# Draft Environmental Assessment for

# Proposed Habitat Conservation Plan and Incidental Take Permit

## Pioneer Trail Wind Farm

## Ford County and Iroquois County, Illinois

**July 2014**

**U.S. Fish and Wildlife Service**
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## List of Acronyms and Abbreviations

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|---|---|
| Applicant | E.ON Climate & Renewables |
| BBA | Breeding Bird Atlas |
| BBCS | Bird and Bat Conservation Strategy |
| BGEPA | Bald and Golden Eagle Protection Act |
| BO | Biological Opinion |
| CEQ | Council on Environmental Quality |
| CFR | Code of Federal Regulations |
| Covered Lands | Habitat Conservation Plan Area |
| E.ON | E.ON Climate & Renewables |
| EA | Environmental Assessment |
| EIS | Environmental Impact Statement |
| EMF | electromagnetic fields |
| ESA | Endangered Species Act |
| FONSI | Finding of No Significant Impact |
| Fowler Ridge Wind Farm | Fowler Ridge |
| FR | Federal Register |
| GIS | Geographic Information Systems |
| HCP | Habitat Conservation Plan |
| HMANA | Hawk Migration Association of North America |
| IA | Implementing Agreement |
| IBA | Important Bird Area |
| ICNIRP | International Commission on Non-ionizing Radiation Protection |
| IDNR | Illinois Department of Natural Resources |
| IEPA | Illinois Environmental Protection Agency |
| IESPB | Illinois Endangered Species Protection Board |
| INHD | Illinois Natural Heritage Database |
| IPCC | Intergovernmental Panel on Climate Change |
| ITP | incidental take permit |
| LWEG | Land-based Wind Energy Guidelines |
| m/s | meters per second |
| MBTA | Migratory Bird Treaty Act |

| | |
|---|---|
| mph | miles per hour |
| MSHCP | Midwest Wind Energy Multi-species Habitat Conservation Plan |
| MW | Megawatt |
| MWh | megawatt hours |
| NAAQS | National Ambient Air Quality Standard |
| NEPA | National Environmental Policy Act |
| NMFS | National Marine Fisheries Service |
| NWI | National Wetlands Inventory |
| OCRU | Ozark-Central Recovery Unit |
| PCB | polychlorinated biphenyls |
| PIF | Partners in Flight |
| Plan Area | Habitat Conservation Plan Area |
| $PM_{2.5}$ | fine particulate matter |
| Project | Pioneer Trail Wind Farm |
| PTWF | Pioneer Trail Wind Farm |
| RA | Risk Assessment |
| REA Model | Resource Equivalency Analysis Model |
| Recovery Plan | Indiana Bat Draft Recovery Plan: First Revision |
| RPM | revolutions per minute |
| SBC | Spring Bird Count |
| Service | U.S. Fish and Wildlife Service |
| SHA | State Habitat Area |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| WNS | white-nose syndrome |

# 1 PURPOSE AND NEED

## 1.1 INTRODUCTION

The U.S. Fish and Wildlife (the Service) received an application for an Incidental Take Permit (ITP), pursuant to the provisions of section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (ESA;16 United States Code [USC] §§ 1531–1544.) for the Pioneer Trail Wind Farm (PTWF or Project). If issued, the ITP would authorize the incidental take of Indiana bats (*Myotis sodalis*), a federally endangered species, during operation of the PTWF in Iroquois and Ford counties, Illinois (Figure 1.1). 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 as long as the take is incidental to, and not the purpose of, otherwise lawful activities. The ITP would also authorize the incidental take of northern long-eared bats (Myotis septentrionalis), a federally proposed species, during operation of the Project upon the time northern long-eared bats are listed.

PTWF's ITP application includes their Habitat Conservation Plan (Project HCP or proposed HCP) that specifies, among other things, the impacts that are likely to result from taking Indiana bats and the measures PTWF will undertake to minimize and mitigate such impacts. In addition to the Indiana bat, the Project HCP covers one unlisted species, northern long-eared bat (*Myotis septentrionalis*), which the Service has proposed for listing under the ESA.

The PTWF is owned and operated by Pioneer Trail Wind Farm, LLC, a wholly owned subsidiary of E.ON Climate & Renewables, North America (hereinafter referred to as E.ON or Applicant). The Applicant is applying for an ITP to provide the PTWF with long-term assurances that no unauthorized take of the Indiana bat will occur that could give rise to liability for PTWF or individuals associated with the covered activities described in the proposed HCP. The following Environmental Assessment (EA) was prepared in accordance with the National Environmental Policy Act of 1969 to evaluate the effects of implementing the Applicant's proposed HCP.

### 1.1.1 THE PIONEER TRAIL WIND FARM

The PTWF is a wind energy facility located east of the towns of Paxton and Loda in Illinois (Figure 1.1). The Project's nameplate capacity is 150-megawatts (MW) and comprises 94 1.6-MW wind turbine generators, an operations and maintenance building, access roads, collector line system, and substation. Approximately 3 miles of overhead transmission line extends from the existing Paxton West substation to a newly constructed substation on the Project site. A pad-mounted transformer is installed at the base of each wind turbine to collect electricity generated by each turbine through cables routed down the inside of the tower.

The PTWF has a power collection system between the pad mounted transformers and a collector substation. The power collection system is installed underground and consists of cables ranging from 2 inches to 5 inches in outside diameter. In addition to the turbines and power collection system, the PTWF includes unpaved access roads leading to the turbines. The temporary paths (approximately 50 feet wide), those used to move the crane between turbine locations during construction, have been restored to agricultural use.

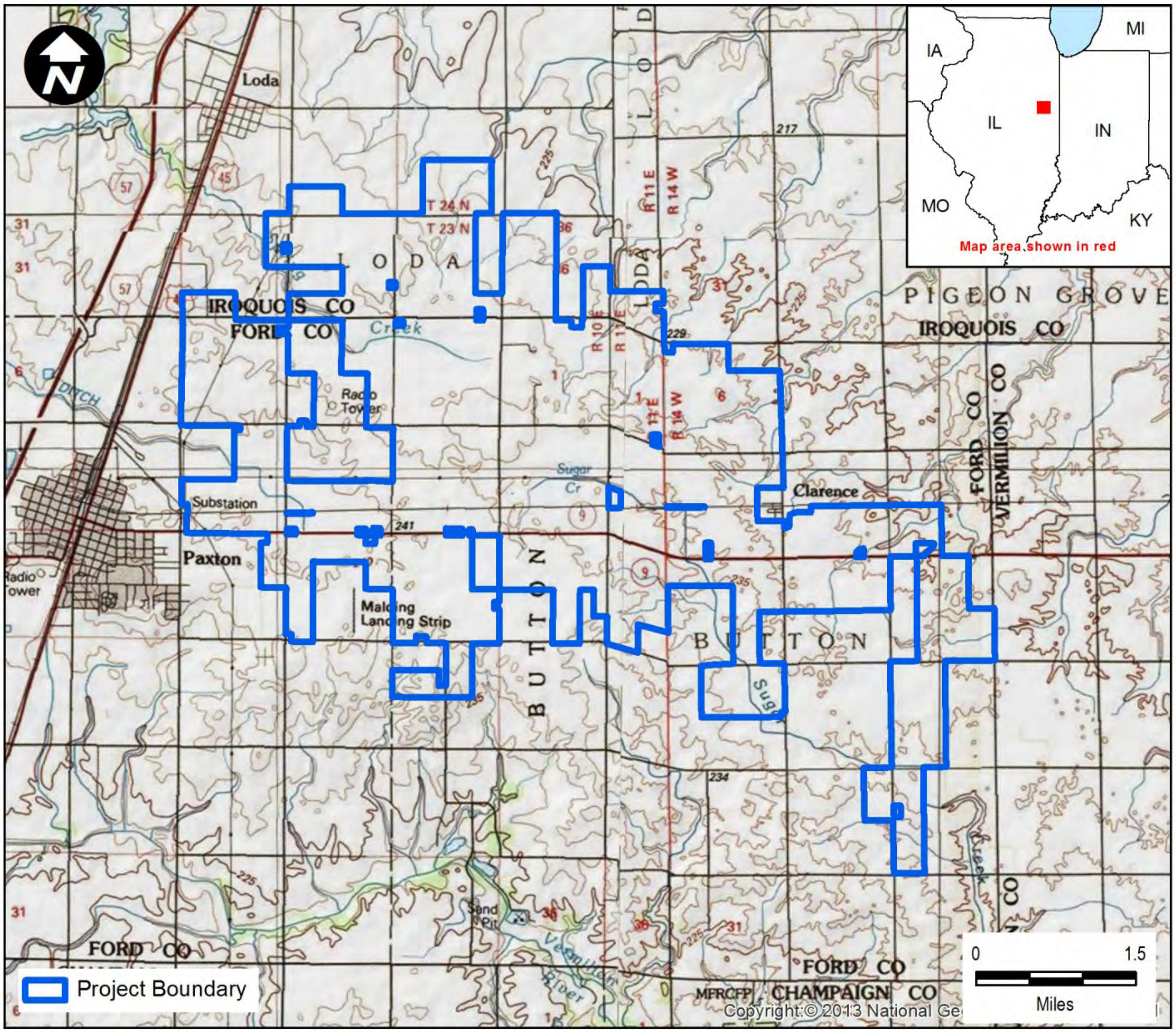


**Figure 1.1.** Project area, Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois.

It is the Applicant's intent to have a wind energy facility while complying with the ESA. The Applicant has prepared an HCP to support their application for an ITP for Indiana bats while operating, maintaining, and decommissioning the PTWF. In the HCP, the Applicant has expressed a goal to maximize energy production using wind power to create renewable energy objectives and stimulate economic opportunities in the local area, while at the same time minimizing impacts to wildlife. The HCP also states implementing renewable energy will produce fewer emissions of greenhouse gases and other air pollutants than traditional sources of energy production, and will help in meeting state energy policies and goals, such as Illinois's Renewable Portfolio Standard.

## 1.2 REGULATORY AND POLICY BACKGROUND

### 1.2.1 NATIONAL ENVIRONMENTAL POLICY ACT

The environmental review process under the National Environmental Policy Act (NEPA) provides the acting agency with the framework for reviewing the federal action, alternatives, environmental effects, and possible mitigation of potentially harmful effects of the action. NEPA is an environmental law fashioned to ensure careful decision-making with respect to the environment. NEPA also established the Council on Environmental Quality (CEQ) in the Executive Office of the President to formulate and recommend national policies to ensure that the programs of the Federal government exercise careful decision-making with respect to the environment. The CEQ has set forth regulations (40 CFR. §§1500-1508) to assist federal agencies in implementing NEPA and to ensure that the environmental impacts of any proposed decisions are fully considered, and that appropriate steps are taken to mitigate potential environmental impacts. The NEPA review also provides an opportunity for the public to be involved in the acting agency's decision-making process. The public will have an opportunity to comment on the drafts EA and Project HCP. The culmination of the EA process is either a Finding of No Significant Impact (FONSI) or a decision to prepare an Environmental Impact Statement (EIS). This EA and its analyses assist the Service with making an informed decision on issuance of an ITP. This EA is the mechanism of the Service's procedure for recording the results of a comprehensive planning and decision-making process surrounding E.ON's application for an ITP.

The purpose of an EA is to determine the significance of environmental impacts associated with a proposed federal action and to look at alternative means to achieve the agency's objectives. EAs are intended to be concise documents that:

1) briefly analyze the impacts of a proposed action to determine the significance of the impacts and to determine whether an EIS is needed,
2) aid an agency's compliance with NEPA when no EIS is necessary, and
3) facilitate preparation of an EIS when one is necessary (40 CFR §1508.9).

An EA should include brief discussions of:

1) the need for the proposal,
2) alternative courses of action for any proposal which involves unresolved conflicts concerning alternative uses of available resources,
3) the environmental impacts of the proposed action and alternatives , and
4) a listing of agencies and persons consulted (40 CFR §1508.9(b)).

When determining whether an EIS should be prepared, the CEQ lists two distinct factors that should be considered when determining whether the environmental impacts will be significant: context and intensity. "Context" means that the significance of an action must be analyzed in several settings, such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the impacts in the locale rather than in the world as a whole. Both short- and long-term effects are relevant (40 CFR §1508.27(a)). "Intensity" refers to the severity of impact, and a number of sub-factors are generally considered in evaluating intensity. These include:

(a) Impacts that may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial;
(b) The degree to which the proposed action affects public health or safety;
(c) Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas;
(d) The degree to which the effects on the quality of the human environment are likely to be highly controversial;
(e) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks;
(f) The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration;
(g) Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts;
(h) The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources;
(i) The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973; and
(j) Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment. (40 CFR §1508.27(b)).

In addition to considering the above factors when determining whether an EIS is necessary, an agency should also determine under its own procedures whether the proposal requires an EIS. Additional criteria that the Service follows in determining whether to prepare an EIS include:

(a) controversy over environmental effects (e.g., major scientific or technical disputes or inconsistencies over one or more environmental effects);
(b) change in Service policy having a major positive or negative environmental effect;
(c) precedent-setting actions with wide-reaching or long-term implications (e.g., special use permits for off-road vehicles, mineral extraction, new road construction);
(d) major alterations of natural environmental quality, that may exceed either local, state or Federal environmental standards;
(e) exposing existing or future generations to increased safety or health hazards;
(f) conflicts with substantially proposed or adopted local, regional, state, interstate or Federal land use plans or policies, that may result in adverse environmental effects;
(g) adverse effects on designated or proposed natural or recreation areas, such as wilderness areas, parks, research natural areas, wild and scenic rivers, estuarine, sanctuaries, national

recreation areas, habitat conservation plan areas, threatened and endangered species, fish hatcheries, wildlife refuges, lands acquired or managed with Dingell-Johnson/Pittman-Robertson funds, unique or major wetland areas, and lands within a 100-year floodplain; and

(h) removal from production of prime and unique agricultural lands, as designated by local, regional, State or Federal authorities; in accordance with the Department's Environmental Statement Memorandum No. ESM 94-7 (USFWS Manual, 550 FW 3 (USFWS 1996)).

Ultimately, the decision whether to prepare an EIS is a matter of professional judgment requiring consideration of the issues in question and the matters documented in the EA. The determination must be reasonable in light of the circumstances involved in the particular project being evaluated, and in light of any past, present or foreseeable future actions.

On January 14, 2011, the CEQ issued a Memorandum for Heads of Federal Departments and Agencies ("Memorandum"). The Memorandum stresses the importance of mitigation under NEPA, and explicitly approves of the use of a "mitigated FONSI" when the NEPA process results in enforceable mitigation measures (Memorandum p. 7, n.18). The Memorandum builds on previous guidance from CEQ that states when an agency develops and makes a commitment to implement mitigation measures to avoid, minimize, rectify, reduce, or compensate for significant environmental impacts (40 CFR §1508.20), then NEPA compliance can be accomplished with an Environmental Assessment (EA) coupled with a FONSI Using mitigation to reduce potentially significant impacts to support a FONSI enables an agency to conclude the NEPA process, satisfy NEPA requirements, and proceed to implementation without preparing an EIS. In such cases, the basis for not preparing the EIS is the commitment to perform those mitigation measures identified as necessary to reduce the environmental impacts of the proposed action to a point or level where they are determined to no longer be significant. That commitment should be presented in the FONSI and any other decision document. CEQ recognizes the appropriateness, value, and efficacy of providing for mitigation to reduce the significance of environmental impacts; consequently, when that mitigation is available and the commitment to perform it is made, there is an adequate basis for a mitigated FONSI.

Based on review of the above referenced factors and CEQ guidance, the Service has concluded that an EA is the appropriate instrument for this project. The Service made this determination based on the following:

1) the wind farm is comparatively small, involving 94 turbines total;
2) the wind farm is not located near any known winter habitat or hibernacula;
3) operation of the wind farm would not impact any suitable bat habitat;
4) all turbines are sited at least 1,000 feet from suitable habitat;
5) the Applicant would implement a robust multi-year monitoring and adaptive management program;
6) the Applicant would share all data and information gathered with the Service and make the information public;
7) the Applicant would fully mitigate for impacts to covered species;
8) the wind farm site is low risk for resident and migratory birds because of its size, distance from sensitive avian resource areas, lack of open water, and predominantly agriculture setting;

9) the mitigation measures undertaken by the Applicant would offset the impact of taking covered species;
10) potential impacts to non-covered species (i.e., birds and bats) would be insignificant;
11) the project would facilitate a positive impact on the quality of the human environment by virtue of reducing the emission of greenhouse gases for the provision of domestic energy;
12) the geographic area is not proximate to historic or cultural resources, park lands, wetlands, wild and scenic rivers or ecologically critical areas;
13) the action would not contribute to cumulatively significant impacts, as local effects will be either avoided and/or minimized and fully mitigated;
14) the action does not adversely affect any object listed or eligible for listing in the National Register of Historic Places or cause loss or destruction of any significant, cultural or historical resources;
15) the project would not impact critical habitat, and effects on endangered species would be fully mitigated.
16) the action does not threaten a violation of Federal, State, or local law or requirements imposed for the protection of the environment;
17) the issuance of an Incidental Take Permit is consistent with Service policy to promote the uses of renewable energy while assiduously implementing its responsibilities under the Endangered Species Act, the Migratory Bird Treaty Act and NEPA; and
18) the action does not expose future generations to increased safety or health hazard, does not conflict with local, regional, state or federal land use plans or policies, and does not impose adverse effects on designated or proposed natural or recreation areas.

### 1.2.2 ENDANGERED SPECIES ACT

The Service is responsible for implementing and enforcing federal wildlife laws, including the ESA. Federally listed threatened and endangered species and designated critical habitat are governed by the ESA and its implementing regulations at 50 Code of Federal Regulations (CFR) parts 13 and 17. The Service is authorized to identify species in danger of extinction and provide for their management and protection. The Service also maintains a list of species that are candidates for listing pursuant to the ESA.

Section 9 of the ESA prohibits certain activities that directly or indirectly affect endangered species. For the purpose of the EA and the proposed ITP, the most relevant activity is the prohibition of take of wildlife species listed under the ESA. The ESA defines the term take to include harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or to attempt any of these acts (16 USC §1532(19)). Take of listed wildlife is illegal unless otherwise authorized by the Service (or National Marine Fisheries Service [NMFS] in marine systems) pursuant to section 10 of the ESA.

#### 1.2.2.1 Endangered Species Act Section 10(a)(1)(B)

The ESA was amended in 1982 to allow the Service and NMFS to authorize the taking of listed species incidentally to an otherwise lawful activity by non-Federal entities, such as states, counties, local governments, and private landowners. To receive a permit, the applicant submits a conservation plan (also referred to as an HCP) that meets the criteria included in the ESA and its implementing regulations (50 CFR parts 17 and 222), as follows:

1) The taking will be incidental to otherwise lawful activities;
2) The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such takings;
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 species in the wild;
5) The applicant has met the measures, if any, required by the Service as being necessary or appropriate, for the purposes of the plan; and
6) The Service has received such other assurances as may be required that the plan will be implemented.

#### 1.2.2.2 HCP Handbook

The Service and NMFS later developed a comprehensive guidance on the incidental take permit program, HCP Handbook (USFWS and NMFS 1996). The HCP Handbook incorporates more than a decade of improvements and innovations in updated policies and procedures in the HCP program, and provides ways to reduce the regulatory burden on private landowners while addressing the habitat needs of listed species.

#### 1.2.2.3 "No Surprises" Policy and Regulation

Eventually, the Service and NMFS decided the HCP program needed a clearer policy associated with the permit regulations in 50 CFR §§17.22, 17.32, and 222.307 regarding the assurances provided to landowners. This prompted the ''No Surprises'' policy, which evolved after more than 10 years of working with private landowners during the development and implementation of HCPs. The Service and NMFS later codified the ''No Surprises'' policy into a final rule, 50 CFR §§17.22(b)(5), 17.32(b)(5) and 222.307(g), on February 23, 1998 (USFWS and NMFS 1998; 63 Federal Register [FR] 8859-8873). The "No Surprises" policy ensures that non-federal property owners are provided economic and regulatory certainty regarding the overall cost of species conservation and mitigation, provided that the affected species are adequately covered, and the permittee is properly implementing the HCP and complying with the terms and conditions of the HCP, permit, and Implementing Agreement (IA, if used).

**Treatment of Unlisted Species**

When amending the ESA in 1982, Congress clearly intended for the section 10 process to provide for the conservation of listed and unlisted species and protect section 10 permittees from the uncertainties of future species listings. Although the take provisions of section 10 only apply to listed species, HCPs may address both listed and unlisted species. If an unlisted species is adequately addressed in the HCP and the species is listed subsequent to the permit issuance, the permittee would not be required to provide additional conservation measures or mitigation requirements (USFWS and NMFS 1998).

#### 1.2.2.4 Five-Point Policy

In June 2000, the Service and NMFS published a final addendum to the HCP Handbook, the Five-Point Policy (USFWS and NMFS 2000; 65 FR 35242-35257). This policy provides clarifying guidance to the

Service and NMFS in conducting the HCP program and to permit Applicants. The final addendum supplements the HCP Handbook and “No Surprises” final rule, and is to be applied within the context of the existing ESA statute and regulations. In addition to the permit issuance criteria (listed above), an HCP should address the following five points:

1. Biological Goals and Objectives
    a. Goals: A statement of the expected biological outcome for the covered species and habitats.
        i. What does the Plan hope to achieve?
    b. Objectives: the specific, measurable actions to be implemented to achieve the goals
        i. What will the Applicant do to achieve the goals?
2. Adaptive Management
    a. A method for examining alternative strategies for meeting measurable biological goals and objectives, and then, if necessary, adjusting future conservation management actions according to what is learned.
3. Monitoring
    a. Assess compliance and project impacts, and verify progress toward the biological goals and objectives
    b. Provide the scientific data necessary to evaluate the success of the HCP’s operating conservation programs with respect to possible use of those strategies in future HCPs or other programs for those covered species
4. Permit Duration
    a. Duration of the applicant’s proposed activities
    b. Duration of expected positive and negative effects on covered species
5. Public Participation
    a. Public comment
        i. 30 days for low-effect HCP, individual permits under a Programmatic HCP, and major amendments to existing HCPs
        ii. 60 days (minimum)
        iii. 90 days for large-scale or regional projects

#### 1.2.2.5 Endangered Species Act Section 7

Under section 7 of the ESA, issuance of an ITP is a federal action subject to section 7 compliance. This means the Service must conduct an internal formal section 7 consultation on permit issuance. For the purposes of the PTWF ITP, the section 7 consultation will be between the Assistant Regional Director for Ecological Services and the Field Office that assisted the Applicant in developing the HCP.

The Service’s internal consultation on the section 10 action ensures that ITP issuance meets ESA standards under section 7. Section 10 issuance criteria includes the regulatory definition of jeopardy under section 7, and the section 7 consultation represents the last internal "check" that the fundamental standard of avoiding jeopardy has been satisfied. Formal consultation terminates with preparation of a biological opinion (BO), which provides the Services' determination as to whether the proposed action is likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat.

The section 7 consultation is also when the Service may develop reasonable and prudent measures and terms and conditions to minimize anticipated incidental take, or, if necessary, reasonable and prudent alternatives to eliminate the risk of jeopardy. Reasonable and prudent measures are required actions the Regional Director believes necessary or appropriate to minimize the impacts of incidental take. Reasonable and prudent measures, terms, and condition are included in the BO.

The BO for a section 10(a)(1)(B) permit application must contain, at a minimum:

1) A summary of the information on which the opinion is based.
2) A detailed discussion of the effects of the HCP and ITP on listed species or critical habitat.
3) The Service's opinion on whether the action is likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat. This constitutes the Service's "jeopardy" or "no jeopardy" determination with respect to the permit application.

## 1.3 ACTION AGENCY PURPOSE AND NEED

The purpose of issuing an ITP to E.ON is to authorize take of listed species that is incidental to, but not the purpose of, their otherwise lawful activities. The ITP would also require implementation of their HCP. The decision whether to issue an ITP to E.ON is based upon the statutory and regulatory criteria of the ESA, which are detailed in Section 1.2.2.1 of this EA.

The need for federal action is E.ON's ITP application to which the Service must respond. Take of the Indiana bat is reasonably anticipated during Project operations. An ITP is required to legally take listed species incidental to otherwise lawful activities. Consistent with the requirements of the ESA, the Applicant commits to a range of conservation measures proposed to minimize and mitigate the effects of taking Indiana bats. Thus, the HCP, if approved, is designed to avoid and minimize take of the species in the course of carrying out the proposed covered activities as well as to mitigate the impact of such take, and the ITP, if issued, is to authorize the limited, unavoidable take that may occur. The Service's goal within the context of the ESA is to protect Indiana bats and the ecosystems upon which they depend in the Project area and region for the continuing benefit of the people of the United States.

In addition to the Indiana bat, the Project HCP covers one unlisted species, northern long-eared bat, which the Service has proposed for listing under the ESA. Like Indiana bats, Project activities are likely to result in take of northern long-eared bats. Addressing northern long-eared bats in the HCP will provide take authorization for the species in the event it becomes listed after the permit is issued without the need for PTWF to apply for a permit amendment.

The Service will analyze the impacts of the proposed covered activities on all elements of the natural and human environment that could be affected, including other wildlife species that occur within the covered lands. Consistent with Service guidance, it will also consider among other things, the effectiveness of the adaptive management strategy in reducing impacts to migratory birds and other bat species.

### 1.3.1 DECISIONS TO BE MADE

The proposed action being evaluated by this EA is the request from E.ON to the Service for an ITP authorizing take of the federally listed Indiana bat at the PTWF, including implementation of E.ON's associated HCP. E.ON has also requested the ITP include northern long-eared bats upon the date of a future listing. The Service must decide whether to issue or deny the permit. If the permit issuance criteria contained in section 10(a)(1)(B) of the ESA (listed above) are satisfied, the Service is required to issue the permit to the Applicant. The Service may decide to issue a permit conditioned upon implementation of the HCP as submitted by the applicant, or to issue a permit conditioned upon implementation of the HCP as submitted together with other measures specified by the Service. If the ESA's criteria are not satisfied, the Service is required to deny the permit request. Thus the Service has limited discretion and authority within which to determine the range of alternatives.

The Service will analyze the impacts of the proposed covered activities on all elements of the natural and human environment that could be affected, including other wildlife species that occur within the covered lands. The Service will indicate the selected alternative in the final EA. The Service will provide a summary of their rationale for issuing or denying the permit in the BO, which is their findings document on the section 7 consultation.

# 2 ALTERNATIVES

Pursuant to NEPA, federal agencies must consider a range of reasonable alternatives to the proposed action when evaluating the environmental effects of their actions (40 CFR 1505.1(e)). This chapter describes the Applicant's proposed action and alternatives to the proposed action.

**Alternative 1: No-Action Alternative.** Under this alternative, all turbines at the PTWF would continue to operate "status quo" under the current operational plan, that is, 6.9 meters per second (m/s) (15.4 miles per hour [mph]) curtailment from 30 minutes before sunset to 30 minutes after sunrise when the ambient temperature is above 10°C (50°F) from August 15 through October 15. Operating the project under this scenario would avoid take of Indiana bats. The HCP would not be implemented, and the ITP would not be issued. The Project would implement the current Bird and Bat Conservation Strategy (BBCS, provided in Appendix A).

**Alternative 2: Preferred Alternative (ITP Issuance, HCP with 5.0 m/s Cut-in Speed Minimization and Mitigation Measures).** The PTWF would implement a less restrictive operational plan, and all turbines would operate at 5.0 m/s (11.2 mph) curtailment from sunset to sunrise when the ambient temperature is above 10°C (50°F) for the period from August 15 through October 15. Together with this measure for minimizing bat fatalities, PTWF would also implement mitigation measures to preserve and restore bat habitat. The Service would issue an ITP for a 43-year term, and PTWF would implement an HCP and the current BBCS.

**Alternative 3: Non-Restricted Operations (ITP Issuance, HCP with 3.5 m/s Cut-in Speed and Mitigation Measures Only).** Under this alternative, all turbines at the PTWF would operate at a 3.5 m/s (7.8 mph) cut-in speed to maximize energy production. The Project would implement the current BBCS and the Applicant's proposed HCP. However, the HCP would not include measures for minimizing Indiana bat and northern long-eared bat fatalities, only mitigation.

## 2.1 DEVELOPMENT OF ALTERNATIVES

The scope of reasonable alternatives is defined by the purpose and need for the action and guided by the goals and objectives of the acting agency. Reasonable alternatives include those that are practical or feasible from both a technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the Applicant. The alternatives were developed to address the potential for take of Indiana bats and northern long-eared bats during Project operation, and as such, are primarily operational alternatives relating to the dates and times of operation and changes in cut-in speed (i.e., the wind speed at which turbines begin generating power and sending it to the grid). The alternatives do not address other aspects of the PTWF, such as turbine siting and construction because:

1) The Project is already constructed and operating;
2) No suitable Indiana bat or northern long-eared bat summer habitat is found within the PTWF Project area;
3) We assume Indiana bats and northern long-eared bats would be at risk to Project operations during late-summer and fall migration; and
4) At present, the only proven mechanism to reduce mortality of migrating bats is operational adjustment of wind turbines.

The PTWF is a 94-turbine wind energy facility that has the potential to harm or kill Indiana bats and northern long-eared bats under certain operational cut-in speeds, thus the necessity for an ITP. We considered reasonable project alternatives in response to the Applicant's request for take of Indiana bats. We evaluated alternatives for their ability to meet the Service's purpose and need for the federal action. The federal action is to respond to PTWF's application (the Project HCP) and request for an ITP. Additionally, this chapter describes alternatives that were considered but eliminated from detailed analyses (pursuant to 40 CFR 1502.14(a)).

We retained three alternatives for detailed analyses, which are a No-Action Alternative, the Preferred Alternative, and a 3.5 m/s Alternative (non-restricted operations). In this chapter, we explain our evaluation of these alternatives to ensure they met stated goals and objectives of the Service's action and project intent (described in Section 1.3). We analyzed the potential effects on the human environment of each of the retained alternatives in detail in Chapter 5: Environmental Consequences.

## 2.2 ALTERNATIVES RETAINED FOR DETAILED ANALYSIS

The alternatives vary by the operational modifications and mitigation measures for Indiana bats and northern long-eared bats. Operational modifications would be implemented through the turbine cut-in speed during the period from August 15 through October 15. Cut-in speed is expected to affect the extent of bat mortality and amount of electrical power generated. Mitigation measures for Indiana bat and northern long-eared bat would be implemented under Alternatives 2 and 3.

### 2.2.1 ELEMENTS COMMON TO ALL ALTERNATIVES

For all three alternatives, common elements include the Plan Area, wind project, and the application of the BBCS's post-construction monitoring and adaptive management plans.

#### 2.2.1.1 Plan Area and Wind Project

The Habitat Conservation Plan Area (Plan Area or Covered Lands) for this Project is the outermost boundary of the approximately 12,500 acres of participating landowner property (Figure 1.1). It includes all areas that would be affected directly and indirectly by activities associated with operation of the PTWF. For all three alternatives, the wind project itself would be the same, consisting of 94 1.6-MW-turbines with a nameplate capacity of up to 150 MW.

#### 2.2.1.2 BBCS

**<u>Post-Construction Monitoring</u>**

Detailed descriptions of the post-construction monitoring are provided in Section 5.1 of the BBCS (Appendix A) and Section 7.3 of the Project HCP. Table 11 in the Project HCP provides a summary of the proposed monitoring program for the PTWF. PTWF will provide a report to the Service after each year of monitoring.

Monitoring will focus on bat fatalities detected in the Project area. PTWF will calculate adjusted bat fatality rates to determine if the operational protocols are effective in reducing all bat fatalities. Fatality rates will also be used to make comparisons with fatality rates at other wind projects in the region. Monitoring will include addressing the following field-sampling biases:

1) Fatalities that occur on a highly periodic basis;
2) Scavenger removal of carcasses;
3) Searcher efficiency; and
4) Site conditions that can affect carcass detection.

During the first 2 years of implementing an operational protocol, PTWF will implement intensive post-construction monitoring, then PTWF will implement follow-up monitoring every 5 years for the life of the Project. Standardized carcass searches will be conducted in spring (April 1 to May 15) and fall (August 15 through October 15). If spring intensive monitoring does not result in certain adaptive management triggers, follow-up monitoring will be conducted during the fall period only.

Searches would occur at 50 of the 94 turbines; the 50 turbines would be selected based on stratified random sampling. Each of the 50 turbines would be searched 1 time per week. At 40 of the monitored turbines, the search plot would include the turbine pads and access roads out to 80 meters (262 feet). At 10 of the monitored turbines, the search plots would be 80 meters by 80 meters (262 feet x 262 feet) and cleared of vegetation (mowed). The cleared search plots would have 13.6-meter (20-foot) transects. PTWF will estimate bat fatality rates using methods originally described in Erickson et al. (2003) and modified in Young et al. (2009). Searchers will also record bird carcasses detected in search plots. However, searchers will not collect bird carcasses, carcass trials will not include birds, and calculated fatality rates will not include estimates for birds. Searchers will photograph bird carcasses and identify to species as much as possible. Also, a USFWS-approved bird expert will examine the photographs to verify identification.

Carcasses found incidentally to standard searches will be documented using the same collision event protocol used for standardized searches. Incidental finds will be noted, but will not be used in the fatality rate calculations. To be statistically valid, fatality rates must be calculated using carcass removal and searcher efficiency trials, which are not possible to conduct with incidental finds.

***Reporting***

PTWF will provide an annual report to the Service following the completion of each year of post-construction monitoring. The report will include bird and bat fatality estimates, data summaries, and assessment of correlations between fatality rates and potentially influential variables, such as weather, location, and turbine operation. Fatalities will be expressed both in terms of fatalities per turbine per season and in terms of fatalities per MW per season, as recommended by the Land-Based Wind Energy Guidelines (LWEG; USFWS 2012e) to facilitate comparison with other studies. The reports will include all data analyses, and a discussion of monitoring results and their implications.

In addition to the mortality monitoring reports, PTWF will promptly report to the Service on fatalities of Indiana bats, northern long-eared bats, other ESA-listed species, or eagles. Mortality monitoring reports would also describe any adaptive management measures implemented.

## Adaptive Management

Under the BBCS, PTWF will implement adaptive management, a process of adjusting minimization measures (i.e., turbine operational protocols), using new information or changing conditions to minimize the Project's effects on birds and bats while minimizing effects to Project practicability. PTWF's adaptive management plan is described in detail in the BBCS in Section 5.2. The results of post-construction monitoring will be used to inform the adaptive management process. If certain triggers are realized, then PTWF will make operational adjustments as necessary to achieve the goals of the BBCS. Conversely, if the results of post-construction monitoring indicate that operational protocols exceed the goals and objectives specified, then PTWF will scale back avoidance and minimization measures as appropriate. Changes to operational protocols will be conducted only in conference with the Service.

Triggers for adaptive management are detailed in the BBCS in Section 5.2 and in the Project HCP in Section 7.4. In summary, adaptive management would be triggered by the following events under all alternatives.

### *Take of an ESA-listed species (other than an Indiana bat)*

If the PTWF takes an ESA-listed species, they will report the event to the Service and work with the Service to determine the circumstances surrounding the event. PTWF will work with the Service to develop the appropriate avoidance, minimization, and mitigation measures, such as increasing the cut-in speed at the turbine associated with the mortality or a group of turbines during specific conditions or seasonal periods. Any operational adjustments will be followed by a year of post-construction monitoring. PTWF will work with the Service to determine the need to pursue an ITP for the ESA-listed species.

### *Take of a bald eagle or golden eagle*

The PTWF is not expected to take eagles. However, if the PTWF takes a bald eagle (*Haliaeetus leucocephalus*) or golden eagle (*Aquila chrysaetos*), the Applicant will report the event to the Service and work with the Service to determine the circumstances surrounding the event. PTWF will work with the Service to develop the appropriate avoidance, minimization, and mitigation measures, such as increasing the cut-in speed at the turbine associated with the mortality or a group of turbines during specific conditions or seasonal periods. Any operational adjustments will be followed by a year of post-construction monitoring. PTWF will work with the Service to determine the need to pursue a permit under the Bald and Golden Eagle Protection Act (BGEPA).

### *Discovery of a mass mortality event involving either birds or bats*

The BBCS does not predict that the PTWF operations will cause large mortality events. However, if monitoring discovers a mass mortality event, PTWF would notify the Service and work with the Service to determine the circumstances surrounding the event. PTWF will work with the Service to develop the appropriate avoidance, minimization, and mitigation measures.

### *New research or PTWF post-construction monitoring results*

It is possible that new research or PTWF post-construction monitoring results could provide compelling evidence that the minimization measures (i.e., turbine operational protocols) exceed those necessary to achieve the biological objectives of the BBCS or Project HCP. If this is the case, PTWF will consult with the Service about adjusting operations to lower the curtailment restriction per the adaptive management plan presented in Section 7.4.2 of the HCP. In contrast, post-construction monitoring results may indicate that Project operations are not meeting the BBCS's objectives. If this is the case, PTWF will consult with the Service about adjusting operations to increase the curtailment restriction per the adaptive management plan presented in Section 7.4.1 of the HCP. PTWF will not implement any operational adjustments without the Service's approval.

### 2.2.2 ALTERNATIVE 1: NO-ACTION ALTERNATIVE

#### 2.2.2.1 Turbine Operational Protocol

PTFW is currently operating under the terms of a Technical Assistance Letter (USFWS letter, dated March 29, 2012) and the supporting BBCS while review of the HCP is completed and until an ITP is issued. Beginning in 2012, the PTWF began implementing operational adjustments and raised the cut-in speed from the manufacturer's rated cut-in speed of 3.5 m/s to 6.9 m/s from 30 minutes before sunset to 30 minutes after sunrise when the ambient temperature is above 10°C (50°F) from August 15 through October 15. Turbines are feathered (i.e., blades are pitched parallel with the wind direction, causing them to spin very slowly) when the ambient temperature is above 10°C and until the cut-in speed is reached. At the Fowler Ridge Wind Farm (Fowler Ridge) in Indiana, Good et al. (2011, 2012) found approximately 73% of all bat activity at the height of the turbine nacelles occurred when wind speeds were below 5.5 m/s (12.3 mph). Good et al. (2012) found most bat activity and bat fatalities occurred when mean nightly temperatures were above 15°C (59°F). Under the No-Action Alternative, PTWF would continue to operate under these restrictions. Because the Project would avoid taking Indiana bats or northern long-eared bats, PTWF would not implement an HCP or provide mitigation measures for Indiana bats or northern long-eared bats. The Service would not issue an ITP.

Impacts to Indiana bats and northern long-eared bats during operation (i.e., collision) are not anticipated under this alternative, therefore PTWF would not prepare an HCP nor mitigate impacts to Indiana bat or northern long-eared bat, and the Service would not issue an ITP. The No-Action Alternative meets the Service's purpose and need for protecting Indiana bats. The No-Action Alternative would have an overall neutral effect on both bats because no take would occur, and no mitigation or other conservation measures would be implemented specifically for either bat. To verify avoidance of take, PTWF is conducting post-construction monitoring and would continue to do so under the No-Action Alternative. The methods of post-construction monitoring are the same for all alternatives and are described in Section 2.2.1.2 above.

#### 2.2.2.2 Adaptive Management Unique to the No-Action Alternative

**<u>Take of an Indiana Bat</u>**

Under the No-Action Alternative, take of Indiana bats is not anticipated. However, if the PTWF takes an Indiana bat, PTWF will work the Service to determine the circumstances surrounding the fatality and develop specific adaptive management and, possibly, mitigation measures. Potential measures may include increasing the cut-in speed at the turbine associated with the mortality or a group of turbines during specific conditions or seasonal periods. Any operational adjustments will be followed by a year of post-construction monitoring. PTWF will work with the Service to determine the need to pursue an ITP for Indiana bats. This would also be the case for northern long-eared bats if they are listed.

#### 2.2.2.3 No-Action Alternative Summary

The No-Action Alternative meets the Service's goals and objectives for protecting and conserving the Indiana bat and its habitats in the context of the Project for the continuing benefit of the people of the United States. Under the No-Action Alternative, the Project operations are unlikely to pose risks to Indiana bats or northern long-eared bats because the turbines would not operate during the fall migration period until wind speeds reach 6.9 m/s or greater. The No-Action Alternative would be the alternative implemented if the Service denies the Applicant the ITP. However, the No-Action Alternative does not meet the Applicant's purpose and need for providing a source of renewable energy practicably and economically (see Sections 4.1 and 4.6.1 of the Project HCP).

### 2.2.3 ALTERNATIVE 2: PREFERRED ALTERNATIVE (ITP ISSUANCE, HCP WITH 5.0 M/S CUT-IN SPEED MINIMIZATION AND MITIGATION MEASURES)

Under Alternative 2, the Preferred Alternative, the Service would issue a 43-year ITP that would authorize incidental take of Indiana bats associated with the operation of 94 turbines. The ITP would include provisions for authorizing take of northern long-eared bats that would become effective if and when they become listed. PTWF would implement an HCP that includes:

1) Operational measures to reduce take of listed bats: turbine feathering at low wind speeds and raised cut-in speeds of 5.0 m/s from sunset to sunrise when the ambient temperature is above 10°C (50°F) for the period from August 15 through October 15;
2) Off-site conservation measures to mitigate for the unavoidable take of Indiana bats and impact of the taking; and
3) Post-construction monitoring and adaptive management plan to measure the effectiveness of turbine operations in reducing bat mortality.

PTWF would also implement the BBCS to reduce the potential for impacts to migratory birds. Elements in the BBCS that address Indiana bats and all other bats would be replaced by the conservation measures addressed in the HCP. The two documents would be consistent with each other.

#### 2.2.3.1 Proposed Indiana Bat Take Limit and Impact of the Taking

The Applicant's method for estimating take of Indiana bats at the PTWF is explained in detail in Section 6.4.2 of the Project HCP. Indiana bat mortality is not expected to occur during maintenance, decommissioning, or mitigation activities. Project operation is the only activity expected to result in Indiana bat take (mortality).

Based on mortality data from Fowler Ridge, the Applicant estimates PTWF could take approximately 5 Indiana bats per year in the absence of the proposed operational protocol (Section 6.4.2.1 of the Project HCP). Implementing the proposed turbine operations, PTWF predicts they can reduce Indiana bat fatalities by at least 50%, bringing the annual take to 3 Indiana bats per year. Hence, PTWF requests a take limit of 129 Indiana bats based on the estimated cumulative take over the 43-year ITP term (3 Indiana bats per year x 43 years).

The Applicant's method for estimating the impact of the taking is described in Section 6.4.3 of the Project HCP. In summary, the Service has assumed more female Indiana bats than male Indiana bats are expected to migrate through the Plan Area, based on the distance of the Plan Area from the nearest hibernaculum (120 miles) and evidence that suggests female Indiana bats may occur more frequently than males as distances from hibernacula increase (USFWS 2012f). The Service estimates a 3:1 ratio of female to male Indiana bats migrating through the Plan Area each fall (USFWS 2012f). Consequently, approximately 75% of the 129 Indiana bats taken at PTWF are expected to be female, for an estimated take of 2.25 female bats per year, or roughly 97 female bats over the 43-year Project life. The loss of those 97 female bats is likely to result in lost reproductive potential in the population in addition to the direct mortality. Thus, the total number of Indiana bats expected to be removed from the population over the 43-year permit term includes the take estimate (129 Indiana bats) as well as the lost reproductive contribution (184 total female pups) of the 97 female bats lost (based on 1.9 female pups/bat), for a total of approximately 313 Indiana bats. This represents 0.16% of the estimated 2013 population of the Ozark-Central Recovery Unit (OCRU) (197,707 Indiana bats; USFWS 2013a), in which the PTWF is located, and take would be distributed over 43 years.

#### 2.2.3.2 Proposed Northern Long-eared Bat Take Limit and Impact of the Taking

Based on the 2010 and 2011 post-construction monitoring, Good et al. (2012) estimated fall bat mortality at control turbines to average 30.17 (90% CI = 24.60-37.13) bats per turbine per fall season. Of the 1,246 bat carcasses detected during the three (2009-2011) fall seasons, searchers found 1 northern long-eared bat at an uncurtailed turbine in 2009, i.e., 0.08% of carcasses detected. Applying the Fowler Ridge average fatality rate (30.17 bats per turbine per fall season) to the PTWF (94 turbines) results in 2,836 (90% CI = 2,312-3,490) bats per fall season without curtailed operations. Considering that 0.08% of all bat fatalities are estimated to be northern long-eared bats, the PTWF would take approximately 3 (90% CI = 2-3) northern long-eared bats each fall, in the absence of minimization measures.

By implementing the proposed turbine operations (described below in Section 2.2.3.3), PTWF predicts they can reduce northern long-eared bat fatalities by at least 50%, bringing the annual take to 2 northern long-eared bats per year.

Over the 43-year life of the Project, the accrued northern long-eared bat debits include the female take estimate (43) as well as the lost reproductive contribution of the taken female northern long-eared bats (82), resulting in approximately 125 female northern long-eared bats. With the addition of 43 males, the total take would be 168 northern long-eared bats.

The northern long-eared bat population in Illinois has not yet seen the declines which have occurred in the eastern U.S. Due to this, and the low level of estimated take, it is likely that overall impacts to the local population from take at Pioneer Trail would be minimal. Due to the common occurrence of northern long-eared bats at mist-netting sites throughout large portions of their range, we assume that the rangewide northern long-eared bat population is significantly larger than the rangewide Indiana bat population (534,239; USFWS 2013a). Nevertheless, if the northern long-eared bat population was of a similar size, the take resulting from the Project would represent only 0.03% of the estimated population. We consider this northern long-eared bat take estimate to be conservative, and resultant northern long-eared bat mortality is likely to be lower.

#### 2.2.3.3 Turbine Operational Protocol

The PTWF curtailment plan is explained in detail in the Project HCP in Section 7.2.2. Under the Preferred Alternative, the cut-in speed would be reduced to 5.0 m/s (11.2 mph) for the period from August 15 through October 15 each year, from sunset to sunrise, when the ambient temperature is above 10°C (50°F) based on a 10-minute rolling average. The hub would not be locked, but blades would be feathered to the wind such that revolutions per minute (rpm) are minimal during periods when wind speed is less than 5.0 m/s. The feathering/cut-in process would be computer-controlled on a real-time basis; turbines will feather or cut-in throughout the night as wind speed fluctuates below and above 5.0 m/s. The Applicant's rationale for 5.0 m/s cut-in speed in fall with nighttime temperatures above 10°C is based on curtailment studies (Baerwald et al. 2009, Arnett et al. 2010, Good et al. 2011) and bat activity studies (O'Farrell and Bradley 1970, Vaughan et al. 1997, Fiedler 2004, Reynolds 2006, USFWS 2007). Under the Preferred Alternative, turbine operating restrictions associated with the Technical Assistance Letter would be lifted and more renewable energy would be generated than the No-Action Alternative.

#### 2.2.3.4 Mitigation

**Indiana Bats**

Within our decision context and in permitting take of Indiana bats pursuant to the ESA, we are primarily interested in reproductive services, specifically female Indiana bat reproductive potential. When an adult female bat is prematurely killed at a wind energy facility, her and her offspring's' reproductive potential is lost. To evaluate mitigation, the Service uses the credits accrued from projects that protect or restore habitat that in turn result in gained females and gained reproductive potential (USFWS 2013b).

The Applicant proposes to implement mitigation measures to compensate for the unavoidable taking of Indiana bats and impact of the taking. PTWF has estimated that over the 43-year term of the ITP, the Project, while implementing the operational protocol, will remove 313 Indiana bats from the population, which includes 97 directly taken females and 184 female pups in the form of lost reproductive contribution of the directly taken females. This results in 281 females as the value for calculating the amount of mitigation that must be provided to offset the impact of the taking Indiana bats.

Because of the Indiana bat's complex life-cycle and the importance of both summer and winter habitat to that life-cycle, PTWF would provide benefits to the Indiana bat population through improvements to winter habitat and summer maternity habitat. The PTWF mitigation plan is described in detail in the Project HCP in Section 7.2.3. The following paragraphs provide a summary of PTWF's proposal for protecting winter and summer Indiana bat habitats and compensating for the impact of the taking.

***Winter Habitat Mitigation***

The Service will accept gating as mitigation for the impact of taking Indiana bats in the situation where there is a vulnerable population of Indiana bats under imminent threat of human disturbance at a hibernaculum (USFWS 2012g). Together with the Service and Illinois Department of Natural Resources (IDNR), PTWF has identified a site for winter habitat mitigation at Griffith Cave located in Hardin County, one of four counties in Illinois where white-nose syndrome (WNS) has been found. In February 2013, Griffith Cave had an estimated Indiana bat population of 2,150 individuals (R. D. McClanahan, Shawnee National Forest and J. Kath, IDNR, unpublished data). PTWF will install one gate to preserve and secure the site and promote long-term use of the hibernaculum by Indiana bats. Securing the cave entrance may also prevent or retard the inadvertent introduction by humans of WNS and other disease vectors that may threaten the Indiana bat in this hibernacula and region-wide.

PTWF will develop a specific plan in cooperation with Service and IDNR for design and implementation of these protective measures. PTWF will also work with Service and IDNR to develop a scope for a 3-year follow-up study that would evaluate effectiveness of the measures implemented at Griffith Cave. PTWF would attempt to complete the gating project within 1 year after issuance of the ITP, such that this component of mitigation including the follow-up study will be complete within 5 years after issuance of the ITP.

PTWF used the mitigation valuation system specified in the Service Region 3 Indiana Bat Resource Equivalency Analysis Model for Wind Energy Projects (REA Model; USFWS 2013b) to determine the level of compensation provided at each mitigation project. Increased survival of 1% is a benefit that the Service assumes has a high probability of accruing over the life of the cave-gating project (USFWS 2012g). The Griffith Cave gating project is assumed to equate to the minimum mitigation credit equal to at least 1% of the vulnerable population. Based on the most recent winter census (2013), the number of Indiana bats vulnerable to human disturbance at Griffith Cave is 2,150 bats. Therefore, the Griffith Cave gating project will compensate for at least 21 female Indiana bats (1% of 2,150), which would then result in future production of 51 female pups. The winter habitat mitigation would compensate for 72 female Indiana bats.

The future effects of WNS on this population are difficult to predict long-term. However, should the population decline, the gating structure is expected to reduce the combined effects of WNS and periodic disturbance on the population. Should the population disappear, the gating is also expected to preserve a future cave environment with minimal disturbance to which the population could recover. Due to the uncertainty of the future cave population, but the certainty of reduced cave disturbance, the 2013 population number was used to calculate mitigation bat credits.

***Summer Habitat Mitigation***

This element of Project mitigation is designed to provide enhanced habitat and connectivity of habitat to increase foraging area and potential roosting areas that would be expected to contribute to persistence of maternity colonies and ultimately juvenile survival.

PTWF is working with local conservation entities to identify lands proximal to the Middle Fork of the Vermillion River earmarked for conservation. PTWF would make a financial contribution to acquire the appropriate acreage for conservation. The local conservation entity would be assigned to conduct long-term management of the conservation property. PTWF would attempt to identify and secure the required acreage and execute a conservation agreement with a local entity within 6 years after issuance of the ITP.

The Service estimates that 46 acres of forest supports 1.346 Indiana bats per year or 58 bats over 43 years. The Service considers it reasonable to conclude that colonies can persist for a minimum of 25 years, and that there is a high probability that summer habitat mitigation benefits will accrue over at least this period (USFWS 2012g). Based on this, the Service assumes each 46-acre block of high-quality summer habitat would result in 0.346 pups per year, and 46 acres of summer habitat also supports the 1 adult female during the reproductive period (USFWS 2012g). The value 0.346 pups per year equates to roughly 15 pups born over 43 years, plus 1 adult female occupying the 46 acres each of the 43 years, resulting in 58 bats for each 46-acre block of maternity colony habitat protected. We have assumed that each 46-acre block of preserved and restored habitat will compensate the loss of 58 female bats (43 x 1.346 bats per year ≈ 58 bats).

Together with PTWF, we are assuming that the proposed site for summer habitat mitigation is high-quality habitat relative to the surrounding landscape, and there is at least one Indiana bat maternity colony. Also, because wooded habitats are so severely reduced in this area, we assume that forest restoration measures are equal in value to preservation measures. Hence, each acre of summer habitat mitigation will compensate for 1.55 Indiana bats.

PTWF is proposing to restore 157 acres of land proximal to the Middle Fork Vermilion River corridor, which has records for Indiana bat maternity colonies. Restoration would include planting and managing trees in cropland. In addition, PTWF is proposing to preserve 49 acres of wooded habitat proximal to the Middle Fork Vermilion River corridor. We expect that 206 acres of summer habitat mitigation would benefit the Indiana bats that have been documented in the river corridor. Therefore, over the 43-year permit duration 206 acres of summer habitat mitigation would compensate the take of 300 female bats (206 acres ÷ 46 acres = 4.48; 4.48 x 58 bats ≈ 260 bats).

**Northern Long-eared Bats**

The Service finds that the summer habitat mitigation described above for Indiana bats would also mitigate the impacts associated with taking northern long-eared bats. Our rationale for accepting this overlap of Indiana bat and northern long-eared bat on the same acreage is based on several points. Northern long-eared bats use forested habitats for roosting (Lacki and Schwierjohann 2001) and foraging (Broders et al. 2006) and probably depend more on the interior than Indiana bats (Timpone et al. 2010). Both Indiana bats and northern long-eared bats were captured during mist-net surveys near the proposed mitigation areas.

The Applicant is proposing to restore and preserve forest on lands adjacent to those already in protection. The proposed summer habitat mitigation project would enhance and protect core forest habitat to the benefit of both species, northern long-eared bats in particular. The forest restoration effort would include those trees species documented as roosts for both Indiana bats and northern long-eared bats.

**Artificial Roosts**

The Applicant is proposing to incorporate up to 10 artificial roost trees in the restoration parcels as a research component. Artificial roosts have the potential to reduce temporal lag of roost development in new tree plantings by providing immediate roosting habitat. Concurrently with post-construction mortality monitoring, PTWF will monitor bat use at these artificial roosts using guano traps, exit counts, mist-netting, or acoustic monitoring. In cooperation with the Service, PTWF will develop a roost monitoring plan prior to implementing the artificial roost study.

**Mitigation Summary**

Together, the proposed winter and summer habitat mitigation projects would compensate for the loss of 332 female Indiana bats (winter = 72; summer = 260). Based on the take estimate of 281 female Indiana bats, the mitigation as proposed would mitigate the impact of the taking. Additionally, the proposed summer habitat mitigation project would compensate for the loss of 125 female northern long-eared bats.

#### 2.2.3.5 Adaptive Management

Adaptive management is a process that will allow the Applicant to incorporate new information or changing conditions to achieve the same goal, that is, minimization of take and conservation of the Indiana bat, while minimizing effects on the operation of the PTWF.

**Indiana Bat Mortality Exceeds Annual Take Limit**

During the initial 2 years of baseline (intensive) post-construction monitoring, if the Indiana bat mortality rate exceeds 3 bats per year, PTWF shall raise turbine cut-in speeds. Cut-in speeds shall be raised from 5.0 m/s to 5.5 m/s during the fall season, if the estimated Indiana bat mortality occurred during the fall season only. If any Indiana bat mortality is found during the spring season, then cut-in speeds shall be raised from 5.0 m/s to 5.5 m/s during the fall and spring seasons.

After an increase in cut-in speeds to 5.5 m/s, PTWF will conduct intensive mortality monitoring as described in Section 2.2.1.2 above for 2 consecutive years to confirm that estimated Indiana bat mortality does not exceed 3 bats per year. After 2 years, follow-up monitoring (described in Section 2.2.1.2 above) would occur every 5 years.

In the event that estimated Indiana bat mortality exceeds 3 in any given year during follow-up monitoring, then intensive monitoring will continue for another year. If during the 2 years of monitoring, the average annual mortality exceeds 3 Indiana bats, PTWF will increase cut-in speeds in 0.5 m/s (1.1 mph) increments. Also, PTWF will conduct at least 2 years of intensive monitoring after each incremental increase in cut-in speed until annual mortality rates are equal to or less than 2 Indiana bats.

**Indiana Bat and Northern Long-eared Bat Mortality Below Annual Take Limits**

Following the initial 2-year intensive post-construction monitoring, PTWF will review the combined Indiana bat and northern long-eared bat mortality estimates. For the entire Plan Area, if the average Indiana bat mortality is equal to or less than 2 Indiana bats per year and the combined northern long-eared bat mortality is equal to or less than 1, then PTWF may reduce turbine cut-in speeds to 4.5 m/s (10.1 mph). Thereafter, and/or after any subsequent 2-year monitoring period, if the cumulative estimated mortality in any given year remains less than or equal 2 for Indiana bats and less than or equal to 1in a given year, PTWF may further reduce cut-in speed in 0.5 m/s increments or such smaller increment as PTWF deems appropriate based on the mortality monitoring data. If at any time following a reduction in cut-in speeds estimated Indiana bat mortality exceeds 2 per year, PTWF will raise cut-in speeds, in 0.5 m/s increments and follow procedures for exceeding annual take described in the preceding subsection.

**Northern Long-eared Bat Mortality Exceeds Annual Take Limit**

During either of the initial 2 years of baseline (intensive) post-construction monitoring, if estimated northern long-eared bat mortality exceeds 2, PTWF shall raise turbine cut-in speeds. Cut-in speeds shall be raised from 5.0 m/s to 5.5 m/s during the fall season if the estimated northern long-eared bat mortality occurred during the fall season only. If any estimated northern long-eared bat mortality is found during the spring season, then cut-in speeds will be raised from 5.0 m/s to 5.5 m/s during both the fall and spring seasons.

After an increase in cut-in speeds to 5.5 m/s, PTWF will conduct intensive mortality monitoring as described in Section 2.2.1.2 above for 2 consecutive years to confirm that estimated northern long-eared bat mortality does not exceed 2 bats per year. After 2 years, follow-up monitoring (described in Section 2.2.1.2 above) would occur every 5 years.

In the event that estimated northern long-eared bat mortality exceeds 2 in any given year during follow-up mortality monitoring, then intensive monitoring will continue for another year. If during the 2 years of monitoring, the average annual mortality exceeds 2 northern long-eared bats, PTWF will increase cut-in speeds in 0.5 m/s (1.1 mph) increments. Also, PTWF will conduct at least 2 years of intensive monitoring after each incremental increase in cut-in speed until annual mortality rates are equal to or less than 2 northern long-eared bats.

#### 2.2.3.6 Unforeseen and Changed Circumstances

Unforeseen and changed circumstances are key elements of the No Surprises Rule (50 CFR 17.22(b)(5), 17.32(b)(5) and 222.307(g)) developed to provide ITP applicants with long-term economic and regulatory certainty (as explained in Section 1.2.2.3 of this EA). Unforeseen circumstances are changes in circumstances that result in a substantial and adverse change in the status of a covered species or geographic area covered by an HCP that the Applicant and Service could not reasonably have anticipated at the time of the HCP's negotiation and development. Changed circumstances are those that affect a covered species or geographic area covered by an HCP the Applicant and Service anticipate and plan for, such as a new ESA-listed species that occurs in the Plan area.

**Unforeseen Circumstances**

If unforeseen circumstances occur that could have a significant negative effect on either Indiana bats, northern long-eared bats, or both, or the ability for PTWF to effectively implement the Project HCP, PTWF will discuss the unforeseen circumstance with the Service and other affected parties, as applicable. If additional conservation and mitigation measures are deemed necessary to respond to unforeseen circumstances, the Service may require additional measures of the permittee where the HCP is being properly implemented, but only if such measures are limited to modifications to the conservation measures set forth in the HCP.

**Changed Circumstances**

PTWF and the Service anticipate circumstances that could occur during the term of the ITP and affect the ability of PTWF to properly implement the HCP. Events identified as changed circumstances are addressed below.

### *Listing of a New Species*

The Project HCP covers the northern long-eared bat, and the ITP would include terms and conditions for the northern long-eared bat if and when it becomes a listed species. In the event of any future listing of other bats or other species as threatened or endangered, PTWF would confer with the Service. First, the Service would determine whether activities covered by the Project HCP have potential for taking the newly listed species. If so, PTWF would modify its operations in coordination with the Service to ensure that incidental take of the species would be unlikely to occur and/or seek to include the newly listed species under the ITP. If PTWF requests ITP coverage for the newly listed species, it shall confer with the Service to determine if the conservation measures for the Indiana bat and northern long-eared bat are applicable to the newly listed species. If the existing measures are determined to be adequate, PTWF may request addition of the newly listed species to the ITP.

If conservation measures in the existing HCP are inadequate for the newly listed species, PTWF would coordinate with the Service to either amend the existing HCP to include additional conservation measures or develop a supplementary HCP with appropriate conservation measures either of which would sufficiently support incidental take authorization.

Adding a new species to a section 10(a)(1)(B) permit is a major amendment and consists of the same process as the original permit application, requiring an amendment to the HCP to address the changed circumstance, a Federal Register notice, NEPA compliance, and an intra-Service section 7 consultation.

### *Delisting of a Species*

If the Indiana bat, northern long-eared bat, or other listed species covered in this HCP (as a result of circumstances described in the above section) is delisted during the term of the ITP, requirements and restrictions under the ITP and conservation measures under this HCP may cease to be relevant for species protection. PTWF will coordinate with the Service to determine whether it is appropriate to modify the Project HCP or terms and conditions of the ITP. It may be that coverage under the ITP is no longer warranted for the continued operation of the PTWF.

### *Widespread Impact of White Nose Syndrome within Ozark-Central Recovery Unit*

It is possible at some point in the future, the Service, could find that the spread of WNS has changed the circumstances of the Indiana bat and northern long-eared bat population within the OCRU. If so, PTWF will evaluate whether survival and recovery of the species will be appreciably reduced by the authorized take and impacts of the authorized take as a result of the reduced population, such that additional measures are necessary to ensure that the implemented conservation measures remain proportional to the impact of the taking. If additional measures are deemed necessary, PTWF would consult with the Service to determine the more constructive and cost-effective strategy, turbine operational adjustments or additional habitat mitigation. The effectiveness of the selected measures would be monitored in accordance with the relevant monitoring protocols for operational adjustment (Section 2.2.3.5 Adaptive Management) or habitat mitigation (Section 2.2.3.4 Mitigation).

***Repowering and Extending Project Life***

PTWF anticipates the Project will operate for 43 years based on existing leases. However, PTWF could conclude they wish to extend operating life of the Project and extend property leases. PTWF would coordinate with the Service to determine if it is appropriate to modify the existing HCP and/or the terms and conditions of the ITP and whether coverage under the ITP is still warranted for extended Project operation. PTWF would seek a permit extension or renewal as described in Section 8.3.1 of the Project HCP.

***Climate Change Effects on Indiana Bat Life History and Ecology***

Climate change refers to changes in the values or variability of states of the climate (e.g., temperature, precipitation, etc.) that can be statistically identified and persist for extended periods, typically decades or longer (IPCC 2007). The Intergovernmental Panel on Climate Change (IPCC) has declared that climate change is an indisputable circumstance (IPCC 2007). There is evidence for several species that recent climate warming is affecting timing in migration and dispersal, and upward shifts in ranges relative to the equator (IPCC 2007).

The Service has acknowledged climate change as an anthropogenic factor that may affect the continued existence of Indiana bats (USFWS 2009) and northern long-eared bats (USFWS 2013e). Warmer temperatures or changes in regional weather patterns may alter spring and fall bat dispersal and migration periods. If the Service announces an observed shift in Indiana bat or northern long-eared bat dispersal and migration, PTWF would modify the timing of operational restrictions such that they are implemented for the duration of the new fall migration periods in Illinois. Changes to the operational protocol will take effect in the first fall migration season after the Service makes their announcement.

Warmer temperatures or changes in regional weather patterns may cause the Indiana bat or northern long-eared bat range to shift in response to prey distributions, habitat suitability, or other factors. Climate change models have predicted a northern expansion of the hibernation range of the little brown bat (*Myotis lucifugus*); the Service considers it likely that modeling for Indiana bat or northern long-eared bat range shifts would have a similar prediction (USFWS 2009). If the Service announces an observed shift in the Indiana bat or northern long-eared bat range, PTWF would evaluate the location of the Project and mitigation projects relative to the new range. If the new range of either species excludes the location of the summer or winter habitat mitigation project, mitigation efforts at the current site will be suspended and PTWF will attempt to identify a new location for the mitigation project within the new range. PTWF will implement the mitigation at the new site within 5 years of the Service announcement. If the species' new range excludes the Project location, PTWF will consult with Service regarding termination of the ITP and/or the operational protocol and mitigation projects set forth in the HCP.

***Natural Disaster Effects on Project HCP Mitigation Measures***

Climate change is expected to increase the frequency and severity of droughts, heavy precipitation events, consequently also increasing the potential for wildfires and flooding, respectively (IPCC 2007). Climate change may impact the effectiveness of the mitigation measures (proposed in Section 7.2.3 of the Project HCP and described briefly in Section 2.2.3.3 of this EA) by increasing the frequency and magnitude of natural disasters above historic patterns. Impacts to mitigation measures cannot be predicted; however, the Project HCP includes triggers and management responses for each foreseeable natural disaster based on known effects.

Droughts often cause an increase in tree mortality resulting in increases in snag density, which may improve roosting habitat for Indiana bats and northern long-eared bats. Conversely, severe or prolonged droughts can cause extreme large-scale vegetation die-off and result in unsuitable conditions for bat foraging and roosting. Similarly, wildfires can cause increases in tree mortality resulting in increases in snag density, which may improve roosting habitat for Indiana bats and northern long-eared bats. However, extreme and intense wildfires can cause extensive tree mortality and alter soil conditions resulting in impeded vegetation recovery.

The National Climatic Data Center of the National Oceanic and Atmospheric Administration maintains a database of all storm events, including flooding, by county. History indicates that all counties in Illinois are susceptible to some type of flooding. Tornadoes are a frequent severe weather event throughout Illinois (State of Illinois 2013). All of Illinois is susceptible to tornadoes; counties in the north, south, east, west, and central areas of the state have been affected by tornadoes.

If extreme to exceptional drought,[1] intense wildfire, extensive flooding, or a tornado is found to cause certain metrics (e.g., tree density, snag size-class density metrics, understory composition, etc.) in the summer habitat mitigation project to be >25% below the target values, PTWF would implement one or more of the following restoration actions, depending on the habitat features (mitigation metrics) affected, within 1 year following the natural disaster:

1) Tree planting in areas where the tree density is >25% below the mitigation metric target value;
2) Tree girdling in areas where the snag density is >25% below the mitigation metric target value (this will be done on a size-class specific basis); and/or
3) Non-native woody invasive species control in areas where the native understory composition is >25% below the mitigation metric target value.

Extreme or exceptional droughts occurring during more than 15% of the 43-year ITP term would be considered an unforeseen circumstance based on the historic and projected patterns of droughts in Illinois. Fires determined to be caused by arson or more than two wildfires triggering corrective action during the 43-year ITP term would be considered unforeseen circumstances based on the historic pattern of wildfire frequency and severity in Illinois (USDA-FS 2000). More than four tornados triggering corrective action during the 43-year ITP term would be considered unforeseen circumstances based on the historic pattern of tornadoes in Illinois (State of Illinois 2013). Response actions for such unforeseen circumstances will be consistent with existing ITP obligations.

#### 2.2.3.7 Preferred Alternative Summary

Within the context of this Project, the Preferred Alternative meets the Service's purpose to ensure ESA compliance for the Project to avoid, minimize, and mitigate take of listed species and legally authorize the

[1] Extreme (D3) to Exceptional (D4) drought as determined by the U.S. Drought Monitor found at http://www.droughtmonitor.unl.edu/monitor.html.

incidental take of the Indiana bat consistent with permit issuance criteria (section 10(a)(1)(B) of the ESA) and associated implementing regulations [50 CFR 17.22(b)(2) and 17.32(b)(2)]. The Service's goal within the context of the permit application is to conserve the Indiana bat and its habitats in the Project area and region for the continuing benefit of the people of the United States. The Preferred Alternative's compensation for the unavoidable Project impacts to covered species is to be achieved through suitable mitigation that offsets the impact of the taking, which is 281 female Indiana bats. If the permit issuance criteria contained in section 10(a)(1)(B) of the ESA are satisfied, the Service is required to issue the permit to the Applicant. As proposed, the off-site mitigation measures compensate for the impact of taking more than 281 female Indiana bats.

The Preferred Alternative addresses minimization and mitigation for the unlisted northern long-eared bat, which may be listed in the future. The Project HCP adequately covers northern long-eared bats and provides more planning certainty to the Applicant in light of the potential future listing of the species. The inclusion of northern long-eared bats as a covered species increases the biological value of the Project HCP through a proactive consideration of the needs of this unlisted species. The Preferred Alternative meets the Service's purpose for providing further regulatory certainty to the Applicant as the ITP would initially include authorization for the taking of northern long-eared bats, and no permit amendment is expected.

The Preferred Alternative meets the Applicant's purpose and need for a Project that provides an affordable and reliable source of renewable energy that has relatively few environmental impacts as compared to energy sources derived from fossil fuels, helps to meet renewable energy goals for the U.S. and the State of Illinois, and supports the local and regional economies through job creation and increased tax revenue. The Preferred Alternative also serves the Applicant's purpose to comply with the ESA and avoid, minimize, and mitigate the Project's impact on the Indiana bat and northern long-eared bat. In the absence of an ITP, the Project would be unlawful if take of Indiana bats occurred.

### 2.2.4 ALTERNATIVE 3: NON-RESTRICTED OPERATIONS (ITP ISSUANCE, HCP WITH 3.5 M/S CUT-IN SPEED AND MITIGATION MEASURES ONLY)

Under the 3.5 m/s Alternative, the cut-in speed would be reduced to 3.5 m/s every hour of every day of operation. The turbine hubs would not be locked and turbines will not feather when wind speed is below 3.5 m/s. The HCP would not include avoidance and minimization in the form of a curtailment strategy. The HCP would include only mitigation to be implemented to offset the impact of the taking of Indiana bats and northern long-eared bats. An ITP would be issued for the PTWF; therefore the Applicant would have legal coverage for incidental take of the Indiana bat and not at risk of violation of section 9 of the ESA. Implementation of this Alternative 3 would include conservation benefits to the Indiana bat through winter habitat protection and summer habitat enhancement and protection and northern long-eared bat through summer habitat enhancement and protection.

Expected impacts to Indiana bats and northern long-eared bats during operation (i.e., collision) are more likely to occur under this alternative than in Alternatives 1 and 2. Because there would be no reduction in bat take, this alternative would take more bats than either Alternative 1 or Alternative 2. Based on mortality data from Fowler Ridge, the Applicant estimates PTWF could take 5 Indiana bats per year and 3 northern long-eared bats per year in the absence of the proposed operational protocol (Section 6.4.2 of the

Project HCP). The PTWF would take 215 Indiana bats over the 43-year permit term, of which 161 are females. The loss of 161 female bats translates to 306 additional Indiana bats in the form of lost reproductive potential. Hence, the impact of the combined take estimate and lost reproductive potential would total 521 Indiana bats over the 43-year permit duration [161 females + 54 males + 306 bats in lost reproductive potential ≈ 521].

Similarly, under Alternative 3, PTWF would take 129 northern long-eared bats over the 43-year permit term, of which 64 are females. The loss of 64 female bats translates to 123 additional northern long-eared bats in the form of lost reproductive potential. Hence, the impact of the combined take estimate and lost reproductive potential would total 252 northern long-eared bats over the 43-year permit duration [64 females + 64 males + 123 bats in lost reproductive potential ≈ 252].

#### 2.2.4.1 Mitigation

Under Alternative 3, the Applicant would not implement operational adjustments to minimize take of Indiana bats resulting in a higher level of take, i.e., approximately 521 Indiana bats and 252 northern long-eared bats for the life of the Project. Therefore, the HCP would include substantially more mitigation to address this level of take as compared to the Preferred Alternative. The Applicant would need to offset greater mortality through gating vulnerable hibernacula and protection and/or restoration of lands adjacent to a known maternity colony.

#### 2.2.4.2 Alternative 3 Summary

Alternative 3 does not meet the Service's goals and objectives for protecting and conserving the Indiana bat and its habitats in context of the Project for the continuing benefit of the people of the United States. As discussed above, PTWF has estimated that the Project may result in the take of 5 Indiana bats and 3 northern long-eared bats per year in the absence of minimization measures (curtailment). This alternative would not result in implementation of avoidance and minimization measures as required in section 10(a)(1)(B). This alternative does not satisfy the section 10(a)(1)(B) criteria that "The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such takings." As demonstrated under Alternative 2, the Applicant has indicated that implementing an avoidance and minimization strategy in the form of curtailment is practicable.

Alternative 3 meets the Applicant's purpose and need for a Project that provides an affordable and reliable source of renewable energy that has relatively few environmental impacts as compared to energy sources derived from fossil fuels, helps to meet renewable energy goals for the U.S. and the State of Illinois, and supports the local and regional economies through job creation and increased tax revenue. However, Alternative 3 does not meet the Applicant's purpose to comply with the ESA and avoid and minimize the Project's impact on listed bats.

In conclusion, the 3.5 m/s Alternative is not a reasonable alternative, but has been retained for detailed analysis in this EA to facilitate comparison and illustrate a worst-case scenario.

## 2.3 ALTERNATIVES ELIMINATED FROM DETAILED ANALYSIS

NEPA requires that federal agencies thoroughly consider and objectively evaluate all reasonable alternatives and briefly explain the basis for eliminating those alternatives that were not retained for detailed analysis (40 CFR 1502.14). Early discourse between the Service and the Applicant on potential minimization and mitigation measures resulted in an initial list of potential alternatives for achieving the purpose and need of the Project. Some of these alternatives were later determined to not meet the purpose and need of either the Service or Applicant. Other alternatives could not be legally undertaken, or were found to be lacking in sufficient protection for the covered species or other wildlife resources, or included conservation measures that were not practicable given the magnitude of potential effects. Therefore, a number of alternatives were considered but eventually dismissed from detailed analysis for reasons summarized below.

### 2.3.1 ADDITIONAL COVERED SPECIES ALTERNATIVE ITP AND HCP TO INCLUDE LITTLE BROWN BAT

This alternative would be similar to Alternative 2 described in Section 2.2.3 but with the addition of little brown bat as a covered species. This alternative would include full implementation of the Project HCP with additional minimization and mitigation measures to address little brown bat. Implementation of this alternative would implement the 5.0 m/s curtailment for the period from April 1 to October 15 each year, from 30 minutes before sunset to 30 minutes after sunrise, when the ambient temperature is above 10°C (50°F) based on a 10-minute rolling average. The hub would not be locked, but blades would be feathered to the wind such that revolutions per minute (rpm) are minimal during periods when wind speed is less than 5.0 m/s. Implementation of this curtailment strategy would assume that this protocol would reduce estimated mortality of little brown bats by 50%.

This alternative would implement the curtailment strategy during the entire bat-active season as little brown bats would be expected to occur in the Project area from April to October. Under this alternative, no take would be authorized for little brown bats as they are not ESA-listed or proposed for listing. However, in the HCP, little brown bats would be treated as if they were listed; that is, avoidance, minimization, and mitigation measures would be implemented for these species as if they were currently listed under the ESA. Should this species be listed as endangered or threatened under the ESA within the period of the ITP (43 years), the ITP would already cover incidental take of little brown bats without the need for any permit amendment.

In consultation with the Service, PTWF considered including little brown bat as a covered species in the Project HCP. However, given the lack of adequate scientific understanding of this species and its current unlisted status, PTWF decided not to include little brown bat as a covered species. The Service Region 3 is developing the Midwest Wind Energy Multi-Species Habitat Conservation Plan (MSHCP; USFWS 2012h; 77 FR 52754-52755), which is likely to include the little brown bat as a covered species. In the event that take coverage for this species becomes necessary during the term of the MSHCP, PTWF may seek to obtain the necessary coverage by opting in to the MSHCP. Therefore, this alternative was dropped from detailed analysis in this EA.

### 2.3.2 ITP WITH FULL IMPLEMENTATION OF HCP AND REDUCED PERMIT TERM (<43 YEARS)

The Reduced Permit Term Alternative would be implemented as described for Alternative 2 with an ITP term for 15 years as opposed to 43 years. The HCP would also be modified to reflect implementation for a 15-year period. Upon nearing the end of the 10-year period, PTWF would seek an extension of the ITP if they saw fit. The length of the renewal period would be decided at the time of renewal and based on the results of the post-construction monitoring and any adaptive management implemented. At the time of the request for a permit renewal, greater certainty would be known about the effectiveness of turbine operational curtailment measures to reduce bat fatalities. The initial permit would authorize less take than Alternative 2, but if renewed, would likely have similar long-term effects as Alternative 2, including its adaptive management strategy.

Under this Alternative, an ITP would be issued contingent upon implementation of the conservation plan set forth in the Project HCP. Therefore, this alternative would meet the Service's purpose to provide a means to protect the Indiana bat and northern long-eared bat and habitats within the context of the Project. The Reduced Permit Term Alternative also meets the Agency's goals of minimizing and mitigating take of Indiana bats and northern long-eared bats.

This alternative would not reduce further any estimated annual take, would create an additional administrative burden, and would likely have similar long-term biological effects as Alternative 2. The annual review process outlined in the Project HCP provides for a system of checks and balances for reducing uncertainty regarding the effectiveness of operational curtailment. This review process will implement procedures for evaluating the effectiveness of the HCP and ensuring that take levels specified in the ITP are not exceeded. Because it does not provide substantially different protection for Indiana bats and northern long-eared bats beyond what is proposed in the Project HCP, this alternative was dropped from consideration.

# 3 AFFECTED ENVIRONMENT

The affected environment is the area and its resources (i.e., physical, biological, socio-economic) potentially impacted by the Proposed Action and alternatives. The purpose of describing the affected environment is to define the context in which the impacts will occur. To make an informed decision about what actions to implement, it is necessary to first identify those resources potentially affected and the extent of the potential impacts. The affected environment section of this document should provide the basis for this understanding.

In describing those resources, we considered the potential impacts associated with the Proposed Action, namely potential issuance of an ITP to PTWF for take of Indiana bat and northern long-eared bat, and implementation of an associated HCP. Consistent with NEPA, three alternative scenarios were developed in response to the Proposed Action, where PTWF would operate their 94-turbine wind farm, minimize and mitigate for impacts associated with take of Indiana bats and northern long-eared bats, and avoid and minimize impacts to other resources.

With regard to implementation of the alternatives considered, bat and bird resources are likely to experience the most pronounced impact. Hence, our analysis is commensurate with the estimated impacts and focuses predominately on these two resources. We recognize some other resources will experience project-related effects. However, we estimate that these effects would be minor, so we provide limited analyses for these resources. These resources include geology and soils, air quality, surface water, vegetation, general wildlife, economics and environmental justice, land use, and public health and safety.

## 3.1 OVERVIEW OF THE PROJECT

### 3.1.1 PIONEER TRAIL WIND FARM

The PTWF is located in the Bloomington Ridged Plain division of the Till Plains Section of the Central Lowland physiographic province. The landscape is characterized by flat to gently rolling topography and agricultural lands marked by creeks and drainages, and dotted with residential and farmstead development. In Ford and Iroquois counties, prairie ecosystems interspersed with narrow tracts of forest associated with streams were the historical dominant land cover. Currently, agriculture dominates the landscape, mostly as row crops of corn and soybeans. Wooded areas are limited to fragmented, narrow, bands of trees found almost entirely along the larger streams (Figure 3.1).

Iroquois and Ford counties include many small towns with residential, commercial, and industrial activity, connected by a comprehensive network of local and state roads, an interstate highway, active railways, and major and minor transmission lines.

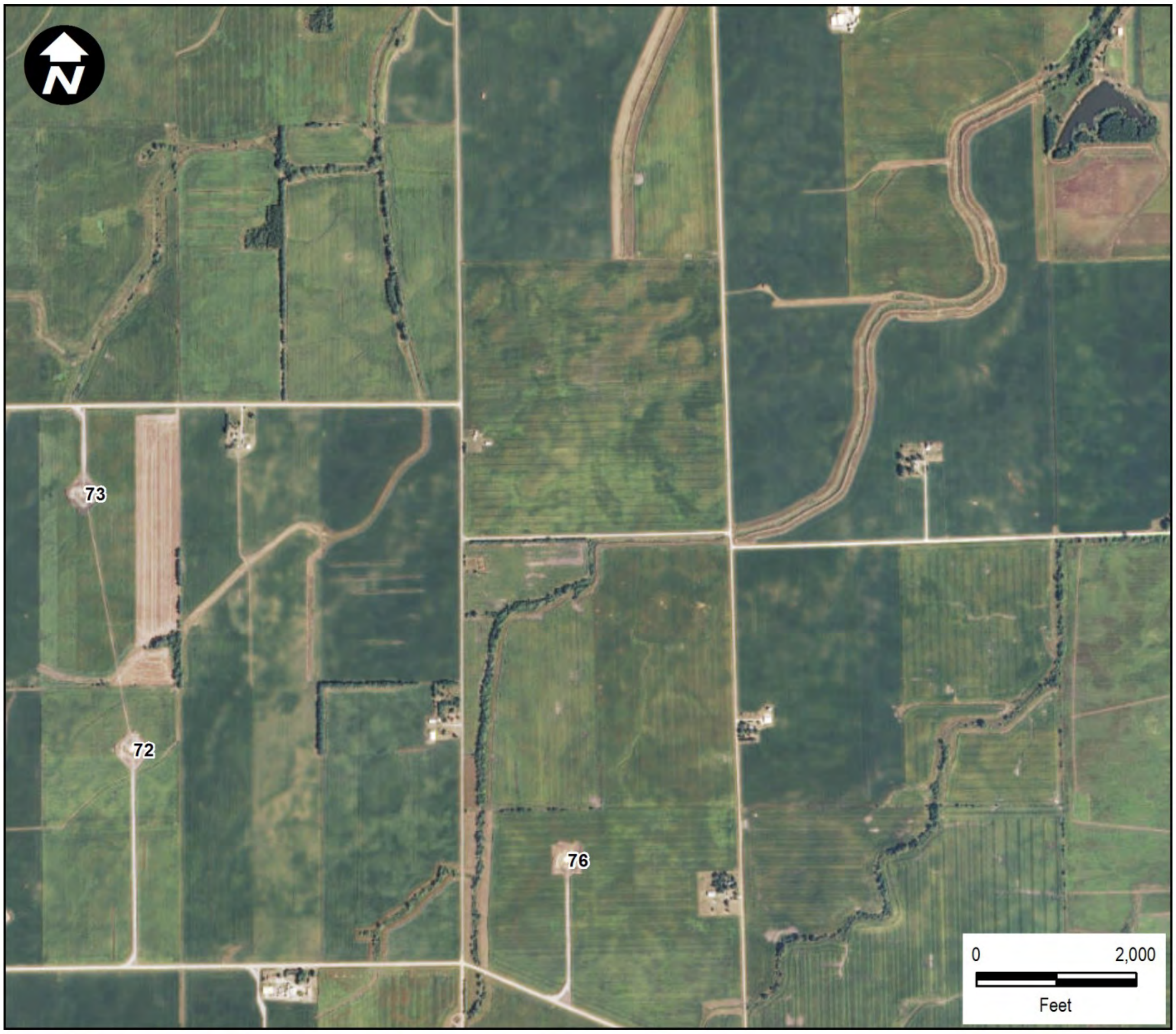


**Figure 3.1.** This aerial photograph illustrates a close-up of a typical segment of the Pioneer Trail Wind Farm at Turbines 72, 73, and 76. Throughout the landscape, wooded areas occur as narrow rows along water courses or field edges or as small clumps of trees.

### 3.1.2 WINTER HABITAT MITIGATION PROJECT

The proposed winter habitat mitigation would be located at Griffith Cave in southwestern Hardin County, Illinois. Access to Griffith Cave is from a hillside located approximately 100 feet above the Big Creek floodplain. The landscape is rural and sparsely developed and consists of small towns, forests, barrens, wetlands, pasture, and cropland. Farming and forestry are the dominant land uses in the region. Bottom land and low terraces along the rivers and streams are primarily farmed. The distinctly steep uplands are used principally for woodland.

### 3.1.3 SUMMER HABITAT MITIGATION PROJECT

The Applicant has not yet identified the exact locations of the site(s) for summer bat habitat mitigation. The Applicant is proposing to conduct mitigation using two methods: 1) restore to native forest and preserve 157 acres of habitat currently in agriculture and 2) preserve 49 acres of currently wooded, occupied Indiana bat and northern long-eared bat habitat that may be under threat. The Applicant is targeting lands proximal to the Middle Fork Vermilion River (Middle Fork) corridor in Ford, Champaign, and Vermilion County, Illinois (Figure 3.2). The Middle Fork watershed flows through these counties and primarily drains lands that are mostly in agriculture. Some of the largest forested areas in east-central Illinois lie within the Middle Fork corridor and are known to support maternity and foraging habitat for Indiana bats and reproductive northern long-eared bats.

