to those triggers.

Indiana bats:

Results from pre-construction surveys and publicly available data on Indiana bats indicate an estimated 8 Indiana bat maternity colonies are present in the permit area (Section 4.1.9.1). The goal of adaptive management for Indiana bat colonies is to minimize impacts to individual maternity colonies. To achieve this goal, the adaptive management process includes thresholds such that no more than one colony exhibits a maximum loss of approximately 30%, and if one colony hits the threshold that would result in this estimated loss, the thresholds for other colonies would become increasingly protective for the Indiana bat (i.e., the second colony would have a loss of less than 30%, the third colony even less than that, etc.). The protocol is based on a set of assumptions, including that maternity colonies can be impacted by turbines up to 2.5 miles from the colony (based on the foraging distance for the Indiana bat), and that female fatalities between April 1 and September 30 may be from the local maternity colonies.

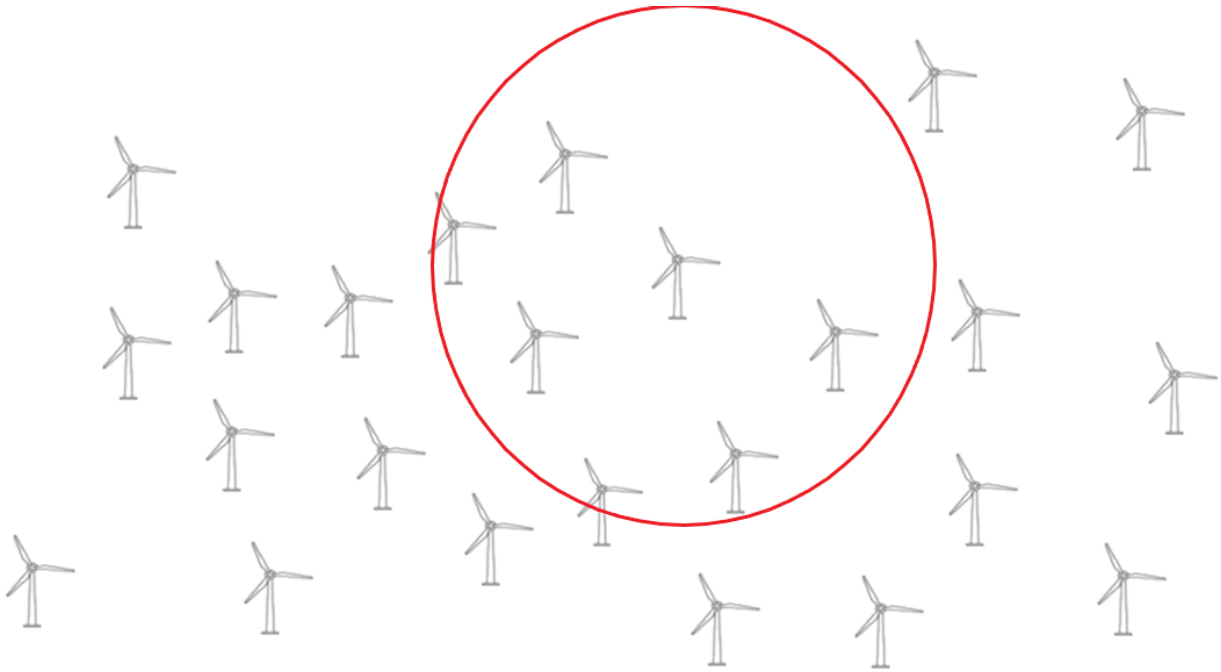
The expected female Indiana bat take from these local maternity colonies is 7.1 females per year, or 42.6 females total over the 6-year permit term. However, the adaptive management for maternity colonies includes the spring migration and the majority of the fall migration, during which an estimated 9 females will be killed per year, or 54 females total over the 6-year permit term (over the entire bat active seasons). The expected number of females that will be found during post-construction monitoring would be the total expected take (54) multiplied by the detection probability (g=0.2), or 10.8 female Indiana bats. Therefore, it is expected that 10 to 11 female Indiana bats will be found. This is the equivalent of finding one female Indiana bat for every 16-18 turbines, or a 6.2% chance of finding a female Indiana bat at any given turbine.