## 3.2 PHYSICAL ENVIRONMENT

This section provides information on physical resources in the Covered Lands and surrounding region that may be impacted by the Proposed Action and alternatives. They include surface water, ground water, geology and soils, air quality, and noise.

### 3.2.1 SURFACE WATER

Surface water quality is a critical component of all site descriptions and planning processes. Surface water includes all forms of natural water found above the ground surface, such as lakes, ponds, rivers, streams, and springs. Semi-permanent manmade water features can also be included, such as reservoirs, retention ponds, ponds, canals, and regularly flooded ditches.

#### 3.2.1.1 Existing Condition

**<u>Hydrologic Units</u>**

The U.S. is divided into a series of Hydrologic Units, often described as drainage areas or watersheds. Hydrologic units describe how a piece of land is drained in an ascending series of greater geographic generalization. The tiered system is made up of cataloging units, which describe part or all of a surface drainage basin, a combination of drainage basins, or a distinct large hydrologic feature. Multiple cataloging units are combined to form accounting units, which are further combined to make the more general hydrologic sub-regions. These sub-regions are then combined to form hydrologic regions.

The Covered Lands fall within two of these regions: the Upper Mississippi River Hydrologic Region and the Ohio Hydrologic Region (Figure 3.3). The winter habitat mitigation site and two potential sites for summer habitat mitigation fall within the Ohio Hydrologic Region (Figure 3.3). The following sections describe water quality and water quality issues within each of these two hydrologic regions.

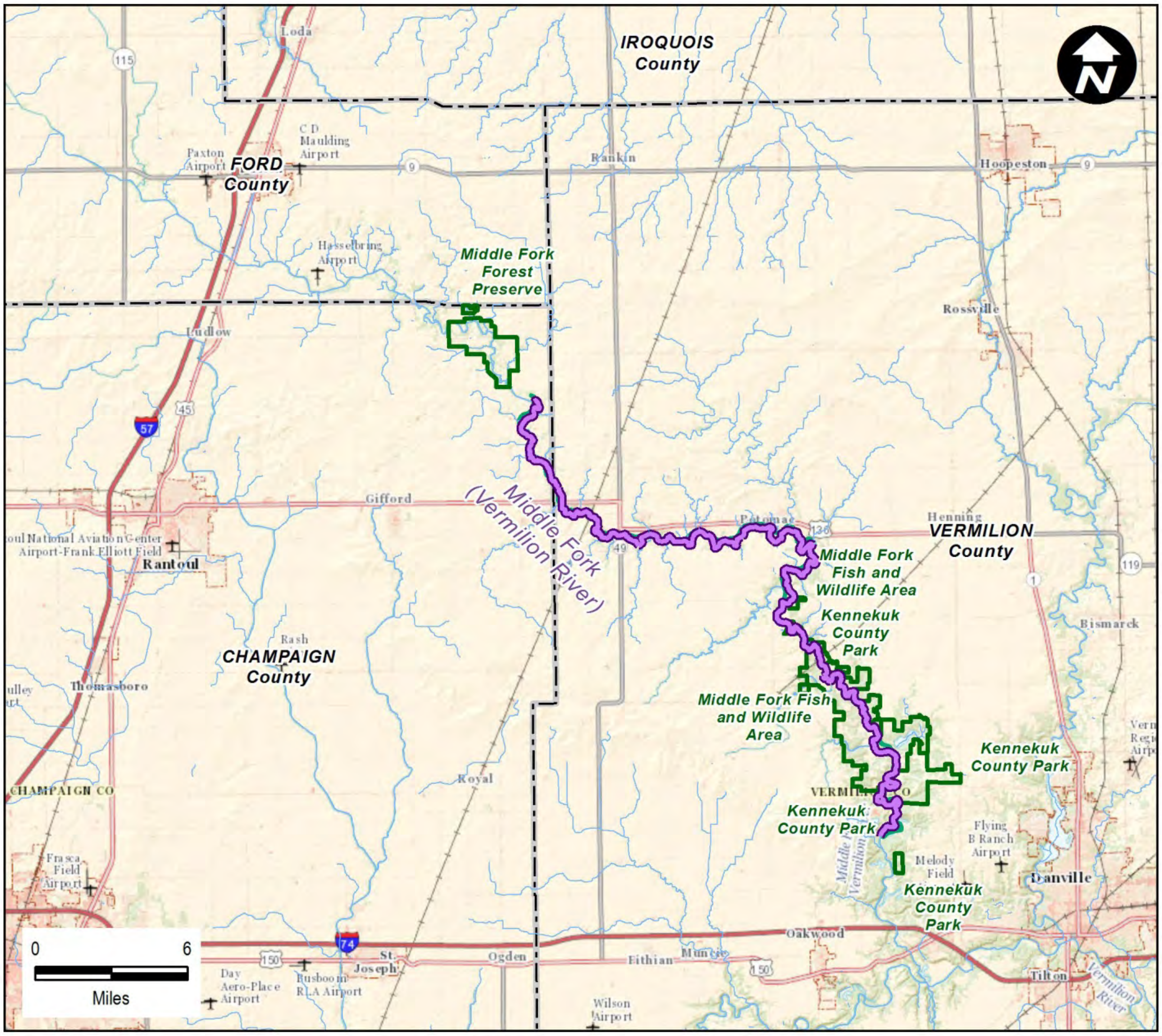


**Figure 3.2.** Located south of the Project area, the Middle Fork Vermilion River is a potential site for Indiana bat and northern long-eared bat summer habitat mitigation. The area of the river highlighted in purple is designated a scenic river under the National Wild and Scenic Rivers Act.

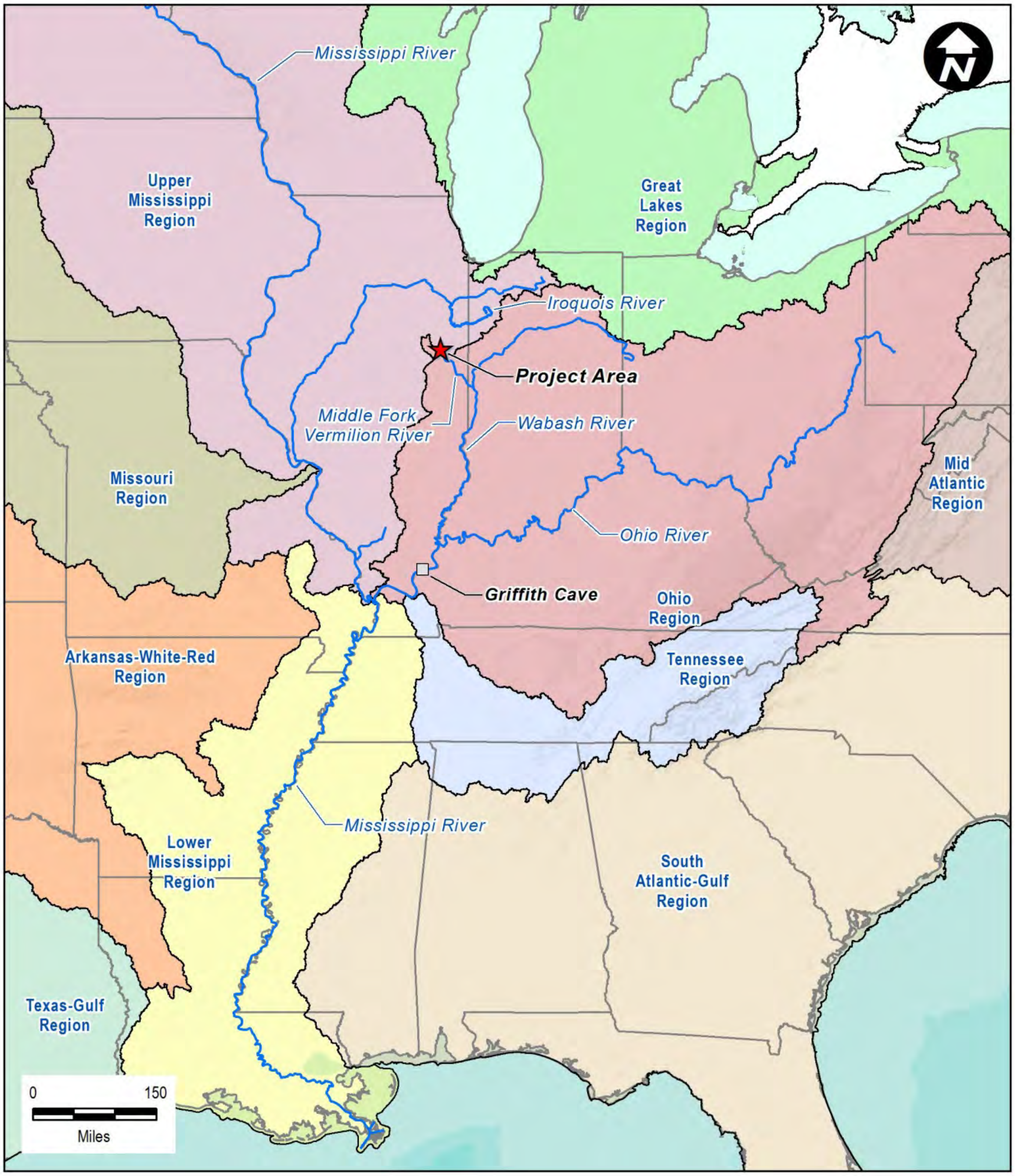


**Figure 3.3.** Hydrologic Regions associated with the Pioneer Trail Wind Farm Project and mitigation sites.

***Upper Mississippi Hydrologic Region***

The Upper Mississippi Hydrologic Region covers over 121 million acres. The region begins in the forested lakes region of northern Minnesota and Wisconsin, stretching south to the St. Louis, Missouri area. The region comprises all of the drainage area of the Mississippi River Basin above the confluence with the Ohio River, excluding the area of the Missouri River Basin. It covers portions of Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, South Dakota, and Wisconsin.

In the Upper Mississippi Region, water quality is relatively pristine in the northern headwater areas, but quickly becomes polluted by the time it reaches the southern area of the region near St. Louis, Missouri. Issues identified for this region include:

**Polluted Runoff:** Pollution due to runoff comes from municipal, industrial, and agricultural sources. Chemicals, sediments, and fertilizer introductions degrade regional water quality. Excessive nutrient inputs from this region contribute to hypoxia in the Gulf of Mexico.

**Industrial and Municipal Pollution:** Point source pollution from regional municipalities and industry is also a growing problem.

**Wetlands Loss:** Loss of regional wetlands, which naturally filter runoff waters before they are introduced into the river system, is also leading to a general lowering of regional water quality.

**Lock and Dam System:** In addition to impacting regional wildlife communities, impoundments result in permanent flooding of historic wetlands and further contribute to the loss of wetlands in the area.

**Organic Waste:** Impoundments not only flood historic wetlands, but they also trap sediments and municipal/industrial pollutants, which build up over time in these stagnant pools leading to both high pollutant loads and oxygen deficiencies.

**Floodplain Loss:** The Upper Mississippi has largely been channelized and levied to allow for agriculture in historic floodplains. Without these floodplains, natural sediment loads in the river are not given the opportunity to settle out in backwaters, leading to higher sediment loads in the main channel.

Portions of one Upper Mississippi Region sub-region fall within the Covered Land area. The Upper Illinois sub-region includes the Iroquois River (HUC 07120002) watershed which drains the Project area to the east and north via Pigeon Creek and to the northwest via Spring Creek.

The Iroquois River originates in Vermillion and Iroquois counties in Illinois and Pulaski and Jasper counties in Indiana and runs for 103 linear miles and drains 2,091 square miles. Bottom substrates in the main stem of the Iroquois River vary from predominately gravel/sand, to sand and silt in slack water areas and along banks (Bales et al. 2013). Substrates in the tributaries vary from predominantly claypan with silt banks to a consolidated gravel/sand mixture (Bales et al. 2013). In their annual water quality report, the Illinois Environmental Protection Agency lists reaches in several streams in the Iroquois River watershed as impaired waters (IEPA 2012a). Aquatic life is the designated use for most of these streams. Impairments are associated with sedimentation/siltation, dissolved oxygen, ammonia, boron, copper, phosphorus, and total suspended solids. Sugar Creek is designated for fish consumption and impaired due to mercury.

***Ohio Hydrologic Region***

The Ohio Hydrologic Region covers over 104 million acres. It comprises the drainage area of the Ohio River Basin, excluding the area of the Tennessee River Basin. It covers portions of Illinois, Indiana, Kentucky, Maryland, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. From the confluence of the Allegheny and Monongahela rivers in Pittsburgh, Pennsylvania, the river flows in a southwesterly direction for 981 miles to its confluence with the Mississippi River near Cairo, Illinois. Hydraulically and ecologically, the entire river has been completely altered to provide year-round navigation via a system of 20 locks and dams. Also, the U.S. Army Corps of Engineers constructed, operates, and maintains 82 reservoirs, primarily for flood control, water supply, and recreation. The Ohio Region serves a large population that uses the Ohio River for a water source, power generation, and barge transportation. Issues common to this region include:

**Dioxin:** The upper two-thirds of the Ohio River have been studied extensively for dioxin contamination, with concentrations exceeding standards in the Pittsburgh, Pennsylvania; Marietta, Ohio; and Kanawha River junction areas.

**Combined Sewer Overflows:** In older cities in the region with combined storm and sanitary sewers, large storm events have been shown to overload the system, leading to overflows of both storm water and untreated human and industrial waste, which results in direct discharges to regional hydrology.

**Acid Mine Drainage:** Abandoned coal mines are a leading cause of regional water degradation due to high acid and metal drainage from historic mines in the region.

**Growth and Urbanization:** Expansion of regional development has led to increased sedimentation, turbidity, nutrient levels, and urban runoff. Thermal pollution in regional industrial discharges has also been identified as a potential problem for aquatic communities and water quality.

Portions of one Ohio Region sub-region are within the Project area. The Wabash sub-region drains the Project area to the south and southeast via the Middle Fork Vermilion River (Middle Fork; HUC 05120109). The winter habitat mitigation site is within the Lower Ohio Bay subregion (HUC 05140203). The area around the winter habitat mitigation site, Griffith Cave, drains to Big Creek, which flows directly into the Ohio River.

Originating in Livingston County, the Middle Fork runs for 83 linear miles and drains 438 $mi^2$. Bottom substrates are predominantly sand and gravel (IDNR 2000). From April 2000 to March 2002, Illinois State Water Survey conducted water quality monitoring on the Vermilion and Little Vermillion rivers. At a U.S. Geological Survey (USGS) stream gage site on the Middle Fork above Oakwood in Kickapoo State Park, Illinois State Water monitored river hydrology, sediment, and nitrate-nitrogen. The Middle Fork site had the highest sediment loads among three Vermilion River stations for both project years (Keefer 2003). The IEPA (2012a) report lists the main stem of the Middle Fork as an impaired waterbody with a designated use of primary contact recreation affected by fecal coliform. The report lists several streams in the Vermilion River watershed with designated uses for aesthetic quality, aquatic life, fish consumption, and primary contact recreation impaired by sedimentation/siltation, dissolved oxygen, mercury, phosphorus, and total suspended solids.

The Ohio River runs for 133 miles along Illinois' southern border before its confluence with the Mississippi River. Causes of pollution in this stretch of the Ohio River include nutrients, siltation, flow alteration, habitat modification, wetland loss, municipal and industrial discharges, suspended solids, urban runoff, and point source discharges.

**Pioneer Trail Wind Farm**

Intermittent streams and drainages are common in the Plan Area. There are also a few perennial streams, including Spring Creek, Pigeon Creek, and Sugar Creek, which are tributaries of larger waterways, the Iroquois River and Middle Fork of the Vermilion River, that are located outside of the Plan Area. National Wetlands Inventory (NWI) data indicate small wetlands scattered throughout the Plan Area, occurring in higher densities along the creeks.

**Summer Habitat Mitigation**

The site for summer habitat mitigation will be a site that is currently in agricultural use and connected to a forested corridor. The Applicant is targeting sites proximal to the Middle Fork Vermilion River corridor (Figure 3.2) for summer habitat mitigation. Middle Fork Vermilion River is Illinois' only designated National Scenic River (Figure 3.2). The river is designated for 17.1 miles from river mile 46.9 near Collison downstream to river mile 29.8 at the Conrail Railroad crossing north of U.S. Highway 150 (west of Danville). The Vermilion River is a tributary to the Wabash River, which is a tributary to the Ohio River.

### 3.2.2 GROUND WATER

Ground water resources include natural water found underneath the ground surface, including aquifers, water supply wells, sink holes, and springs. Groundwater is a source of drinking water in many areas associated with the Covered Land, along with providing a source for agricultural and residential irrigation.

In the Project area, water supplies sourced from groundwater originate primarily from the Mahomet aquifer, a broad buried bedrock valley, 4 to 14 miles across and 200 to 300 feet deep (Visocky and Schicht 1969). Groundwater elevations in the Project area are relatively high in this region of the Mahomet aquifer, 670 to 692 feet above mean sea level (Burch 2008). Hence, depth to groundwater, albeit variable, is often found at the surface via man-made or natural pathways of access (e.g. water wells, seep crevices) or near the surface (<20 feet).

### 3.2.3 GEOLOGY AND SOILS

Geologic resources consist of surface and subsurface materials and their inherent properties, including topography, seismic characteristics, and soil stability.

#### 3.2.3.1 Existing Condition

**Pioneer Trail Wind Farm**

Most of Illinois is in the Heavy Till Plain physiographic section. As stated previously, the Covered Land area is within the Bloomington Ridged Plain physiographic division. Devonian shale and limestone is the predominant underlying bedrock. The relief in the region is a result of differences in the thickness of moraine deposits left by the Wisconsinan glaciation. The moraine deposits in the Covered Land area are relatively thick, around 400 feet (Calsyn 2004). The main soil associations are Swygert, Rutland, and Clarence silty clay loams and Bryce silty clay. These soils are somewhat poorly drained and formed from till, loess or other silty material, and lacustrine deposits.

**Winter Habitat Mitigation**

All of Hardin County is within the Shawnee Hills section of the Interior Low Plateaus Province and is mostly dissected upland underlain by Mississippian-age limestone, sandstone, and shale. The main soil associations at and around the Griffith Cave are Homer, Ashford, and Wellston silt loams, and Wellston-Berks complex on very steep slopes (Williams et al. 2008). These soils are well-drained with medium to high potential for surface runoff and were formed on loess or loess on residuum (Williams et al. 2008).

***Karsts and Caves***

Conditions for cave development occur in the karst regions of Illinois along the margins of the Illinois Basin, which includes the southern boundary of Illinois and Hardin County. Karst topography is a landscape shaped by the dissolution of a layer or layers of soluble bedrock, usually carbonate rock such as limestone or dolomite. Due to subterranean drainage, there may be very limited surface water rivers and lakes may be absent. Many karst regions display distinctive surface features, with dolines or sinkholes being the most common. However, distinctive karst surface features may be completely absent where the soluble rock is mantled, such as by glacial debris, or confined by a superimposed non-soluble rock stratum. Some karst regions include thousands of explored caves; though evidence of caves that are big enough for human exploration is not a required characteristic of a karst.

**Summer Habitat Mitigation**

The main soil associations of the Middle Fork Vermillion River are Swygert-Bryce-Mokena, Varna-Elliott-Ashkum, and Morely-Blount-Beecher (Calsyn 2009). These soils are somewhat poorly to moderately well-drained with medium to very high surface runoffs and slopes ranging from 0 to 20%. They formed on thin loess deposits in clay till, silty clay, loam till, and lacustrine sediments in the undissected parts of the Wisconsinan Till plain (Calsyn 2009).

### 3.2.4 AIR QUALITY

#### 3.2.4.1 Existing Conditions

We used data presented from the Illinois Environmental Protection Agency's (IEPA) 2011 air monitoring report (IEPA 2012b) to assess air quality conditions in the Project Area and the three potential mitigation areas. No air quality monitoring sites are located in either Ford, Iroquois, Vermilion, Hardin, or Jackson counties. Hence, there are no emissions data for these counties, but we looked at data from the monitoring stations closest to each project site. Also, we looked at point source emission estimates for each county.

**Pioneer Trail Wind Farm and Middle Fork Vermilion River**

For the Project area and Middle Fork Vermilion River, this air quality analysis is based on data from two air monitoring stations in Champaign County in Champaign (30 miles south of Project) and Thomasboro (20 miles south of Project). The land uses in Ford, Iroquois, Vermilion, and Champaign counties are similar (i.e., mostly rural agriculture and small town). However, we recognize that the city of Champaign will show relatively elevated levels of emissions compared to the rest of Champaign County. Ambient concentrations obtained from these stations were assumed to be representative of the ambient concentrations in the Project area and area of the Middle Fork River.

The Thomasboro station monitors ozone, and the Champaign station monitors fine particulate matter ($PM_{2.5}$). All levels monitored at the stations were within National Ambient Air Quality Standard (NAAQS) set by the U.S. Environmental Protection Agency (USEPA). Based on the available air quality information, the air quality in the Project area and Middle Fork River is in attainment for all monitored criteria pollutants.

**Griffith Cave**

We looked at air quality data from the Knight Prairie Township in Hamilton County 60 miles north of Griffith Cave. The Knight Prairie station monitors ozone, $PM_{2.5}$, and atmospheric lead. Based on available information, the air quality in the area of Griffith Cave is in attainment for all monitored criteria pollutants.

### 3.2.5 NOISE

#### 3.2.5.1 Existing Condition

**Project Area**

The Project area is located east of Paxton, Illinois in active cropland in a landscape dominated by agricultural activities. The PTWF's 94 turbines are distributed in a loose group over 12,500 acres. Turbines are located in active agricultural fields and set 1,000 feet or more from woodland. The terrain is flat with minimal relief. Consequently, the wind turbines are in very exposed settings. Lightly traveled paved and unpaved roads cross the covered land and surrounding area. Farmsteads dot the landscape along with an occasional residence.

Ambient noise levels in the covered land were not measured and are not known. However, we can assume that ambient noise is that of a typical farming landscape with a community-scale wind project Illinois. Sound levels included both steady background and short-term intrusive sounds. Characteristic sound sources in the covered land would include farming operations, vehicle road noise, wind turbines, wind moving through vegetation, human voices, dogs barking, bird song, and aircraft flying overhead. Sensitive receptors to these sounds would include residences in the Project area and the City of Paxton.

## 3.3 BIOLOGICAL ENVIRONMENT

### 3.3.1 VEGETATION

Vegetation resources include all plants, including rare, threatened, and endangered plants. Project operations under any alternative under consideration are not expected to have major impacts to vegetation. Decommissioning would restore approximately 50 acres to agriculture, which would have no benefits to native vegetation unless the lessee wishes to reclaim to native vegetation. Potential vegetation impacts would be limited to the summer habitat mitigation project.

#### 3.3.1.1 Existing Condition

**Summer Habitat Mitigation Project**

The Vermilion River basin is in a zone where beech-maple forests of the east converge with oak-hickory forests of the west. Habitats found along the Middle Fork include upland hardwood forest, fields (hay and pasture), and agriculture (row crops). There are very small amounts of remnant prairie wetland. Portions of the Middle Fork have been found to possess natural community diversity. The Middle Fork possesses four high-quality seeps that provide habitat for a few state-listed species, such as Wolfe's bluegrass (*Poa wolfii*). One seep community is found within Windfall Prairie Nature Preserve. The preserve consists of a gravel bluff prairie on the east bank of the Middle Fork and a seep spring at the base of the bluff with a large stand of fen grass of Parnassus (*Parnassia glauca*), a rare species in Illinois.

### 3.3.2 GENERAL WILDLIFE

This section addresses non-volant wildlife, as birds and bats are addressed in separate sections. Wildlife includes terrestrial and aquatic animals and rare, threatened, and endangered animals. Effects to wildlife could occur as a result of operating the PTWF and implementing the summer habitat mitigation project.

#### 3.3.2.1 Existing Condition

**Project Area**

Approximately 95% of the PTWF is used for the production of cultivated crops. The PTWF contains less than 1% of deciduous forest and open water. Roughly 5% of the PTWF is developed. Consequently, the majority of the terrestrial wildlife in the Project area are generalist species adapted to an agricultural environment. No habitat for aquatic species exists in the Project area.

Mammal species present may include coyote (*Canis latrans*), white-tailed deer (*Odocoileus virginianus*), red fox (*Vulpes vulpes*) raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), Virginia opossum (*Didelphis virginiana*), squirrels (*Sciurus* spp.), eastern cottontail (*Sylvilagus floridanus*), eastern mole (*Scalopus aquaticus*), and meadow vole (*Microtus pennsylvanicus*).

Creeks and drainages, although limited in the Project area, may be used by amphibians, such as the American toad (*Anaxyrus americanus*) and Fowler's toad (*Bufo woodhousii fowleri*) and reptiles, such as painted turtle (*Chrysemys picta*), Texas rat snake (*Pantherophis obsoletus*), and garter snake (*Thamnophis sirtalis*).

**Rare, Threatened, and Endangered Wildlife**

Federally listed species are afforded protection under the Endangered Species Act. In Illinois, state-listed species are afforded protection under the Illinois Endangered Species Protection Act (520 ILCS 10).

***Franklin's Ground Squirrel***

The Franklin's ground squirrel (*Spermophilus franklinii*), a state-listed threatened mammal, is largely an inhabitant of the Great Plains, but its range extends to northwestern Indiana (Hall 1981 as cited in Martin et al. 2003). Suitable habitat in the southeastern part of their range, in Illinois and Indiana, would consist of remnant tallgrass prairie, woodland edges and openings, and anywhere there are stands of tall, dense grasses, forbs, and shrubs. In agricultural landscapes suitable habitat can be found among fencerows, old fields, infrequently mowed roadsides and waste places, and the banks of ditches and railroad rights-of-way (Martin et al. 2003). Franklin's ground squirrel feeds on vegetation, cultivated grains and garden vegetables, fruits and seeds from plants including grass, thistle, dandelion, clover, and blackberry, and insects (Kurta 1995).

In the Project area, suitable habitat for Franklin's ground squirrel would be restricted to roadsides and waste places; there is little suitable habitat in the Project area capable of supporting this species. In addition, cultivation practices throughout the Project area such as pesticide application would limit the insect prey items for this species. At the request of IDNR, PTWF conducted a habitat assessment and determined the Project would not be likely to affect Franklin's ground squirrel (K. Shank, IDNR, personal communication).

***Plains Hog-nose Snake***

The plains hog-nose snake (*Heterodon nasicus*), a state-listed threatened reptile, inhabits the sand prairies, savannas, and woodlands of the central U.S. and its range is limited to the northern and western portion of Illinois. Suitable habitat in Illinois includes the sand prairies in Kankanee County and remnant sand prairie patches bordering the Mississippi and Illinois Rivers, and northwestern Illinois. These snakes are most often observed crossing sandy roads in brushy or weedy sand prairie remnants. The Project area does not contain remnant sand prairie; the nearest sand prairie remnant to the PTWF is in the Iroquois County State Conservation Area, roughly 30 miles northeast of the PTWF. However, there are no records of plains hog-nose snakes from either Ford or Iroquois counties. The Project area does not contain suitable habitat for this species, and this species is not likely to occur at the PTWF.

**Summer Habitat Mitigation Project**

Habitat conditions for the Middle Fork Vermilion River are briefly summarized in Section 3.3.1.1. Mammals likely to occur include the state-threatened river otter (*Lontra canadensis*), which was reintroduced in the late-1990s at Kennekuck Cove County Park which has a tributary leading west to the Middle Fork. The Vermilion River basin is known to support 23 amphibian and 27 reptile species, including the state-endangered silvery salamander *(Ambystoma platineum)* and state threatened four-toed salamander (*Hemidactylium scutatum*) (IDNR 2000). The four-toed salamander is associated with undisturbed forests containing seeps or bogs, but they may also be found near rocky, spring-fed creeks.

The Middle Fork Woods Nature Preserve has the state's only known colony of the silvery salamander, which inhabits underground burrows and runways constructed by rodents and shrews in forested areas.

### 3.3.3 AVIAN RESOURCES

For the purposes of this EA, the scope of this analysis includes avian resources within the Project area and surrounding region. Impacts to birds are likely to occur as a result of turbine interactions, and the analysis area for avian resources is the Project area. The analysis area also includes the summer habitat mitigation project, as birds are likely to be affected by the reforestation. The winter habitat mitigation project is not likely to affect birds.

#### 3.3.3.1 Scope of Analysis

Avian species that occur in the region of the Project are diverse and utilize variable habitats; therefore, for ease of analysis, avian resources were considered based on the following bird group classifications, which have been generalized from the taxonomic orders in the subclass Neornithes, or modern birds:

- passerines (songbirds and corvids),
- nocturnal non-passerines (nightjars),
- shorebirds,
- waterbirds (waterfowl, loons, grebes),
- game birds, and
- raptors (falcons, eagles, hawks), vultures, and owls.

Birds are highly mobile, and dispersal and migration are important aspects of their life strategies and survival. Birds will move among locations within the Project area and will travel through the Project area while flying to and from natural resources within the surrounding landscape.

With the exception of gallinaceous birds and introduced species, all birds that occur in the U.S. are protected by the Migratory Bird Treaty Act (MBTA; 16 U.S.C., 703-712). Species protected under the MBTA are listed under 50 CFR 10.13. The MBTA prohibits the taking and disturbance (both intentional and unintentional) of migratory birds, their nests, or young without prior authorization from the Service. Because the Project has the potential to take or disturb birds protected under the MBTA, this analysis addresses impacts to migratory birds. This analysis specifically addresses impacts to federally endangered and threatened migratory birds that may be impacted by the project and are protected under Section 9 of the ESA (16 U.S.C.1538; ESA 3[19]). Section 9 prohibits the ‘take’ of federally threatened or endangered species, unless otherwise specifically authorized by regulation.

Another component of the regulatory framework which applies to this analysis includes the BGEPA (50 CFR 22.26). The BGEPA prohibits the ‘take’ of a bald or golden eagle. The Service developed the Eagle Conservation Plan Guidance (USFWS 2013c) to interpret eagle take permit regulations in 50 CFR 22.26 and 22.27. The guidance also informs biological survey requirements, avoidance and minimization measures, and monitoring requirements at commercial wind developments.

Also relevant to this analysis is the IDNR Illinois Endangered Species Protection Act (520 ILCS 10/); under this Act, any species or subspecies of animal or plant designated as endangered or threatened by the Secretary of the Interior of the United States pursuant to the ESA is automatically listed as an endangered or threatened species on the Illinois State List. Under this Act, the incidental take of any listed species must be approved by the Service. The Illinois Endangered Species Protection Board maintains a list of state-endangered and threatened species (IESPB 2011). The Illinois Endangered Species Protection Act prohibits the possession, taking, transportation, sale, offer for sale, or disposal of any listed animal or products of listed animals without a permit issued by the Department of Conservation.

This analysis is specific to species protected under the aforementioned regulatory and legal framework, particularly those species considered at possible risk due to the Project as indicated by Service and/or IDNR during agency communications. As such, this analysis focuses on species federally listed as threatened, endangered, candidate, proposed, and species of concern or state-listed as threatened, endangered or special concern; however this analysis also considers species that are common to the Project area and are considered regionally abundant.

This analysis considers site-specific biological survey data, publically available regional databases, and information previously provided by the Service and IDNR during E.ON's correspondences with the agencies. Information sources include:

- Bird and Bat Conservation Strategy for Pioneer Trail Wind Farm (BBCS; Stantec 2014; see Appendix A)
- Resident/breeding bird and migratory bird survey results at the PTWF in 2010 (ARCADIS 2010; provided in Appendix B)
- Pioneer Trail Wind Farm Avian Risk Assessment (ARA; ARCADIS 2010; provided in Appendix B),
- PTWF Project HCP
- E.ON's information requests and communications with the Service and IDNR in 2008, 2010, 2011, and 2012 (see Section 4.6.2.1 in Project HCP, and Appendices A and B in ARA[ARCADIS 2010] provided in Appendix B of this EA)
- Illinois Natural Heritage Database Illinois Threatened and Endangered Species Occurrences by County (IDNR 2013) available at http://www.dnr.illinois.gov/ESPB/Documents/ET_by_County.pdf
- The Illinois Spring Bird Count (SBC) database (INHS 2013) available at http://www.inhs.illinois.edu/databases/sbc/about.html
- Illinois Breeding Bird Atlas (BBA; Kleen et al. 2004) available at http://www.inhs.illinois.edu/animals_plants/birds/breeding.php

#### 3.3.3.2 Existing Conditions

**<u>Project Area</u>**

***Land Cover***

The Project is located in the Till Plains section of the Central Lowland physiographic province (Illinois State Geological Survey 2011). This region is characterized by flat to gently rolling topography. Elevations in Ford and Iroquois counties range from 620 feet to 820 feet above mean sea level. The topography in the Project area is relatively flat with minimal relief, and elevations are generally around 785 feet above mean sea level.

While the region was historically dominated by prairie ecosystems, Iroquois and Ford counties are currently dominated by agriculture. Land cover within the Project area is primarily agriculture (approximately 95%), consisting of mainly corn and soybeans row-crops. Residential areas and other types of low intensity development represent most of the remaining land cover. There are no large, contiguous tracks of forest in the Project area: forested habitat is limited to fragmented, linear tracts primarily along roads, railroad rights-of-way, residential areas, and drainages or riparian areas associated with streams. Small intermittent streams and drainages occur throughout the Project area, the few perennial streams in the Project area include Spring Creek, Pigeon Creek, and Sugar Creek. The Project area contains a few small, isolated wetlands primarily associated with agriculture and runoff ditches. Remnant prairie in the Project area consists of fringe habitats of annual grasses in in 6- to 12-foot swaths bordering the roadways, abandoned railroads, and drainage ditches.

***Available Habitats in the Project Area***

Potential resources for avian species within the Project area include tilled row-crop fields potentially used by shorebirds, blackbirds, and waterfowl as stopover habitat during migration or over-wintering habitat. Tilled crop-fields provide foraging opportunities for raptors such as northern harrier and red-tailed hawk. Raptors, eagles, owls, and American crow (*Corvus brachyrhynchos*) may perch on telephone poles, abandoned railroad structures, and trees along roadsides in the Project. Farm and residential buildings in the Project area may provide roosting habitat for some passerines and owls. Some species of shorebird and wading birds may use wetlands and drainages in the Project area during migration; however, these small patches are low-quality stopover habitat. Limited forest patches provide minimal, low quality habitat for forest-breeding birds and minimal stopover habitat for migrants. Small patches of Remnant 'Railroad Prairie' (remnant of Grand Prairie habitat) provide habitat for grassland nesting birds; however, these narrow fragments are along roads within the Project area and occasionally are mowed, therefore are low quality. As many birds migrate at high altitudes, the airspace above the Project area is potential migration habitat for a variety of species of birds, including passerines, nightjars, shorebirds, waterbirds, and raptors.

**Regional Habitats**

More substantial waterways and natural resources used by birds occur in the area surrounding the Project, such as the Iroquois River to the east and Middle Fork Vermilion River to the south. The Service and IDNR indicated wildlife conservation areas in the vicinity of the Project during communications regarding the Project from 2008 to 2010. Additional natural resources are summarized in the BBCS, ARA, or other public database sources. These resources are shown in Figure 3.4 and include:

- Middle Fork Forest Preserve, including a 130-acre waterfowl management area (4 miles south of the Project area)
- Grandma Patton Woods along the Middle Fork (4 miles south of the Project)
- Loda State Habitat Area (SHA; 2 miles northwest of the Project)
- Herschel Workman SHA (2.5 miles east of the Project), which supports Henslow's sparrow (*Ammodramus henslowii*; Illinois species of concern) and provides extensive wintering and migratory staging habitat for other state-listed birds (see Appendix B in ARA (ARCADIS 2010) provided in Appendix B of this EA)

- Pellville Cemetery Nature Preserve (2.5 miles east of the Project area), which supports Henslow's sparrow (IDNR 2008)
- Gifford SHA (9 miles south of the Project)
- Perdueville SHA (7 miles west of the Project), which supports large numbers of breeding Henslow's sparrows and provides extensive wintering and migratory staging habitat for some state-listed birds (IDNR 2008)
- Prospect Cemetery Nature Preserve (2 miles west of the Project)
- Loda Cemetery Nature Preserve (2 miles northeast of the Project), provides extensive wintering and migratory staging habitat for some state-listed birds (IDNR 2008)
- Tomlinson Pioneer Cemetery Prairie Nature Preserve (5 miles south of the Project),
- Two separate segments of Railroad Prairie in Clarence, Ford County (at the edge of the eastern portion of the Project area)
- South of Sibley Grove in Ford County (18 miles northwest of the Project), American golden-plover (*Pluvialis dominica*; Illinois species of concern) staging area where large numbers of plovers are regularly observed during Spring Bird Count Surveys (IDNR 2008)

There are no designated Important Bird Areas (IBA) in Ford or Iroquois counties. The closest IBAs are in Moultrie, La Salle, and Grundy counties, and these locations offer high quality habitat for waterfowl and grassland nesting birds (ABC 2003).

**Raptors and Eagles**

Illinois is part of the Central Continental Hawk Migration Flyway, as designated by the Hawk Migration Association of North America (HMANA). Because the Great Lakes dictate the migration path of migrant raptors within this expanse (along the southern shorelines in the spring, and around the northern shorelines in the fall), more pronounced raptor activity occurs along the shorelines of the Great Lakes (HMANA 2006). Therefore, raptor migration occurs as a broad front across the rest of the flyway, including Illinois, where there are no water barriers and ridges that could produce updrafts (HMANA 2006). The HMANA hawk watch sites in Illinois occur along the southern shore of Lake Michigan and there are no hawk watch sites in Ford or Iroquois counties.

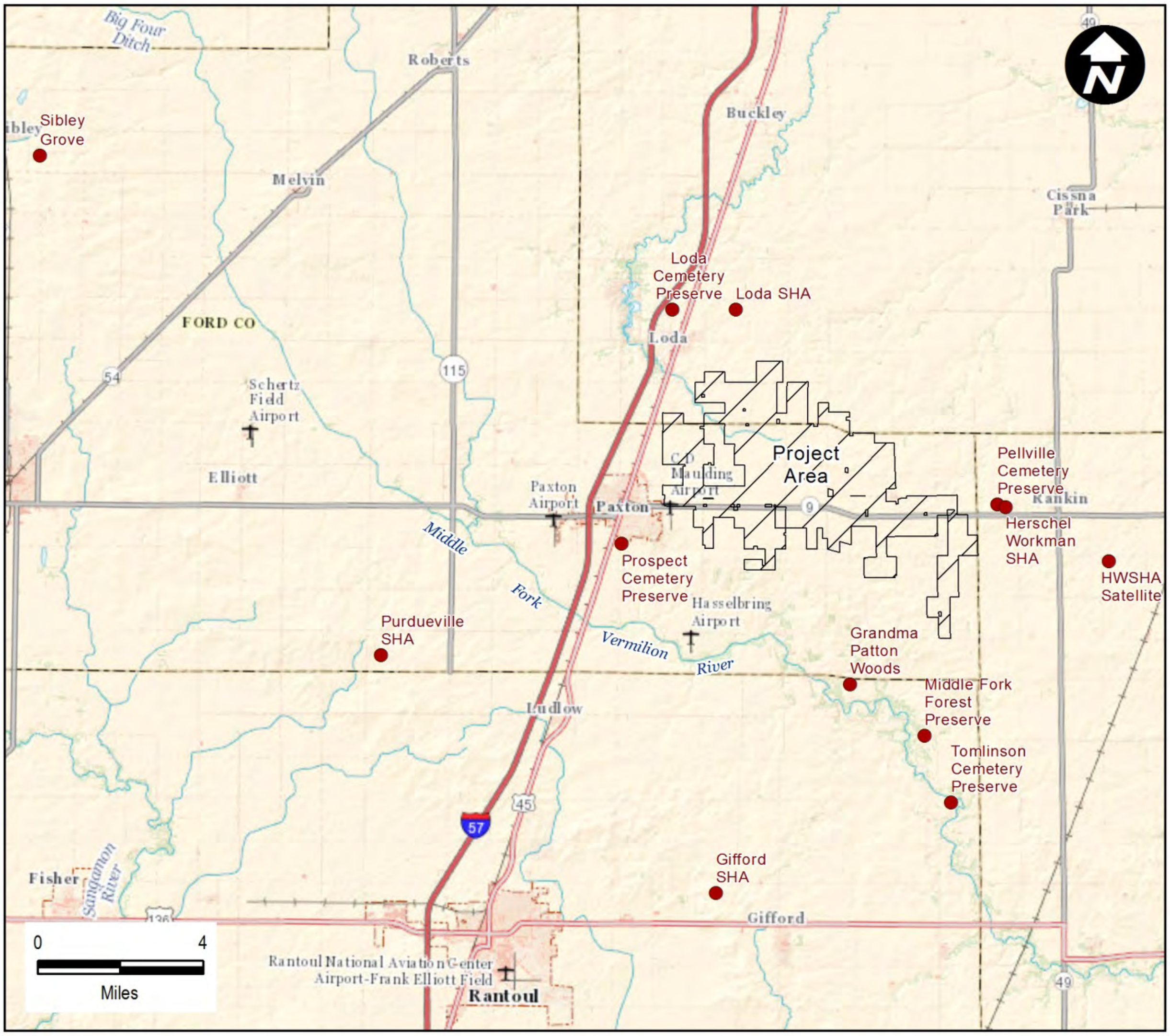


**Figure 3.4.** Notable bird-use sites in the region of the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois.

In Illinois, bald eagles are known to nest at the Crab Orchard National Wildlife Refuge and Savannah in the southern part of the state, with nesting locations in central and northern parts of the state previously unknown (Project HCP). Inquiries to the Service in 2012 indicated that no bald eagle nest locations were known to occur within 10 miles of the Project area (Project HCP). However, during development of the HCP and more recent communications with the agencies, the Service reported two bald eagle territories in the County Forest Preserve at the Middle Fork of the Vermilion River, located approximately 3 miles to the south of the Project. Bald eagles are known to winter primarily along the Mississippi, Rock, and Illinois Rivers in the State; the Illinois River is the closest known wintering area but is at least 20 miles from the Project (Project HCP).

## Rare, Threatened, and Endangered Species

The IDNR and Service identified 12 bird species of particular concern for the Project. Table 3.1 summarizes available data for rare bird species in Ford and Iroquois counties and in relationship to the PTWF. Table 3.1 lists these species, their status and regulatory protection, their season(s) of occurrence in the region, and records of occurrence in the Project area or in Ford and/or Iroquois counties from publically available data, agency communication, or on-site field surveys. This analysis focuses on these 12 species in particular because 1) they are considered at particular risk due to their status, or 2) because they may occur in the Project during sensitive life cycle periods. For example, American golden-plover are known to stopover in the area during their spring migration prior to traveling to their breeding grounds. On-site avian surveys targeted the species listed in Table 3.1, particularly American golden-plover.

## Project Surveys

### *Spring Migration and Early Breeding Periods*

Avian surveys at the PTWF targeted two timeframes: 1) the migratory period of the American golden-plover during early spring (migratory surveys; April 19 to April 22), and 2) the late-spring migratory period and early breeding season (breeding surveys; May 21 to May 24). Refer to the ARA (ARCADIS 2010, provided in Appendix B) for details on the methods and results of these surveys.

Surveys documented 52 species and 1,223 individuals; 37 species were observed during the migratory surveys and 36 species were observed during the breeding surveys. Bird groups observed included passerines, nightjars, waterfowl, shorebirds, game birds, and raptors. See the ARA in Appendix B for the complete list of species observed during surveys. American golden-plover was the only species of concern observed during Project surveys (Table 3.1). However, observers documented sandpipers and longspurs, but not to species. Observers documented 264 golden-plovers during transect surveys and an additional 300 or more golden-plovers in an agricultural field within the Project area outside of the transect survey areas.

Observers recorded 723 breeding birds. Of birds observed, 85% were passerines with brown-headed cowbird (*Molothrus ater*), common grackle (*Quiscalus quiscula*), red-winged blackbird (*Agelaius phoeniceus*), and song sparrow (*Melospiza melodia*) among the most common species; 15% were water birds (shorebirds and waterfowl), and less than 1% were represented by other bird groups. Approximately 100% of golden-plovers occurred in actively farmed agricultural fields. For breeding birds, 67% were observed in agricultural habitat, particularly actively farmed land; 20% occurred in railroad edge habitats, drainages, and grassland buffers; 7% occurred in wetland habitats; and 5% occurred within residential habitats. Species diversity was highest within railroad edge habitats.

Wetland standing water had the highest species utilization rate among habitats surveyed with 2.21 species per survey, followed by actively farmed agricultural land (1.28 species per survey).

**Table 3.1.** Rare bird species and their documented occurrence relative to the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois.

| | | | **Detection by data source** [1] | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Species* | *Status* | *Potential season of occurrence* | *Project area surveys* | *SBC* | *BBA* | *INHD* | *IDNR or Service correspondence* | *Notes / Sources* |
| American golden-plover *Pluvialis dominica* | IL species of concern | Spring migration | Yes | Yes | No | No | Yes | Migrants documented during on-site surveys and SBC. IDNR reported stopover hot spot near Sibley Grove Nature Preserve in Ford County (IDNR 2008), ~15 miles northwest of Project |
| Bald eagle *Haliaeetus leucocephalus* | ESA delisted in 2007 BGEPA | Year-round | No | Yes | No | No | Yes | SBC in Iroquois County detected 3 individuals in 2003 and 1 in 1995. Two nests on Middle Fork Vermilion River 2.75 miles from southeastern edge of Project. |
| Barn owl *Tyto alba* | IL endangered | Year round | No | No | No | Yes | No | INHD has breeding records in Iroquois and Ford counties in 2010 and 2011. |
| Golden eagle *Aquila chrysaetos* | BGEPA | Rare vagrant during migration | No | No | No | No | No | -- |
| Henslow's sparrow *Ammodramus henslowii* | IL species of concern | Breeding, migration | No | Yes | No | No | Yes | IDNR reported breeding within 3 miles of Project. |
| Loggerhead shrike *Lanius ludovicianus* | IL endangered | Breeding, migration | No | No | Yes | No | No | Possible breeding in Iroquois County. |
| Northern harrier *Circus cyaneus* | IL endangered | Year-round | No | Yes | Yes | No | No | Confirmed breeding in Iroquois County; possible breeding in Ford County. |

| | | | Detection by data source [1] | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Species* | *Status* | *Potential season of occurrence* | *Project area surveys* | *SBC* | *BBA* | *INHD* | *IDNR or Service correspondence* | *Notes / Sources* |
| Sandhill crane *Grus canadensis* | None | Migration | No | No | No | No | Yes | IDNR reported 100 individuals in Ford County during spring 1008 (IDNR 2008). |
| Short-eared owl *Asio flammeus* | IL endangered | Winter | No | No | No | No | No | -- |
| Smith's longspur *Calcarius pictus* | None | Spring migration | Possible | No | No | No | No | Unidentified longspurs detected during on-site migration survey. |
| Upland sandpiper *Bartramia longicauda* | IL endangered | Breeding, migration | Possible | No | No | Yes | No | Unidentified sandpipers detected during on-site migration survey; INHD reports breeding record in Ford County in 1994. |
| Whooping crane *Grus americana* | ESA endangered | Migration | No | No | No | No | Yes | IDNR reported records of stopover birds in Ford and Iroquois counties from spring or fall 2003, 2006, and 2008 (IDNR 2008). |

[1] SBC: INHS spring bird counts, 1975-2005 (INHS 2012)
BBA: Illinois Breeding Bird Atlas (Kleen et al. 2004)
INHD: Illinois Natural Heritage Database
IDNR or Service correspondence (see Appendices A and B in ARA (ARCADIS 2010) provided in Appendix B of this EA)

*Behaviors Observed During Project Surveys*

Sixty-nine (26%) of the 264 golden-plovers observed in transect areas were observed flying overhead in flocks of 1 to 30 birds. The other individuals occurred on the ground in agricultural fields (tilled and partially tilled soy and corn fields) and in one wetland.

For breeding birds, 40% (n=289) were observed resting or foraging on the ground, 35% were observed flying, 10% were seen flying within or landing in habitat, 8% were heard acoustically, and 5% were interacting with other birds. Observers documented red-winged blackbirds, mourning doves (*Zenaida macroura*), and cowbirds perching on power lines.

Flights observed in the Project area generally were described as short and sporadic for the purposes of foraging or nest building. Passerine flight heights were described as below the rotor-sweep zone of the proposed turbines and flights generally were localized movements for foraging, finding nest materials, and territorial purposes. Waterbirds (such as killdeer [*Charadrius vociferous*] and mallards [*Anas platyrhynchos*]) at the PTWF occurred below the rotor sweep zone. Canada geese (*Branta canadensis*) and golden-plovers typically flew higher than the sweep zone; golden-plovers were observed in the rotor-sweep zone, but only while landing or taking off. Flight heights were not described for other bird groups. It should be noted that flight heights were documented during daytime and crepuscular periods, and nighttime migratory flight heights were not sampled. Except during take-off and landing, nighttime migratory flights would be expected to be above the rotor-swept zone as many species travel at great heights during nighttime migration. Long-distance migrants have been documented at tens of thousands of feet above ground level (Zimmerman 1998).

***2012-2013 Post-construction Monitoring at the Project***

During the period from August 15 through October 15, 2012, the Project operated during night-time hours (30 minutes before sunset to 30 minutes after sunrise) when wind speeds were 6.9 m/s or higher when the ambient temperature is above 10°C (50°F). In accordance with their BBCS (Appendix A) and the Service's Technical Assistance Letter (Appendix E), PTWF conducted post-construction avian and bat mortality monitoring from August 13 through October 10, 2012 and April 2 through May 8, 2013 (ARCADIS 2013). Monitoring and mortality estimation methods followed the protocols described in the BBCS (see Appendix A, Section 5).

ARCADIS (2013, see Appendix C) provides the fatality estimates from the 2012-2013 post-construction monitoring at the PTWF. ARCADIS biologists collected 13 bird carcasses during scheduled searches and incidental finds, representing 7 identified species and 6 unidentified individuals. Bird carcasses identified to species included those belonging to chimney swift (1), American robin (1), house sparrow (1), American redstart (1), red-breasted nuthatch (1), and golden crowned kinglet (2). The results of post-construction monitoring at the Project and relationships to life-of-Project bird mortality are discussed in more detail in Section 4.3.3.2.

**<u>Summer Habitat Mitigation Project</u>**

Habitat conditions for the Middle Fork Vermilion River are briefly summarized in Section 3.3.1.1. More than 270 bird species regularly occur in the Vermilion River basin (IDNR 2000). Breeding birds include 4 state-endangered species (northern harrier, upland sandpiper, short-eared owl, and Henslow's sparrow) and 5 state-threatened species (pied-billed grebe [*Podilymbus podiceps*], least bittern [*Ixobrychus exilis*], red-shouldered hawk [*Buteo lineatus*], brown creeper [*Certhia americana*], and loggerhead shrike).

### 3.3.4 BAT RESOURCES

#### 3.3.4.1 Scope of Analysis

This section describes bat resources within the Project area and mitigation action areas. For the purposes of this NEPA analysis, federally listed and unlisted bats (those species not listed as threatened or endangered under the ESA) are addressed together in Section 3.3.4.2. Separately, we provide additional information specific to Indiana bats and northern long-eared bats that is pertinent to the analysis of covered species. The bat resources analysis is based on the following:

- Service internal consultations with other field offices and the regional office
- Consultations with staff at the IDNR
- Project HCP
- BBCS (Appendix A)
- Pre-construction acoustic bat survey in the Project area (Appendix D)
- Results of post-construction monitoring at the Project in 2012 and 2013 (Appendix C)

#### 3.3.4.2 Existing Conditions

**Project Area**

***Distribution, Habitat Use, and Populations of Bats***

Twelve bat species occur in Illinois, 9 of which could occur in Iroquois and Ford counties based on their normal ranges (England et al. 2001; Table 3.2). Of these species, only the Indiana bat is listed as threatened or endangered (federally and state-endangered). The IDNR also includes the Indiana bat in its Wildlife Action Plan as a species of increased conservation need (IDNR 2012). The Center for Biological Diversity petitioned the Service to list the northern long-eared bat, and after a status review, the Service's Region 3 found that listing the northern long-eared bat is warranted (USFWS 2013e; 78 FR 61046-61080). The Service is also collecting information to review the status of the little brown bat to determine if threats to the species may be increasing its risk of extinction. Listing considerations and status reviews for both bat species focus on impacts from WNS.

**Table 3.2.** Status and typical winter habit of bat species potentially occurring in Ford and Iroquois counties.

| Common Name | Scientific Name | Abundance[1] | Typical Winter Habit[2] |
|---|---|---|---|
| little brown bat | *Myotis lucifugus* | Common[3] | Hibernates in caves and mines |
| Indiana bat | *Myotis sodalis* | Rare (federal and state endangered) | Hibernates in caves and mines |
| northern long-eared bat | *Myotis septentrionalis* | Common; federal proposed endangered[3] | Hibernates in caves and mines |
| silver-haired bat | *Lasionycteris noctivagans* | Limited distribution / Uncommon | Tree-roosting, long-distance migrant |
| tri-colored bat | *Perimyotis subflavus* | Common | Hibernates in caves and mines |
| big brown bat | *Eptesicus fuscus* | Common | Hibernates in caves, mines, structures |
| eastern red bat | *Lasiurus borealis* | Common | Tree-roosting, long-distance migrant |
| hoary bat | *Lasiurus cinereus* | Limited distribution / Uncommon | Tree-roosting, long-distance migrant |
| evening bat | *Nycticeius humeralis* | Limited distribution / Uncommon | Probable long-distance migrant |

[1] UI Extension (2013; http://m.extension.illinois.edu/wildlife/directory_show.cfm?species=bat)
[2] England et al. (2001)
[3] Regional population declines due to WNS have prompted evaluation for listing under then ESA

*Bat Roosting Habitat*

When not hibernating, bats in the region roost in a variety of habitats including tree crevices or cavities, underneath loose tree bark, and sometimes in buildings or other structures. Reproductive females of *Myotis* species, tri-colored bat, and evening bat typically form maternity colonies of up to 75 or more bats in suitable roosts, occasionally switching among various roosts. Males and non-reproductive females of these species, on the other hand, are typically solitary during the spring and summer, but also use tree and/or buildings or other suitable structures for roosting habitat (England et al. 2001). Cave-hibernating bats disperse up to several hundred miles from hibernacula during summer, with females often dispersing further from hibernacula than males (Fleming and Eby 2003). Regional information is limited on seasonal roosting habitat and distribution of long-distance migratory species including the hoary bat, silver-haired bat, and eastern red bat, although mortality patterns at existing wind farms and a growing body of long-term acoustic survey records indicate that long-distance migratory species move through the region between mid-August and mid-September, likely roosting in trees or foliage during the day.

The woodland tracts in the Project area, although limited in size, provide potential summer roost habitat for bats, and the barns and outbuildings of farms in the area may provide roost or even winter hibernacula for certain bat species such as the big brown bat and little brown bat. Otherwise, the active agricultural habitats in the Project area do not likely provide suitable roosting habitat for bats. Based on a survey conducted in July 2010, IDNR documented an Indiana bat maternity colony in a forested corridor of the Middle Fork River in Ford and Champaign counties approximately 2.5 miles from the southern boundary of the Project (IDNR personal communication cited in Project BBCS, USFWS email correspondence cited in Project HCP). This forested corridor likely provides high-quality roosting habitat for a variety of bat species. Mist-net surveys conducted in this forested corridor captured juvenile and post-lactating female northern long-eared bats.

*Foraging Habitat*

Bat species likely to occur in the Project area forage in a variety of habitats and include species adapted to foraging in cluttered and open habitats. Foraging habitat preference varies among species, likely driven by distribution and abundance of suitable insect prey and morphology of each bat species. Little is known regarding bats' use of agricultural areas in the Midwest. In the Project area, foraging bats likely concentrate along existing woodland strips, streams, and other features that may attract a greater diversity and abundance of insect prey or serve as linear flight corridors.

*Hibernacula*

No known bat hibernacula exist in Iroquois or Ford Counties (J. Kath, IDNR, personal communication). Some bats may hibernate in buildings and other structures in or near the Project area. Blackball Mine is the nearest known large hibernaculum for bats, located approximately 120 miles to the northwest in LaSalle County, Illinois. This cave typically contains, in decreasing order of abundance, little brown bats, Indiana bats, tri-colored bats, big brown bats, and northern long-eared bats. Cave counts at the Blackball Mine complex conducted every other year from 1999 to 2007 documented a steady increase in Indiana bat numbers from 1,455 to 2,513 and total bat numbers ranging from 20,254 to 26,352 bats (IDNR, unpublished data).

*Migration*

Bats are highly mobile, and dispersal and migration are important aspects of their life strategies. Species potentially occurring in the Project area include short-distance migrants that hibernate colonially within the region in winter (typically in caves or mines) and long-distance migrants that migrate out of the region in winter and are thought to hibernate primarily in trees. Bats of all species are typically absent from the landscape in the region of the Project area between November and March and either emerge from hibernacula or migrate to the region in spring (April-May).

Little is known about the migratory behavior of bats. Seasonal timing and species composition of bat mortality at wind farms indicate bats are at increased risk of collision during fall migration in particular. This increased risk of mortality may be related to an attraction to tall structures, mating or courtship behavior, increased flight height, or failure to detect turbines during migratory flight (Kunz et al. 2007a, b; Cryan 2008).

***On-site Bat Surveys***

On-site bat surveys included a GIS-based Indiana bat habitat assessment of the Project area, one season (April – November) of stationary acoustic bat monitoring, and a series of mobile acoustic surveys along driving transects in the Project area. Stationary and mobile acoustic surveys are appropriate survey techniques to assess bat activity patterns at proposed and existing wind farms (Redell et al. 2006, Kunz et al. 2007a, b). Following is a summary of relevant results from on-site surveys; the full survey report is included as Appendix D.

According to the USGS Gap Analysis Program (GAP) landcover data, the Project area contains six landcover categories (as summarized in Stantec 2011a and listed in Table 3.3). Agricultural crops and grasslands are the primary landcover, and forested habitats are limited to narrow wooded strips along a series of named and unnamed streams making up less than 0.5% of total landcover in the Project area. Currently, no woodland tracts in the Project area meet the minimum forest cover requirement of >15% for suitable Indiana bat summer habitat (Stantec 2011a). Natural habitat features or resource areas for other bat species are also limited in the Project area. Two designated natural areas occur in the Project area (Clarence Railroad Prairie and Clarence West Railroad Prairie); both are considered restored or natural prairies and are not likely to provide summer roosting habitat for bats (Stantec 2011a).

**Table 3.3.** Landcover type and area within the Project area.

| Landcover Type[1] | Total Acres | Percent of Total |
|---|---|---|
| Agriculture (row crop) | 12081.3 | 95.6 |
| Grassland (pasture) | 477.9 | 3.8 |
| Developed | 75.9 | 0.6 |
| Upland forest | 3.6 | 0.03 |
| Open water | 1.6 | 0.01 |
| Forested wetland | 0.9 | <0.01 |

[1] Illinois GAP landcover data, as summarized in Stantec 2011a.

On behalf of PTWF, Stantec Consulting Services Inc. (Stantec) conducted stationary acoustic bat surveys in the Project area between April 17 and November 4, 2010. Two detectors, one at 190 feet and one at 16.5 feet above ground, were mounted on a 197-foot tall meteorological tower. Detectors recorded bat activity during 201 calendar nights (402 detector-nights of sampling). Detectors recorded bats on 145 out of 201 (72%) nights and 1,026 classifiable bat passes (mean = 2.6 passes/night). Surveyors estimated the call filtering process removed an additional 243 unclassifiable passes, resulting in an adjusted total of 1,269 bat passes (mean = 3.2 passes/night; Table 3.4).

**Table 3.4.** Summary of bat passes (mean per night) by detector height, season, and frequency group for stationary pre-construction surveys in 2010 at the Pioneer Trail Wind Farm, Iroquois and Ford counties, Illinois (Stantec 2011a).

| | Detector Height | | |
|---|---|---|---|
| Season | 5 meters (16 feet) | 58 meters (190 feet) | Total |
| *Spring (15 April – 15 May)* | | | |
| Low frequency bat passes | 18 (0.6) | 41 (1.4) | 59 (1.0) |
| High frequency bat passes | 10 (0.3) | 3 (0.1) | 13 (0.2) |
| Total passes (Spring) [1] | 29 (1.0) | 45 (1.6) | 74 (1.3) |
| *Summer (16 May – 15 July)* | | | |
| Low frequency bat passes | 77 (1.3) | 83 (1.4) | 160 (1.3) |
| High frequency bat passes | 15 (0.2) | 10 (0.2) | 25 (0.2) |
| Total passes (summer) [1] | 97 (1.6) | 96 (1.6) | 193 (1.6) |
| *Fall (16 July – 31 October)* | | | |
| Low frequency bat passes | 244 (2.2) | 376 (3.4) | 620 (2.8) |
| High frequency bat passes | 44 (0.4) | 56 (0.5) | 100 (0.5) |
| Total passes (fall) [1] | 309 (2.8) | 450 (4.1) | 759 (3.4) |
| *Curtailment period (15 August – 15 October)* | | | |
| Low frequency bat passes | 137 (2.2) | 250 (4.0) | 387 (3.1) |
| High frequency bat passes | 14 (0.2) | 17 (0.3) | 31 (0.3) |
| Total passes (curtailment period) [1] | 160 (2.6) | 272 (4.4) | 432 (3.5) |
| % of total for activity season | 37% | 46% | 42% |
| Total low frequency passes for activity season | 339 (1.7) | 500 (2.5) | 839 (2.1) |
| Total high frequency passes for activity season | 69 (0.3) | 69 (0.3) | 138 (0.3) |
| Total classifiable passes for activity season* | 435 (2.2) | 591 (2.9) | 1,026 (2.6) |
| Estimated total unclassifiable passes for activity season | 243 | | |
| Adjusted total passes for activity season | 1,269 (3.2) | | |

[1] Some recorded bat sound files contained both low and high frequency species or were too poor quality to characterize the call by frequency group. Therefore, the sum of bat passes for these groups may not equal the "Total Passes" recorded.

Stantec surveyed six driving transects from a slowly moving (< 5 mph) vehicle on 15 occasions each (90 mobile surveys). Each transect was surveyed five times in spring, two times in summer, and eight times in fall. Active surveys recorded 58 definitive bat passes (mean = 0.6 passes/transect/night; Table 3.5).

Transect 4, located in the southwest corner of the Project area, yielded the highest amount of bat activity, with 28 total passes (mean = 1.9/night).

**Table 3.5.** Bat passes (mean per transect per survey night) for mobile pre-construction surveys in 2010 at Pioneer Trail Wind Farm, Iroquois and Ford counties, Illinois (Stantec 2011a).

| Category | Transect 1 | Transect 2 | Transect 3 | Transect 4 | Transect 5 | Transect 6 |
|---|---|---|---|---|---|---|
| Low Frequency Bat Passes | 0 (0.0) | 3 (0.2) | 2 (0.1) | 14 (0.9) | 4 (0.3) | 4 (0.3) |
| High Frequency Bat Passes | 2 (0.1) | 2 (0.1) | 0 (0.0) | 9 (0.6) | 10 (0.7) | 3 (0.2) |
| Total Passes | 2 (0.1) | 5 (0.1) | 2 (0.1) | 28 (1.9) | 14 (0.9) | 7 (0.5) |
| Total Passes for Activity Season[1] | 58 (0.6) | | | | | |

[1] Some recorded bat sound files contained both low and high frequency species or were too poor quality to characterize the call by frequency group. Therefore, the sum of bat passes for these groups may not equal the "Total Passes" recorded.

Monthly mean bat activity peaked in August. Of all bat passes, 74% (n=755 passes) occurred in July, August, and September. Bat activity levels (mean number of bat passes per detector night) were highest during fall. Of all bat activity, 42% occurred between 15 August and 15 October, during which mean nightly activity levels were similar to the fall levels. Acoustic surveys documented five species (big brown bat, silver-haired bat, eastern red bat, hoary bat, and tri-colored bat) and several *Myotis* calls that were likely to be little brown bat and possibly northern long-eared bat (see Section 3.3.1 in BBCS, Appendix A). Confirmed *Myotis* calls represented 7% of the identifiable call sequences from the mobile survey, but only 0.8% of the identifiable calls recorded during the stationary survey.

Long-distance migratory species comprised greater than 70% of identifiable bat passes during stationary and acoustic surveys in each season. Eastern red bats, hoary bats, and silver-haired bats accounted for 92% of identifiable bat passes recorded in the rotor zone (58-meter [19-foot] detector) and 50% of identifiable bat passes recorded by the low (5-meter [16-foot]) detector. Tri-colored bats occurred only during the fall and were not documented in the rotor zone.

### *2012-2013 Post-construction Monitoring at the Project*

During the period from August 15 through October 15, 2012, the Project operated during night-time hours (30 minutes before sunset to 30 minutes after sunrise) when wind speeds were 6.9 m/s or higher when the ambient temperature is above 10°C (50°F). In accordance with their BBCS (Appendix A) and the Service's Technical Assistance Letter (Appendix E), PTWF conducted post-construction avian and bat mortality monitoring from August 13 through October 10, 2012 and April 2 through May 8, 2013 (ARCADIS 2013, provided in Appendix C). Monitoring and mortality estimation methods followed the protocols described in the BBCS (see Appendix A, Section 5).

ARCADIS (2013, provided in Appendix C) provides the fatality estimates from the 2012-2013 post-construction monitoring at the PTWF. ARCADIS biologists collected 27 bat carcasses during scheduled searches and incidental finds, representing 26 identified and 1 unidentified species. Bat carcasses identified included those belonging to red bats, silver-haired bats, and little brown bats. ARCADIS (2013) estimated 38 mortalities for the fall 2012 period and 20 mortalities in the spring 2013 period. The Applicant will implement the same interim modified operations up until the time they obtain an ITP. The results of post-construction monitoring at the Project and relationships to life-of-Project bird mortality are discussed in more detail in Section 4.3.3.2.

**Rare, Threatened, and Endangered Bats**

***Indiana Bat***

Section 5.0 of the proposed HCP provides a thorough summary of Indiana bat biology, behavior, and status. Following is a brief description of Indiana bat characteristics, habitat requirements, and range and status in the vicinity of the Project area as related to this Environmental Assessment and Alternatives Analysis.

*Indiana Bat Status*

The Indiana bat is the only bat species potentially occurring in the Project area that is currently legally protected under the Endangered Species Act. The Service originally listed the Indiana bat as being in danger of extinction on March 11, 1967 under the Endangered Species Preservation Act of 1966 (USFWS 1967; 32 FR 4001). The species remains listed as endangered under the ESA of 1973, as amended. The estimated rangewide Indiana bat population in 2011 was 424,708, up 2.2% from 2009 and roughly17% higher than the 2003 estimate (USFWS 2012a). As of 2006, the Service had records of extant winter populations at approximately 281 hibernacula in 19 states and 269 maternity colonies in 16 states (USFWS 2007).

The Indiana bat is listed as state endangered in Illinois, protected under Illinois Endangered Species Protection Act-520 ILCS 10/1, with regulatory authority under state law the responsibility of IDNR. Indiana bat reproductive records are concentrated in southwestern Illinois, and Ford County is one of only two counties in east-central Illinois with confirmed summer reproductive records (USFWS 2007). Blackball Mine, the nearest Indiana bat hibernacula to the Project area, was designated as critical habitat on September 24, 1976 (USFWS 1976; 41 FR 41914-41916) and is the only designated critical habitat in Illinois.

Threats to Indiana bats have traditionally included modification to hibernacula that change the airflow and alter the microclimate, human disturbance and vandalism causing direct mortality during hibernation, natural events during winter affecting large numbers of individuals, disease, and loss and degradation of summer habitat (USFWS 2007). WNS is a new, potentially devastating threat to Indiana bats throughout their range. WNS is a fungal infection first identified in eastern New York during the winter of 2006-2007 and is named for the visible presence of a white fungus around the muzzles, ears, and wing membranes of some infected bats. A previously unreported species of cold-loving fungus (*Pseudogymnoascus destructans*, formerly *Geomyces destructans*) is the primary pathogen associated with WNS. It is an invasive exotic fungus with probable origins in Europe (Lorch et al. 2011, Minnis and Lindner 2013) and thrives in conditions characteristic of bat hibernacula.

WNS causes bats to arouse more frequently during hibernation, with reductions in the length of bouts of torpor associated with increased mortality rates (Reeder et al. 2012). In 2012, the Service estimated the fungus has killed 5.7 to 6.7 million bats total since its discovery in 2006 (USFWS 2012d). WNS affects most bat species of bats that hibernate in the northeast, with the little brown bat, northern long-eared bat, and Indiana bat among the most impacted. The Service estimates a 46% decline in the Indiana bat population in the Service's Northeast Region between 2007 and 2011 due to WNS (USFWS 2012a).

The Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision (Recovery Plan; USFWS 2007) defines four Recovery Units based on "evidence of population discreteness and genetic differentiation, differences in population trends, and broad-level differences in macrohabitats and land use." The Project area is within the OCRU, which includes the Indiana bat's range in Illinois, Missouri, Arkansas, and Oklahoma (USFWS 2007). According to the 2011 Rangewide Population Estimate, the overall Indiana bat population in Illinois was approximately 55,956 in 2011 (Table 3.6). This represents 79% of the 2011 Indiana bat population in the OCRU (70,822) and 13.2% of the overall 2011 Indiana bat population (424,708) (USFWS 2012a). The Indiana bat population in the OCRU increased steadily between 2003 and 2011 (Table 3.6). WNS was first documented in the OCRU in Oklahoma and Missouri during the winter of 2009-2010, and was confirmed in Illinois (LaSalle, Monroe, Hardin, and Pope Counties) in February 2013.

**Table 3.6.** Indiana bat population estimates for the Ozark-Central Recovery Unit.

| State | 2005 | 2007 | 2009 | 2011 | 2013 | % Change from 2011 |
|---|---|---|---|---|---|---|
| Illinois | 55,090 | 53,823 | 53,342 | 55,956 | 57,074 | 2.0 |
| Missouri | 139,038 | 138,831 | 136,624 | 138,379 | 139,772 | 1.0 |
| Arkansas | 2,067 | 1,829 | 1,480 | 1,206 | 856 | -29.0 |
| Oklahoma | 2 | 0 | 0 | 13 | 5 | -61.5 |
| Total | 196,197 | 194,475 | 191,446 | 195,554 | 197,707 | 1.1 |

Source: USFWS (2013a)

Illinois has 22 historical Indiana bat hibernacula, all of which, except for Blackball Mine, are located in southern or western Illinois. Blackball Mine contained 2,513 Indiana bats during the most recent count (2007). Indiana bats were the second most abundance species in the mine complex, accounting for 12% of the hibernating population in the cave. Griffith Cave, located approximately 200 miles to the south of the Project in Hardin County, is a candidate hibernaculum for protection as part of the mitigation plan for the PTWF HCP. In February, 2013, Griffith Cave contained 2,150 Indiana bats, up from the 2010 count of 623 and the 2009 count of 787, although WNS was confirmed in the cave in winter 2013 (IDNR, unpublished data). Griffith cave is on privately owned land and is currently not fitted with a bat friendly gate.

Indiana bat maternity colonies have occurred historically in Ford and Vermilion counties in Illinois (USFWS 2007). Based on a survey in July 1010, IDNR documented an Indiana bat maternity colony in a forested corridor of the Middle Fork River in Ford and Champaign counties approximately 2.5 miles from the southern boundary of the Project (IDNR personal communication cited in Project BBCS, USFWS email correspondence cited in Project HCP). Currently, there are no records of Indiana bats in Iroquois County (USFWS 2007).

*Indiana Bat Hibernation and Seasonal Migration*

Indiana bat maternity colonies tend to disband beginning in the first 2 weeks of August, with most bats leaving their summer ranges by mid-September. Indiana bats are highly mobile during fall, eventually congregating near hibernacula between August and October and swarming on a nightly basis for up to several weeks. Although swarming occurs near cave entrances, bats roost in trees during the day at this time of year rather than in the caves, traveling large distances from hibernacula and occasionally moving between hibernacula (USFWS 2007). Bats mate near the end of the swarming period, with females entering hibernation soon after mating and males remaining active until later in fall.

Indiana bats typically begin hibernation between mid-October and mid-November, concentrating in a limited number of caves or abandoned mines having suitable characteristics. Spring emergence varies with latitude and weather conditions, with studies in Indiana and Kentucky documenting peak emergence of females in mid-April and males in early May (Cope and Humphrey 1977). After emerging from hibernacula in spring, Indiana bats travel up to several hundred miles to their summer range, with females typically traveling greater distances than males (USFWS 2007). Behavior and habitat needs of Indiana bats during spring migration are poorly understood, although they appear to move quickly to summer ranges.

*Indiana Bat Summer Roosting Habitat Requirements and Foraging Behavior*

Indiana bats roost primarily in trees during summer, usually under exfoliating bark and occasionally using narrow crevices or cracks in trees located in semi-open areas of forest with greater solar exposure (USFWS 2007). Indiana bats switch among primary and secondary roosts throughout the summer, with maternity colonies focusing use on a small number of primary roosts but using up to 10-20 total trees throughout the summer (USFWS 2007).

Indiana bats are nocturnal insectivores, feeding exclusively on flying insects. They typically forage from 6 feet to 100 feet above the ground and hunt primarily around, not within, the canopy of trees (USFWS 2007). Indiana bats preferentially forage in wooded areas, with forest type varying among studies, including closed to semi-open forests and forest edges (USFWS 2007). Foraging habitat studies in Illinois indicated floodplain forest was the most preferred habitat, followed by ponds, old fields, row crops, upland woods, and pastures (USFWS 2007).

Telemetry studies have documented nightly foraging distances for female Indiana bats ranging from 0.3 to 5.2 miles from nightly roosts, with foraging ranges typically in the range of 1.6 miles to 2.8 miles from nightly roosts (USFWS 2007). The size of foraging areas likely depends on extent of suitable habitat, interspecific competition, and prey availability. Rather than crossing large areas of unsuitable habitat, Indiana bats tend to follow corridors of suitable habitat, even if it means flying a greater distance (USFWS 2007).

### *Northern Long-eared Bat*

The proposed HCP provides a summary of northern long-eared bat biology, behavior, and status (see Section 5.2). Below we provide a brief description of northern long-eared bat characteristics, habitat requirements and status in the vicinity of the Project area and mitigation areas.

#### *Northern Long-eared Bat Status*

The Service proposed listing the northern long-eared bat as endangered on October 2, 2013(USFWS 2013e). The Service is preparing a formal listing package that will address factors and reasons for decline and expects to list the northern long-eared bat in spring 2015. Primarily, the Service finds that listing is warranted due to the recent severe and ongoing decline of the species due to WNS. The Service's 12-month finding lists other reasons for decline, but none is as serious as WNS (USFWS 2013e). (See Indiana bat section above for a brief description of WNS and its associated fungus.)

The northern long-eared bat is a relatively wide-ranging bat, but it appears to be patchily distributed and found in low numbers in both roosts and hibernacula (Griffin 1940, Barbour and Davis 1969, Caire et al. 1979, Amelon and Burhans 2006, ASRD and ACA 2009). The Service categorizes the U.S. range of the species in four parts, eastern, Midwestern, southern, and western populations (USFWS 2013e). The northern long-eared has been noted in typically small numbers in numerous hibernacula across its range, but insufficient data are available at this time to estimate a rangewide population. Population estimates are also unavailable for the Midwestern population, although mist-net survey data indicate that the species is commonly captured in this region.

#### *Northern Long-eared Hibernation and Seasonal Migration*

Depending on the geographic area, northern long-eared bats occupy summer habitats from approximately March through August and then begin to swarm near their hibernacula in August or September (Caire et al. 1979). At Copperhead Cave in Indiana, Whitaker and Mumford (2009 as cited in USFWS 2013e) observed the majority of northern long-eared bats enter hibernation during October and emerge from the second week of March to mid-April. Hibernation periods farther north may begin earlier and end later (Stones and Fritz 1969 as cited in Fitch and Shump 1979). Northern long-eared bats share hibernacula with other bat species (Fitch and Shump 1979, Whitaker and Mumford 2009 as cited USFWS 2013e), but Barbour and Davis (1969) did not find them in concentrations with over 100 individuals in one hibernaculum. Individuals may also rouse and switch hibernacula throughout the winter, which makes it difficult to accurately estimate winter population numbers (Griffin 1940, Whitaker and Rissler 1992, Caceres and Barclay 2000).

#### *Northern Long-eared Bat Summer Roosting Habitat Requirements and Foraging Behavior*

During the summer, northern long-eared bats inhabit forests and roost singly or in colonies in the cracks, crevices, and bark of both live and dead trees (Lacki and Schwierjohann 2001). They have also been found roosting in structures, such as buildings, barns, sheds, and cabins. Foster and Kurta (1999) have indicated that northern long-eared bats do not appear to depend on any particular species of tree for roosting, but rather tree characteristics, such as structure of decay. Northern long-eared bats have been found roosting below the canopy in forests with a variety of canopy cover percentages, but Perry and Thill (2007) found relatively open forests in Arkansas to be important for female roosts as compared to male roosts.

The northern long-eared bat forages on a variety of insects, and the most common include moths, beetles, and spiders (Brack and Whitaker 2001, Feldhamer et al 2009). Northern long-eared bats forage and commute primarily in forested interiors (Jung et al. 1999, Owen et al. 2003, Carter and Feldhamer 2005, Broders et al. 2006). Foraging techniques include hawking (catching insects in flight) and gleaning (Ratcliffe and Dawson 2003, Feldhamer et al. 2009). Northern long-eared bats have shown a preference for forested hillsides and ridges, as opposed to riparian areas (LaVal et al. 1977, Brack and Whitaker 2001). This preference corresponds with the suggestion in Caceres and Pybus (1998) that mature forests are important foraging habitat for northern long-eared bats. Recent capture efforts have found northern long-eared bats in young stands and disturbed forests (Crampton and Barclay 1998, Foster and Kurta 1999, Cryan et al. 2001, Menzel et al. 2002, Henderson and Broders 2008, Henderson et al. 2008, ASRD and ACA 2009).

**Summer Habitat Mitigation Project Area**

Nine bat species are documented for the Vermilion River basin. Among these nine species, the little brown bat, big brown bat, northern long-eared bat, tri-colored bat, and evening bat forage in forested habitats and nest in trees or man-made structures such as buildings. Indiana bat maternity roosts have been found at two locations in the Middle Fork Vermilion River corridor. Conversely, specific roosts for northern long-eared bats have not been identified because captured bats have not been radio-tagged and tracked. Post-lactating females as well as male and female juvenile northern long-eared bats have been found in this corridor, and therefore it can be inferred that maternity roosts are also present.

## 3.4 SOCIOECONOMIC ENVIRONMENT

### 3.4.1 ECONOMICS AND ENVIRONMENTAL JUSTICE

For the purposes of this EA, impacts on economics would largely occur in association with local employment for the PTWF and mitigation projects. Taxes and base lease payments for the Project would not differ among alternatives. However, royalties to participating landowners are paid based on the actual energy production. Accordingly, the Non-Restricted Operations Alternative would result in the greatest positive impact on the local economy due to the higher royalty payments that would result from the greater energy production, and the No Action Alternative would contribute the least to the local economy due to the lower energy production that would result. The energy production from the preferred alternative and the resulting royalties to landowners from the project would have an impact on the local economy somewhere between the other two alternatives. This section describes economic characteristics of Ford and Iroquois counties.

#### 3.4.1.1 Project Area

**Economic Resources**

Relative to the Project, Paxton is the nearest city and has a population around 4,500. Major economic centers are located in Champaign-Urbana (~ 45 miles) and Danville (~35 miles). Income data for the state and Ford and Iroquois counties are presented in Table 3.7 and are based on 2010 U.S. Census data.

**Table 3.7.** Income statistics in the region of the Pioneer Trail Wind Farm.

| | Population | Median Household Income | Persons Below Poverty Level (%) |
|---|---|---|---|
| State of Illinois | 12,830,632 | $56,853 | 1,757,797 (13.7%) |
| Ford County | 14,081 | $50,203 | 1,394 (9.9%) |
| City of Paxton | 4,473 | $48,917 | 496 (11.1%) |
| Iroquois County | 29,718 | $47,908 | 3,418 (11.7%) |

Source: U.S. Census Data (2014)

Ford County is within the Champaign- Urbana Metropolitan Statistical Area, which reported 8.7% unemployment rate in June 2013 (IDES 2013a). At the county-level, Illinois Department of Employment Security reported 8.3% and 7.7% unemployment rates for Ford and Iroquois counties, respectively, in June 2013 (IDES 2013b).

PTWF employs full-time, permanent workers to operate and maintain the wind farm. PTWF also has contracted part-time, temporary workers to conduct post-construction carcass monitoring in spring (April 1 through May 15) and fall (August 15 through October 15).

**Environmental Justice**

Executive Order 12898 requires federal agencies to address, as appropriate, any disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority and low-income populations.

There will not be any disproportionate adverse environmental impacts to minority and low income populations in the affected environment requiring additional consideration under environmental justice requirements. Minority and low income groups or individuals will not be impacted at a rate that appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group. Therefore, further consideration of the environmental justice policy under NEPA is not required. If environmental impacts occur to minority or low-income individuals and rise to the level of significance under NEPA, it is highly improbable that there will be a disproportionate impact. Hence the impacts, positive or negative, that would occur under the Proposed Action or any alternative will be neither disproportionately gained nor borne by minority or low income populations.

### 3.4.2 LAND USE

Land uses may be affected in association with Project operations and implemented summer habitat mitigation.

#### 3.4.2.1 Existing Condition

**Project Area**

The Project site includes those areas at 10 turbines to be maintained in mowed conditions to facilitate carcass searchers from April 1 to May 15 and August 15 to October 15 for the first 2 years following construction. Surrounding these 10 cleared areas and the Project footprint, the land use is in agriculture, farm roads, and farmhouses and buildings.

**Summer Habitat Mitigation Site**

The site for summer habitat mitigation will be a site that is currently in agricultural use and connected to a forested corridor. Land uses within the Middle Fork Vermilion River corridor include cropland, small privately owned bottomland-forests and prairies, and 9,600 acres of state-owned land (recreation area, fish and wildlife area, and natural areas; Figure 3.2).

### 3.4.3 HEALTH AND SAFETY

There are identified public health and safety issues related to wind power facilities. The safety issues described in this section are primarily related to operation and/or failure of one or more wind project components, particularly wind turbines and electricity transmission. The analysis area also includes Griffith Cave, where the project is likely to eliminate risks to public safety. The health and safely analysis is based on readily available information on electrical power generating facilities, wind projects, and caves.

#### 3.4.3.1 Existing Condition

**Project Area**

Public safety concerns associated with the PTWF may arise during operation or decommissioning and are largely regarding the potential for falling overhead objects. Examples include ice shedding, tower collapse and blade failure. Other health and safety concerns may include stray voltage, fire, lightning strikes, and shadow flicker. Because the Project is constructed and operating, these risks are already in place and part of the existing condition. Their likelihood of occurring and potential consequences are addressed in Section 4.4.2 of Environmental Consequences.

***Structural Failure and Ice Shedding***

Turbine structural failure includes turbine collapse and blade shear. Blade shear occurs when a turbine blade detaches and is thrown due to the spinning motion. Ice shedding occurs when ice builds up on a turbine blade and either sheds straight to the ground or is thrown by the spinning motion. Under such conditions, ice would build up on the rotor blades and/or sensors, slowing its rotational speed and potentially creating an imbalance in the weights of the blades. Turbine control systems are designed to sense such effects of ice accumulation and to shut down the turbine until the ice melts. The layout of the PTWF followed Ford County's standards for wind energy conversion systems (Ford County 2009). Turbines in PTWF are a minimum of 1,000 feet from any primary structure. The owner of a primary structure may waive this setback requirement; but in no case shall a turbine tower be located closer than 1.10 times the tower tip height (~ 400 feet, in the case of turbines at PTWF).

***Lightning Strikes***

Wind turbines are susceptible to lightning strikes due to their height and metal/carbon components. The energy discharged during a lightning strike can cause severe damage to blades, which may lead to complete blade failure, although blade failure from lightning strikes is uncommon. All modern wind turbines include lightning protection systems which are designed to prevent catastrophic blade failure. To protect wind turbines from damage caused by lightning strikes and to provide grounding for the electrical components of the turbine, each turbine is equipped with an electrical grounding system.

***Shadow Flicker***

Shadow flicker from wind turbines can occur when moving turbine blades pass in front of the sun, creating alternating changes in light intensity or shadows. These flickering shadows can cause an annoyance when cast on nearby residences ("receptors"). The distance between a wind turbine and a receptor, along with weather characteristics such as wind direction and sunshine probability are key factors related to shadow-flicker impacts. Shadow flicker becomes much less noticeable at distances beyond about 305 meters (1,000 feet), except at sunrise and sunset when shadows are long (NRC 2007).