If a female Indiana bat is killed at Turbine X during the summer (May 15 – August 15), it presumably came from a maternity colony within 2.5[1] miles of Turbine X. In addition, High Prairie is conservatively assuming that fatalities during the spring migration (April 1 to May 14) and the first six weeks of fall migration (August 16 to September 30) may also be from the local maternity colony. Because a maternity colony is at risk of take from turbines within 2.5 miles of the colony, if the maternity colony is

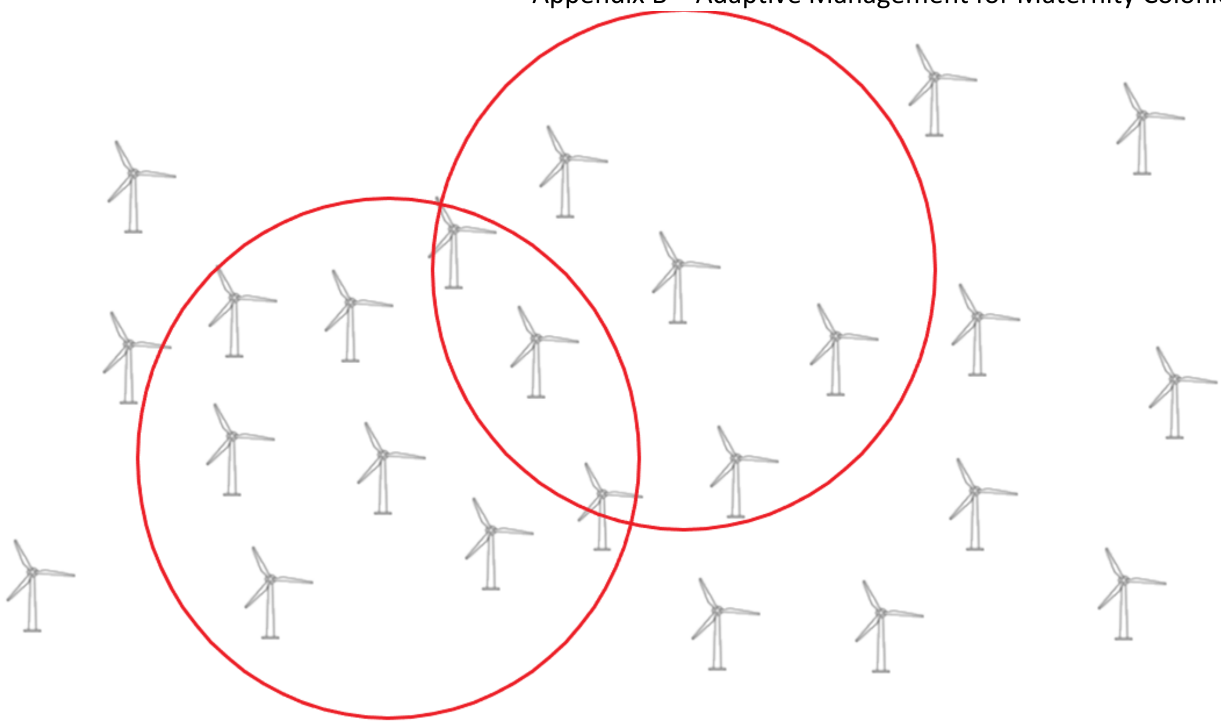
[1] Based on the foraging distance for the Indiana bat.

located 2.5 miles away from Turbine X, it could be at risk of take from turbines up to 5 miles away from Turbine X. Therefore, the following analysis will be conducted for summer take of female Indiana bats:

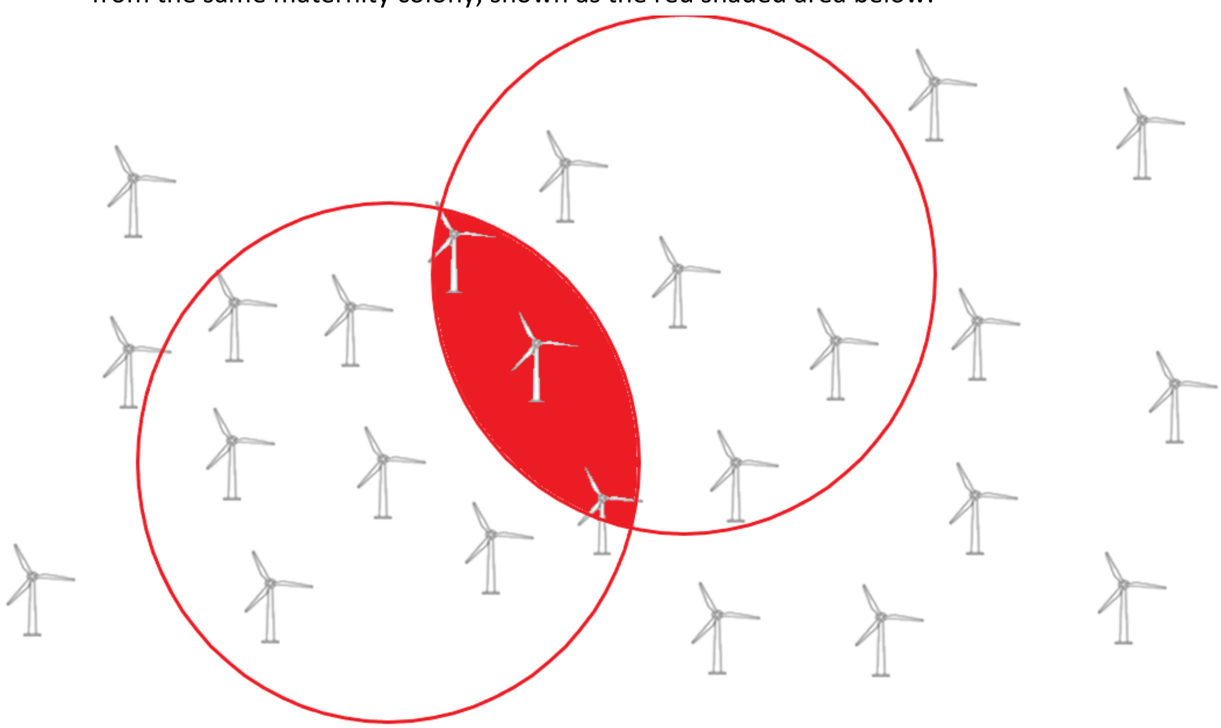
1. If at any time during the 6-year permit term a female Indiana bat is killed at a turbine between April 1 and September 30 a 2.5-mile buffer (red) would be drawn around the turbine:



2. If another female Indiana bat were killed at a turbine at some point during this time period during the 6-year permit term, a 2.5-mile buffer would be drawn around that turbine as well. This would occur for each turbine that a female Indiana bat is killed at during the April 1 – September 30 time period. As explained at the beginning of this Appendix, it is assumed that approximately 10-11 female Indiana bats (total) will be found over the course of the 6-year Permit Term.



3. The Indiana bats that were killed could be from anywhere within each respective 2.5-mile buffer, but the concern is that they could be from within the overlap area, and thus potentially from the same maternity colony, shown as the red shaded area below:



4. Multiple fatalities from the same maternity colony may occur. Using EofA estimates, management triggers will be in place to adjust operations and minimize impacts to maternity

colonies. Multiple fatalities from a single maternity colony are only a concern if the estimated take in Evidence of Absence is at a level high enough to negatively impact the maternity colony. Below is an explanation of the EofA estimates.

a. **Observed Carcasses vs Actual Fatalities**: The number of observed bat carcasses found may not represent all actual fatalities (see HCP, Section 7.3, for detailed explanation) for several reasons:

- carcasses may be missed due to searcher efficiency,
- carcasses may be scavenged prior to the search, and
- carcasses may fall outside of the searched area.