***Fire and Fuels***

Although the turbines contain relatively few flammable components, the presence of electrical generating equipment and electrical cables, along with storage and use of various oils, including diesel fuels, lubricating oils, and hydraulic fluids, can create the potential for fire or medical emergencies within the tower or the nacelle, or in places where these oils may be stored such as the substation, electrical transmission structures, staging area(s), and the operations and maintenance building.

***Stray Voltage, Electrocution, and Electromagnetic Fields***

Proper electrical installation and grounding practices prevent stray voltage from occurring. The Applicant has indicated the Project's electrical collection system meets applicable design and safety regulations, is properly grounded, has adequate spacing from other electrical cables, and is not connected to local distribution lines. Based on this assumption, the Project will not have any adverse impacts on human health and safety due to stray voltage.

Electric fields are created by changes in voltage: the higher the voltage, the stronger the resultant electric field. Magnetic fields are created when electric current flows: the greater the current, the stronger the magnetic field. An electric field will exist even when there is no current flowing. Electromagnetic fields (EMF) above certain levels can trigger biological effects. Experiments indicate that short-term exposure of EMF at the levels present in the environment or home does not cause any apparent detrimental effects in healthy individuals (WHO 1999). Exposures to higher levels that might be harmful are restricted by national and international guidelines.

EMF at a wind project can originate from the collection system, turbine generators, transformers, and underground network cables. The primary source of EMF from the Project is the generation lead line used to connect the Project substation to the existing Paxton West substation. This generation lead line is approximately 3 miles long.

**Winter Habitat Mitigation Project**

The winter habitat mitigation project would be located at Griffith Cave in Hardin County. Griffith Cave is located on private land, but that might not exclude cavers from exploring the cave. Caves are inherently dangerous environments, and this applies to Griffith Cave. In 2007 and 2008, American Caving Accidents (2010) reported 73 incidents related to caving activities. Incidents include falls, striking body parts on rock, hypothermia, getting lost, drowning, getting stuck, stranded due to poor equipment, and exhaustion.

# 4 ENVIRONMENTAL CONSEQUENCES

## 4.1 OVERVIEW OF THE EFFECTS ANALYSIS

This chapter describes the environmental effects of each of the three alternatives retained for detailed analysis. The chapter is organized by resource and corresponds to the organization of Chapter 3. Each of the alternatives would include the operation of a wind project, implementation of the BBCS, and post-construction monitoring. The three alternatives differ with respect to operational adjustments and the extent of mitigation implemented to offset the taking of Indiana bats and northern long-eared bats (Table 4.1).

**Table 4.1.** Summary of alternatives retained for detailed analysis.

| | Alternative | | |
|---|---|---|---|
| Element | 1: No-Action | 2: Preferred | 3: Non-Restricted |
| Operations | All 94 turbines would be curtailed and feathered until wind speeds reach the raised 6.9 m/s cut-in speed from 30 minutes before sunset to 30 minutes after sunrise when the ambient temperature is above 10°C (50°F) from August 15 through October 15. | All 94 turbines would be curtailed and feathered until wind speeds reach the raised 5.0 m/s cut-in speed from sunset to sunrise when the ambient temperature is above 10°C (50°F) from August 15 through October 15. | All 94 turbines would be feathered until wind speeds reach the manufacturer's specified 3.5 m/s cut-in speed 24 hours per day year-round. |
| Indiana bat take | Take: 0 | Take: 129<br>Females: 97<br>Males: 32<br>Reproductive potential: 184<br>Total: 313 | Take: 215<br>Females: 161<br>Males: 54<br>Reproductive potential: 306<br>Total: 521 |
| Northern long-eared bat take | Take: 0 | Take: 86<br>Females: 43<br>Males: 43<br>Reproductive potential: 82<br>Total: 168 | Take: 129<br>Females: 64<br>Males: 64<br>Reproductive potential: 123<br>Total: 252 |
| HCP / Mitigation implemented | No | Yes. Minimization measures. Mitigation for summer habitat for both species and winter habitat for Indiana bats. | Yes. No minimization measures. Mitigation for winter and summer habitat. |
| BBCS implemented [1] | Yes | Yes | Yes |

[1] Bird and Bat Conservation Strategy (see Appendix A)

Our analysis is commensurate with the estimated impacts associated with Project operations and focuses predominately on bird and bat resources. We estimate that effects to geology and soils, air quality, surface water resources, noise, vegetation, wildlife, socioeconomics, land use, and health and safety would be minor. Hence, we provide limited analyses for these resources.

In each resource section, we first address direct and indirect effects for each alternative. Each resource section concludes with a summary of effects each alternative would have on that resource. At the end of all resource sections, we address cumulative effects. As per the CEQ guidelines (CEQ 1997), resources that would be unaffected by the Preferred Alternative or other alternatives, experience beneficial effects, or subject to temporary effects were excluded from our cumulative effects analysis. Upon using this screening process, we limited our cumulative effects analysis to bird and bat resources (found in Sections 4.5.2 and 4.5.3.

## 4.2 PHYSICAL ENVIRONMENT

### 4.2.1 SURFACE WATER

#### 4.2.1.1 Impact Criteria

Effects to water resources are regulated at the federal level by the Federal WPCA (CWA) of 1972, Executive Order 11988: Floodplain Management (1977), Wild and Scenic Rivers Acts of 1968, and Safe Drinking Water Act of 1974. Dangers associated with development in floodplains are also addressed under Executive Order 11988.

Major impacts to surface water resources can occur when any of the following result:

- Lost functions and values at a unique hydrological feature;
- Significant alteration of the quantity or quality of a water supply for existing users;
- Compromised safety and security of any water supply; or
- Natural functions of a floodplain or wetland that provides flood storage are affected, thus creating a potentially unsafe condition.

However, otherwise minor impacts to surface water resources can result in major effects to other resources. For example, specialized flora or fauna that are highly dependent on certain hydrologic conditions may become vulnerable should these conditions become altered.

#### 4.2.1.2 Direct and Indirect Effects Common Among Alternatives

**Project Operations**

Under any of the three alternatives, activities associated with Project operations would not result in erosion or sedimentation into surface waters. Project decommissioning under any of the three alternatives would necessitate ground disturbance for removing Project components and return soils to agricultural or other uses depending on landowner preferences. The Applicant is committed to using erosion and sediment control measures to prevent impacting surface waters in the Project area.

Operating the Project under any of the alternatives could result in minor oil spills from leaking transformers or gear boxes which could cause localized effects to water quality should these spills enter surface waters. However, major adverse effects would be unlikely due to the small volume of oil that could potentially spill. Any potential oil spills would be addressed in the Applicant’s Spill Prevention, Control and Countermeasure (SPCC) Plan. No major adverse effects to water resources would occur as a result of operation of the Project under any of the -three alternatives under consideration.

#### 4.2.1.3 Direct and Indirect Effects Presented by Alternative

This section focuses on the potential effects to water resources associated with the summer habitat mitigation project.

**Alternative 1: No-Action Alternative**

The No-Action Alternative does not include any mitigation projects because take of Indiana bats and northern long-eared bats would be avoided. The No-Action Alternative is not expected to affect water resources.

**Alternative 2: Preferred Alternative (5 m/s Curtailment)**

***Winter Habitat Mitigation Project***

Implementation of Alternative 2 would include the gating project at Griffith Cave. The winter habitat mitigation project is not expected to affect surface water resources. This project would occur more than 2,000 feet from the nearest surface water resource (Big Creek to the east). Disturbance to rock during the cave-gating project is not expected to affect surface waters.

***Summer Habitat Mitigation Project***

The summer habitat mitigation project includes planting tree seedlings on 157 acres of cropland, hayland, pasture, or old field and preserving 49 acres of forest. The Applicant is targeting forest protection and habitat restoration on lands proximal to the Middle Fork Vermilion River corridor. The tree planting activity itself would not directly affect surface water resources. As the trees mature, the eventual reforestation of agricultural lands would have beneficial effects to water resources. Effects associated with run-off and sedimentation from agricultural lands would be reduced considerably at the local level. The summer habitat mitigation project is expected to have long-term beneficial effects to water resources in the Middle Fork watershed. If the restoration occurs in a natural floodplain or wetland that provides flood storage functions, these functions are likely to improve in the long-term as the planted trees mature.

In summary, the Preferred Alternative is unlikely to result in lost functions and values at any unique hydrological feature. There would be no significant alteration of the quantity of a water supply for existing users. The Preferred Alternative is not expected to result in compromised safety and security of any water supply or flood storage site. The summer habitat mitigation project is likely to improve water quality conditions in the watershed where these measures would be implemented. If located in floodplain, the summer habitat mitigation is likely to improve flood storage functions in the long-term.

**Alternative 3: Non-Restricted Operations Alternative**

***Winter Habitat Mitigation Project***

Implementation of Alternative 3 would include the gating project at Griffith Cave. The winter habitat mitigation project is not expected to affect surface water resources. This project would occur more than 2,000 feet from the nearest surface water resource (Big Creek to the east). Given the nature of cave-gating projects, disturbance to surface waters is unlikely.

***Summer Habitat Mitigation Project***

The summer habitat mitigation project includes planting tree seedlings on cropland, hayland, pasture, or old field. Under Alternative 3, the Applicant would need to implement summer habitat mitigation measures on at least 252 acres of previously disturbed, unrestored lands in addition to winter habitat mitigation to offset the impact of taking 521 Indiana bats and 252 northern long-eared bats. If the Applicant is unable to implement adequate winter habitat mitigation, then the amount of summer habitat mitigation would affect an even larger area of agricultural lands.

Under Alternative 3, effects to water resources would be as described for the Preferred Alternative but on a larger scale. The summer habitat mitigation is expected to have long-term beneficial effects to water resources in the Middle Fork watershed or other watersheds wherever these measures may occur.

In summary, Alternative 3 is unlikely to result in lost functions and values at any unique hydrological feature. There would be no significant alteration of the quantity of a water supply for existing users. Alternative 3 is not expected to result in compromised safety and security of any water supply or functioning flood storage site. The summer habitat mitigation project is likely to improve water quality conditions in the watershed where these measures would be implemented. If located in floodplain, the summer habitat mitigation is likely to improve flood storage functions in the long-term.

#### 4.2.1.4 Surface Water Summary

Potentially affected water resources would include surface waters and wetlands in the Project area during decommissioning and in the areas of the summer habitat mitigation projects. We do not expect implementation of any alternative to have adverse effects to surface water resources. The summer habitat mitigation projects under Alternatives 2 and 3 would have minor to moderate beneficial effects to water resources at the local scale.

### 4.2.2 GROUNDWATER

Effects to groundwater resources are regulated at the federal level by the Safe Drinking Water Act of 1974 and the state level through Illinois' Groundwater Protection Act.

#### 4.2.2.1 Impact Criteria

Impacts to groundwater resources can occur should any of the following result:

- Alteration of the quantity or quality of a water supply for existing users; or
- Compromised safety and security of any water supply.

**Direct and Indirect Effects Common Among Alternatives**

***Project Operations***

As explained in Section 3.2.2, water supplies from groundwater in Project area originate primarily from the Mahomet aquifer. No discharge of water or materials into the groundwater system would occur as a result of Project Operations under any of the three alternatives. There would be no ground disturbance associated with operating the Project. Project decommissioning under any of the three alternatives would necessitate ground disturbance for removing Project components and return soils to agricultural or other uses depending on landowner preferences. These excavation activities would not be expected to affect any aquifer system because of the shallow depth of excavation (<12 feet). In addition, no new groundwater wells would be drilled as a result of Project operations or decommissioning; therefore, no large ground water withdrawals would occur that may affect groundwater supplies.

No major adverse effects to groundwater would occur as a result of Project operations under any of the three alternatives under consideration.

#### 4.2.2.2 Direct and Indirect Effects Presented by Alternative

**Alternative 1: No-Action Alternative**

The No-Action Alternative does not include any mitigation projects because take of Indiana bats would be avoided. The No-Action Alternative is not expected to affect groundwater resources. There would be no excavation activities down to groundwater depths, and there would be no water withdrawals.

**Alternative 2: Preferred Alternative (5 m/s Curtailment)**

***Winter Habitat Mitigation Project***

Implementation of Alternative 2 would include the gating project at Griffith Cave. The winter habitat mitigation project is not expected to affect groundwater resources. This mitigation project would not include excavation down to groundwater levels. Disturbance to rock would occur above ground or just below ground. The cave-gating project is not expected to affect groundwater.

***Summer Habitat Mitigation Project***

The summer habitat mitigation project includes planting tree seedlings on 157 acres of cropland, hayland, pasture, or old field and preserving 49 acres of forest. Tree-planting is unlikely to involve reaching depths to groundwater. Tree-planting is likely to occur in sites that are not expected to experience drought conditions. We do not foresee that it will be necessary to conduct extensive watering of tree-seedlings. Water withdrawals from groundwater sources are not anticipated. Summer habitat mitigation projects are unlikely to affect groundwater resources.

**Alternative 3: Non-Restricted Operations Alternative**

***Winter Habitat Mitigation Project***

Implementation of Alternative 3 would include the gating project at Griffith Cave. The winter habitat mitigation project is not expected to affect groundwater resources. This mitigation project would not include excavation down to groundwater levels. Disturbance to rock would occur above ground or just below ground. More mitigation would be required to offset the unavoidable impact of the taking, and the Applicant would need to provide gating and protection for at least one other hibernaculum. However, given the nature of cave-gating projects, disturbance to groundwater resources is unlikely at any site.

***Summer Habitat Mitigation Project***

The summer habitat mitigation project includes planting tree seedlings on cropland, hayland, pasture, or old field. Under Alternative 3, the Applicant would need to implement summer habitat mitigation measures on at least 252 acres of previously disturbed, unrestored lands in addition to winter habitat mitigation to offset the impact of taking 521 Indiana bats and 252 northern long-eared bats. If the Applicant is unable to implement adequate winter habitat mitigation, then the amount of summer habitat mitigation would affect an even larger area of agricultural lands. Tree-planting is unlikely to involve reaching depths to groundwater. Tree-planting is likely to occur in sites that are not expected to experience drought conditions. We do not foresee that it will be necessary to conduct extensive watering of tree-seedlings. Water withdrawals from groundwater sources are not anticipated. Summer habitat mitigation projects are unlikely to affect groundwater resources.

### 4.2.3 GEOLOGY AND SOILS

#### 4.2.3.1 Impact Criteria

There are no specific federal or state regulations pertaining to geology and soils that are relevant to the analysis for this Project. As per NEPA and CEQ guidelines, the human environment includes geologic resources, and impacts to these resources can result in secondary effects to other resources. Additionally, we considered potential geologic hazards with respect to project location that could pose a risk to people, structures, and other aspects of the human environment.

Impacts to soils and geology would be considered major should any of the following occur:

1) The project results in substantial soil erosion; or
2) The project is located on an unstable geologic unit or on soil that has a high likelihood of resulting in a major landslide.

#### 4.2.3.2 Direct and Indirect Effects Presented by Alternative

Under any of the three alternatives, Project operations are not expected to have effects to geologic and soil resources. Activities associated with Project operations would not result in ground disturbance where soils or rock may be affected. Project decommissioning under any of the three alternatives would necessitate ground disturbance for removing Project components and return soils to agricultural or other uses depending on landowner preferences. The effects analysis for geologic and soils resources focuses on activities associated with the mitigation projects.

**Alternative 1: No-Action Alternative**

The No-Action Alternative does not include any mitigation projects because take of Indiana bats would be avoided. The No-Action Alternative is not expected to affect geology and soils.

**Alternative 2: Preferred Alternative (5 m/s Curtailment)**

The Preferred Alternative includes winter and summer habitat mitigation to offset the unavoidable impacts of taking Indiana bats.

***Winter Habitat Mitigation***

The process of gating Griffith Cave would involve some disturbance to cave rock at the entrance. The installation of the gate includes drilling several 1-inch diameter holes into the bedrock surrounding the cave entrance. Each of these holes would be several inches deep. All columns and select horizontal bars would be attached to the entrance walls with 1-inch round steel pins that are pounded into the 1-inch drilled holes. The drilled holes and steel pins would be minor impacts to the entrance bedrock only and would not have wide-ranging effects on the local geology. The gating project would not affect soils.

***Summer Habitat Mitigation***

The summer habitat mitigation project includes planting tree seedlings on 157 acres of cropland, hayland, pasture, or old field and preserving 49 acres of forest. Tree planting would not affect geologic resources. Tree planting would disturb the soil at the site of each plant to the depth equivalent to the length of the seedling root plus 1 or 2 inches.

Rates of soil erosion would depend on the current agricultural use. If tree-planting occurs in hayland, pasture, or old field, the risk of soil erosion would be low or absent as existing vegetation would anchor soils. Conversely, row-crop fields would have the highest rates of erosion due to the exposed, unvegetated soil. This risk would be pronounced for the time that tree seedlings and naturally occurring herbaceous plants become established, which would be a slower process than that expected for seeded row-crops. However, this risk of soil erosion is likely to be a one-time event, as compared to an annual or biennial event typically associated with row-crop practices.

Tree seedling planting is not expected to have negative effects on soil properties. Reforestation in the long-term may have beneficial effects to local soils. Planting trees was found to result in a relatively rapid and sustained increase in organic matter content of surface soils on marginal cropland in Iowa (Sauer et al. 2009). Depending on where vegetation conversion is conducted, the summer habitat mitigation project may result in short-term soil erosion. Disturbance to soils would be short-term and, unlike agricultural practices, would not occur again for decades or in perpetuity.

Under the Preferred Alternative, impacts to soils and geology would be minor. Project operations and either mitigation project would not result in substantial soil erosion or a major landslide.

**Alternative 3: Non-Restricted Operations Alternative**

***Winter Habitat Mitigation Project***

Effects to geology and soils under Alternative 3 would be as described for the Preferred Alternative. More mitigation would be required to offset the unavoidable impact of the taking, and the Applicant would need to provide gating and protection for at least one other hibernaculum. Hence, this alternative would result in similar effects to geology and soils at least one other hibernaculum. Hence, gating would have minor impacts to local geology and soils at the site of at least one other hibernaculum.

***Summer Habitat Mitigation Project***

The summer habitat mitigation project includes planting tree seedlings on cropland, hayland, pasture, or old field. Under Alternative 3, the Applicant would need to implement summer habitat mitigation measures on at least 252 acres of previously disturbed, unrestored lands in addition to winter habitat mitigation to offset the impact of taking 521 Indiana bats and 252 northern long-eared bats. If the Applicant is unable to implement adequate winter habitat mitigation, then the amount of summer habitat mitigation would affect an even larger area of unrestored lands.

Under Alternative 3, effects to geologic and soil resources would be as described for the Preferred Alternative but on a larger scale. The beneficial effects to soils from reforestation would be expanded to include the additional acreage of summer habitat mitigation. Alternative 3 is not expected to adversely affect geologic or soil resources.

In summary, Alternative 3 would not have major impacts to soils and geology. Project operations and either mitigation project would not result in substantial soil erosion or a major landslide. Summer habitat mitigation is likely to result in benefits to local soil conditions.

### 4.2.4 AIR QUALITY

#### 4.2.4.1 Impact Criteria

The Clean Air Act of 1970 (CAA), and the CAA Amendments of 1990 established National Ambient Air Quality Standards (NAAQS) for selected pollutants. The NAAQS established maximum levels of acceptable background pollution with a margin of safety to protect public health and welfare. NAAQS compliance in Illinois is monitored by IEPA.

#### 4.2.4.2 Direct and Indirect Effects Common Among Alternatives

**Project Operations**

Per the CAA and the Amendments of 1990, USEPA has established New Source Performance Standards (NSPS) to regulate air pollution emissions from new stationary sources. These standards apply to various facilities, but because wind turbines generate electricity without releasing air pollutants, NSPSs do not apply to the PTWF.

The Acid Rain Program, established by CAA Amendments of 1990 to lower sulfur dioxide and nitrogen oxides emissions, does not apply to the Project because wind turbines generate electricity without releasing air pollutants. Likewise, the Prevention of Significant Deterioration (PSD) does not apply to the Project for the same reason.

Recent federal greenhouse gas (GHG) policy has focused on voluntary initiatives to reduce GHG emissions. In 2010, the CEQ drafted guidance regarding GHG emissions in evaluating federal actions under NEPA. The guidance indicated that if the Project leads to 25,000 metric tons or more of carbon dioxide equivalent emissions then it may warrant some description in the appropriate NEPA analysis.

No phase of the Project would emit new major sources of air pollutants; therefore, the Project would not be a source of air pollution.

Regardless of the alternative implemented, Project operations would not release pollutants into the atmosphere or result in major adverse effects to air quality. Project operations require a small amount of vehicular traffic resulting in the release of carbon dioxide emissions and particulates. During decommissioning, construction equipment will add to the releases of emissions and particulates for the short-term. These emissions are not estimated to have a measurable effect on local or regional air quality or contribute greatly to the amount of greenhouse gases. Project operations would not generate any new sources of air pollutants.

Energy production would be highest under Alternative 3 (3.5 m/s cut-in speed), followed by Alternative 2 (5.0 m/s cut-in speed) then Alternative 1 (6.9 m/s cut-in speed). The No-Action alternative would produce the least electricity annually because the turbines would not operate at night between August 15 and October 15 when wind speeds are less than 6.9 m/s. Under any of the three alternatives under consideration, power delivered to the grid from the Project would not cumulatively add to the emissions produced at existing conventional power plants.

Operation of the PTWF would displace direct emissions of 25,000 metric tons or more of carbon dioxide-equivalent greenhouse gas emissions annually. It is estimated that the electricity generated by the Project will provide emissions-free power for the equivalent of 45,000 homes, displacing fossil fuel generation equivalent to taking approximately 47,000 cars off the road, and avoiding the release of approximately 270,000 tons of $CO_2$ per year and 1,350 tons of $SO_2$, the leading cause of acid rain. Therefore, the Project would not result in greenhouse gas emissions that would contribute to problems associated with climate change.

#### 4.2.4.3 Direct and Indirect Effects Presented by Alternative

**Alternative 1: No-Action Alternative**

The No-Action Alternative does not include any mitigation projects because take of Indiana bats would be avoided. The No-Action Alternative is not expected to affect air quality.

**Alternative 2: Preferred Alternative (5.0 m/s Curtailment)**

***Winter Habitat Mitigation Project***

Implementation of Alternative 2 would include the gating project at Griffith Cave. The winter habitat mitigation project is not expected to emit pollutants beyond a small amount of vehicular traffic and use of a small generator to operate power tools. Air emissions created during this mitigation project would be minor.

***Summer Habitat Mitigation Project***

Trees can reduce pollution by actively removing pollution from the atmosphere. Leaf stomata, the pores on the leaf surface, take in polluting gases which are then absorbed by water inside the leaf. Trees also act as filters by intercepting airborne particles. Particles are captured by the surface area of the tree and its foliage until they are either washed off by rainwater or blown off by winds. Tree cover can reduce the amount of harmful gasses and particulate matter in the air. This is particularly true for urban areas. In urban areas, trees have been shown to improve air quality, and to lower air temperatures, which can reduce energy use.

The summer habitat mitigation project includes planting tree seedlings on 157 acres of cropland, hayland, pasture, or old field. We recognize that trees have the ability to enhance air quality. The reforestation of 157 acres of disturbed, unrestored land would have a minor beneficial effect at the local scale.

In summary, Alternative 2 would have minor impacts to air quality. Project operations and the mitigation projects would not result in substantial changes in air quality conditions. Summer habitat mitigation is likely to result in minor benefits to local air quality conditions.

**<u>Alternative 3: Non-Restricted Operations Alternative</u>**

***Winter Habitat Mitigation Project***

Effects to air quality under Alternative 3 would be as described for the Preferred Alternative. More mitigation would be required to offset the unavoidable impact of the taking, and the Applicant would need to provide gating and protection for at least one other hibernaculum. Hence, this alternative would result in similar effects to air quality for at least one other hibernaculum. Hence, gating would have minor, short-term impacts to local air quality around at least one other hibernaculum in addition to air quality at Griffith Cave.

***Summer Habitat Mitigation Project***

Under Alternative 3, the summer habitat mitigation project includes planting tree seedlings on cropland, hayland, pasture, or old field. Under Alternative 3, the Applicant would need to implement summer habitat mitigation measures on at least 252 acres of previously disturbed, unrestored lands in addition to winter habitat mitigation to offset the impact of taking 521 Indiana bats and 252 northern long-eared bats. If the Applicant is unable to implement adequate winter habitat mitigation, then the amount of summer habitat mitigation would affect an even larger area of agricultural lands.

Under Alternative 3, effects to air quality would be as described for the Preferred Alternative but on a larger scale. The beneficial effects to air quality from reforestation would be expanded to include the additional acreage of summer habitat mitigation.

In summary, Alternative 3 would have minor impacts to air quality. Project operations and either mitigation project would not result in substantial changes in air quality conditions. Summer habitat mitigation is likely to result in minor benefits to local air quality conditions.

#### 4.2.4.4 Summary of Effects to Air Quality and Climate

We do not believe there will be differences among alternatives with regard to impacts to air quality. Project maintenance, decommissioning, and post-construction monitoring would necessitate some increases in vehicular traffic and construction equipment in and around the Project. This added impact to air quality is expected to be inconsequential.

As part of Alternatives 2 and 3, the mitigation actions proposed in the HCP that would protect and restore forest habitat could potentially improve air quality, at least at local scales. These actions may contribute toward improvements in air quality, as increasing the amount of tree cover in an area could help reduce harmful gasses and particulate matter in the air. In the long term, the reforestation project will benefit air quality, but the amount is immeasurable and would be negligible.

No specific mitigation measures for air would be implemented under any of the three alternatives.

### 4.2.5 NOISE

#### 4.2.5.1 Impact Criteria

In Illinois, standards for wind farms are defined at the county level. Both Ford and Iroquois counties have standards for wind farms and procedures for siting approval. Ford County does not specify noise limits for wind farms (Ford County 2009), but Iroquois County indicates the noise emitted by a wind farm shall not exceed 35dbA during the hours of 7:00 AM to 10:00 PM and 30 dBA during the hours of 10:00 PM to 7:00 AM (Iroquois County 2008). Landowners participating in lease agreements with a wind farm can opt out of these noise standards.

Sound pressure level is measured in decibels (dB). The quietest sound level that can be heard by a healthy human ear is around 0 dB. A moderate sound level is 55 dB to 60 dB, about the level of normal conversation. What one considers to be loud becomes somewhat subjective; generally, sounds around 80 dB and higher often are interpreted to be loud. Sound frequency or tonality is measured in Hz, and most sounds include a composite of frequencies. The normal range of healthy human hearing extends from 20 Hz to 20,000 Hz. Hearing sensitivity varies, and humans generally hear best in the frequency range of human speech, around 500 Hz to 4,000 Hz.

**Direct and Indirect Effects Common Among Alternatives**

***Project Operations***

Across the three alternatives, day time operations would have the same noise impacts. Turbines would operate at the 3.5 m/s cut-in speed and generate the same levels of noise. Project vehicles and maintenance repairs would generate the same levels of noise regardless of alternative.

#### 4.2.5.2 Direct and Indirect Effects Presented by Alternative

This section addresses potential direct and indirect effects of noise by alternative. Ambient noise levels in the covered land were not measured and are not known. PTWF conducted predictive noise modeling for the project, which showed compliance with local ordinances. E.ON provided a letter to Ford County regarding those results as part of their conditional use permit application. Also, we looked at the predictive noise modeling results from the Fowler Ridge Wind Farm Phase IV Project (Stantec 2011c), which is comparable to the PTWF being a proposed 94-turbine wind project with 1.6-MW turbines set in an agricultural landscape 50 miles away in northwestern Indiana. The predictive modeling results for Fowler Ridge found that the 1.6-MW turbine emits sounds that are greater than 40 dB out to 1,500 feet and are less than 35 dB at around 2,200 feet.

**Alternative 1: No-Action Alternative**

Under the No-Action Alternative, the Project would operate at the raised cut-in speed of 6.9 m/s from 30 minutes before sunset to 30 minutes after sunrise when the ambient temperature is above 10°C (50°F) from August 15 through October 15. Under these restricted operations, on nights during this period when wind-speeds are less than 6.9 m/s, turbines would not be operating and would emit no noise.

Because the No-Action Alternative is not predicted to take Indiana bats, no mitigation is being proposed under the No-Action Alternative.

## Alternative 2: Preferred Alternative

### *Project Operations*

Under the Preferred Alternative, turbine operations would be curtailed at the raised cut-in speed of 5.0 m/s from sunset to sunrise when the ambient temperature is above 10°C (50°F) for the period from August 15 to October 15. This would be a less restrictive operating regime than the No-Action Alternative. Generally speaking, on nights during this period when wind-speeds are less than 5.0 m/s, turbines would not be operating and would emit no noise.

### *Winter Habitat Mitigation Project*

Implementation of Alternative 2 would include the gating project at Griffith Cave. The winter habitat mitigation project would generate small amounts of intermittent noise over the period of 1 day. Noises would be associated with a small amount of vehicular traffic, use of a small generator, operation of power tools, and drilling and hammering on rock. Noise emissions created during this mitigation project would be minor and short-term.

### *Summer Habitat Mitigation Project*

Implementation of Alternative 2 would include planting tree seedlings on 157 acres of cropland, hayland, pasture, or old field and preserving 49 acres of forest. Tree-planting is not expected to generate any new or added noise to sites of summer habitat mitigation.

## Alternative 3: Non-restricted Operations

Under Alternative 3, turbine operations would not be curtailed. Turbines would operate at the manufacturer's specified cut-in speed of 3.5 m/s every hour of every day of operation. The turbine hubs would not be locked and turbines will not feather when wind speed is below 3.5 m/s. This would be the least restrictive operating regime of the three alternatives, and it would also emit the most nighttime noise.

### *Winter Habitat Mitigation Project*

Similar to the Preferred Alternative, implementation of Alternative 3 would include a gating project at a vulnerable cave. Because Alternative 3 would take substantially more Indiana bats than the Preferred Alternative, protection of other hibernacula in addition to Griffith Cave would be warranted. Similar to the Preferred Alternative, winter habitat mitigation projects implemented under Alternative 3 would generate small amounts of intermittent noise over the period of 1 day. Noise emissions created during these mitigation projects would be minor and short-term.

### *Summer Habitat Mitigation Project*

Implementation of Alternative 3 would forest preservation and restoring cropland, hayland, pasture, or old field to forest. Because Alternative 3 would take substantially more Indiana bats than the Preferred Alternative, reforestation efforts on additional acres of disturbed land may be implemented to offset the impacts of the taking. Nonetheless, tree-planting is not expected to generate any new or added noise to sites of summer habitat mitigation.

## 4.3 BIOTIC ENVIRONMENT

### 4.3.1 VEGETATION

#### 4.3.1.1 Impact Criteria

Federally listed plants are afforded protection under the ESA. State-listed plants are afforded protection under the Illinois Endangered Species Protection Act (520 Illinois Compiled Statutes [ILCS] 10). Executive Order 13112 addresses federal coordination and response to the problems associated with invasive species. There are no specific federal or state regulations pertaining to unlisted plants that are relevant to the analysis for the Applicant's proposal. As per NEPA and CEQ guidelines, the human environment includes vegetation resources, and impacts to these resources can result in secondary effects to other resources.

Vegetation can be impacted at the individual, population, or community level. Major impacts to vegetation can occur when any of the following result:

- Naturally occurring population reduced in numbers below levels for maintaining viability at local or regional level;
- Substantial loss or degradation of soil stabilization services;
- Substantial loss or degradation of habitat for a rare, threatened, or endangered animal species; and
- Introduction of invasive species that results in substantial replacement of native species.

**Alternative 1: No-Action Alternative**

Under the No-Action Alternative, there would be minimal impacts to vegetation. In the Project area, the wind farm is already constructed and operating. Vegetation will be mowed periodically at 10 turbines to facilitate carcass searches. The No-Action Alternative does not include any mitigation projects because take of Indiana bats would be avoided. The No-Action Alternative is not expected to adversely affect vegetation resources.

**Alternative 2: Preferred Alternative**

The Preferred Alternative includes winter and summer habitat mitigation to offset the unavoidable impacts of taking Indiana bats. The entrance to Griffith Cave, the site of winter habitat mitigation, is only a few yards from a paved road. The winter habitat gating project would not involve altering or removing vegetation. Some vegetation would be inadvertently trampled and crushed as gate materials are brought to the cave entrance, but these effects are expected to be minor and temporary.

***Summer Habitat Mitigation***

The summer habitat mitigation project includes planting tree seedlings on 157 acres of cropland, hayland, pasture, or old field and preserving 49 acres of forest. Tree planting would disturb the soil at the site of each plant to the depth equivalent to the length of the seedling root plus 1 or 2 inches. As explained in Section 4.2.3.2 under Geology and Soils, the reforestation project may result in short-term soil erosion.

Conversely, if the summer habitat mitigation is to be located in cultivated cropland, particularly tilled cropland, the forest restoration would result in erosion prevention as the trees grow to mature woodland.

The summer habitat mitigation project would restore native vegetation within the Middle Fork Vermilion River drainage, an area that has lost most of its native plant communities. Permanently vegetated sites, such as in protected woodlands, are less likely to be compromised by extensive stands of invasive, non-native vegetation.

In summary, the Preferred Alternative would have beneficial effects to native vegetation resources where reforestation would occur in association with the summer habitat mitigation project. The Preferred Alternative would not reduce any naturally occurring plant population to numbers below levels for maintaining viability at the local or regional level. Substantial loss or degradation of soil stabilization services or habitat for a rare, threatened, or endangered animal species are not expected. The Preferred Alternative is not expected to result in the introduction of invasive species, and may actually inhibit invasive plants from becoming established in the long-term.

**Alternative 3: Non-Restricted Operations Alternative**

Effects to vegetation under Alternative 3 would be as described for the Preferred Alternative. More mitigation would be required to offset the unavoidable impact of the taking, and this alternative would result in additional acreage of reforestation on disturbed, unrestored lands.

The summer habitat mitigation project includes planting tree seedlings on cropland, hayland, pasture, or old field. Under Alternative 3, the Applicant would need to implement summer habitat mitigation measures on at least 252 acres of previously disturbed, unrestored lands in addition to winter habitat mitigation to offset the impact of taking 521 Indiana bats and 252 northern long-eared bats. If the Applicant is unable to implement adequate winter habitat mitigation, then the amount of summer habitat mitigation would affect an even larger area of unrestored lands. Alternative 3 would have beneficial effects to vegetation resources at the sites of summer habitat mitigation.

In summary, Alternative 3 would have moderate, beneficial impacts to native forest communities.

### 4.3.2 WILDLIFE

This section analyzes the effects of the Preferred Alternative and alternatives on terrestrial, non-volant wildlife. Refer to Sections 4.3.3 and 4.3.4 for impact analyses for birds and bats, respectively. This analysis uses information on wildlife for the region. Habitat for aquatic species in the Project area is limited, and Project operations are not be expected affect aquatic wildlife. Discussion of potential effects to aquatic wildlife is limited to those associated with the summer habitat mitigation project.

#### 4.3.2.1 Impact Criteria

Major impacts to wildlife and aquatic resources are those that substantially affect a species' population (locally, regionally, or rangewide) or reduce its habitat quality or quantity. Impacts to species can be both direct and indirect. Examples of direct effects include disturbance, injury, mortality, and habitat alteration. Examples of indirect effects include habitat loss or degradation over time or effects to resources used by wildlife in different life stages (i.e., alterations to surface water or alterations to plant composition).

Another indirect effect may be the creation of habitat such as edges and openings that favor a different mix of species and in some cases, increase predation pressure, thereby causing displacement or avoidance.

#### 4.3.2.2 Direct and Indirect Effects Common to All Alternatives

The operation of the PTWF under any of the three alternatives is expected have similar effects to general wildlife. We first describe these similar effects then effects unique to each alternative.

**Project Operations**

There are limited data available addressing impacts to mammals, reptiles, and amphibians associated with habitat loss due to displacement from operating wind farm developments in the U.S.; the majority of studies have focused on bird and bat collision mortality. However potential effects to mammals in particular likely depend on the species, geographic location, project size, and the spatial and temporal scales at which these effects are studied (Helldin et al. 2012).

Common species such as white-tailed deer, raccoon, and skunk become habituated to human activity and habitat modification. While habituation may not be immediate, species likely to occur in the PTWF would adapt quickly to the presence of man-made features in their habitat, evidenced by the abundance of these species in suburban and working farm settings. White-tailed deer, coyote, red fox, and other terrestrial mammals have been observed at recently constructed wind projects in the eastern U.S. (Stantec 2010a, b). Marked displacement of common mammals from a wind project has not been reported.

Turbines are not located in wet areas and are not likely to affect movements of amphibian species in the landscape. We can expect that other wildlife that use agricultural fields would continue to occur, including insects, common mammals, and a few common reptiles.

The effect of shadow flicker on terrestrial animals currently is unknown. Reports from operational wind projects have documented the electrocution of hawks from overhead transmission lines (Stantec 2010a). However the effect of electrocution or stray voltage on other terrestrial wildlife is unknown. During times when ice can form on turbine blades, ice sheets could be thrown from tower blades. In rare events, turbine towers could collapse or fires could occur. However the likelihood of these phenomena killing a mobile terrestrial animal is very low.

Project operations may attract terrestrial wildlife if they are drawn to investigate downed carcasses while searching for food. If consistent presence is a regular event, carcasses may become a regular food source for some species including coyote, raccoon, and red fox.

The agricultural habitat in the Project area is common and the terrestrial species known to inhabit agriculture areas are common; therefore, habitat loss, avoidance, or displacement effects to terrestrial wildlife populations, should they occur, are expected to be minor. Consequently, population level effects from operation of the Project under any of the three alternatives are not expected for any species of terrestrial wildlife.

**Project Maintenance**

Maintenance activities generally are restricted to inside the turbine tower and nacelle. Project maintenance activities may include periodic road maintenance (i.e., grading) and possibly herbicide application. During travel in the Project area for maintenance activities, maintenance vehicles may collide with terrestrial wildlife causing injury or death.

Disturbance from noise, vibration, and increased human activity and traffic associated with maintenance activities would occur infrequently and for relatively short durations. Species in the Project area likely are habituated to noise, vibration, and activity due to the intense farming activities involving tractors, plows, and other agricultural equipment in the Project area. Materials used during maintenance activities (i.e., tools) and turbine parts such as bolts have the potential to fall from the turbines during maintenance. However the likelihood of such materials striking and killing a terrestrial animal is low.

**Post-Construction Monitoring**

All three alternatives include post-construction monitoring to be implemented as described in the BBCS and HCP, both of which implement the same protocol. Effects to terrestrial wildlife resulting from post-construction monitoring may include disturbance or mortality due to increased vehicle traffic and human presence. Furthermore, any vehicle-induced fatalities may attract scavengers. Post-construction monitoring studies also involve trials, in which carcasses are positioned in the Project area to test the ability of the searchers to find carcasses.

Post-construction monitoring would also include searcher efficiency and carcass persistence trials, in which carcasses are placed in the Project area to assess searcher success and carcass removal by scavengers (i.e., mammals and birds). Local wildlife such as coyote, red fox, and raccoon may be attracted to the PTWF during either of these trials. Cleared turbine pads would make fatalities easily detectable to scavengers. Smallwood (2013) estimates that on average 74% of bird carcasses and 70% of bat carcasses are taken by scavengers within 30 days at wind projects in North America. Non-volant wildlife would not be susceptible to turbine collisions, but may be susceptible to vehicle collisions while moving between turbine plots to scavenge.

**Project Decommissioning**

Impacts on wildlife from decommissioning activities would be disturbance or potential displacement via vehicular traffic, construction noise, overhead equipment and materials with the potential to fall, vibration, and increased human presence. However decommission impacts would be localized and for a relatively short duration. Species in the Project area likely are habituated to noise, vibration, and activity due to the intense farming activities in the Project area.

Project decommissioning would minimize the long-term impacts to terrestrial wildlife (as opposed to permanent presence and operation) by removing turbines from the Project area and restoring the area to the pre-existing agricultural condition. Decommissioning would increase habitat for species that use agricultural landscapes.

**PTWF Operations Summary**

Project operations under any considered alternative are not expected to result in major impacts to general (non-volant) and aquatic wildlife that would substantially affect a species' population (locally, regionally, or rangewide) or significantly reduce its habitat quality or quantity.

#### 4.3.2.3 Direct and Indirect Effects Presented by Alternative

**Alternative 1: No-Action Alternative**

Effects of the PTWF operations on terrestrial wildlife under the No-Action Alternative would be as described above in Section 4.3.2.2. However the likelihood that downed carcasses will attract wildlife will be reduced as bat fatality is expected to be lower under this alternative as compared to Alternatives 2 and 3. Because Indiana bat fatalities would be avoided, there would be not mitigation projects implemented under the No-Action Alternative. General (non-volant) and aquatic wildlife would not experience the long-term benefits associated with the expansion and enhancement of woodland habitat proximal to the Middle Fork Vermilion River or any other watershed.

**Alternative 2: Preferred Alternative**

Effects of the PTWF operations on general wildlife under the Preferred Alternative would be as described above in Section 4.3.2.2. However, the likelihood that downed carcasses will attract scavengers will be higher as bat fatality is expected to be higher under this Alternative.

***Winter Habitat Mitigation***

Gating the entrance to Griffith Cave will primarily affect the bats utilizing this hibernaculum. For a discussion of the effects of gating on bats, see Section 4.3.4.2. Cave entrance gating would exclude large wildlife from using the cave as a den, but continue to allow smaller wildlife to enter and exit at will. At this time it is not known if large mammals use the cave as a den site. Gating will necessitate only a small amount of construction traffic, which would not be enough to significantly disturb or displace nearby wildlife. Small terrestrial wildlife such as mice, voles, and snakes could be trampled during cave entrance gating, but this is unlikely. Gating activities will create noise that may disturb or displace wildlife. Gating will occur during the growing season, and therefore is not expected to impact wildlife during the winter when they would be most sensitive to energy loss from disturbance. Given the above, any minor effects associated with the gating project are expected to be temporary.

PTWF is proposing a 3-year follow-up study to evaluate the effectiveness of the cave gating. Vehicle traffic and increased human presence during monitoring may disturb local wildlife, but these disruptions would be infrequent and of short duration.

In summary, the cave-gating project would have minor effects to general local wildlife.

***Summer Habitat Mitigation***

In the long-term, the reforestation project on lands within the Middle Fork Vermilion River watershed will benefit forest-dwelling mammals, birds, reptiles, and amphibians. If trees are planted in floodplains or on river banks, the project is likely to benefit aquatic animals. Planted trees along the river will benefit smallmouth bass by providing shade and root systems in the river for cover. Trees may stabilize the banks of the Middle Fork thereby reducing erosion and sedimentation impacts on aquatic wildlife.

Some native wildlife may be disturbed and potentially displaced during tree planting due to the presence of humans and disturbing soils. However these disturbances would be temporary, minor, and bear little lasting effect. Reforestation would expand woodland connected to the river corridor providing cover for species that use the river for feeding, drinking, and traveling. The expanded woodland cover may protect some smaller species as they travel to and from the river. Conversely, this same cover is also likely to provide cover for predators, resulting in increased depredation of small terrestrial wildlife.

In summary, the Preferred Alternative is not expected to result in major adverse impacts to general and aquatic wildlife that would substantially affect a species' population (locally, regionally, or rangewide) or significantly reduce its habitat quality or quantity. Conversely, the summer habitat mitigation project would have long-term beneficial effects to general and aquatic wildlife at the local scale through forested habitat expansion and enhancement in a riverine community.

**Alternative 3: Non-Restricted Operations**

Effects of the PTWF operations on terrestrial wildlife under Alternative 3 would be as described above in Section 4.2.2.2. However, the likelihood that downed bat carcasses would attract wildlife would be greater under this alternative compared to Alternatives 1 and 2 as bat fatalities are expected to be highest under this alternative.

Effects to general wildlife associated with the mitigation projects under Alternative 3 would be similar to those as described for the Preferred Alternative. However, the Applicant would need to increase acreage of summer habitat mitigation to offset the higher impact of the taking Indiana bats. Under Alternative 3, the Applicant would need to implement summer habitat mitigation measures on at least 252 acres of previously disturbed, unrestored lands in addition to winter habitat mitigation to offset the impact of taking 521 Indiana bats and 252 northern long-eared bats. If the Applicant is unable to implement adequate winter habitat mitigation, then the amount of summer habitat mitigation would affect an even larger area of unrestored lands. Alternative 3 would have long-term beneficial effects to general and aquatic wildlife at the local scale through forested habitat expansion and enhancement in a riverine community.

In summary, Alternative 3 would have moderate, beneficial impacts to aquatic and terrestrial wildlife at the local scale in relationship to the summer habitat mitigation. Relative to the Preferred Alternative, Alternative 3 could have greater benefits to general wildlife that use forests, bottomlands, and forested river corridors if additional summer habitat mitigation is implemented.

In summary, Alternative 3 is not expected to result in major adverse impacts to general and aquatic wildlife that would substantially affect a species' population (locally, regionally, or rangewide) or significantly reduce its habitat quality or quantity. Conversely, the summer habitat mitigation project would have substantial, long-term beneficial effects to general and aquatic wildlife at the local scale through forested habitat expansion and enhancement in a riverine community.

### 4.3.3 AVIAN RESOURCES

#### 4.3.3.1 Impact Criteria

Federally listed birds are afforded protection under the ESA. The BGEPA protects bald and golden eagles. The MBTA affords protection of native migratory birds. As per NEPA and CEQ guidelines, the human environment includes avian resources. Under Executive Order 13186, federal agencies are expected to carry out, among other things, the following:

1) Ensure that environmental analyses of Federal actions required by the NEPA or other established environmental review processes evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern; and,
2) Identify where unintentional take reasonably attributable to agency actions is having, or is likely to have, a measurable negative effect on migratory bird populations, focusing first on species of concern, priority habitats, and key risk factors.

Birds can be affected at the individual and population-level. Impacts to avian resources would be considered major should implementation of an alternative result in any of the following:

- Naturally occurring population reduced in numbers below levels for maintaining viability at local or regional level;
- Substantial loss or degradation of habitat for a rare, threatened, or endangered bird species; or
- Substantial change in habitat conditions producing indirect effects that cause naturally occurring populations to be reduced in numbers below levels for maintaining viability at local or regional levels.

#### 4.3.3.2 Direct and Indirect Effects Common to All Alternatives

The operation of the PTWF under any of the three alternatives is expected to have similar effects to avian resources. We first discuss the effects of Project operations on birds, then discuss distinctive effects under each alternative.

**Project Operations**

Impacts to avian species due to operations of a wind project can be both direct and indirect. Examples of direct effects include mortality, injury, disturbance, and habitat loss and degradation. Examples of indirect effects include avoidance or displacement due to habitat alterations and decreased survival or breeding success due to the presence of operating project structures or increased human presence or vehicle traffic. Indirect effects due to habitat alteration can result in changes in species abundance and diversity; these types of indirect effects can be complex and can change over time.

The three alternatives under consideration vary only in seasonal nighttime operational adjustments. While turbine operational adjustments during relatively low wind speeds are known to reduce bat mortality, these same adjustments are not known to reduce bird mortality. This likely is due to differences between bird and bat migratory behaviors. There does appear to be a relationship between increased risk of avian mortality and facility lighting at night during periods of inclement weather (i.e., rain or fog). There have been occurrences during peak nocturnal migration periods when facility lighting has resulted in mass avian collision events (Kerns and Kerlinger 2004, Young et al. 2010; Stantec, unpublished data). Potential nighttime lighting impacts have been minimized at the Project, as discussed below.

For the purposes of our analysis, we assumed operational differences among alternatives (i.e., turbine cut-in speeds) would not result in different potential direct or indirect impacts to avian resources.

***Impact minimization***

This evaluation considers the best management practices, impact minimization efforts, and mitigation measures of the Project during operation. PTWF agreed to follow best management practices throughout the life of the Project. Impact minimization measures began during siting of the Project. The project is located primarily in active agricultural fields, which provide low-quality breeding habitat for most avian species. As such, there were no impacts associated with forest fragmentation or impacts to native habitats such as prairie remnants or riparian areas. Other impact minimization efforts and mitigation measures are discussed in the following sections, as applicable.

***Disturbance and Displacement***

Avian species at PTWF may be susceptible to disturbance and displacement related impacts during Project operations. Potential sources of disturbance include the presence of Project structures (particularly operating turbines and meteorological [MET] towers), human presence and vehicle traffic during maintenance activities, and noise associated with spinning turbines. Other disturbances could include long- and short-term habitat alterations. The level of disturbance associated with habitat impacts at wind projects relates to the topography, the baseline condition of habitat(s) present, the amount of existing roads or infrastructure, and turbine layout (NRC 2007). Potential habitat disturbances are species-specific and would depend on the condition and availability of habitat prior to construction (NRC 2007). The PTWF largely is located in active agricultural fields; a smaller portion of the Project is in residential habitats. At the PTWF, disturbance effects will vary among species and habitats. Species with specific habitat requirements or species of conservation concern may be at increased risk as a result of disturbance or displacement.

Disturbances during operations at the Project could displace some species. Available literature suggests that varying degrees of bird displacement have been documented at operational wind farms. Observed effects vary among bird groups and species. Displacement effects can impact breeding birds, but also migrating, nesting, and foraging birds (Strickland 2004). Available literature suggests displacement effects can occur at distances from roughly 250 feet to 2,600 from turbines (Strickland 2004).

Some species of birds, including grassland nesting species or raptors, may be more sensitive to disturbance effects and displacement. At the Buffalo Ridge wind facility in Minnesota, grassland nesting birds were less dense in study plots near turbines than in reference plots (Leddy et al. 1999). However, displacement effects were considered small-scale, occurring out to a maximum distance of approximately 328 feet (Johnson et al. 2000). Although the majority of grassland nesting birds used areas adjacent to the turbines at the Buffalo Ridge wind facility less, waterfowl continued to use the area in the vicinity of turbines (Osborn et al. 1998). Waterfowl continued to nest in the area, and a mallard nested 100 feet away from a turbine. These results suggest some waterfowl species may become habituated to the presence of operating turbines (Osborn et al. 1998). At a wind project in North and South Dakota, some species including killdeer, western meadowlark, and chestnut collared longspur did not show any avoidance to wind turbines, and killdeer appeared to be attracted to the bare ground surrounding turbine areas (Poulton 2010). However, some species, such as grasshopper sparrow and clay-colored sparrow, showed avoidance of turbine areas (Poulton 2010). Other studies conducted in Wisconsin and Iowa reported no clear relationships between bird abundance in turbine areas compared to reference areas and variable results among survey years (Poulton 2010).

At the Maple Ridge wind facility in upstate New York, nesting savannah sparrow did not exhibit observable displacement effects due to the presence of turbines. Nesting bobolinks were minimally affected at distances within 328 feet from turbines (Kerlinger and Dowdell 2008). Ground nesting species demonstrated continued breeding in the direct vicinity of operating turbines. At the Cohocton wind project in western New York, observers documented successful nests of horned lark, savannah sparrow, vesper sparrow, and dark-eyed junco approximately 100 feet to 260 feet from operating turbines (Stantec 2010b). A red-winged blackbird nested in a hayfield within 164 feet of a turbine at the Steel Winds wind project along Lake Erie (Stantec, unpublished data). Killdeer and their young came in close proximity to turbines at these New York projects (Stantec, unpublished data).

Observed impacts to raptors among wind energy projects have been variable. Researchers found no raptor nests where they expected to find nests during an initial year of monitoring at Buffalo Ridge in Minnesota. At the Montezuma wind facility in California, observers found a similar number of nests before and after construction of the wind farm, and wind projects in Oregon and Wyoming documented successful breeding of raptors within a mile of turbines (Strickland 2004). A variety of eastern raptor species have demonstrated continued use of wind projects for foraging in forested and agricultural settings. At the Cohocton wind project, post-construction searchers recorded a variety of raptor species foraging and perching within the Project area (Stantec 2010b). Species included red-tailed hawk, northern harrier, turkey vulture, sharp-shinned hawk, and American kestrel.

Species that use PTWF for foraging, resting, or roosting are generally common, regionally abundant species that show little response to human-related disturbances. Brown-headed cowbird, common grackle, and red-winged blackbird, all abundant species within the Project area, are known to regularly use human-altered and disturbed habitats. Commonly occurring bird species in the Project area will likely continue to use the crop field habitats for foraging and roosting. We expect some ground nesting species, such as horned lark, killdeer, and mallard, to continue to breed within proximity of turbines.

The Project footprint contains low-quality breeding habitat for raptors. Raptor species observed during pre-construction surveys at the Project, such as red-tailed hawk, merlin, and turkey vulture, are likely to use the Project area for foraging. Pre-construction surveys did not document bald eagles. Golden eagles may occur in the Project area as vagrants. PTWF will conduct 1 year of post-construction monitoring to document levels of eagle activity in the Project area.

The habitat available and results of pre-construction field surveys at PTWF indicate a low-likelihood of species of concern breeding in the Project area. However, some species of concern, particularly American golden-plover, are known to occur within the different habitats in the PTWF during migration. American golden-plovers may be displaced from areas in the direct vicinity of turbines or from Project access roads.

Some preliminary results (O'Neal et al 2008 as cited in IDNR 2008) indicate that American golden-plovers occur at distances of 230 feet or greater from roadways, suggesting a preference for contiguous blocks of foraging or roosting habitat. Results are consistent with 2009 surveys at Fowler Ridge in Indiana which found that no golden-plovers occurred within 1,312 feet of the newly built turbines, despite the plover-use of these areas in 2007 and 2008 prior to construction (USFWS 2013d). It is unclear if this result was influenced by annual variation in weather, and it is unclear if this displacement from the turbine area is a temporary or long-term effect to golden-plovers at Fowler Ridge. However, while American golden-plovers have demonstrated some avoidance or displacement from within 1,300 feet of operating turbines, they have demonstrated continued use of operational wind sites (USFWS 2013d). Therefore, golden-plovers may occur within the PTWF during Project operation and may be subject to small-scale displacement effects from areas directly around operating turbines.

American golden-plovers migrate northward through central North America to the arctic tundra during their spring migration (they fly along a different path in the fall [National Audubon Society 2001]). Illinois has important staging habitat at which these birds stopover for one or more months during spring migration during a molting period. Displacement impacts to golden-plovers would be minimal at PTWF due to the regional abundance of agricultural habitat. Soybean and corn crop fields dominate the Project area.

Bird groups such as grassland birds, forest edge species, wading birds, and other shorebirds may be susceptible to displacement if they stopover during migration. Turbines at PTWF are not located within preferred habitats of migrant grassland species, such as Henslow's sparrow, or forest edge species, such as loggerhead shrike. Turbine locations were not sited in sizable wetlands that could attract large numbers of migrant wading birds. Flocking species, such as Canada geese, that stopover in the PTWF may not be displaced or disturbed by Project operations as they are tolerant of human-disturbed environments.

Individuals from the whooping crane experimental population, which migrates through Illinois, are unlikely to stopover in the Project area. The Project area does not contain habitat features that would attract cranes (i.e., palustrine wetlands and rivers). The Project is sited in soybean and corn cropland, and this will minimize impacts to many migrants. In addition, there are several alternative natural resources (such as the nature preserves) in the area surrounding the Project that migrants are more likely to use.

Operational turbines have the potential to obstruct the flight paths of migrants to the extent that birds may alter their flight path around the PTWF. Flocks of Canada geese have been observed altering their flight paths to fly around wind projects rather than pass over them (Stantec, unpublished data). This avoidance could result in increased energy expenditure and possibly reduced survivorship. However, most migrants are expected to fly well above the height of the turbines during migration, thereby avoiding them. Further, the turbines at PTWF in agricultural fields have been widely spaced, so birds may fly between them.

***Turbine Related Mortality***

Avian collision mortality at wind farms is a well-known occurrence. Erickson et al. (2005) estimated 28,500 avian collisions with wind turbines each year in the U.S. Smallwood (2013) estimated 573,000 bird fatalities per year (with 83,000 raptor fatalities) at 51,630 MW of installed wind-energy capacity in the U.S. as of 2012. Avian mortality estimates at wind projects across the U.S. are fairly uniform, with a national average mortality estimate of approximately 2.5 birds per turbine per year. Using mortality estimates from wind farms in different regions of the U.S., weighted averages range from 1.5 birds per turbine per year in the Rocky Mountains to 4.27 birds per turbine per year in the East (NRC 2007).

Avian collision mortality occurs during both the breeding and migration seasons, but patterns in avian collision mortality at communication towers, buildings, wind turbines, and other man-made structures suggest that the majority of fatalities occur during spring and fall migration (NRC 2007). Among bird species, nocturnal, migrating passerines represent the bird group most commonly involved in fatalities at wind-energy facilities, likely due to their abundance and migratory behavior (NRC 2007).

To estimate the number of bird collision fatalities at PTWF and infer the species that may be impacted, we reviewed mortality studies from operational wind farms in the region. Wind farms within the same region and with similar land cover characteristics as the Project were included to consider the most applicable data. As such, this analysis looked at 12 states in the Midwestern U.S. to identify those wind projects that had publicly available data from post-construction mortality studies. States included: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. Based on this search, we identified post-construction data from the following wind projects: Buffalo Ridge, Minnesota (1994-1999; Johnson et al. 2000, Osborn et al. 2000); Kewaunee County, Wisconsin (1999-2000; Howe et al. 2002); Top of Iowa, Iowa (2003-2004; Koford et al. 2004, 2005); Crescent Ridge, Illinois (2005-2006; Poulton 2010); NPPD Ainsworth, Nebraska (2007; Derby et al. 2007); Blue Sky Green Field, Wisconsin (2008; Gruver et al. 2009); Forward Energy Center, Wisconsin (2008-2009; Grodsky and Drake 2011); Cedar Ridge, Wisconsin (2009; BHE 2010); and Fowler Ridge, Indiana (2009; Johnson et al. 2010). See Appendix F, Table F-1 for a summary of each study. We realize that Nebraska is relatively remote to the PTWF, but we chose to use the NPPD Ainsworth data to bolster our bird mortality rate for estimating our values for Project mortality.

For those studies that provided estimates of annual mortality, rates ranged from 0.44 to 11.83 birds per turbine per year. Median and mean mortality rates for these studies were 2.69 birds per turbine per year and 4.26 birds per turbine per year. We expect avian mortality at the Project to be within the range of mortality estimates from the projects listed above and similar to the median of the mortality estimates of 2.69 birds per turbine per year. Mortality at the Project is expected to be similar to the median because the project shares similar landscape and land cover types as these other projects. The Midwest mean is weighted heavily by two projects in Wisconsin with high mortality rates, Blue Sky Green Field (11.83 birds per turbine per year; Gruver et al. 2009) and Cedar Ridge (10.82 birds per turbine per year; BHE 2010). While Blue Sky Green Field and Cedar Ridge have similar land cover types as that of the PTWF, these projects are closer to Lake Michigan. Some studies conducted at projects on or near Lake Ontario and Lake Erie have resulted in relatively high bird fatality estimates, with numbers comparable to those observed at Blue Sky Green Field and Cedar Ridge. At Wolfe Island (on Lake Ontario) and Steel Winds (on Lake Erie), avian fatality estimates were 8.27 birds per turbine year (Stantec 2011b) and 8.46 bats per turbine year (Stantec 2013a), respectively. Conversely, proximity to the Great Lakes has not always resulted in higher bird mortality; the Kewaunee County Project proximal to Lake Michigan showed relatively low bird mortality, 1.29 birds per turbine year (Howe et al. 2002).

The maximum height of the turbines from base to blade tip at PTWF is 398 feet, which is similar to other modern turbines. There is concern that modern turbines with taller towers and greater rotor-swept heights may result in higher levels of fatality for birds and bats. However, Barclay et al. (2007) found that increasing tower height and rotor-swept area were not related to increased risk of avian collision (results were different for bats).

Individuals found during these studies (with the exception of the Crescent Ridge wind farm) are summarized by bird group and species in Table 4.2. Searchers found 273 birds during these studies. Note this number was not corrected with observer or carcass persistence biases so it does not represent the total number of fatalities expected to have occurred. Passerines represented the majority of species (68%) identified during mortality searches at these projects. Fifty-nine species of passerine (as well as unidentified meadowlark, unidentified passerine, unidentified sparrow, or unidentified swallow) were involved in collisions. Passerine species most commonly involved in collisions included horned lark, tree swallow, and European starling. Gamebirds represented 6% of fatalities found; rock dove was the most common gamebird found. Raptors represented 5% of avian fatalities; red-tailed hawk fatalities were the most commonly found. Waterbirds represented 10% of avian fatalities, with killdeer and mallard being the most commonly found.

**Table 4.2.** Number of fatalities by bird group and species found at Midwestern wind projects.[1]

| Bird group and species | Number[2] | Bird group and species | Number[2] |
|---|---|---|---|
| *Passerines* | *185* | *Passerines cont.* | |
| horned lark<br>*Eremophila alpestris* | 17 | chipping sparrow<br>*Spizella passerina* | 1 |
| tree swallow<br>*Tachycineta bicolor* | 15 | common grackle<br>*Quiscalus quiscula* | 1 |
| European starling<br>*Sturnus vulgaris* | 11 | eastern meadowlark<br>*Sturnella magna* | 1 |
| golden-crowned kinglet<br>*Regulus satrapa* | 9 | gray catbird<br>*Dumetella carolinensis* | 1 |
| ruby-crowned kinglet<br>*Regulus calendula* | 8 | house sparrow<br>*Passer domesticus* | 1 |
| barn swallow<br>*Hirundo rustica* | 7 | least flycatcher<br>*Empidonax minimus* | 1 |
| common yellowthroat<br>*Geothlypis trichas* | 7 | Lincoln's sparrow<br>*Melospiza lincolnii* | 1 |
| savannah sparrow<br>*Passerculus sandwichensis* | 6 | loggerhead shrike[3]<br>*Lanius ludovicianus* | 1 |
| black-and-white warbler<br>*Mniotilta varia* | 5 | ovenbird<br>*Seiurus aurocapilla* | 1 |
| mourning dove<br>*Zenaida macroura* | 5 | snow bunting<br>*Plectrophenax nivalis* | 1 |
| western meadowlark<br>*Sturnella neglecta* | 5 | song sparrow<br>*Melospiza melodia* | 1 |
| magnolia warbler<br>*Setophaga magnolia* | 4 | spotted towhee<br>*Pipilo maculatus* | 1 |
| orange-crowned warbler<br>*Oreothlypis celata* | 4 | swamp sparrow<br>*Melospiza georgiana* | 1 |
| red-eyed vireo<br>*Vireo olivaceus* | 4 | unidentified meadowlark<br>*Sturnella* sp. | 1 |
| brown-headed cowbird<br>*Molothrus ater* | 3 | unidentified swallow | 1 |
| red-winged blackbird<br>*Agelaius phoeniceus* | 3 | yellow-bellied flycatcher<br>*Empidonax flaviventris* | 1 |

| Bird group and species | Number[2] | Bird group and species | Number[2] |
|---|---|---|---|
| sedge wren<br>*Cistothorus platensis* | 3 | yellow-headed blackbird<br>*Xanthocephalus xanthocephalus* | 1 |
| unidentified passerine | 3 | yellow-throated vireo<br>*Vireo flavifrons* | 1 |
| vesper sparrow<br>*Pooecetes gramineus* | 3 | *Gamebirds* | 17 |
| American goldfinch<br>*Spinus tristis* | 2 | rock pigeon<br>*Columba livia* | 9 |
| American robin<br>*Turdus migratorius* | 2 | ring-necked pheasant<br>*Phasianus colchicus* | 2 |
| blackpoll warbler<br>*Setophaga striata* | 2 | sharp-tailed grouse<br>*Tympanuchus phasianellus* | 2 |
| cedar waxwing<br>*Bombycilla cedrorum* | 2 | wild turkey<br>*Meleagris gallopavo* | 2 |
| chimney swift<br>*Chaetura pelagica* | 2 | gray partridge<br>*Perdix perdix* | 1 |
| cliff swallow<br>*Petrochelidon pyrrhonota* | 2 | greater prairie-chicken<br>*Tympanuchus cupido* | 1 |
| dark-eyed junco<br>*Junco hyemalis* | 2 | *Raptors/owls/vultures* | 15 |
| Dickcissel<br>*Spiza americana* | 2 | red-tailed hawk<br>*Buteo jamaicensis* | 11 |
| eastern kingbird<br>*Tyrannus tyrannus* | 2 | American kestrel<br>*Falco sparverius* | 2 |
| *Empidonax* flycatcher | 2 | turkey vulture<br>*Cathartes aura* | 1 |
| grasshopper sparrow[3]<br>*Ammodramus savannarum* | 2 | short-eared owl<br>*Asio flammeus* | 1 |
| house wren<br>*Troglodytes aedon* | 2 | *Waterbirds* | 27 |
| purple martin<br>*Progne subis* | 2 | killdeer<br>*Charadrius vociferus* | 7 |
| Tennessee warbler<br>*Oreothlypis peregrina* | 2 | Mallard<br>*Anas platyrhynchos* | 4 |
| unidentified sparrow | 2 | American coot<br>*Fulica americana* | 3 |
| warbling vireo<br>*Vireo gilvus* | 2 | blue-winged teal<br>*Anas discors* | 3 |
| yellow warbler<br>*Setophaga petechia* | 2 | herring gull<br>*Larus argentatus* | 2 |
| yellow-bellied sapsucker<br>*Sphyrapicus varius* | 2 | pied-billed grebe[3]<br>*Podilymbus podiceps* | 2 |
| yellow-rumped warbler<br>*Setophaga coronata* | 2 | unidentified waterfowl | 2 |
| American redstart<br>*Setophaga ruticilla* | 1 | green-winged teal<br>*Anas crecca* | 1 |
| American tree sparrow<br>*Spizella arborea* | 1 | ruddy duck<br>*Oxyura jamaicensis* | 1 |
| black-billed cuckoo[3]<br>*Coccyzus erythropthalmus* | 1 | upland sandpiper[3]<br>*Bartramia longicauda* | 1 |

| Bird group and species | Number[2] | Bird group and species | Number[2] |
|---|---|---|---|
| black-throated green warbler *Setophaga virens* | 1 | Franklin's gull *Leucophaeus pipixcan* | 1 |
| blue jay *Cyanocitta cristata* | 1 | unidentified bird | 26 |
| bobolink *Dolichonyx oryzivorus* | 1 | unidentified large bird | 3 |
| brown creeper *Certhia americana* | 1 | Total | 273 |

[1] Studies include those conducted at Buffalo Ridge, MN 1994-1999; Kewaunee County, WI 1999-2000; Top of Iowa, IA 2003-2004; NPPD Ainsworth, NE 2007; Blue Sky Green Field, WI 2008; Forward Energy Center, WI 2008-2009; Cedar Ridge, WI 2009; and Fowler Ridge, IN 2009.
[2] Numbers are actual carcasses detected and were not corrected for searcher efficiency or carcass persistence biases.
[3] USFWS Bird of Conservation Concern for Bird Conservation Region 22 (USFWS 2008a).

The composition of species susceptible to collision fatality at the PTWF is expected to be similar to species composition at other projects in the region. The regional list of fatalities does not necessarily include every species that may be impacted at the PTWF, nor is it expected that all of these species will be involved in collisions at PTWF.

It is likely that passerines will comprise the majority of fatalities found at the PTWF, consistent with other available studies in the region and in the U.S. in general. The timing of the majority of fatalities at the PTWF is expected to occur during spring and fall migration, consistent with the results of other studies (NRC 2007). However, some fatalities of wintering and breeding birds such as horned lark may occur outside of migratory periods. It is likely that individuals from other bird groups also will be fatalities.

Red-tailed hawks and other large raptors are mainly diurnally active and would be expected to avoid large obstructions when detected within their flight paths. However, some raptors distracted by prey while hovering to forage may be at increased risk of collision. Bald eagles, among other species of raptor, have been observed to avoid collisions when in the vicinity of turbines at operational wind projects (Sharp et al. 2010, Stantec 2010a). There have been 6 confirmed bald eagle fatalities at wind projects in the contiguous U.S. (Pagel et al. 2013) and one additional potential turbine-collision fatality at a wind project in Minnesota. One bald eagle was injured during a turbine collision at a project in Iowa (USFWS, unpublished data). Bald eagle fatalities in the contiguous U.S. have been rare, despite continued use of operational wind projects by bald eagles.

Red-tailed hawks were the most commonly observed raptor during pre-construction surveys at the Project and are the most frequently documented raptor species fatality at Midwestern wind project. We expect red-tailed hawk fatalities at the PTWF. However, 10 different studies documented 11 red-tailed hawk fatalities, and the Project will probably take no more than 1 or 2 red-tailed hawk individuals each year.

It is likely that some species of waterfowl and waterbirds will be involved in collisions, primarily mallards, as they have been found during fatality searches at regional projects and they occur at the PTWF. Killdeer may be involved in collisions at the PTWF. Fatality searches at Fowler Ridge in 2009 found more killdeer fatalities than any other species (Johnson et al. 2010). However, as a group, passerines constituted the majority of bird fatalities recorded at Fowler Ridge (Johnson et al. 2010). There were no American golden-plover fatalities documented at Fowler Ridge despite its proximity to an Important Bird Area (IBA) where large numbers of golden-plover are known to stopover during spring migration. No other projects in the region have documented golden-plover fatalities.

Some species of concern documented at the PTWF have been involved in collisions at other regional projects: loggerhead shrike (n=1), upland sandpiper (n=1), and short-eared owl (n=1). Because these species are not expected to frequent the Project area (except as rare vagrants during migration or in winter), we expect the risk of collision for these species at the PTWF to be very low. Refer to the following section, *Population Level Effects of Operations on Birds*, for a discussion of the implications of expected levels of mortality for species at the Project.

Bird flight behaviors and abundance are expected to influence their risk of collision at the Project. Birds have demonstrated turbine avoidance behaviors at other operational projects. While the ability of birds to avoid turbines likely depends on a variety of factors, some studies have attempted to quantify or estimate turbine avoidance rates, either through visual observation or computer modeling. Birds presumably avoid encountering turbines by seeing the blades or detecting the motion of spinning blades, or by hearing them (Dooling 2002). Avian turbine avoidance rates were estimated using the 'Band Model' (Madders and Whitefield 2006) at several existing wind farms in the U.S. The avoidance rates of geese and raptor species were estimated at greater than 95% (Fernley et al. 2006). Golden eagles were estimated to have a turbine avoidance rate of 99.5% (Chamberlain et al. 2006). The limitations to these turbine avoidance estimates include failure to account for differences among bird flight patterns and behaviors under a range of conditions, as well as a general lack of information and data about avoidance behaviors of many species of birds (Chamberlain et al. 2006). Visual observations of turbine avoidance behavior by birds were made by researchers documenting movement patterns and flight behaviors at the Buffalo Ridge facility. Birds seen flying through turbine strings often adjusted their flight when turbine blades were rotating and typically made no adjustments when turbines were not operating (Osborn et al. 1998).

At the PTWF, migrant birds would be most at risk of collision with turbines when taking off or landing, or if flying low during inclement weather (rain or fog), particularly at night. Local birds or stopover birds would be at lower risk of collision when making small-scale flights at low altitudes between foraging and roosting locations in the area, as they typically remain below the rotor-swept height during these activities. Pre-construction surveys documented most avian species at heights below the proposed rotor-swept zone, but results show a few birds in the rotor-swept zone, including American golden-plover (ARCADIS 2010). Most species of birds flying below rotor-zone during periods of good visibility will generally avoid turbine collisions. However, birds foraging at heights within the rotor-zone may be more at risk when distracted by prey. Additionally, birds engaged in territorial or courtship flights can be distracted putting these individuals at risk of collision if distracted when flying through the rotor-swept zone.

The Project was designed with impact minimization measures to reduce the risk of avian collision. The new generation turbines used at the Project have tubular support structures instead of lattice structures, which eliminate perching by avian species such as raptors. Newer turbines also have larger blades, which reduces motion blur. The turbines at PTWF have been adequately spaced within crop fields, allowing birds greater reaction times to avoid turbines when approaching them. Nighttime lighting at the Project has been designed to minimize risk of collision of nocturnal migrants; see a discussion in the following section for a more detailed description of the lighting schemes at the Project. The Applicant has agreed to implement adaptive management to identify possible further mitigation in the event of an eagle fatality, mass avian fatality, or ESA-listed species fatality.

*Results of 2012 Post-construction Monitoring at Pioneer Trail Wind Farm*

As part of the Service's Technical Assistance Letter, PTWF conducted post-construction monitoring in fall 2012 and spring 2013 following the methodology described in the BBCS (provided in Appendix A). Searchers detected 9 birds combined for both seasons. Rare, threatened, or endangered species were not identified among the fatalities, but only 4 of these 9 birds were positively identified. Using the fatality estimator described in Erickson et al. (2003), ARCADIS (2013) estimated fatalities and rates of fatalities for birds shown in Table 4.3. One would expect PTWF to have bird mortality rates similar to those observed at other Midwestern wind projects, 0.00 to 11.83 birds per turbine per year. Based on two seasons of sampling, bird mortality rates at the Project were very close to the low end of the range of mortality found at other Midwestern projects.

**Table 4.3.** Results of post-construction monitoring at Pioneer Trail Wind Farm (ARCADIS 2013).

| | Fall 2012[1] | | Spring 2013[1] | |
|---|---|---|---|---|
| *Measure* | *Mortality (90% CI[2])* | *SD[3]* | *Mortality (90% CI[2])* | *SD[3]* |
| Total | 23.00 (8.51-38.30) | 11.60 | 12.00 (2.67-20.40) | 1.15 |
| Mean per turbine | 0.46 | 0.23 | 0.24 | 0.02 |
| Mean per MW | 0.29 | 0.14 | 0.15 | 0.01 |

[1] Fall = August 13 - October 10; Spring = April 2 – May 8
[2] CI = confidence interval; statistic used to indicate the accuracy of the estimate, which is not the true value. The interval is used to illustrate how far the estimate is likely to be from the true value 90% of the time.
[3] SD = Standard deviation; statistic used to show the dispersion of data from the mean.

For the purposes of showing bird mortality at PTWF annually and for the life of the Project, we chose to use the range of mortality found at other Midwestern wind projects because this is a larger, more robust data set (Table 4.4). Again, we assume that bird mortality will not be affected by operational adjustments. Using the rates shown in Table 4.4, annual bird mortality could range from 41 birds to over 1,000 birds. Realistically, however, in most years we would predict values closer to the average (mean) value than the extreme ends of variation. Annual bird mortality is more likely to be around 400 birds per year in most years resulting in a life-of-Project mortality around 18,000 birds.

**Table 4.4.** Predicted bird mortality resulting from Project operations under all alternatives for the Pioneer Trail Wind Farm. Estimates are based on mortality rates reported for 10 post-construction studies in the Midwest. [1]

| Mortality rate (birds per turbine per year) | | Annual mortality (94 turbines) | Life-of-Project mortality (43 years) |
|---|---|---|---|
| Minimum | 0.44 | 41 | 1,861 |
| Maximum | 11.83 | 1,112 | 50,041 |
| Median | 2.69 | 253 | 11,379 |
| Mean | 4.26 | 400 | 18,020 |

[1] Based on Johnson et al. (2000, 2010), Osborn et al. (2000), Howe et al. (2002), Koford et al. (2004, 2005), Derby et al. (2007), Gruver et al. (2009), BHE (2010), Poulton (2010), Grodsky and Drake (2011).

### *Other Sources of Mortality Associated with Project Operations*

Birds are susceptible to other sources of mortality at wind projects beyond turbine collision. Other sources of mortality include collision with maintenance vehicles, collision or electrocution from transmission lines, and collisions with other project structures such as MET towers. Additionally, nighttime lighting at wind facility substations or Operations and Maintenance buildings can increase the risk of collision with Project structures or nearby turbines.

*Vehicle collisions*

Birds may be susceptible to collision with maintenance vehicles when crossing roads within the Project area. Avian-vehicle collisions have been reported at other operational projects, but, they represent a smaller proportion of fatalities than turbine collisions (Stantec, unpublished data). The PTWF does not specify a speed limit on Project area roads. A slower traffic speed, such as 15 mph, would allow for birds to better detect and avoid a vehicle and drivers to slow when approaching birds on roadways. Post-construction monitoring search plots include access roads leading to turbine pads. It is possible that searches may recover bird carcasses that resulted from vehicle collisions, and it is not possible to distinguish between this source of blunt-force trauma and that from wind turbine collision.

*Transmission line collisions and electrocutions*

Transmission lines represent a significant source of collision and electrocution risk to birds including passerines, waterfowl, and raptors. To avoid the risk of transmission line collisions and electrocutions, PTWF minimized the amount of aboveground collection and transmission lines and buried collection cables wherever possible. This impact minimization measure is expected to reduce the risk of avian collisions and electrocutions with transmission lines at the Project.

*Collisions with MET towers*

Collisions with MET towers at wind projects have been well documented, and in some cases, collisions with guyed MET towers have represented greater risk of avian collision than wind turbines (Johnson et al.

2000, Stantec 2013b). Avian risk of collision mortality at towers (including MET towers and communication towers) varies depending on tower height, lighting, color, structure, and the presence of guy wires (The Ornithological Council 2007). Avian risk increases with tower height (Longcore et al. 2008). Guywires substantially increase the risk of avian collision; birds are suspected to collide more frequently with guywires and not as frequently with the tower itself as documented collisions are substantially lower at unguyed towers (Longcore et al. 2008). At the PTWF, there is one permanent 80-meter (262-foot) MET tower. The tower is a self-supported, unguyed, lattice, steel structure, substantially decreasing the risk for avian collisions with the MET tower.

*Wind facility lighting*

Nocturnal migrants aggregate at artificial light sources when they become disoriented or "trapped" by lights (Longcore et al. 2008). The potential for this phenomenon to occur is increased when fog is present to reflect the light and when inclement weather or topographic factors influence migrating birds to fly at lower heights above ground level (Longcore et al. 2008). Mass avian collision events associated with lighting at wind facilities have been documented in the eastern U.S. These events generally have occurred in rain and fog conditions during peak periods of migration. One such event occurred at a substation at the Mountaineer Wind Energy Center in West Virginia where a sodium vapor spot light was left on at night at the substation and 33 birds collided with turbines near the substation and with the substation itself (Kerns and Kerlinger 2004). Similar circumstances resulted in the collision of nearly 500 birds at a substation at the Laurel Mountain wind project in West Virginia (Stantec, unpublished report). Another similar, large-scale collision event was documented at the Mount Storm Wind Energy Facility in West Virginia (Young et al. 2010).

The Applicant designed the lighting schemes at the PTWF to minimize the risk to nocturnal migrants. Current federal regulations specify the use of nighttime lighting for aviation safety on all structures greater than 200 feet above ground level (Longcore et al. 2008). Turbines at the PTWF are equipped with red strobe L-864 FAA lights that flash at night. Strobe or flashing lights on towers decrease the risk of bird collisions compared to steady-burning lights (Longcore et al. 2008). Kerlinger et al. (2010) found no significant difference between fatality rates at turbines with FAA lights as opposed to turbines without FAA lighting. FAA lighting at the Project is not expected to increase risk of collision to nocturnal migrants.

The Applicant has incorporated other measures to minimize impacts to nocturnal migrants. Personnel will turn off internal lights at towers at night (when these lights are not required for safety compliance). Any nighttime lighting at the substation will be equipped with downward facing shields.

***Population Level Effects of Operations on Birds***

There is some concern that population level effects during operations at wind projects could result from displacement or collision related impacts. The potential for population-level effects due to displacement is not well understood. To date, no effects have been documented at terrestrial wind projects in the U.S. (NRC 2007). Impacts associated with direct effects such as turbine mortality have received more attention.

Passerine species that migrate long distances at night are most frequently involved with collisions at turbines and other manmade structures (Erickson et al. 2005, NRC 2007, Arnold and Zink 2011). Collisions typically occur during nighttime migration (Arnold and Zink 2011). To date, no significant population level impact to any one species has been documented; this is largely because the nocturnal migrant passerines most at risk of collision are regionally abundant (NRC 2007, Erickson et al. 2002, Arnold and Zink 2011). There is some concern that raptor species, such as golden eagles at western projects, may be more susceptible to population-level impacts because they have relatively smaller populations (NRC 2007). For example, in some regions in the West, the take of one individual golden eagle could be considered an impact to the local population of eagles within the region (USFWS 2013c). However, this has not been the case for most populations of birds as species that are typically involved in collisions with manmade structures are often those that have stable populations (Arnold and Zink 2011).

Available data suggest that species abundance is a significant factor in risk of collision at wind farms. At the PTWF, the species most at risk of collision are those that are regionally abundant and engage in flight behaviors that put them at risk of collision, and those that migrate through the area at night at lower altitudes. This would include a variety of passerine species and species found most commonly during fatality studies in the region, such as European starling, horned lark, and tree swallow. As discussed previously, raptors (e.g., red-tailed hawk), waterfowl (e.g., mallard) and shorebirds (e.g., killdeer) would also be at risk, but these species fatalities would be very infrequent. The Partners in Flight landbird population database estimates for the North American populations of these common species are provided in Table 4.5. Because populations of these species are stable, the take of a few individuals each year would not likely result in population-level effects. However, as wind power grows in the region, it is unclear how impacts from multiple projects will affect some populations.

**Table 4.5.** Partners in Flight land bird population estimates for regionally abundant species involved in collision mortality at wind projects in the Midwest.

| Species | North American estimate [1] |
|---|---|
| European starling | 57 million |
| horned lark | 80 million |
| tree swallow | 17 million |
| red-tailed hawk | 2 million |
| mallard | 10.6 million [2] |
| killdeer | 1 million [3] |

[1] PIF population estimate available at http://rmbo.org/pifpopestimates/Database.aspx (PIF 2013).

[2] Not available in PIF database; estimate provided by http://www.flyways.us/status-of-waterfowl/population-estimates/2012-population-estimates (Flyways.us 2013)

[3] Not available in PIF database; estimate provided by BirdLife International (2012).

Species considered at risk from population-level effects would include those with relatively small or unstable populations. In the Midwest, there have been few documented fatalities of species of particular conservation concern. Collectively at several projects and over more than 10 years, post-construction monitoring results in the region documented one individual of each of the following species of conservation concern: loggerhead shrike, upland sandpiper, and short-eared owl. The PIF landbird population database indicates that the North American population of loggerhead shrike is 4.9 million and short-eared owl is 600,000. The global population of upland sandpiper is estimated to be 350,000 (Houston et al. 2011). While the reported numbers of these species fatalities have not been corrected for searcher and persistence biases, fatalities of these species, as well as other species of concern for the PTWF, are expected to occur very rarely in the region. The take of one or a few of these individuals at Projects in the region over the course of 10 years would not likely result in population-level effects. The potential for population-level effects due to Project operations is not expected.

**Project Maintenance**

Maintenance effects on birds may include disturbance and possible mortality due to human activity, the presence of large equipment (e.g., cranes), nighttime lighting, and vehicle traffic. These impacts are expected to be minimal and temporary and would only be in effect when personnel are on-site for maintenance activities.

Impacts associated with human presence at towers during maintenance activities are expected to be minimal and temporary. Birds in the immediate area may be temporarily displaced when personnel are on-site. However, they are expected to return to the area after maintenance activities. Many species that occur in the Project area commonly occupy human-disturbed habitats and are tolerant of some human activity. Other species are more sensitive to human presence and could be displaced. However, as maintenance activities are expected to be temporary, substantial impacts associated with disturbance and displacement are not expected. If a more long-term maintenance activity is required (e.g., blade repair or replacement), some species may be displaced from the area for the duration of the activity. The habitat in the Project area is relatively uniform and therefore birds would be expected to utilize similar surrounding habitat if displaced from the immediate area.

If a crane or other large equipment is required, there may be risk of mortality or decreased nesting success for birds breeding in the immediate area. Possible species impacted could include horned lark or killdeer which may nest on the bare ground surrounding towers. Nests or nestlings could be destroyed. However, the use of large equipment to maintain turbines is expected to occur infrequently. Most turbine maintenance happens by accessing the nacelle through the ladder located inside the tower. Therefore, impacts associated with decreased nesting success are expected to be minimal.

Birds could collide with large equipment such as cranes. Further, if lighting at towers is required for nighttime maintenance activities during rain or fog conditions, there may be an increased risk of avian collisions with towers or nearby equipment. These risks would be short-term and temporary. Personnel will turn off any internal or external lights in maintenance areas at night when not actively working (and when these lights are not required for safety compliance). Therefore, impacts associated with collision impacts during maintenance are expected to be minimal.

Birds also could collide with maintenance vehicles or flush as maintenance vehicles drive by them. Slower traffic speeds would allow for birds to detect approaching vehicles from a greater distance, affording them more time to leave the immediate area. Slowly approaching vehicles allow drivers to slow when approaching birds on roadways or when groups of birds fly across roadways. As such, impacts associated with maintenance vehicle collisions are expected to be minimal.