To resolve these sources of error, Eof A will be used to provide estimated fatalities based on the actual observations. Using an overall detection probability of 20% (see Section 7.3 of the HCP), the table below provides estimated total fatalities (M*) and fatality rates (λ) by year for up to 5 actual observed carcasses (X):

Cumulative Carcasses Found (X)	Estimated Total Mortality (M*)	Annual Mortality Rate (λ)
0	1	0.17
1	6	1
2	11	1.83
3	16	2.67
4	21	3.5
5	26	4.33

This analysis will be conducted for each of the Covered Species based on actual carcasses found (X) on-site and the actual detection probability (g) achieved each year of post-construction monitoring.

Sustainable Loss Analysis (Population Projections): An analysis was run on the population projections of a single Indiana bat maternity colony (see Appendix B of the HCP for an explanation on how population projections were performed) with varying levels of take (1, 6, 11, 16, 21, and 26 total bats over the permit term, see above table for the associated annual rates). Finding 5 female Indiana bats (X=5) would represent an estimated 37.9% reduction in the maternity colony population size if a declining population model is used, or an estimated 33.7% reduction if a stable population model is used. Therefore, to keep the potential reduction closer to 30% or less, the first adaptive management trigger (see below for trigger responses) for maternity colonies would occur once 4 female Indiana bats are found from within 2.5 miles of the same patch of suitable habitat (X=4). The second trigger (for another potential maternity colony, i.e., within 2.5 miles of a different patch of suitable habitat) would occur once 3 female Indiana bats are found within 2.5 miles of the same patch of suitable habitat (X=3). After that, subsequent adaptive management triggers for maternity colonies would be the finding of 2 female Indiana bats within 2.5 miles of the same patch of suitable habitat (i.e., from the same maternity colony; X=2)). This strategy effectively becomes increasingly conservative over time and is thus increasingly protective of Indiana bat maternity colonies.