**Post-Construction Monitoring**

All three alternatives include post-construction monitoring to be implemented as described in the BBCS and HCP, both of which specify the same protocol. Effects to birds resulting from post-construction monitoring may include disturbance or mortality due to increased vehicle traffic and human presence. Furthermore, any vehicle-induced fatalities may attract scavengers.

Post-construction monitoring would also include searcher efficiency and carcass persistence trials, in which carcasses are placed in the Project area to assess searcher success and carcass removal by scavengers (i.e., mammals and birds). Local scavenging type birds, such as vultures, raptors, and crows may be attracted to the PTWF during either of these trials. Cleared turbine pads would make fatalities easily detectable to birds. Avian scavengers could collide with spinning turbine blades while attempting to take a carcass.

**Project Decommissioning**

PTWF agreed to follow best management practices throughout the life of the Project, including decommissioning. Decommissioning effects may include disturbance and mortality related to human activity, the presence of large equipment, nighttime lighting, and increased vehicle traffic. After decommissioning, the habitat and land-use activities would be restored to pre-construction conditions or as per landowner wishes. Impacts to birds associated with decommissioning activities at the Project are expected to be minimal and generally short-term. Adverse impacts to birds are not expected from decommissioning of the Project.

**Summary of the Effects of Project Operations on Avian Resources**

- No major adverse effects to the local bird community are anticipated under any of the three alternatives due to the large amount of similar habitat available adjacent to all permanently disturbed areas.
- Over the 43-year permit term, it is estimated that approximately 18,000 birds would be killed.
- No adverse impacts at the population level are anticipated under any of the three alternatives.
- The effect of potential displacement of American golden-plovers from the Project area is expected to be minor, given that both protected and comparably large areas of other suitable habitat is available proximal to the Project area.
- No impacts to bald eagles or golden eagles from the Project are anticipated based on the location of the Project area and the distribution of eagles in the area.
- No major adverse effects to the local bird community as a result of maintenance or decommissioning are expected for any bird species.
- No specific mitigation measures for birds would be implemented under any of the three alternatives.

#### 4.3.3.3 Direct and Indirect Effects Presented by Alternative

**Alternative 1: No-Action Alternative**

Effects to birds from Project operations under the No-Action Alternative would be as described in Section 4.3.3.2. However, all bat mortality is expected to be lower under this alternative as compared to Alternatives 2 and 3. Hence, it is possible the Project may attract fewer scavenging-type birds. Because Indiana bat fatalities would be avoided, the Applicant would not implement either of the habitat mitigation projects under the No-Action Alternative. Because there would be no summer habitat mitigation, birds that use forest or bottomland forest habitats would not experience any potential long-term benefits that would result from the expansion and enhancement of woodland habitat in the Middle Fork Vermilion River watershed.

The No-Action Alternative is not expected to result in major impacts to avian resources. The No-Action Alternative would not result in reducing any naturally occurring population to numbers below that for maintaining viability at the local or regional level. The No-Action Alternative is not expected to result in substantial loss or degradation of habitat for a rare, threatened, or endangered bird species. The No-Action Alternative would not result in substantial changes in habitat conditions producing indirect effects that cause naturally occurring populations to be reduced in numbers below levels for maintaining viability at local or regional levels.

**Alternative 2: Preferred Alternative**

Effects to birds from Project operations under the Preferred Alternative would be as described in Section 4.3.3.2. Under the Preferred Alternative, the Applicant is proposing to mitigate the unavoidable impact of taking 327 Indiana bats over the duration of the permit. The summer habitat mitigation project is likely to affect avian resources.

***Winter Habitat Mitigation***

While this mitigation action will result in benefits to Indiana bat and other bat species, this proposed mitigation project is expected to have no substantial benefits to bird populations or their habitat. Gating activities will create short-term noise that may disturb or displace some nearby birds.

***Summer Habitat Mitigation***

While the goal of this mitigation project is to restore, preserve, and enhance 206 acres of Indiana bat summer maternity habitat and northern long-eared bat habitat, this project also will provide benefits to forest-dwelling birds. This mitigation will impact 157 acres of land in agricultural use. In the long-term, these forested parcels will offer large tracts of habitat for forest interior breeding birds and may also provide high quality stopover habitat for some migrants.

During the regeneration period (3 to 15 years after planting), the mitigation site would attract early-successional species, such as prairie warbler, white-eyed vireo, and yellow-breasted chat. In the long-term, mature forest habitat is likely to result in increases in local populations of Acadian flycatcher, eastern wood-pewee, great-crested flycatcher, ovenbird, red-eyed vireo, and yellow-billed cuckoo.

It is difficult to predict the species and density of birds that may be attracted to a restored habitat (Herkert et al. 1993). Studies suggest that species richness and density of birds attracted to either forested or grassland habitats increases with increasing area. However, area is just one of several influencing factors (Herkert et al. 1993). Isolated or fragmented habitat patches are not as readily used by some area-sensitive species such as cerulean warbler, yellow-throated vireo, and worm-eating warbler (Herkert et al. 1993). Attracting area-sensitive species will depend on area and connectivity with other habitat blocks of similar character. The reforestation mitigation project will serve to increase the overall area of already preserved tracts of land near the Middle Fork. As such, area-sensitive species of birds also are expected to benefit from the proposed mitigation.

The Preferred Alternative is not expected to result in major impacts to avian resources. The Preferred Alternative would not result in reducing any naturally occurring population to numbers below that for maintaining viability at the local or regional level. The Preferred Alternative is not expected to result in substantial loss or degradation of habitat for a rare, threatened, or endangered bird species. The Preferred Alternative would not result in substantial changes in habitat conditions producing indirect effects that cause naturally occurring populations to be reduced in numbers below levels for maintaining viability at local or regional levels. The summer habitat mitigation project would have long-term beneficial effects to general and aquatic wildlife at the local scale through forested habitat expansion and enhancement in a riverine community.

**<u>Alternative 3: Non-Restricted Operations Alternative</u>**

Effects to birds from Project operations under Alternative 3 would be as described in Section 4.2.3.2. However, all bat mortality is expected to be higher under this alternative as compared to Alternatives 1 and 2. Hence, it is possible the Project may attract more scavenging-type birds.

Under Alternative 3, the Applicant would need to mitigate the unavoidable impact of taking 521 Indiana bats and 252 northern long-eared bats over the duration of the permit. Effects to birds associated with the mitigation projects under Alternative 3 would be similar to those as described for the Preferred Alternative. However, the Applicant would need to increase acreage of summer habitat mitigation to offset the higher impact of the taking Indiana bats. Under Alternative 3, the Applicant would need to implement summer habitat mitigation measures on at least 252 acres of previously disturbed, unrestored lands in addition to winter habitat mitigation to offset the impact of taking 521 Indiana bats and 252 northern long-eared bats. If the Applicant is unable to implement adequate winter habitat mitigation, then the amount of summer habitat mitigation would affect an even larger area of unrestored lands. Alternative 3 would have long-term beneficial effects to forest and riparian birds through forested habitat expansion and enhancement in a riverine community.

In summary, Alternative 3 would have moderate, beneficial impacts to birds that use forested habitats at the local scale. Relative to the Preferred Alternative, Alternative 3 would have greater benefits to birds that use forests, bottomlands, and forested river corridors.

In summary, Alternative 3 is not expected to result in major adverse impacts to avian resources that would substantially affect a species' population (locally, regionally, or rangewide) or appreciably reduce its habitat quality or quantity. Alternative 3 would not result in substantial changes in habitat conditions producing indirect effects that cause naturally occurring populations to be reduced in numbers below levels for maintaining viability at local or regional levels. Conversely, the summer habitat mitigation project would have substantial, long-term beneficial effects to birds that use forested habitats.

### 4.3.4 BAT RESOURCES

#### 4.3.4.1 Impact Criteria

The following sections analyze potential impacts of each alternative on listed and unlisted bats. The federally listed Indiana bat is protected under the ESA and is also the only bat species protected by Illinois state law. The northern long-eared bat is proposed for listing under the ESA. With the exception of the Indiana bat, population data is lacking. Therefore, although we discuss all bat species, we are able to assess the effects of the alternatives to the population viability for only the Indiana bat.

Major impacts may occur to other bats should implementation of an alternative result in any of the following:

- Observed Project mortality rates greatly exceed the estimated rate for a wind project in the region;
- Substantial loss or degradation of habitat; or
- Substantial change in habitat conditions producing indirect effects that result in additive reductions in naturally occurring populations.

Major impacts to Indiana bats and northern long-eared bats could occur should implementation of an alternative result in any of the following:

- Naturally occurring population reduced in numbers below levels for maintaining viability at local or regional level;
- Substantial loss or degradation of habitat, or;
- Substantial change in habitat conditions producing indirect effects that cause naturally occurring populations to be reduced in numbers below levels for maintaining viability at local or regional levels.

#### 4.3.4.2 Direct and Indirect Effects Presented by Alternative

This section analyzes the potential effects to listed and unlisted bat species anticipated for each alternative. Because operational adjustments are proposed for August 15 to October 15 in each alternative, we assume potential impacts to bats outside this date range will not vary among alternatives. Table 4.6 identifies direct effects of each alternative, indicating which potential impacts are unique to each alternative (italicized). We summarize these anticipated general impacts first, and then evaluate impacts to listed and unlisted bats for each alternative.

**Table 4.6.** Comparison of direct effects for proposed alternatives with italicized effects unique to that alternative.

| Alternative | Unlisted Bats | Indiana Bats | Northern Long-eared Bats |
|---|---|---|---|
| *Alternative 1: No-Action (Take Avoidance)*<br>• 6.9 m/s curtailment, August 15 – October 15<br>• No Mitigation | • No loss of roost habitat<br>• Bat mortality during spring migration and early summer comparable to projects in region<br>• *~80% reduction in bat mortality during curtailed period* [1]<br>• Long-distance migratory species primarily affected<br>• No benefits from mitigation | • No loss of summer maternity roost habitat<br>• No mortality anticipated during spring and early summer<br>• *No mortality anticipated during curtailed period*<br>• No benefits from mitigation | • No loss of summer maternity roost habitat<br>• No mortality anticipated during spring and early summer<br>• *No mortality anticipated during curtailed period*<br>• No benefits from mitigation |
| *Alternative 2: Preferred Alternative (Authorized Take)*<br>• 5.0 m/s curtailment, August 15 – October 15<br>• Mitigation Plan | • No loss of roost habitat<br>• Bat mortality during spring migration and early summer comparable to projects in region<br>• *~50% reduction in bat mortality during curtailed period*<br>• Long-distance migratory species primarily affected<br>• Potential regional habitat improvements due to mitigation plan | • No loss of summer maternity roost habitat<br>• No mortality anticipated during spring and early summer<br>• *Mortality of up to 3 Indiana bats for facility annually between August 15 and October 15*<br>• Protection of winter habitat and creation of potential summer roost and foraging habitat from mitigation plan | • No loss of summer maternity roost habitat<br>• No mortality anticipated during spring and early summer<br>• *Mortality of up to 2 northern long-eared bats for facility annually between August 15 and October 15*<br>• Creation of potential summer roost habitat from mitigation plan |
| *Alternative 3: Non-Restricted Operations with Mitigation*<br>• 3.5 m/s cut-in speed, August 15 – October 15<br>• Mitigation Plan | • No loss of roost habitat<br>• *Bat mortality rates comparable to uncurtailed projects in region*<br>• Long-distance migratory species primarily affected<br>• Potential regional habitat improvements due to mitigation plan | • No loss of summer maternity roost habitat<br>• No mortality anticipated during spring and early summer<br>• *Mortality of up to 6 Indiana bats for facility annually between August 15 and October 15*<br>• Protection of winter habitat and creation of potential summer roost and foraging habitat from mitigation plan | • No loss of summer maternity roost habitat<br>• No mortality anticipated during spring and early summer<br>• *Mortality of up to 3 northern long-eared bats for facility annually between August 15 and October 15*<br>• Creation of potential summer roost habitat from mitigation plan |

[1] Studies conducted at wind projects in the mid-Atlantic Highlands found when turbines were curtailed and feathered at 6.5 to 6.9 m/s cut-in speeds, bat mortality rates were reduced from 73 to 92% as compared to mortality rates observed at uncurtailed projects in the eastern US (Arnett et al. 2010, Shoener Environmental 2013, Tidhar et al. 2013).

**General Bat Mortality Patterns at Wind Farms**

Bat mortality at rates of concern to wildlife agencies has occurred at commercial wind farms throughout the Midwest and eastern U.S. Mechanisms for bat mortality at wind turbines include trauma associated with direct collision with spinning turbine blades and barotrauma (i.e., tissue damage to lungs and respiratory organs that occurs when bats fly through a wake of low pressure that follows immediately behind fast-moving turbine blades). Barotrauma can cause mortality even when bats do not physically collide with turbine blades, as was the case for an estimated 50% of carcasses recovered during a mortality study at a wind farm in Alberta, Canada (Baerwald et al. 2008). Bats do not appear to be at risk of mortality when turbines are fully feathered (blades pitched to rotate at <2 revolutions per minute when wind speeds are below the indicated cut-in speed).

Long-distance migratory bats consistently account for the majority of fatalities in studies of wind farm mortality in the U.S. (Arnett et al. 2008). These patterns occurred during each of 3 years of post-construction monitoring at Fowler Ridge, approximately 30 miles east of the Project area (Johnson et al. 2010, Good et al. 2011, 2012). Migratory tree bats have accounted for the majority of fatalities regardless of the immediate landscape or habitat and in both agricultural settings of the Midwest and forested ridgelines in the Appalachian Mountains and accounted for a combined 87% of bat mortality among 9 wind projects in the Midwest with publicly available monitoring results (Table 4.7).

**Table 4.7.** Species composition of bat carcasses found and identified at wind projects in the Midwest with publicly available post-construction monitoring reports.

| Project | State | Bat carcasses identified | Long-distance migratory[1] | Cave-hibernating [2] | Reference |
|---|---|---|---|---|---|
| Buffalo Ridge, Phases I-III | MN | 163 | 93% | 7% | Johnson et al. (2003) |
| Buffalo Ridge, Lake Benton I & II | MN | 151 | 93% | 7% | Johnson et al. (2004) |
| Blue Sky Green Field | WI | 235 | 50% | 50% | Gruver et al. (2009) |
| Kewaunee County | WI | 72 | 90% | 10% | Howe et al. (2002) |
| Cedar Ridge | WI | 215 | 73% | 27% | BHE (2010) |
| Crescent Ridge | IL | 20 | 100% | 0% | Kerlinger et al. (2007) |
| Top of Iowa | IA | 76 | 64% | 36% | Jain (2005) |
| Forward Energy Center | WI | 108 | 78% | 22% | Grodsky and Drake (2011) |
| Fowler Ridge | IN | 809 | 95% | 5% | Good et al. (2011) |
| Fowler Ridge | IN | 573 | 96% | 4% | Good et al. (2012) |
| Total | | 2,422 | 87% | 13% | |

[1] hoary bat, eastern red bat, silver-haired bat, Seminole bat (*Lasiurus seminolus*)

[2] *Myotis* species, big brown bat, tri-colored bat, evening bat

Seasonal timing of bat mortality has also been consistent among wind farms, with most mortality occurring during the presumed fall migratory period between mid-August and mid-October (Arnett et al.

2008). At Fowler Ridge, 89.6% of estimated bat mortality occurred between August 1 and October 15 (Good et al. 2012). Typically, wind farm mortality records do not show a comparable spring peak in collision mortality despite the fact that bats also migrate during spring. Although reasons for this remain unclear, factors may include differing flight height during spring and fall migration, different spring and fall migration routes, or mating behavior and courtship flight during fall migration (Cryan 2008, Johnson et al. 2011). Migratory tree bats are expected to account for the majority of bat mortality under each Alternative at this Project.

To date, post-construction studies have documented 5 Indiana bat mortalities at four wind farms (Table 4.8). Due to the infrequency of Indiana bat mortality, risk factors for this species at wind farms are poorly understood, although patterns of mortality in similar species such as little brown bats have been used to quantify potential mortality rates and to predict patterns in Indiana bat mortality. Of the 5 documented Indiana bat mortalities, 3 occurred in September, 1 in July, and 1 in October.

**Table 4.8.** Documented Indiana bat mortalities at wind projects in the U.S.

| Site | Location | Date | Reference |
|---|---|---|---|
| Fowler Ridge Wind Farm (BP Wind Energy) | Benton County, IN | September, 2009 | Good et al. (2012) |
| Fowler Ridge Wind Farm (BP Wind Energy) | Benton County, IN | September, 2010 | Good et al. (2012) |
| North Allegheny Wind Farm (Duke Energy) | Cambria and Blair Counties, PA | September, 2011 | USFWS (2011a) |
| Laurel Mountain (AES Corporation) | Randolph and Barbour Counties, WV | July, 2012 | USFWS (2012b) |
| Blue Creek (Invenergy) | Van Wert County, OH | October 2, 2012 | USFWS (2012c) |

To date, post-construction studies have documented 24 northern long-eared bat mortalities at 12 wind farms (Table 4.9). Like the Indiana bat, due to the rarity of northern long-eared bat fatalities, risk factors for this species at wind farms are poorly understood. Of the 24 northern long-eared bat mortalities, searches found 1 in May and 4 in June.

**Table 4.9.** Documented northern long-eared bat mortalities at wind projects in the U.S. and Canada.

| Site | Location | Number | Study Period | Date(s) Found | Reference |
|---|---|---|---|---|---|
| Fowler Ridge (BP Wind) | Benton County, IN | 1 | Apr 6 – Oct 30, 2009 | Aug 25 | Johnson et al. (2010) |
| Cohocton and Dutch Hill (First Wind) | Steuben County, NY | 1 | Apr 26 – Oct 22, 2010 | Jun 22 | Stantec (2011d) |
| Mountaineer (NextEra) | Tucker and Preston counties, WV | 6 | Apr 4 – Jun 24, Jul 28 – 29, and Aug 18 – Nov 22, 2003 | From Aug 18 to Sep 8 | Kerns and Kerlinger (2004) |
| Mt. Storm (NedPower) | Grant County, WV | 1 | Jul 18 – Oct 17, 2008 | Aug 26 | Young et al. (2009) |
| Meyersdale (NextEra) | Somerset County, PA | 2 | Aug 2 – Sep 13, 2004 | Sep 11<br>Sep 13 | Kerns et al. (2005) |
| Ellenburg (Noble) | Clinton County, NY | 1 | Apr 28 - Oct 13, 2008 | Unspecified | Jain et al. (2009) |
| Kingsbridge I (Capital Power) | Huron County, Ontario | 1 | May 2 – 23 and Sep 6 – Oct 26, 2006 | Oct 5 | Stantec Ltd. (2007) |
| Ripley (Suncor / Acciona) | Bruce County, Ontario, CA | 2 | Apr 13 – May 31 and Jul 1 – Oct 17, 2008 | Aug 5<br>Sep 5 | Jacques Whitford (2009) |
| Wethersfield (Noble) | Wyoming County, NY | 1 | Apr 15 – Oct 15, 2010 | Jun 11 | Jain et al. (2011) |
| Erie Shores (Aim Power Gen, now Capstone) | Elgin County, Ontario | 6 | Mar 13 – Jun 15 and Aug 21 – Nov 7, 2007 [1] | May 25<br>June 11, 12<br>Aug 28 (2), 30 | James (2008) |
| Undisclosed site | Pennsylvania | 1 | 2009, unspecified period | September | Taucher et al. (2012) |
| Undisclosed site | Pennsylvania | 1 | 2012, unspecified period | Jul 30 | J. Taucher, personal communication [2] |
| | **TOTAL** | **24** | | | |

[1] Dates of study period not specified in report. Dates estimated based on dates of carcass detections.
[2] J. Taucher, Pennsylvania Game Commission, personal communication with M. Turner, USFWS.

While species composition and seasonal timing of bat mortality have been consistent across wind projects, magnitude of bat mortality, usually expressed as the estimated number of bats killed per MW or per turbine, has varied among projects and across regions. Estimated bat fatality rates have been lower at wind projects in agricultural landscapes of the Midwest versus those on forested ridges in the Appalachians, although estimated mortality rates ranged from 2.3 to 30.6 bats per MW per survey period for studies conducted in the region between 1999 and 2010 (Table 4.10). The arithmetic mean among studies listed in Table 4.10 is roughly 12.0 bats per MW per study. Means ranged from 1.71 bats per MW per study to 17.50 bats per MW per year. We used the regional mean to estimate cumulative effects to bats (Section 4.5.3). It should be noted that our derived mean is different from that derived in the HCP (Table 8).

**Table 4.10.** Bat mortality estimates for wind projects in the Midwest with publicly available post construction monitoring reports.

| Project | State | MW | Bat fatalities per MW per study | Study Period | Reference |
|---|---|---|---|---|---|
| Buffalo Ridge, Phases I-III | MN | 235.6 | 2.30[1] | Mar 15 – Nov 15, 1996<br>Mar 15 – Nov 15, 1999 | Johnson et al. (2003) |
| Buffalo Ridge, Lake Benton I & II | MN | 210.8 | 2.88[1] | Jun 15 – Sep 15, 2001<br>Jun 15 – Sep 15, 2002 | Johnson et al. (2004) |
| Blue Sky Green Field | WI | 145 | 24.60 | Jul 21 – Oct 31, 2008<br>Mar 15 – May 31, 2009 | Gruver et al. (2009) |
| Kewaunee County | WI | 20.5 | 6.45[1] | Jul 1999 – Jul 2001 | Howe et al. (2002) |
| Cedar Ridge | WI | 67.6 | 30.60 | Sep – Nov 2005<br>Mar – May 2006<br>Aug 2006 | BHE (2010) |
| Crescent Ridge | IL | 54.5 | 1.71[1] | Sep – Nov, 2005<br>August 2006 | Kerlinger et al.(2007) |
| Top of Iowa | IA | 80.1 | 8.57[1] | Apr 15 – Dec 15, 2003<br>Apr 15 – Dec 15, 2004 | Jain (2005) |
| Forward Energy Center | WI | 129.0 | 17.50[1] | Jul 15 – Nov 15, 2008<br>Apr 15 – May 31, 2009<br>Jul 15 – Oct 15, 2009<br>Apr 15 – May 31, 2010 | Grodsky and Drake (2011) |
| Fowler Ridge | IN | 600.0 | 16.60[1] | Apr 13 – May 15, 2010<br>Aug 1 – Oct 15, 2010<br>Apr 1 – May 15, 2011<br>Jul 15 – Oct 29, 2011 | Good et al. (2011, 2012) |
| Arithmetic mean | | | 12.36 | | |

[1] Averaged across multiple survey years

### *Effectiveness of Turbine Curtailment at Reducing Bat Mortality*

Wind turbine blades can be automatically feathered, or pitched such that turbines do not spin, under particular weather conditions. Under normal operation, turbine blades usually remain pitched so that the turbine spins, or freewheels below “cut-in speed”, the wind speed at which the turbines begin to generate electricity. Turbine curtailment refers to increasing cut-in speed and feathering turbines so they do not spin below this increased cut-in speed. Studies conducted at wind projects in a variety of landscapes have demonstrated that curtailment effectively reduces bat mortality and that an inverse relationship exists between cut-in speed and bat mortality rates (Arnett et al. 2010, Baerwald et al. 2009, Fiedler 2004, Good et al. 2011, Kerns et al. 2005). A recent synthesis of publicly available curtailment studies reported at least a 50% reduction in bat fatalities when turbine cut-in speed was increased by 1.5 m/s above the manufacturer’s cut-in speed (Arnett et al. 2013).

Studies at the Beech Ridge Wind Project in Greenbrier and Nicholas counties, West Virginia between April 1 and October 28, 2012, estimated an overall bat mortality rate of 2.03 bats per MW per year for turbines feathered at wind speeds below 6.9 m/s (Tidhar et al. 2013). Although no turbines were fully operational for comparison, this estimate was 89% less than the mortality estimate at two comparable projects in West Virginia with fully operational turbines. No other publicly available studies have assessed bat mortality using 6.9 m/s, although a curtailment study at the Casselman Wind Farm in Pennsylvania documented 78% reduction in estimated bat mortality when turbines were curtailed above 6.5 m/s (Arnett et al. 2010).

***Estimating Seasonal Bat Mortality at PTWF***

The Service has concluded that Indiana bats are most at risk of collision mortality during the fall migratory period, here defined as August 15 through October 15. In their final Environmental Impact Statement for the Fowler Ridge Wind Farm HCP, the Service reached the same conclusion based on the lack of suitable summer habitat, lack of documented *Myotis* mortality in spring and early summer, and because both Indiana bat fatalities at that site occurred in September (USFWS 2013d). No Indiana bat impacts are anticipated outside this period.

Conversely, 2 northern long-eared fatalities occurred in early-summer at two wind projects in western New York. However, over 2 years of monitoring, Fowler Ridge reported 1 northern long-eared bat fatality, which occurred in late-August.

During the period from August 15 through October 15, 2012, the Project operated during night-time hours (30 minutes before sunset to 30 minutes after sunrise) when wind speeds were 6.9 m/s or higher when the ambient temperature is above 10°C (50°F). The Applicant will implement the same interim modified operations up until the time they obtain an ITP. In accordance with their BBCS (Appendix A) and the Service's Technical Assistance Letter (Appendix E), PTWF conducted post-construction avian and bat mortality monitoring from August 13 through October 10, 2012 and April 2 through May 8, 2013 (ARCADIS 2013). Monitoring and mortality estimation methods followed the protocols described in the BBCS (see Appendix A, Section 5).

ARCADIS (2013, see Appendix C) provides the fatality estimates from the 2012-2013 post-construction monitoring at the PTWF. ARCADIS biologists collected 27 bat carcasses during scheduled searches and incidental finds, representing 26 identified and 1 unidentified species. Bat carcasses identified included those belonging to red bats, silver-haired bats, and little brown bats. The Project's fatality rates were based on carcasses found during scheduled searches and did not include the 1 silver-haired bat found incidentally. ARCADIS (2013) estimated 38 mortalities for the 2012 fall period and 20 mortalities in the 2013 spring period. Table 4.11 provides a summary of the monitoring results.

**Table 4.11.** Bat mortality estimates based on results of post-construction monitoring at Pioneer Trail Wind Farm (ARCADIS 2013).

| | Fall 2012[1] | | Spring 2013[1] | |
|---|---|---|---|---|
| *Measure* | *Mortality (90% CI[2])* | *SD[3]* | *Mortality (90% CI[2])* | *SD[3]* |
| Total | 38.00 (23.13–53.10) | 11.60 | 20.00 (9.78–30.90) | 1.15 |
| Mean per turbine | 0.76 | 0.23 | 0.40 | 0.28 |
| Mean per MW | 0.48 | 0.14 | 0.25 | 0.03 |

[1] Fall = August 13 - October 10; Spring = April 2 – May 8
[2] CI = confidence interval; statistic used to indicate the accuracy of the estimate, which is not the true value. The interval is used to illustrate how far the estimate is likely to be from the true value 90% of the time.
[3] SD = Standard deviation; statistic used to show the dispersion of data from the mean.

Unlisted bat mortality will likely occur outside the curtailment period as indicated from the results of the monitoring at the Project and patterns observed at wind projects in the region. Located approximately 30 miles east of the Project in a similar landscape with turbines of similar size, Fowler Ridge is probably the most comparable wind project in the area. Also, we chose to use the more robust dataset from Fowler Ridge to estimate bat mortality as opposed to the results from 2 seasons of monitoring at the PTWF. It is reasonable to conclude that mortality patterns at PTWF would be similar to Fowler Ridge assuming turbines were operated under the same parameters.

Fowler Ridge studies estimated bat mortality between August 1 and October 15, so we first adjusted this estimate to match the August 15 – October 15 curtailment period proposed for PTWF. During fall surveys (August 1 to October 15, 2011) at Fowler Ridge, 12% of bat carcasses at cleared control plots were found between August 1 and 14 and the remaining 88% were found between August 15 and October 15. We multiplied the fall mortality estimate from Fowler Ridge (30.54 bats per turbine) by 88% to derive an estimate of 26.8 bats per turbine at PTWF between August 15 and October 15 for fully operational turbines. We then added the spring/summer mortality estimate from Fowler Ridge (3.56 bats per turbine) to the residual 12% of fall mortality (3.71 bats per turbine) to derive a bat mortality estimate for fully operational turbines at PTWF outside the fall curtailment period (7.27 bats per turbine). These seasonal estimates for fully operational turbines form the basis of the unlisted bat mortality estimates for alternatives analyzed in sections 4.3.3.1 through 4.3.3.3.

***Habitat Impacts***

Land use within the Project area is primarily agricultural crops (95% of area), with forest accounting for less than 0.1% of land area. No potential roost habitat was impacted during Project construction, and the Applicant relocated two turbines that were within 1,000 feet of a wooded corridor to avoid potential impacts. Because the Project is already constructed, no impacts to roost habitat are anticipated for any Alternative. Similarly, potential impacts to foraging habitat within the Project area (i.e., behavioral displacement of foraging bats) are not anticipated and would be expected to be identical among Alternatives. Similarly, alternatives are not expected to differ in their potential to cause habitat impacts during eventual repowering or decommissioning of the Project.

**Alternative 1: No-Action Alternative (No Take)**

The Service has concluded that feathering turbines fully when wind speeds exceed 6.9 m/s eliminates the risk of collision mortality for all *Myotis*, even if they are present in the area (USFWS 2012e). Because all Project turbines would be fully feathered in this alternative when wind speeds are less than 6.9 m/s, we anticipate the Project will not take Indiana bats and northern long-eared bats. Because we do not expect take of Indiana bats or northern long-eared bats, we would not require mitigation for summer or winter bat habitat.

Based on the demonstrated effectiveness of curtailing turbines below 6.9 m/s in reducing bat mortality by 88% at Beech Ridge (USFWS 2013f), West Virginia, and the 78% reduction in mortality when turbines at Casselman, Pennsylvania were curtailed below 6.5 m/s, we predict that Alternative 1 will reduce bat mortality by at least 80% during the August 15 – October 15 time frame. We estimated mortality of unlisted bats within the curtailment period (August 15 – October 15) under Alternative 1 by assuming an 80% reduction of the predicted bat mortality rate from 26.8 bats per turbine to 5.36 bats per turbine during the curtailment period. Outside the curtailment period, the unlisted bat mortality rate would remain 7.27 bats per turbine as described above, yielding a cumulative predicted estimate of 12.6 bats per turbine. We estimated the total unlisted bat take for this alternative by multiplying the per-turbine rate (12.6) by 94 turbines for an annual estimate of 1,187 bats, or approximately 51,000 bat fatalities for the Project over the 43-year life of the permit. Bat mortality rates and totals are provided in Table 4.12 for each of the three alternatives.

These fatalities would presumably consist primarily of long-distance migratory bat species. Applying the regional breakdown of bat mortality at Midwestern projects would suggest approximately 44,500 bats would be long-distance migrants and approximately 6,500 would be cave-hibernating species. These estimates include project-related mortality alone and do not attempt to account for lost reproductive potential.

**Alternative 2: Preferred Alternative (5 m/s Curtailment)**

Based on the aggregated results of available curtailment studies, the PTWF HCP assumes that mortality rates of all bats, including Indiana bats, would be reduced by 50% during the August 15 through October 15 curtailment period specified in the Preferred Alternative. According to estimates in the HCP, up to 3 Indiana bats would be taken annually at the Project under this alternative, for a cumulative total of 129 Indiana bats over the 43-year duration of the permit. The HCP estimates that the lost reproductive potential from female Indiana bats taken by the project (97 of 129) would result in lost reproductive potential in an additional 184 female Indiana bats. Thus, the Project would take 313 Indiana bats of which there would be 281 female Indiana bats over the duration of the permit.

Northern long-eared bat mortality would also be reduced by an estimated 50% during the August 15 through October 15 curtailment period. The Applicant estimates the Project would take up to 2 northern long-eared bats annually and 86 northern long-eared bats cumulatively over the 43-year duration of the permit. The HCP estimates that the lost reproductive potential from female northern long-eared bats taken by the project (43 of 86) would result in lost reproductive potential in an additional 123 female northern long-eared bats. Thus, the Project would take 252 northern long-eared bats of which there would be 125 female Indiana bats over the duration of the permit.

Unlisted bat mortality rates would also be reduced by an estimated 50% during the August 15 through October 15 curtailment period under Alternative 2. To estimate bat mortality under the Preferred Alternative, we added the estimated bat mortality rate outside the curtailment period (7.27 bats per turbine) to the bat mortality rate within the curtailment period reduced by 50% (13.4), yielding an annual estimate of 20.7 bats per turbine. We estimated the total unlisted bat take for the Preferred Alternative by multiplying the per-turbine rate (20.7) by 94 turbines for an annual estimate of 1,946 bats, or approximately 83,700 bat fatalities for the Project over the 43-year life of the permit. Similar to the No-Action Alternative, these fatalities would presumably consist primarily of long-distance migratory bat species. Applying the regional breakdown of bat mortality at Midwestern projects would suggest approximately 72,700 bats would be long-distance migrants and approximately 11,000 would be cave-hibernating species. These estimates include project-related mortality alone and do not attempt to account for lost reproductive potential. Bat mortality rates and totals are provided in Table 4.12 for each of the three alternatives.

***Winter Habitat Mitigation Project***

The Applicant plans to install a bat-friendly gate on a cave that serves as an Indiana bat hibernaculum and is currently vulnerable to human disturbance. If a large vulnerable population is under imminent threat of human disturbance at a hibernaculum, then the Service will accept gating as partial mitigation for the impact of take and assumes a gating project would avert a marginal baseline impact equating to loss of 1% of the vulnerable population (USFWS 2012g). Based on the most recent winter census (2013), Griffith Cave contains 2,150 Indiana bats vulnerable to human disturbance. Therefore, gating Griffith Cave would compensate for at least 21 Indiana bats (1% of the cave population), which would then result in future production of 51 female pups. The winter habitat mitigation would compensate for 72 female Indiana bats.

The 2013 winter census documented only 2 northern long-eared bats. Based on such a low number of detected individuals in Griffith Cave, we cannot presume that this gating project would have any compensatory benefit to northern long-eared bats.

The 2013 winter census at Griffith Cave recorded an additional 464 bats, primarily southeastern bats (*Myotis austroriparius*, 353) and little brown bats (102). Applying the same 1% mitigation benefit to other unlisted bat species, gating Griffith Cave would indicate compensation for roughly 5 additional bats.

***Summer Habitat Mitigation Project***

The Applicant plans to offset the remaining authorized Indiana bat take using summer habitat mitigation consisting of providing funding to protect and restore forested habitat proximal to the Middle Fork Vermilion River. The Service estimates that 46 acres of forest supports 1 adult female plus 0.346 pups per year (USFWS 2013b). This translates to support for 15 pups born over 43 years plus 43 additional females during each of 25 years or a total mitigation benefit of 58 Indiana bats per 46-acre parcel during the 43-year permit period. We assume that each 46-acre block protected or restored and protected will compensate 58 bats over the 43-year permit term (43 x 1.346 bats ≈ 58 bats).

PTWF is proposing to take 281 female Indiana bats over a 43-year period, 72 of which will be compensated through the winter habitat project at Griffith Cave. PTWF is proposing to restore 157 acres of land proximal to the Middle Fork Vermilion River corridor, which has records for Indiana bat maternity colonies and juvenile and post-lactating female northern long-eared bats. Restoration would include planting and managing trees in cropland. In addition, PTWF is proposing to preserve 49 acres wooded habitat also within the Middle Fork corridor. We predict that 206 acres of summer habitat mitigation would benefit Indiana bats and northern long-eared bats that roost and forage along the river corridor. Therefore, over the 43-year permit duration 206 acres of summer habitat mitigation would compensate the take of approximately 260 female bats (206 acres ÷ 46 acres = 4.48; 4.48 x 58 bats ≈ 260 bats).

The Service finds that the summer habitat mitigation described above for Indiana bats would also mitigate the impacts associated with taking 125 female northern long-eared bats over the life of the Project. Northern long-eared bats use forested habitats for roosting (Lacki and Schwierjohann 2001) and foraging (Broders et al. 2006) and probably depend more on the interior forest than Indiana bats (Timpone et al. 2010). The proposed summer habitat mitigation project would enhance and protect core forest habitat to the benefit of both species, northern long-eared bats in particular.

Protecting forested habitat and restoring forested habitat on 206 acres would also benefit unlisted bat species. Studies on habitat use by bats in the Midwest show that bat activity is positively correlated with amount of available forest habitat for *Myotis* species and tri-colored bats and negatively correlated for big brown bats and eastern red bats, which frequently forage in more developed habitats (Duchamp et al. 2004). Because the landscape surrounding the Project is dominated by agricultural land use, creation of additional forested habitat will improve the habitat diversity of the area and will benefit all resident bats by increasing the extent and diversity of roosting and foraging habitat. Additional forest habitat in the region would also presumably provide stopover habitat for long-distance migratory species, possibly reducing mortality associated with migration. However, quantifying the potential benefit to unlisted bats associated with the summer mitigation plan is not possible without knowing baseline population densities and factors limiting population.

### Alternative 3: Non-Restricted Operations (3.5 m/s Cut-in Speed) with Mitigation

Absent curtailment, bat mortality patterns at the PTWF would likely be comparable to those documented at uncurtailed turbines at Fowler Ridge. Two years of intensive monitoring resulted in an estimate of 34.1 bats per turbine per year at control turbines (3.5 m/s cut-in speed, no feathering) (Good et al. 2012). Although the rate might differ among years and be slightly different at PTWF versus Fowler Ridge, it is reasonable to assume a per turbine annual mortality rate of 34.1 for PTWF based on the similarity in landscape and proximity of the two projects.

The Indiana bat take estimate for PTWF based on Fowler Ridge monitoring is 5 bats per year (90% CI = 4-6) for the Project without turbine curtailment. Based on this rate, the Project would take 215 Indiana bats over the 43-year duration of the permit. As indicated in the PTWF HCP, Indiana bats taken at the Project may include non-reproductive juveniles as well as adult males and females. Following the same methods used in the HCP to estimate lost reproductive potential (1.9 young per female over 2 breeding seasons), the reproductive loss associated with removal of 161 female Indiana bats over the permit duration (assumed female to male ratio of 3:1) would be an additional 306 Indiana bats. Therefore, the impact of the combined take estimate and lost reproductive potential would total 521Indiana bats over the 43-year permit duration.

Similarly, the northern long-eared bat take estimate for PTWF based on Fowler Ridge monitoring is 3 bats per year (90% CI = 4-6) for the Project without turbine curtailment. Based on this rate, the Project would take 215 Indiana bats over the 43-year duration of the permit. As indicated in the PTWF HCP, Indiana bats taken at the Project may include non-reproductive juveniles as well as adult males and females. Following the same methods used in the HCP to estimate lost reproductive potential (1.9 young per female over 2 breeding seasons), the reproductive loss associated with removal of 161 female Indiana bats over the permit duration (assumed female to male ratio of 3:1) would be an additional 306 Indiana bats. Therefore, the impact of the combined take estimate and lost reproductive potential would total 521Indiana bats over the 43-year permit duration.

Impacts to unlisted bats would be assumed to be equivalent to the annual rate estimated at Fowler Ridge for uncurtailed turbines, or 34.1 bats per turbine per year. Multiplied by 94 turbines, this would predict annual mortality of 3,205 bats and approximately 138,000 unlisted bats taken during the 43-year permit duration. As for the other alternatives, long-distance migratory species would presumably account for most of this mortality. Applying the regional breakdown of bat mortality at Midwestern projects would suggest approximately 120,000 bats would be long-distance migrants and approximately 18,000 would be cave-hibernating species. These estimates include project-related mortality alone and do not attempt to account for lost reproductive potential. Bat mortality rates and totals are provided in Table 4.12 for each of the three alternatives.

***Mitigation Plan***

Under Alternative 3, the Applicant would need to offset mortality of 640 Indiana bats through gating vulnerable hibernacula and summer habitat mitigation. Given the limited number of Indiana bat hibernacula, it may not be possible to effectively gate hibernacula containing sufficient numbers of Indiana bats. Furthermore, opportunities for suitable summer habitat mitigation for Indiana bats and 129 northern long-eared bats may be difficult to implement for such a high-level of take.

Quantifying the benefit to unlisted bats is not possible without specific population estimates for the caves to be protected or regions to be reforested. However, the potential benefits associated with a larger mitigation effort will presumably be scaled commensurate to the level of mitigation. The mitigation benefit of reforestation efforts will depend greatly on the location, size, and configuration of parcels to be reforested and the type of forested habitat eventually created.

**Table 4.12.** Comparison of estimates of Indiana bat, northern long-eared bat, and unlisted bat mortality by alternative.

| Species | Impact | 1: No-Action | 2: Preferred | 3: Non-restricted Operations |
|---|---|---|---|---|
| Indiana bat | *Annual mortality* | 0 | 3 | 6 |
| | *Permit duration mortality* | 0 | 129 | 258 |
| | *Total impact of Project take* | 0 | 352 | 640 |
| Northern long-eared bat | *Annual mortality* | 0 | 2 | 3 |
| | *Permit duration mortality* | 0 | 86 | 129 |
| Unlisted bats | *Annual mortality* | 1,187 [1] | 1,946 [2] | 3,205 [3] |
| | *Permit duration mortality (43 years)* | ~51,000 | ~83,700 | 138,000 |
| | *Potential mitigation benefit* | None | Protect hibernaculum for ~2,150 Indiana bats; restore and preserve 206 acres of Indiana bat and northern long-eared bat summer habitat | Protect hibernacula for Indiana bats; restore and preserve Indiana bat and northern long-eared bat summer habitat in amounts greater than Preferred Alternative |

[1] Based on the average mortality rate of 12.6 bats per turbine per year
[2] Based on the average mortality rate of 20.7 bats per turbine
[3] Based on the average mortality rate of 34.1 bats per turbine per year

## 4.4 SOCIOECONOMIC RESOURCES

### 4.4.1 LAND USE

The NEPA analysis must consider the effects of a proposed action and alternatives on the human environment, which includes land use. The following section addresses effects to land uses associated with Project operations and implementing the summer habitat mitigation. The winter habitat mitigation project would occur on privately owned land, at a hibernaculum that is not open to the public, and would not result in effects to land use.

#### 4.4.1.1 Impact Criteria

Effects of the Preferred Alternative or alternatives would be considered major if the outcome eliminated current land uses within and proximal to the Project area. We analyzed whether the habitat mitigation would affect land uses.

Major impacts to land use and recreational resources could occur should implementation of an alternative result in any of the following:

- Incompatibility with local land use, zoning, and future planned development;

- Results in indirect effects to surrounding lands; and
- Results in substantial degradation in a designated recreational use on surrounding lands.

#### 4.4.1.2 Direct and Indirect Effects Presented by Alternative

The PTWF operations would affect land uses similarly across the three considered alternatives. The 94-turbine Project is already constructed and will have an on-going effect in removing approximately 50 acres of farmland from agriculture production for the life of the Project, 43 years). This is not significant as this affects only a small percentage of lands in the region that will remain in agriculture. Project decommissioning will return up to approximately 50 acres to agricultural production (or some other condition based on the landowner's wishes). Operating the Project would not affect agricultural operations within and in proximity to the Project area. There are no prominent recreational uses that occur within and proximal to the PTWF. Project operations will not affect recreational uses.

**Alternative 1: No-Action Alternative**

The No-Action Alternative does not include any mitigation projects because take of Indiana bats would be avoided. The No-Action Alternative is not expected to affect land uses.

**Alternative 2: Preferred Alternative**

***Summer Habitat Mitigation Project***

Under the Preferred Alternative, the Applicant would implement an Indiana bat and northern long-eared bat summer habitat mitigation project that involves planting tree seedlings on 157 acres of land that is currently in some form of agriculture production, either cropland, hayland, pasture, or old field and preserving 49 acres of forest. The Applicant is targeting lands in the Middle Fork Vermilion River watershed.

This reforestation would remove 157 acres from agricultural production. This would be a minor change in land use in this part of Illinois where counties are from 80% to 90% in agriculture. Summer habitat mitigation would also include preserving an additional 49 acres of forest. The Applicant may be required to implement some additional management measures for the summer habitat project, such as periodic prescribed fire or invasive species eradication. The summer habitat mitigation project would become part of conservation lands, leaving the possibility that additional lands would be open to the public for uses such as hiking, fishing, and hunting.

The Preferred Alternative would have a beneficial impact in the form of an increase of conservation lands associated with the Middle Fork.

**Alternative 3: Non-Restricted Operations Alternative**

Effects to land use and recreation under Alternative 3 would be as described for the Preferred Alternative. More summer habitat mitigation would be required to offset the higher unavoidable impact of taking Indiana bats and northern long-eared bats. If the Applicant is unable to implement adequate winter habitat mitigation, then the amount of summer habitat mitigation would affect an even larger area of unrestored lands, which may include croplands.

In summary, Alternative 3 would change land use at a local scale. Relative to the Preferred Alternative, Alternative 3 may result in converting cropland to conservation land. Again, this would be a minor change in land use in this part of Illinois where counties are from 80% to 90% in agriculture. There would be a greater beneficial effect through the increase in conservation lands. Alternative 3 is not expected to adversely affect land use or recreational opportunities.

#### 4.4.1.3 Summary of Effects to Land Use

None of the three alternatives would eliminate current land uses within and proximal to the Project area. Under the Preferred Alternative and Alternative 3, the summer habitat mitigation would have minor negative effects on agricultural land uses and moderate beneficial effects on the availability of conservation lands.

Implementation of any of the three alternatives would not result in any incompatibility with local land use, zoning, and future planned development. Implementation of any of the three alternatives would not result in indirect effects to surrounding lands or cause substantial degradation in a designated recreational use on surrounding lands.

### 4.4.2 HEALTH AND SAFETY

#### 4.4.2.1 Impact Criteria

This section evaluates potential concerns related to health and safety that could occur as a result of Project operations. This analysis includes evaluation of risks to the rural communities in Ford and Iroquois counties, major transportation routes, utility corridors, buildings, residences, and public and private recreational areas. Effects would be significant if any of the features listed above would be at a measurable risk from exposure to Project elements. We also review potential changes in safety conditions in association with the winter habitat mitigation.

#### 4.4.2.2 Direct and Indirect Effects Common to All Alternatives

**Pioneer Trail Wind Farm**

We assumed that health and safety concerns associated with Project operations would not be affected by operational adjustments. The Project's potential effects to health and safety would be similar for all three alternatives.

Potential safety risks associated with Project operations are in place in the Project area and typical of all modern wind projects. As described in Section 3.4.3.1, potential risks include ice shedding, tower collapse and blade failure, stray voltage, fire, lightning strikes, and shadow flicker. All design safety measures for the Project are in compliance with Ford and Iroquois counties wind siting ordinances and all applicable industry standards.

To date, PTWF has not experienced any catastrophic failure of Project components. The entire facility operates under a Health and Safety Plan that addresses multiple safety concerns, including conducting daily job safety evaluations prior to the start of any work activities, safely approaching potential icing situations, emergency response, working at heights, energy isolation, and company vehicle safety.

***Structural Failure and Ice Shedding***

Turbine structural failure includes turbine collapse and blade shear, both of which are potentially very serious, but also very rare. Such occurrences have been largely eliminated due to technological improvements and mandatory safety standards during turbine design, manufacturing, and installation. There are no known occurrences of tower collapse or blade shear at large-scale wind farms in Illinois or in Indiana, and to date, PTWF has not experienced any failure of Project components.

Currently, there are no standard setbacks in the wind industry. The layout of the PTWF followed Ford County's standards for wind energy conversion systems (Ford County 2009). Turbines at the PTWF are a minimum of 1,000 feet from any primary structure. The owner of a primary structure may have waived this setback requirement, but in no case did PTWF site a turbine tower closer than 1.10 times the tower tip height (~ 400 feet, in the case of turbines at PTWF).

Rademakers and Braam (2005) reviewed documented incidences of turbine failure in Europe and found:

- 1,650 feet was the maximum throw distance for small blade parts and tips
- 495 feet was the maximum confirmed throw distance for an entire blade
- The risk zone is approximately equal to one-half the rotor diameter for rotor and nacelle collapse
- The risk zone is equal to the height of the tower plus one-half the rotor diameter for entire tower collapse

Ice shedding occurs when ice builds up on a turbine blade and either sheds straight to the ground or is thrown by the spinning motion. Although limited observations of ice throw exist, field observations indicate that most fragments fall within 330 feet of the turbine base (Morgan et al. 1998).

As stated above, PTWF turbines are located a minimum of 400 feet from participating residences, and most of them are located more than 1,000 feet from residences and major roadways. Based upon the implementation of these setbacks, low volume of people from the general public that access the site, and the low known incidence rate of blade shear, tower collapse, and ice throw, it is unlikely that the Project would result in risks to health and safety of the general public.

***Lightning Strikes***

An electrical grounding system is installed at each turbine to prevent damage caused by lightning strikes and provide grounding for electrical components. Modern turbines have lightning protection systems, which typically include automatic shutdown procedures in the case of damage to the blades or turbine. As such, Project turbines would have no significant adverse impact on health and safety due to lightning strikes.

***Shadow Flicker***

The effects of shadow flicker are expected to be minimal due to setbacks from residential structures and roads. Turbines at the PTWF are a minimum of 1,000 feet from any primary structure. The owner of a primary structure may have waived this setback requirement, but in no case is a turbine tower located closer than 1.10 times the tower tip height (~400 feet, in the case of turbines at PTWF).

### *Fire Fuels*

The fire risk associated with PTWF operations and maintenance is similar to that associated with other industrial and storage facilities. Although these are rare events, the nacelles on wind turbines have caught fire. Although unlikely, a turbine fire could produce additional hazards should the fire spread to adjacent cropland in extreme dry conditions. Wind turbine operations and maintenance personnel are trained in fire safety and response. The risks associated with fire in the Project area are minimal.

### *Stray Voltage, Electrocution, Electromagnetic Fields*

Proper electrical installation and grounding practices prevent stray voltage from occurring. The Project's electrical collection system meets applicable design and safety regulations, is properly grounded, has adequate spacing from other electrical cables, and is not connected to local distribution lines. Based on this assumption, the Project will not have any adverse impacts on human health and safety due to stray voltage or electrocution.

Electric fields are created by changes in voltage: the higher the voltage, the stronger the resultant electric field. Magnetic fields are created when electric current flows: the greater the current, the stronger the magnetic field. An electric field will exist even when there is no current flowing. Electromagnetic fields (EMF) above certain levels can trigger biological effects. Experiments indicate that short-term exposure of EMF at the levels present in the environment or home does not cause any apparent detrimental effects in healthy individuals (WHO 1999). Exposures to higher levels that might be harmful are restricted by national and international guidelines.

National standards for exposure to EMF generally draw from the guidelines set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The ICNIRP's exposure limits for the public are 5 kilovolts per meter (kV/m) for electric field and 100 microteslas for magnetic field (WHO 1999). Electric field levels directly beneath transmission power lines can be as high as 10 kV/m. At a 50-meter to 100-meter (165-foot to 330-foot) distance, the fields are normally at levels that are found in areas away from high-voltage power lines (WHO 1999). In addition, house walls substantially reduce the electric field levels from those found at similar locations outside the house.

EMF at a wind project can originate from the collection system, turbine generators, transformers, and underground network cables. The primary source of EMF from the Project is the generation lead line used to connect the Project substation to the existing Paxton West substation. This generation lead line is approximately 3 miles long and comes within 1,000 feet of residences. Given the distance of the 138-kV line from nearby homes, the generation lead line is not likely to emit electric fields that exceed the limit of 5 kV/m set by the ICNIRP at any residences.

### *Summary of Project Effects to Health and Safety*

Threats to public safety during operation of the Project are expected to be minimal due to the implementation of required setbacks from residential structures and public roads. The PTWF would operate under a health and safety plan that addresses potential safety risks to Project staff and the general public. Assuming proper planning and implementation of a site health and safety plan under any of the three alternatives, the general risks associated with Project operations would have no significant adverse effect on human health and safety.

#### 4.4.2.3 Direct and Indirect Effects Unique to Each Alternative

**Alternative 1: No-Action Alternative**

The No-Action Alternative does not include any mitigation projects because take of Indiana bats and northern long-eared bats would be avoided. The No-Action Alternative is not expected to have unique effects on health and safety.

**Alternative 2: Preferred Alternative**

***Summer Habitat Mitigation Project***

Any summer habitat mitigation effort is not expected to affect human health and safety.

***Winter Habitat Mitigation Project***

Implementation of the Preferred Alternative includes winter habitat mitigation, specifically gating the entrance to Griffith Cave. Gating Griffith Cave would limit human access to the cave. The landowner would have access to the cave during the non-hibernation season. The IDNR would continue to monitor winter bat populations under the current schedule, i.e., biennially. Gating Griffith Cave would reduce the likelihood of any sort of cave accident.

The Preferred Alternative would have a beneficial effect on human health and safety by reducing risks associated with public access to a potentially dangerous environment.

**Alternative 3: Non-Restricted Operations Alternative**

***Summer Habitat Mitigation Project***

Any summer habitat mitigation effort is not expected to affect human health and safety.

***Winter Habitat Mitigation Project***

Effects to health and safety under Alternative 3 would be as described for the Preferred Alternative. The Applicant would be required to implement additional habitat mitigation to offset the higher unavoidable impact of taking Indiana bats. This would result in the gating the entrance to at least one other Indiana bat hibernaculum. This would have a greater beneficial effect on human health and safety by further reducing risks associated with public access to another potentially dangerous environment.

#### 4.4.2.4 Summary of Effects to Health and Safety

Implementation of any alternative would not result in adverse effects to human health and safety. Threats to public safety during operation of the Project are expected to be unlikely. Implementation of any cave gating projects would be expected to reduce risks associated with accidents that occur in cave environments.

## 4.5 CUMULATIVE EFFECTS

The CEQ guidelines acknowledge that while “in a broad sense all the impacts on affected resources are probably cumulative,” it is important to “count what counts” and narrow the focus of the analysis to important national, regional, and local issues (CEQ 1997). The CEQ recommends potential cumulative effects issues included should be those effects with direct influence on the Project and Project decision-making.

Following the tiered approach recommended by the CEQ guidelines for analyzing cumulative impacts, we focus our analysis on potential impacts to birds, Indiana bats, northern long-eared bats, and unlisted bats, as these are the only resources potentially affected by Project operations. Furthermore, only bats would be affected to varying degrees by the alternatives considered in this EA as we have assumed operational adjustments do not affect bird mortality. Similarly, this analysis largely focuses on cumulative effects of current, proposed, and projected wind energy project operation on birds and bats. We also analyze impacts associated with WNS for bats and other mortality sources for birds.

For decades, researchers have monitored bird mortality to some degree at other sources, such as communications towers and other tall structures. However, both wind energy development and WNS have emerged as new but substantial sources of bat mortality in the past decade. While some level of bat mortality likely went unnoticed at wind projects previously, the rapid expansion of wind development and the increased awareness of bat mortality at wind turbines have revealed the potential for substantial cumulative impacts to bats from the wind industry.

This section analyzes cumulative effects of the alternatives and other past, current, proposed, or reasonably foreseeable future actions on birds, Indiana bats, northern long-eared bats, and unlisted bats. The spatial scope of analysis for Indiana bats is the OCRU, and for birds, and northern long-eared bats, and unlisted bats, it is the Service's Region 3. The 43-year permit duration is the temporal scope for all three groups.

### 4.5.1 WIND ENERGY DEVELOPMENT

According to 2013 data compiled by the American Wind Energy Association (AWEA), 9,935 turbines totaling 15,754 MW are currently installed in the 8 states that make up USFWS Region 3 (Table 4.13).

An additional 2,012 MW of wind generation capacity is under construction or seeking power purchase agreements. While growth in the wind sector has been rapid over the previous few years, the U.S. Energy Information Administration's energy forecasts recently indicated a nationwide growth rate of 1.8% annually for installed wind energy capacity between 2013 and 2040 (USEIA 2013). Applying this growth rate to installed and proposed capacity in the states in Region 3 over the 43-year permit duration would predict total capacity of 32,156 MW in the Region by year 2058. We estimated wind energy development in the OCRU by adding the estimates for Illinois, Missouri, and 50% of Iowa. Although the OCRU includes small portions of Oklahoma and Arkansas, no wind projects occur in these areas. Currently, the OCRU includes approximately 4,406 turbines, totaling 6,594 MW of installed capacity with an additional 525 MW in development. Applying the same 1.8% annual growth rate to the installed and proposed capacity in the OCRU yields an estimate of 12,884 MW of installed wind capacity by year 2058. We recognize that wind development, realistically, is likely to vary among states. Also, we derived these estimates using only one method among several that could be implemented. Nonetheless, our method represents a straightforward means of estimating reasonably foreseeable wind energy development in the future.

**Table 4.13.** Installed, proposed, and projected wind energy development in Service Region 3 and OCRU.

| | Current Installed [1] | | Proposed [1, 2] | | Projected growth up to 2058 (43 years) [3] | |
|---|---|---|---|---|---|---|
| *State* | *# MW* | *# Turbines* | *# Projects* | *Proposed # MW* | *# MW* | *# Turbines* [4] |
| Illinois | 3,568 | 2,195 | 46 | | 6,458 | 4,305 |
| Wisconsin | 648 | 417 | 17 | | 1,173 | 782 |
| Michigan | 988 | 577 | 19 | 362 | 2,444 | 1,629 |
| Minnesota | 2,987 | 2,124 | 98 | 400 | 6,130 | 4,087 |
| Iowa | 5,133 | 3,198 | 100 | 1,050 | 11,191 | 7,461 |
| Missouri | 459 | 252 | 6 | | 831 | 554 |
| Indiana | 1,543 | 929 | 17 | 200 | 3,155 | 2,103 |
| Ohio | 428 | 243 | 30 | | 775 | 517 |
| Total | 15,754 | 9,935 | 333 | 2,012 | 32,156 | 21,437 |
| Total OCRU [5] | 6,594 | 4,046 | 102 | 525 | 12,884 | 8,589 |

[1] From state fact sheets on AWEA.org, accessed August 20, 2013.
[2] Projects in construction, permitting, development, or land acquisition but not yet operational, and requests for wind power from utility managers.
[3] Assuming 1.8% annual growth, the nationwide trend from 2013 to 2040 (USEIA 2013).
[4] Assuming 1.5-MW turbines; MW divided by 1.5
[5] OCRU totals based on sum of Illinois, Missouri, and 50% of Iowa.

### 4.5.2 BIRDS

Our cumulative effects analysis for birds primarily focuses on mortality attributable to the Project in the context of other existing and planned wind facilities in Region 3. This analysis also considers some other anthropogenic sources of bird mortality. We briefly discuss on a national scale those elements that are known to cause avian mortality. Researchers typically use data at the national scale to provide estimates of bird mortality from an anthropogenic source.

This analysis includes past and present actions and reasonably foreseeable future sources of impacts to birds during the 43-year operation of the Project. Based on our analysis of direct and indirect effects to avian resources in Section 4.3.3.2, the proposed Project has the potential to kill, disturb, and displace birds due to Project presence and operations. We recognize that birds are likely to sustain these same effects at all wind projects in Region 3.

#### 4.5.2.1 Wind Project Mortality

Based on mortality rates reported for 10 post-construction studies at wind power projects in the Midwest, we estimate the Project's average rate of mortality would be 4.26 birds per turbine per year resulting in roughly 400 bird deaths per year of which roughly 70% would be passerines. This is roughly 0.9% of the total bird mortality from installed wind projects in Region 3. Based on the average mortality rate, over the permit term the Project would kill approximately 18,000 birds. This is roughly 0.6% of the total bird mortality from installed wind projects in Region 3 through 2058. Table 4.14 shows a summary of the current and future cumulative effects of wind energy in Region 3.

**Table 4.14.** Cumulative bird mortality estimates at Pioneer Trail Wind Farm and current and projected installed wind power capacity in the Service's Region 3.

| | | PTWF | | Region 3 | | | | |
|---|---|---|---|---|---|---|---|---|
| | | *Annual mortality* | *43-year cumulative mortality* | *Annual mortality in 2013* | *PTWF % contribution to annual* | *Annual mortality in 2058* | *43-year cumulative mortality* | *PTWF % contribution to cumulative* |
| Mortality rate (birds per turbine per year) | | 94 turbines | 94 turbines | 9,935 turbines[1] | | 21,437 turbines[2] | 9,935-21,437 turbines | |
| Minimum | 0.44 | 41 | 1,845 | 4,371 | 0.9 | 9,432 | ~300,000 | 0.6 |
| Maximum | 11.83 | 1,112 | 50,040 | 117,531 | 0.9 | 253,600 | ~8 million | 0.6 |
| Mean | 4.26 | 400 | 18,000 | 42,323 | 0.9 | 91,322 | ~3 million | 0.6 |

[1] Current installed capacity.
[2] Based on a projected annual growth of 2.6% a year (USEIA 2013).

We applied our Midwestern regional average avian mortality rate of 4.26 birds per turbine per year to the current installed capacity of wind projects in Region 3, 9,935 turbines. Using the mean rate, roughly 42,000 birds may be killed at all wind energy facilities in Region 3 each year. It is expected that nearly 30,000 of these fatalities will be passerines. As discussed, bird mortality at PTWF is expected to be the same regardless of the alternative under which the Project operates, on average 400 birds per year. Therefore, PTWF will contribute <1% of the annual bird mortality from wind projects in Region 3.

The rate at which wind energy would develop over the next 43 years is difficult to predict, but we assumed the 1.8% growth estimated in USEIA (2013). Based on the maximum rate of bird mortality (11.83 birds per turbine per year), wind projects in Region 3 may kill up to 8 million birds over the permit term, averaging approximately 180,000 birds per year. This illustrates a worst-case scenario, and it is possible that some years may exhibit such high mortality rates. However, we expect to see in most years rates closer to the mean (4.26 birds per turbine per year), and cumulative bird mortality is likely to be closer to 3 million birds in Region 3.

In Section 4.3.3.2, Table 4.2 lists bird species and numbers documented during post-construction monitoring at projects in the Midwest. This list includes 5 Birds of Conservation Concern for Bird Conservation Region 22 (USFWS 2008), where the PTWF is located. Carcass searches during the monitoring projects found 2 pied-billed grebes, 2 grasshopper sparrows, 1 upland sandpiper, 1 black-billed cuckoo, and 1 loggerhead shrike out of the total 273 birds, a combined total over several years. We do not expect that wind projects in Region 3 would cause population-level effects to avian resources, even those species of regional concern.

#### 4.5.2.2 Anthropogenic Sources of Avian Mortality Other than Wind Power Facilities

Discussed below are estimates of anthropogenic sources of bird mortality for the U.S. in general. Table 4.15 provides annual mortality levels of birds due to anthropogenic sources in the U.S. We recognize that the national level is not the cumulative effects analysis area selected for birds in this EA. However, similar data scaled to any region of the U.S. are not available.

**Table 4.15**. Estimated annual avian mortality from anthropogenic causes in the U.S.

| Mortality source | Estimated annual mortality | % of overall mortality |
|---|---|---|
| Depredation by domestic cats | 1.4–3.7 billion | 71-75 |
| Collisions with buildings (including windows) | 97-1,200 million | 5-23 |
| Collisions with power lines | 130-174 million | 3-7 |
| Legal harvest | 120 million | 6 |
| Automobiles | 50-100 million | 2-3 |
| Pesticides | 67 -72 million | 4 |
| Communication towers | 4-50 million | <1 |
| Oil pits | 1.5-2 million | <1 |
| Wind turbines | 20,000-440,000 | <1 |
| Total mortality | 1.9-5.2 billion | |

Sources: USFWS (2002), Erickson et al. (2005), Thogmartin et al. (2006), Manville (2009), Loss et al. (2013).

<u>**Communication Towers**</u>

Avian collisions with communication towers in the U.S. present a significant source of annual mortality, particularly for nocturnally migrating songbirds; namely warblers, vireos, and thrushes (Erickson et al. 2005). Erickson et al. (2005) suggest the number of communication towers in the U.S. may be as high as 200,000 towers; and that 5,000 to 10,000 new towers are being built each year. Cellular, radio, and television towers range in height from less than 100 feet to over 2,000 feet (Kerlinger 2000). Mortality estimates range from 4-5 million to 40-50 million birds per year in the U.S. and involve over 230 species (Kerlinger 2000, Shire et al. 2000, Erickson et al. 2005, Manville 2005, Thogmartin et al. 2006). Collisions occur throughout the year but are most frequent during migration periods. Studies indicate fatality rates are highest at taller, guyed towers (Gehring et al. 2009, 2011). Data associate higher collision rates at pulsating beacons and steady burning FAA obstruction lighting as compared to towers lit only with flashing or white-strobe beacons (Erickson et al. 2005, Gehring et al. 2009, 2011). During nights with fog or low, cloud-ceiling heights, researchers believe nocturnal migrants become disoriented by strobe or steady burning lights on towers (Erickson et al. 2005). Estimates of mean annual collisions per tower have ranged from 82 birds per year at a 250-meter (825 feet) tower in Alabama, to 3,199 birds per year at a 305-meter (1,000-foot) tower in Wisconsin (Erickson et al. 2005).

**Buildings**

USEIA (2008) estimates there were 4.9 million commercial buildings in 2003. More than 130 million residential housing units existed in the U.S. in 2009 (U.S. Census Bureau 2011). Estimates of collisions with buildings and windows suggest a range of 97 million to 1,200 million bird deaths per year (Erickson et al. 2005, Thogmartin et al. 2006). Loss et al. (2014) estimate that between 365 and 988 million birds (median 599 million) are killed annually by building collisions in the U.S. The vast majority of avian collisions with buildings and windows involve passerines (Erickson et al. 2005). A study conducted in 1996 in Toronto, Ontario estimated 733 avian fatalities per building per year (Erickson et al. 2005). A study of avian collisions with residential windows indicated that avian fatalities range from 0.65 to 7.7 birds per house per year (Erickson et al. 2005). Collisions with other tall structures such as smoke stacks are estimated to result in tens to hundreds of thousands of collisions.

**Power Lines**

Manville (2005) estimated that there are collectively 500,000 miles of transmission lines in the U.S. There is an estimate of 116,531,289 distribution poles in the U.S. An accurate estimate of the collective distance of distribution lines is not feasible, but Manville (2005) suggests the length may be in the millions of miles. In general, avian collision and electrocution mortality at power transmission and distribution lines are not systematically monitored or subject to observational biases. Collision estimates range from hundreds of thousands to 175 million birds annually, and estimates of electrocutions range from tens to hundreds of thousands of birds annually. Raptors, particularly eagles, are most commonly reported for collision or electrocution with transmission or distribution lines in the U.S. (Manville 2005).

The species composition of birds involved in power line collisions is largely dependent on location. For example, power lines located in wetlands have resulted in collisions of mainly waterfowl and shorebirds; while power lines located in uplands and away from wetlands have resulted in collisions of mainly raptors and passerines (Erickson et al. 2005, Manville 2005).

**Legal Harvest**

Banks (1979 as cited in Thogmartin et al. 2006) estimated that 120 million game birds are legally harvested by hunters each year in the U.S. State and federal wildlife managers' census waterfowl and monitor harvests annually. These data are used to regulate harvest levels through bag limits such that hunting does not contribute to population declines.

**Vehicles and Airplanes**

Vehicle strikes are estimated to result in 50 million to 100 million avian fatalities per year (Thogmartin et al. 2006). Numbers and species involved in vehicle collisions are dependent on habitat and geographical location (Erickson et al. 2005). Including both United States Air Force and civil aircraft strikes, it is estimated that over 28,500 avian collisions occur each year (Erickson et al. 2005). The majority of bird species involved in airplane strikes includes gulls, waterfowl, and raptors (Erickson et al. 2005).

**Pesticides**

The USDA 2007 Census of Agriculture (USDA 2009) indicates there were approximately 406.5 million acres of cropland in the U.S. Pesticides are used on the vast majority of U.S. cropland. Table 4.16 lists acres of agricultural lands treated with chemicals in 2007. These values are based on the agricultural census and do not include those acres treated with pesticides associated with other commercial uses (e.g., utility corridors, forest management, golf courses) or residential use. Piemental et al. (1991 as cited by USFWS 2002 and Erickson et al. 2005) estimate 67.2 million birds die from exposure to pesticides in the U.S. annually. Other estimates indicate 72 million pesticide-related avian fatalities per year (USFWS 2002). One study indicated that there are 0.1 to 3.6 avian fatalities per acre of pesticide-treated cropland (Mineau 1988 as cited by Erickson et al. 2005).

**Table 4.16.** Acres of agricultural lands treated with chemicals in the U.S. in 2007 based on targeted pest.

| Pest Type: | Acres |
|---|---|
| Insects | 90,947,822 |
| Weeds, grass, brush | 226,295,783 |
| Nematodes | 7,560,158 |
| Diseases | 22,693,212 |
| Growth, fruit production, or defoliation | 12,125,799 |

Source: USDA 2009

**Domestic Cats**

Dauphiné and Cooper (2009) estimate that 117 to 157 million feral and free-ranging domestic cats within the U.S. kill at least 1 billion birds annually. Loss et al. (2013) estimate that free-ranging domestic cats kill 1.4 to 3.7 billion birds annually in the U.S. Based on these estimates and others (Manville 2005, Erickson et al. 2005), cat predation is considered the most significant anthropogenic source of bird mortality in the U.S. (Dauphiné and Cooper 2011). Butchart et al. (2006) cited domestic cats as significant threats to rare, threatened, and endangered birds and sources of species extinction worldwide.

#### 4.5.2.3 Other Cumulative Effects to Birds in Region 3

**Habitat Loss and Displacement**

In Region 3, avian resources have experienced impacts due to land conversion (habitat loss) associated with oil and gas development, urbanization, agriculture, and residential development. All of these activities are likely to continue into the reasonably foreseeable future. Most of these land conversion activities often include extensive road networks.

Agriculture activities, urbanization, and residential development convert habitat for the length of time that the development is maintained. Development that results in pavement (asphalt, concrete) results in an extreme conversion of habitat with a very slow recovery rate unless pavement is removed. Conversely, some active agricultural lands may become inactive and revert to native habitats within the 43-year permit term.

Reasonably foreseeable future actions in the Project area for the next 43 years that would affect avian resources include low-density development for residences. This would largely affect those birds that would be likely to use agriculture lands.

#### 4.5.2.4 Cumulative Effects Summary

We acknowledge that bird mortality at wind projects does contribute to overall mortality. Compared to other anthropogenic sources of avian mortality (see Table 4.15), the effect of avian mortality at wind energy facilities is minor.

None of the alternatives considered is expected to cause naturally occurring populations of common birds to be reduced to numbers below levels for maintaining viability at local or regional levels. The alternatives would not result in substantial losses or degradation of habitat for a rare, threatened, or endangered animal species. None of the alternatives is expected to result in substantial changes in habitat conditions producing indirect effects that cause naturally occurring populations to be reduced in numbers below levels for maintaining viability at local or regional levels. The conversion of approximately 50 acres of agricultural land to developed land cannot be considered a major loss of this habitat type given the Project is located in a landscape dominated by extensive agriculture.

Project mortality will contribute cumulatively to other sources of mortality, such as other wind projects. Species with high collision rates that are already compromised by other factors and exhibiting decreasing trends would be affected more than common species with secure populations, yet the effect is currently predicted to amount to a fraction of a percent of any population of a bird species of conservation concern. These small percentages of wind power mortality contribute a relatively minor cumulative effect to many other sizeable sources of human-caused bird mortality. The small percentage contribution from wind power does not diminish the need to reduce sizeable sources of bird mortality when practicable.

The BBCS for all alternatives includes a monitoring plan and adaptive management framework designed to monitor bird mortality and respond to significant bird mortality events should they occur.

### 4.5.3 BATS

#### 4.5.3.1 Indiana Bats

Although Indiana bat mortality has not been documented at any wind projects in the OCRU, any project within the species' range has the potential to take an Indiana bat during the fall migratory season. Such was the case on 2 documented occasions at Fowler Ridge, where 2 years of monitoring led to a baseline mortality estimate of 0.05 Indiana bats per MW per year at fully operational turbines. Applying this same estimate to the current installed wind energy capacity in the OCRU yields approximately 330 Indiana bats taken cumulatively per year within the OCRU. By year 2058, the annual take estimate would be roughly 700 Indiana bats based on the projected wind development indicated in Table 4-13. This represents 0.4% of the 2013 Indiana bat population in the OCRU (197,707). Annualizing the 1.8% mortality increase over the entire permit duration results in approximately 22,000 Indiana bats taken by wind projects cumulatively in the OCRU over a period of 43 years (Table 4.17). This estimate assumes no operational curtailment, no mitigation benefit, and baseline Indiana bat populations remain constant, none of which is a likely scenario. However, this represents a worst case scenario for the purposes of assessing the contribution of each alternative to the cumulative totals.

**Table 4.17.** Cumulative effects to Indiana bats and unlisted bats from current and projected installed wind power capacity in the Midwest.

| | | Alternative | | | |
|---|---|---|---|---|---|
| Species | Impact | 1: No-Action 150 MW | 2: Preferred Alternative 150 MW | 3: Non-restricted Operations 150 MW | Projected Wind Capacity, OCRU, 2058 12,884 MW |
| Indiana bat | Cumulative mortality | 0 | 129 | 258 | ~22,000 |
| | Project % contribution to regional cumulative mortality[1] | 0 | 0.6 | 1.2 | 100 |

| | | Alternative | | | |
|---|---|---|---|---|---|
| Species | Impact | 1: No-Action 150 MW | 2: Preferred Alternative 150 MW | 3: Non-restricted Operations 150 MW | Projected Region 3 Wind Capacity, 2058 32,156 MW |
| Northern long-eared bat | Cumulative mortality | 0 | 86 | 129 | ~25,800 |
| | Project % Contribution to regional cumulative mortality[1] | 0 | 0.3 | 0.5 | 100 |
| Cave-hibernating bats | Cumulative mortality | ~6,500 | ~11,000 | ~18,000 | ~1.6 million |
| | Project % contribution to regional cumulative mortality[1] | 0.4 | 0.7 | 1.1 | 100 |
| Long-distance migratory bats | Cumulative mortality | ~44,500 | ~72,700 | ~120,000 | 11 million |
| | Project % contribution to regional cumulative mortality[1] | 0.4 | 0.7 | 1.1 | 100 |

The No-Action Alternative for PTWF would result in 0 Indiana bat mortalities and would therefore not contribute to cumulative impacts to Indiana bats. The Preferred Alternative would take an estimated 3 Indiana bats per year, or 135 bats over the course of the permit duration, accounting for 0.6% of the cumulative take estimated for the OCRU during the same period (Table 4.17). If all other projects that have the potential to take Indiana bats were to implement similar curtailment protocols and also reduced their take of Indiana bats by 50%, the contribution from the Preferred Alternative would rise to 1.2% because the cumulative take of Indiana bats would be reduced by half [23,033 Indiana bats x 0.5 = 11,516 Indiana bats; 135 Indiana bats divided by 11,516 Indiana bats = 0.012 x 100 = 1.2%]. The uncurtailed operation would take an estimated 6 Indiana bats per year, or 270 bats over the full permit duration, accounting for 1.2% of the cumulative take estimated for the OCRU during this period (Table 4.17), or

2.4% of cumulative take assuming all other projects reduced their take by 50%. The proposed alternatives are not substantially different in the extent to which they contribute to cumulative impacts to Indiana bats, particularly considering that the Applicant would offset estimated take associated with Alternatives 2 and 3 using mitigation of winter and summer habitat. Mitigation efforts also have the potential to increase the bat population beyond what is needed to offset take.

#### 4.5.3.2 Northern Long-eared Bats

Post-construction monitoring in Region 3 reported 1 northern long-eared bat fatality at a wind project. However, any project within the species' range has the potential to take northern long-eared bats, particularly during the fall migratory season. Such was the case for the 1 documented occasion at Fowler Ridge over 3 years of monitoring leading to a baseline mortality estimate of 0.025 northern long-eared bats per MW per year at fully operational turbines. Applying this same estimate to the current installed wind energy capacity in Region 3 (15,574 MW) yields approximately 390 northern long-eared bats taken cumulatively per year within Region 3. By year 2058, the annual take estimate would be roughly 840 northern long-eared bats based on the projected wind development indicated in Table 4.13. Annualizing the 1.8% mortality increase over the entire permit duration results in approximately 25,800 northern long-eared bats taken by wind projects cumulatively in Region 3 over a period of 43 years (Table 4.17). This estimate assumes no operational curtailment and no mitigation benefit, neither of which would be a likely scenario. However, this represents a worst case scenario for the purposes of assessing the contribution of each alternative to the cumulative totals.

We do not have an estimate for the population of northern long-eared bats in Region 3 and cannot put in context the significance for the annual wind project mortality of 390 to 840 northern long-eared bats.

The No-Action Alternative for PTWF would result in 0 northern long-eared bat mortalities and would therefore not contribute to cumulative impacts to northern long-eared bats. The Preferred Alternative would take an estimated 2 northern long-eared bats per year and 86 individuals over the course of the permit duration, accounting for 0.3% of the cumulative take estimated for Region 3 during the same period (Table 4.17). If all other projects that have the potential to take northern long-eared bats were to implement similar curtailment protocols and also reduced their take of northern long-eared bats by 50%, the contribution from the Preferred Alternative would rise to 0.7% because the cumulative take of northern long-eared bats would be reduced by half [25,800 bats x 0.5 = 12,900 bats; 86 bats divided by 12,900 bats = 0.0067 x 100 ≈ 0.7%].

The Non-restricted Alternative would take an estimated 3 northern long-eared bats per year, or 129 individuals over the full permit duration, accounting for 0.5% of the cumulative take estimated for Region 3 during this period (Table 4.17), or 1% of cumulative take assuming all other projects reduced their take by 50%.

The proposed alternatives are not substantially different in the extent to which they contribute to cumulative impacts to northern long-eared bats, particularly considering that the Applicant would offset estimated take associated with Alternatives 2 and 3 using mitigation of summer habitat. Mitigation efforts also have the potential to increase the bat population beyond what is needed to offset take.

#### 4.5.3.3 Unlisted Bats

Rates of mortality of unlisted bats vary substantially among projects and depend to a large extent on operational decisions and turbine characteristics, both of which are subject to change over time as the wind industry grows and becomes more sophisticated. Nevertheless, for the purposes of assessing cumulative impacts to unlisted bats, we use an average mortality rate of 12.0 bats per MW per year calculated among 9 active projects in the Midwest and assume this rate will remain constant during the 43-year permit duration. Applying this rate to the 15,754 MW of installed wind capacity in Region 3 yields a current mortality estimate of 189,048 unlisted bats regionally per year. Scaling this estimate up to the potential installed capacity of 32,156 MW at the 43$^{rd}$ year of the permit indicates annual mortality of 385,878 unlisted bats in Region 3, for a cumulative total of roughly 12.6 million bats taken during this 43-year period. Assuming similar species composition to that documented at 9 Midwestern projects in the past decade, long-distance migratory species would account for approximately 11 million of these mortalities and cave-hibernating bats would account for roughly 1.6 million of these mortalities (Table 4.17). As is the case for Indiana bats and northern long-eared bats, actual mortality rates of bats are likely to be less than predicted, as operational curtailment is becoming more common and may reduce unlisted bat mortality by 50% or more regionwide.

Unlisted bat mortality across the three alternatives ranges from 51,000 bats to 138,000 bats over the 43-year permit duration, accounting for 0.4 to 1.0% of cumulative mortality for the region, with the Preferred Alternative accounting for 83,700 bats or 0.7% of total cumulative mortality (Table 4.17). Whether these contributions to the cumulative predicted mortality are significantly different, or to what extent the cumulative estimate of 12.6 million bat fatalities over 43 years jeopardizes populations of unlisted bats, is impossible to determine as no baseline population estimates exist for unlisted species. This particularly applies to the long-distance migratory species, the species group most likely to be affected by wind turbine mortality. However, operational decisions made by individual wind projects will have a substantial effect on cumulative mortality rates for bats on a regional level. Because bats are relatively long-lived and reproduce at a slow rate, removal of a substantial number of adults from the population is more likely to have adverse effects on bat populations than similar impacts to a species group with higher fecundity (Kunz et al. 2007a, b, NRC 2007).

**White-nose Syndrome**

WNS has emerged as the largest single source of mortality for cave-hibernating bats in recent years. Section 3.3.4.2 summarizes the current extent of the epidemic and indicates that current estimates of total bat mortality reach 6.7 million bats total since discovery of the disease in 2006 (USFWS 2012d). Turner et al. (2011) documented an 88% decline in overall numbers of hibernating bats comparing pre- and post-WNS counts at 42 sites in five northeastern states with declines varying by species. At these sites, northern long-eared bat decreased by 98%, little brown bats by 91%, tri-colored bats by 75%, Indiana bats by 72%, big brown bats by 41%, and eastern small-footed bats by 12% (Turner et al. 2011). To date, WNS has not been documented in long-distance migratory bat species (hoary bat, silver-haired bat, eastern red bat), which account for the majority of wind turbine related mortality.

The Service estimates a rangewide decline of 46% in the number of Indiana bats across the Appalachian Mountain Recovery Unit between 2011 and 2013 (USFWS 2013a) more than likely due to WNS, while

Indiana bat mortality estimates in individual hibernacula have reached 100% (Turner et al. 2011). This does not necessarily represent the total decline due to WNS, although certain northeastern bat populations appear to be stabilizing or even increasing gradually several years following the initial outbreak of WNS. The disease was confirmed in multiple hibernacula in the OCRU during winter 2009-2010 surveys and in 2013 winter surveys. Mortality associated with the disease in the OCRU and Region 3 could be similar to that documented in the Northeast. A 46% decline in Indiana bat population in the OCRU from 2011 would amount to a loss of approximately 89,955 Indiana bats during a period of 3 to 4 years. Such a decline in Indiana bat populations across the region will likely reduce the probability of mortality of affected species at wind projects, but will also increase the ecological impact of all sources of mortality.

As described in the HCP, if the USFWS determines that the decline in the Indiana bat population in the OCRU constitutes a changed circumstance, PTWF will reassess the degree to which the authorized take impacts the population and will determine whether incremental increases in turbine cut-in speed or additional mitigation are warranted. Similarly, should additional bat species be listed due to declines from WNS, PTWF will evaluate the potential for take of newly listed species and will determine whether to add the species to the HCP.

**Habitat Loss and Fragmentation**

Cumulative impacts of land use conversion and habitat fragmentation on bats in the Midwest have largely taken place in the past, as agricultural land use has dominated the region for decades. Construction of PTWF and most other Midwestern wind projects does not result in additional forest clearing and may even create forested habitat through efforts to mitigate impacts to bats. Therefore, PTWF and expansion of wind energy in the region are not expected to contribute to any incremental cumulative effects of summer bat habitat loss.

Similarly, winter bat habitat (caves and mines) are relatively static features on the landscape and are not being threatened by specific threats associated with habitat loss. WNS may have drastic impacts on hibernating bat populations, but will not alter the physical characteristics of hibernacula. Mitigation efforts to gate hibernacula to prevent human access and disturbance like that proposed by the Applicant will further avoid cumulative impacts to winter bat habitat.

#### 4.5.3.4 Cumulative Effects Summary

We acknowledge that bat mortality at wind projects contributes to overall bat mortality, and the Project mortality will contribute cumulatively to the other wind project mortality. Compared to the effects of WNS, cave-dwelling bat mortality at wind energy facilities is minor. However, wind energy facilities kill more migratory tree-dwelling bats than any other known documented source.

The BBCS for all alternatives includes a monitoring plan and adaptive management framework designed to monitor bird mortality and respond to major bird mortality events should they occur.

All three alternatives will contribute cumulatively to effects associated with bat mortality. Based on results of post-construction monitoring, we find that the No-Action Alternative results in a small amount of bat mortality to both cave-dwelling bats and migratory tree-roosting bats (ARCADIS 2013). Among the three alternatives, the No-Action Alternative (Alternative 1) would contribute the least to cumulative bat mortality, and Alternative 3 would contribute the most. Under any of the three alternatives, there would be some impact associated with either avoidance or displacement should bats react to the presence of turbines. The HCP as part of the Preferred Alternative and BBCS for all alternatives both include a monitoring plan and adaptive management framework designed to monitor bat mortality and respond to significant bat mortality should it be identified.

By 2058, the cumulative impact of wind power projects is predicted to result in mortality of roughly 12.6 million bats within Region 3, most of these being the long-distance migratory bats (~87%). The effect of cumulative mortality on long-distance migratory bat populations is highly uncertain because estimates of current population sizes are unknown. However, their mortality at wind power projects is significantly higher than that experienced by cave-dwelling bats and is considered an additive effect to other stressors adversely affecting population levels (such as disease, predation, and habitat loss and degradation which decreases reproduction and survival. The cumulative effect of wind power mortality on slowly reproducing cave-dwelling bats is also additive to already high mortality caused by WNS.