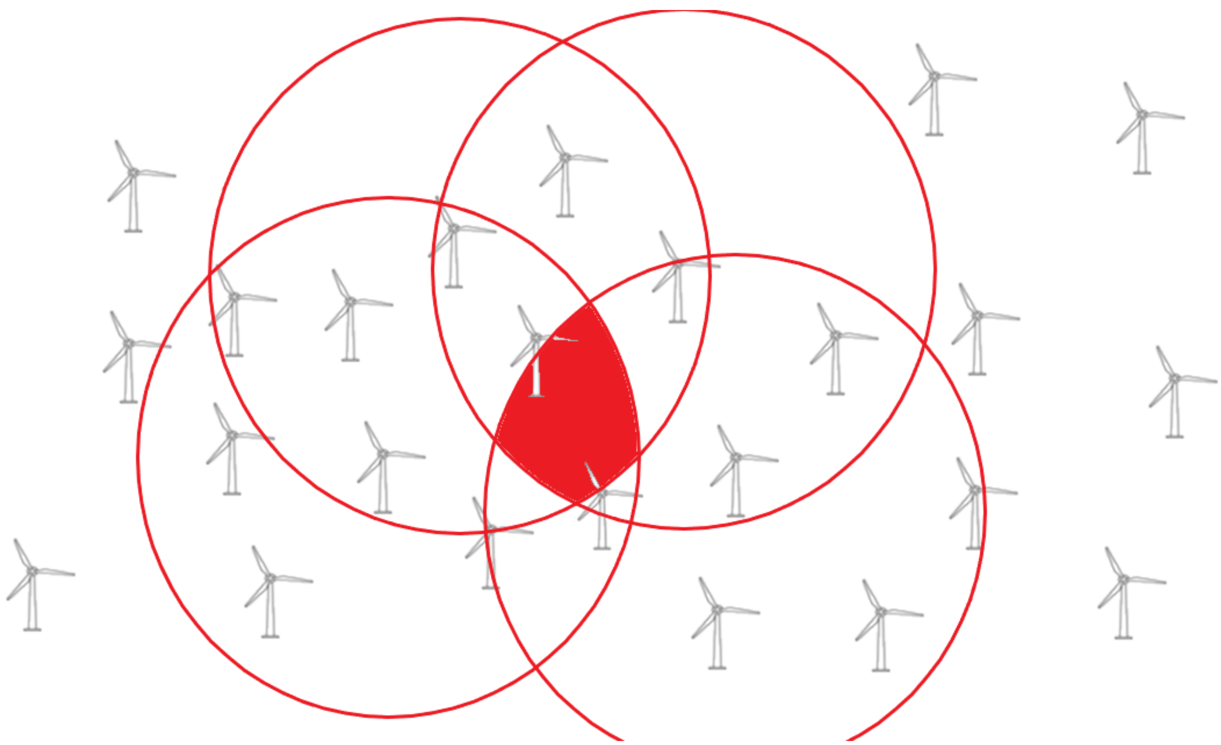
It is important to note that this tiered approach ensures that the 30% reduction would only occur at one maternity colony, and subsequent maternity colonies would be reduced by fewer and fewer bats due to the lowering of the trigger threshold. This approach is also conservative in that all spring migratory fatalities, and the majority of fall migratory fatalities, are also included, despite the fact that some of these fatalities may be from other maternity colonies. In addition, TG High Prairie may choose (at their discretion) to operate certain turbines at higher cut-in speeds prior to reaching an adaptive management trigger, depending on information discovered about bat habitat use and the risk level of individual turbines or areas of the Project.

a. **Setting of Trigger Level**: Finding[2] 4 female Indiana bat carcasses between April 1 and September 30 (over the 6-year permit term) will be the initial adaptive management trigger for the Indiana bat (e.g., an estimated loss in EofA of 21 female Indiana bats). A female Indiana bat was found prior to permit issuance in April 2021, and this carcass will conservatively be included in the adaptive management to account for the impact of this take (i.e., only ~3 additional female Indiana bats [dependent on the calculated probability of detection] can be found near that turbine before meeting the bat-in-hand threshold, and each subsequent fatality near that turbine will be evaluated to determine whether the M* threshold is met. Meeting either threshold would trigger adaptive management).
b. **Adaptive Changes to the Initial Trigger**: The initial trigger is based on an average detection probability (g) of 0.2. In reality, the detection probability will likely vary slightly from year to year, and the take estimate will also vary depending on when carcasses are found and under what conditions (e.g., carcasses found at a plot with a higher searcher efficiency would result in a lower take estimate than a carcass found at a plot with a lower searcher efficiency). Therefore, an analysis in EofA will be run for turbines within 2.5 miles of any overlap area (i.e., anywhere that multiple female Indiana bats have been killed within 5 miles of each other between April 1 and September 30) to determine if the potential overall take within the foraging distance of any maternity colony present in the overlap area could be ≥ 21 female Indiana bats. This analysis will include inputting the number of female carcasses found at those specific turbines, and the weighted-average of the bias correction factors for those turbines (based on the percent of full plots to roads and pads).
c. **Response to the Trigger**: If there is a potential for 21 female Indiana bats to have been taken from a single maternity colony based on output from EofA, then the question still

[2] Or determined to have been killed [e.g., a bat found on October 4th but determined to have been killed a week prior].

remains as to whether there is a maternity colony present, and if so, whether all bats came from that colony. Therefore, TG High Prairie will then proceed with Step #5 below. All turbines within 2.5 miles of the associated suitable habitat will operate at avoidance (6.9 m/s) between April 1 and September 30 while TG High Prairie completes Step #5.

5. To determine maternity colony presence, TG High Prairie will look at suitable habitat, as described in the Indiana Bat Survey Guidelines (USFWS 2020), within the overlap areas. For the purposes of this example, this was done with an area based on four turbines – in reality, the overlap area may be based on three or two turbines for later adaptive management triggers. If no habitat exists in any of the overlapping areas, then it is assumed that the fatalities came from separate colonies (and turbines in question no longer are required to operate at avoidance). If habitat exists within the overlap area, presence/absence surveys will be conducted within the suitable habitat to inform mist-net surveys used to determine location of maternity colonies.



After the presence/absence surveys (either acoustic or mist-netting, following current USFWS guidelines), in areas with presence, mist-netting and radio-telemetry/emergence counts will be conducted to determine the location of any maternity colonies. These colonies would be monitored following the protocols in Section 7.4 of the HCP. Cut-in speeds of 6.9 m/s will continue to be implemented at all turbines within 2.5 miles of this colony. Additional investigations will be conducted at TG High Prairie's discretion to determine if the fatalities likely occurred from the same maternity colony (e.g., radio-telemetry to determine home range, genetic testing of carcasses and captures, etc.), and curtailment may be adjusted based on the results of these investigations and coordination with USFWS. This investigation may occur at other maternity colonies, to determine if fatalities are coming from another source. Once it has been determined where the maternity colony is located, the turbines with a raised cut-in speed (i.e., all turbines within 2.5 miles of suitable habitat) will be refined to include only those turbines within 2.5 miles of the maternity colony (or otherwise deemed at risk based on radio-telemetry results).

This same method for maternity colony adaptive management would be used for little brown bats and northern long-eared bats, but with the following species-specific inputs (Indiana bat included for comparison).

	Indiana bat	Northern long-eared bat	Little brown bat
Colony Size (# females)	60 adults, 15 juveniles, 15 pups	20 adults, 5 juveniles, 5 pups	50 adults, 12 juveniles, 12 pups
Estimated Number of colonies	8	12	4
Expected Annual Take of females from local maternity colonies	7.1	1.1	5.8
Total expected take of females from local maternity colonies over 6-year permit term	42.6	6.6	34.8
Expected total female take (migratory and summer over 6 years)	54	9	48
Expected number of females found (total expected take * 0.2 detection probability)	10.8	1.8	9.6
Buffers for Adaptive Management Analysis	2.5-mile foraging distance	1.5-mile foraging distance	3.9-mile foraging distance
Expected annual take per maternity colony	1	0.1	1.45
Initial Trigger[1] (# females found between April 1 and September 30)	4	1[2]	4

[1]Because the actual detection probability (g) of post-construction monitoring will likely differ from the value predicted in the HCP, the actual triggers will need to be determined on an annual basis based on the post-construction monitoring effort and an analysis in Evidence of Absence.

[2]Because no northern long-eared bat maternity colonies were found during pre-construction surveys, and based on the analysis provided here, finding a single female carcass during the maternity season (May 15 to August 15) will trigger adaptive management for the northern long-eared bat. Spring and fall migratory fatalities are assumed to be from migratory individuals unless a summer fatality has confirmed an on-site maternity colony. All suitable habitat within 1.5 miles of the fatality will be evaluated for suitable habitat, and acoustics and/or mist-netting will be conducted to locate maternity colonies. Protocols will follow Section 7.4 of the HCP.