Under the Preferred Alternative, bat mortality would be reduced by 50% or more due to the curtailment strategy. The Preferred Alternative also includes mitigation to offset mortality to Indiana bats and northern long-eared bats and may benefit other cave-dwelling bats.

# 5 CONSULTATION AND COORDINATION

## 5.1 CONSULTATION AND COORDINATION

### 5.1.1 AGENCY COORDINATION

In support of their application to build a wind energy project in Ford and Iroquois counties, the Applicant consulted with the Service, IDNR, Illinois State Historic Preservation Agency (IHPA), and other state and local agencies. The Service has engaged IDNR in discussions on possible sites for conducting projects suitable for mitigating the unavoidable impacts of taking Indiana bats.

### 5.1.2 DISTRIBUTION OF THE DRAFT EA

In accordance with NEPA, this Draft EA is being circulated for public review and comment. The public review period is initiated with the publication of the Notice of Availability (NOA) in the Federal Register and the public comment period will extend for 60 days from the date of publication.

The draft EA has been distributed to individuals and organizations who specifically requested a copy of the document. The Service will provide copies to other interested organizations or individuals upon request. In addition, copies or web links have been sent to the following elected officials, federal agencies, and state, county, and local offices:

- Federal Agencies
  - U.S. Department of the Interior
  - U.S. Department of the Interior, U.S. Fish and Wildlife Service
  - U.S. Forest Service, Shawnee National Forest
  - U.S. Department of Transportation, Office of the Secretary
  - U.S. Army Corps of Engineers, Rock Island District
  - U.S. Environmental Protection Agency, Region 5
  - U.S. Department of Agriculture Rural Development – Champaign Area Office
  - Natural Resources Conservation Service
  - U.S. Department of Energy
  - U.S. Department of Housing and Urban Development
  - Federal Emergency Management Agency, Region 5
  - Federal Communications Commission
  - Federal Aviation Administration
  - Federal Railroad Administration
  - Federal Highway Administration, Midwest Resource Center
  - U.S. Department of Commerce
  - Advisory Council on Historic Preservation
- State Agencies
  - Office of the Secretary of State Jesse White
  - Attorney General’s Office Lisa Madigan
  - Illinois Environmental Protection Agency
  - Illinois Department of Agriculture

- Illinois Historic Preservation Agency
- Illinois Department of Transportation
- Illinois Department of Natural Resources

• Federal and State Elected Officials

- Governor Pat Quinn
- Honorable Mark Kirk (U.S. Senator)
- Honorable Dick Durbin (U.S. Senator)
- Honorable John Shimkus (U.S. Representative)
- Honorable Josh Harms (State Senator)
- Honorable Jason Barickman (State Representative)

• Local Units of Government

- Ford County Commissioners
- Iroquois County Commissioners

• Others

- The Nature Conservancy – Illinois
- Illinois Audubon Society
- Illinois Natural History Survey

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# Appendix A: Bird and Bat Conservation Strategy

## Appendix B: Avian Risk Assessment

## Appendix C: Fall 2012 and Spring 2013 Avian and Bat Post-Construction Mortality Monitoring Report

**Appendix D: Bat Screening Analysis and Pre-Construction Bat Survey**

## Appendix E: USFWS Technical Assistance Letter

## Appendix F: Table F-1. Comparison of Bird Mortality at Existing Wind Farms in Midwestern U.S.

## Appendix A: Bird and Bat Conservation Strategy

# Bird and Bat Conservation Strategy for Pioneer Trail Wind Farm Ford and Iroquois Counties, Illinois

May 2014

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# 1 INTRODUCTION

Pioneer Trail Wind Farm, LLC (PTWF), a wholly owned subsidiary of E.ON Climate & Renewables, North America (E.ON), developed and is operating the Pioneer Trail Wind Farm (Project) in Ford and Iroquois counties, Illinois (Figure 1). The Project is designed to generate approximately 150 megawatts (MW) with 1.6-MW wind turbine generators (WTGs) and associated operations and maintenance building, access roads, collector line system, and substation. The Project began Commercial Operation on 19 January, 2012.

## 1.1 Purpose of the Bird and Bat Conservation Strategy

Wind energy is one of the fastest-growing sources of renewable energy in the United States. Construction and operation of wind energy projects provides a competitive source of inexhaustible, zero-emissions energy to meet the nation's rapidly growing energy demands, but does have the potential to impact bird and bat populations through habitat fragmentation, displacement, and mortality due to collision with or proximity to WTG blades (NWCC 2010). PTWF has developed this Bird and Bat Conservation Strategy (BBCS) in a good faith effort to avoid and reduce potential impacts to birds and bats at the Project. This BBCS is also intended to ensure that, in the absence of a federal Incidental Take Permit (ITP), impacts to federally-listed species are avoided. This BBCS is a living document that will evolve in response to Project conditions, but will remain in effect through the life of the Project unless and to the extent replaced in whole or in part by a Habitat Conservation Plan (HCP) approved in connection with the issuance of an ITP issued pursuant to Section 10(a)(1)(B) of the federal Endangered Species Act (ESA).

Specific goals of the Pioneer Trail BBCS are to:

1) Develop measures that will avoid and reduce potential impacts to birds and bats during operation, maintenance, and decommissioning of the Project;

2) Ensure the potential for impacts to protected and sensitive bird and bat species is reduced;

3) Ensure the potential for impacts to federally-listed bat species is avoided; and

4) Develop effective post-construction monitoring and adaptive management procedures to guide management actions for the life of the Project.

**Table 1 Identified Avian Species Issues and PTWF Project Strategy**

| Species | Status | Comments | Strategy |
|---|---|---|---|
| Upland sandpiper (*Bartramia longicauda*)<br>Short-eared owl (*Asio flammeus*)<br>Barn owl (*Tyto alba*) | IL endangered<br>IL endangered<br>IL endangered | Issues of potential concern are associated with courtship behavior, breeding/nesting habitat; species breed/nest mid-April to May. Suitable on-site habitat does not exist or would be limited at this site, although species have been observed in less suitable habitat. | Risk considered low. Pre-construction observations made during spring point counts[1] to confirm habitat and identify any nesting activity. |
| Loggerhead shrike (*Lanius ludovicianus*)<br>Northern harrier (*Circus cyaneus*) | IL threatened<br>IL endangered & USFWS species of concern | Issues of potential concern are associated with courtship behavior, breeding/nesting habitat and migration; species breed/nest mid-April to May. Suitable on-site habitat does not exist or would be limited at this site, although species have been observed in less suitable habitat. | Risk considered low. Pre-construction observations made during spring point counts[1] to confirm habitat and identify any nesting or migratory activity. |
| Sandhill crane (*Grus canadensis*)<br>Whooping crane (*Grus americana*)<br>Smith's longspur (*Calcarius pictus*)<br>American golden-plover (*Pluvialis dominica*) | IL threatened<br>ESA endangered<br>No status<br>IDNR species of concern | Each of these species has the potential to migrate through the general Project area, with variable migratory patterns. Habitat features that would attract cranes are limited in the Project area. | Risk considered low for cranes, moderate for other species. Pre-construction spring point counts[1] conducted to document migratory activity. |

[1]Survey results are presented in Section 3.2.
Table Source: ARCADIS 2010

## 1.2 Regulatory Framework

### 1.2.1 Endangered Species Act

The purpose of the ESA is to provide a means whereby the ecosystems upon which threatened and endangered species depend may be conserved, and to provide a program for the conservation of such species.

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)].

The Service's 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." They also define harass as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, 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 endangered and threatened 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, as long as the take is incidental to, and not the purpose of, otherwise lawful activities.

PTWF is currently developing an HCP and working to obtain an ITP (Section 10(a)1(B)) for the Indiana bat and northern long-eared bat. This document, originally written as an Avian and Bat Protection Plan (ABPP), served as the basis for the development of a technical assistance letter from the Service, to document that the take of the listed species (only the Indiana bat at that time) was not expected to occur if the Project is operated pursuant to the measures contained in this BBCS.

### 1.2.2 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA, 16 U.S.C. §§ 703-712) prohibits the taking, killing, injuring, or capture of listed migratory birds. Neither the MBTA nor its implementing regulations found in 50 CFR Part 21 provide for the permitting of "incidental take" of migratory birds that may be killed or injured by wind turbines. To avoid and reduce potential impacts to species protected under the MBTA at the Project, PTWF will implement this BBCS throughout the life of the Project. This BBCS incorporates the results of pre-construction avian use surveys within the Project area, patterns of bird mortality reported at other wind energy facilities in the Midwest, and recommendations obtained through consultation with the Service and the IDNR for reducing impacts to birds. Avoidance and minimization measures for reducing impacts to MBTA-listed species at the Project were developed based on these data and are described in this BBCS.

### 1.2.3 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act of 1940 (BGEPA, 50 CFR 22.26), and its implementing regulations, provides additional protection to bald eagles and golden eagles (*Aquila chrysaetos*) such that it is unlawful to take an eagle. In this statute the definition of "take" is to "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, or molest, or disturb." The term "disturb" is defined in regulations found at 50 CFR 22.3 to include "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available: (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

The Service published a final rule (Eagle Permit Rule) on September 11, 2009 under BGEPA authorizing limited issuance of permits to take bald eagles and golden eagles ''for the protection of...other interests in any particular locality'' where the take is compatible with the preservation of the bald eagle and the golden eagle, is associated with and not the purpose of an otherwise lawful activity, and cannot practicably be avoided (FR 46836-46879). This final rule was revised on December 9, 2013 to extend the maximum term for programmatic permits to 30 years in an effort to facilitate the responsible development of renewable energy and other projects designed to operate for decades, while still protecting eagles (78 FR 73704-73725).

1) On May 2nd, 2013, the Service announced the availability of the Eagle Conservation Plan Guidance: Module 1 – Land-based Wind Energy, Version 2 (FR 10387)[1] (the "Guidance"). The Guidance provides a means of compliance with the BGEPA by providing recommendations and in-depth guidance for: Conducting early pre-construction assessments to identify important eagle use areas;

2) Avoiding, minimizing, and/or compensating for potential adverse effects to eagles; and,

3) Monitoring for impacts to eagles during construction and operation.

The Eagle Conservation Plan Guidance interprets and clarifies the permit requirements in the regulations at 50 CFR 22.26 and 22.27, and do not impose any binding requirements beyond those specified in the regulations.

[1] http://www.fws.gov/windenergy/eagle_guidance.html.

As for other MBTA-listed species, this BBCS incorporates site-specific, regional, and agency information and measures developed based on this information to avoid and reduce impacts to bald and golden eagles at the Project.

### 1.3 BBCS Term

This BBCS will be in effect through operation, maintenance, and decommissioning of the Project (Term). This Term will cover the 25-year terms for the Project site leases with two, 10-year extensions at PTWF's option. PTWF may elect not to exercise one or both of its options, or otherwise decide to decommission the Project sooner than anticipated. PTWF will update this BBCS, as needed, through adaptive management (Section 5.2) throughout the Term. Should the Project be re-powered at the end of the Project's expected life, the BBCS will automatically renew and remain in effect until the Project is decommissioned.

### 1.4 BBCS Project Area

This BBCS applies to all those lands leased by PTWF for construction and operation of the Project (Figure 1). These lands include the locations for all 94 turbines and associated Project facilities.

## 2 PROJECT DESCRIPTION

Pioneer Trail is a state-of-the-art wind energy facility located in Ford and Iroquois counties, Illinois, just east of the towns of Paxton and Loda (Figure 1). The Project is designed to generate approximately 150 MW with 1.6-MW WTGs and associated operations and maintenance building, access roads, collector line system, and substation. Approximately 3.00 miles (4.83 kilometers [km]) of overhead transmission line extends from the existing Paxton West substation to a newly constructed substation on the Project site. The Project began Commercial Operation on 19 January, 2012.

### 2.1 Site Selection

The Project site was first identified through a review of available wind resource mapping. As a renewable resource, wind is classified according to wind power classes, which are based on typical wind speeds. These classes range from Class 1 (the lowest) to Class 7 (the highest). Strong wind resources were indicated in the Iroquois and Ford County area.

In addition to a strong, reliable wind resource, wind energy must be well supported by transmission that will provide the generated power to the electrical grid. The presence of an existing 138 kilovolt (kV) high voltage transmission line within an area that has a significant area of agricultural land continued to support a focus in the Iroquois and Ford County area. Initial landowner contacts began, and PTWF contracted with ARCADIS to conduct a fatal flaw evaluation of a preliminary Project area.

PTWF's Project boundaries were defined by carefully considering environmental and community issues in the siting of WTGs and associated components within a given property. Wetland impacts were avoided except for potential temporary disturbance associated with underground cable installation. Avoidance of stream and wetland areas, as well as mature trees, was a priority for the Project layout. Appropriate setbacks to allow for buffering of the WTGs from residences and other land uses were also important elements of the layout. The final Project layout is presented in Figure 2.

## 2.2 Project Characteristics

The Project area is located just east of the towns of Paxton and Loda, Illinois. Land use throughout much of the Project area is dominated by agriculture (i.e., row crops and pasture), with unnamed drainageways found throughout the Project limits. The Project is located on land leased from participating landowners, who will continue existing use of the land to a significant extent. As a leaseholder, PTWF's rights are limited to those incorporated in the lease agreement to allow for safe and effective construction, operation, maintenance and decommissioning of the Project. PTWF has no control over landowner activities on the property within which the Project will be located to the extent not covered in specific lease provisions.

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

### 2.2.1 Turbines

There are 94 turbines associated with PTWF. Each wind turbine consists of three major components; the tower, the nacelle, and the rotor. The height of the tower, or "hub height" (height from foundation to top of tower) is approximately 362 feet (ft) (80 meters [m]). The nacelle sits atop the tower, and the rotor hub is mounted to the front of the nacelle. The total turbine height (i.e., height at the highest blade tip position) is approximately 398 ft (121 m). Descriptions of each of the turbine components are provided below.

Tower: The tubular towers used for this Project are conical steel structures manufactured in multiple sections. The towers have a base diameter of 14 ft (4.3 m) and a top diameter of approximately 8.4 ft (2.6 m). 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.

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. Attached to the top of nacelles located on the outside perimeter of the Project area and some additional locations within the Project area per specifications of the Federal Aviation Administration (FAA), are single, medium-intensity aviation warning lights. These lights are flashing red strobes (L-864) and operate only at night.

Rotor: A rotor assembly is mounted to the nacelle to operate upwind of the tower. Each rotor consists of three composite blades that are approximately 135 ft (41.25 m) in length (total rotor diameter of 271 ft [82.5 m]). The rotor attaches to the drive train at the front of the nacelle. Hydraulic motors within the rotor hub feather each blade according to wind conditions, which enables the turbine to operate efficiently at varying wind speeds. Also, the rotor can spin at varying speeds to operate more efficiently at lower wind speeds. The wind turbines begin generating energy (cut-in) at wind speeds as low as 7.8 mph (3.5 meters per second [m/s]) and cut out when wind speeds reach 60 mph (25 m/s) for 10 minutes.

Steel reinforced concrete foundations were constructed to anchor each WTG. A pad mounted transformer was installed at the base of each WTG that collects electricity generated by each turbine through cables routed down the inside of the tower.

### 2.2.2 Access Roads

The Project includes new or improved roads to provide access to the proposed turbines and substation site, including a ring-road around each turbine. The roads were constructed to a width of approximately 40 ft (12 m) initially to allow for crane travel, but all but an approximately 16-ft (5-m) width has been returned to agricultural use following construction. The roads are gravel-surfaced.

### 2.2.3 Collection System and Substation

PTWF includes a power collection system (underground where interference with other features would not preclude it, with cables ranging from approximately 2 to 5 inches [5 to 13 centimeters (cm)] in outside diameter) between the pad mounted transformers and a collector substation.

### 2.2.4 Transmission Line

Approximately 3.00 miles (4.83 km) of overhead transmission line extends from the existing Paxton West substation to a newly constructed substation on the Project site.

### 2.2.5 Meteorological Tower

One 362-ft (80-m) tall permanent meteorological tower has been installed to collect wind data and support performance testing of the Project. The tower is a self-supporting, lattice steel structure and is unguyed. The tower includes wind monitoring instruments.

### 2.2.6 Operations and Maintenance Building

An operations and maintenance building and associated storage yard has been constructed to house operations personnel, equipment, and materials and provide staff parking. Dimensions of the building are: 50 ft (15.2 m) by 64 ft (19.5 m). The building is located adjacent to the Project's substation.

### 2.3 Project Operations, Maintenance, and Decommissioning

The Project will be operated according to the turbine operational protocol described in Section 4.3.2 of this BBCS. Modifications to the Project's operational protocol may be implemented as described in the adaptive management plan (Section 5.2). Project maintenance activities during operation may include turbine maintenance as needed, vegetation control if necessary, periodic re-grading, and reviewing the Project drainage plans.

Commercial WTGs such as the Project's WTGs typically have a life expectancy of 20 to 25 years; after which time, or if turbines are non-operational for an extended period of time with no expectation of their returning to operation, they will be decommissioned. Decommissioning will be performed under a decommissioning plan that would address removal of Project components/improvements as well as site/land reclamation. Complete decommissioning of the facility or individual wind turbines will be completed within 12 months after the end of the useful life of the facility or of individual WTGs. Areas disturbed during decommissioning will be re-graded, reseeded, and restored.

## 3 AVIAN AND BAT RESOURCES

### 3.1 Habitat Description

The Project area is located in east-central Illinois. The Project area is within the Till Plains section of the Central Lowland physiographic province (Illinois State Geological Survey 2011). This region is characterized by flat to gently rolling topography produced by glacial processes. Elevation within Ford and Iroquois counties ranges from 620 to 820 ft (189 to 250 m) above sea level; there is even less topographic relief in the immediate Project area (Figure 1). Ford and Iroquois counties are largely comprised of agricultural lands interspersed with creeks, drainages, and small clusters of development.

Land use within the Project area is dominated by agriculture (approximately 95%), mostly rowcrops of corn and soybeans (Figure 3). Developed open space (approximately 3%) and low intensity development (approximately 2%) cover nearly all of the remaining land within the Project area (Table 2). Small, intermittent streams and drainages are common within the Project area. A few perennial streams also occur within the Project area, including Spring Creek, Pigeon Creek, and Sugar Creek. Larger waterways that are located outside of the Project area include the Iroquois River and the Middle Fork of the Vermilion River. Forested areas are limited to fragmented, linear tracts and small forested bands associated with larger streams.

Designated conservation areas within 10 miles (16 km) of the Project include the Middle Fork Forest Preserve, which includes a 130-acre (53-hectare [ha]) waterfowl management area, and the Grandma Patton Woods. Both parks are located along the Middle Fork of the Vermilion River to the south of the Project area (Figure 4). State Habitat Areas (SHAs) in the Project vicinity include the Loda SHA to the north of the Project, the Herschel Workman SHAs to the east of the Project, the Gifford SHA to the south of the Project, and the Perdueville SHA to the southwest of the Project; all of these SHAs are managed to provide high-quality permanent habitat for ring-necked pheasants (*Phasianus colchicus*) and hunting opportunity for Illinois sportsmen. Also located within 10 miles (16 km) of the Project are the Prospect Cemetery, Loda Cemetery, and Tomlinson Pioneer Cemetery Prairie Nature Preserves. No Important Bird Areas (IBAs) are known to occur in the vicinity of the Project.

**Table 2 National Land Cover Database Land Cover Types and Extents within the Pioneer Trail Wind Farm Project Area (Iroquois and Ford Counties, Illinois)**

| Land Cover Type | Acres (ha) | Approximate Percent Composition |
|---|---|---|
| Open Water | 1 (0.4) | <0.1% |
| Developed, Open Space | 371 (150) | 3.0% |
| Developed, Low Intensity | 269 (109) | 2.1% |
| Developed, Medium Intensity | 2 (0.8) | <0.1% |
| Developed, High Intensity | 1 (0.4) | <0.1% |
| Deciduous Forest | 5 (2) | <0.1% |
| Pasture Hay | 18 (7) | 0.1% |
| Cultivated Crops | 11,820 (4,783) | 95% |

Due to high levels of disturbance and lack of native vegetation, agricultural habitats are of limited quality for birds and bats. Cultivated agriculture is rarely used as nesting habitat by birds, although certain, disturbance-tolerant species may forage in crops. Agricultural fields may attract large flocks of birds, such as blackbirds and Canada geese (*Branta canadensis*), during the fall migration and winter seasons (Erickson et al. 2002). Agricultural habitat does not provide roosting habitat for bats, but certain bat species, primarily big brown bat (*Eptesicus fuscus*) and evening bat (*Nycticeius humeralis*), may forage over agricultural fields within the Project area. Other bat species in the region may occasionally forage over crops within the Project area but are more likely to use forested and open water habitats (BCI 2010). Fallow fields and areas of pasture or hay within the Project area may provide habitat for grassland birds including the state-endangered northern harrier and the state-endangered short-eared owl and may support grassland breeding birds.

Forest fragments such as those found within the Project area are typically not considered high-quality nesting habitat due to their limited size and abundance of edge habitat, which is associated with higher incidence of nest predation and parasitism (U.S. Geological Survey 2011). These small patches of forest habitat may receive higher levels of bird use during migration, as forest fragments often provide stopover habitat for migrating passerines and other birds (Packett and Dunning 2009). Forest fragments within the Project area may also provide limited amounts of foraging or roosting habitat for the nine bat species whose geographic distributions include Ford and Iroquois counties. Many of these species also forage along stream corridors or over water and may use the small areas of open water within the Project area (BCI 2010).

## 3.2 Pre-Construction Avian Surveys

As a result of coordination with IDNR, it was resolved that PTWF's avian survey regime would consist of point count transects. Consistent with IDNR recommendations for other nearby wind energy projects, two specific survey periods were identified, scheduled to overlap with spring migratory and breeding/residential periods. Because it has been well documented that the American golden-plover frequents Iroquois and Ford counties as a stopover location during its spring migration from northeastern South America to the Arctic coastal plain (fall migration is along a different route), the timing of the spring migratory survey (April 19 to April 22, 2010) was intended to coincide with the timing of potential golden-plover migration. The breeding/residential survey period selected was later in the spring (May 21 to May 24, 2010), timed to reflect more generalized avian activity. The two survey periods together provided a representative view of general migratory bird activity at the Project area. This section presents a summary of the survey results: refer to the survey report (ARCADIS 2010) for more information.

Survey methods were similar for the spring migratory surveys and the breeding/resident bird surveys; however, the respective surveys were conducted during two separate field events. Five transects were chosen to represent a range of habitat types characteristic of the overall Project area. At each of the five transects, birds were surveyed at five points during three time periods (post-dawn, afternoon, and pre-dusk) for a total of 15 surveys per transect. Each point was surveyed for a period of 10 minutes.

### 3.2.1 Spring Migratory Surveys

There were 500 total birds of 37 different species observed during the migratory bird survey. Species included:

- Seven shorebird species: American golden-plover, common snipe (*Gallinago gallinago*), great blue heron (*Ardea herodias*), lesser yellow legs (*Tringa flavipes*), killdeer (*Charadrius vociferus*), unidentified plover species (*Charadriiformes* spp,), unidentified yellowlegs species (*Charadriiformes* spp.),
- Two raptor species: turkey vulture (*Cathartes aura*), red-tailed hawk (*Buteo jamaicensis*)
- One gamebird species: ring-necked pheasant,
- Two corvid species: blue jay (*Cyanocitta cristata*), American crow (*Corvus brachyrhynchos*),
- Two falcon species: American kestrel (*Falco sparverius*), merlin (*Falco columbarius*), and
- One waterfowl species: mallard (*Anas platyrhynchos*).

Passerines comprised the remaining 22 species. No species listed as threatened or endangered by the State of Illinois were observed during the spring migratory surveys. No eagles were observed during the spring migratory surveys.

American golden-plovers were observed resting/foraging in agricultural fields as well as flying overhead in flocks. Approximately 264 total plovers were observed. Of these, 69 birds were observed flying overhead in flocks of one to approximately 30 birds. The remaining 195 were observed on the ground in the agricultural fields in groups of six to 50 birds. Plovers were observed in tilled and partially tilled soybean and corn fields as well as in one wetland area. A flock of more than 300 plovers was incidentally observed within the Project area during the surveys, actively foraging in an active agricultural field.

### 3.2.2 Resident/Breeding Bird Surveys

During the resident/breeding bird surveys, a total of 723 birds of 36 different species were observed. Species included:

- One caprimulgidae species: common nighthawk (*Chordeiles minor*),
- One corvid species: American crow,
- One falcon species: American kestrel,
- Two waterfowl species: Canada goose and mallard,
- Five shorebirds species: killdeer, semipalmated sandpiper (*Calidris pusilla*), Western sandpiper (*Calidris mauri*), unidentified sandpiper species (*Charadriiformes* spp.), unidentified plover species,
- One gamebird species: ring-necked pheasant, and
- Two raptor species: red-tailed hawk and turkey vulture.

Passerines comprised the remaining 22 species and 85 percent of all birds observed during the surveys. Waterfowl comprised 14 percent of all bird observations; all other bird species accounted for less than one percent of the bird observations. Considering all bird species together, 40 percent of the recorded birds were observed resting or foraging on the ground, 35 percent were observed flying overhead, 10 percent were observed flying in or landing in habitat, eight percent were observed audibly, and five percent were observed interacting. No species listed as threatened or endangered by the State of Illinois were observed during the resident/breeding bird surveys. No eagles were observed during the resident/breeding bird surveys.

The highest percentage of habitat use by resident and breeding birds was agricultural habitat (67%), which is the most dominant habitat type in the Project area. Although most birds were observed in actively farmed land (423 birds), actively farmed lands were used by only 22.2 percent of all observed species. The most common species in actively farmed land was brown-headed cowbird (*Molothrus ater*), followed by common grackle (*Quiscalus quisicula*), red-winged blackbird (*Agelaius phoeniceus*), killdeer, barn swallow (*Hirundo rustica*), horned lark (*Eremophila alpestris*), and American robin (*Turdus migratorius*). Flight paths tended to be sporadic and limited in duration to movements between habitats to gather nesting materials or forage.

## 3.3 Pre-Construction Bat Surveys

Acoustic bat surveys were conducted in the Project area from 15 April through 4 November, 2010. This section presents a summary of the survey results: refer to the survey report (Stantec 2011) for more information. Acoustic surveys incorporated both stationary (i.e. passive) and mobile (i.e. active) echolocation detectors, which have been proven to be acceptable methodologies for bat/wind farm screening (e.g. Kunz et al. 2007a, Redell et al. 2006). Surveys were divided among time periods, or seasons, generally recognized as appropriate for pre-construction screening-level surveys at wind farms (Table 3).

**Table 3 Timing and Frequency of Bat Surveys Conducted at the Pioneer Trail Wind Farm (Iroquois and Ford Counties, Illinois)**

| Screening Survey Period | 2010 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | April | | | | May | | | | June | | | | July | | | | August | | | | September | | | | October | | | |
| Spring Migration | | x | x | x | x | x | | | | | | | | | | | | | | | | | | | | | | |
| Summer | | | | | | | | | | | x | x | | | | | | | | | | | | | | | | |
| Fall Migration | | | | | | | | | | | | | | | x | | | x | x | x | | x | x | x | | | x | |

Seasonal stationary detector survey periods (yellow)
x Mobile field survey visits

### 3.3.1 Stationary Survey

Stationary detectors were used to determine species presence and relative activity levels at varying heights. One Remote Bat Acoustic Technology System (ReBAT™; Pandion Systems, Inc., Gainesville, Florida) array was deployed on one 197-ft (60-m) tall meteorological (MET) tower located within the Project area. Two receivers were deployed on the tower at different heights in a vertical transect to capture information about bat species flying at variable altitudes. Based on accepted methodology, receivers were placed at 16.5 ft (5 m) and 190 ft (58 m; within the rotor swept zone).

The ReBAT™ unit was operational between 17 April and 4 November, for a total of 402 detector nights (one detector for one night = one detector night; therefore, there are two detector nights for each night that both detectors are operational). Bats were recorded on 145 of 201 (72.1%) survey nights at the tower. A total of 1,026 classifiable bat passes (mean = 2.6 passes/night) were recorded by the stationary detectors during the activity season (Table 3). It is estimated that 243 unclassifiable passes were removed during the filtering process. Therefore, the adjusted total bat passes for the 2010 activity season at the PTWF is 1,269 (mean = 3.2 passes/night) (Table 4).

**Table 4 Summary of Bat Passes (mean per night) by Detector Height, Season, and Frequency Group for Stationary Pre-Construction Surveys at the Pioneer Trail Wind Farm (Iroquois and Ford Counties, Illinois, 2010)**

| | 5 Meter | 58 Meter | Total |
|---|---|---|---|
| Spring | | | |
| Low Freq. Bat Passes | 18 (0.6) | 41 (1.4) | 59 (1.0) |
| High Freq. Bat Passes | 10 (0.3) | 3 (0.1) | 13 (0.2) |
| **Total Passes (Spring)*** | **29 (1.0)** | **45 (1.6)** | **74 (1.3)** |
| Summer | | | |
| Low Freq. Bat Passes | 77 (1.3) | 83 (1.4) | 160 (1.3) |
| High Freq. Bat Passes | 15 (0.2) | 10 (0.2) | 25 (0.2) |
| **Total Passes (Summer)*** | **97 (1.6)** | **96 (1.6)** | **193 (1.6)** |
| Fall | | | |
| Low Freq. Bat Passes | 244 (2.2) | 376 (3.4) | 620 (2.8) |
| High Freq. Bat Passes | 44 (0.4) | 56 (0.5) | 100 (0.5) |
| **Total Passes (Fall)*** | **309 (2.8)** | **450 (4.1)** | **759 (3.4)** |
| **Total Low Frequency Passes for Activity Season** | **339 (1.7)** | **500 (2.5)** | **839 (2.1)** |
| **Total High Frequency Passes for Activity Season** | **69 (0.3)** | **69 (0.3)** | **138 (0.3)** |
| **Total Classifiable Passes for Activity Season*** | **435 (2.2)** | **591 (2.9)** | **1026 (2.6)** |
| **Est. Total Unclassifiable Passes for Activity Season** | **243** | | |
| **Adjusted Total Passes for Activity Season** | **1269 (3.2)** | | |

*Some recorded bat sound files contained both low and high frequency species or were too poor quality to characterize the call by frequency group. Therefore, the sum of bat passes for these groups may not equal the "Total Passes" recorded

### 3.3.2 Mobile Survey

Surveys with mobile hand-held Anabat detectors (Titley Electronics, Australia) were used to supplement stationary surveys. Six mobile transects were selected along roads within the Project area. Survey routes were selected in a variety of habitat types to adequately represent the Project area (e.g., agricultural fields, woodlots, wetlands or stream corridors). Transects were driven at a slow rate of speed (<5 mph) by surveyors while holding the mobile bat echolocation detector outside of the vehicle. A total of 15 mobile surveys were conducted (spring-5, summer-2, fall-8), with emphasis placed on the critical fall migration period.

During the 90 mobile surveys (15 surveys of 6 transects), 58 definitive bat passes (mean = 0.6 passes/transect/night) were recorded (Table 5). Of the transects, Transect 4, located in the southwest corner of the Project area, recorded the highest number of total bat passes at 28 (mean = 1.9/night). Transects 1 and 3, located in the northwestern portion of the Project area, recorded the lowest total number of bat passes at only two passes each (mean = 0.1/night).

**Table 5 Bat Passes (mean per transect per survey night) by Season for Mobile Pre-Construction Surveys at Pioneer Trail (Iroquois and Ford Counties, Illinois, 2010)**

| | **Transect 1** | **Transect 2** | **Transect 3** | **Transect 4** | **Transect 5** | **Transect 6** |
|---|---|---|---|---|---|---|
| **Low Frequency Bat Passes** | 0 (0.0) | 3 (0.2) | 2 (0.1) | 14 (0.9) | 4 (0.3) | 4 (0.3) |
| **High Frequency Bat Passes** | 2 (0.1) | 2 (0.1) | 0 (0.0) | 9 (0.6) | 10 (0.7) | 3 (0.2) |
| **Total Passes** | 2 (0.1) | 5 (0.1) | 2 (0.1) | 28 (1.9) | 14 (0.9) | 7 (0.5) |
| **Total Passes for Activity Season*** | **58 (0.6)** | | | | | |

*Some recorded bat sound files contained both low and high frequency species. Therefore, the sum of bat passes for these groups may not equal the "Total Passes" recorded.

### 3.3.1 Bat Species and Frequency Groups Detected During Surveys

Using classifiable calls and files that contained high quality bat passes, a species list was developed for the Project area. Approximately 73.5% of the 1,026 classifiable calls recorded during the stationary survey and 72.4% of the 58 calls recorded during the mobile surveys were identifiable to species or species group (e.g., big brown bat/silver-haired bat, *Myotis* sp.).

Seven bat species were identified by either an experienced bat biologist or an automated acoustic identification software to be present at the site:

- Big brown bat
- Silver-haired bat
- Eastern red bat
- Hoary bat
- Tri-colored bat
- Little brown bat
- Northern long-eared bat

None of the species confirmed in the Project area are listed as state or federally threatened or endangered. Six confirmed *Myotis* calls were recorded by the 16.5 ft (5 m) receiver during the stationary survey. A single call was recorded on 3 July, 27 July, 11 August and 14 August, and two calls were recorded on 11 October. All six calls exhibited characteristics typical of *Myotis* calls; however, due to the overlap in call characteristics between *Myotis* species and the quality of the calls, positive manual identification to species was not possible. These six call files were also run through a USFWS candidate automated acoustic identification software program (Kaleidoscope Pro), as recommended by USFWS in their 2013 Indiana Bat Summer Survey Guidance. Due to overlap in call characteristics between *Myotis* species and the quality of the recorded calls, four of these calls were still not identifiable to the species level. Of the remaining three calls, two were identified as little brown bats and one as a northern long-eared bat (27 July 2010). However, the northern long-eared bat identification could not be confirmed by a bat expert, and only 2 of the 10 pulses in the call fit the criteria in Kaleidoscope for the species. Based on the detection zone of the receivers, bats recorded by the 16.5 ft (5 m) detector were not within the rotor swept zone (>127 ft [38.75 m]). There were no confirmed Indiana bat calls, and only one possible northern long-eared bat call (0.1% of all identifiable calls).

Three confirmed *Myotis* calls were recorded during mobile surveys: one along Transect 5 on 20 August and two along Transect 4 on 25 August. *Myotis* calls represented 7% of the identifiable calls recorded during the mobile survey, but only 0.8% of the identifiable calls recorded during the stationary survey. None of these could be identified to the species level.

### 3.3.2 <u>Seasonal Distribution of Bat Activity</u>

During the 2010 activity season, bat activity within the Project area was highest from mid-July through early October, peaking in early August and again in early October. Bat passes at the two stationary detector heights was similar throughout much of the activity season; during the fall season, more activity was recorded at the upper detector (Figure 5).

The total number of bat passes at the stationary detector during the spring season (74) was the lowest among the three seasons (74; mean = 1.3 passes/night) (Figure 6). Low frequency species were recorded more often than high frequency species during both stationary and mobile surveys. Total bat passes recorded during spring mobile surveys were the highest of the three seasons (27), but only slightly above the fall surveys (25).

The total number of bat passes at the stationary detector during the summer season (193) increased over what was observed during the spring season (74); and the average number of passes/night increased from 1.3 to 1.6 (Figure 6). Low frequency species were recorded at the stationary detector more often than high frequency species. Bat activity recorded during summer mobile surveys was significantly lower than spring (5 total passes vs. 20 total passes), with twice as many high frequency bats recorded as low frequency bats.

The total number of bat passes at the stationary detector during the fall season (759) was the highest among the three seasons. The average number of passes/night (3.4) was over two times the average number of passes/night recorded in the spring or summer (1.3 and 1.6 respectively) (Figure 6). Low frequency species were recorded at the stationary detector six times more often than high frequency species. Total bat passes recorded during fall mobile surveys (25) were nearly equal to what was recorded in the spring (27) and four times that recorded in the summer (6).

## 3.4 Additional Site-Specific Bird and Bat Information

### 3.4.1 <u>Birds</u>

Consultation with the Service and IDNR identified 10 avian species of potential concern for PTWF (Table 1). Pre-construction surveys were conducted to address these concerns and assess potential risk from the Project. No bird species listed as threatened or endangered under the ESA or by the State of Illinois were observed during pre-construction surveys in April and May, 2010 (ARCADIS 2010). Early spring pre-construction surveys were scheduled specifically to coincide with American golden-plover migration through the Project area; these surveys documented use of agricultural fields in the Project area by migrating plovers. However, most plovers were observed resting or foraging on the ground; flights were observed to be primarily at high elevations above the rotor-swept area. Plovers were occasionally observed flying through the rotor-swept area to land or take to wing. Post-construction monitoring studies at other wind energy facilities located within the plover spring migration corridor, including the Buffalo Ridge Wind Resource Area in Minnesota (Johnson et al. 2000 as cited in NWCC [2010]), and the Fowler Ridge Wind Farm, which is located in close proximity to a plover IBA in Benton County, Indiana (Good et al. 2011), have not reported any plover mortalities to-date.

The Project area is within the historic breeding, wintering, and migration range of the bald eagle. Bald eagles have been noted by the Service (pers. comm., H. Woeber, USFWS, October 2008) to occur in many Illinois counties. The population trend for wintering bald eagles in Illinois fluctuates but is deemed by the Illinois Natural History Survey to probably be fairly stable. Bald eagles winter primarily along the Mississippi, Rock, and Illinois Rivers in the state; none of these rivers are within or adjacent to the Project area. The Illinois River is closest to the Project area, but is more than 20 miles (32 km) away at its nearest point. There is now limited nesting by bald eagles at the Crab Orchard National Wildlife Refuge and Savannah in southern Illinois, but nesting in the central and northern parts of the state is not currently known to occur (INHS 2011). There are no large reservoirs or lakes within the Project area and the two nearest major rivers, the Iroquois and the Middle Fork of the Vermilion, are not know to support bald eagles. No known occurrences were listed by the Service for Iroquois County (pers. comm., H. Woeber, USFWS, October 2008). Based on the species' limited geographic distribution within the state and the lack of highly suitable wintering or breeding habitat in the Project area, bald eagles are expected to occur only rarely within the Project area. Bald eagles were not observed during the resident/breeding bird or migratory bird surveys conducted within the Project area (ARCADIS 2010). Additionally, inquiries to the Service and IDNR in 2012 and 2011, respectively, indicated that no bald eagle nest locations are known to occur within 10 miles (16 km) of the Project area.

Golden eagles have never been common in the eastern U. S., and are not currently known to occur in Illinois except as occasional transient visitors. Golden eagles will occupy a wide variety of plant communities within open habitats, but prefer cliffs and large trees with large horizontal branches for roosting, perching, and nesting (Tesky 1994). Nesting habitat for golden eagles is very limited within the Project area and the species was not observed during the resident/breeding bird or migratory bird surveys conducted within the Project area (ARCADIS 2010). Inquiries to the Service and IDNR in 2012 and 2011, respectively, indicated that no golden eagle nest locations are known to occur within 10 miles (16 km) of the Project area. Golden eagles are therefore not expected to occur within the Project area.

### 3.4.2 Bats

Twelve species of bats occur in Illinois. Nine species, all members of the family Vespertilionidae, have geographic distributions that include Ford and Iroquois counties: Indiana bat, evening bat, little brown bat *(Myotis lucifugus*), northern long-eared bat (*Myotis septentrionalis*), silver-haired bat, Eastern red bat, hoary bat, tri-colored bat, and big brown bat (Schwartz and Schwartz 1986; Harvey et al. 1999; BCI 2010). Of these, only the Indiana Bat is listed as threatened or endangered (Illinois-state and federally endangered). The Indiana Bat is also considered a Species in Greatest Need of Conservation by the Illinois DNR (IDNR 2010). The northern long-eared bat has been proposed for listing as endangered by USFWS after publication of the 12-month finding (USFWS 2013a). This species is not currently listed by the State of Illinois, however per the Illinois Endangered Species Protection Act (Section 2.3.5), if the species becomes federally listed it will automatically also be listed by the State. The Service is also collecting information for a status review of the little brown bat to determine if threats to the species may be increasing its risk of extinction. Listing considerations and status reviews for both bat species are focused on the impacts of white-nose syndrome (WNS) on these species.

Indiana bat maternity colonies are historically known from Ford County (USFWS 2007). Recent records include a July 2010 survey that identified an Indiana bat maternity colony on the Middle Fork of the Vermilion River in Ford and Champaign counties (IDNR correspondence dated 6 December 2010). Maternity colonies are also known from Vermillion County, located adjacent to Ford County to the southeast (USFWS 2007). No records of Indiana bats are known from Iroquois County (USFWS 2007). The closest known hibernaculum is Blackball Mine located in

LaSalle County, Illinois approximately 120 miles (193 km) to the northwest of the Project area (USFWS 2007). No known hibernacula occur within the Project area or within Ford or Iroquois counties (USFWS 2007). No Indiana bats are expected to be in the Project area during the hibernation period, from November through March.

Because the northern long-eared bat has only recently been proposed for listing, public records of captures are limited. Northern-long eared bats are commonly captured in the Shawnee National Forest in southern Illinois, and have been captured fairly consistently during surveys between 1999 and 2011 at Oakwood Bottoms in the Shawnee National Forest (USFWS 2013a). There are 36 known hibernacula (sites with one or more winter records) in the State (USFWS 2013a). None of these are located within the Project area, though it is within the known range of the northern long-eared bat, and they are likely present at certain times of the year.

Approximately 5 acres (2 ha) of total deciduous forest cover is found within the Project area. Results of a desktop Indiana bat habitat assessment, based on Illinois Gap Analysis Program data, indicated that no woodland tracts within the Project area meet the minimum forest cover requirement of >15% for suitable Indiana bat summer habitat (USFWS 2007). The northern long-eared bat generally selects roosts with more canopy cover than Indiana bats select, suggesting that none of the woodland tracts within the Project area would meet their forest cover requirements of >44% to >84% (USFWS 2014). However, suitable summer habitat for both species may be present in the larger woodland tracts located south and west of the Project area. In addition, a number of creeks and unnamed drainageways are also present within the Project area. There is no designated critical habitat for any species in the Project area (USFWS 2007).

# 4 POTENTIAL IMPACTS TO BIRDS AND BATS

## 4.1 Birds

### 4.1.1 Overview of Potential Impacts

Operational impacts of wind energy facilities on birds include varying degrees of displacement from the wind turbines and surrounding habitat, as well as mortalities resulting from collisions with turbines, transmission lines, and other facility structures (Winegrad 2004).

Wind turbines may displace birds from an area due to the creation of edge habitat, the introduction of vertical structures and/or disturbances directly associated with turbine operation (e.g., noise, shadow flicker). Disturbance impacts are often complex, involving shifts in abundance, species composition, and behavioral patterns. The magnitudes of these impacts vary across species, habitats, and regions. Concerns have been raised that displacement from habitat may significantly affect certain avian populations (The Ornithological Council 2007). Although most research to-date has focused on collision mortality associated with wind energy facilities, the limited data available indicate that avoidance impacts to birds generally extend approximately 246-2,625 ft (75-800 m) from a turbine, depending on the environment and the bird species affected (Strickland 2004). Studies in the western and Midwestern U.S. consistently show small-scale (<328 ft [100 m]) impacts on birds (Strickland 2004).

Fatality rates ranged from 0.00 birds/turbine/year to 9.33 birds/turbine/year and averaged 2.08 birds/turbine/year in 22 studies conducted at wind energy facilities across North America (Barclay et al. 2007). Mortality rates at sites in the west and Midwest, particularly agricultural ones, have typically been at the low end of the national range. Recent studies at the Blue sky Green Field and Crescent Ridge sites in Wisconsin recorded unusually high bird fatality rates which increased the upper limit of the Midwest bird fatality range (Poulton 2010). Publicly-available estimates for the Midwest now range from 0.00 to 11.83 birds/turbine/year (Barclay et al. 2007, Poulton 2010). The number of avian fatalities at wind energy facilities is generally low when compared to the total number of birds detected at these sites (Erickson et al. 2002). No particular species or family has been identified as incurring greater numbers of fatalities at wind energy facilities. However, likely due to differences in abundance and use of habitat, bird groups have experienced varied impacts from wind turbines. Passerines, both resident and migrant, represent the majority (approximately 75%) of mortalities at wind turbines nation-wide (Erickson et al. 2001 and Johnson et al. 2002) and result in spring and fall peaks of bird mortality rates at most wind energy facilities (Johnson et al. 2002). Although waterbird (waterfowl, shorebirds, and seabirds) mortality at wind energy facilities has been highly variable, national research has demonstrated that waterbirds rarely collide with inland turbines (Everaert 2003 and Kingsley and Whittam 2007 as cited in NWCC [2010]). The only sites experiencing regular waterfowl fatalities have been those located on the shores of large, open expanses of water (Erickson et al. 2002). Raptor mortality rates at Midwest sites have been very low; generally one or two carcasses are found per study (Poulton 2010).

#### 4.1.2 Potential Impacts from the Project

The Project is sited within previously altered habitat that is dominated by tilled and untilled agriculture (corn and soybeans). Turbines are located only in actively farmed land, a habitat that only 22.2 percent of the species observed during pre-construction surveys were observed to use. Although Project operations have the potential to cause displacement of birds from the Project area, bird species sensitive to disturbance currently exhibit low use of the Project area and minimal suitable habitat for these species is present. Most birds observed using actively farmed habitat were members of common, disturbance-tolerant passerine species (ARCADIS 2010). The passerine utilization rate in actively farmed land was only 1.12 birds per survey. Utilization of actively farmed land by other species groups was even lower, between 0.003 birds per survey (goatsuckers) and 0.13 birds per survey (shorebirds); raptors and falcons were not observed utilizing any particular habitat, only flying by (ARCADIS 2010). Therefore, it is unlikely that displacement impacts from the turbines would greatly alter the composition of the area's avian community. The IDNR expressed concern that the PTWF may displace certain state-listed grassland species, including northern harrier, loggerhead shrike, and short-eared owl, from the Project area. However, these species were not observed during pre-construction surveys in the Project area and suitable habitat for these species is limited. For species or individuals that are displaced, it is unclear if displacement impacts would persist for the life of the Project; certain species may adapt to the presence of the turbines (The Ornithological Council 2007). Studies of displacement impacts to birds from operating turbines are limited; clear and consistent patterns of impacts have yet to be established.

The operating turbines will also pose a risk of bird mortalities from collisions. Bird mortality rates at other wind energy facilities in the Midwest have ranged from 0.00 to 11.83 birds/turbine/year (Barclay et al. 2007 and Poulton 2010). Studies at the Crescent Ridge site, located in an agricultural landscape in Illinois, reported mortality rates of 0.49 bird/turbine in fall 2005 and 0.47 bird/turbine in spring 2006 (Kerlinger et al. 2007). However, recent post-construction studies at the Blue Sky Green Field (Gruver et al. 2009) and Cedar Ridge (BHE 2010) facilities in Wisconsin have demonstrated that avian mortality rates at the high end of this range have the potential to occur at facilities sited in agricultural habitats.

A comparison of the pre-construction avian survey results to other available pre-construction survey reports indicates that surveys within the Project area detected many fewer birds and fewer species than have generally been detected at other Midwestern wind energy sites. Publicly available pre-construction surveys for wind energy projects in Illinois are extremely limited; however, surveys at several other agricultural wind energy project sites in Wisconsin reported much higher numbers of birds detected for given levels of survey effort. Survey results are not directly comparable across these sites due to variations in sample plot size, timing of surveys, and other differences in study design. Instead, these data provide a high-level reference of bird detections over given periods of survey effort for Midwestern wind energy projects.

Over a total of 25 survey hours at the Project area in April and May of 2010, 1,223 birds comprised of 52 species were observed. Overall, passerine use rates at the Project area were observed to average 2.09 birds per 10-minute survey in actively farmed habitat (overall average of 8.2 birds/10-minute period; ARCADIS 2010), placing the Project area at the low end of bird use in the Midwest. At the Glacier Hills wind energy site, located in an agricultural landscape in Wisconsin, a total of 59,643 birds of 151 species were observed over 123.5 survey hours (average of 80.5 birds/10-minute period; Cutright 2009). Pre-construction surveys at the Cedar Ridge Wind Farm, Wisconsin, detected 52,956 birds of 120 species over a total of 275.3 survey hours (average of 32.1 birds/10-minute period; Guarnaccia and Kerlinger 2008). At the Blue Sky and Green Field Wind Energy Projects, Wisconsin, a total of 79.5 survey hours were conducted at each site. Surveys detected 31,136 birds of 125 species at Blue Sky (65.3 birds/10-minute period) and 16,211 birds of 116 species at Green Field (34.0 birds/10-minute period; Gruver et al. 2009).

Based on the results of post-construction mortality studies at similar facilities, the Project should have fatality rates similar to those observed at other Midwestern facilities, within the range of 0.00 to 11.83 birds/turbine/year (Barclay et al. 2007 and Poulton 2010). While turbines in the Project are up to 82 ft (25 m) taller than turbines used to develop this range (turbines at existing projects typically do not exceed 410 ft [125 m]), fatality rates at the Project are expected to be within this range because avian use at the site is low, habitat is disturbed and homogenous, other risk factors contribute to a site's risk profile (e.g., facility lighting [Kerlinger et al 2010]), and PTWF has incorporated wildlife protection measures that reduce risk into the Project's design (Section 4.3).

Bird fatality rates at the PTWF are likely to peak during the spring and fall migration seasons, as has been observed at most wind energy facilities (Johnson et al. 2002). Passerines, both resident and migrant, are likely to constitute the greatest number of fatalities in the Project area, as this avian group represents the majority (75%) of mortalities at wind turbines nationwide and was by far the group most frequently observed during surveys within the Project area (ARCADIS 2010, Erickson et al. 2001, Johnson et al. 2002). Passerines observed using the Project area during the daytime pre-construction surveys in spring 2010 exhibited flight heights typically below the rotor-swept area and flight durations typically limited to localized movements for foraging, finding nest materials, guarding nests, etc. (ARCADIS 2010). Night-migrating passerines may be at a higher risk for collision with WTGs, as this group has accounted for over 50 percent of avian fatalities at certain sites. However, no particular passerine species or group of species has been identified as incurring greater numbers of fatalities (Erickson et al. 2002). Birds taking off at dusk or landing at dawn or birds traveling in low cloud or fog conditions (which lower the flight altitude of most migrants) are likely at the greatest risk of collision (Kerlinger 1995). Nationally, these mortalities have not been known to result in a significant population level impact to any one species, mainly because the migratory species with relatively high collision mortality are regionally abundant.

Collision risk is likely to be much lower for other bird groups in the Project area. Waterfowl and shorebirds together comprised 30 percent of the total species observed during pre-construction spring surveys. Most waterfowl and shorebirds were observed on the ground or flying well below the rotor-swept area; Canada goose and American golden-plover were the only species observed flying higher in the sky, though most observed flights by these species were at heights above the rotor-swept area (ARCADIS 2010). Waterfowl use may be increased on the Project area during the winter months if the croplands within the Project area attract large flocks of Canada geese (Erickson et al. 2002). National research has demonstrated that waterfowl and shorebirds rarely collide with inland turbines (Everaert 2003, Kingsley and Whittam 2007 as cited in NWCC [2010]), perhaps because of the consistently high (500- 5,000 ft [150-1,500 m]) altitudes at which these species migrate over land (Kerlinger 1995).

Together, raptors and falcons comprised only 0.4 percent of the total species observed during the pre-construction surveys. Additionally, the prey base for raptor species was not noted to be overly abundant in the Project area (ARCADIS 2010). The Project area lacks strong topographic features, such as ridgelines and large bodies of water that are known to funnel migrating raptors into narrow migration paths (IDNR 2007). Given the lack of major raptor migration routes through the Project area, low expected prey densities, and the relatively low raptor use of the Project area, raptor fatality rates at the PTWF are expected to be lower than or similar to those at other Midwestern sites, not likely to exceed one or two strikes a year (Poulton 2010).

American Golden-Plovers

Risk of disturbance or displacement to the American golden-plovers at the PTWF is expected to be minimal. The avian risk assessment conducted by ARCADIS subsequent to the pre-construction surveys cited studies on the European golden-plovers (*Pluvialis apricaria*) that indicated they are a species of high risk for collision or disturbance by turbines (Pearce-Higgins et al. 2009 as cited in ARCADIS 2010), as well as studies that showed no effect on the European plovers (Percival 2000, 2003 as cited in ARCADIS 2010). Because American golden-plovers were observed using habitat in which turbines have been constructed within the Project area, there is a possibility of these birds being displaced to avoid the turbines. American golden-plover use rates were observed to average 0.74 birds per 10-minute survey in actively farmed habitat. However, plovers are expected to be present and at risk within the Project area during only one month each year (ARCADIS 2010). The avian risk assessment noted that at a wind farm in Scotland, bird surveys were conducted four years after the turbines were in place and while the numbers of European golden-plovers remained constant at a control site, the overall abundance at the wind farm actually increased. The Scotland survey concluded that the turbines had no effect on the plovers and no sign of displacement was noted (Percival 2000 as cited in ARCADIS 2010).

The favored habitat of the American golden-plover (tilled or partially tilled agricultural fields of soybeans and corn) is locally abundant, abundant throughout Ford and Iroquois counties, and abundant throughout the state of Illinois. Moreover, migration of the plover is not restricted to the state of Illinois but can occur throughout the Great Plain states (The Wilderness Society 1998 as cited in ARCADIS 2010). The approximate footprint of the PTWF (estimated 13,421 acres [5,431 ha] of cultivated soybeans and corn) would impact less than 2 percent of actively managed soybean and corn fields in Ford and Iroquois counties, and less than 1/10th of a percent of similar agricultural lands throughout the state. In addition, WTGs will only affect a very small percentage of habitat within the Project area itself; the remaining area will continue in agricultural production and retain its habitat value. Therefore, because the impact area where the turbines are located is such a small fraction of the overall available habitat for plovers, and alternative suitable habitat is readily available, the expected disturbance and displacement impacts to plovers are expected to be relatively minimal (ARCADIS 2010).

Pre-construction surveys conducted during the 2010 plover spring migration period demonstrated plovers using actively farmed agricultural habitat, the habitat in which all PTWF WTGs have been located. Most plovers were observed resting or foraging on the ground; flights were observed to be primarily at high elevations above the rotor-swept area. In the absence of WTGs, plovers were occasionally observed flying through the rotor-swept area to land or take to wing (ARCADIS 2010). Flocks of plovers are expected to continue to fly at altitudes within the rotor-swept area as they migrate into and out of stopover habitat in the Project area, which may present a risk of collision with the WTGs. However, plover mortality at PTWF is expected to be low relative to the number of individuals present. Post-construction monitoring studies at other wind energy facilities located within the plover spring migration corridor, including the Buffalo Ridge Wind Resource Area in Minnesota (Johnson et al. 2000 as cited in NWCC [2010]), and the Fowler Ridge Wind Farm, which is located in close proximity to a plover IBA in Benton County, Indiana (Good et al. 2011), have not reported any plover mortalities to date.

Eagles

Bald eagles have been noted by the Service (pers. comm., H. Woeber, USFWS, October 2008) to occur in many Illinois counties. No known occurrences were listed for Iroquois County and no bald eagles were observed during pre-construction avian surveys in April and May, 2010 (ARCADIS 2010). The Project area lacks primary bald eagle habitat in the form of mature forest and large, fish-bearing waters. The lack of open water and tree cover in the Project area and surrounding vicinity is expected to result in minimal risk of species presence, as bald eagles feed on fish and prefer to roost in trees near open water. Bald eagles winter and congregate primarily along the Mississippi, Rock, and Illinois Rivers in Illinois, none of which are within 10 miles (16 km) of the Project area. There are no large reservoirs or lakes within the Project area or in Ford and Iroquois counties, and the two major rivers in the Project vicinity, the Iroquois and the Middle Fork of the Vermillion, are not known to support bald eagles (INHS 2011). The Project area and surrounding vicinity also lacks cliff lines, ridges, and escarpments along which bald eagles tend to migrate (USFWS 2011a). The bald eagle was not observed during field surveys (April-May 2010) (ARCADIS 2010). Additionally, inquiries to the Service and IDNR in February, 2012 indicated that no bald eagle nest locations are known to occur within 10 miles (16 km) of the Project area.

Golden eagles have never been common in the eastern U. S., and are not currently known to occur in Illinois except as occasional transient visitors. No golden eagles were observed during pre-construction avian surveys in April and May, 2010 (ARCADIS 2010). The Project area and surrounding vicinity lacks primary golden eagle habitat in the form of grasslands and other native habitat. Foraging and nesting opportunities in the Project area are considered very low for golden eagles, as flat tilled and untilled agriculture (soybean and corn fields) comprises the majority of the habitat. PTWF is located outside of the breeding range of the golden eagle (Cornell University 2011). Inquiries to the Service and IDNR in February, 2012 indicated that no golden eagle nest locations are known to occur within 10 miles (16 km) of the Project area. Finally, the Project area lacks cliff lines, ridges, and escarpments along which golden eagles tend to migrate (USFWS 2011a).

The USFWS Eagle Conservation Plan Guidance (USFWS 2013b) considers eagle nests, foraging areas, migration corridors and stopover sites, and communal roost sites that eagles rely on for breeding, sheltering, or feeding, to be important eagle-use areas. PTWF is not within 10 miles (16 km) of any known important eagle-use areas for bald or golden eagles, as described above. Based on this data, the lack of suitable habitat within the Project area, and the lack of eagle observations during pre-construction surveys in the Project area, it is expected that PTWF will pose little risk to eagles. Mortality monitoring and a plan of action if eagles are taken during Project operation are included in Section 5, in accordance with the guidance recommendations.

## 4.2 Bats

### 4.2.1 Overview of Potential Impacts

Direct mortality at wind turbines is currently the greatest concern for bats in general at wind facilities (Cryan 2008a); commercial wind facilities have been found to impact many bat species (Arnett et al. 2008). Whether bats are attracted to wind turbines and the exact mechanisms by which wind turbines cause mortality are unclear (reviewed in Kunz et al. 2007b); however, several hypotheses have recently been put forth and tested, including the role of land cover and environmental conditions in attracting bats to wind turbine locations, behavioral factors that might make wind turbines attractive to bats, pressure changes from rotating blades causing "barotrauma", or direct impact of unsuspecting migrant bats (Baerwald et al. 2008; Horn et al. 2008; Johnson et al. 2004; Kerns et al. 2005; reviewed in Kunz et al. 2007b).

The influence of landcover on bat mortality at wind turbine sites is unclear (Arnett et al. 2008). Johnson et al. (2004), for example, found no significant relationship between bat fatalities and landcover type within 328 ft (100 m) of wind turbines. They also found no significant relationship between bat mortality and distance to wetlands or woodlands (Johnson et al. 2004). Weather conditions, such as wind speed, rainfall, and temperature, have been found to have a significant impact on bat mortalities (Arnett et al. 2008). Bat mortality and insect activity are both high on nights with low wind speed when wind turbines are adjusted to rotate near their maximum revolutions per minute (Kerns et al. 2005). Bat fatalities decrease with increases in wind speed and precipitation intensity (Kerns et al. 2005; Good et al. 2011, Arnett et al. 2009, Baerwald et al. 2009).

The primary bat species affected by wind facilities are believed to be migratory, foliage- and tree-roosting species that mostly emit low frequency calls (Johnson et al. 2004; reviewed by Kunz et al. 2007b). Arnett et al. (2008) compiled data from 21 studies at 19 wind facilities in the United States 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, nearly 75 percent were the migratory, foliage-roosting hoary bat, eastern red bat, and silver-haired bat (Kunz 2007a).

Prior to September 2009, no mortality of species listed as threatened or endangered under the ESA had been reported, including the Indiana bat (Arnett et al. 2008). Since the first known fatality in September 2009 at Fowler Ridge Wind Farm, four additional Indiana bat fatalities have been documented (Pruitt and Okajima 2013). While the Indiana bat is the only currently listed bat species in the area, the northern long-eared bat has been proposed for listing as endangered. As of 2011, only 13 northern long-eared bat fatalities had been documented at wind energy facilities located in the United States, representing less than 0.2% of the total bat mortality (USFWS 2013a).

Some researchers have suggested that bats that roost in foliage of trees for most of the year may be attracted to wind turbines because of their migratory and mating behavior patterns (e.g. Kunz et al. 2007b; Cryan 2008b). At dawn, these tree bats may mistake wind turbines for roost trees, thereby increasing the risk of mortality (Kunz et al. 2007b). Cryan (2008b) suggested that male tree bats may be using tall trees as lekking sites, calling from these sites to passing females. If this is the case, then tree bats may be more attracted to wind turbine sites after the turbines are erected. Migrating tree bats are also thought to depend on sight for navigation rather than echolocation, possibly resulting in the bats being unaware of the presence of wind turbines during migration (Cryan and Brown 2007). As further support for these hypotheses, the majority of bat fatalities occur mid-summer through fall, during approximately the same time frame as southward migration of tree bats (Arnett et al. 2008). Tree bats tend to be larger species that emit low frequency calls. Bats that use low frequency calls may be more inclined to forage above tree tops where there are few obstructions. Migratory bats may also fly higher to maximize efficiency. Thus, tree bats may be more likely to fly in the rotor-swept area of wind turbines when compared to smaller bat species that have different foraging and migration strategies.

Although the number of bat fatalities recorded at wind energy facilities varies regionally, reports of mortality have been highest along forested ridge tops in the eastern U.S. and lowest in open landscapes of Midwestern and western states (Kunz et al. 2007b). However, it is difficult to make direct comparisons among projects due to differences in study length, metrics used for searches, and calculations for compensating for study biases (Arnett et al. 2008). Fatality rates ranged from 0.00 bats/turbine/year to 42.7 bats/turbine/year and averaged 7.12 bats/turbine/year in 21 studies conducted at wind energy facilities across North America (Barclay et al. 2007). In the Midwest, bat fatalities range from 0.1 to 40.5 bats/turbine/year (Poulton 2010), but higher fatality rates (up to 69.6 fatalities/turbine/year) have been reported in the eastern U.S. (Arnett et al. 2008).

### 4.2.1 Potential Impacts from the Project

Pre-construction acoustic bat surveys indicated a moderate level of bat activity at sites within the Project area. Compared to the 3.4 average bat passes per detector night recorded during the fall at the PTWF (Stantec 2011), 2.2 and 1.9 mean bat passes per detector-night were recorded in 2001 and 2002, respectively, at the Buffalo Ridge site in Minnesota (Johnson et al. 2004), 2.8 and 7.7 mean bat passes per detector-night were recorded at elevated and ground detectors, respectively, at the Blue Sky Green Field site in Wisconsin (Gruver 2008a), 5.7 mean bat passes per detector-night were recorded at the Glacier Hills site in Wisconsin (Gruver 2008b), 12.4 mean bat passes per detector-night were recorded at the Buckeye Wind site in Ohio (Stantec 2009), and 34.9 mean bat passes per detector-night were recorded at the Top of Iowa site in Iowa (Jain et al. 2011).

Seasonally, overall bat activity in the Project area peaked during early August and again in early October. Bat activity recorded at the stationary detectors was much higher during the fall season than during the spring and summer; low frequency bat activity comprised the majority of all bat activity at the stationary detectors (Stantec 2011). For most bat species summering in central Illinois, autumn migration typically occurs between August and September (Cryan 2003); the higher level of bat activity observed at the Project area in August and throughout the fall season is therefore likely to be associated with dispersal from summer habitat, juvenile bats becoming volant, the onset of breeding, and migration to winter habitats.

PTWF turbines will present a risk of bat mortality due to collisions or barotrauma. Due to the lack of unique bat species or habitat features that may attract bats, it is expected that bat mortality within the Project area will follow patterns similar to those observed at other Midwestern wind energy facilities, but mortality rates should be lower due to Project siting and micro-siting (i.e., WTGs are sited on active agricultural plots in an agriculture-dominated landscape). Bat mortalities in the Midwest have mostly occurred in the swarming and migration seasons, typically between mid-July and mid-September (e.g., Kerlinger et al. 2007; Johnson et al. 2003; Howe et al. 2002). Migratory tree bat species have comprised the majority of fatalities in the Midwest and nationally (Erickson et al. 2002; Kunz et al. 2007b). Mortality risk at the current Project is therefore expected to primarily affect bats that are migrating through the Project area during the late summer or early fall. Additionally, certain weather conditions, including low wind speeds and warmer temperatures are likely to increase the risk of bat mortality at the Project area, as these conditions have been demonstrated to coincide with nights of high bat mortality at wind energy facilities (Good et al. 2011, Gruver et al. 2009, Kunz et al. 2007b).

The lack of forested habitat and open water within the Project area likely reduces risk to bats, as most bat species in Illinois prefer forests and bodies of open water for foraging and migration stopover roosting habitat (BCI 2010). Bats migrating through the vicinity of the Project area may prefer the Iroquois and Middle Fork Rivers and associated forests compared to the open landscape within the Project area. The Project has been sited to avoid high-quality bat habitat altogether, but the presence of the turbines, even in open, non-forested areas, poses a risk of bat mortality. Bat mortality has been documented at Midwestern wind energy facilities in agricultural areas during the migration season, demonstrating that some migrating bats will fly over open land (Good et al 2011; Kerlinger et al. 2007; Johnson et al. 2003; Howe et al. 2002). Bat migration patterns and behaviors, and, subsequently, indicators of bat fatality risk at wind energy sites, are not well understood (Poulton 2010). However, PTWF has used the best science available to incorporate avoidance and minimization strategies, including a turbine curtailment strategy, into the siting, design, and operation strategies for this Project (described in Section 4.3) in an attempt to reduce bat risk at the Project area to the best of our current understanding. The operational strategies are intended to avoid take of federally listed bat species at the PTWF; although not listed, tree bat species, including the red bat, hoary bat, and silver-haired bat, are particularly likely to benefit from the operational strategies, as these species are expected to comprise the majority of bat mortality at PTWF.

## 4.3 Avoidance and Minimization

### 4.3.1 Summary of Measures Incorporated into the Project during Siting and Design

Pre-construction surveys were conducted to assess potential impacts to avian and bat resources, and assist in developing measures to avoid and minimize the identified potential impacts. These studies are described in Sections 3.2 and 3.3. The Project siting process incorporated considerations to avoid and minimize impacts to birds and bats, including eagles and Indiana bats. Although the northern long-eared bat was proposed for listing after Project siting, similarities between the northern long-eared bat and the Indiana bat suggest that the measures taken for Indiana bats should also prove beneficial to northern long-eared bats. The Project was developed in an agricultural setting to avoid fragmentation or other impacts to native habitats (i.e., riparian, grassland, wooded areas) and the sensitive species they support. All PTWF WTGs have been constructed in tilled agriculture. This avoids direct and indirect impacts to many of the sensitive species identified during consultation with the IDNR and the Service as potentially occurring in the Project vicinity. Prior to Project construction, PTWF relocated the proposed sites of two WTGs that were within 1,000 ft (305 m) of woodland with a direct connection to Indiana bat summer maternity habitat. Because Indiana bat summer habitat is not present within the Project area or within Ford or Iroquois counties, all impacts to potential summer habitat were thereby avoided. The Project area is located outside of the 10-mile (16 km) buffer zone of known eagle nests, foraging habitat, and communal roosting areas in Illinois. PTWF's setting also avoids landscape features known to channel migrating eagles and other raptors into narrowed migration routes.

The planning and development stages of the Project incorporated industry best practices and measures based on the best available scientific data to reduce risk to birds and bats. WTGs were constructed with conical steel towers; lattice structures were not used to avoid creating perches for raptors and other bird species. The permanent meteorological tower is a self-supporting, unguyed, lattice steel structure. Turbines around the perimeter of the Project area and at some additional locations within the Project area are lighted per FAA specifications, with a single, medium-intensity aviation warning light. These lights are flashing red strobes (L-864) and operate only at night. All PTWF employees are required to immediately turn off internal lights in turbines at night when lights are not required for safety or compliance purposes. All of the Project substation lights are equipped with downward facing shields. The power collection system was buried underground in all areas where interference with other features would not preclude it. No substantial tree clearing was conducted during Project construction, and construction staging areas were sited to avoid sensitive features, including surface waters.

The avoidance and minimization measures incorporated during Project siting and design, described above were the initial methods of reducing potential avian and bat impacts at the Project. Overall impacts to birds and bats are expected to be low at the Project area, based on the Project area's agricultural landscape, moderate levels of bird and bat use, lack of attractive habitat characteristics, lack of use by protected species (ARCADIS 2010), and implementation of the above-listed avoidance and minimization measures. Bird and bat fatality rates at the Project are expected to be at the lower ends of the fatality ranges reported at Midwestern wind energy facilities (0.0-11.83 birds/turbine/year and 0.1-40.5 bats/turbine/year) (Barclay et al. 2007 and Poulton 2010).

### 4.3.2 Turbine Operational Protocols

Pre-construction surveys recorded low bird use and low species density in the Project area, as well as a lack of sensitive species, eagles, and native avian habitats. Based on these data, the Project is not expected to pose a high level of risk to sensitive avian species, eagles, or birds in general. Therefore, no operational minimization measures for birds are determined to be necessary at this time. This determination will be re-evaluated throughout the life of the Project, through the adaptive management framework described in Section 5.2, below.

Although the Project is not located in an area of high concern for bats, and avoids bat habitat in the form of forested areas and open water, studies at other wind energy facilities have shown that bat mortality during the fall migration season is a potential concern at all wind energy facilities, even those located in agricultural landscapes (Good et al 2011, Kerlinger et al. 2007, Johnson et al. 2003, Howe et al. 2002). Additionally, based on the uncertainties associated with the five Indiana bat wind farm fatalities on record (Pruitt and Okajima 2013), and the 13 known northern long-eared bat wind farm fatalities on record (USFWS 2013a), it is assumed that any wind energy facility located within the range of either species may pose some unknown level of risk to that species. Therefore, PTWF will implement the following turbine operational protocols to avoid take of listed bats and minimized impacts to all bats in general.

PTWF has committed to raising turbine cut-in speeds from the manufacturer's rated cut-in speed of 7.8 mph (3.5 m/s) to 15.4 mph (6.9 m/s) from 0.5 hour before sunset to 0.5 hour after sunrise when the ambient temperature is above 50° F (10° C) during the fall migratory period from 15 August through 15 October, unless an ITP is issued, in which case PTWF would operate under the operational protocols described in the corresponding HCP. Turbines will remain fully feathered (i.e. turbine blades are pitched parallel with the wind direction, causing them to only spin at very low RPMs, if at all) when the ambient temperature is above 50° F (10° C) until the cut-in speed (i.e. the wind speed at which turbines begin generating power and sending it to the grid) is reached. At that time, blades will be pitched into the wind to enable the turbine to begin spinning and generating electricity.

All curtailment studies to-date show a consistent inverse relationship between cut-in speeds and bat mortality (Baerwald et al. 2009, Arnett et al. 2009, Good et al. 2011, Kerns et al. 2005, Fiedler 2004). Baerwald et al. (2009) found that increasing turbine cut-in speed to 12.3 mph (5.5 m/s) or turbine feathering at wind speeds less than 12.3 mph (5.5 m/s) reduced fatality of hoary bats and silver-haired bats from 50 to 70 percent. Arnett et al. (2009) found that increasing turbine cut-in speed to 11.2 mph (5.0 m/s) or 13.4 mph (6.0 m/s) resulted in reductions in average nightly bat fatality ranging from 53 to 93 percent. Similarly, Good et al. (2011) found that bat fatalities were reduced by a mean of 50 percent when cut-in speeds were increased to 11.2 mph (5.0 m/s).

Based on the results of these studies, raising the nighttime cut-in speed at PTWF to 11.2 mph (5.0 m/s) would be expected to significantly reduce overall bat mortality. Tree bat species, including red bat, hoary bat, and silver-haired bat, would be particularly likely to benefit from this turbine operation measure, as these species are expected to comprise the majority of bat mortality at PTWF. However, the cut-in speed at PTWF will be raised even higher than the wind speeds demonstrated in previous studies to significantly reduce bat mortality, to 15.4 mph (6.9 m/s), in an effort to ensure that take of Indiana and northern long-eared bats is avoided. PTWF's proposed cut-in speed is significantly higher than the highest cut-in speed at which an Indiana bat fatality is known to have occurred (11.0 mph [5.5 m/s]) (Good et al. 2011, USFWS 2011b).

The raised cut-in speed will be reduced back down to the manufacturer's rated cut-in speed and turbines will no longer be feathered if ambient temperatures fall below 50° F (10° C) for thirty (30) consecutive minutes. Nightly bat activity is correlated with temperature, and several studies have shown that bats and their prey become constrained by falling temperatures as autumn progresses (USFWS 2007). The relative abundance of insect prey in open, exposed agricultural lands decreases with cooling temperatures and crop harvest, causing bat use to switch more heavily to forested areas as autumn progresses (Brack 2006). Therefore, the exposure potential of bats to turbines located in agricultural landscapes (as the PTWF turbines are) declines greatly with decreasing temperatures. USFWS guidance states that mist-netting is unlikely to be successful when ambient temperatures are below 50° F (10° C) due to a sharp decrease in bat activity (USFWS 2007). This temperature is also understood to be the general threshold for hibernation by Indiana bats (USFWS 2007) and other bat species.

A study of the relationship between weather conditions and bat mortality at the Fowler Ridge wind energy facility in Indiana found that bat casualty rates were highest on nights with higher mean temperature and increasing variance in temperature (Good et al. 2011). Specifically, 91 percent of all bat fatalities during the fall migration period occurred on nights with mean nightly temperatures above 68° F (20° C). Regression analysis indicated that bat mortalities increased by 15% for every 1.8° F (1.0° C) increase in average nightly temperature at the Fowler site (Good et al. 2011). These data indicate that the 50° F (10° C) temperature at which PTWF proposes to implement the raised cut-in speed is conservative and should avoid risk to Indiana and northern long-eared bats as well as greatly reduce risk to all bats in general.

If cut-in speeds have been reduced to the manufacturer's rated cut-in speed on any particular night based on ambient temperature, and the ambient temperature subsequently rises above 50° F (10° C) for thirty (30) consecutive minutes, cut-in speeds will be raised back to 15.4 mph (6.9 m/s) and turbines will again be fully feathered.

These operational Indiana and northern long-eared bat avoidance and minimization measures will be implemented every night during the fall migration season, from 15 August through 15 October. After 15 October, migrating Indiana bats are not expected to occur within the Project area due to the distance (120 miles [193 km]) to the nearest hibernaculum. For Indiana bats to arrive at hibernacula, especially those farther from the Project, within the fall swarming and mating season (typically mid-August through mid-October), Indiana bats are expected to have passed through the Plan Area and surrounding vicinity by the end of September at the latest. For northern long-eared bats, the hibernation season in Illinois is estimated to begin by 1 November (USFWS 2014), indicating that individuals are expected to have passed through the Plan Area and surrounding vicinity by the middle of October at the latest. Additionally, northern long-eared bats swarm within 4.55 miles (7.32 km) of their roost tree (USFWS 2014), indicating an overall low likelihood of swarming behavior in the Plan Area due to the lack of summer habitat. Additionally, average nightly temperatures typically begin to decline throughout September, constraining bat activity and inducing bats to enter hibernation (USFWS 2007). Therefore, a nighttime cut-in speed of 15.4 mph (6.9 m/s) when ambient temperature is above 50° F (10° C) during the fall migration season is expected to avoid take of Indiana and northern long-eared bats and greatly reduce overall bat mortality.

PTWF will monitor bird and bat fatalities at the site in accordance with the monitoring plan presented in Section 5.1 to verify the effectiveness of the avoidance and minimization strategies incorporated into the Project.

# 5 MONITORING AND ADAPTIVE MANAGEMENT PLAN

## 5.1 Post-Construction Monitoring

### 5.1.1 Monitoring Goals

The goals of the post-construction monitoring are to determine overall bat fatality rates from the Project and evaluate the circumstances under which fatalities occur. Post-construction monitoring results will also provide triggers for adaptive management, as described in Section 5.2.

### 5.1.1 Species to be Monitored

The post-construction monitoring plan will address all bird and bat fatalities observed within the Project area. Based on the analysis provided in Sections 3 and 4.3, Indiana and northern long-eared bat mortalities are not expected to occur at the Project, and thus the monitoring plan is designed to detect carcasses and calculate all bat fatality estimates with enough precision to determine if the operational protocols are effective in reducing all bat fatalities at the Project. The monitoring plan is also designed to enable comparison with other operating wind energy projects. Within the overall bat and bird fatality estimates, estimates by species will be made, if possible, based on the number of carcasses detected. Monitoring designed specifically to detect Indiana and northern long-eared bat carcasses is not proposed because 1) Indiana and northern long-eared bat fatalities are not expected, 2) such a study would require extensive ground surveys and considerable expense for the purposes of detecting an unlikely event, 3) the study as proposed could detect Indiana or northern long-eared bat fatalities should they occur, and 4) more extensive monitoring will be implemented, as described in the adaptive management plan (Section 5.2), should one of the adaptive management triggers be met.

### 5.1.2 Permits and Wildlife Handling Procedures

Permits

All necessary wildlife salvage/collection permits will be obtained from the IDNR Division of Wildlife Resources and the Service to facilitate legal transport of injured animals and/or carcasses.

Wildlife Handling Procedures

All bat carcasses found will be labeled with a unique number, individually bagged, and retained in a freezer at the Pioneer Trail operations and maintenance 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. In the event that a carcass of an ESA- or state-listed species is found, PTWF will arrange to submit the carcass to the appropriate authorities. If an injured bird or bat is found, the animal will be sent to a local wildlife rehabilitator, when possible. All bird carcasses will be left where found, but photographed for documentation and identification to the species level when possible.

### 5.1.3 Intensive Monitoring

Study Design

The results of post-construction monitoring efforts intended to provide an estimate of overall fatality at a facility can be influenced by several sources of bias during field-sampling. To provide corrected estimates of overall fatality rates, the methodology of mortality monitoring efforts must account for important sources of field-sampling bias including 1) fatalities that occur on a highly periodic basis, 2) carcass removal by scavengers, 3) searcher efficiency, 4) failure to account for the influence of site conditions (e.g., vegetation) in relation to carcass removal and searcher efficiency rates, and 5) fatalities or injured birds or bats that may land or move to areas not included in the search plots (Kunz et al. 2007a). PTWF's proposed post-construction mortality monitoring plan methodology is designed to account for these sources of bias and adapt to preliminary results such that effectiveness, efficiency, and accuracy of the study is maximized.

Post-construction mortality monitoring at the Project will involve initial monitoring during the first two years of operation ("baseline monitoring") and follow-up monitoring conducted once every five years after the completion of the baseline monitoring period, for the life of the Project. Standardized carcass searches will be conducted during the spring (1 April to 15 May) and fall (15 August to 15 October) in the first two years of operations. If spring monitoring results confirm expected low risk (i.e., the lower 90% confidence interval estimates less than 0.5 bat/season) and if no adaptive management measures are implemented pursuant to Section 5.2, follow-up monitoring in subsequent years would occur during the fall migratory season only.

All monitoring periods will include searcher efficiency trials and carcass removal trials in addition to the standardized carcass searches. Standardized carcass searches will allow statistical analysis of the search results, calculation of overall fatality estimates, and assessment of correlations between fatality rates and potentially-influential variables (e.g., weather, location). Searcher efficiency and carcass removal rates are two sources of field bias in mortality studies that have been proven to be highly variable and site- and researcher-specific; mortality estimators are highly sensitive to these parameters (Huso 2010). Kunz et al. (2007a) and the USFWS (2012) both strongly recommend that all mortality studies should conduct searcher efficiency and carcass removal trials that follow accepted methods and address the effects of differing vegetation types.

*Focus Species*

The post-construction monitoring study design is intended to enable detection of all bird and bat carcasses that may occur within searched areas of the Plan Area, as well as support the development of fatality estimates for bat species found during the mortality searches.

*Sample Size*

Standardized carcass searches will be conducted at 50 of the 94 turbines. This sample size optimizes field survey effort while maximizing expected confidence in the data and associated results. The 50 turbines to be sampled will be determined using a stratified random sampling approach. The stratification will involve a weighted approach, with 50% of the sample turbines being selected from the southern 25% of the Project area (closer to known bat habitat). This approach will meet the study goal of detecting and analyzing overall bat fatalities at the facility by providing sufficient sample size to support reliable data analysis and related interpretations and conclusions.

*Search Interval*

The search interval will be once weekly for all of the turbines during the first two years of monitoring as well as during the follow-up monitoring every fifth year. The turbine search schedule and order will be randomized so that each turbine's search plot will be sampled at differing periods during the day. If more or less intensive monitoring is deemed necessary following initial data collection (carcass searches and carcass removal trials) at the Project area, the search intervals will be modified accordingly. The USFWS guidelines recommend that "carcass search intervals should be adequate to answer applicable questions at an appropriate level of precision to make general conclusions about the project" (USFWS 2012). A weekly search interval for fatality monitoring was deemed adequate by Kunz et al. (2007a) and studies have demonstrated that a weekly search interval provides effective mortality monitoring and adequately estimates impacts from wind energy facilities (Gruver et al. 2009; Young et al. 2009), such that the added effort associated with more frequent intervals is not warranted.

<u>Field Methods</u>

*Plot Size and Vegetation Mowing*

During each monitoring period, at 80 percent of the turbines only the turbine pads and access roads out to 262 ft (80 m) from the turbine will be searched. This method targets the areas shown to support the highest searcher efficiency while greatly reducing the financial and logistical restraints associated with clearing and searching large study plots, enabling much broader sampling coverage of the facility.

At the remaining 20 percent of the turbines, 262 ft x 262 ft (80 m x 80 m) plots will be cleared and searched using a full-coverage transect methodology. This search plot size is recommended for detecting carcasses of both birds and bats (USFWS 2012). Several other studies that have indicated that the majority of bird and bat carcasses typically fall within 100 ft (30 m) of the turbine or within 50 percent of the maximum height of the turbine (Kerns and Kerlinger 2004; Arnett et al. 2005; Young et al. 2009; Jain et al. 2007; Piorkowski and O'Connell 2010; USFWS 2010). This plot size will exceed one-half the maximum turbine rotor height of the Project WTGs (246 ft [75 m]). This should minimize the number of fatalities or injured birds or bats that land or move outside of the search plots and thereby reduce the number of bird or bat carcasses that would be undetected, causing underestimation of overall fatality.

Study turbines will remain assigned to either the pads and roads search group or the cleared plot search group throughout the entire search year. The subset of full-coverage turbines will provide a reference for estimating the number of fatalities that may fall outside the searched area at the other turbines. This mixed sampling methodology is consistent with other post-construction monitoring studies being conducted (e.g. Good et al. 2011) and will enable comparison of study results.

Each 262 ft x 262 ft (80 m x 80 m) search plot will be centered on a turbine location. Thirteen 20-ft (6-m) transects will be established in each plot for complete survey coverage. Vegetation will be mowed to a reasonable search height (< 5 inches [13 cm]) in each plot prior to the beginning of each study period to improve searcher efficiency. Searchers will notify PTWF staff when vegetation requires mowing throughout the study period to ensure vegetation does not hinder search results.

*Timing and Duration*

Standardized carcass searches will be conducted within the Project area for a total of six weeks in the spring (1 April to 15 May) and nine weeks in the fall (15 August to 15 October). Carcass searches will be conducted during the first two years of Project operation, and every fifth year thereafter for the life of the Project. Following two years of monitoring with favorable results, spring monitoring will be discontinued, and only fall monitoring will be conducted every five years.

*Standardized Carcass Searches*

Carcass searches will be conducted under applicable permits by qualified individuals experienced in fatality search methods, including proper handling and reporting of carcasses. Searchers will be familiar with and able to accurately identify bird and bat species likely to be found in the Plan Area. Any unknown bats or suspected Indiana or northern long-eared bats discovered during fatality searches will be sent to a qualified USFWS-approved bat expert for positive identification. Bird carcasses will be photographed from several angles to provide the best chance of photographic identifications, and photos will be verified by a USFWS-approved bird expert for positive identification when possible. During searches, searchers will walk at a rate of approximately 2 mph (45 to 60 m per minute) while searching 10 ft (3 m) on either side of each transect.

For all carcasses found, data recorded will include:

- Date and time,
- Initial species identification,
- Sex, age, and reproductive condition (when possible),
- 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 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 (with a copy of the original data sheet) at the Project operations and maintenance building.

Bird and 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. Any carcasses found by maintenance personnel will also be considered incidental finds. 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.

*Searcher Efficiency and Carcass Removal Trials*

Searcher efficiency trials will be used to estimate the percentage of all bat fatalities that are detected during the carcass searches. Similarly, carcass removal trials will be used to estimate the percentage of bat fatalities that are removed by scavengers prior to being located by searchers. When considered together, the results of these trials will represent the likelihood that a bat fatality that falls within the searched area will be recorded and considered in the final fatality estimates.