The northern long-eared bats would not have a tiered approach (i.e., the trigger would remain the same for all maternity colonies), however, the little brown bat would follow the same tiered approach as the Indiana bat. The tiered approach is summarized below:

Tier	Description	Adaptive Management Action	Result
1	4 female Indiana bat carcasses found within 2.5 miles of the same suitable habitat between April 1 and September 30	All turbines within 2.5 miles of the same suitable habitat will adjust cut-in speeds to avoid additional impact to the population for the remainder of the permit term (turbines may be refined if additional studies are conducted)	Any turbines associated with the assumed colony no longer affect that population Other turbines (outside the affected area) continue to operate as usual.
	4 female little brown bat carcasses found within 3.9 miles of the same suitable habitat between April 1 and September 30	All turbines within 3.9 miles of the same suitable habitat will adjust cut-in speeds to avoid additional impact to the population for the remainder of the permit term (turbines may be refined if additional studies are conducted)	Any turbines associated with the assumed colony no longer affect that population Other turbines (outside the affected area) continue to operate as usual.
2	The first threshold has been met for an Indiana bat maternity colony, and elsewhere in the permit area 3 female Indiana bat carcasses are found within 2.5 miles of the same suitable habitat between April 1 and September 30	All turbines within 2.5 miles of the same suitable habitat will adjust cut-in speeds to avoid additional impact to the population for the remainder of the permit term (turbines may be refined if additional studies are conducted)	Any turbines associated with the assumed colony no longer affect that population Other turbines outside of the two assumed populations continue to operate as usual
	The first threshold has been met for a little brown bat maternity colony, and elsewhere in the permit area 3 little brown bat carcasses are found within 3.9 miles of the same suitable habitat between April 1 and September 30	All turbines within 3.9 miles of the same suitable habitat will adjust cut-in speeds to avoid additional impact to the population for the remainder of the permit term (turbines may be refined if additional studies are conducted)	Any turbines associated with the assumed colony no longer affect that population Other turbines outside of the two assumed populations continue to operate as usual
3	The first two thresholds have been met for two Indiana bat maternity colonies, and 2 female Indiana bat carcasses are found within 2.5 miles of the same suitable habitat	All turbines within 2.5 miles of the same suitable habitat will adjust cut-in speeds to avoid additional impact to the population for the remainder of the permit term (turbines may be refined if additional studies are conducted)	Any turbines associated with the assumed colony no longer affect that population Other turbines outside of the three assumed populations continue to operate as usual

Tier	Description	Adaptive Management Action	Result
	between April 1 and September 30		
	The first two thresholds have been met for two little brown bat maternity colonies, and 1 female little brown bat carcass is found between April 1 and September 30	All turbines within 3.9 miles of the fatality will adjust cut-in speeds to avoid additional impact to the population for the remainder of the permit term (turbines may be refined if additional studies are conducted)	Any turbines associated with the assumed colony no longer affect that population Other turbines outside of the three assumed populations continue to operate as usual

In summary, adaptive management will be triggered if one or more of the following occurs:

- $M^* \geq 21$ Indiana bats for a single maternity colony (X=4),
    - After this trigger has been met, the next colony will trigger at $M^* \geq 16$ (X=3),
        - After this trigger has been met, subsequent colonies will trigger at $M^* \geq 11$ (X=2);
- $M^* \geq 6$ northern long-eared bats for a single maternity colony (X=1); and,
- $M^* \geq 21$ little brown bats for a single maternity colony (X=4),
    - After this trigger has been met, the next colony will trigger at $M^* \geq 16$ (X=3),
        - After this trigger has been met, subsequent colonies will trigger at $M^* \geq 6$ (X=1).