Trials will be conducted during each study period by placing "trial" carcasses in the searched areas (one trial during the spring monitoring season and two trials during the fall monitoring season) to account for changes in personnel, searcher experience, weather, and scavenger densities. The number of trial carcasses used will depend on the number of carcasses available following initial carcass searches in the Plan Area, though surrogate carcasses (such as mice) may be used in order to achieve a sufficient sample size. Searcher efficiency and carcass removal trials will be limited to one spring and one fall trial each year to avoid attracting scavengers to the Plan Area with carcasses and potentially artificially inflating the carcass removal rate.

Each trial carcass will be discretely marked and labeled with a unique number so that it can be identified as a trial carcass. Prior to placement, the date of placement, species, turbine number, and distance and direction from turbine will be recorded. No more than two trial carcasses will be placed simultaneously at a single turbine.

Searcher efficiency trials will be conducted blindly; the searchers will not know when trials are occurring, at which search turbines trial carcasses are placed, or where trial carcasses are location within the subplots. The number and location of trial carcasses found by the searchers will be recorded and compared to the total number placed in the subplots. Searchers will be instructed prior to the initial search effort to leave carcasses, once discovered to be trial carcasses, in place. The number of trial carcasses available for detection (non-scavenged) will be determined immediately after the conclusion of the trial.

Carcass removal trials will be conducted immediately following the baseline searcher efficiency trials using the same trial carcasses. Trial carcasses will be left in place by searchers and monitored for a period of up to 30 days. Carcasses will be checked on days 1, 2, 3, 4, 5, 6, 7, 10, 14, 20, and 30. The status of each trial carcass will be recorded throughout the trial.

### 5.1.4 Statistical Methods for Estimating Fatality Rates

The methodology for estimating overall bat fatality rates will largely follow the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). Huso (2010) has recently proposed an estimator that may offer less bias than the Erickson estimator. The positive bias and different sensitivity to searcher efficiency and carcass removal rates associated with the Huso estimator may make comparisons to estimates derived using the Erickson (2003) or Shoenfeld (2004) estimators, which tend towards negative biases, problematic. Therefore, maintaining the same biases and assumptions in estimating overall bat fatality at the Project area will be useful for developing fatality estimates that can be compared to other sites and used to determine if any of the adaptive management triggers have been met.

Following Erickson et al. (2003), the estimate of the total number of wind turbine-related casualties will be based on four components: (1) observed number of casualties, (2) searcher efficiency, (3) scavenger removal rates, and (4) estimated percent of casualties that likely fall in non-searched areas, based on percent of area searched around each turbine. Variance and 90 percent confidence intervals will be calculated using bootstrapping methods (Erickson et al. 2003 and Manly 1997 as presented in Young et al. 2009). Calculations and analyses will be conducted separately for medium/large birds, small birds, and bats to provide results specific to each group.

Mean Observed Number of Casualties (c)

The estimated mean observed number of casualties (c) per turbine per study period will be calculated as:

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

where n is the number of turbines searched, and cj is the number of casualties found at a turbine. Incidental mortalities (those found outside of the searched area or by maintenance personnel) will not be included in this calculation, nor in the estimated fatality rate.

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 dividing the number of trial carcasses observers found by the total number that remained available during the trial (non-scavenged). Searcher efficiency will be calculated for each season and for all search methods (roads and pads, full plots).

Estimation of Carcass Removal Rate (t)

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

$$t = \frac{\sum_{i=1}^{s} t_i}{s - s_c}$$

where s is the number of carcasses placed in the carcass removal trials and sc is the number of carcasses censored. This estimator is the maximum likelihood (conservative) estimator assuming the removal times follow an exponential distribution, and there is right-censoring of the data. Any trial carcasses still remaining at 30 days will be collected, yielding censored observations at 30 days. If all trial carcasses are removed before the end of the search period, then sc will be zero and the carcass removal rate will be calculated as the arithmetic average of the removal times. Carcass removal rate will be calculated for each season and for all search methods (roads and pads, full plots).

Search Area Adjustment (A)

Approximation of *A*, the adjustment for areas which were not searched, will be adapted from the Erickson et al. (2003) estimator, as modified by Young et al. (2009), to accommodate differences in carcass search study design (discussed in Section 5.1.3). For the PTWF fatality estimates, *A* will represent the adjustment for the proportion of carcasses which likely fell outside of the area searched. The value for *A* will be approximated using the following formula, or a variation thereof:

$$\mathrm{A} = \frac{\left(\frac{C_{RP}}{P_{RP} * S_{RP}}\right) + \left(\frac{C_{FP}}{P_{FP} * S_{FP}}\right)}{\left(\frac{C_{RP}}{P_{RP}}\right) + \left(\frac{C_{FP}}{P_{FP}}\right)}$$

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

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

Searcher efficiency and carcass removal rates will be combined to represent the overall probability ($\pi$) that a casualty incurred at a turbine would be reflected in the post-construction mortality study results. This probability will be calculated as:

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

where I is the interval between searches. For this study, I=7 for baseline carcass searches during the spring and fall periods and for the fall period during follow-up carcass searches.

Estimation of Facility-Related Mortality (m)

Mortality estimates will be calculated using the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). The estimated mean number of casualties/turbine/study period (m) will be calculated by dividing the estimated mean observed number of casualties/turbine/study period (c) by π, an estimate of the probability a carcass was not removed and was detected, and then multiplying by A, the adjustment for the area within the search plots which was not searched:

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

### 5.1.5 Data Analysis, Reporting, and Consultation

Data Analysis

Analysis of data collected during the post-construction mortality monitoring will include spring and fall season fatality estimates for all birds and bats to the taxonomic level where fatality estimates can be calculated (i.e., it is difficult to calculate representative fatality rates from small numbers of carcasses, so species- and genus-level fatality calculations may not be possible for some species/genera). Data analysis will be performed to assess fatality estimates by turbine location. Data will also be analyzed to determine the influence of factors such as date and location on bat fatality rates.

A variety of statistical tests may be applied to the data to analyze the patterns of fatality rates in relationship to species/genera/taxa, season, and location. Statistical tests applied to the data may include: ANOVA, tabular summary, graphical representation (least squares, regression, interaction plot, etc), t-test, univariate association analyses (Pearson's and Spearman's rank correlations, linear regression), multivariate regression, chi-square goodness-of-fit and test of independence, and F test. Tests will be selected based on the parameter(s) under analysis, the ability of the data to meet test assumptions, and the suitability of tests for different forms of data. Comparisons between baseline overall bat fatality estimates and those of follow-up studies will be evaluated using t-tests. In general, p values equal to or less than 0.10 will be considered significant.

Reporting

PTWF will provide an annual mortality monitoring report to the Service following the completion of each year of post-construction monitoring. The report will include fatality estimates, data summaries, and assessment of correlations between fatality rates and potentially influential variables such as weather, location, turbine operation, etc. Fatalities will be expressed both in terms of fatalities/turbine/season and in terms of fatalities/MW/season, as recommended (USFWS 2012) to facilitate comparison with other studies. The reports will include all data analyses, including correlation analyses and overall fatality estimates, and a discussion of monitoring results and their implications. In addition to the mortality monitoring reports, PTWF will report the discovery of any Indiana bat fatalities, northern long-eared bat fatalities, other ESA-listed species, or eagles to the Service within 24 hours of discovery. Any adaptive management measures implemented shall be described in the annual fatality monitoring report.

## 5.2 Adaptive Management

This BBCS represents a process through which PTWF plans to reduce impacts to birds and bats at the wind energy facility while maintaining optimal Project operation and generating electricity from renewable, emissions-free wind. PWTF has sited the Project and incorporated measures to avoid and minimize impacts to birds and bats, including sensitive and listed species. The effectiveness of these measures will be informed by post-construction monitoring of fatality rates.

Adaptive management is a process that will allow PTWF to adjust the minimization measures outlined in this BBCS to reflect new information or changing conditions in order to reach a goal – in this case, avoidance of Indiana and northern long-eared bat take and minimization of impacts to all other bird and bat species, while minimizing effects on the operation of the Project. Changes to the Project's avoidance and minimization plan may be triggered by certain events, but no changes to the agreed-upon turbine operational protocols will occur without USFWS concurrence (except temporary cessation of turbine operations for maintenance). The adaptive management plan will apply throughout the life of the Project; on-going evaluation and adaptation of the Project will provide effective measures for avoiding and reducing impacts to birds and bats.

Adaptive management will allow PTWF to minimize the uncertainty associated with gaps in scientific information or biological requirements. Information used in the adaptive management process will come from the post-construction mortality monitoring activities described in Section 5.1 and from other new research as it becomes available. Monitoring data will be analyzed to determine if the objectives of this BBCS are being met. If the minimization measures are not producing the desired results, adjustments will be made as necessary to achieve the biological objectives of this BBCS. If post-construction mortality monitoring indicates that the minimization measures specified in this BBCS exceed those necessary to achieve the biological objectives, adaptive management will enable PTWF to conservatively scale back conservation measures to reduce the impact on the Project's operations while still avoiding direct mortality of Indiana and northern long-eared bats and minimizing mortality of birds and bats in general.

Adaptive management at PTWF will be implemented as described below. All references to a monitoring year shall mean one spring season (1 April through 15 May) and one fall season (15 August through 15 October) of monitoring. All cut-in speed limitations shall refer only to the period from 0.5 hour prior to sunset until 0.5 hour after sunrise during the spring and/or fall season, as indicated.

Adaptive management consideration triggers for PTWF will be triggered by such events as:

- Take of an Indiana bat, northern long-eared bat, or other ESA-listed species
- Take of a bald or golden eagle
- Discovery of a mass avian or bat mortality event
- PTWF obtains an ITP permitting take of an ESA-listed bat species
- New research or results of post-construction mortality monitoring at PTWF provide compelling evidence that the BBCS minimization measures exceed those necessary to achieve the biological objectives of the BBCS

**Take of an Indiana bat, northern long-eared bat or other ESA-listed species**

If take of an Indiana bat, northern long-eared bat, or other ESA-listed species occurs at PTWF, the event will be reported to the Service within 24 hours. PTWF will work with the Service to determine the cause and circumstances of the mortality, if possible, and develop specific mitigation measures. Such measures may include raising the cut-in speed at the offending turbine or a group of turbines during specific weather conditions or seasonal periods, followed by a year of mortality monitoring to assess whether the mitigation measures are sufficient. PTWF will work with the Service to determine the need to pursue a permit under the ESA.

A separate HCP is currently being developed, with the goal of obtaining an ITP for both the Indiana and northern long-eared bat. Should an ITP be issued, the adaptive management thresholds set forth in the HCP would supersede this trigger in the BBCS, and the adaptive management framework for take of Indiana and northern long-eared bats in the HCP would be followed.

**Take of a bald or golden eagle**

If take of a bald or golden eagle occurs at PTWF, the event will be reported to the Service within 24 hours. PTWF will work with the Service to determine the cause and circumstances of the mortality, if possible, and develop specific mitigation measures. Such measures may include raising the cut-in speed at the offending turbine or a group of turbines during specific weather conditions or seasonal periods, followed by a year of mortality monitoring to assess whether the mitigation measures are sufficient. PTWF will work with the Service to determine the need to pursue a permit under BGEPA.

**Discovery of a mass avian or bat mortality event**

Mass avian or bat mortality events are not expected to occur at PTWF, based on the assessment of potential impacts presented in Section 4. However, should post-construction monitoring or incidental observation detect a mass mortality event, PTWF will take remedial actions. PTWF will notify the Service of the discovery within 48 hours and investigate, based on the available data, the circumstances under which the mortality event occurred. PTWF will coordinate with the Service to identify potential mitigation measures.

**PTWF obtains an ITP permitting take of an ESA-listed bat species**

If an ITP is obtained by PTWF to permit the take of an ESA-listed bat species, the conservation plan included in the HCP associated with the ITP will be implemented at PTWF. The conservation plan and adaptive management measures of the HCP will supersede the avoidance, minimization, and adaptive management measures included in this BBCS with regards to any covered species.

**New research or results of post-construction mortality monitoring at PTWF provide compelling evidence that the BBCS minimization measures exceed those necessary to achieve the biological objectives of the BBCS**

If new research or results of post-construction mortality monitoring at PTWF produce compelling evidence that the BBCS minimization measures exceed those necessary to achieve the objectives of the BBCS, PTWF will consult with the Service to determine if the minimization measures, specifically turbine operational protocols, may be adjusted to allow for greater operation of the Project. PTWF will not implement adjustments to the agreed-upon turbine operational protocol without approval from the Service (except temporary cessation of turbine operations for maintenance).

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# FIGURES

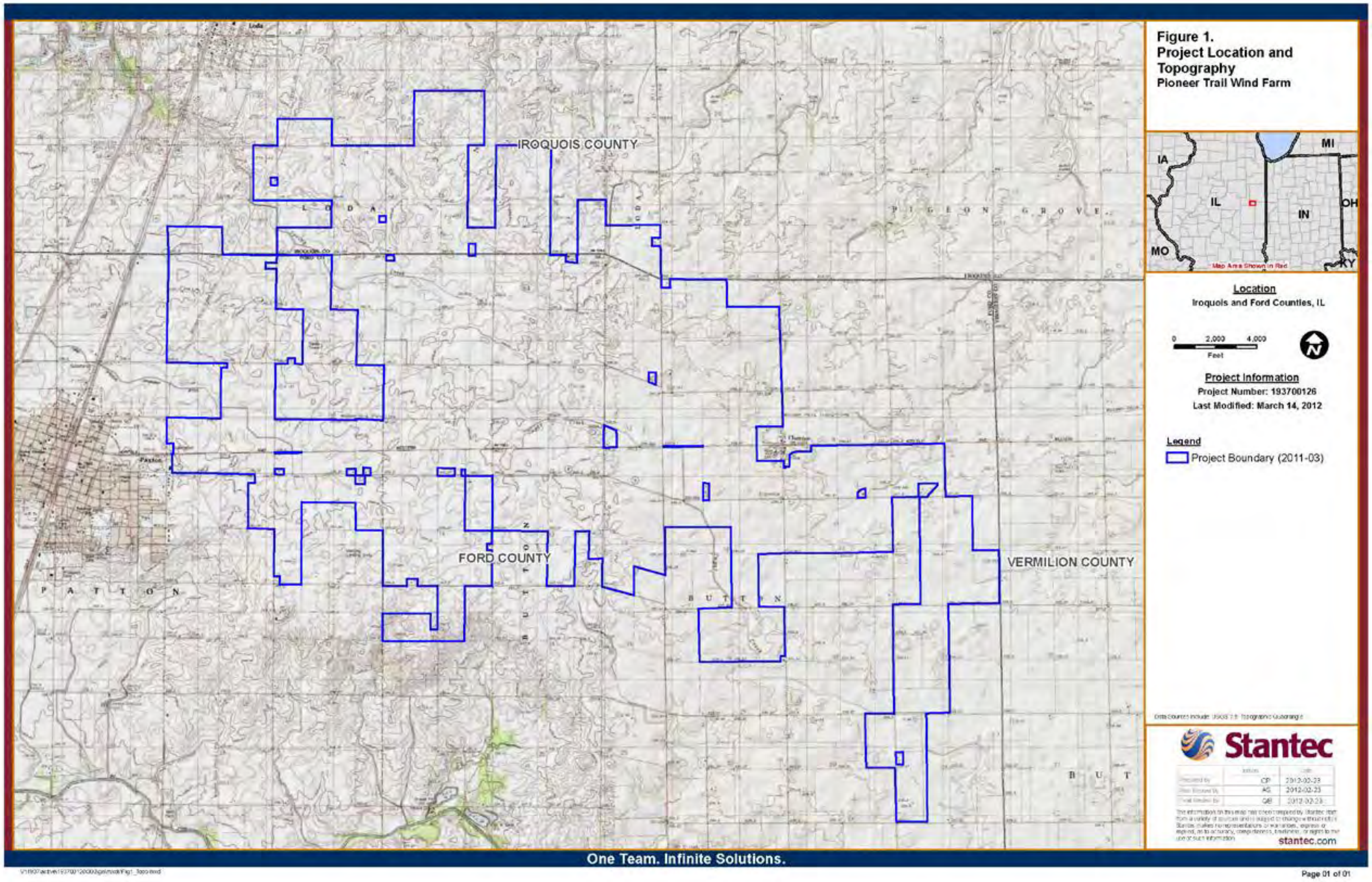


**Figure 1. Project Location and Topography**

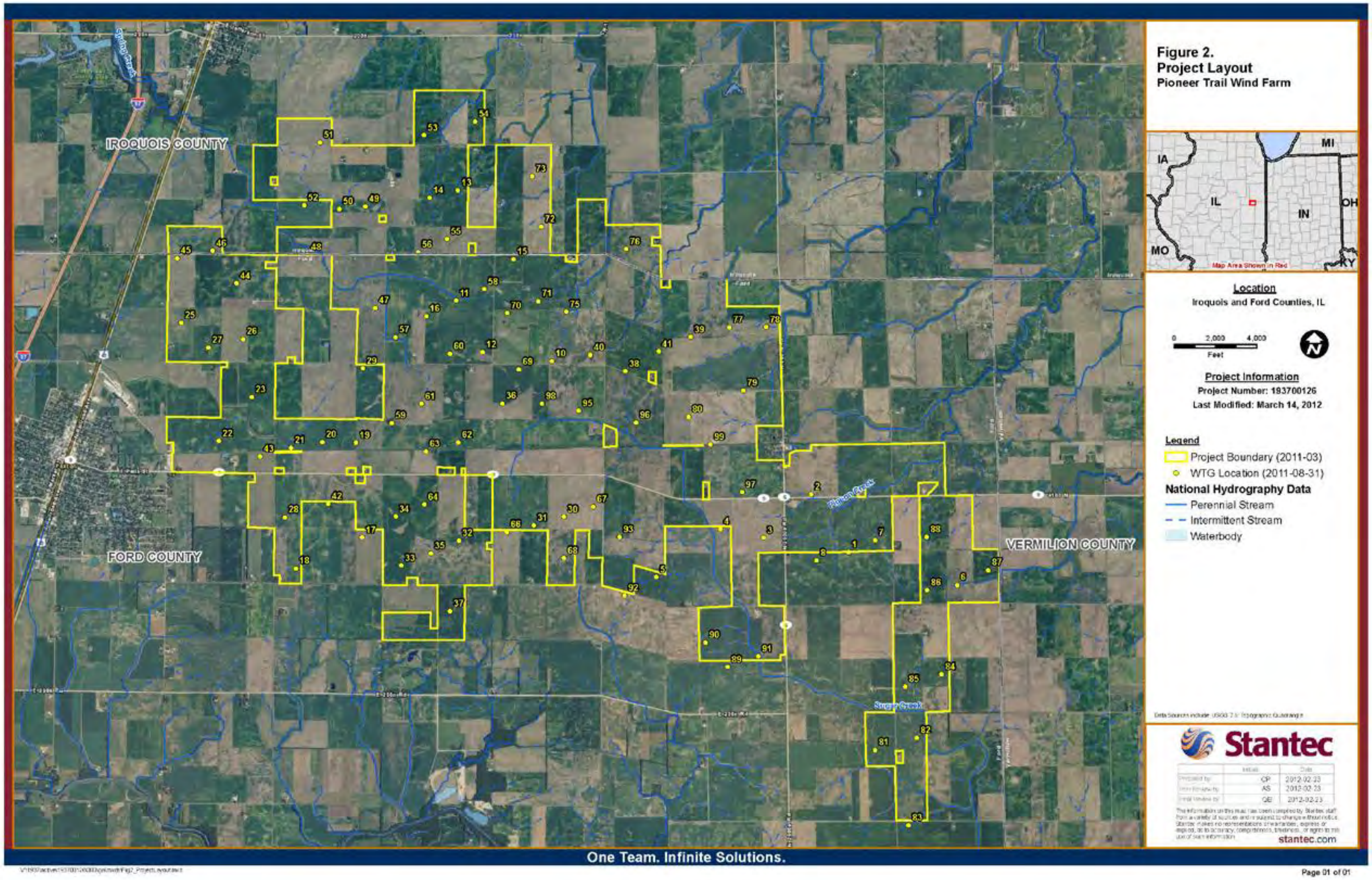


Figure 2. Project Layout

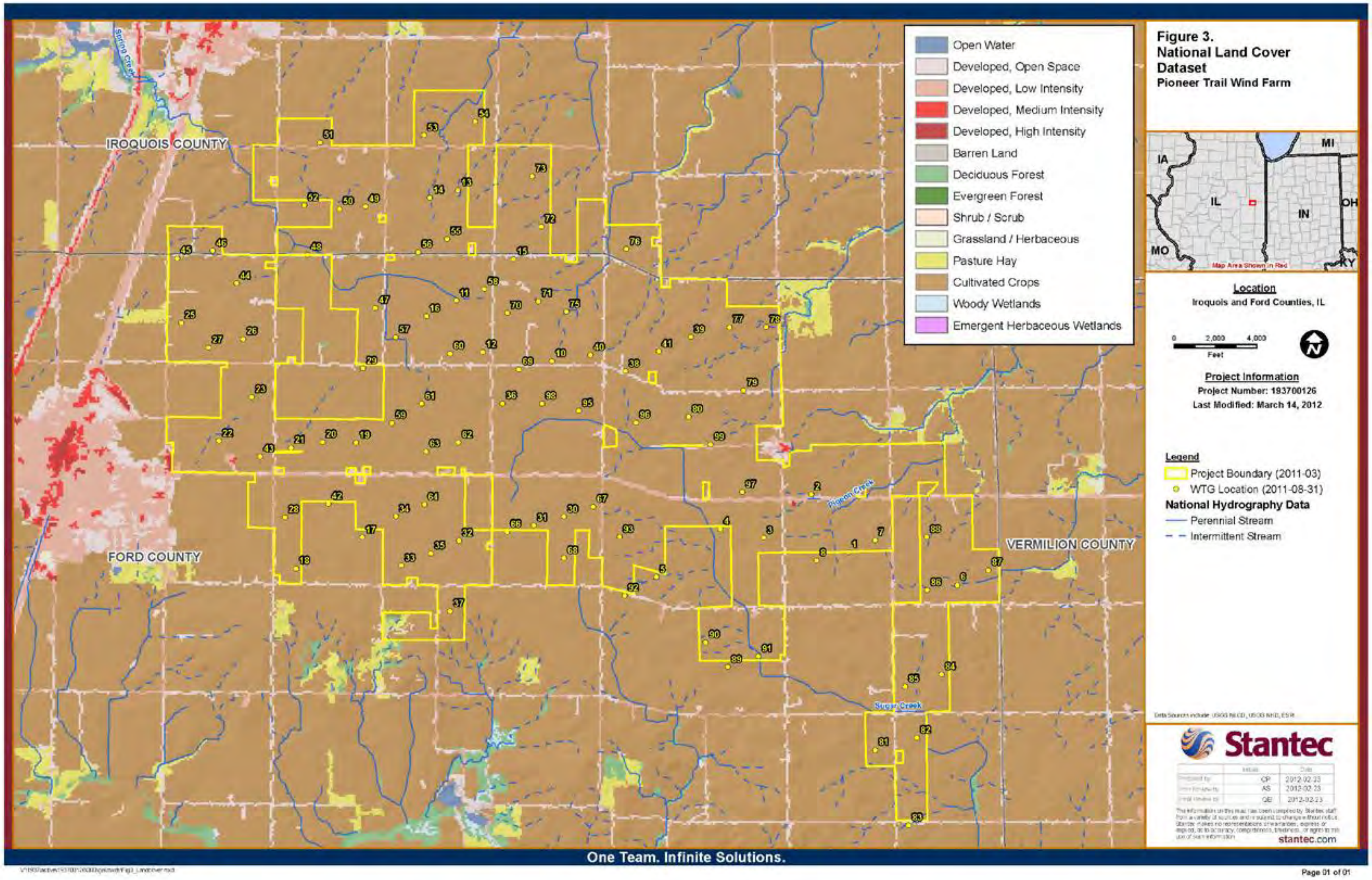


**Figure 3. National Land Cover Dataset**

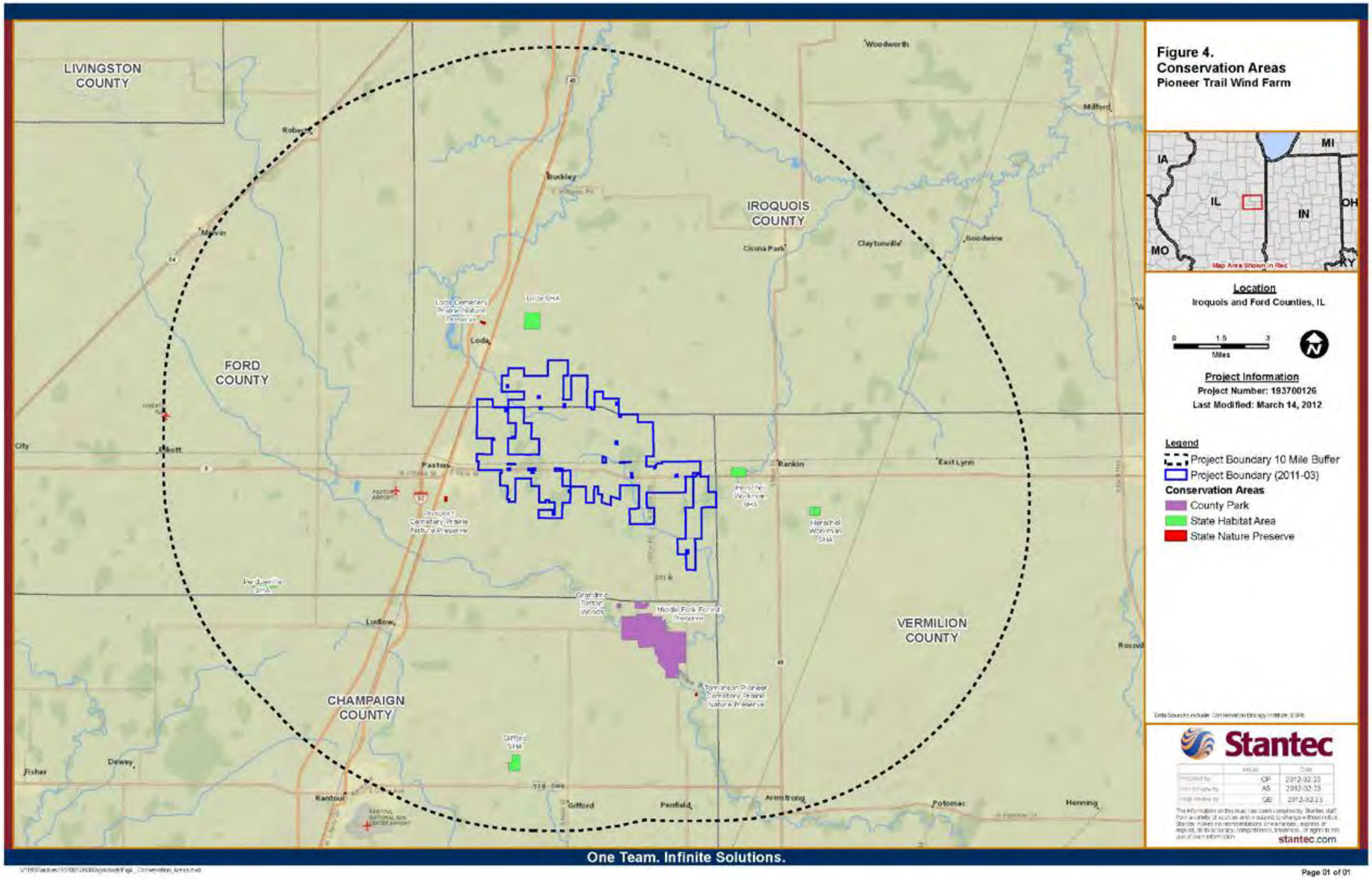


Figure 4. Conservation Areas

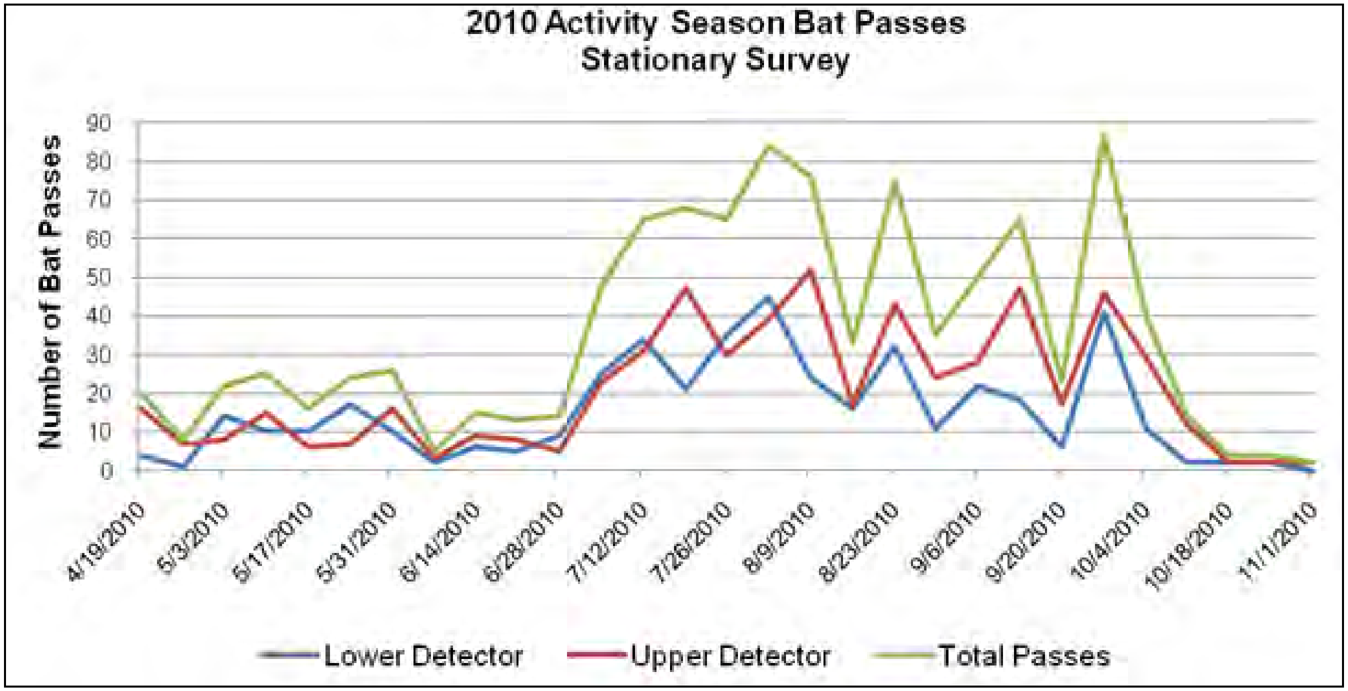


**Figure 5. 2010 Activity Season Bat Passes Recorded During the Stationary Survey**

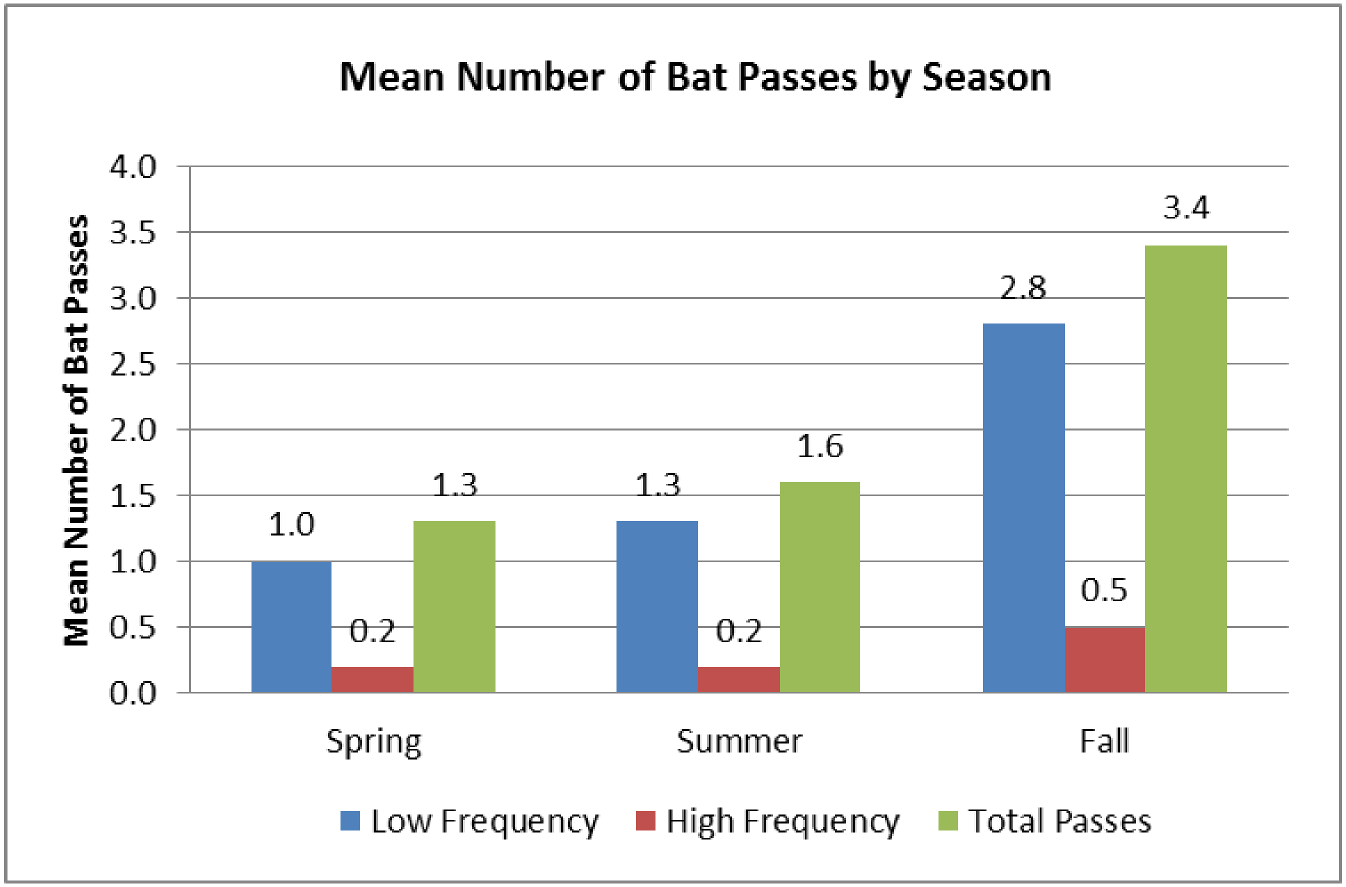


**Figure 6. Mean Number of Bat Passes Recorded by Season**

## Appendix B: Avian Risk Assessment

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**Pioneer Trail Wind Farm, LLC**

# Pioneer Trail Wind Farm
# Avian Risk Assessment

Ford and Iroquois Counties, Illinois

October 19, 2010

ARCADIS

**Pioneer Trail Wind Farm**
**Avian Risk Assessment**

Ford and Iroquois Counties,
Illinois

Prepared for:
Pioneer Trail Wind Farm, LLC

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Our Ref.:
CO001397.0004.00005

Date:
October 19, 2010

**Figures**



**Tables**

## Appendices

## 1. Introduction

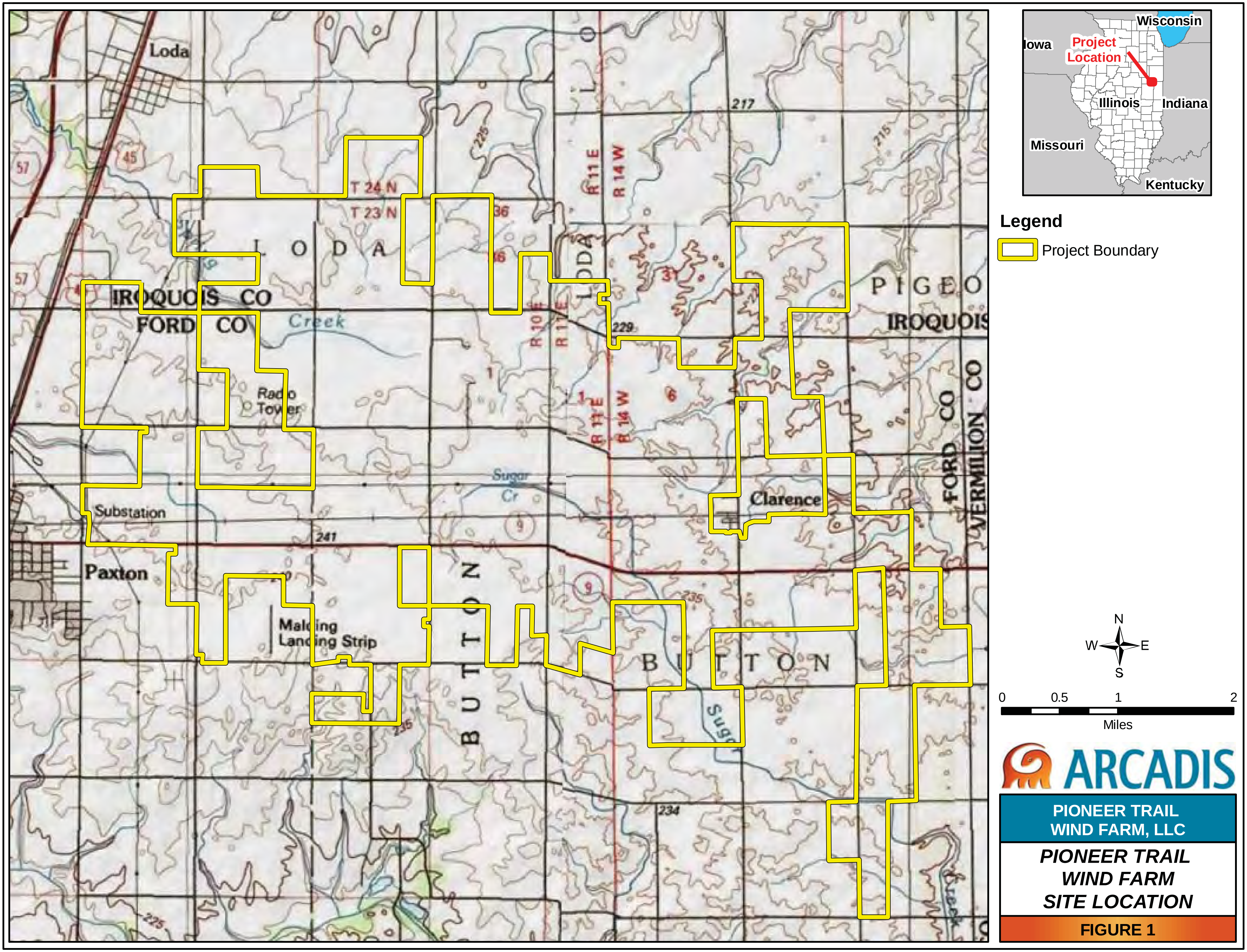
The Pioneer Trail Wind Farm is a wind energy facility proposed within approximately 14,000 acres of agricultural properties located in Paxton, Illinois, on the eastern outskirts of town in Ford and Iroquois Counties (Figure 1).

Topography is relatively flat; the majority of the project area is in active agricultural use for corn and soy crop production; residences and ancillary structures are scattered throughout. Trees are present along several drainage tributaries, around homesteads, and in limited planted shelterbelts within the project area. Wetlands are rare, and are limited to small areas along low-relief drainage features and standing areas of water within and around the agricultural lands. No major differences between land cover within the project area and the surrounding areas are apparent.

The purpose of this Avian Risk Assessment is to determine the potential risk to birds at the Pioneer Trail Wind Farm location (hereafter, the Site). Wind is considered an important source of renewable energy and recent advances in wind turbine technologies have led to an increase in the generation of electricity from wind. In 2009, the United States wind energy industry installed over 10,000 megawatts (MW) of new generating capacity, increasing the nation's total wind power capacity to over 35,000 MW (AWEA 2010). Bird mortality as a result of wind turbines has been studied as one of many human-caused threats affecting bird populations.

Several federal laws exist that afford protection to avian species. The Endangered Species Act (ESA) and the Bald and Golden Eagle Protection Act (BGEPA) each address specifically identified species. In addition, the Migratory Bird Treaty Act (MBTA) makes it unlawful to kill or otherwise take a protected migratory bird. This report documents Pioneer Trail Wind Farm, LLC's consultation with federal and state agencies to identify whether particular risk to species protected under the ESA would be anticipated, and describes field surveys and analysis completed to facilitate compliance with the MBTA and BGEPA.

In addition, the Ford County wind ordinance requires an evaluation of avian habitat to support a determination that no substantial adverse impacts to birds will occur as a result of a proposed wind energy project.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Kentucky
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ARCADIS
PIONEER TRAIL WIND FARM, LLC
PIONEER TRAIL WIND FARM SITE LOCATION
FIGURE 1
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FORD CO
Creek
Radio Tower
Substation
Paxton
Malding Landing Strip
B U T T O N
Sugar Cr
Clarence
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IROQUOIS
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## 2. Agency Consultation

Pioneer Trail Wind Farm, LLC has consulted with the United States Fish and Wildlife Service (USFWS) and the Illinois Department of Natural Resources (IDNR) to identify potential concerns and the need for studies associated with understanding the potential for avian risk associated with the project.

### 2.1 United States Fish and Wildlife Service

Heidi Woeber of the USFWS provided information on October 2, 2008 that identified habitat descriptions for federal threatened and endangered species in Ford and Iroquois Counties. Correspondence with USFWS is provided in Appendix A.

The only bird species identified was the bald eagle (*Haliaeetus leucocephalus*); although it was delisted in 2007, it is still afforded protection under the BGEPA. This species was noted to occur in many Illinois counties; no known occurrences were listed for Iroquois County. The species feeds on fish, and tends to roost in trees near open water. The lack of open water and tree cover in the project area result in minimal risk of species presence. The bald eagle was not observed during field surveys (April – May 2010).

### 2.2 Illinois Department of Natural Resources

Correspondence from Keith Shank of IDNR on December 22, 2008 identified a number of protected species potentially occurring within the project area. Table 1 summarizes each avian species identified in the IDNR correspondence, and presents Pioneer Trail Wind Farm, LLC's strategy for addressing each issue. Correspondence with IDNR is provided in Appendix B.

As a result of coordination with IDNR, it was resolved that Pioneer Trail Wind Farm, LLC's avian survey regime would consist of point count transects. Consistent with IDNR requests for the nearby Settlers Trail Wind project (in Iroquois County, Illinois) two specific survey periods were identified, scheduled to overlap with spring migratory and breeding/residential periods. Because it has been well documented that the American golden plover (*Pluvialis dominica*) frequents Iroquois and Ford Counties as a stopover location during its spring migration from northeastern South America to the Arctic coastal plain (fall migration is along a different route), the timing of one survey was intended to coincide with the timing of potential golden plover migration (INHS 2010). The second survey period selected was later in the season, timed to reflect more generalized avian activity. The two survey periods together provided a representative view of general migratory bird activity at the project Site. The completed field efforts and subsequent analysis are the subject of this report.

**Table 1. Identified Avian Species Issues and Proposed Project Strategy**

| Species/Resource | Status | Comments | Strategy |
|---|---|---|---|
| upland sandpiper<br>short-eared owl<br>barn owl | IL endangered<br>IL endangered<br>IL endangered | Issues of potential concern are associated with courtship behavior, breeding/nesting habitat; species breed/nest mid-April to May. Suitable on-site habitat does not exist or would be limited at this site, although species have been observed in less suitable habitat. | Risk considered low. Pre-construction observations will be made during spring point counts to confirm habitat and identify any nesting activity. |
| Northern harrier<br><br>loggerhead shrike | IL endangered; USFWS species of concern<br><br>IL threatened | Issues of potential concern are associated with courtship behavior, breeding/nesting habitat and migration; species breed/nest mid-April to May. Suitable on-site habitat does not exist or would be limited at this site, although species have been observed in less suitable habitat. | Risk considered low. Pre-construction observations will be made during spring point counts to confirm habitat and identify any nesting or migratory activity. |
| sandhill crane<br>whooping crane<br>American golden plover<br>Smith's longspur | IL threatened<br>USFWS endangered<br>IL species of concern<br>No status | Each of these species has the potential to migrate through the general project area, with variable migratory patterns. Habitat features that would attract cranes are limited in the project area. | Risk considered low for cranes, moderate for other species. Pre-construction spring point counts are proposed to document migratory activity. |

## 3. Survey Methodology

Avian monitoring at the Site was conducted in two separate surveys. The first was timed to coincide with the anticipated migratory period for the American golden plover, and the second was conducted later to reflect other migratory species as well as a survey of resident and breeding bird populations.

### 3.1 Study Objectives

This study was designed with three objectives: 1) document any use of Site habitat by the golden plover; 2) document what other avian species are present at the Site and characterize their habitat use; and 3) using information from 1) and 2), evaluate the risk to bird populations at the Site associated with the proposed construction and operation of wind turbines.

### 3.2 Methods

Survey methods were similar for the golden plover and spring point count surveys; however, the respective surveys were conducted during two separate field events. Golden plover surveys were conducted in mid April of 2010 and spring point count surveys in late May of 2010. Five transects were chosen to represent a range of habitat types that are characteristic of the overall Site environment (see Table 2). At each of the five transects, birds were surveyed during three time periods: 1) post-dawn; 2) afternoon; and 3) pre-dusk at five points, for a total of 15 surveys per transect.

**Table 2. Habitat Types and Dominant Characteristics**

| Primary Habitat Type | Secondary Habitat Type | Dominant Habitat Features |
|---|---|---|
| Agriculture | Actively Farmed | Soy field (tilled or newly planted), corn field (tilled, or newly planted) |
| | Drainage Ditch | Grassland habitat fringe on bank of agricultural drainage ditch. Also includes power lines or fencerows where ditches are present |
| | Green Belt | Grassland habitat between agricultural fields |
| Railroad | Green Belt | Grassland habitat fringe, approximately 10-15 feet on each side of railroad tracks and drainage ditches; category also includes grassland habitat between agricultural fields |
| | Canopy (tree line) | Remnant old forest habitat (oak, sycamore, etc.) along railroad tracks and windbreak bordering agriculture lands |
| Wetlands | Standing Water | Isolated wetland within agricultural field |
| | Green Belt | Grassland habitat bordering wetland within agricultural field |
| Residential | Housing and Landscape | Fragmented habitat associated with structure residential structures (house/barn), trees and grass |

Surveys consisted of walking a distance of approximately 100 meters (m) from the road or habitat edge and stopping at the first of five points. This point was surveyed for 10 minutes and the following recorded:

- All birds seen, heard, or flushed;
- Habitat type the bird was utilizing;
- Approximate distance to the bird when it was first noted;
- If the bird was a repeat sighting from an earlier point; and
- Bird behavior (i.e., nesting, resting, foraging, in flight).

After ten minutes, the surveyors walked another 200 m to the second point. The same survey was conducted until a total of five points at each of the five separate transect locations was completed. This method is used to standardize observation time along transects.

Birds that were identified by call but were not observed (audibles) and birds that were observed flying overhead (flyovers) were also noted, but assigning these observations to a specific habitat type was not always possible. Birds observed in this manner are discussed in this report but are not included in the analysis where observations of habitat use are included.

Species of birds that were observed at each transect were grouped into eight taxonomic categories corresponding to a family level of classification:

- ***Passerines*** were considered in two separate groups to account for potential habitat utilization differences:
    - ***Corvids*** are in the Corvidae family and are sometimes considered medium to large passerine birds.
    - ***Passerines*** are of the order Passeriformes and include almost one-half of all the bird species. They are considered perching or songbirds. Near passerines were observed in the surveys and grouped with passerines.
- ***Caprimulgidae*** are in the Caprimulgidae family and are crepuscular or nocturnal nonpasserine birds.
- ***Shorebirds*** are considered long-legged wading birds of the order Charadriiformes.
- ***Waterfowl*** are of the order Anseriformes and include duck, geese and swans.
- ***Raptors*** are diurnal birds of prey.
- ***Falcons*** are diurnal birds of prey.
- ***Game birds*** are hunted for sport and include grouse, pheasant and quail.

### 3.2.1 Habitat Classification

The Pioneer Trail Wind Farm is located on relatively flat converted farmland. Most waters and wetlands on the Site have been converted into active farmland or have been managed to sustain only small, isolated wetlands and agricultural runoff ditches. Prairie fringe habitat consisting primarily of annual grasses borders the road, abandoned railroads on the Site, and drainage ditches. The prairie habitat ranges from 2 to 4 m wide on each side of the road or railroad right-of-way and are occasionally mowed. There are no large forested areas on the Site, other than a few rows of trees located along drainages, railroad rights-of-way, and residential properties. The majority of potential habitat on the Site is agricultural land that is actively farmed for corn and/or soy.

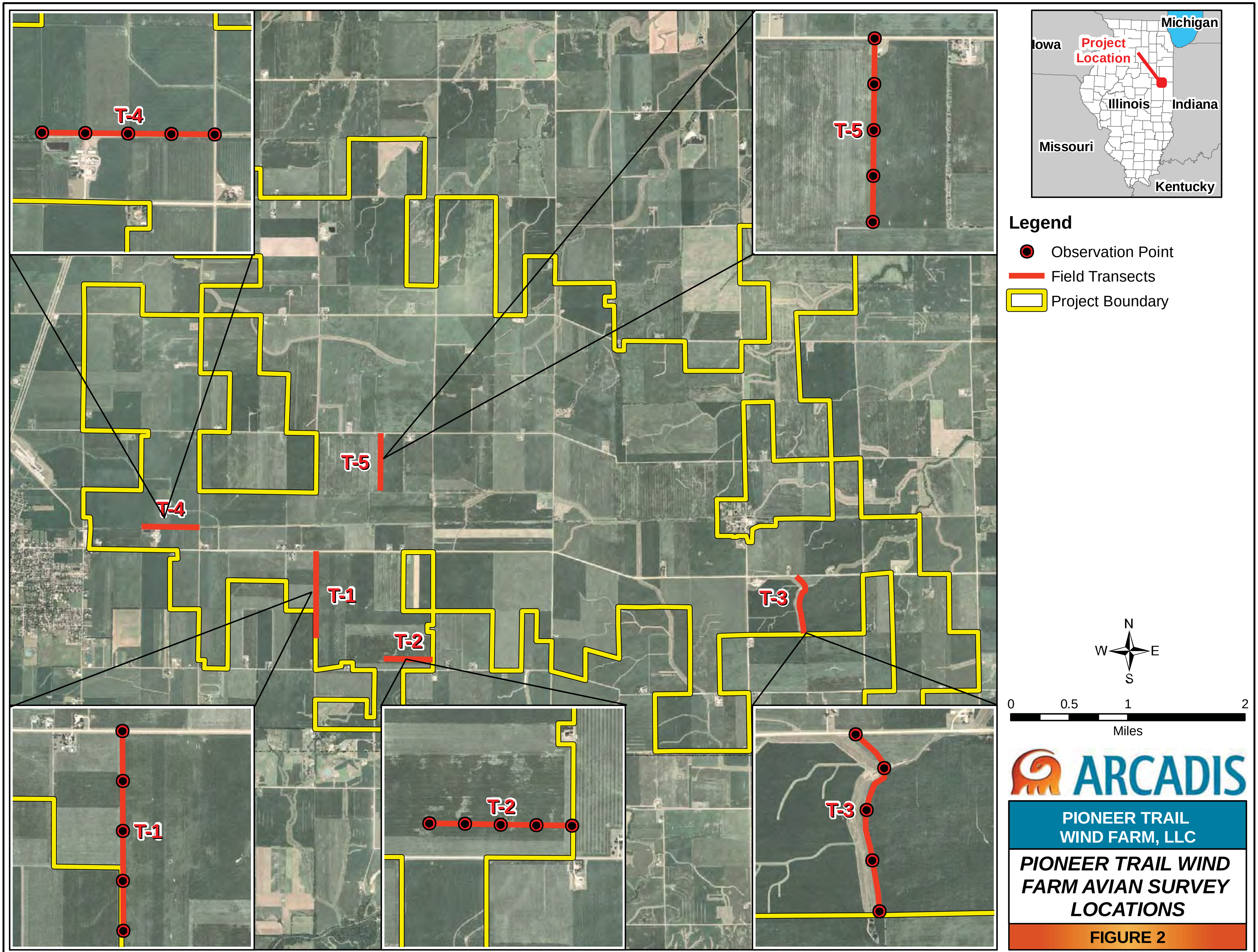
Habitats were classified as either primary or secondary depending on land use. Four primary habitat types and eight secondary habitat types were identified in the project area (Table 2). The eight secondary habitats were used to evaluate bird utilization rates for purposes of the risk analysis. Photographs of representative habitats are provided in Appendix A.

### 3.2.2 Transect Locations

Five transects were chosen to represent the range of possible habitat types that exist in the project area. The five transects established for the resident and breeding bird surveys were used throughout the survey period; in addition, farming activity was much greater during the May spring point counts then during the April survey. Figure 2 shows the location of transects for surveys. The habitat characteristics at each transect are summarized in Table 3.

The initial period for migratory bird surveys was from April 19 to April 22, intended to coincide with migration of the American golden plover. Temperature during the surveys ranged from a low in the 40s to mid 70s (°F). It was mostly clear, with a few patches of clouds and light rain. Winds were variable and ranged from 5 to 10 miles per hour (mph) up to approximately 20 mph.

In addition to recording observations while on transects, sightings of plovers were noted if they were flying in the vicinity, or observed at locations as surveyors drove between transects. Because of the migratory behavior of the golden plovers, it was important to note plovers that were observed and may have been missed if the surveyors only recorded those present within the transect boundaries. In Appendix C,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Michigan
Iowa
Project Location
Illinois
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Missouri
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ARCADIS
PIONEER TRAIL WIND FARM, LLC
PIONEER TRAIL WIND FARM AVIAN SURVEY LOCATIONS
FIGURE 2

Photo 5 illustrates observations of 300+ golden plovers and multiple other plover species that were observed as surveyors drove around the survey area between observation times.

In addition to observations of golden plovers, other bird species observed at transects were recorded and included in the species list for the Site.

Spring point count surveys were also conducted between the dates of May 21 to May 24, 2010 to evaluate migratory birds, as well as the residential and breeding bird populations. Weather during this survey period was warm, ranging from the 70s to high 80s (°F). Wind was variable at 5 to 20 mph, and there was an occasional morning fog that burned off by the mid-day surveys. The May survey utilized the same methodology as the survey in April.

**Table 3. Habitat Types at Transect Locations**

| Transect Number | Habitats | Dominant Habitat Features |
|---|---|---|
| Transect 1 | Agricultural – Actively Farmed | Farmed (corn, soy) |
| | Wetlands – Standing Water | Standing water |
| | Residential – Housing and Landscape | Resident home and barn with farm equipment. |
| Transect 2 | Agricultural – Actively Farmed | Farmed (soy and corn) |
| | Wetland – Standing Water | Standing water |
| Transect 3 | Agricultural – Actively Farmed; Drainage Ditch | Farmed (soy and corn) Drainage ditch |
| | Residential – Housing and Landscape | Farm equipment along drainage ditch |
| | Agriculture – Drainage Ditch | 2 m wide drainage ditch bisecting agriculture fields. |
| Transect 4 | Agricultural – Actively Farmed | Farmed (soy and corn) |
| | Railroad – Green Belt | Former railway; 2 m wide drainage ditch along both sides of former railway |
| Transect 5 | Agricultural – Actively Farmed | Farmed (soy and corn) |
| | Railroad – Green Belt | 5 m wide grass area between corn and soy fields |
| | Residential – Housing and Landscape | Barn buildings present |

### 3.2.3 Analysis

Avian risk from exposure to wind farms can be evaluated by estimating the utilization of habitats by birds at locations where turbines are planned for construction (NWCC 1999). Bird utilization of each habitat type was calculated by dividing the total number of species in a bird group (defined in Section 3.2) observed using a habitat by the total number of surveys that were completed for that habitat. The equation is:

$$\text{Utilization}_{\text{(Habitat Y)}} = \frac{\text{Total No. of Individuals}_{\text{(Bird Group X)}}\text{ Observed in Habitat Y}}{\text{Total No. of Surveys in Habitat Y}}$$

The total number of surveys in a habitat was calculated by multiplying the frequency of habitat presence by the number of transect survey points. For example, as shown in Table 3, residential habitats were observed at three transect locations. A total of four 10-minute survey points out of those three transects were located in residential habitat and each was visited at three different times of the day (post-dawn, mid-day, and pre-dusk). The total number of surveys is therefore:

$$\text{Total No. of Surveys}_{\text{(Residential Habitat)}} = \text{3 transects * 4 survey points per transect * 3 times per day} = 36$$

The total number of surveys varied for each habitat type and was dependent on the frequency that a habitat was present among the five transects. A percent utilization rate for each habitat was calculated by comparing the habitat-specific utilization rates of a bird group by the total utilization rates of birds among all habitats.

## 4. Survey Results

A total of 52 species of birds and 1,223 individuals were observed during the resident/breeding and migratory bird surveys (Table 4 and Table 5). No species that were listed on the threatened and/or endangered species list for the State of Illinois were observed during the spring point count surveys.

The other bird of importance that was observed was the golden plover. It is not listed as a threatened or endangered species, but similar to the other migratory birds, it is protected under the MBTA (16 U.S.C. 703-712; Ch. 128; July 13, 1918; 40 Stat. 755). The American golden plover is discussed in Section 4.2.

**Table 4. Bird Species Observed During Resident/Breeding and Migratory Surveys (page 1 of 3)**

| Common Name | Genus / species | Species Type | Observed During Resident/Breeding Bird Survey? | Observed During Migratory Bird Survey? |
|---|---|---|---|---|
| American crow | *Corvus brachyrhynchos* | Corvid | Y | Y |
| American golden plover | *Pluvialis dominica* | Shorebird | | Y |
| American goldfinch | *Carduelis tristis* | Passerine | Y | |
| American kestrel | *Falco sparverius* | Falcon | Y | Y |
| American robin | *Turdus migratorius* | Passerine | Y | Y |
| barn swallow | *Hirundo rustica* | Passerine | Y | Y |
| blue jay | *Cyanocitta cristata* | Corvid | | Y |
| brown-headed cowbird | *Molothrus ater* | Passerine | Y | Y |
| brown thrasher | *Toxostoma rufum* | Passerine | Y | |
| Canadian goose | *Branta canadensis* | Water Fowl | Y | |
| chimney swift | *Chaetura pelagic* | Near Passerine | Y | |
| chipping sparrow | *Spizella passerina* | Passerine | | Y |
| common snipe | *Gallinago gallinago* | Shorebird | | Y |
| common nighthawk | *Chordeiles minor* | Caprimulgidae | Y | |
| dickcissel | *Spiza Americana* | Passerine | Y | |
| Eastern kingbird | *Tyrannus tyrannus* | Passerine | Y | |
| Eastern meadowlark | *Sturnella magna* | Passerine | Y | Y |

**Table 4. Bird Species Observed During Resident/Breeding and Migratory Surveys (page 2 of 3)**

| Common Name | Genus / species | Species Type | Observed During Resident/Breeding Bird Survey? | Observed During Migratory Bird Survey? |
|---|---|---|---|---|
| Eastern phoebe | *Sayornis phoebe* | Passerine | | Y |
| European starling | *Sturnus vulgaris* | Passerine | Y | Y |
| common grackle | *Quiscalus quisicula* | Passerine | Y | Y |
| great blue heron | *Ardea Herodias* | Shorebird | | Y |
| horned lark | *Eremophila alpestris* | Passerine | | Y |
| house sparrow | *Passer domesticus* | Passerine | Y | Y |
| indigo bunting | *Passerina cyanea* | Passerine | Y | |
| killdeer | *Charadrius vociferus* | Shorebird | Y | Y |
| lesser yellow legs | *Tringa flavipes* | Shorebird | | Y |
| longspurs* | *Passeriformes* | Passerine | | Y |
| mallard | *Anas platyrhynchos* | Water Fowl | Y | Y |
| merlin | *Falco columbarius* | Falcon | | Y |
| mourning dove | *Zenaida macroura* | Near Passerine | Y | Y |
| Northern cardinal | *Cardinalis cardinalis* | Passerine | Y | Y |
| Northern rough-winged swallow | *Stelgidopteryx serripennis* | Passerine | | Y |
| pipit* | *Passeriformes* | Passerine | | Y |
| pigeon | *Columbiformes* | Near Passerine | Y | |
| plover* | *Charadriiformes* | Shorebirds | Y | Y |
| red tailed hawk | *Buteo jamaicensis* | Falcon | Y | Y |
| red throated humming bird | *Archilochus colubris* | Near Passerine | Y | |
| red-winged blackbird | *Agelaius phoeniceus* | Passerine | Y | |
| ring-necked pheasant | *Phasianus colchicus* | Game Bird | Y | Y |
| ruby-crowned kinglet | *Regulus calendula* | Passerine | | Y |

**Table 4. Bird Species Observed During Resident/Breeding and Migratory Surveys (page 3 of 3)**

| Common Name | Genus / species | Species Type | Observed During Resident/Breeding Bird Survey? | Observed During Migratory Bird Survey? |
|---|---|---|---|---|
| rock dove | *Columba livia* | Near Passerine | Y | Y |
| sandpiper* | *Charadriiformes* | Shorebirds | T | |
| Savannah sparrow | *Passerculus sandwichensis* | Passerine | Y | Y |
| sharp tailed sparrow | *Passeriformes* | Passerine | | Y |
| semipalmated sandpiper | *Calidris pusilla* | Shorebird | Y | |
| song sparrow | *Melospiza melodia* | Passerine | Y | Y |
| sparrow* | *Passeriformes* | Passerine | Y | |
| turkey vulture | *Cathartes aura* | Raptor | Y | Y |
| vesper sparrow | Pooecetes gramineus | Passerine | | Y |
| Western sandpiper | Calidris mauri | Shorebird | Y | |
| woodpecker* | *Piciformes* | Near Passerine | | Y |
| yellow legs* | *Charadriiformes* | Shorebird | | Y |

Notes:
* = not identified to species level

**Table 5. Spring Point Count Survey Total Species Analysis of Habitat Usage**

| Species Type | Habitat | Numb er Obser ved | Percentage Representation of all Bird Sitings |
|---|---|---|---|
| Caprimulgidae | Agriculture Actively Farmed | 1 | 0.08 |
| Total Caprimulgidae | | 1 | .08 |
| Corvid | Agriculture Actively Farmed | 3 | 0.25 |
| Total Corvid | | 3 | .25 |
| Falcon | Agriculture Actively Farmed | 3 | 0.25 |
| | Agriculture Drainage Ditch | 1 | 0.08 |
| Total Falcon | | 4 | 0.33 |
| Game Bird | Agriculture Actively Farmed | 2 | 0.16 |
| | Railroad Green Belt (agriculture) | 2 | 0.16 |
| Total Game Bird | | 4 | 0.33 |
| Passerine | Agriculture Actively Farmed | 659 | 53.88 |
| | Agriculture Drainage Ditch | 33 | 2.70 |
| | Railroad Green Belt (agriculture) | 29 | 2.37 |
| | Railroad Green Belt | 35 | 2.86 |
| | Railroad Green Belt (drainage ditch) | 32 | 2.62 |
| | Wetlands Standing Water | 50 | 4.09 |
| | Residential Housing and Landscape | 5 | 0.41 |
| Total Passerine | | 843 | 68.9 |
| Raptor | Agriculture Actively Farmed | 1 | 0.08 |
| Total Raptor | | 1 | 0.08 |
| Shorebird | Agriculture Actively Farmed | 257 | 21.01 |
| | Railroad Green Belt (agriculture) | 5 | 0.41 |
| | Agriculture Drainage Ditch | 3 | 0.25 |
| | Wetlands Standing Water | 70 | 5.72 |
| Total Shorebird | | 335 | 27.4 |
| Water Fowl | Agriculture Actively Farmed | 6 | 0.49 |
| | Wetlands Standing Water | 26 | 2.13 |
| Total Water Fowl | | 32 | 2.6 |
| Total | | **1,223** | |

#### 4.1 Migratory Birds

There were 37 different bird species observed during the migratory bird survey: seven shorebirds (golden plover, common snipe, great blue heron, lesser yellow legs, killdeer unidentified plover and yellow legs species); one raptor (turkey vulture); one game bird (ring-necked pheasant); two corvids (blue jay and American crow); three falcons (American kestrel, merlin and red-tailed hawk); one water fowl (mallard duck); and the remaining 22 were passerine or near passerine species.

Golden plovers were observed resting/foraging in agricultural fields as well as flying overhead in flocks. The total number of golden plovers observed was approximately 264 birds (includes flyovers) (Table 6). Of these, 26 percent, or 69, were observed flying overhead in flocks of 1 to approximately 30 birds. The remaining 195 were observed on the ground in the agricultural fields. Golden plovers that were observed on the ground were observed in groups of 6 to 50 in tilled and partially tilled soybean and cornfields as well as in one wetland area in Transect 2. Golden plovers were more commonly observed during the early morning hours. Driving the Site between surveys, 300+ golden plovers were observed actively foraging within an active agriculture field that was not adjacent to or used as a transect. This number was not added to the total species count in Table 6 because the observation occurred while not on a transect.

**Table 6. Total Number of Golden Plover Birds Observed During Time of Day and for Each Habitat Type**

| Primary Habitat Type | Secondary Habitat Type | AM | Noon | PM | Total | Relative Percent |
|---|---|---|---|---|---|---|
| Agriculture (including flyovers) | Actively Farmed | 164 | 0 | 100 | 264 | 100% |
| | Totals | 164 | 0 | 100 | 264 | |

It should be noted that some of the golden plover counts (as observed in farmed land or as flyovers) could be repeat sightings due to difficulties in determining how long birds remained in the area. For example, a flock observed in a particular field one evening may have been the same observed the following morning, or a small flock flying overhead may have come from an area where they had already been counted. Therefore, the actual counts observed in this survey may be biased high and the relative percent (not direct counts) of birds in habitats or as flyovers is likely to be a more accurate estimate of bird use of the Site.

Utilization Rate of habitats by the golden plover is shown in Table 7. The only habitat that was utilized by the golden plovers was actively farmed agriculture fields, with a Utilization Rate of 3.01. This Utilization Rate is lower than the Utilization Rate of all habitats by resident and breeding bird populations (5.7, Table 10), as a result of high numbers of species diversity utilizing the farmed habitat during the resident and breeding bird survey. Utilization of agricultural fields by the golden plover for resting and foraging is further assessed in the following sections, as wind turbines would be placed directly in this habitat.

**Table 7. Utilization of Habitats by Golden Plovers**

| Primary and Secondary Habitat Type | Total Number Observed | Total Surveys | Utilization Rate | Total Percent Bird Utilization of Habitat Type |
|---|---|---|---|---|
| Agriculture Actively Farmed | 226 | 75 | 3.01 | **100%** |
| **Total** | 226 | | 3.01 | |

#### 4.2 Resident and Breeding Birds

Resident/breeding birds were observed audibly; resting/foraging in agricultural fields, drainage ditches, railroad rights-of-way and wetlands; as well as flying overhead. The total number of resident/breeding birds observed was 723 birds. Of these, 40 percent were observed resting or foraging on the ground, 35 percent were observed flying overhead, 10 percent were observed flying in/landing in habitat, 8 percent were observed audibly and 5 percent were observed interacting. There were 36 different bird species represented in the total bird count: one caprimulgidae (Common nighthawk); one corvid (American crow); two falcons (American kestrel and red tail hawk); two water fowl (Canadian goose and mallard); five shorebirds (killdeer, semipalmated sandpiper, Western sandpiper, unidentified sandpiper species, and unidentified plover species); one game bird (ring-necked pheasant); one raptor (turkey vulture); and the remaining 22 were passerine or near passerine species. The percent composition of bird groups that were observed during the spring bird surveys is shown in Table 8. This does not include those birds that were "fly bys" or observed audibly where there was no habitat associated or assigned to the bird. Of the 723 birds observed, 85 percent were passerines, or near passerine species illustrating that songbirds are the major species that use habitats in the project area and 14 percent were waterbirds. All other bird species made up less than 1 percent of the observations.

**Table 8. Bird Species Observed During Resident/Breeding Surveys**

| Species Group | Total Number | Percent Composition |
|---|---|---|
| Caprimulgidae[1] | 1 | 0.14% |
| Passerine[2] | 615 | 85% |
| Waterbirds[3] | 106 | 15% |
| Gamebirds | 1 | 0.14% |
| | | |
| **Total** | **723** | |

Note: Total number only include species observed on a specific habitat and, therefore, does not include species observed audibly or those that were considered "fly bys" where no habitat had been assigned.
[1]Caprimulgidae = includes nighthawk
[2]Passerine= includes corvids, passerines and near passerine species.
[3]Waterbirds= includes shorebirds and waterfowl
.

Table 9 lists all of the habitat types and the total number of birds observed, at post-dawn (a.m.), afternoon (noon), and pre-dusk surveys (p.m.). Overall, there were more birds observed during the post-dawn surveys (283 birds) compared to the pre-dusk and afternoon surveys (216 birds and 224 birds, respectively).

The highest percentage of habitat use by resident and breeding birds was agricultural habitat (67%), which is the most dominant habitat type at the Site. Most birds were observed within actively farmed land (n=423). The most common species in actively farmed land were brown headed cowbirds, followed by common grackles, red-winged blackbirds, killdeer, barn swallows, horned lark and American robin. Tall grasses (in Agricultural Green Belt and Railroad Green Belt habitats) also appeared to provide useful habitat for cover and nesting materials (n = 201). Red-winged black birds and song sparrow were two of the more common residents observed nesting in these grassy borders. Other passerines that appeared to favor these grassy habitats were indigo bunting, American robin and European starlings.

Habitats that border railroads – particularly the drainage ditch and the grassland buffer between the railroad and the farmed land edge – were used by 20 percent of birds observed in the survey. Species diversity in this habitat type was higher than in actively farmed land, with primarily song sparrows, as well as American robins, indigo buntings and northern cardinals among the most common species observed.

**Table 9. Total Number of Resident/Breeding Birds Observed During Time of Day and for Each Habitat Type**

| Primary Habitat Type | Secondary Habitat Type | AM | Noon | PM | Total | Relative Percent |
|---|---|---|---|---|---|---|
| Agriculture | Actively Farmed | 170 | 121 | 132 | 423 | |
| | Drainage Ditch | 1 | 2 | 2 | 5 | 67% |
| Railroad | Green Belt (agriculture) | 30 | 11 | 18 | 59 | |
| | | | Total Agriculture | | 487 | |
| Railroad | Green Belt | 58 | 47 | 37 | 142 | |
| | Drainage Ditch | 2 | 1 | 3 | 6 | 20% |
| | | | Total Railroad | | 148 | |
| Wetlands | Standing Water | 7 | 23 | 23 | 53 | 7% |
| | | | Total Wetlands | | 53 | |
| Residential | Housing and Landscape | 15 | 11 | 9 | 35 | 5% |
| | | | Total Residential | | 35 | |
| | TOTALS | 283 | 216 | 224 | 723 | |

Very little wetland habitat is present at the Site, and only seven percent of birds observed during the survey appeared to use this habitat. Most common were mallard ducks and sandpipers. Only five percent of bird observations were reported at residential properties; European starlings and barn swallows were the most common birds to use the residential habitat type.

Flight paths tended to be sporadic and limited in duration to movements between habitats to gather nesting materials or forage. Power lines were common for perch locations for red winged blackbirds, mourning doves, and brown headed cowbirds.

Utilization of habitats by resident and breeding bird groups is shown in Table 10. Wetland standing water in the middle of farmed land was the most heavily utilized habitat by all bird groups with a combined utilization rate of 2.21 species/survey, despite a low passerine utilization of 0.13 species/survey. In all, this habitat accounted for 38.5 percent of the observed utilization by all bird groups at the Site. Combined, wetlands and all other habitat types except agricultural actively farmed lands account for 77.8% of observed bird utilization at the Site. Turbines will only be placed in agricultural actively farmed lands, which are utilized by only 22.2 percent of all bird species. Wetlands and other habitat types will not be significantly impacted.

## 5. Avian Risk Estimation

### 5.1 Review of Avian Risk and Wind Power Projects in the United States

Many studies have been completed to assess avian risk to collision or displacement by wind turbines pre- and post-construction. In order to estimate avian risk at the Pioneer Trail Wind Farm Site, it is valuable to compare the habitat and species observed at similar sites where studies have been completed. Two main types of risk to avian species are usually addressed and will be discussed here: 1) disturbance and displacement of birds due to construction and operation of the turbines; and 2) collision mortality with turbines, meteorology towers and related infrastructure.

#### 5.1.1 Disturbance and Displacement

For agricultural environments, actual loss in habitat from turbine construction is reportedly minimal (NRC 2007). At this Site, where agricultural use will continue in the areas surrounding the turbines, actual direct impact to avian habitat is anticipated to be relatively small.

Studies have been conducted that evaluate whether increased human activity around wind turbines associated with construction and maintenance alters bird populations, and whether birds tend to avoid turbines and are potentially displaced from their natural habitat (Erickson et al. 2001). Although these studies are not conclusive, a study in Oklahoma (Mabey and Paul 2007) showed no negative effect on breeding grassland birds near turbines compared to those studied at intermediate (i.e., 1 to 5 kilometers

**Table 10. Utilization of Habitats by Resident and Breeding Birds**

| Primary and Secondary Habitat Type | Species Type | Total Number Observed | Total Surveys | Utilization Rate | Total Percent of Habitat Utilization by Bird Type | Total Percent Bird Utilization of Habitat Type |
|---|---|---|---|---|---|---|
| Agriculture Drainage Ditch | Passerine | 10 | 24 | 0.42 | 100% | |
| | **Total** | **10** | | **0.42** | | **7.3%** |
| Agriculture Actively Farmed | Caprimulgidae | 1 | 360 | 0.003 | 0.24% | |
| | Corvid | 2 | 360 | 0.006 | 0.48% | |
| | Passerine | 403 | 360 | 1.12 | 87.8% | |
| | Water fowl | 6 | 360 | 0.017 | 1.33% | |
| | Shorebird | 47 | 360 | 0.13 | 10.2% | |
| | **Total** | **459** | | **1.276** | | **22.2%** |
| Agriculture Road Side | Passerine | 1 | 15 | 0.67 | 100% | |
| | **Total** | **1** | | **0.67** | | **11.7%** |
| Residential Housing and Landscape | Passerine | 20 | 36 | 0.56 | 100% | |
| | **Total** | **20** | | **0.56** | | **9.8%** |
| Railroad Canopy | Passerine | 6 | 15 | 0.4 | 100% | |
| | **Total** | **6** | | **0.4** | | **7.0%** |
| Railroad Green Belt | Passerine | 3 | 15 | 0.2 | 100% | |
| | **Total** | **3** | | **0.2** | | **3.5%** |
| Wetland Standing Water* | Passerine | 3 | 24 | 0.13 | 5.7% | |
| | Water Fowl | 26 | 24 | 1.08 | 49.0% | |
| | Shorebird | 24 | 24 | 1.00 | 45.3% | |
| | **Total** | **53** | | **2.21** | | **38.5%** |
| | | | | | | |
| | | **552** | | **5.736** | | **100%** |

*No Wetlands Green Belt habitat was represented in the survey transects.

[km] away) and distant (i.e., 5 to 10 km away) locations. Similarly, bird use within 200 m of turbines at the San Gorgonio Pass site in California was not found to be different compared to reference sites (Anderson et al. 2005). A study at the Altamont Pass Wind Resource Area of California indicated that, after a few weeks of exposure, trained red-tailed hawks (*Buteo jamaicensis*) appeared to become acclimated to the turbines and began flying in similar behaviors compared to resident red-tailed hawks (as cited in Curry and Kerlinger, 2002).

Certain studies (e.g., Leddy et al. 1999, which studied grasslands surrounding a wind project in Minnesota) indicate the importance of restoration of surrounding areas to original habitat conditions. At this site, where seasonal crops are planted, restoration is anticipated to readily occur in the surrounding areas.

Details regarding the risk associated with disturbance and displacement as a result of this project will be discussed below.

#### 5.1.2 Collision Mortality

Erickson et al. (2005) estimates a potential annual mortality of one billion birds in the United States as a result of human-caused sources. Mortalities to birds due to wind turbines amounted to less than 0.01 percent of that estimate. The highest source of bird mortality due to collisions with human-caused sources is buildings (window collisions or tall buildings) at 58.2 percent, averaging 550 million (Klem 1990). The second highest source of fatalities is power lines, 13.7 percent or 130 million (Koops 1987), then cats at 10.6 percent or 100 million (Coleman and Temple 1996), cars at 8.5 percent or 80 million (Hodson and Snow 1965, Banks 1979), pesticides at 7.1 percent or 67 million (Erickson et al. 2005), and communication towers at 0.5 percent or 4.5 million (Erickson et al. 2005). Therefore, compared to the other sources of human-caused bird mortality, mortality from collisions with wind turbines is extremely low.

Fatality of birds due to collision with wind turbines throughout the United States was estimated at approximately 20,000 to 37,000 birds annually, based on the number of turbines present in 2003. This was estimated by an average mortality of 2.11 birds per turbine and 3.04 birds per MW per year. Due to the heightened sensitivity to raptor fatality at turbines, a separate fatality estimate was established for raptors as approximately 933 raptors killed annually. Of this estimate, 80 percent will occur at the older wind project sites in California (advances in siting considerations and turbine design are considered strong influences) and only approximately 195 deaths (20%) outside California (Erickson et al. 2005).

Each species group has a different behavior and flight pattern. The mortality risk due to collision with the turbines is addressed for each species group below.

*5.1.2.1 Passerines and Corvids*

A wind power facility in Minnesota with approximately 350 1.8-MW turbines had low numbers of avian mortalities. The fatality rate ranged from one bird per turbine to four birds per turbine per year. However, the highest percent of mortality was for night-migrating passerine species. They composed about 70 percent of the overall fatalities (Johnson et al. 2002). Similarly, in Wisconsin at a wind power facility with 31 0.7-MW turbines, 24 songbird fatalities were recorded in two years. Only two waterfowl fatalities were recorded. It was estimated that the fatality rate per turbine was 1 to 2 birds per year. The total height of the turbines at this study site was 89 m (Howe et al. 2002).

At the San Gorgonio wind facility in California, it was estimated that approximately 69 million birds pass through the Coachella Valley annually during spring and fall migrations. The site consists of approximately 3,000 wind turbines located at various elevations. A study was conducted to monitor nocturnal migrant fatalities, and fatalities of only 38 birds were observed for 25 different species. Of those 25 species, 15 were passerines, seven waterfowl, two shorebirds, and one raptor. Considering the high level of migration that occurs in this area, the fatality number was determined to be insignificant (McCrary et al. 1983, 1984, 1986).

Erickson et al. (2001) summarized avian fatality data from numerous wind turbine sites. In particular, a range of three to 69 turbines were monitored at ten separate sites located outside of California. Of the fatalities due to collisions, 78 percent were passerines (excluding house sparrows, *Passer domesticus* and European starlings, *Sturnus vulgaris*) and only 2.7 percent were raptors. As many as 59.9 percent of the passerines are nocturnal migrants. Although most nocturnal migrating bird species fly higher than most turbine heights, weather or other external factors may affect flight pattern and result in collisions with wind turbines (Erickson et al. 2001).

*5.1.2.2 Raptors*

Most studies show that raptor mortality is low compared to other species (Johnson et al. 2000; Erickson et al. 2001; Strickland et al. 2003). The Altamont Pass Wind Resource Area in California is one of the few locations to have had a significant negative effect on avian populations, particularly for raptors. In one study over a four year period 108 raptor fatalities were recorded (CEC 1989). A separate two-year study recorded 182 fatalities, of which 68 percent were raptors and 26 percent were passerines (Orloff and Flannery 1992). Bird fatality studies at other wind plants in California have not reported similar results. This may be due to the fact that Altamont Pass has: 1) a large number of turbines (5,400) concentrated in a small area; 2) turbines spaced 10 m apart rotor-to-rotor distance; 3) a high prey base of California ground squirrels that attract more raptor species; 4) steep topography with turbines in valleys and canyon edges; 5) turbines that sweep within 10 m of the ground, affecting raptor foraging habitat; 6) turbines with lattice type towers that allow for perching and nesting; and 7) small turbine rotors that turn quickly, making it difficult for birds to see (Orloff and Flannery 1996; Thelander and Rugge 2000). Recent improvements in technology as well as spacing the turbines farther apart and on higher points of the topography instead of in valleys or low areas are believed to have contributed to reduced mortalities at more recent wind plant sites when compared to the Altamont Study.

Turkey vultures have been observed to have higher mortality numbers compared to other bird species in two studies (Schnell et al. 2007; Tierney 2007). A study at a wind plant in Texas recorded 21 avian mortalities at 21 turbines, of which 15 were turkey vultures, mostly juveniles. Adults were observed flying around the turbines and appeared to be able to avoid the blades (Tierney 2007). In Oklahoma, of 15 casualties at 50 turbines, 11 were turkey vultures and two were red-tailed hawks (Schnell et al. 2007). No age was reported in order to compare if juveniles were equally affected compared to the Tierney study.

The studies that observed high raptor mortalities have typically been in high elevation areas where the prey base is diverse and abundant. These conditions are not common in actively managed farmland.

#### *5.1.2.3 Waterfowl and Shorebirds*

A wind power facility in Iowa with 89 turbines was studied over a two-year period. The turbines were approximately 100 m high and rotated at a speed of 130 mph. There were no fatalities to Canadian geese or other waterfowl. This is significant because the wind power facility studied is located within 1 – 2 miles of waterfowl management areas and a significant amount (>1.5 million duck and goose days per year) were observed utilizing the habitat (Koford et al. 2005).

Another study at the San Gorgonio wind power facility in California that occurred over 15 months documented a higher number of waterfowl fatalities (9) compared to passerines (6), rock doves (6), owls (5), waterbirds (2), diurnal raptors (2) and shorebirds (1). It was noted that the waterfowl and shorebird mortality was higher in areas where water was present in the vicinity of the project site (Erickson et al. 2001). Also, in Europe, shorebirds (golden plovers and lapwings) kept a distance of 250-500 m from wind turbines (Winkelman 1990).

The Buffalo Ridge Wind Resource Area in Minnesota had three phases of development. Strickland et al. (2003) studied the use, behavior and mortality at Phase I and Phase II. Phase I had 33 m diameter turbines with a rotor-swept area of 19.5 to 52.5 m above the ground. For Phase II, the sweep zone area of the larger 48 m turbines was 26 to 74 m above the ground. During the passerine and small bird surveys, a total of 26 percent of all flying birds were observed within the sweep zone of the Phase I turbines and 16 percent were observed within the sweep zone of the Phase II turbines. However, there was no significant difference in the number of birds observed within the sweep zone of the Phase I turbines compared to the Phase II turbines.

During the raptor and large birds surveys (which included waterfowl species), 47 percent of all flying birds were observed within the sweep zone of the Phase I turbines, and 36 percent within the sweep zone of the Phase II turbines. Combining all the species, there were significantly ($p<0.10$), more species observed flying within the sweep zone of the Phase I turbines compared to the Phase II turbines. The most abundant species types within the sweep zones were shorebirds, raptors and waterfowl. Strickland et al. (2003) concluded that the larger turbines installed during Phase II have less of a risk to avian fatalities than the smaller turbines installed in Phase I.

#### *5.1.2.4 Game Birds*

Game bird mortality is generally low compared to other fatalities observed at the wind power facilities. For example, a study was conducted over three years at Buffalo Ridge, Minnesota at a 350 (0.3 to 0.75 MW) turbine wind farm. The study identified an annual mortality of 2.8 birds per turbine based on a total of 55 fatalities observed. Of these, 76.4 percent were passerines, 9.1 percent waterfowl, 5.5 percent water birds, and 5.5 percent game birds. Most of the fatalities were determined to be night migrants (Johnson et al. 2000).

### 5.2 Avian Risk at the Pioneer Trail Wind Farm

The habitat at the Pioneer Trail Wind Farm consists of farmland with tilled and untilled corn and soybean fields as the primary crop. Many of the habitat types that are described in this report – such as agricultural ditches, railroads, urban roads, residential properties, and wetlands – will be actively avoided in the development of the turbine layout and disturbance to agricultural habitats will be minimal. The following lists the potential risks of disturbance and displacement as well as risk of collision with the turbines that could occur as a result of this project.

#### 5.2.1 Disturbance and Displacement

Disturbance and displacement of resident and migratory birds may occur as a result of increased activity during construction and maintenance and improved road access as a result of development, especially in areas where there was little traffic before. In addition, the presence and noise of turbines may deter birds from using habitat close to them (Powlesland 2009). However, some studies appear to show little to no behavioral impact of turbines on birds and spacing turbines widely in an attempt to reduce the likelihood of blocking bird movement may potentially increase the area from which birds will be displaced by disturbance (Powlesland 2009).

Risk of disturbance and/or displacement at the Pioneer Trail Wind Farm from construction activities are expected to be minimal and temporary in nature. Typically, construction of wind plants is completed in six months to a year and, therefore, any impacts as a result of heavy machinery, increased road traffic, and the presence of workers is temporary and also not concentrated in one area. The workers will be moving across the Site installing the turbines at the designated areas. Agricultural uses will continue on the property except in the relatively small footprint area of the turbines and access ways.

##### *5.2.1.1 Passerines*

The majority of the species observed on the Site in actively farmed land where the turbines will be placed were passerine species (54 percent, Table 5). However, the utilization rate for passerines in actively farmed land was only 1.12 species/survey (Table 10). Risk of disturbance and displacement to these passerines is low because this species group has been exposed to changes in habitat from one crop to another, workers actively tilling and/or harvesting the fields, and activity at residential properties or along roads. Furthermore, nesting and breeding habitats are not typically altered during construction, there are few to no species that nest in actively managed croplands, and overall impacts are not considered to be significant (Curry and Kerlinger 2002).

*5.2.1.2 Raptors*

Forested habitat at the Pioneer Trail Wind Farm Site is sparse and limited to highly fragmented rows of single trees along rails and urban roads; therefore, raptors that depend on forested habitat for perching, nesting, etc., are not as common and these species tend to not have a high risk of displacement. In addition, of all the species observed on the Site, raptors only made up 0.08 percent. A utilization rate was not determined due to the fact that this species was not observed utilizing any particular habitat, but only flying by.

*5.2.1.3 Other Species*

Other species, including waterfowl, shorebirds (excluding the golden plover) and game birds, use habitats that are not dominant at the Site or will be actively avoided during construction (Table 5). Excluding the plovers, the total percentage of waterfowl, shorebirds, and game birds observed on the Site compared to other bird species was only 8.7%. In agricultural actively farmed land where the turbines will be placed, waterfowl and shorebird utilization rates were only 0.017 and 0.13 individuals/survey, respectively (Table 10). Disturbance risk for these species would be temporary and displacement highly unlikely.

It has been well documented that the golden plover frequents agricultural fields in Iroquois and Ford Counties as a stopover location during their spring migration from northeastern South America to the Arctic coastal plain and that the numbers of golden plovers in Iroquois County may be high during migration (INHS 2010; Table 11). Fall migration of the plover is through the Canadian provinces and along the eastern United States coast back to their wintering grounds and is, therefore, not evaluated here.

Risk of disturbance or displacement to the American golden plover on this Site is expected to be minimal. There are studies on the European golden plovers (*Pluvialis apricaria*) that indicate they are a species of high risk for collision or disturbance by turbines (Pearce-Higgins et al., 2009), as well as studies that show no effect on the European plovers (Percival 2000, 2003). Because this species utilizes habitat on the Site where the turbines will be placed, there is a possibility of these birds being displaced to avoid the turbines (Table 7). However, at a wind farm in Scotland, bird surveys were conducted four years after the turbines were in place and while the numbers of European golden plovers remained constant at a control site, the overall abundance at the wind farm actually increased. They concluded that the turbines had no effect on the plovers and no sign of displacement was noted (Percival 2000).

**Table 11. Most Abundant Illinois County Golden Plover Observations (1975-2005)**

| Illinois County | Number of American Golden Plover | Percent of Total Birds Observed in All Counties |
|---|---|---|
| Livingston | 43,028 | 21% |
| La Salle | 18,831 | 9% |
| ***Iroquois*** | ***18,125*** | ***9%*** |
| Champaign | 14,328 | 7% |
| McLean | 13,799 | 7% |
| Will | 10,277 | 5% |
| Kankakee | 8,311 | 4% |
| Grundy | 8,148 | 4% |
| Vermilion | 7,807 | 4% |
| Douglas | 6,069 | 3% |
| ***Ford*** | ***3,157*** | ***< 2%*** |

SOURCE:INHS 2010 (http://www.inhs.uiuc.edu/databases/sbc/ )

The favored habitat of golden plover – tilled (or partially tilled) agricultural fields of soy and sometimes corn – are locally abundant, abundant throughout the county, and abundant throughout the state. Moreover, migration of the plover is not restricted to the state of Illinois but can occur throughout the Great Plain states (The Wilderness Society 1998). Table 12 shows that the approximate footprint of the Pioneer Trail Wind Farm (estimated 13,421 acres of cultivated soy and corn) would impact less than 2 percent of actively managed soy and corn fields in Ford and Iroquois counties which is less than 1/10$^{th}$ of a percent of this same agricultural use throughout the state. With the wide range of the migration route and the predominance of soy and corn fields throughout the State of Illinois (and the Midwest), golden plover populations should not be significantly displaced. In addition, within the project Site itself, wind turbines will only affect a very small percentage of the Site's habitat; the remaining area will continue in agricultural production and retain its habitat value. Therefore, because the impact area where the turbines are placed is such a small fraction of the overall available habitat for the golden plovers, the expected disturbance and displacement should be comparatively low.

**Table 12. Estimated Size of Site Relative to Total Available Agricultural Land Use Habitat**

| Total Soy and Corn Planted | Acreage | Percent of Site Related to County/State |
|---|---|---|
| Site | 13,421 | NA |
| Ford and Iroquois Counties | 886,000 | 1.5% |
| Illinois | 21,400,000 | 0.1% |

Source (USDA 2010): http://www.nass.usda.gov/QuickStats/Create_County_All.jsp

#### 5.2.2 Collision with Wind Turbines

The collision risk for avian species at the Pioneer Trail Wind Farm varies according to the bird type. For example, species that are ground nesters and foragers and do not spend much time flying near the sweep zone of the turbines would have a lower risk of collision. However, there was a group of birds observed, characterized as “fly by” species that were not resting in a particular habitat, but were observed in flight. The majority of the birds were either observed high above the sweep zone or flying low (below the sweep zone) across the fields. Time spent in the sweep zone was minimal and included flocks flying in and landing in a field to rest or forage. The various species groups are discussed below.

##### *5.2.2.1 Passerines and Corvids*

Research has shown that most collisions of passerine birds at the turbines occur during night migrations and are usually of single birds (Curry and Kerlinger 2002). Erickson et al. (2001) estimated that passerines will make up 45.5 percent of the total fatalities due to collisions with the wind turbines.

Johnson et al. (2000) surveyed both wind turbines and guyed meteorological (met) towers, both approximately 60 m in height. The two types of towers were surveyed once a month for a year, and an annual average of 7.5 and 1.8 bird fatalities per year were identified for met towers and turbines, respectively. Wind turbines do not pose as great a risk to passerine birds compared to communication towers because of three factors: 1) they are relatively shorter in height compared to the tall communication towers (152-183 m), 2) they lack guy wires which are less visible and provide additional obstructions, and 3) the Federal Aviation Administration (FAA) obstruction lights do not appear to attract nocturnal migrants like the sodium-vapor lights on the communication towers do (Johnson et al. 2000). Currently there are no data that indicate a difference in the fatality rate at turbines with lights versus unlit turbines (Kerns and Kerlinger 2004; Kerlinger 2004). The guy wires on the communication towers account for most collisions of night-migrating passerines. There are no data that support collision fatalities at free-standing towers such as met towers at wind power sites (Kerns and Kerlinger 2004).

The majority of the birds observed on the Pioneer Trail Wind Farm Site were passerine species and corvids.[1] Overall, these species groups comprised 69 percent of the total birds observed. (Table 5). Passerines appear to be most susceptible to collision with wind turbines during seasonal movements and while migrating at night; however, once these species have established residence at a site the risk of collision with turbines appears to decrease. Passerine behavior observed during this study indicates that, in the absence of wind turbines, flight heights were typically below the sweep zone of turbines, and flight durations are generally restricted to localized movements for foraging, finding nest materials, guarding nests, etc. Potential for impact is also reduced through minimizing the use of guy wires, limiting the area of disturbance, maintaining substantial turbine spacing and limiting lighting to that required for FAA safety purposes. Risk of collision with wind turbines by this group is expected to be moderate to low.

*5.2.2.2 Raptors*

Although the Altamont Pass Wind Resource Area has experienced a large number of raptor collisions with turbines, the Pioneer Trail Wind Farm is designed to avoid the project features that were determined to contribute to the high fatality rate there (Orloff and Flannery 1996; Thelander and Rugge 2000). For example, project turbines will be on flat terrain, the rotation of the blades will be much slower as compared to the Altamont rotation, turbines will be spaced father apart, there will be no lattice towers

[1] Corvids are sometimes included with passerines because their behavior is similar. Corvids are treated as a separate group in this risk evaluation but their numbers are small compared to those considered as “true” or “near” passerines.

allowing perching, the prey base is low and few raptors were observed during bird surveys.

Overall, raptors comprised 0.08 percent of the total species observed on a specific habitat type during the surveys (Table 5). According to a comprehensive study conducted by Erickson (2001), diurnal raptors comprised 34.3 percent of the total fatalities due to collisions with wind turbines. Since so few raptors were observed on this site and the prey base for these species did not appear to be overly abundant, the risk of raptor collision with proposed wind turbines at this location is expected to be low.

*5.2.2.3 Waterfowl and Shorebirds*

Waterfowl species observed on the Site include the Canadian goose and mallard. The shorebirds observed include the sandpiper, golden plover and killdeer. Together these species comprised 30 percent of the total species observed during the spring bird surveys (Table 5). In the comprehensive study by Erickson et al. (2001), the total percent of fatalities to waterbirds including waterfowl and shorebirds comprised only 4.3 percent of total fatalities.

At the Pioneer Trail Wind Farm Site, the killdeer and mallard were all observed flying well below the sweep zone. The Canadian goose and golden plover were the only waterbird observed higher in the sky, but they were seen generally flying higher than the sweep zone. Golden plover were occasionally observed flying through rotor sweep zone height, although only to land or take to wing.

The golden plover was listed in the top ten species of birds with the highest exposure potential for impact with wind turbines at the Buffalo Ridge Wind Resource Area in Minnesota (Johnson et al. 2000). However, of the available mortality data for wind farms in their migratory pathway, mortalities of golden plovers have not been reported. One reason for this is that many of the wind farms are constructed at higher elevations and not in agricultural fields where golden plovers are likely to forage and rest, and so golden plovers are less likely to move within sweep zones (The Wilderness Society 1998). However, because this Site is located within agricultural fields, the expected results are unknown. Although, most observations of golden plovers were when birds were resting or foraging on the ground, or when flocks were flying at heights well above a “typical” sweep zone of wind turbines. Golden plover were occasionally observed flying through rotor sweep zone height, although only to land or take to wing.

Another reason golden plover mortalities associated with wind farms have not been reported is that golden plovers appear to actively avoid turbines to land in fields. Open spaces (even space beneath active turbines) is important to the golden plover to defend against raptors that are the main cause of population mortality – estimated at nearly 50 percent (The Wilderness Society 1998). However, because the turbines will be placed in habitat that the golden plovers utilize and they were observed at times flying into the sweep zone, there is a potential for collision with the turbines.

##### *5.2.2.4 Game Birds*

A few gamebirds, such as the ring-necked pheasant were observed during the surveys, but numbers were low accounting for only 0.33 percent of the total birds observed (Table 5). Although gamebird facilities are located proximate to the project (for example, the Herschel Workman and Loda State Habitat Areas, managed as pheasant habitat), risk of collision with wind turbines is considered low for two reasons. First, most gamebirds tend to stay low to the ground and should not frequently pass by the sweep zone. Second, Erickson et al. (2001) estimated that of total fatalities due to collisions, gamebirds made up only 1.1 percent. The risk to game bird fatalities due to wind turbines is expected to be low.

#### 5.2.3 Temporal Considerations in Estimating Risk

In ecological risk assessments involving the evaluation of wildlife exposure to environmental contaminants in media (surface waters, soils, sediments or prey), exposure factors are derived that consider the species life history requirements. Temporal considerations are given to exposed species that would use an environment at only certain times of the year. Factors related to the species behavior (migration, hibernation, home range for foraging), and the conditions of the habitat (snow cover, ice, poor habitat for foraging) can limit the exposure of species to contaminated media or prey. For these reasons, Temporal Use Factors (TUFs) are derived in ecological risk assessments to characterize more accurately risk of exposure to contaminants at a site rather than assuming the organism is at risk 100 percent of the time. The United States Environmental Protection Agency (EPA) Region 5, which includes the State of Illinois, provides guidance on the use of TUFs for ecological risk assessments.

A similar technique can be used to better understand potential risk issues associated with the Pioneer Trail Wind Farm. Resident and breeding birds are not always present at the site, as habitat conditions are not always favorable to sustain populations of these birds. Similarly, migratory birds like the golden plover only spend a brief period of time in Illinois before moving north to their breeding grounds. Therefore, estimates of habitat utilization for these species are “biased high,” because the calculations require that species counts are presented as a function of the number of surveys taken, and these surveys are generally conducted at the time when birds are most abundant.

An example of how TUFs provide a more accurate representation of “risk” to avian species at the Pioneer Trail Wind Farm is provided in Table 13. This table shows temporally adjusted utilization rates for passerines and golden plover, with the assumption that each would utilize habitats at the Site for eight and one month(s) of the year, respectively. The results clearly show that if the migratory behavior of the golden plover is factored into an estimate of habitat utilization at the Site, that the resulting “average” utilization for the year drops significantly from the originally estimated 0.74 birds surveyed within actively farmed areas to 0.06 birds. The adjusted utilization rate for passerines within actively farmed areas is somewhat higher, at 1.40 birds, but still significantly less than the unadjusted rate of 2.09 birds. Understanding the temporal utilization of the Site provides important context for risk assessment to bird species.

**Table 13. Utilization Rates of Bird Groups Adjusted for Temporal Use of the Pioneer Trail Wind Farm Site**

| Species | Primary and Secondary Habitat Type | Total Number Observed | Total Surveys | Utilization Rate | TUF | Adjusted Utilization Rate |
|---|---|---|---|---|---|---|
| Passerines | Agriculture Drainage Ditch | 66 | 24 | 2.75 | 0.67 | 1.84 |
| | Agriculture Actively Farmed | 752 | 360 | 2.09 | 0.67 | 1.40 |
| | Railroad Canopy | 32 | 15 | 2.1 | 0.67 | 1.43 |
| Golden Plover | Agriculture Actively Farmed | 226 | 360 | 0.74 | 0.08 | 0.06 |

Notes: Temporal Use Factor (TUF) for passerines assumes that this group is present for 8 out of 12 months (0.66).
TUF for migratory golden plovers assumes that this group is present for 1 out of 12 months (0.08).
The adjusted utilization rate is simply the original utilization rate multiplied by the TUF.

## 6. Summary and Conclusions

Although golden plover and general avian usage was observed at and near the Site, the Pioneer Trail project Site will not result in substantial adverse impacts or unacceptable levels of risk to resident, breeding, or migratory species for the following reasons:

- **Avian utilization rates are low and no critical or unique habitat will be impacted by the project.** Turbines will be located on agricultural actively farmed lands, which is abundant within the project area and the county. There is no “critical” or unique habitat used by birds that is threatened by the presence of turbines. This is supported by the low avian utilization rates observed throughout the project area.
- **The life history requirements and behavior of birds limit exposure to wind turbines.** Birds are not present at the Site throughout the year and migrating birds that are not nesting in the area would be exposed to turbines even less then resident and breeding populations. In addition, published studies confirm that for most species, abnormally high fatalities are not expected at wind farms. In the event of bird collision and mortality with turbines, it is rarely considered significant to the success of populations. Most birds appear to actively avoid (or adjust to) the presence of turbines.
- **For resident and breeding bird populations:** Many resident or breeding birds were observed at the Site; however, most were observed flying well below rotor sweep zone height. Birds that flew in the potential sweep zone were only flying from distances above the sweep zone down to the fields to rest or forage. Time spent in the sweep zone was limited. Flight patterns were restricted to localized movements among habitat types and of short duration. Risk of exposure to turbines is not expected to result in significant impact to the bird populations that utilize habitats at the Pioneer Trail Wind Farm Site.
- **For migratory birds:** Golden plover were occasionally observed flying through rotor sweep zone height, although only to land or take to wing. Most flocks of plovers were observed well above the sweep zones, and only very limited flying was observed while flocks were resting or foraging in fields.
- **Best management practices have been incorporated in the pre-construction design of the project to reduce risk of mortality to bird populations.** In addition to the above ecological factors, best management practices are planned in the pre-construction design of the project that is expected to reduce mortality to birds by: 1) using tubular towers without guy

wires and turbine designs that reduce or eliminate perching opportunities; 2) establishing adequate spacing of turbines in farmlands; 3) avoiding heavily utilized or sensitive habitats such as drainage ditches, railroads, wetlands, and associated habitats; and 4) burying electrical collection and transmission lines to the greatest extent practicable.

The project has been designed to consider and avoid potentially sensitive biological resources wherever possible. The proposed project area does not appear to contain any unique habitat or topographic features compared to other wind projects in Illinois. The proposed project occurs within an area that is predominantly active agricultural use, and native prairie is rare within the project area, limited to low-quality habitat surrounding the on-site rail corridors. Construction and operation of the project, taking place predominantly within areas of active agricultural cropland, are not expected to significantly impact migratory birds or jeopardize any protected species or their essential habitat.

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# APPENDIX A

# USFWS CORRESPONDENCE

**Habitat Descriptions for Federal Threatened and Endangered Species in Ford County, Illinois**

The **bald eagle** (*Haliaeetus leucocephalus*) is listed as threatened and known to occur in many Illinois counties. Potential wintering habitat for this species occurs statewide including Ford County although we are unaware of any known occurrences. During the winter, this species feeds on fish in the open water areas created by dam tailwaters, the warm water effluents of power plants, and municipal and industrial discharges, or in power plant cooling ponds. The more severe the winter, the greater the ice coverage and the more concentrated the eagles become. They roost at night in groups in large trees adjacent to the river in areas that are protected from the harsh winter elements. They perch in large shoreline trees to rest or feed on fish. There is no critical habitat designated for this species. The eagle may not be harassed, harmed, or disturbed when present nor may nest trees be cleared.

The endangered **Indiana bat** (*Myotis sodalis*) is known to occur in Ford County. Indiana bats are considered to potentially occur in any area with forested habitat.

Indiana bats migrate seasonally between winter hibernacula and summer roosting habitats. Winter hibernacula include caves and abandoned mines. Females form nursery colonies under the loose bark of trees (dead or alive) and/or cavities, where each female gives birth to a single young in June or early July. A single colony may utilize a number of roost trees during the summer, typically a primary roost tree and several alternates. The species or size of tree does not appear to influence whether Indiana bats utilize a tree for roosting provided the appropriate bark structure is present.

During the summer, the Indiana bat frequents the corridors of small streams with riparian woods as well as mature upland forests. It forages for insects along stream corridors, within the canopy of floodplain and upland forests, over clearings with early successional vegetation (old fields), along the borders of croplands, along wooded fencerows, over farm ponds, and in pastures.

Suitable summer habitat in Illinois is considered to have the following characteristics within a ½ mile radius of a project site:

1) forest cover of 15% or greater;
2) permanent water;
3) one or more of the following tree species: shagbark and shellbark hickory that may be dead or alive, and dead bitternut hickory, American elm, slippery elm, eastern cottonwood, silver maple, white oak, red oak, post oak, and shingle oak with slabs or plates of loose bark;
4) potential roost trees with 10% or more peeling or loose bark

If the project site contains any habitat that fits the above description, it may be necessary to conduct a survey to determine whether the bat is present. In addition, a search for this species should be made prior to any cave-impacting activities. If habitat is present or Indiana bats are known to be present, they must not be harmed, harassed, or disturbed, and this field office should be contacted for further assistance.

The **Mead's milkweed** (*Asclepias meadii*) is listed as threatened and occurs in Ford County where it occupies virgin prairies. There is no critical habitat designated for this species. Federal regulations prohibit any commercial activity involving this species or the destruction, malicious damage or removal of this species from Federal land or any other lands in knowing violation of State law or regulation, including State criminal trespass law. This species should be searched for whenever prairie remnants are encountered.

The **eastern prairie fringed orchid** *(Platanthera leucophaea)* is listed as threatened and considered to potentially occur statewide in Illinois based on its historical records and habitat distribution, but we are unaware of any record for Ford County. It occupies mesic to wet grassland habitats. There is no critical habitat designated for this species. Federal regulations prohibit any commercial activity involving this species or the destruction, malicious damage, or removal of this species from Federal land or any other lands in knowing violation of State law or regulation, including State criminal trespass law. Growth of the prairie fringed orchid begins in May and flowering occurs in July. This species should be searched for whenever wet prairie remnants or other wet meadows are encountered.

The **prairie bush clover** (*Lespedeza leptostachya*) is listed as threatened and considered to potentially occur statewide in Illinois based on its historical records and habitat distribution, but is not listed as currently occurring in Ford County. It occupies dry to mesic prairies with gravelly soil. There is no critical habitat designated for this species. Federal regulations prohibit any commercial activity involving this species or the destruction, malicious damage, or removal of this species from Federal land or any other lands in knowing violation of State law or regulation, including State criminal trespass law. This species should be searched for whenever prairie remnants are encountered.

The project lies within the range of the freshwater **sheepnose mussel** (*Plethobasus cyphyus)* that is declining throughout its national range and is currently a Federal Candidate species. It is known to occur in Ford County. Significant declines relative to its historical distribution and its small isolated remaining populations continue to be threatened due to habitat loss and degradation. Your proactive efforts to conserve these species now may help avoid the need to list the species under the Endangered Species Act in the future. We encourage early project coordination to avoid potential impacts to this mussel and its habitat.

The sheepnose mussel is primarily a larger-stream species occurring mainly in shallow shoal habitats with moderate to swift currents over coarse sand and gravel but includes mud, cobble, and boulders as well. This includes larger rivers with deep runs, while those specimens found in streams occur mainly in stable flow refuges with little sediment turbidity.

At a minimum, project evaluations should contain delineations of whether or not sheepnose mussel habitat occurs within project boundaries. In cases where the species is known to occur or potential habitat is rated moderate to high, surveys may be necessary.  Please contact this office for further information should this species or their habitat be suspected.

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**Habitat Descriptions for Federal Threatened and Endangered Species in Iroquois County, Illinois**

The **bald eagle** (*Haliaeetus leucocephalus*) is listed as threatened and known to occur in many Illinois counties. Potential wintering habitat for this species occurs statewide including Iroquois County although we are unaware of any known occurrences. During the winter, this species feeds on fish in the open water areas created by dam tailwaters, the warm water effluents of power plants, and municipal and industrial discharges, or in power plant cooling ponds. The more severe the winter, the greater the ice coverage and the more concentrated the eagles become. They roost at night in groups in large trees adjacent to the river in areas that are protected from the harsh winter elements. They perch in large shoreline trees to rest or feed on fish. There is no critical habitat designated for this species. The eagle may not be harassed, harmed, or disturbed when present nor may nest trees be cleared.

The **eastern prairie fringed orchid** *(Platanthera leucophaea)* is listed as threatened and is known to occur in Iroquois County. It occupies mesic to wet grassland habitats. There is no critical habitat designated for this species. Federal regulations prohibit any commercial activity involving this species or the destruction, malicious damage, or removal of this species from Federal land or any other lands in knowing violation of State law or regulation, including State criminal trespass law. Growth of the prairie fringed orchid begins in May and flowering occurs in July. This species should be searched for whenever wet prairie remnants or other wet meadows are encountered.

The **prairie bush clover** (*Lespedeza leptostachya*) is listed as threatened and considered to potentially occur statewide in Illinois based on its historical records and habitat distribution, but we are unaware of any record for Iroquois County. It occupies dry to mesic prairies with gravelly soil. There is no critical habitat designated for this species. Federal regulations prohibit any commercial activity involving this species or the destruction, malicious damage, or removal of this species from Federal land or any other lands in knowing violation of State law or regulation, including State criminal trespass law. This species should be searched for whenever prairie remnants are encountered.

The endangered **Indiana bat** (*Myotis sodalis*) is known to occur in several Illinois counties, but we are unaware of any record for Iroquois County. Potential habitat for this species occurs statewide, therefore, Indiana bats are considered to potentially occur in any area with forested habitat.

Indiana bats migrate seasonally between winter hibernacula and summer roosting habitats. Winter hibernacula include caves and abandoned mines. Females form nursery colonies under the loose bark of trees (dead or alive) and/or cavities, where each female gives birth to a single young in June or early July. A single colony may utilize a number of roost trees during the summer, typically a primary roost tree and several alternates. The species or size of tree does not appear to influence whether Indiana bats utilize a tree for roosting provided the appropriate bark structure is present.

During the summer, the Indiana bat frequents the corridors of small streams with riparian woods as well as mature upland forests. It forages for insects along stream corridors, within the canopy of floodplain and upland forests, over clearings with early successional vegetation (old fields), along the borders of croplands, along wooded fencerows, over farm ponds, and in pastures.

Suitable summer habitat in Illinois is considered to have the following characteristics within a ½ mile radius of a project site:

1) forest cover of 15% or greater;
2) permanent water;
3) one or more of the following tree species: shagbark and shellbark hickory that may be dead or alive, and dead bitternut hickory, American elm, slippery elm, eastern cottonwood, silver maple, white oak, red oak, post oak, and shingle oak with slabs or plates of loose bark;
4) potential roost trees with 10% or more peeling or loose bark

If the project site contains any habitat that fits the above description, it may be necessary to conduct a survey to determine whether the bat is present. In addition, search for this species should be made prior to any cave-impacting activities. If habitat is present or Indiana bats are known to be present, they must not be harmed, harassed, or disturbed, and this field office should be contacted for further assistance.

# APPENDIX B

# IDNR CORRESPONDENCE

December 22, 2008

Ms. Candice Short, Zoning Administrator
Ford County
200 W. State St., Room 104
Paxton, IL 60957-1199

RE: **E.ON Climate & Renewables Paxton Wind Power Facility, Ford County**
**Endangered Species Consultation Program**
**EcoCAT Database Review #0902944**

Dear Ms. Short:

The Department received from E.ON Climate and Renewables, Inc., this proposed action near Paxton for consultation in accordance with the *Illinois Endangered Species Protection Act* [520 ILCS 10/11], the *Illinois Natural Areas Preservation Act* [525 ILCS 30/17], and Title 17 *Illinois Administrative Code* Part 1075.

As indicated by the accompanying EcoCAT Report, the Department currently has documented records of State-listed endangered or threatened species in the vicinity of or within the provided footprint of this proposal. However, for various reasons, this does not mean other listed species are currently absent from the vicinity, or that they may not occur within the vicinity at some time during the extended life of this activity (>25 years). The Department's data are far from comprehensive, and land owners in this area are free to alter potential habitats as their needs require, which will affect the incidence of State-listed species.

Notable among these species are three federally-listed species: the Eastern Prairie Fringed Orchid, the Mead's Milkweed, and the Indiana Bat. The latter two species, in particular, may be directly affected by this proposed action.

The proposed activity will occur in the watershed of the Iroquois River (Pigeon Creek) and the



Middle Fork of the Vermilion River, both of which provide essential habitat to several

endangered or threatened species of fish and mussels, which are not necessarily limited to the rivers, but may also ascend tributary streams. Soil erosion associated with construction and long-term operation of wind energy facilities has the potential to adversely affect these species and habitats unless carefully controlled.
In addition, Ford County provides important staging areas for migratory birds protected by federal law. Extensive wind energy facilities may adversely affect the ability of such species to arrive on their arctic breeding grounds in good reproductive condition.

An attachment is provided which describes endangered, threatened, and migratory species which may be affected by this proposal and some recommendations to avoid, minimize, or mitigate for potential adverse effects.

The consultation process for this proposal is terminated, unless the County desires additional information or advice related to this proposal.

Should you need additional information regarding the consultation process, or should you have any questions, please do not hesitate to contact me.

Sincerely,

Keith M. Shank
Impact Assessment Section
Division of Ecosystems and Environment
Ph. (217) 785-5500
Fax (217) 524-4177

cc: Joe Borkowski, E.ON Climate and Renewables North America, Inc.
D. Lynn Gresock, ARCADIS US, Inc.

**Code 0902944**

December 22, 2008

Ms. Gloria Schleef, Zoning Administrator
Planning and Zoning Office
Iroquois County
1001 E. Grant, Room 107
Watseka, IL 60970

RE: **E.ON Climate & Renewables Paxton Wind Power Facility, Iroquois County**
**Endangered Species Consultation Program**
**EcoCAT Database Review #0902944**

Dear Ms. Schleef:

The Department received from E.ON Climate and Renewables, Inc., this proposed action near Loda for consultation in accordance with the *Illinois Endangered Species Protection Act* [520 ILCS 10/11], the *Illinois Natural Areas Preservation Act* [525 ILCS 30/17], and Title 17 *Illinois Administrative Code* Part 1075.

As indicated by the accompanying EcoCAT Report, the Department currently has documented records of State-listed endangered or threatened species in the vicinity of or within the provided footprint of this proposal. However, for various reasons, this does not mean other listed species are currently absent from the vicinity, or that they may not occur within the vicinity at some time during the extended life of this activity (>25 years). The Department's data are far from comprehensive, and land owners in this area are free to alter potential habitats as their needs require, which will affect the incidence of State-listed species.

The proposed activity will occur in the watershed of the Iroquois River (Pigeon Creek), which provides essential habitat to several endangered or threatened species of fish and mussels, which are not necessarily limited to the river, but may also ascend tributary streams. Soil erosion associated with construction and long-term operation of wind energy facilities has the potential to adversely affect these species and habitats unless carefully controlled.

In addition, Iroquois County provides important staging areas for migratory birds protected by federal law. Extensive wind energy facilities may adversely affect the ability of such species to arrive on their arctic breeding grounds in good reproductive condition.

An attachment is provided which describes endangered, threatened, and migratory species which may be affected by this proposal and some recommendations to avoid, minimize, or mitigate for potential adverse effects.

The consultation process for this proposal is terminated, unless the County desires additional information or advice related to this proposal.

Should you need additional information regarding the consultation process, or should you have any questions, please do not hesitate to contact me.

Sincerely,

Keith M. Shank
Impact Assessment Section
Division of Ecosystems & Environment
Ph. (217) 785-5500
Fax (217) 524-4177
keith.shank@illinois.gov

cc: Joe Borkowski, E.ON Climate and Renewables North America, Inc.
D. Lynn Gresock, ARCADIS US, Inc.

Attachment

**Attachment**

**E.ON Paxton Wind Facility**
**Ford County and Iroquois County**

## Wildlife Impact Recommendations

Ford County and Iroquois County may wish to consider permit conditions requiring the applicant to monitor, assess, and report possible fish and wildlife effects of the proposed action in the following ways.

$ Incorporate best management practices to minimize risk to federally-listed and state-listed species, as outlined in this Attachment. Focus should be on appropriate avoidance and minimization of habitat disturbance, with mitigation measures implemented as applicable.

$ Where feasible, permanent engineering solutions to soil erosion and water quality issues should be required and maintained, particularly with reference to service and access roads.

$ Perform pre-construction assessments of avian and bat usage within the project area. Such assessments should include inventories of habitat types in and near the project area, including crop rotations or choices, and observations of both migratory and resident bird usage. Consideration of all seasons should be included, although spring migration is anticipated to be of greatest interest. Acoustic bat activity monitoring is also appropriate, particularly during the fall migratory season when activity would be expected to be highest. Specific federally-listed and state-listed species of interest are discussed in the following narrative. Risks to protected species should be evaluated and appropriate regulatory permits sought for potential incidental taking of protected animals.

$ Perform at least one year of post-construction monitoring and assessment, noting any changes in wildlife usage patterns and evaluating potential causes of such changes.

$ Consideration should be given to periodic repetition of the post-construction wildlife surveys during the life of the project.

Natural resources within, or in the vicinity of, the proposed wind energy facility are listed below, along with a discussion of potential issues.

## Clarence RR Prairies INAI Sites

Two separated segments of "railroad prairie" exist to the east and west of Clarence, Ford County, north of Illinois Route 9, along a former RR right-of-way. These remnants of Illinois' once-vast Grand Prairie support high-quality native plant communities and provide habitat for prairie-ecosystem insects, birds, and other animals. Construction and operation of a wind energy facility have the potential to directly and indirectly adversely modify these areas: directly, through construction and transportation of wind facility components, and indirectly, by shadowing the prairie segments, or by displacing or excluding prairie animals whose activities are beneficial to the natural community.

**Middle Fork of the Vermilion River INAI Site**

The Middle Fork, Illinois' only designated National Scenic River, runs in Ford County south of the prospective project area, which in turn is drained by several tributaries of the Middle Fork. Erosion related to wind facility construction and operation has the potential to adversely affect tributaries and the Middle Fork through siltation and sedimentation, and to adversely modify feeder stream habitats essential to Middle Fork fish and mussels, several of which are unique to the Vermilion River system in Illinois.

**Pelville Cemetery INAI Site**

Pelville Cemetery lies half a mile into Vermilion County, and is therefore outside the proposed facility footprint. Although it supports breeding pairs of the Henslow's Sparrow (see below), it is at a sufficient distance the Cemetery itself should suffer no adverse modification as a result of this proposed action.

**Prospect Cemetery INAI Site and Nature Preserve**

Prospect Cemetery is located just south of Paxton, outside of the footprint and distant enough that it will be unaffected by the proposed action.

**Loda Cemetery Prairie INAI Site and Nature Preserve**

Loda Cemetery is located northwest of Loda, Iroquois County. This Site lies beyond the reach of any adverse effects from the proposed action, but, importantly, supports a population of the federally-listed endangered Eastern Prairie Fringed Orchid (see below).

**Loda State Habitat Area.**

The Department's Loda State Habitat Area consists of 160 acres in the Northeast Quarter of Section 22, located a half-mile northeast of Loda in Iroquois County; it lies only a mile north of the provided project footprint. Although not an INAI Site itself and it does not have a breeding records for State-listed species, it does provide a large expanse of suitable wintering habitat and migratory staging area attractive to State-listed bird species described below.

**Henschel Workman State Habitat Area.**

The Department's 135-acre Henschel Workman State Habitat Area is located adjacent to the Pelville Cemetery INAI Site one mile west of Rankin in Vermilion County, and one mile east of the provided project footprint. It supports breeding Henslow's Sparrows and provides a large expanse of suitable wintering habitat and migratory staging area attractive to other State-listed bird species described below.

**<u>Perdueville State Habitat Area</u>.**

The Department's 120-acre Perdueville SHA is located about seven miles southwest of the provided project footprint. It supports significant numbers of breeding Henslow's Sparrows and provides a large expanse of suitable wintering habitat and migratory staging area attractive to other State-listed bird species described below.

**<u>Documented Listed Species</u>**

**<u>Mead's Milkweed, *Asclepias meadii*</u>.**

This federally-listed endangered plant was last documented from the Clarence RR Prairie East INAI Site in Ford County. The local population may have been extirpated by disturbance of the Prairie, but the possibility exists some individuals persist at that site or similar locations elsewhere. Avoidance of the Prairie will assure that any remaining individual plants or seed-banks are unaffected.

**<u>Eastern Prairie Fringed Orchid, *Platanthera leucophaea*</u>.**

A small population of the federally-listed endangered Eastern Prairie Fringe Orchid occurs in Loda Cemetery Prairie INAI Site and Nature Preserve north of Loda, Iroquois County. While this population is generally beyond the reach of adverse effects stemming from the proposed action, its presence indicates that unidentified populations may persist elsewhere in the vicinity in suitable habitat.

A peculiar trait of this plant is that it appears that only a few members of the hawk-moth genus are capable of pollinating its flowers. Consequently, limits on the local hawk-moth population can seriously affect the success of this plant's reproduction by seed.

**<u>Henslow's Sparrow, *Ammodramus henslowii*</u>.**

The Henslow's Sparrow is listed by Illinois as a threatened species. Breeding populations of this grassland bird have been documented both east and west of the proposed project area, and may occur within the project area where suitable habitat exists. More northern breeding populations may migrate through the project area.

As a breeding bird, the Henslow's Sparrow is area-sensitive, requiring minimum amounts of contiguous habitat. It is sensitive to and avoids vertical structures and habitat openings, such as roads and trails, which fragment habitat. Wind turbines have the potential to fragment otherwise suitable habitat, exclude or displace breeding birds from suitable habitat, and to kill or injure birds through blade-strike. The response of this species to the presence of distant wind turbines has yet to be documented.

**<u>Indiana Bat, *Myotis sodalis*.</u>**

Summer nursery colonies of this bat, listed by the federal government and Illinois as endangered, have been documented in forested riparian tracts along the Middle Fork of the Vermilion River and the Big Four Ditch in Ford County. Nursing females may forage above crop-fields a mile or more from the nursery colony. This species winters in caves or mines some distance from summer habitats, but its migratory behavior is poorly understood. No hibernation sites are known from Ford or Iroquois County, although critical hibernating habitat is known in LaSalle County.

The risk to bats from collisions with moving wind turbine blades appears to be up to four times higher than for birds. To date, no Indiana Bats have been documented as killed by wind turbines. But, until recently, no utility-scale wind farms have been proposed or constructed within the range of Indiana Bats, so the risk to this species from wind turbines remains unquantified.

The project area appears to contain no potential summer nursery or roosting habitat for the Indiana Bat, but individuals roosting along the Middle Fork may forage above fields within the project area. Because the winter hibernation sites of these bats are unknown, the greatest risk may be to Indiana Bats migrating across or through the project area. Efforts to identify and monitor the foraging and migration behavior of this bat population may establish the degree of risk which this facility would pose to this species.

The Department rates the potential for an incidental take of an Indiana Bat at this facility as low, but cannot rule it out. More common bat species undoubtedly occupy habitats in the vicinity, and are probably at risk of mortality, directly through collisions with wind turbines, or indirectly through barotrauma (lung hemorrhages caused by extremely low air pressures in the vortices created by wind turbine vanes).

It is recommended that an Anabat detector survey be conducted, particularly during the fall bat migratory season (August 1 through October 31) when activity would be expected to be the highest, in order to characterize bat activity in the project area. High frequency bat signals could indicate the presence of the Indiana Bat in the vicinity, and a high level of bat activity may warrant post-construction mortality studies.

**Wavy-Rayed Lampmussel, *Lampsilis fasciola*, and Little Spectaclecase, *Villosa lienosa*.**

These endangered and threatened mussel species are found in the Middle Fork, and their populations may extend up tributary streams and ditches in the project area in Ford County. (Some of the largest populations of the Little Spectaclecase exist in agricultural drainage ditches.) They require high water quality, and are sensitive to siltation, sedimentation, and pollution. They are dependent for successful reproduction on the presence of healthy populations of their host fishes, the Small-Mouth Bass (Wavy-Rayed Lampmussel), and Bluegill and Largemouth Bass (Little Spectaclecase).

**Ironcolor Shiner, *Notropis chalybaeus*.**

This State-listed threatened fish was collected from Pigeon Creek, near Cissna Park, in 2000, about ten miles downstream of the project footprint, but it may occur higher in the watershed. Pigeon Creek drains the northern slopes of the project in both Iroquois and Ford Counties. This species favors low-gradient streams and ditches with sand/silt substrates and abundant aquatic vegetation. Water only a few inches deep or wide is sufficient to support this species.
Wind energy development may adversely affect this species and its essential habitat through siltation and sedimentation related to construction activities, including the modification of roads, culverts, and bridges, and the use of temporary fords and crossings of streams and drainage ditches. Best management practices should be incorporated to minimize risk of impact. If in-stream work may occur, an Incidental Take Authorization should be considered.

**Potential Listed Species**

**Loggerhead Shrike, *Lanius ludovicianus*.**

The threatened Loggerhead Shrike is adapted to the savanna conditions of interspersed grasslands, shrubs, and trees. This species has been adversely affected by the decline in animal husbandry and the abandonment of the "shelter-belt" fence-row conservation practice, which has severely reduced both breeding and foraging habitat. The Shrike, also known as the "butcher bird," needs thorny trees and shrubs, even barbed wire, on which to impale its prey, which may be left for several days before being eaten. Areas which support large insects and small rodents, major food items, are also necessary. Due to losses of suitable habitat, Loggerhead Shrikes may attempt reproduction in trees near human habitations and in other areas where they would normally not be expected. The Shrike has not been reported as breeding in Ford or Iroquois County since its listing.

The primary consideration for wind energy facilities is the potential for further loss of remaining habitat, if fence-rows are cleared to avoid wind turbulence or to improve turbine exposure, or if road-side trees are cleared to create turning radii for turbine carriers or to establish power lines. A pre-construction survey to identify the presence of Shrike nests should be conducted for areas with suitable habitat if work is proposed during the breeding season in order to avoid direct mortality. “Resident” foraging birds are not thought to be at significant risk from operating wind turbines, but potential risk associated with migrants should be considered.

**Short-Eared Owl, *Asio flammeus*.**

The endangered Short-Eared Owl also nests and winters in grasslands and wetlands. Ford and Iroquois County lie in both breeding and wintering ranges, although breeding Short-Eared Owls have not been reported in Ford or Iroquois County since they were listed. However, large numbers of wintering owls have been observed in suitable winter habitat in Iroquois County.

Highly nomadic, the Short-Eared owl depends heavily on vole and mouse populations, and the size of its breeding and hunting territories varies inversely with prey population sizes. When prey populations are high, owls may be ground-roosting every few meters in suitable habitat.

The Northern Harrier often harasses this Owl, stealing its food.

This Owl's hunting flights are often less than ten feet off the ground (a circumstance which makes this bird highly vulnerable to collisions with vehicles); during aerial mating rituals, flights occur at typical wind turbine rotor-swept height. This Owl is highly dependent on its acute hearing to locate and seize prey. The degree to which noise from wind turbines may interfere with predation behavior is unknown.

The effects of wind turbines on Short-Eared Owls may be heavily influenced by the proximity of turbines to breeding, roosting, and hunting areas. Once turbines are built, this proximity relationship will be subject to change as land owners alter land management practices. This is likely to be of concern mainly if attractive habitat for Owls and their prey is created within or near the turbine array following construction.

**Barn Owl, *Tyto alba*.**

This endangered raptor nests in larger tree cavities and in barns or abandoned buildings, sometimes within city limits. A breeding record exists for Ford County, west of Melvin; none have been recorded from Iroquois County since the species was listed. This owl hunts both open woodlands and grasslands; its preferred prey consists of small rodents such as mice and voles. The main risk posed by wind power facilities to this species is the removal of suitable nesting trees and abandoned buildings to facilitate transportation of wind turbine components or to maximize wind energy conversion. Both trees and buildings should be examined for Barn Owl occupancy prior to removal.

**Upland Sandpiper, *Bartramia longicauda*.**

This State-listed threatened grassland bird prefers habitat of short-grass prairie/pasture. For many years this ground-nesting species was thought to be area sensitive, requiring ten acres or more of grassland habitat for successful breeding. However, many recent breeding efforts are occurring in grassed waterways of row-crop fields, which provide considerably less than ten acres of habitat, and from along roadsides.

While no breeding records are known from Iroquois County, a breeding record exists for Ford County, west of Thawville, and this species undoubtedly appears as a migrant in Ford and Iroquois Counties. There has already been at least one instance in 2008 of identification of Upland Sandpipers at the commencement of wind project construction in Stephenson County, a county which had, until then, no prior breeding record for this species.

The Upland Sandpiper engages in an aerial courtship display which passes through the rotor-swept elevations of utility-scale wind turbines, placing it at risk of collision mortality. Whether this species will be sensitive to the proximity of vertical structures, or to shadow "flicker" on potential nesting areas, has not been demonstrated.

The Department recommends mapping all habitat types within the project footprint, and checking even relatively small areas of appropriate habitats for the presence of this species prior to any initiation of construction disturbance during the breeding season.

**Northern Harrier, *Circus cyaneus*.**

The State-listed endangered Northern Harrier is a ground-nesting grassland hawk. It has not been recently documented as nesting from Ford or Iroquois County, but is a frequently-observed migrant. The species has a statewide range. While many sources indicate the species needs large open areas of habitat, Illinois studies have demonstrated this hawk can use relatively small patches of habitat for successful breeding, especially in the vicinity of larger habitats. Breeding is often associated with wetlands such as marshes, sedge meadows, and wet prairies.

While most hunting activities occur at fairly low altitudes, below typical rotor-swept elevations, hunting can expose this bird to collision risk. Like the Upland Sandpiper, this species engages in an aerial courtship display which places it at risk of collision with wind turbines. Wind farm construction and operation may alter concentrations of prey species.

This hawk relies heavily on its acute hearing to locate prey, and--if the noise generated by wind turbines interferes with this function (which is not known to be the case)--turbines might adversely affect their ability to hunt near the turbines, reducing available food resources.

If pre-construction surveys indicate use of the project area by migrant Harriers, post-construction surveys should be performed to determine whether the Harrier continues to hunt territories in proximity to turbines.

**Migratory Birds**

**American Golden Plover, *Pluvialis dominica*.**

This migratory bird breeds in the Arctic tundra, migrates south along the Atlantic seaboard to South America in the winter, but returns northward through central North America. Areas of Illinois and Indiana provide important spring migration staging areas, which may be occupied by this species for a month or more while birds go through a molt before resuming migration. It has become a species of concern due to its relatively low global population estimate of around 300,000 birds.

Based on 25 years of Spring Bird Count data, it is likely that significant numbers of this species congregate in Ford and Iroquois Counties, within or adjacent to the project footprint. Because large operating wind energy facilities already exist in Benton County, IN, up to the State line, it is possible Plovers which usually stage in Indiana may be displaced into Iroquois County. Large numbers of this species are routinely observed south of Sibley Grove in Ford County. Pre- and post-construction surveys should be performed to observe this species.

Plovers tend to aggregate in dense concentrations, and are known to fly in large tight groups through the approximate rotor-swept elevation, which may expose them to collision mortality risk.  Concerns also exist pertaining to habitat fragmentation by service roads, and displacement from habitat due to potential sensitivity to vertical structures and human activity.

A research project has begun in an effort to better understand the behavior and needs of this species, as well as how it may be affected by the presence of wind turbines.  Some preliminary results were recently published [O'Neal, *et. al.* (2008)] .

One apparent finding is that the species definitely concentrates in a few areas, rather than being generally dispersed across suitable habitat, resulting in temporarily dense population "hot-spots." However, where these may be located may be influenced year-to-year by poorly understood climatic cues.  Very few birds appeared in 2008 in the expected concentration areas; instead, major concentrations occurred more than one hundred miles to the south.  Anecdotal evidence indicates this is an unusual occurrence.

A number of observers had reported a daytime habitat preference for short grass, soybean stubble, or bare ground with standing water or residual moisture, but O'Neal first reported a night roost preference for standing corn stubble cover, with crepuscular movement between the two. O'Neal reported all observations were located more than 70 meters from adjacent roads, suggesting an intolerance for breaks in habitat.  (Effects of traffic were not investigated.) Interestingly, O'Neal also reported several observations of predation of the Golden Plover by the Northern Harrier.

**Smith's Longspur, *Calcarius pictus***

The Smith's Longspur breeds along the northern margin of the boreal forest, wintering in southern Missouri and southwestern Illinois, and returning north through Illinois in the early spring, a few weeks earlier than the Golden Plover.  Consequently, it is rarely recorded during Spring Bird Counts.  The global population estimate for this species is a mere 75,000 birds. Moving in small flocks of 10-20 individuals, local flights are at high speed within rotor-swept elevations.  It has similar habitat preferences to that of the Plover.  Sensitivity to the presence of vertical structures is unknown.

**Whooping Crane, *Grus americana*, and Sandhill Crane, *Grus canadensis*.**

An experimental population of the federally-listed endangered Whooping Crane has been established with breeding grounds in Wisconsin and wintering areas in Florida.  Spring and Fall migrations take these very large birds through Illinois.   Whooping Cranes often "stop over" during migration and this may occur virtually anywhere in the State.  The State-listed threatened Sandhill Crane, which breeds in Illinois, may accompany Whooping Cranes during migration in mixed flocks, as well as in flocks consisting solely of Sandhill Cranes.

Whooping Cranes may "stop over" in Ford and Iroquois Counties for extended periods.  In November 2006, during their first unescorted Fall Migration, a pair of Cranes rested for four days along the upper East Branch Vermilion River (Wabash Drainage) in Ford County.  That same month, two groups of Whooping Cranes, on separate occasions, spent several days west of Chebanse, Iroquois County. A Whooping Crane spent two months near Beaverville, Iroquois County, in 2003, and another loitered near Danville, Vermilion County, until the end of June 2008. Nearly 100 Sandhill Cranes were observed in Ford County during spring migration in 2008. And during the Fall 2008 migration, 22 Whooping Cranes "stopped-over" in Livingston County. During the Fall 2008 ultra-light-led migration, one of the 14 young birds refused to fly over a wind energy facility in McLean County at an elevation of 2,500 feet, and had to be led around.

During such stop-overs, cranes often forage on waste corn in nearby agricultural fields. Wind turbines and associated power lines pose a collision risk for these large birds, which require some distance to achieve safe altitudes. Most non-predation losses to this flock have been to power line collisions. The Fall 2008 refusal of a young Crane to fly over a wind farm in McLean County suggests that at least some birds may shy away from wind turbine arrays.

One strategy to reduce the danger to these species is to avoid siting turbines close to potential stop-over habitat (ponds or wetlands of any type). (In November 2007, photographic evidence was obtained of a Whooping Crane and about 50 Sandhill Cranes foraging well within a quarter mile of a Wisconsin wind turbine, suggesting these species are not deterred by the presence of a turbine.) Buffers as great as five miles have been suggested, but in Illinois' landscape such buffers would preclude wind turbines in most locations, and have not been shown to be necessary.

Alternatively, stop-over habitat more distant from planned turbine locations could be enhanced to be more attractive to cranes and draw then away from danger (although the factors which cause cranes to choose particular sites are poorly understood). The visibility of power lines should be maximized with appropriate line markers. The developer may wish to consider other voluntary efforts to promote Crane conservation.

Due to the very high public profile of the Whooping Crane, the Department suggests the developer/operator of this particular facility coordinate at least annually with the Whooping Crane Eastern Partnership (www.bringbackthecranes.org) to track the passage of Whooping Cranes through the vicinity, and explore additional measures to reduce potential losses of these birds. If either species is consistently observed in proximity to wind turbines or associated power lines, the developer or operator should seek an Incidental Take Authorization from the appropriate regulatory agency.

EcoCAT
Ecological Compliance Assessment Tool

| | | | |
|---|---|---|---|
| *Applicant:* | E.ON Climate and Renewables North America, Inc. | *IDNR Project #:* | 0902944 |
| *Contact:* | Joe Borkowski | Date: | 10/01/2008 |
| *Address:* | 401 N. Michigan Ave., Suite 1720<br>Chicago, IL 60611 | | |

*Project:* E.ON Paxton Wind Energy Center
*Address:* Rural Paxton, Paxton

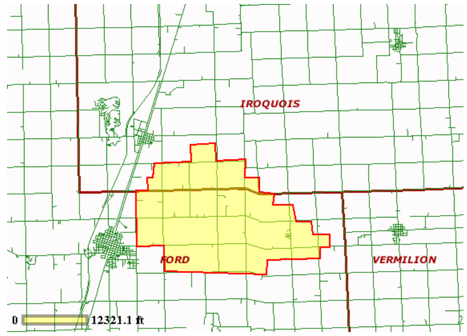
*Description:* Utility-scale wind energy facility.

## Natural Resource Review Results

**Consultation for Endangered Species Protection and Natural Areas Preservation (Part 1075)**
The Illinois Natural Heritage Database shows the following protected resources may be in the vicinity of the project location:

Clarence Railroad Prairie INAI Site
Clarence West Railroad Prairie INAI Site
Loda Cemetery Prairie INAI Site
Middle Fork Of The Vermilion River INAI Site
Pellville Cemetery INAI Site
Prospect Cemetery Prairie INAI Site
Loda Cemetery Prairie Nature Preserve
Prospect Cemetery Prairie Nature Preserve
Eastern Prairie Fringed Orchid *(Platanthera leucophaea)*
Henslow'S Sparrow *(Ammodramus henslowii)*
Indiana Bat *(Myotis sodalis)*
Ironcolor Shiner *(Notropis chalybaeus)*
Little Spectaclecase *(Villosa lienosa)*
Mead'S Milkweed *(Asclepias meadii)*
Wavy-Rayed Lampmussel *(Lampsilis fasciola)*

**An IDNR staff member will evaluate this information and contact you within 30 days to request additional information or to terminate consultation if adverse effects are unlikely.**




**Location**

The applicant is responsible for the accuracy of the location submitted for the project.

*County:* Ford

*Township, Range, Section:*

| | |
|---|---|
| 23N, 10E, 1 | 23N, 10E, 2 |
| 23N, 10E, 3 | 23N, 10E, 4 |
| 23N, 10E, 8 | 23N, 10E, 9 |
| 23N, 10E, 10 | 23N, 10E, 11 |
| 23N, 10E, 12 | 23N, 10E, 13 |
| 23N, 10E, 14 | 23N, 10E, 15 |
| 23N, 10E, 16 | 23N, 10E, 17 |
| 23N, 10E, 23 | 23N, 10E, 24 |
| 23N, 11E, 1 | 23N, 11E, 12 |
| 23N, 11E, 13 | 23N, 11E, 24 |
| 23N, 14W, 5 | 23N, 14W, 6 |
| 23N, 14W, 7 | 23N, 14W, 8 |
| 23N, 14W, 9 | 23N, 14W, 16 |
| 23N, 14W, 17 | 23N, 14W, 18 |

*County:* Iroquois

*Township, Range, Section:*

| | |
|---|---|
| 24N, 10E, 25 | 24N, 10E, 26 |
| 24N, 10E, 27 | 24N, 10E, 28 |
| 24N, 10E, 33 | 24N, 10E, 34 |
| 24N, 10E, 35 | 24N, 10E, 36 |
| 24N, 11E, 25 | 24N, 11E, 36 |
| 24N, 14W, 31 | |

**IL Department of Natural Resources Contact**

Keith Shank

217-785-5500

Division of Ecosystems & Environment

**Local or State Government Jurisdiction**

Ford County Zoning Office
Candice Short
200 W. State St., Rm 104
Paxton, Illinois 90957-1199

**Disclaimer**

The Illinois Natural Heritage Database cannot provide a conclusive statement on the presence, absence, or condition of natural resources in Illinois. This review reflects the information existing in the Database at the time of this inquiry, and should not be regarded as a final statement on the site being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments. If additional protected resources are encountered during the project's implementation, compliance with applicable statutes and regulations is required.

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# APPENDIX C

# SITE PHOTOGRAPHS


Photo 1. Agricultural land use at the Pioneer Trail Wind Farm. The field to the right is partially tilled corn field, and the field to the left is tilled soy field.


Photo 2. Typical active agriculture field present within survey and used for transects, the field on right is untilled corn field and on left is partially till corn field (April surveys).


Photo 3. Drainage ditch and green belt area with tilled corn field in foreground.


Photo 4. Previously railroad, now access road between agriculture fields with drainage ditch lines and canopy present on both sides of access road.


Photo 4. Example of active agriculture field with tilled soy field on left and semi-tilled corn field on right with green belt transition zone between two fields.


Photo 5: Active agriculture field with 300+ golden plovers and other plover spp foraging within field while tractor is present tilling up land. Field was not used as transect or observation point.


Photo 6: Active agriculture field with 300+ golden plovers and other plover spp foraging within field while tractor is present tilling up land.  Field was not used as transect or observation point.

**Appendix C: Fall 2012 and Spring 2013 Avian and Bat Post-Construction Mortality Monitoring Report**

Imagine the result

**E.ON Climate & Renewables, North America**

# Fall 2012 and Spring 2013 Avian and Bat Post-Construction Mortality Monitoring Report

Pioneer Trail Wind Farm

August 2013

Bret Graves
Staff Ecologist/Scientist

Allison Chapin
Project Ecologist/Scientist

Brian J. Maillet
Certified Project Manager/Principal-In-Charge

**Fall 2012 and Spring 2013 Avian and Bat Post-Construction Mortality Monitoring Report**

Pioneer Trail Wind Farm

Prepared for:
E.ON Climate & Renewables, North America

Prepared by:
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Our Ref.:
WI001302.0001

Date:
August 14, 2013

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## EXECUTIVE SUMMARY

ARCADIS conducted post-construction avian and bat mortality monitoring at the Pioneer Trail Wind Farm, operated by Pioneer Trail Wind Farm, LLC, for the fall 2012 and spring 2013 seasons in accordance with the Avian and Bat Protection Plan (ABPP) (Stantec 2012) and the draft Pioneer Habitat Conservation Plan (HCP), (Stantec 2013). The main objectives of this post-construction monitoring study were to estimate the number of avian and bat mortalities attributable to wind turbines in the Pioneer Trail Wind Farm Project Area (Project Area) and to assess the potential impacts to birds and bats, including federal and state special status (endangered, threatened, or special concern) species. The mortality study protocols were developed based on recommendations provided by the Illinois Department of Natural Resources (IDNR), Division of Wildlife Resources and the U.S. Fish and Wildlife Service (USFWS), as well as ARCADIS' best knowledge with regards to post-construction mortality monitoring methodologies. The study included searcher efficiency and carcass removal trials to account for biases in mortality estimates. The monitoring and removal trial data was used in the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009) to calculate avian and bat mortality rates for the Project Area.

Using the modified Erickson estimator produced an estimate of 23.00 ± 11.60 (90% confidence limits 8.51-38.30) total bird mortalities for the fall 2012 study period and 12.00 ± 1.15 (90% confidence limits 2.67-20.40) total bird mortalities for the spring 2013 study period. This equates to 0.46 ± 0.232 birds per wind turbine, 0.29 ± 0.145 birds per MW, and 0.000099 ± 0.0000498 birds per rotor-swept square meter for the fall 2012 study period and 0.24 ± 0.023 birds per wind turbine, 0.15 ± 0.014 birds per MW, and 0.000052 ± 0.00000494 birds per rotor-swept square meter for the spring 2013 study period. The Erickson estimator produced an estimate of 38.00 ± 11.60 (90% confidence limits 23.13-53.10) total bat mortalities for the fall 2012 study period and 20.00 ± 1.40 (90% confidence limits 9.78-30.90) total bat mortalities for the spring 2013 study period. This equates to 0.76 ± 0.232 bats per wind turbine, 0.48 ± 0.145 bats per MW, and 0.00163 ± 0.0000498 bats per rotor-swept square meter for the fall 2012 study period and 0.40 ± 0.028 bats per wind turbine, 0.25 ± 0.018 bats per MW, and 0.000086 ± 0.00000601 bats per rotor-swept square meter for the spring 2013 study period.

Compared to published mortality rates at other wind farm sites across the U.S., the estimated avian and bat mortality rates at the Project Area were low. The levels of mortality that were estimated are not expected to have population-level impacts on any species. In addition, all of the bird and bat carcasses that were found during this study were all relatively common species, and no federally listed, state listed or special concern species were found. The estimated fatality rates from the modified Erickson estimator, along with the assumed proportion of Indiana bat fatalities to total bat fatalities, produces Indiana bat fatality estimates of 0.05 and 0.03 during the fall 2012 and spring 2013 study periods, respectively. However, these estimates do not indicate that any actual Indiana bat fatality has occurred, and we re-iterate that no Indiana bat mortality was found during either study period.

ARCADIS recommends that Pioneer Trail Wind Farm, LLC operations personnel continue to follow wildlife incident reporting procedures to document incidentally observed avian and bat mortalities and continue to conduct formal post-construction avian and bat mortality monitoring for the fall 2013 and spring 2014 study periods. Per the ABPP (and consistent with the draft HCP), following one more year of monitoring with favorable results, spring monitoring will be discontinued and only fall monitoring will be conducted every five years (Stantec 2012).

## 1. Introduction

Pioneer Trail Wind Farm, LLC, an indirect wholly owned subsidiary of E.ON Climate and Renewables, N.A. (E.ON), is currently operating the Pioneer Trail Wind Farm Project Area (Project Area). The Project Area is located on privately owned land approximately one mile east of the city of Paxton in Iroquois and Ford counties, Illinois (Figure 1). The Project Area consists of 94, 1.6 megawatt (MW) turbines, for a total generating capacity of 150.5 MW. The turbines began operating in December of 2011.

### 1.1 Regulatory Background

The Migratory Bird Treaty Act (MBTA) is a federal statute that makes it unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product, manufactured or not. The majority of birds in the United States are legally protected under the MBTA, with the exception of game bird species and non-native species such as European starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*), and rock pigeon (*Columba livia*). In addition, the federal Bald and Golden Eagle Protection Act (BGEPA) prohibits the take of bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*). The Endangered Species Act (ESA) protects species that are federally listed as endangered or threatened.

The U.S. Fish and Wildlife Service (USFWS) has acknowledged that they will focus their resources on "investigating and prosecuting those who take migratory birds without identifying and implementing reasonable and effective measures to avoid take" (USFWS 2012). In March 2012, the USFWS finalized their Land-based Wind Energy Guidelines, which recommend that developers use a tiered approach for evaluating impacts of wind energy facilities on wildlife (USFWS 2012). With this study, Pioneer Trail Wind Farm, LLC has moved through four of the five possible tiers described in the Recommended Guidelines. The post-construction avian and bat mortality study described in this report is consistent with Tier 4 of these guidelines, "Post-construction Studies to Estimate Impacts."

Illinois statutes give legal protection to wildlife species that are listed as endangered or threatened at the state level. The Illinois Department of Natural Resources (IDNR), Division of Wildlife Resources also list species with declining populations as "Special Concern" species (IDNR 2013). These species have no legal protection beyond those under the MBTA (as applicable), but IDNR provides recommendations for their protection so they do not become listed as threatened or endangered in the State of Illinois.

### 1.2 Purpose

The primary purposes for conducting post-construction mortality monitoring were to document avian and bat mortalities associated with operation of the Project Area and to help Pioneer Trail Wind Farm, LLC comply with federal and state wildlife statutes. The main objectives of this study were to estimate the number of avian and bat mortalities attributable to wind turbines in the Project Area and to assess the potential impacts of wind farm operations on birds and bats, especially federal and state special status (endangered, threatened, or special concern) species.

### 1.3 Project Area Description

The Project Area encompasses approximately 12,500 acres of privately owned land and is comprised of all or portions of the following Sections, Townships, and Ranges as mapped on Figure 1.

| PIONEER WIND FARM, PROJECT AREA | |
|---|---|
| **Township/Range** | **Section(s)** |
| T23N R10E | 1-4, 9-16, 23 |
| T23N R11E | 1, 12-13 |
| T23N R14W | 6-9, 16-19, 21, 28-29 |
| T24N R10E | 26-27, 33-36 |
| T24N R11E | 36 |
| **USGS Quad Name** | **USGS Quad ID** |
| Paxton | 40088-D1 |
| Buckley | 40088-E1 |
| Rankin | 40087-D8 |

The Project Area is located on relatively flat converted farmland. Most water features and wetlands on the site have been converted into active farmland or have been managed to sustain only small, isolated wetlands and agricultural runoff ditches.

Prairie fringe habitat consisting primarily of annual grasses borders the roads, abandoned railroads, and drainage ditches. The prairie habitat ranges from 2 to 4 meters wide on each side of the road or railroad right-of-way and is occasionally mowed. There are no large forested areas within the Project Area, and there are only a few isolated small woodlots and tree-lined areas located along drainage ditches, railroad rights-of-way, and residential properties. The majority of potential habitat within the Project Area is agricultural land that is actively farmed for corn, soy beans and winter wheat (Figure 1).

The nearest known Indiana bat maternity colony to the Project Area is located approximately three miles south of the Project Area along the Middle Fork of the Vermilion River and the nearest hibernaculum to the Project Area is the Blackball Mine, approximately 120 miles (190 km) northwest of the Project Area. Indiana bats in the maternity colony along the Middle Fork of the Vermilion River may originate from the Blackball Mine, or from hibernacula in southwestern Indiana and Kentucky, or they may migrate in both directions, with bats from different caves mingling during the summer (IDNR 2010). If Indiana bats from the Middle Fork of the Vermilion River maternity colony hibernate in the Blackball Mine, their migration route may take them through the Project Area and may present a risk of mortality for these bats, (although bat movement patterns in fall often do not follow a simple linear path of migration from summer habitat to hibernacula [USFWS 2007]). Conversely, if the bats hibernate to the south or southeast, the wind turbine generators (WTGs) in the Project Area are unlikely to pose a risk.

## 2. Methods

This section describes the methods for the various components of post-construction mortality monitoring, including the methods for avian and bat carcass searches, carcass removal trials, and searcher efficiency trials. The following methods were based on the recommendations provided by IDNR, Division of Wildlife Resources, ARCADIS' past experience, and a review of current, published scientific literature.

### 2.1 Avian and Bat Carcass Searches

The post-construction avian and bat mortality monitoring was conducted following the commencement of WTG operations in December 2011. The studies were completed over the fall season of 2012 and spring season of 2013. Two ARCADIS biologists as well as an ARCADIS contracted dog-and-handler team from the Illinois area (Rock Hollow Conservation Club) searched for avian and bat carcasses for nine weeks between August 13 and October 10, 2012 and for six weeks between April 2 and May 8, 2013. Standardized carcass searches were conducted weekly at 50 of the 94 WTGs each week. The nine week fall study period began on August 13, 2012 in order to accommodate crop clearing activities in the full plot areas. The 50 WTGs that were sampled were determined using a stratified random sampling approach with a weighted component; 50 percent of the sample WTGs were selected from the southern 25 percent of the Project Area (closer to the Middle Fork of the Vermilion River Indiana bat maternity colony).[1]

Eighty percent of the 50 WTGs selected (40 locations) were part of a limited standardized carcass search (hereafter referred to as 'limited-search') of only the turbine pads and access roads out to 262 feet (80 m) from the WTG. The remaining ten WTGs were part of a full-coverage standardized carcass search (hereafter referred to as 'full-search').

The full-search utilized a transect methodology within an 80 meter x 80 meter square search plot. ARCADIS used ESRI, ArcGIS 10.0 software in order to: 1) center each full-search plot on the WTG location and 2) establish the 13 transects. ARCADIS uploaded the search transects and plots onto handheld Global Positioning System (GPS) units. Once in the field, searchers used handheld GPS units to navigate on foot along search transects. This methodology assisted with documentation of the full-search results.

During searches, the ARCADIS biologists walked parallel to each other at a rate of approximately 2 mph (45 to 60 m per minute) while searching 10 ft (3 m) on either side of each transect.

For all carcasses found, data recorded included:

- Date and time,
- Initial species identification,

---

[1] The stratified random sampling approach was decided through agency communication during the Habitat Conservation Plan review process for the Indiana Bat Incidental Take Permit. The approach was not determined until the fall 2012 surveys were already started, and therefore not implemented until week 5 of the fall 2012 surveys. For weeks 5 through 9, the stratified random sampling was applied to the 40 limited plots, but not the full search plots because those locations were already communicated to the client and the 80 by 80 meter plots were cleared. All 50 WTGs were included in the stratified random sampling approach for the spring 2013 surveys.

- Sex, age, and reproductive condition (when possible),
- 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 was taken before the carcass was handled and removed. All carcasses were labeled with a unique number, bagged, and stored in a freezer at the Pioneer Trail Wind Farm, LLC operations and maintenance building.

Bird and bat carcasses found in non-search areas were coded as "incidental finds" and documented as much as possible in a similar fashion to those found during standard searches. These finds were excluded from statistical analyses.

ARCADIS also had one dog-and-handler team (hereafter referred to as 'dog team') perform 50 percent or five of the ten weekly full-searches at the Project Area to assess the relative effectiveness and logistic feasibility of using dog teams to perform standardized carcass searches at the Project Area.

The dog team was experienced in recovery of both bat and bird carcasses. The dog team search plots were rotated weekly with those searched by human searchers. This removed individual WTGs and locations as potential confounding factors and allowed ARCADIS to obtain fully comparable datasets for each search methodology. One ARCADIS biologist (separate from the two-person ARCADIS search team) documented the dog team for a one day period every other week to ensure compliance with the project objectives.

### 2.2 Searcher Efficiency Trials

Searcher efficiency trials were used to estimate the percentage of all bat and bird fatalities that were detected during the carcass searches. Similarly, carcass removal trials were used to estimate the percentage of bat and bird fatalities that were removed by scavengers prior to being located by searchers (Refer to Section 2.3). When considered together, the results of these trials represent the likelihood that a fatality which falls within the searched area will be recorded and considered in the final fatality estimate.

Trials were conducted during each study period by placing "trial" carcasses in the searched areas (one trial during the spring monitoring season and two trials during the fall monitoring season) to account for changes in personnel, searcher experience, weather, and scavenger densities. The number of trial carcasses used varied based on the number of carcasses available following initial carcass searches in the Project Area. During the fall survey, there were 17 trial carcasses placed for the human team and 17 additional carcasses placed for the dog team. During the spring survey, there were ten trial carcasses placed for each the human team and dog team. Carcasses used included tree swallow (*Tachycineta bicolor*), chimney swift, (*Chaetura pelagica*), American robin (*Turdus migratorius*), golden-crowned kinglet (*Regulus calendula*), house sparrow (*Passer domesticus*), little brown bat (*Myotis lucifugus*), eastern red bat (*Lasiurus borealis*) and silver-haired bat (*Lasionycteris noctivagans*). Searcher efficiency and carcass removal trials were limited to one spring and two fall trials to avoid attracting scavengers to the Project Area with carcasses and potentially artificially inflating the carcass removal rate.

Each trial carcass was discretely marked and labeled with a unique number so that it could be identified as a trial carcass. Prior to placement, the date of placement, species, WTG number, distance and direction from the WTG was recorded and the locations were also recorded into a handheld GPS unit

Searcher efficiency trials were conducted blindly; the searchers did not know at which search turbines trial carcasses were placed or where trial carcasses were located within the subplots. The number and location of trial carcasses found by the searchers were recorded and compared to the total number placed in the subplots. After the trial carcasses were discovered by searchers, they were left in the same location as found. The number of trial carcasses available for detection (non-scavenged) was determined immediately after the conclusion of the trial. In addition, searcher efficiency trials were frequently conducted over a two-day period; as such, some trial carcasses may have been scavenged prior to the efficiency trials. Therefore, any carcasses that were scavenged prior to the start of the searcher efficiency trial were removed from the total count of carcasses available for detection and were not included in the searcher removal trials.

### 2.3 Carcass Removal Trials

The removal of avian and bat carcasses by scavenging, or other means, (e.g., surface disturbing activities), can bias carcass search results. Mortality rates can be underestimated if carcasses are removed from the search plot before biologists detect them. To account for this potential bias, carcass removal trials were conducted as part of this study. The objective of these trials was to determine the average number of days an avian or bat carcass remained visible to searchers before being removed by scavengers or otherwise rendered undetectable.

As previously mentioned, two carcass removal trials were conducted in the fall and one trial in the spring to avoid attracting scavengers to the Project Area with carcasses and potentially artificially inflating the carcass removal rate. During the fall 2012 survey period, 18 carcasses were placed out for removal trials, which included eight little brown bats, two silver-haired bats, six eastern red bats, one American redstart (*Setophaga ruticilla*) bird, and one tree swallow bird. During the spring 2013 survey period, ten carcasses were placed out for removal trials, which included seven little brown bats, one silver-haired bat, and two eastern red bats. Bird carcasses located during the fall 2012 survey period had decomposed to the point that none of them could be used for the spring 2013 efficiency and removal trials. No bird carcasses were located during the spring 2013 study prior to the conducted efficiency and removal trials. Trial carcasses were left in place after the searcher efficiency trials and monitored for a period of up to 30 days. Carcasses were checked on days one and two, then approximately every-other day that the ARCADIS biologists were onsite until the survey period was completed, or 30 days was reached. The presence or absence status of each trial carcass was recorded throughout the trial.

### 2.4 Data Analysis

The methodology for estimating overall bird and bat fatality rates largely followed the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). Huso (2010) has recently proposed an estimator that may offer less bias than the Erickson estimator. The positive bias and different sensitivity to searcher efficiency and carcass removal rates associated with the Huso estimator may make comparisons to estimates derived using the Erickson (2003) or Shoenfeld (2004) estimators, which tend towards negative biases, problematic. Therefore, maintaining the same biases and assumptions in estimating overall bat fatality at the Project Area will be useful for developing fatality estimates that can be compared to other sites and used to determine if any of the adaptive management triggers have been met.

Following Erickson, et al. (2003), the estimate of the total number of WTG-related casualties was based on four components: (1) observed number of casualties, (2) searcher efficiency, (3) scavenger removal rates, and (4) estimated percent of casualties that likely fall in non-searched areas, based on percent of area searched around each WTG. Variance and 90 percent confidence intervals were calculated using bootstrapping methods (Erickson, et al. 2003 and Manly 1997 as presented in Young, et al. 2009) or jackknife methods (USEPA, 2010), depending on sample size.

### 2.4.1 Calculating Observed (Unadjusted) Number of Mortalities

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

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

where n is the number of WTGs searched, and $c_j$ is the number of casualties found at a WTG. Incidental mortalities, (those found outside of the searched area or by maintenance personnel) were excluded from this calculation and from the estimated fatality rate.

### 2.4.2 Estimated Searcher Efficiency Rates

Searcher efficiency (p) represented the average probability that a carcass was detected by searchers. The searcher efficiency rates were calculated by dividing the number of trial carcasses observers found by the total number that remained available during the trial (non-scavenged). Searcher efficiency was calculated for each season and for all search methods (roads and pads, full plots, and human searchers).

### 2.4.3 Estimating Carcass Persistence Time

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

$$t = \frac{\sum_{i=1}^{s} t_i}{s - s_c}$$

Where s is the number of carcasses placed in the carcass removal trials and $s_c$ is the number of carcasses censored. This estimator is the maximum likelihood (conservative) estimator assuming the removal times follow an exponential distribution, and there is right-censoring of the data. Any trial carcasses still remaining at 30 days were collected, yielding censored observations at 30 days. If all trial carcasses had been removed before the end of the search period, then $s_c$ would have been zero and the carcass removal rate would have been calculated as the arithmetic average of the removal times. Carcass removal rate was calculated for each season and for all search methods (roads and pads, full plots, and human searchers).

### 2.4.4 Area Adjustment

Approximation of *A*, the adjustment for areas which were not searched, was adapted from the Erickson et al. (2003) estimator, as modified by Young et al. (2009), to accommodate differences in carcass search study design (discussed in Section 6.8.4). For the Pioneer Trail Wind Farm fatality estimates, *A* represented the adjustment for the proportion of carcasses which likely fell outside of the area searched. The value for *A* was approximated using the following formula:

$$\mathrm{A} = \frac{\left(\frac{C_{RP}}{P_{RP} * S_{RP}}\right) + \left(\frac{C_{FP}}{P_{FP} * S_{FP}}\right)}{\left(\frac{C_{RP}}{P_{RP}}\right) + \left(\frac{C_{FP}}{P_{FP}}\right)}$$

where $C_{RP}$ is the number of observed casualties on roads and pads, $C_{FP}$ is the number of observed casualties on full plots, $P_{RP}$ is the searcher efficiency on roads and pads, $P_{FP}$ is the searcher efficiency on full plots, $S_{RP}$ is the proportion of roads and pads searched across all study turbines, and $S_{FP}$ is the proportion of full plots searched across all study turbines. For this study, $S_{RP} = 0.8$ and $S_{FP} = 0.2$, as only roads and pads were searched at 80 percent of the study turbines and full plot searches were conducted at the remaining 20 percent of the study turbines.

### 2.4.5 Estimation of the Probability of Carcass Availability and Detection (π)

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

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

where I is the interval between searches. For this study, I=7 for baseline carcass searches during the spring and fall periods.

#### 2.4.6 Calculating Estimated (Adjusted) Number of Mortalities

Mortality estimates were calculated using the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). The estimated mean number of casualties/turbine/study period (m) was calculated by dividing the estimated mean observed number of casualties/turbine/study period (c) by π, an estimate of the probability a carcass was not removed and was detected, and then multiplying by A, the adjustment for the area within the search plots which was not searched:

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

## 3. Results

In total, 40 carcasses were found during the survey period; of those five were incidental observations and excluded from statistical analysis. During the fall of 2012, 21 total carcasses were observed during searches, of which five were birds including the American redstart, turkey vulture (*Cathartes aura*), red-breasted nuthatch (*Sitta canadensis*) and two unknown bird species. The remaining 16 were bats, including eight eastern red bats, two silver-haired bats, five little brown bats, and one unidentified (unknown bat). The unknown bat that was located was a pile of bones, in situ, that contained no hair and no head and was completely encased in soil.

During the spring of 2013, 14 total carcasses were observed during searches, of which four were birds including two golden-crowned kinglets, one unidentified sparrow, and one unidentified (unknown) species. The remaining ten were bats, including three eastern red bats and seven silver-haired bats.

Most WTGs had only one carcass observed, six WTGs had two carcasses observed over the study period and one WTG had five carcasses observed over the study period (Figure 2). The WTG with five carcasses observed (E10), did not have any unique characteristics when compared to other WTGs searched. E10 was searched each of the six weeks during the spring study and two times during the fall study. Four of the five carcasses observed were found during the spring study when the turbine was searched each week and three of those four were silver-haired bats. Silver-haired bats are rather common locally in migration during a two week period in May in Illinois which is when they were observed. Autumn migration is spread over a longer period of time, these bats seem less common. Silver-haired bats are also known to forage over woodland ponds and streams and often times are observed flying repeatedly over the same circuit during the evening (Harvey et al. 1999) which could explain the multiple hits in the same location during that migration window. Additional statistical analysis is recommended if this turbine and general location continues to have a higher number of carcasses observed during the following year of this study.

The following sections include a detailed summary of the results of this study.

### 3.1 Observed (Unadjusted) Avian and Bat Carcass Search Results

Twenty-seven bat carcasses and 13 bird carcasses were found during the survey period. Of these, four bird carcasses and one bat carcass were incidental observations found outside of the survey plots or designated search times, and therefore were not included in the mortality estimates. Therefore, 35 total carcasses were used to estimate mortality rates. The bird and bat carcasses that were found during this study were all relatively common species, and no federally listed, state listed or special concern species were found. Table 1 and Figure 2 summarize observed bird and bat mortality data for the fall 2012 to spring 2013 monitoring period.

#### 3.1.1 Incidental Carcass Observations

Five carcasses were found incidentally during the study period; one silver-haired bat, one chimney swift, two American robins, and one house sparrow. The silver-haired bat and chimney swift were both observed during the fall 2012 surveys near turbines A8 and A6, respectively. Both were found in good condition. The remaining three birds were observed during the spring 2013 surveys near turbines D7, C7 and B9. Two of the three were in good condition and one was partially scavenged.

### 3.2 Searcher Efficiency Trial Results

Searcher efficiency trial results are presented in Table 2. There were two separate trials conducted on the human search teams and the dog team during the fall survey period, and one trial was conducted for each team in the spring.

Because only two bird carcasses were available (i.e. not highly decomposed) for use in searcher efficiency trials, the human searcher efficiency for birds and bats was combined and thus results in a more conservative estimate of human searcher efficiency. Human searcher efficiency was variable throughout the monitoring period, with a low of 0.57, a high of 0.78, and an average of 0.71 across all biologists and visibility classes.

Dog team searcher efficiency for birds and bats combined varied from 0.29 to 0.88, with an average of 0.63 across all visibility classes.

### 3.3 Carcass Removal Trial Results

Carcass removal trial results for the monitoring period are summarized on Table 3. Carcass persistence times varied across the monitoring period from 9.9 days for bats during the spring survey period to 28.9 days for bats during the fall survey period. The carcass persistence time for birds was 8.0 days during the fall survey period. No birds were used for carcass removal trials during the spring survey period due to the limited quantity of readily available bird carcasses. Therefore, the fall carcass removal results were used for the entire study period.

### 3.4 Calculated (Adjusted) Avian and Bat Mortality Rates

Due to the limited number of unique mortality rates, a jackknife resampling approach was used when calculating the lower confidence limits (LCLs) and upper confidence limits (UCLs) (USEPA 2010). Jackknife resampling was selected as it uses a subset of the data, verses bootstrapping, which uses replacement of randomly selected data points. Given the limited number of unique observations, the use of a subset (jackknife) approach allows for a more accurate determination of standard errors and confidence intervals.

Mortality estimates, standard errors, and confidence intervals for the study period are summarized on Table 4. The Erickson estimator resulted in an estimate of 23.00 ± 11.60 (90% confidence limits 8.51-38.30) total bird mortalities for the fall 2012 study period and 12.00 ± 1.15 (90% confidence limits 2.67-20.40) total bird mortalities for the spring 2013 study period. This equates to 0.46 ± 0.232 birds per wind turbine, 0.29 ± 0.145 birds per MW, and 0.000099 ± 0.0000498 birds per rotor-swept square meter for the fall 2012 study period and 0.24 ± 0.023 birds per wind turbine, 0.15 ± 0.014375 birds per MW, and 0.000052 ± 0.0000049 birds per rotor-swept square meter for the spring 2013 study period. The Erickson estimator produced an estimate of 38.00 ± 11.60 (90% confidence limits 23.13-53.10) total bat mortalities for the fall 2012 study period and 20.00 ± 1.40 (90% confidence limits 9.78-30.90) total bat mortalities for the spring 2013 study period. This equates to 0.76 ± 0.232 bats per wind turbine, 0.48 ± 0.145 bats per MW, and 0.001630 ± 0.0000498 bats per rotor-swept square meter for the fall 2012 study period and 0.40 ± 0.028 bats per wind turbine, 0.25 ± 0.018 bats per MW, and 0.000086 ± 0.0000060 bats per rotor-swept square meter for the spring 2013 study period.

### 3.5 Full Search Plots - Human Search Team versus Dog Search Team

A total of 13 carcasses were located by the human search team and a total 12 carcasses were located by the dog search team within full search plots during the fall 2012 - spring 2013 study period. During the fall season, a total of five carcasses were located by the human search team, of which four were bats and one was a bird. A total of eight carcasses were located by the dog search team, of which seven were bats, and one carcass was a bird.

During the spring 2013 season, a total of eight carcasses were located by the human search team, of which three carcasses were birds and five were bats. A total of four carcasses were located by the dog search team, all of which were bats.

Overall human search efficiency for the full plots was found to be slightly higher at 0.71 (71 percent efficient) compared to the dog team search efficiency for the full plots of 0.63 (63 percent efficient) for the combined fall 2012-spring 2013 study period. Broken down by season, the human search efficiency in the fall was 0.69 (69 percent) compared to the dog team at 0.50 (50 percent efficient). In the spring, human search efficiency was 0.75 (75 percent efficient) compared to the dog team at 0.88 (88 percent efficient).

During the fall season, visibility was lower than the spring season when fields were plowed. Efficiency was higher for both teams in the spring (high visibility class). In addition, efficiency appeared to increase over time for both the human search team and the dog search team. Based on the searcher efficiency trials, ARCADIS recommends that dog search teams be eliminated from future studies.

## 4. Indiana Bat Take Estimate

During this study period there were no Indiana bat carcasses recovered resulting in insufficient data collected at the Project Area to support calculation of a site-specific ratio of Indiana bat mortality to total bat mortality. Therefore, as described in the draft HCP, the ratio of Indiana bat mortality to estimated overall bat mortality (1:800) observed during studies at the Fowler Ridge Wind Farm may be used as a proxy.

Use of the ration from the Fowler Ridge Wind Farm is appropriate for the Pioneer Trail Wind Farm for several reasons. 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. A second Indiana bat was taken at Fowler Ridge in 2010. Following the first documented Indiana bat mortality event at the Fowler Ridge wind energy facility, an extensive program of study was initiated to not only develop a take estimate for the facility but to evaluate operational adjustments and consider layout features that could contribute to minimizing that projected take. The resulting studies provide information potentially relevant to sites with similar landform characteristics, such as the Pioneer Trail Wind Farm. Both Fowler Ridge and Pioneer Trail Wind Farm have a lack of summer roosting habitat and are in active agricultural use. Both sites have minimal topography and, while drainage channels extend within both project areas, associated tree cover is minimal. The Pioneer Trail Wind Farm is located approximately 52 miles from the Fowler Ridge facility. The Fowler Ridge facility is substantially larger than Pioneer Trail Wind Farm, incorporating a maximum build out of 449 turbines over an area of 72,947 acres.

During the fall 2012 season, the adjusted mortality for bats was 38. Using the 1:800 ratio developed from the Fowler Ridge study gives an estimated Indiana bat take of 0.05 individual bats in the fall season. In the spring 2013 season, adjusted mortality for bats was 20, which corresponds to an estimated Indiana bat mortality of 0.03 individual bats in the spring season.

In accordance with the ABPP (and consistent with the draft HCP), following one more year of monitoring with favorable results, spring monitoring will be discontinued and only fall monitoring will be conducted every five years (Stantec 2012).