Appendix C. Summary of Changes Made Between Draft HCP and Final HCP

- Cover page:
  - Updated title to include facility name (High Prairie Renewable Energy Center)
  - Updated date
  - Updated Applicant to Ameren
- Throughout the text, the following changes were made:
  - Changed project name to "High Prairie Renewable Energy Center"
  - Changed applicant from TG High Prairie LLC to Ameren Missouri
  - Changed tense throughout to reflect that construction has occurred
  - Added clarification on Ameren vs TG High Prairie where needed
  - Added commitments to coordinate with MDC
  - Grammatical edits as needed
  - Figures updated with final boundary (no changes from boundary used in draft, just name change) and updated Applicant and Project Name in figure titles
  - Time frame for minimization revised from 30 minutes to 45 minutes before sunset and after sunrise
  - Temperature threshold for minimization lowered from 50°F to 40°F
- Section 1.3.2 – clarified that the criteria listed are paraphrased
- Section 2.0 – updated to final layout
- Section 2.4 – added clarification on Plan Area, including updating the mitigation acres (increase to 217) and providing details on land control
- Section 2.9 – added text about the draft HCP comment period
- Section 2.10 – added text related to coordination that has occurred between the draft and final HCPs, and committed to ongoing coordination with both USFWS and MDC
- Section 4.2.8.1 – clarified that colony size was an assumption, not a recommendation from USFWS
- Section 6.3.2 – updated mitigation requirement to reflect use of Chariton Hills Conservation Bank (149 acres required), and footnote explaining how the REA model was applied
- Section 6.3.3 - updated mitigation requirement to reflect use of Chariton Hills Conservation Bank (24 acres required), and footnote explaining how the REA model was applied
- Section 6.3.4 - updated mitigation requirement to reflect use of Chariton Hills Conservation Bank (108 acres required, slight rounding edits to credits based on REA model output), and footnote explaining how the REA model was applied
- Section 7.2.1.4 – added language allowing for a reversion of the timeframe (45 minutes prior to sunset and 45 minutes after sunrise) and 40°F temperature threshold based on site-specific acoustic data to be collected, in consultation with USFWS and MDC, and written approval of USFWS.
- Section 7.2.2 - updated mitigation acres to reflect changes that were made in Section 6.3 and use of the Chariton Hills Conservation Bank; updated mitigation commitment from 165 to 217 acres
- Section 7.3.3 – footnote added to the temporal coverage citing why April 1 through October 31 is considered to be 100% of the risk period for the Covered Species

- Section 7.3.3 – clarified that detection probability (g) is a minimum goal and based on the point estimate of g, added text allowing for dogs to be used to increase searcher efficiency if needed
- Section 7.4 – added commitment to coordinate with USFWS and MDC on study design, and added language allowing for data to be compared to other comparable studies (rather than limiting it to the two MDC studies previously mentioned)
- Section 7.5 – added clarifying language about the types of adaptive management
- Section 7.5.1 – added clarifying language about the time span of adaptive management for maternity colonies
- Section 7.5.2 – multiple edits, including:
    - Added "bat in hand" triggers and text explaining how those triggers were calculated and would work
    - Clarified that any adaptive management change other than site-wide curtailment (e.g., spatial or temporal refinements) would be determined in consultation with USFWS and MDC and would need to be approved in writing by USFWS
    - Added footnote for triggers for the Indiana bat to account for April 2021 take and associated monitoring
    - Added text explaining that Applicant can choose to take adaptive management actions (e.g., increase cut-in speeds) prior to triggering adaptive management
- Section 8.0 – updated mitigation to clarify that it has already been reserved, and updated acreage to 217 (from 165)
- Section 8.0 – deleted debt financing language and replaced with Ameren financial language, added details on Surety and updated costs throughout this section based on contracts in place
- Section 8.2.2.3 – added text clarifying that changed technologies would only be implemented if funding could be assured at that time
- Section 8.3.1 – deleted permit renewal/extension language and clarified that this ITP, if issued, cannot be renewed or extended
- Section 9.0 – added Ameren staff names to the list of preparers
- Appendix B
    - Text edits were made throughout this Appendix to clarify the adaptive management for maternity colonies.
    - A female Indiana bat was found prior to permit issuance in April 2021; this female has conservatively been added to the adaptive management approach (i.e., turbines within 2.5 miles of the fatality would trigger adaptive management after 3 additional females were found, or if calculated take within 2.5 miles reaches 21 individuals)
    - The adaptive management for little brown bats was edited to a tiered approach.