#### 4.1 Stratified Random Sampling Results

The stratified random sampling approach included a weighted component; 50 percent of the sample turbines were selected from the southern 25 percent of the Project Area (closer to the Middle Fork of the Vermilion River Indiana bat maternity colony). This approach helped to meet the study goal of detecting and analyzing overall bat fatalities at the facility by providing sufficient sample size to support reliable data analysis and related interpretations and conclusions. Due to the very low expected Indiana bat fatality at the Project Area, designing the monitoring plan such that a representative estimate of site-wide bat fatality is available as a surrogate estimator of Indiana bat fatality has greater potential to provide a more accurate estimate of fatality for this species than would a study designed specifically to survey turbines nearest to suitable

Indiana bat habitat, in a potentially futile attempt to detect fatalities of this species. Additionally, the weighted approach to selecting the sample WTGs provided increased coverage of WTGs closer to known Indiana bat habitat.

A graphical representation of where the WTGs in the lower 25 percent are located within the Project Area and where the bird and bat takes occurred is shown on Figure 2. However, because no Indiana bats were recovered, this study suggests that the probability of Indiana bat take is very low for the Project Area.

## 5. Discussion and Comparison of Results to Other Studies

Methods implemented during the 2012-2013 study are similar to those that have been used for studies at other wind energy projects across the United States, with some modifications to address differences in site-specific characteristics and agency recommendations. Figure 3 provides a comparison of per megawatt avian mortality rates for different wind energy projects across the United States, to provide perspective on the mortality rate observed in this study. Figure 4 provides a comparison of per megawatt bat mortality rates for different wind energy projects across the United States, including the Project Area.

Compared to other studies included in Figures 3 and 4 that were conducted during similar times of the year, the relative level of mortality within the Project Area during the fall 2012 to spring 2013 study periods were low for both birds and bats. These results corroborate with the results of pre-construction avian and bat studies that were conducted in the Project Area, which predicted that the project would have an overall low risk of impacts on birds and bats (ARCADIS 2010). In addition, the bird and bat carcasses that were found during this study were all relatively common species, and no federally listed, state listed or special concern species were found.

## 6. Conclusion

Bird and bat mortalities recorded during the fall 2012 and spring 2013 study periods were those of relatively common species in Illinois. Therefore, the small numbers of mortalities of these species recorded within the Project Area are not expected to cause significant population-level impacts. The bird and bat mortality rates estimated for this project are also low compared to rates reported for other wind energy projects across the United States. No Indiana bat mortality was found during either study periods. As stated in Section 4, Indiana bat fatality rates of 0.05 and 0.03 were estimated for the fall 2012 and spring 2013 study periods, respectively.

In accordance with the ABPP (and consistent with the draft HCP), following one more year of monitoring with favorable results, spring monitoring will be discontinued and only fall monitoring will be conducted every five years (Stantec 2012).

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Tables

**Table 1. Avian and Bat Carcasses Observed During the 2012-2013 Study Period**
**E.ON Climate and Renewables North America**
**Pioneer Trail Wind Farm**

| Season | Species: Common Name | Species: Scientific Name | # of Carcasses | Date Observed | Nearest Turbine |
|---|---|---|---|---|---|
| **Fall 2012** (August 13, 2012 through October, 10, 2012) | Turkey Vulture | *Cathartes aura* | 1 | 9/20/2012 | C9 |
| | Silver-Haired Bat | *Lasionycteris noctivagans* | 2 | 8/15/2012 | A4 |
| | | | | 9/20/2012 | F10 |
| | Red Bat | *Lasiurus borealis* | 8 | 8/15/2012 | E10 |
| | | | | 8/17/2012 | D7 |
| | | | | 8/20/2012 | C10 |
| | | | | 8/29/2012 | A14 |
| | | | | 8/29/2012 | C7 |
| | | | | 9/11/2012 | B5 |
| | | | | 9/13/2012 | F7 |
| | | | | 9/26/2012 | B16 |
| | Little Brown Bat | *Myotis lucifigus* | 5 | 9/12/2012 | E15 |
| | | | | 9/12/2012 | E15 |
| | | | | 9/12/2012 | A7 |
| | | | | 10/10/2012 | A15 |
| | | | | 10/10/2012 | D4 |
| | American Redstart | *Setophaga ruticilla* | 1 | 9/5/2012 | C6 |
| | Red-Breasted Nuthatch | *Sitta canadensis* | 1 | 9/25/2012 | F13 |
| | Unknown bird - 1 | Unknown | 1 | 9/12/2012 | B13 |
| | Unknown bird - 2 | Unknown | 1 | 9/19/2012 | B13 |
| | Unknown bat - 1 | Unknown | 1 | 9/26/2012 | B16 |
| | | *Subtotal* | 21 | (5 birds, 16 bats) | |
| **Spring 2013** (April 2, 2013 through May 8, 2013) | Silver-Haired Bat | *Lasionycteris noctivagans* | 7 | 4/23/2013 | E14 |
| | | | | 5/1/2013 | E10 |
| | | | | 5/1/2013 | E10 |
| | | | | 5/7/2013 | C9 |
| | | | | 5/7/2013 | C6 |
| | | | | 5/8/2013 | E10 |
| | | | | 5/8/2013 | F11 |
| | Red Bat | *Lasiurus borealis* | 3 | 4/17/2013 | E13 |
| | | | | 4/30/2013 | B7 |
| | | | | 5/8/2013 | E10 |
| | Golden-Crowned Kinglet | *Regulus satrapa* | 2 | 4/11/2013 | F15 |
| | | | | 4/23/2013 | E4 |
| | Unknown bird - 1 | Unknown | 1 | 4/9/2013 | C7 |
| | Unknown bird - 2 | Unknown | 1 | 4/9/2013 | C3 |
| | | *Subtotal* | 14 | (4 birds, 10 bats) | |
| | | *Grand Total* | 35 | (9 birds, 26 bats) | |

**Table 2. Searcher Efficiency Data for the 2012-2013 Study Period**
**E.ON Climate and Renewables North America**
**Pioneer Trail Wind Farm**

| Season | Week | Visibility Class | Team | Searcher Efficiency [1] |
|---|---|---|---|---|
| Fall 2012 | 4 | low [2] | Human | 0.57 |
| | 4 | low [2] | Dog | 0.29 |
| | 8 | low | Dog | 0.67 |
| | 5 | low | Human | 0.78 |
| Spring 2013 | 1 | high | Human | 0.75 |
| | 1 | high | Dog | 0.88 |
| | 1 | low | Dog | NONE |
| | | | | |
| Fall [3] | | low | Human | 0.69 |
| | | | Dog | 0.50 |
| Spring [3] | | high | Human | 0.75 |
| | | | Dog | 0.88 |
| | | overall [4] | Human | 0.71 |
| | | | Dog | 0.63 |

[1] Due to the low number of bird carcasses, both the small bird trial carcasses and bat trial carcasses were used to estimate each searcher team's efficiency.
[2] Low visibility class was assumed during week 4 due to mowing of crops
[3] Combined seasons for low and high visibility classes per team
[4] Combined seasons and visibility classes per team

**Table 3. Carcass Removal Data for the 2012-2013 Study Period**
**E.ON Climate and Renewables North America**
**Pioneer Trail Wind Farm**

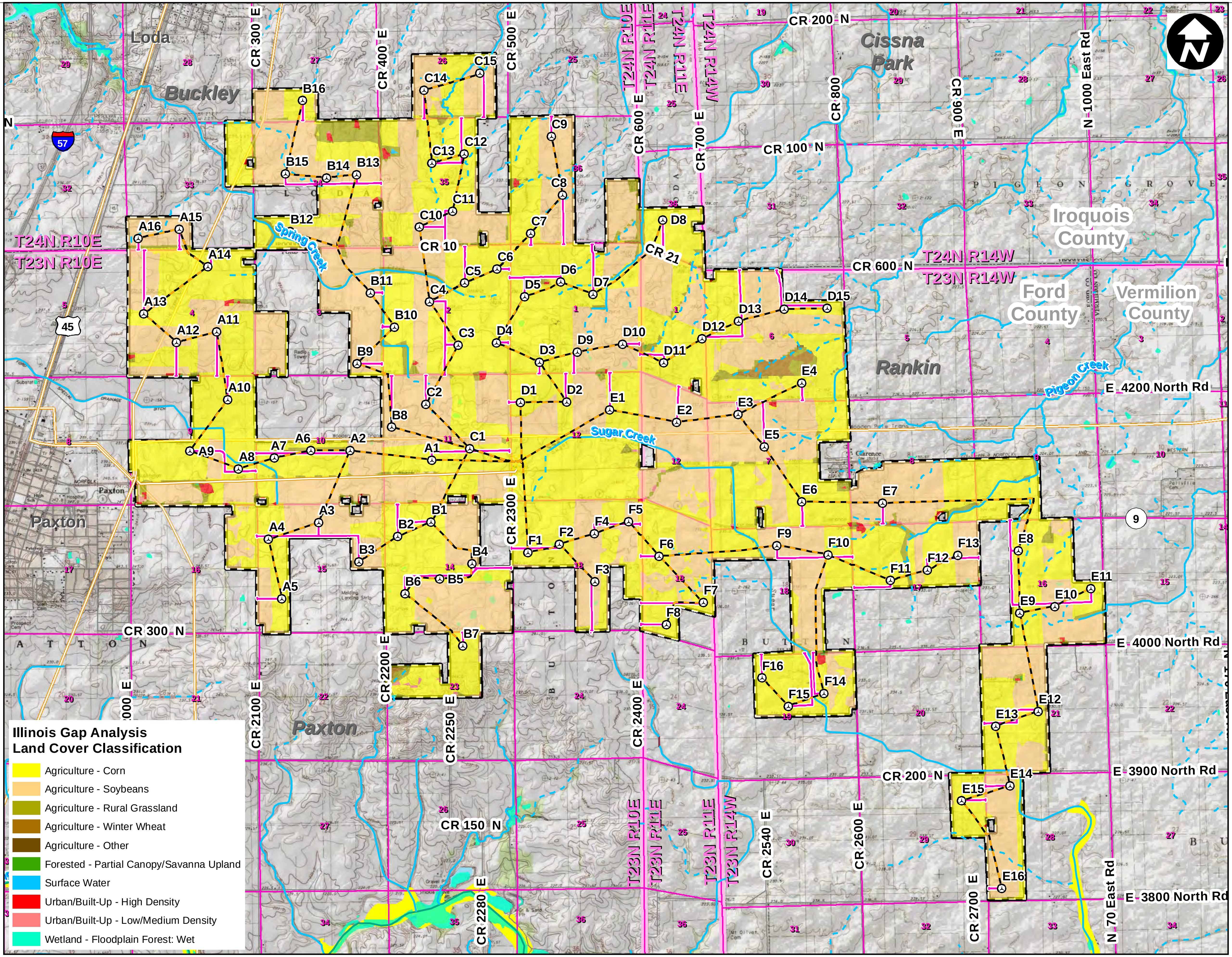
| Carcass Type | Season | Visibility Class | Number of Carcasses Used for Trial (s) | Number of Remaining Carcasses at the End of Season ($s_c$) | Carcass Persistence Time in Days ($\bar{t}$) |
|---|---|---|---|---|---|
| Bird | Fall 2012 | low | 2 | 0 | 8 |
| Bat | Fall 2012 | low | 16 | 8 | 28.9 |
| | Spring 2013 | -- * | 10 | 0 | 9.9 |

* Because few bat carcasses were available, carcass removal was combined across visibililty class for bats.

**Table 4. Avian and Bat Mortality Rates for the 2012-2013 Study Period**
**E.ON Climate and Renewables North America**
**Pioneer Trail Wind Farm**

| Study Period | | Birds | Bats |
|---|---|---|---|
| Fall 2012 | Total Unadjusted Mortality | 5.00 | 16.00 |
| | Total Adjusted Mortality | 23.00 | 38.00 |
| | Mortality per Turbine | 0.46 | 0.76 |
| | Standard Error | 0.232 | 0.232 |
| | 90% Confidence Interval | 0.1701 - 0.7659 | 0.4626 - 1.062 |
| | Mortality per Megawatt | 0.29 | 0.48 |
| | Mortality per Rotor-swept Square Meter | 0.000099 | 0.000163 |
| Spring 2013 | Total Unadjusted Mortality | 4.00 | 10.00 |
| | Total Adjusted Mortality | 12.00 | 20.00 |
| | Mortality per Turbine | 0.24 | 0.40 |
| | Standard Error | 0.023 | 0.028 |
| | 90% Confidence Interval | 0.0534 - 0.408 | 0.1956 - 0.618 |
| | Mortality per Megawatt | 0.15 | 0.25 |
| | Mortality per Rotor-swept Square Meter | 0.000052 | 0.000086 |

Figures





## PROJECT COMPONENTS

- Wind Turbine 02/27/2012
- Collection Lines
- Access Roads
- Substation and O&M Building
- Existing Transmission Line
- Project Boundary, March 2011

## BASE DATA

- Stream/River Perennial
- Stream/River Intermittent
- Waterbodies
- Existing Road
- Sections
- Townships
- County Boundary

*Source: USGS Topographic Source - ESRI Online Services. Access date: 6/20/2013, via ArcGIS v. 10. This image is not for re-sale or distribution outside of the use of this PDF.*

*Projection: NAD_1983_StatePlane_Illinois_East FIPS_1201_Feet*

0 2,500 5,000
Feet

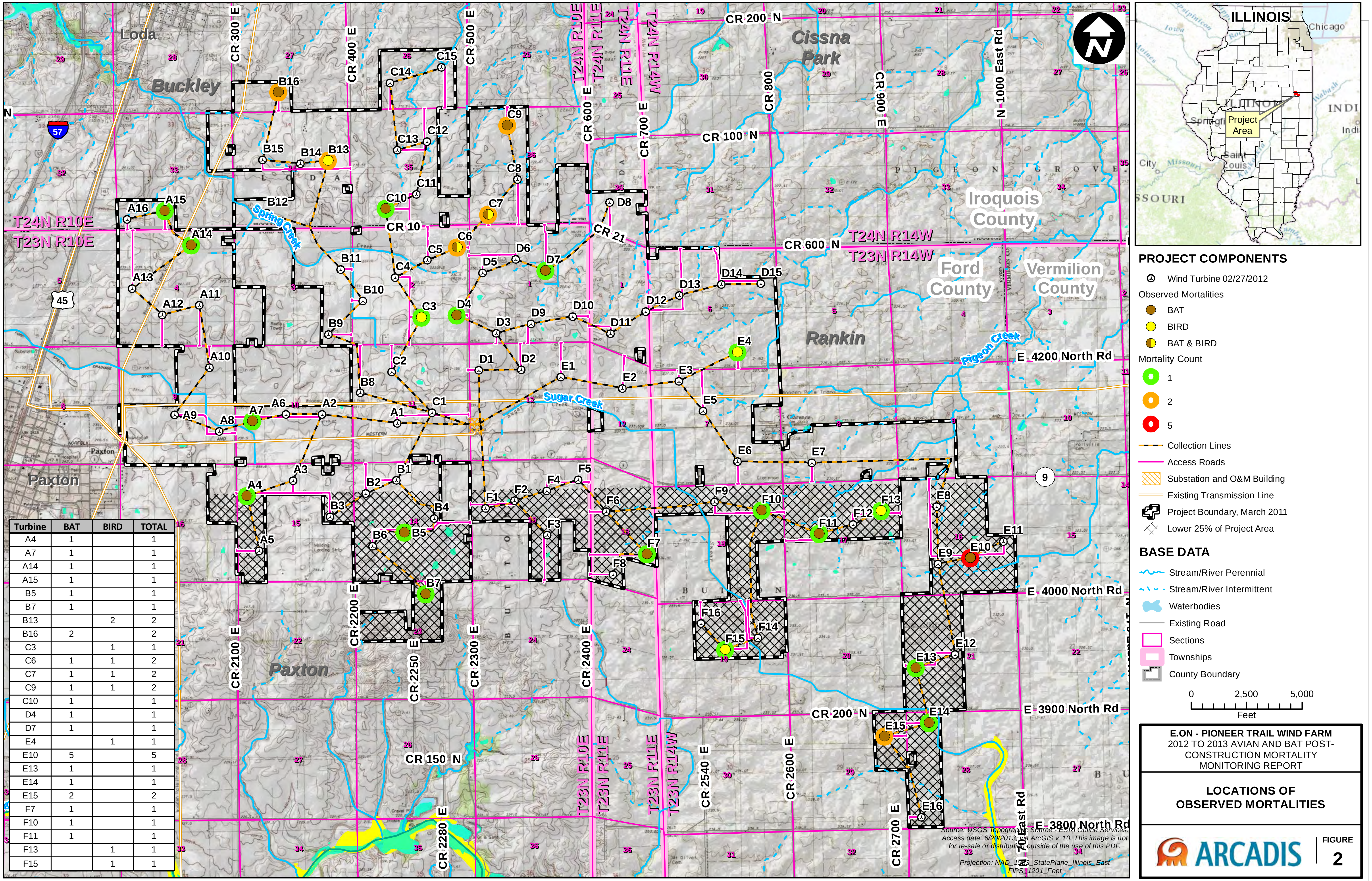
**E.ON - PIONEER TRAIL WIND FARM**
2012 TO 2013 AVIAN AND BAT POST-CONSTRUCTION MORTALITY MONITORING REPORT

**PIONEER TRAIL WIND FARM PROJECT AREA**

ARCADIS

FIGURE 1

CITY: CHICAGO Author: MNESTA
Path: G:\Aproject\EON\GIS\PAXTON\MXDs\SURVEY_2013\REPORT\PT_2012_13_PostConstrReport_Monitoring.mxd




| Turbine | BAT | BIRD | TOTAL |
|---|---|---|---|
| A4 | 1 | | 1 |
| A7 | 1 | | 1 |
| A14 | 1 | | 1 |
| A15 | 1 | | 1 |
| B5 | 1 | | 1 |
| B7 | 1 | | 1 |
| B13 | | 2 | 2 |
| B16 | 2 | | 2 |
| C3 | | 1 | 1 |
| C6 | 1 | 1 | 2 |
| C7 | 1 | 1 | 2 |
| C9 | 1 | 1 | 2 |
| C10 | 1 | | 1 |
| D4 | 1 | | 1 |
| D7 | 1 | | 1 |
| E4 | | 1 | 1 |
| E10 | 5 | | 5 |
| E13 | 1 | | 1 |
| E14 | 1 | | 1 |
| E15 | 2 | | 2 |
| F7 | 1 | | 1 |
| F10 | 1 | | 1 |
| F11 | 1 | | 1 |
| F13 | | 1 | 1 |
| F15 | | 1 | 1 |

Source: USGS Topographic. Source - ESRI Online Services. Access date: 6/20/2013. via ArcGIS v. 10. This image is not for re-sale or distribution outside of the use of this PDF.

Projection: NAD_1983_StatePlane_Illinois_East FIPS_1201_Feet

**PROJECT COMPONENTS**

- Wind Turbine 02/27/2012
- Observed Mortalities
  - BAT
  - BIRD
  - BAT & BIRD
- Mortality Count
  - 1
  - 2
  - 5
- Collection Lines
- Access Roads
- Substation and O&M Building
- Existing Transmission Line
- Project Boundary, March 2011
- Lower 25% of Project Area

**BASE DATA**

- Stream/River Perennial
- Stream/River Intermittent
- Waterbodies
- Existing Road
- Sections
- Townships
- County Boundary

0 2,500 5,000
Feet

E.ON - PIONEER TRAIL WIND FARM
2012 TO 2013 AVIAN AND BAT POST-CONSTRUCTION MORTALITY MONITORING REPORT

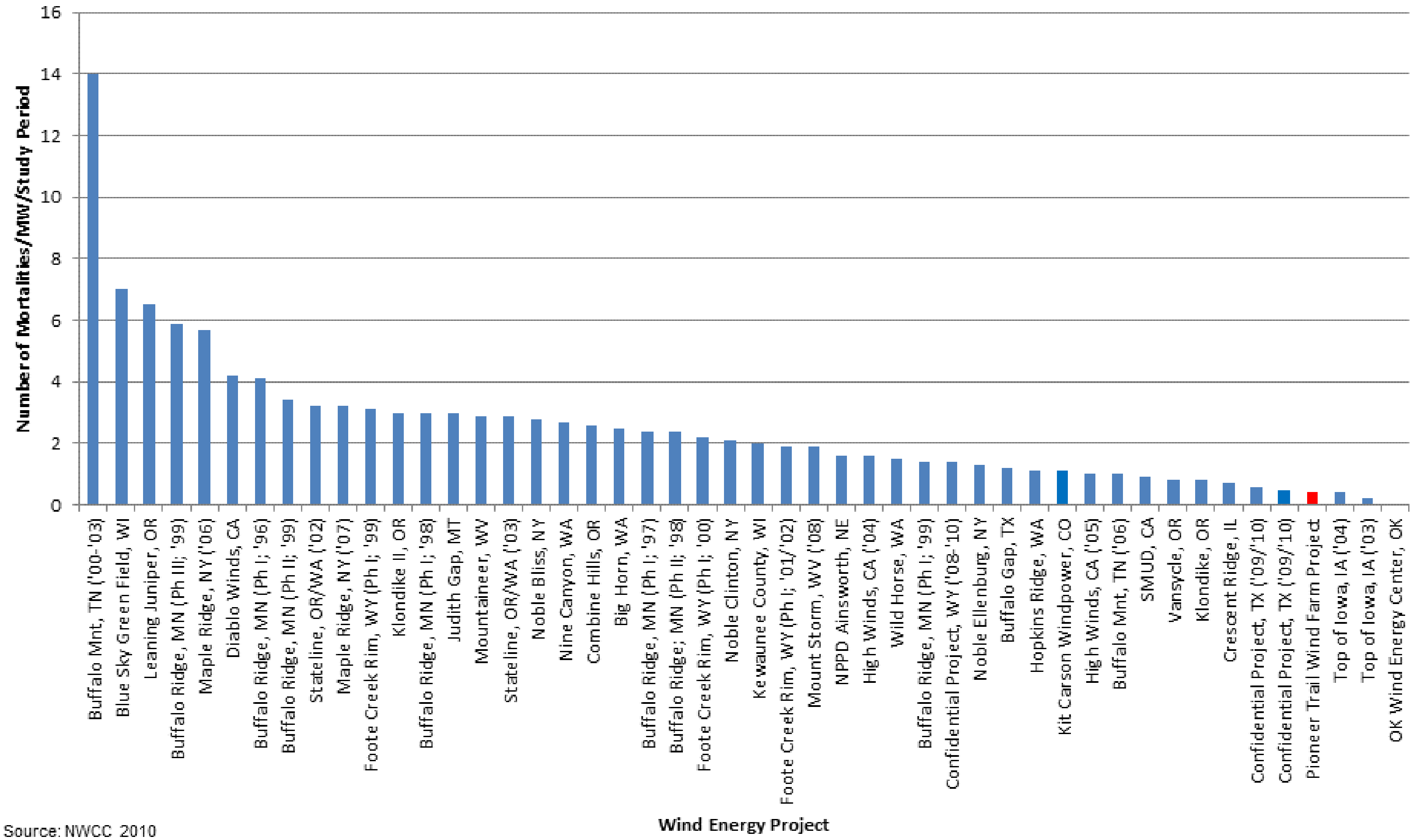
**LOCATIONS OF OBSERVED MORTALITIES**

ARCADIS

FIGURE 2

CITY: CHICAGO Author: MNESTA
Path: G:\Aproject\EON\GIS\PAXTON\MXDs\SURVEY_2013\REPORT\PT_2012_13_PostConstrReport_MortalityCount.mxd

Figure 3. Comparison of per Megawatt Avian Mortality Rate at Pioneer Trail Wind Farm Project to other U.S. Wind Energy Projects.




Source: NWCC 2010

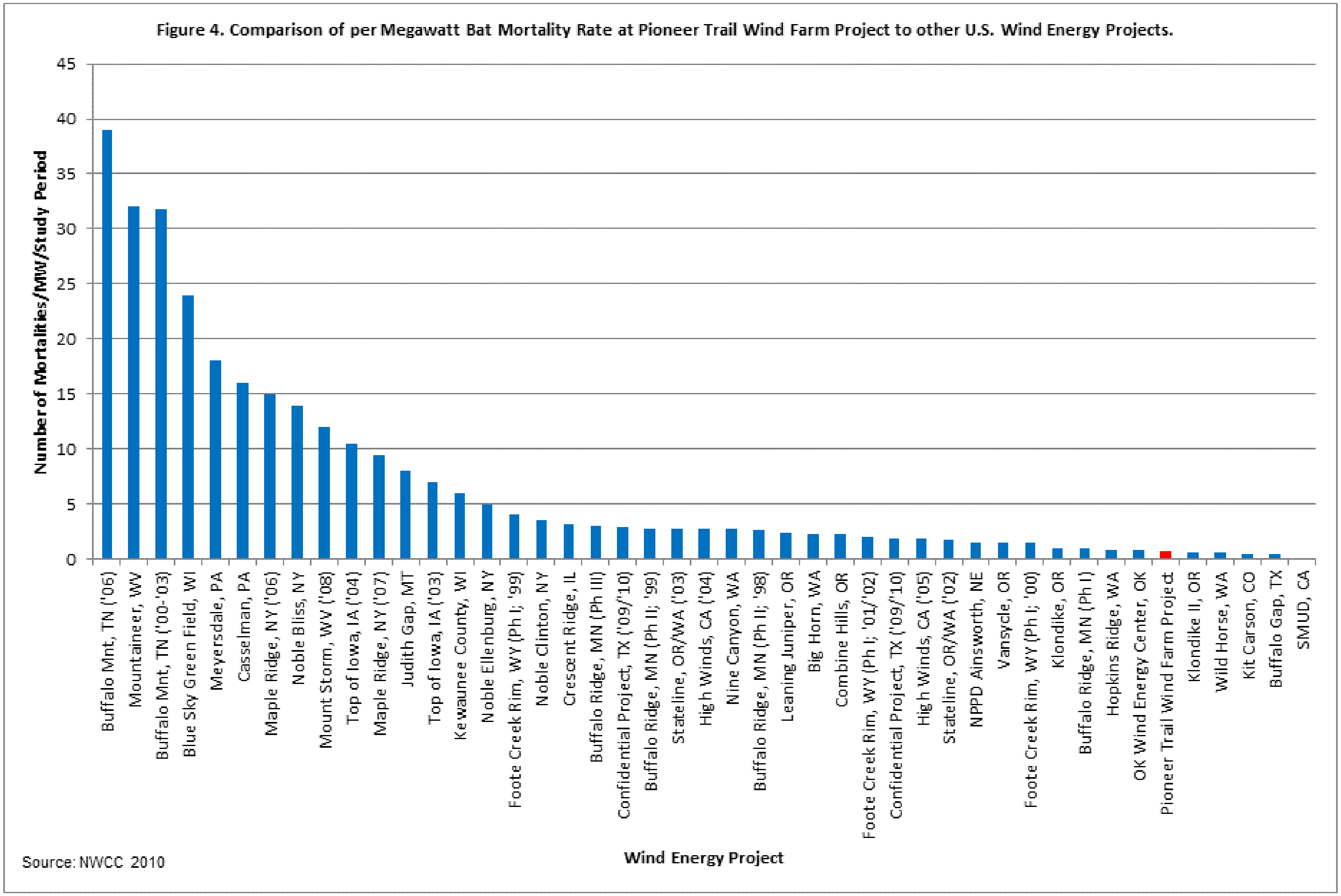


Figure 4. Comparison of per Megawatt Bat Mortality Rate at Pioneer Trail Wind Farm Project to other U.S. Wind Energy Projects.
Number of Mortalities/MW/Study Period
0
5
10
15
20
25
30
35
40
45
Buffalo Mnt, TN ('06)
Mountaineer, WV
Buffalo Mnt, TN ('00-'03)
Blue Sky Green Field, WI
Meyersdale, PA
Casselman, PA
Maple Ridge, NY ('06)
Noble Bliss, NY
Mount Storm, WV ('08)
Top of Iowa, IA ('04)
Maple Ridge, NY ('07)
Judith Gap, MT
Top of Iowa, IA ('03)
Kewaunee County, WI
Noble Ellenburg, NY
Foote Creek Rim, WY (Ph I; '99)
Noble Clinton, NY
Crescent Ridge, IL
Buffalo Ridge, MN (Ph III)
Confidential Project, TX ('09/'10)
Buffalo Ridge, MN (Ph II; '99)
Stateline, OR/WA ('03)
High Winds, CA ('04)
Nine Canyon, WA
Buffalo Ridge, MN (Ph II; '98)
Leaning Juniper, OR
Big Horn, WA
Combine Hills, OR
Foote Creek Rim, WY (Ph I; '01/'02)
Confidential Project, TX ('09/'10)
High Winds, CA ('05)
Stateline, OR/WA ('02)
NPPD Ainsworth, NE
Vansycle, OR
Foote Creek Rim, WY (Ph I; '00)
Klondike, OR
Buffalo Ridge, MN (Ph I)
Hopkins Ridge, WA
OK Wind Energy Center, OK
Pioneer Trail Wind Farm Project
Klondike II, OR
Wild Horse, WA
Kit Carson, CO
Buffalo Gap, TX
SMUD, CA
Wind Energy Project
Source: NWCC 2010

## Appendix D: Bat Screening Analysis and Pre-Construction Bat Survey

# BAT SCREENING ANALYSIS AND PRE-CONSTRUCTION BAT SURVEY

PIONEER TRAIL WIND FARM
IROQUOIS AND FORD COUNTIES, ILLINOIS

Project No. 193700126
January 2011

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Stantec

# BAT SCREENING ANALYSIS AND PRE-CONSTRUCTION BAT SURVEY

## PIONEER TRAIL WIND FARM
## IROQUOIS AND FORD COUNTIES, ILLINOIS

**January 2011**

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## 1.0 INTRODUCTION

Wind energy is one of the fastest growing sources of renewable energy in the United States (AWEA 2007). However, construction and operation of wind energy projects has the potential to impact bird and bat populations through habitat fragmentation, displacement, and mortality due to collision with or proximity to Wind Turbine Generator (WTG) blades. An important step in the process of siting and developing potential wind energy sites is to evaluate wildlife use for the project area. Stantec (formerly NRC) was retained to perform a bat screening analysis and one activity season of pre-construction bat activity surveys at the Pioneer Trail Wind Farm.

### 1.1. Background Information Regarding Bat Mortality at Wind Farms

Commercial wind facilities have been found to affect many bat species (Arnett et al. 2008). These impacts may include displacement of individuals, fragmentation of habitat, and direct mortality from collisions with or proximity to WTG blades (Kunz et al. 2007a). Whether bats are attracted to WTGs and the exact mechanisms by which WTGs cause mortality are unclear (reviewed in Kunz et al. 2007b); however, several hypotheses have recently been put forth and tested, including the role of land cover and environmental conditions in attracting bats to WTG sites, behavioral factors that might make WTGs attractive to bats, pressure changes from rotating blades causing "barotrauma", or direct impact of unsuspecting migrant bats (Baerwald et al. 2008; Horn et al. 2008; Johnson et al. 2004; Kerns et al. 2005; reviewed in Kunz et al. 2007b). Determining the effects of wind farms on bats is of critical importance to the future conservation of these poorly understood mammals.

The influence of landcover on bat mortality at WTG sites is unclear (Arnett et al. 2008). Johnson et al. (2004), for example, found no significant relationship between bat fatalities and landcover type within 100 meters of WTGs. They also found no significant relationship between bat mortality and distance to wetlands or woodlands (Johnson et al. 2004). Weather conditions, such as wind speed, rainfall, and temperature, have a significant impact on bat mortalities (Arnett et al. 2008). Bat mortality and insect activity are both high on nights with low wind speed when WTGs are adjusted to rotate near their maximum revolutions per minute (rpm) (Kerns et al. 2005). Bat fatalities drop with increases in wind speed and precipitation intensity (Kerns et al. 2005).

The primary bat species affected by wind facilities are believed to be migratory, foliage- and tree-roosting species that mostly emit low frequency calls (Johnson et al. 2004; reviewed by Kunz et al. 2007b). Arnett et al. (2008) compiled data from 21 studies at 19 wind facilities in the United States 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, nearly 75% were the migratory, foliage roosting Hoary Bat (*Lasiurus cinereus*), Eastern Red Bat (*Lasiurus borealis*), and Silver-haired Bat (*Lasionycteris noctivagans*) (Kunz 2007a).

Prior to September 2009, no mortality of species listed as threatened or endangered under the federal Endangered Species Act had been reported, including the Indiana Bat (*Myotis sodalis*) (Arnett et al. 2008). In September 2009, the first documented take of an endangered Indiana Bat at a wind facility occurred at BP Wind Energy's Fowler Ridge wind farm located in Benton County, Indiana.

Some researchers have suggested that bats that roost in foliage of trees for most of the year may be attracted to WTGs because of their migratory and mating behavior patterns (e.g. Kunz et al. 2007b; Cryan 2008). At dawn, these tree bats may mistake wind WTGs for roost trees, thereby increasing the risk of mortality (Kunz et al. 2007b). Cryan (2008) suggested that male tree bats may be using tall trees as lekking sites, calling from these sites to passing females. If this is the case, then tree bats may be more attracted to WTG sites post-construction. Migrating tree bats are also thought to depend on sight for navigation rather than echolocation, possibly resulting in the bats being unaware of the presence of WTGs during migration (Cryan and Brown 2007). As further support for these hypotheses, the majority of bat fatalities occur mid-summer through fall, approximately the same time frame as southward migration of tree bats (Arnett et al. 2008). Tree bats tend to be larger species that emit low frequency calls. Bats that use low frequency calls may be more inclined to forage above the treeline where there are few obstructions. Migratory bats may also fly higher to maximize efficiency. Thus, tree bats may be more likely to fly in the rotor swept zone of WTGs when compared to smaller bat species that have different foraging and migration strategies.

Although the number of bat fatalities recorded at wind facilities varies regionally, reports of mortality have been highest along forested ridgetops in the eastern U.S. and lowest in open landscapes of Midwestern and western states (Kunz et al. 2007b). However, it is difficult to make direct comparisons among projects due to differences in study length, metrics used for searches and calculations for compensating bias (Arnett et al. 2008). In the Midwestern U.S., bat fatalities range from 0.2 to 8.7 bats killed/megawatt generated, but higher fatality rates (up to 53.3 fatalities/MW generated) have been reported in the eastern U.S. (Arnett et al. 2008).

### 1.2. Project Description

The Pioneer Trail Wind Farm is a state-of-the art wind energy project located in Iroquois and Ford counties, Illinois just east of the towns of Paxton and Loda, Illinois, in Sections 26 and 33 – 36, T24N, R10E; Section 31, T24N, R14W; Sections 1 – 4, and 10 – 16, T23N, R10E; Sections 5 – 9 and 16 – 18, T55N, R31W; Sections 1 and 12 – 13 T23N, R11E (Figure 1).

Currently, the wind project is proposed to be a 150 megawatt farm with 1.6 megawatt wind turbine generators (WTGs) and associated access roads and collector line system. Steel reinforced concrete foundations will be constructed to anchor each WTG. A pad mount transformer will be installed at the base of each WTG and will collect electricity generated by each turbine through cables routed down the inside of the tower.

An underground power collection system will be trenched in between the pad mount transformers and a collector substation. This power collection system will consist of a series of underground cables ranging from approximately 2 to 5 inches in outside diameter. In addition to the WTGs and power collection system, the Pioneer Trail Wind Farm project would construct service roads allowing access to the turbines during and after construction.

The site is located immediately east of the town of Paxton, Illinois. Land use throughout much of the project area is dominated by agriculture (i.e. rowcrops and pasture); however, several creeks and unnamed drainageways are found throughout the project limits (Figure 2). Forest cover is minimal throughout the project area (Figure 3).

### 1.3. Purpose and Objectives

The purpose of this report is to identify and summarize general bat activity within the project area, based on review of existing literature and data collected during surveys. The process used to evaluate the project area generally follows recommended project siting guidelines of the U.S. Fish and Wildlife Service (2010).

The objectives of the pre-construction bat activity surveys have been developed to provide a scientific pre-permitting/pre-construction bat survey of sufficient duration and focus to address the potential impact concerns through collection of site-specific baseline data. The survey objective is to characterize general bat activity by collecting site-specific baseline data on bat species activity, richness, frequency, and behavior in order to:

1. Estimate the spatial and temporal extent of bat use of the project area;
2. Determine the spatial and temporal extent of rare bat species use of the project area.

This report includes the results of literature and database reviews and observations made during pre-construction field surveys.

## 2.0 METHODS

### 2.1. Bat Screening Analysis and Baseline Data Collection

Information on the ecology and distribution of bats is sparse for the entire upper Midwestern United States, including Illinois (Schwartz and Schwartz 1986; Kurta 2000; Laubach et al. 2004). Therefore, the bat screening analysis relied on what little information currently exists, which included a review of publicly available literature and bat resources. Illinois Gap Analysis Program (GAP) landcover data were used to provide information on available habitat and sensitive environmental areas that may influence bat abundance, distribution, or movement within or near the project area. Each of these screening level components is described in more detail below.

#### 2.1.1. Bat Data Acquisition and Analysis

A literature and database review was used to identify bat species known to occur within or in close proximity to the project area, including review of distribution and ecological information provided by Bat Conservation International (BCI; www.batcon.org). BCI is the foremost bat conservation association in the world. Headquartered in Austin (TX) and founded in 1982, BCI currently has a membership of over 14,000 individuals, spread across 70 countries. They have been involved in cutting edge research and educational products on the subject of bat ecology and conservation. BCI provides not only accessible information on bat ecology, but also provides recommendations on how to monitor and conserve them on a global scale. In addition, literature resources, such as Schwartz and Schwartz (1986), Harvey et al. (1999), Kurta (2000) and Laubach et al. (2004) were reviewed for general ecology and distribution information regarding species found in Illinois.

#### 2.1.2. Spatial Data Acquisition and Landcover Analysis

In addition to bat data acquisition, aerial photograph interpretation via a Geographic Information System (GIS) was used to locate and evaluate land features within the project area. Spatial data layers used in the GIS included base orthophotography, the 24K hydrology layer, USGS 24K topography, and Illinois GAP Landcover data. A desktop review of maps and GIS data was performed to evaluate the physical attributes of the project area, as well as the sensitive environmental areas within or near the project area that may influence bat movement and concentration patterns. Examples of physical attributes that could influence bat use include project size, topography, weather, infrastructure, and environmental corridors. Examples of sensitive environmental areas include State or County Natural Areas, State Wildlife Areas, and National Wildlife Refuges.

2.1.3. Indiana Bat Habitat Assessment

A desktop analysis was conducted to determine the presence of potential Indiana bat habitat within the project area. Suitable Indiana bat summer habitat is considered to have the following characteristics within a 0.5 mile radius of permanent water (USFWS Rock Island Field Office guidance 2010):

- Forest cover of 15% or greater
- One or more of the following tree species: shagbark and shellbark hickory that may be dead or alive, and dead bitternut hickory, American elm, slippery elm, eastern cottonwood, silver maple, white oak, red oak, post oak, and shingle oak with slabs or plates of loose bark
- Potential roost trees with 10% or more peeling or loose bark

Aerial photography and ArcMap GIS data were used to evaluate habitat suitability within the entire project area. A 0.5-mile radius plot was drawn centered on a permanent water source (e.g., perennial and intermittent streams, farm ponds, etc) to determine if the area met the 15% forest cover requirement within 0.5 mile of permanent water. For the purposes of this analysis, it was assumed that all waterways identified as “blue line” streams on USGS 1:24,000 scale topographic maps contained water for the majority of the year; however, the presence of water was not field verified. The area of the woodland tracts located within the 0.5 mile buffer was measured to determine the percent cover of woodland.

No walking surveys or field verification were conducted as part of this determination. Therefore, habitat suitability was based on the presence of 15% or greater forest cover within 0.5 mile of permanent water.

## 2.2. Pre-Construction Bat Activity Surveys

2.2.1. Acoustic Data Capture

Pre-construction bat activity surveys at the project site incorporated both stationary (i.e. passive) and mobile (i.e. active) echolocation detectors, which have been proven to be an acceptable methodology for bat/wind farm screening (e.g., Kunz et al. 2007a; Redell et al. 2006). These detectors record the real-time ultrasonic calls emitted by echolocating bats. The data produced by these detectors are sonograms of the bat calls recorded by the unit’s receiver. In many cases, bat calls can be identified to species group, and tallied. In addition, the number of “bat passes”, or times in which a bat was recorded by the receiver, can be determined, which yields a rough estimate of activity or bat use of the area being sampled. Bat activity surveys were conducted at the site from 15 April through 4 November 2010. Surveys were divided among time periods, or seasons, generally recognized as appropriate for pre-construction screening level surveys at wind farms (Table 1).

**Table 1. Timing and frequency of bat surveys conducted at the Pioneer Trail Wind Farm (Iroquois and Ford counties, Illinois)**

| Screening Survey Period | 2010 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | April | | | | May | | | | June | | | | July | | | | August | | | | September | | | | October | | | |
| Spring Migration | | x | x | x | x | x | | | | | | | | | | | | | | | | | | | | | | |
| Summer | | | | | | | | | | | x | x | | | | | | | | | | | | | | | | |
| Fall Migration | | | | | | | | | | | | | | | x | | | x | x | x | | x | x | x | | | x | |

Seasonal stationary detector survey periods
x Mobile field survey visits

2.2.1.1. Stationary Survey

Stationary detectors were used to determine species presence and relative activity levels at varying heights. One Remote Bat Acoustic Technology System (ReBAT™; Pandion Systems, Inc., Gainesville, Florida) array was deployed on one 60-meter tall meteorological (MET) tower located within the project area (Figure 2).

Two receivers were deployed on the tower at different heights in a vertical transect to capture information about bat species flying at variable altitudes. Based on accepted methodology, receivers were placed at 16.5 ft (5 m) and 190 ft (58 m; within the rotor swept zone). Acoustic receivers were protected from the elements in weather-resistant aluminum housing units that are raised and lowered on a pulley system attached to the tower. To avoid microphone damage from precipitation, the microphones were positioned within the protective aluminum housing pointing straight down. A plastic reflector plate was attached to the aluminum housing at a 45° angle to allow for maximum bat detectability.

The array was programmed to record bat acoustic data nightly from one hour before sunset to one hour after sunrise. Recordings were triggered based on frequency (kHz) and decibel (dB). Recorded sound files were 1.7 seconds in duration. Data from the acoustic receivers were transmitted to a custom-built computer located at the base of the tower. The data were transmitted via cellular signal to Pandion Systems, Inc. for storage and then transmitted to Stantec staff for analysis. The entire system was powered through a series of batteries and solar panels. All critical components were secured and stored in weatherproof housing at the base of the tower.

2.2.1.2. Mobile Survey

Surveys with mobile hand-held Anabat detectors (Titley Electronics, Australia) were used to supplement stationary surveys. Landcover analysis was used to select transect locations. Transects were ground-truthed on-site to ensure the selected locations were appropriate for mobile bat surveys. Six mobile transects were selected along roads within the project area (Figure 2). Survey routes were selected in a variety of habitat types to adequately represent the project area (e.g., agricultural fields, woodlots, wetlands or stream corridors). Transects were driven at a slow rate of speed (<5 mph) by surveyors while holding the mobile bat echolocation detector outside of the vehicle. Hand-held units have a limited range and only detect bats in the lower altitudes. However, by conducting mobile surveys, the chances of detecting a species or species group not captured by detectors on the MET tower are increased because the surveyor could follow a bat as it was calling and record long call sequences suitable for call identification.

A total of 15 mobile surveys were conducted (spring-5, summer-2, fall-8), with emphasis placed on the critical fall migration period (Table 1). This information was used for comparison with data from stationary detectors on the MET tower to determine variation in bat activity based on location within the project area.

2.2.2. Acoustic Data Analysis

2.2.2.1. Stationary Survey

Qualitative analysis of echolocation calls recorded by the ReBAT™ unit was performed on all operational detector nights using SCAN'R (Binary Acoustic Technology 2007) filtering software to remove noise files. Stantec staff further filtered the files using the Sonobat Batch Scrubber 3 (Sonobat, Arcata, CA).

2.2.2.2. Mobile Survey

To analyze sound files recorded with Anabat detectors, a rough "activity filter" was created in AnalookW Software v. 3.7i (Titley Electronics, Australia). This filter was designed to eliminate non-bat noise. The filter parameters were mainly the settings of the default filter, with slight modifications: minFc=12, maxFmean=90, minFmean=12, smooth=80 and bodyover=1000 microseconds. Files retained by the filter were visually inspected to confirm that the associated sound was produced by a bat. Files containing confirmed bat calls were then analyzed by applying slight modifications to the existing activity filter that divided call sequences into either a "low frequency species" category (highstart=yes, smooth=12, maxFmin=34) or a "high frequency species" category (highstart=yes, smooth=12, minFmin=35). Bat passes were considered any file with equal to or greater than one call or pulse. The total number of bat files, and the number that met the criteria in each frequency category were summed.

2.2.2.3. Call Classification

Data collected were analyzed by trained Stantec staff using SonoBat v. 2.9.5 and 3.0.5 acoustic analysis software (stationary data) and AnalookW Software v. 3.7i (Titley Electronics, Australia) (mobile data). Bat activity was measured by the number of "bat passes", or times in which a bat was recorded by the receiver, which yields a rough estimate of activity or bat use of the area being sampled. A "pass" was defined as any file with ≥ 2 echolocation pulses. Bat pass data represent levels of activity rather than numbers of individuals because individuals cannot be distinguished by their calls. The total number of bat passes divided by the number of detector nights (i.e. one detector for one night = one detector night) was used as an index of bat activity.

Bat calls were classified as either high frequency (≥ 34 kHz) bats (e.g., Eastern Red Bat *(Lasiurus borealis),* Little Brown Bat *(Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), Indiana Bat (*Myotis sodalis*), Tri-colored Bat (*Perimyotis subflavus*) and Evening Bat (*Nycticeius humeralis*)), or low frequency (<34 kHz) bats (e.g. Big Brown Bat (*Eptesicus fuscus*), Silver-haired Bat (*Lasionycteris noctivagans*) and Hoary Bat (*Lasiurus cinereus*)).

The Sonobat Batch Scrubber 3 rejects calls less than 2 msec and those with weak signals. As a result, some poor quality, unclassifiable calls will get filtered (scrubbed) out. These unclassifiable calls are the weakest calls and are not classifiable as high or low frequency or suitable for species identification. However, in order to accurately represent total bat activity at the site, the number of unclassifiable calls that were scrubbed out (i.e. false negatives) was estimated and added to the total classifiable calls to produce an adjusted total bat activity number.

The number of unclassifiable calls was estimated by analyzing the scrubbed files of a random sample of 25% of the survey nights distributed among the three seasons (i.e. spring, summer, and fall). The scrubbed files for each of the sample nights were visually inspected to determine the number of false negative calls. A correction factor was then calculated by dividing the total number of false negatives in the random sample by the total number of bat calls (false negatives + positives) in the random sample. The total number of classifiable bat passes for the activity season was then multiplied by the correction factor to produce the estimated total unclassifiable bat passes for the activity season.

2.2.2.4. Species Identification

Where possible, attempts were made to identify bat species or species groups (e.g. *Myotis*) utilizing high quality bat passes and comparing those calls with the species' known call parameters and with known calls found in established call libraries. Although each bat species has specific call characteristics, there is considerable overlap among call parameters between species. In addition, bats can vary their calls based on habitat conditions (e.g. open vs. cluttered environments). Due to the known overlap in echolocation call characteristics occurring among some sympatric species (i.e. closely related species occurring in the same geographic area) (Barclay 1999), a portion of the acoustic data was classified to species groups rather than to individual species. Classification to species or species group was possible only for calls with a low signal-to-noise ratio and minimal echo. If the species or species group could not be determined because of call quality, or if calls were assignable to more than three species due to overlap in echolocation call parameters, the call was categorized as "unknown."

## 3.0 RESULTS

### 3.1. Bat Screening Analysis and Baseline Data Collection

3.1.1. Project Specific Landcover Characteristics

Landcover within the project area is highly agricultural (i.e. rowcrop and pastureland), with drainageways scattered across the site. Illinois GAP landcover data indicate a total of six land cover categories within the project area, including various types of row and close grown crops, grasses (i.e. pasture), upland forest, forested wetland, open water and developed land (Table 2; Figure 3). Of these, cropland comprises 95.6% of the project area, with the next most abundant landcover type being grassland (3.8%). Forest, forested wetland, and open water collectively comprise <0.1% of the landcover within the project area (Table 2; Figure 3).

**Table 2. Landcover type and amount within the proposed project area determined through analysis of Illinois GAP Landcover Data**

| Landcover | Total Acres | Percent of Total |
|---|---|---|
| Agriculture (Rowcrop) | 12081.3 | 95.6 |
| Grassland (Pasture) | 477.9 | 3.8 |
| Developed | 75.9 | 0.6 |
| Upland Forest | 3.6 | 0.03 |
| Open Water | 1.6 | 0.01 |
| Forested Wetland | 0.9 | <0.01 |

A series of unnamed streams are present throughout the project area (Figure 2). Three named streams are also present: Spring Creek in the northwestern and north central portion of the project area; Sugar Creek in the south central portion; and, Pigeon Creek located in the southeastern portion of the site (Figure 2). In general, woodlots are absent in the project area and the few wooded riparian areas that are present tend to be small and/or narrow.

Several bat species native to Illinois prefer woodlands for feeding or roosting at some time during the year. In addition, many species of bats feed along wooded stream corridors or over water. Several of the more common species, such as the Little Brown Bat and Big Brown Bat, are known to roost in attics or the peaks of other large buildings. Natural habitat features or resource areas that typically attract bats are limited within the project area. However, large outbuildings associated with agricultural settings may provide suitable roosting locations for some of the more common bat species.

3.1.2. Designated Natural Resource Areas

Two designated natural resource areas occur within the project area (Figure 3), neither of which would provide significant bat habitat:

- Clarence Railroad Prairie – Located in the southeastern portion of the project area. Six acres designated as restored or natural prairie.
- Clarence West Railroad Prairie – Located in the south central portion of the project area. Five acres designated as restored or natural prairie.

Five natural areas are located within four miles of the project area:

- Herschel Workman – Located one mile east of the project area, this 141 acre property with six acres of timber is managed by the Illinois Department of Natural Resources (DNR).
- Loda Cemetery Prairie – Located approximately 1.5 miles northwest of the project area. This area is 12.4 acres of native prairie managed by The Nature Conservancy (TNC).
- Prospect Cemetery Prairie – Five acres of native prairie located approximately 1.5 miles west of the project area, managed by the Paxton Township Cemetery Association.
- Patton Woods – Located approximately three miles south of the project area. This area is 14 acres of dry oak hickory forest containing mature oaks and hickories. It is managed by the Champaign County Forest Preserve District.
- Middle Fork River Forest – A 1702 acre area located approximately four miles south of the project area composed of old hardwood timber, reforested lowlands, ponds, and four miles of the Middle Fork River managed by Champaign County Forest Preserve District.

3.1.3. Bat Species Potentially Present and Species of Concern

A total of 12 species of bats occur in Illinois. Nine species, all members of the family Vespertilionidae, have geographic distributions that include Iroquois and Ford counties (Schwartz and Schwartz 1986; Harvey et al. 1999; Batcon.org 2010) (Table 3). Of these, only the Indiana Bat is listed as threatened or endangered (Illinois-state and federally endangered). The Indiana Bat is also considered a Species in Greatest Need of Conservation by the Illinois DNR (IDNR 2010). Currently, a petition has been submitted to the USFWS requesting that the Northern Myotis be listed under the Endangered Species Act and a separate request has been submitted for a status review of the Little Brown Bat. At present, these species are not yet listed; however, it may be prudent to consider these species during the project planning process.

Indiana bat maternity colonies are historically known from Ford County (USFWS 2007). Recent records include a July 2010 survey that identified an Indiana Bat maternity colony on the Middle Fork of the Vermilion River in Ford and Champaign counties (Illinois DNR correspondence dated 6 December 2010). Maternity colonies are also known from Vermillion County, located adjacent to Ford County to the southeast (USFWS 2007). No records of Indiana Bats are known from Iroquois County (USFWS 2007). The closest known hibernaculum is Blackball Mine located in LaSalle County, Illinois approximately 120 miles to the northwest of the site (USFWS 2007).

All nine bat species use woodland habitat for feeding or roosting at some time during the year. In addition, many species of bats feed along stream corridors or over water. A limited number of narrow, linear tracts of woodland associated with stream corridors are found within the project area and may, at times, serve as habitat for these species. While these areas may provide potentially suitable foraging habitat for bats, review of landcover data indicate that overall forest cover in the project area is minimal (Table 2; Figure 3).

Illinois GAP data were used to identify those areas that may provide Indiana Bat habitat. GAP predicted areas are based on specific modeling criteria that produce a geographic range extent for the species. In addition, GAP data identify those areas with GIS features or conditions to which the species is likely to be associated. These areas are identified as possible habitat.

Illinois GAP data indicate approximately 7,383 acres of possible Indiana Bat habitat in Iroquois County, and no areas of possible Indiana Bat habitat in Ford County. No GAP indicated possible or predicted Indiana Bat habitat is found within the project area.

Approximately 4.5 acres of total forest cover (upland forest and forested wetland) is found within the project area (Table 2; Figure 3). Results of the desktop Indiana Bat habitat assessment indicate that no woodland tracts within the project area meet the minimum forest cover requirement of >15% for suitable Indiana Bat summer habitat; therefore, no suitable summer habitat is present within the project area. However, suitable summer habitat may be present in the larger woodland tracts located south and west of the project area (see Section 3.1.2). While suitable summer habitat may not be present in the project area, due to the site's location within the known geographic range of the Indiana Bat, the potential does exist for Indiana Bats to migrate through the project area.

Although the desktop assessment indicates that no suitable Indiana Bat habitat is present within the current project boundary, habitat impacts are not the only potential impacts to Indiana Bats posed by a wind facility. Although it may be possible to avoid impacts to Indiana Bat habitat altogether, the presence of the turbines, even in open, non-forested areas, may pose a risk of bat mortality due to rotor strikes and barotrauma.

**Table 3. Abundance, call frequency group and winter habits of Illinois bat species with potential to occur in Iroquois and Ford counties, Illinois.**

| Scientific Name | Common Name | Abundance[1] | Frequency Group[2] | Winter Habits |
|---|---|---|---|---|
| *Myotis lucifugus* | Little Brown Bat | Common | High | Short Distance Migrants (<300 km) |
| *Myotis sodalis* | Indiana Bat | Rare (Federal and State Endangered) Species in Greatest Need ofConservation[3] | High | Short Distance Migrants (<300 km) |
| *Myotis septentrionalis* | Northern Long-eared Bat | Common | High | Short Distance Migrants (<300 km) |
| *Lasionycteris noctivagans* | Silver-haired Bat | Limited Distribution/Uncommon | Low | Long Distance Migrants (>500 km) |
| *Perimyotis subflavus* | Tri-colored Bat | Common | High | Short Distance Migrants (<300 km) |
| *Eptesicus fuscus* | Big Brown Bat | Common | Low | Short Distance Migrants (<300 km) |
| *Lasiurus borealis* | Eastern Red Bat | Common | High | Long Distance Migrants (>500 km) |
| *Lasiurus cinereus* | Hoary Bat | Limited Distribution/Uncommon | Low | Long Distance Migrants (>500 km) |
| *Nycticeius humeralis* | Evening Bat | Limited Distribution/Uncommon | High | Probably Long Distance Migrant |

[1] http://m.extension.illinois.edu/wildlife/directory_show.cfm?species=bat

[2] Low frequency bats are considered to be those using calls in which the highest minimum frequency is 34 kHz, while high frequency bats are considered to be those using calls in which the lowest minimum frequency is ≥ 34 kHz.

[3] IDNR 2010.

## 3.2. Pre-Construction Bat Activity Surveys

The ReBAT™ unit was operational between 17 April and 4 November, for a total of 402 detector nights (one detector for one night = one detector night; therefore, there are two detector nights for each night that both detectors are operational). Bats were recorded on 145 of 201 (72.1%) survey nights at the tower. A summary of ReBAT™ operational data by season is shown in Table 4.

**Table 4. Summary of ReBAT™ operational data by season at the Pioneer Trail Wind Farm (Iroquois and Ford counties, Illinois, 2010)**

| | No. Survey Nights | No. Detector Nights[1] | No. Survey Nights Bats Recorded | % of Survey Nights Bats Recorded |
|---|---|---|---|---|
| **Spring** | 29 | 58 | 16 | 55.1 |
| **Summer** | 61 | 122 | 47 | 77.0 |
| **Fall** | 111 | 222 | 82 | 73.9 |
| **Total** | **201** | **402** | **145** | **72.1** |

[1]One detector for one night = one detector night

A total of 1026 classifiable bat passes (mean = 2.6 passes/night) were recorded by the stationary detectors during the activity season (Table 5). It is estimated that 243 unclassifiable passes were removed during the filtering process. Therefore, the adjusted total bat passes for the 2010 activity season at the Pioneer Trail Wind Farm is 1269 (mean = 3.2 passes/night) (Table 5). Bat activity by month is shown in Figure 4. August had the most activity followed closely by July and September.

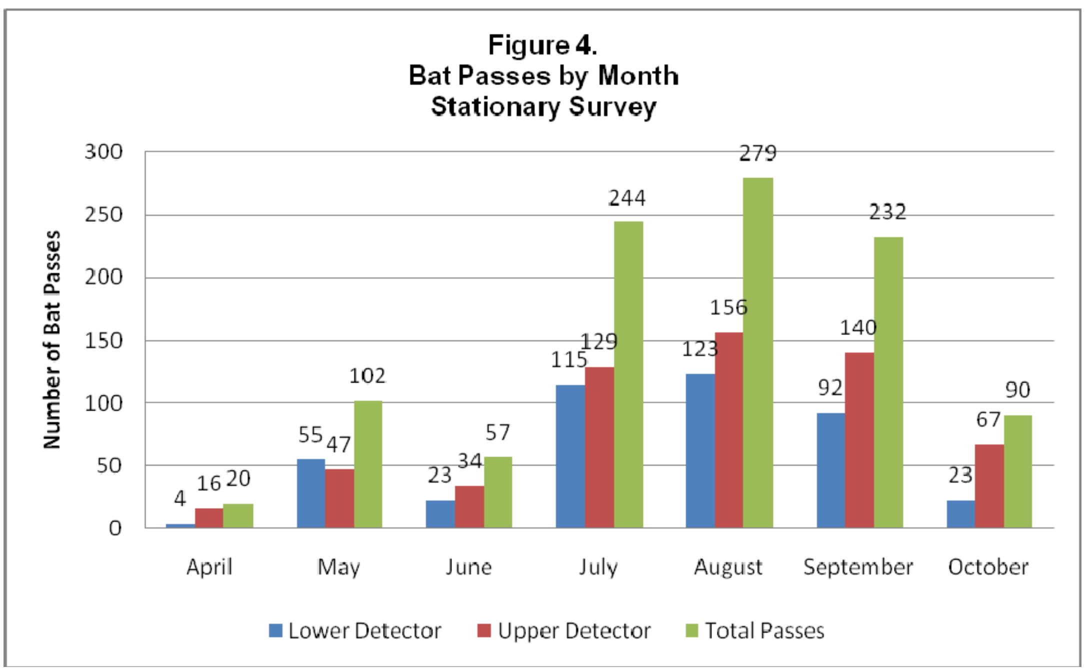


**Table 5. Summary of bat passes (mean per night) by detector height, season and frequency group for stationary pre-construction surveys at the Pioneer Trail Wind Farm (Iroquois and Ford counties, Illinois, 2010).**

| | 5 Meter | 58 Meter | Total |
|---|---|---|---|
| Spring | | | |
| Low Freq. Bat Passes | 18 (0.6) | 41 (1.4) | 59 (1.0) |
| High Freq. Bat Passes | 10 (0.3) | 3 (0.1) | 13 (0.2) |
| **Total Passes (Spring)*** | **29 (1.0)** | **45 (1.6)** | **74 (1.3)** |
| Summer | | | |
| Low Freq. Bat Passes | 77 (1.3) | 83 (1.4) | 160 (1.3) |
| High Freq. Bat Passes | 15 (0.2) | 10 (0.2) | 25 (0.2) |
| **Total Passes (Summer)*** | **97 (1.6)** | **96 (1.6)** | **193 (1.6)** |
| Fall | | | |
| Low Freq. Bat Passes | 244 (2.2) | 376 (3.4) | 620 (2.8) |
| High Freq. Bat Passes | 44 (0.4) | 56 (0.5) | 100 (0.5) |
| **Total Passes (Fall)*** | **309 (2.8)** | **450 (4.1)** | **759 (3.4)** |
| **Total Low Frequency Passes for Activity Season** | **339 (1.7)** | **500 (2.5)** | **839 (2.1)** |
| **Total High Frequency Passes for Activity Season** | **69 (0.3)** | **69 (0.3)** | **138 (0.3)** |
| **Total Classifiable Passes for Activity Season*** | **435 (2.2)** | **591 (2.9)** | **1026 (2.6)** |
| **Est. Total Unclassifiable Passes for Activity Season** | **243** | | |
| **Adjusted Total Passes for Activity Season** | **1269 (3.2)** | | |

*Some recorded bat sound files contained both low and high frequency species or were too poor quality to characterize the call by frequency group. Therefore, the sum of bat passes for these groups may not equal the "Total Passes" recorded.

During the 90 mobile surveys (15 surveys of 6 transects), 58 definitive bat passes (mean = 0.6 passes/transect/night) were recorded (Table 6). Among the transects, Transect 4, located in the southwest corner of the project area (Figure 2), recorded the highest number of total bat passes at 28 (mean = 1.9/night) (Table 6). Transects 1 and 3, located in the northwestern portion of the project area (Figure 2), recorded the lowest total number of bat passes at only 2 each (mean = 0.1/night) (Table 6).

**Table 6. Bat passes (mean per transect per survey night) by season for mobile pre-construction surveys at Pioneer Trail (Iroquois and Ford counties, Illinois, 2010).**

| | Transect 1 | Transect 2 | Transect 3 | Transect 4 | Transect 5 | Transect 6 |
|---|---|---|---|---|---|---|
| **Low Frequency Bat Passes** | 0 (0.0) | 3 (0.2) | 2 (0.1) | 14 (0.9) | 4 (0.3) | 4 (0.3) |
| **High Frequency Bat Passes** | 2 (0.1) | 2 (0.1) | 0 (0.0) | 9 (0.6) | 10 (0.7) | 3 (0.2) |
| **Total Passes** | 2 (0.1) | 5 (0.1) | 2 (0.1) | 28 (1.9) | 14 (0.9) | 7 (0.5) |
| **Total Passes for Activity Season*** | **58 (0.6)** | | | | | |

*Some recorded bat sound files contained both low and high frequency species. Therefore, the sum of bat passes for these groups may not equal the “Total Passes” recorded.

### 3.2.1. Bat Species and Frequency Groups Detected During Surveys

Using classifiable calls and files that contained high quality bat passes, a species list was developed for the project area. Approximately 73.5% of the 1026 classifiable calls recorded during the stationary survey and 72.4% of the 58 calls recorded during the mobile surveys were identifiable to species or species group (e.g. Big Brown Bat/Silver-haired Bat, *Myotis* sp.). Five bat species were confirmed to be present at the site:

- Big Brown Bat
- Silver-haired Bat
- Eastern Red Bat
- Hoary Bat
- Tri-colored Bat

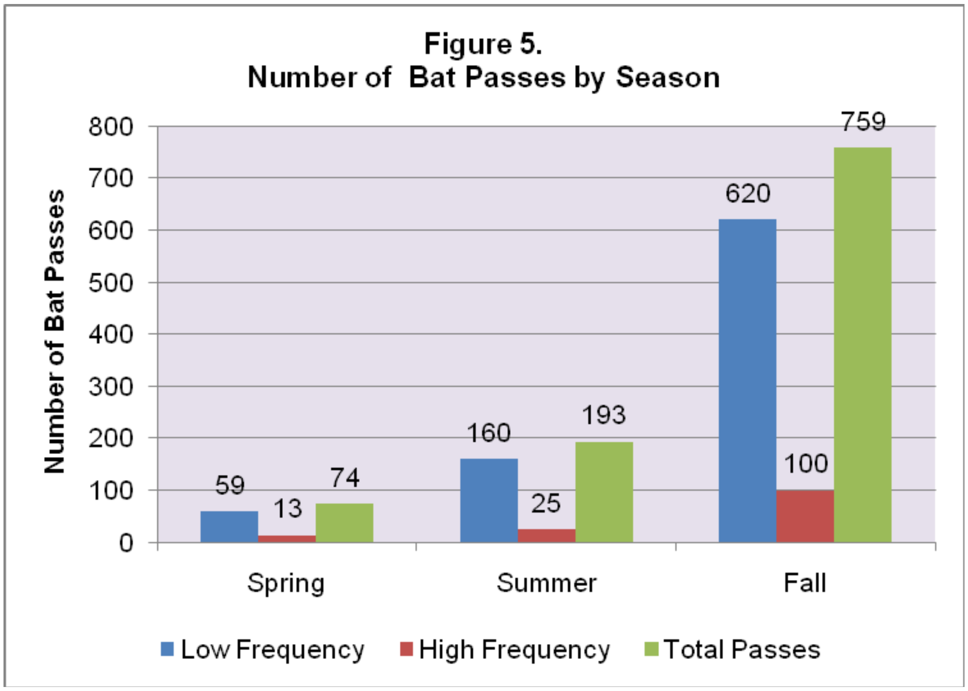
None of the species confirmed in the project area are listed as state or federally threatened or endangered. Six confirmed *Myotis* calls were recorded by the 5 m receiver during the stationary survey. A single call was recorded on 3 July, 27 July, 11 August and 14 August, and two calls were recorded on 11 October. All six calls exhibit characteristics found in both Little Brown Bat and Indiana Bat calls; however, due to the overlap in call characteristics between the two species, positive identification to species is not possible. Based on the detection zone of the receivers, bats recorded by the 5 m detector are not within the rotor swept zone (>38.75 m). Three confirmed *Myotis* calls were recorded during mobile surveys: one along Transect 5 on 20 August and two along Transect 4 on 25 August. *Myotis* calls represent 7% of the identifiable calls recorded during the mobile survey, but only 0.8% of the identifiable calls recorded during the stationary survey.

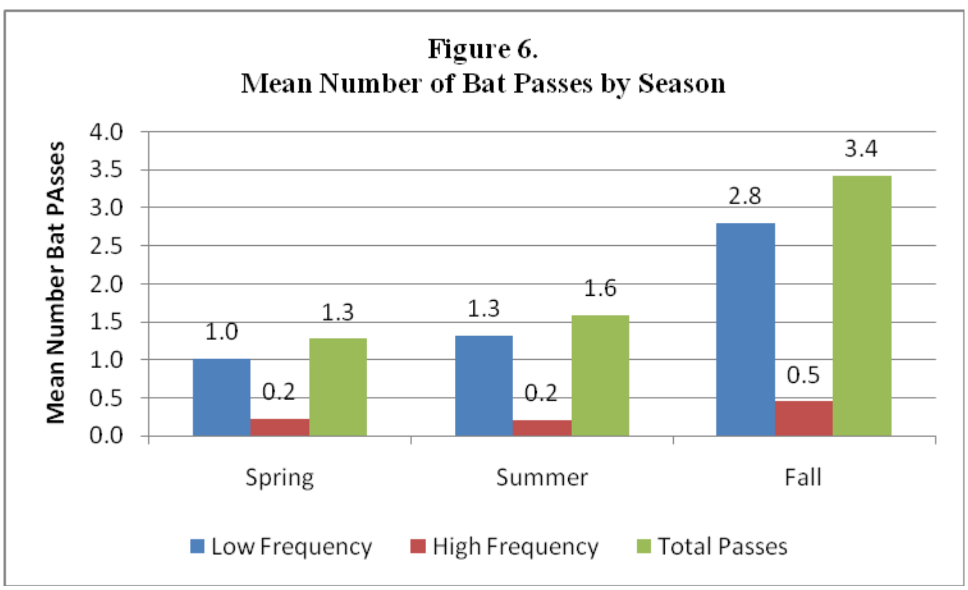
Three additional possible *Myotis* calls were recorded during stationary surveys: one on 27 July and one on 31 July, both at the upper detector, and one at the lower detector on 15 September. All three calls exhibit characteristics found in *Myotis* calls, but are also consistent with Red Bat calls; therefore, positive identification is not possible.

Both low and high frequency bat species were recorded during stationary and mobile surveys. During stationary surveys, specifically when all receiver heights and time periods are considered together, on average, low frequency species were recorded more often than high frequency species (mean = 2.1 and 0.3 passes/night, respectively); with the total number of passes per species group greater for the low frequency species (839 passes) vs. high frequency species (138 passes) (Table 5). During mobile surveys, passes from low frequency and high frequency species were recorded in nearly equal numbers (27 and 26 total passes; mean = 1.8 and 1.7 bats/night, respectively).

3.2.2. Seasonal Distribution of Bat Activity

A summary of bat activity by season at the Pioneer Trail Wind Farm site is shown in Figures 5 and 6 and a discussion by season is presented below.



3.2.2.1. Spring (15 April – 15 May)

The total number of bat passes at the stationary detector during the spring season (74) was the lowest among the three seasons (74; mean = 1.3 passes/night) (Table 5). Low frequency species were recorded more often than high frequency species during both stationary and mobile surveys (Tables 5, 6 and 7). Total bat passes recorded during spring mobile surveys were the highest of the three seasons (27), but only slightly above the fall surveys (25) (Table 7).

**Table 7. Bat passes (mean/transect/survey night) by season for mobile pre-construction bat surveys at the Pioneer Trail Wind Farm (Iroquois and Ford Counties, Illinois, 2010).**

| | Spring | Summer | Fall |
|---|---|---|---|
| Low Frequency Bat Passes | 16 (0.5) | 2 (0.2) | 9 (0.2) |
| High Frequency Bat Passes | 6 (0.2) | 4 (0.3) | 16 (0.3) |
| **Total Passes** | 27 (0.9) | 6 (0.5) | 25 (0.5) |
| **Total Passes for Activity Season*** | **58 (0.6)** | | |

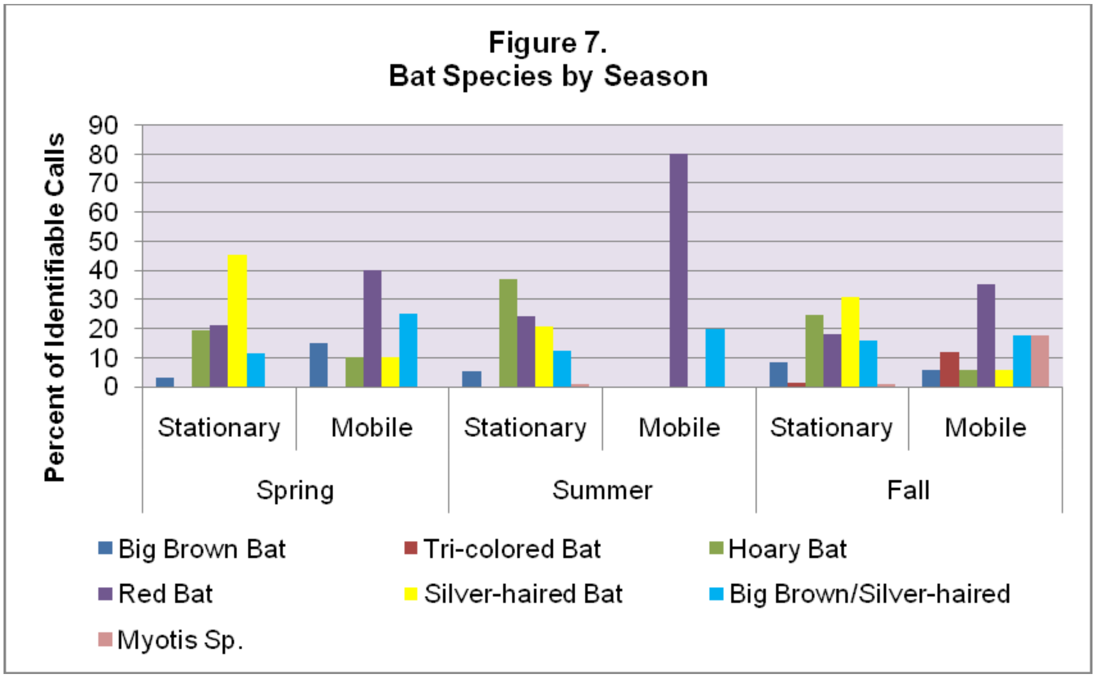
*Some recorded bat sound files contained both low and high frequency species. Therefore, the sum of bat passes for these groups may not equal the “Total Passes” recorded.

The approximate distribution of the classifiable bat passes recorded at the stationary unit, during the spring season, where species identification was possible is shown below and in Figure 7:

- Silver-haired Bat 45%
- Red Bat 21%
- Hoary Bat 19%
- Big Brown Bat/Silver-haired Bat group 11%
- Big Brown Bat 3%

The approximate distribution of identifiable bat passes recorded during spring mobile surveys where species identification was possible is shown below and in Figure 7:

- Red Bat 40%
- Big Brown Bat/Silver-haired Bat group 25%
- Big Brown Bat 15%
- Hoary Bat 10%
- Silver-haired Bat 10%




3.2.2.2. Summer (16 May – 15 July)

The total number of bat passes at the stationary detector during the summer season (193) increased over what was observed during the spring season (74); and the average number of passes/night increased from 1.3 to 1.6 (Table 5). Low frequency species were recorded at the stationary detector more often than high frequency species (Table 5; Figure 5). Bat activity recorded during summer mobile surveys was significantly lower than spring (5 total passes vs. 20 total passes), with twice as many high frequency bats recorded as low frequency bats (Table 7).

The approximate distribution of the classifiable bat passes recorded at the stationary unit, during the summer season, where species identification was possible is shown below and in Figure 7:

- Hoary Bat 37%
- Red Bat 24%
- Silver-haired Bat 21%
- Big Brown Bat/Silver-haired Bat group 13%
- Big Brown Bat 5%
- *Myotis* sp. <1%

The approximate distribution of identifiable bat passes recorded during summer mobile surveys where species identification was possible is shown below and in Figure 7:

- Red Bat 80%
- Big Brown Bat/Silver-haired Bat group 20%

3.2.2.3. Fall (16 July – 31 October)

The total number of bat passes at the stationary detector during the fall season (759) was the highest among the three seasons. The average number of passes/night (3.4) was over two times the average number of passes/night recorded in the spring or summer (1.3 and 1.6 respectively) (Figures 5 and 6). Low frequency species were recorded at the stationary detector six times more often than high frequency species (Table 5). Total bat passes recorded during fall mobile surveys (25) were nearly equal to what was recorded in the spring (27) and four times that recorded in the summer (6) (Table 7).

The approximate distribution of the classifiable bat passes recorded at the stationary unit, during the fall season, where species identification was possible is shown below and in Figure 7:

- Silver-haired Bat 31%
- Hoary Bat 25%
- Red Bat 18%
- Big Brown Bat/Silver-haired Bat group 16%
- Big Brown Bat 8%
- Tri-colored Bat 1%
- *Myotis* sp. <1%

The approximate distribution of identifiable detections recorded during mobile surveys where species identification was possible is shown below and in Figure 7:

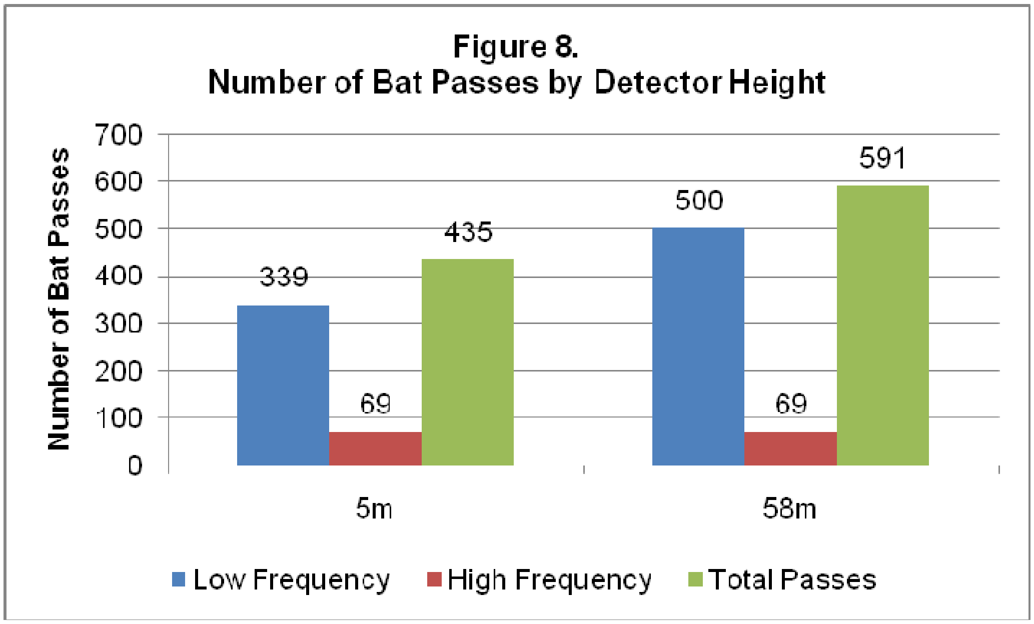
- Red Bat 35%
- Big Brown Bat/Silver-haired Bat group 18%
- *Myotis* sp. 18%
- Tri-colored Bat 12%
- Silver-haired Bat 6%
- Hoary Bat 6%
- Big Brown Bat 6%

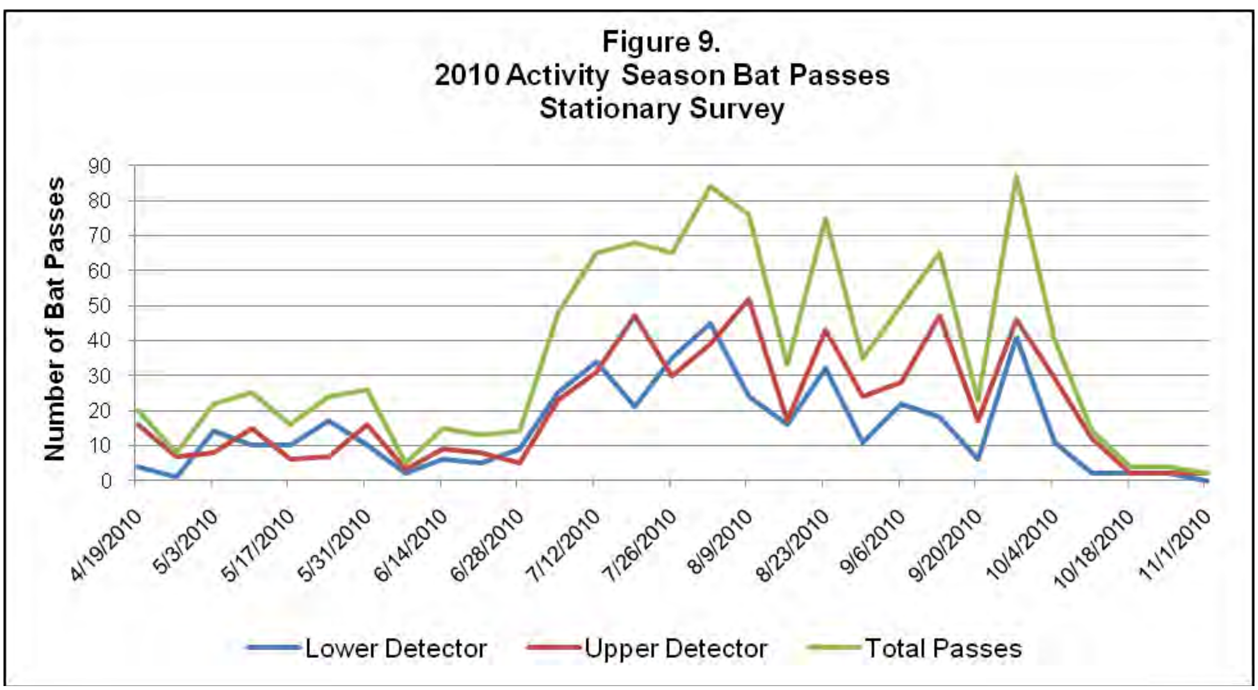
3.2.3. Vertical Distribution of Bat Activity – Stationary Survey

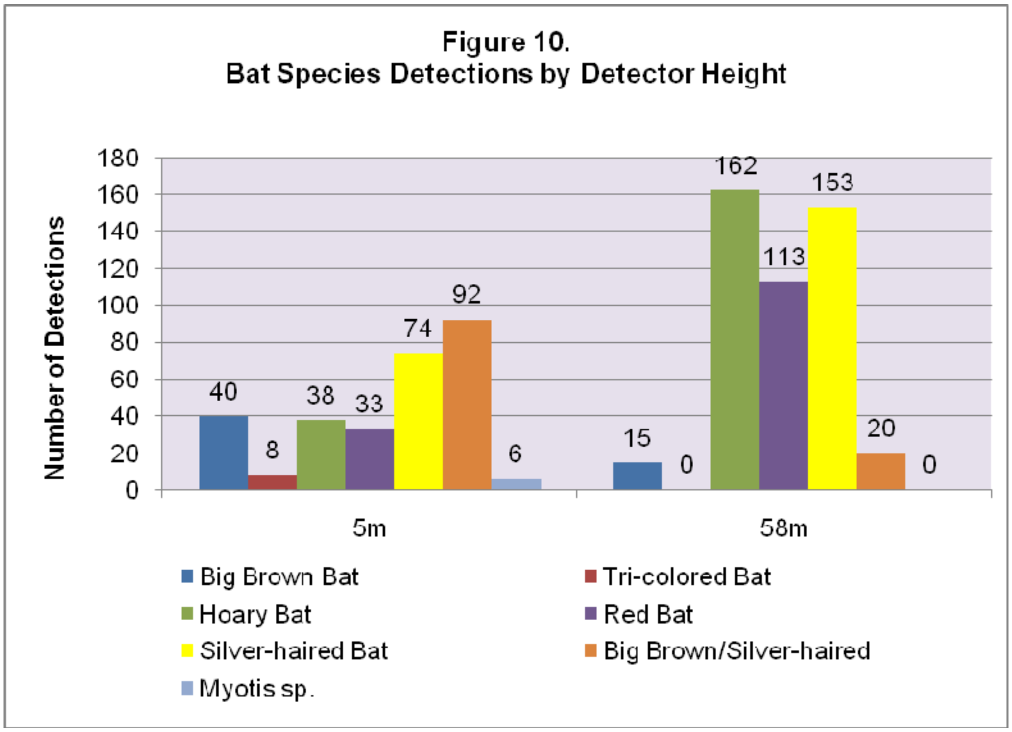
More total bat calls were recorded at the 58 m height (rotor-swept zone) (591 total passes; mean = 2.9 passes/night) than at the 5 m height (435 total passes; mean = 2.2 passes/night) (Table 5; Figure 8). Bat passes at the 58 m height outnumbered those at the 5 m height off and on from the beginning of the study period (17 April) through 16 July, at which time, bat passes at the 58 m height outnumbered those at the 5 m height and continued to do so until the end of the survey (4 November) (Figure 9). The increase in activity at the 58 m height from the mid-July through October coincides with the fall migration period.

Low frequency calls outnumbered high frequency calls at both the 5 m height and 58 m height (rotor-swept zone). At the 5 m height, low frequency calls were recorded approximately five times as often as high frequency calls, while at the 58 m height, low frequency calls were recorded approximately seven times as often (Table 5; Figure 8). The total number of bat passes on a single day ranged from 0 – 40, with the largest daily total recorded on 27 September, of which, 68% were recorded at the 5 m height.

Red Bats, Hoary Bats, Silver-haired Bats, and Big Brown Bats were all detected at both detector heights (Figure 10). Tri-colored Bats and *Myotis* sp. were only detected at the 5 m height. Silver-haired Bats were the most frequently recorded species at the 5 m height and Hoary Bats were recorded most frequently at the 58 m height. Within the rotor swept zone, the migratory, foliage roosting Red Bat, Hoary Bat and Silver-haired Bat were the most frequently recorded species, accounting for at least 72% of all detections, and 92% of all identifiable calls, at that height.






## 4.0 DISCUSSION

### 4.1. Summary and Conclusions

The Pioneer Trail project area is located in an agricultural setting dominated by farmsteads, livestock operations, pastures and fields used for rowcrop production. Natural habitat features, such as woodlands, woodlots and wooded riparian corridors that typically attract bats, are basically non-existent within the project area, and those that are present, are small and fragmented (Figure 2). However, larger blocks of woodland are found outside of the project area to the south and west, including Patton Woods, an area of mature oak and hickory woodland approximately three miles south of the project area, and Middle Fork River Forest, an area of old hardwood timber and reforested lowlands along the Middle Fork River approximately four miles south of the project area (Figure 3).

The majority of the bat species found in Illinois prefer to roost in woodlands and many species forage along wooded stream corridors or over water (Schwartz and Schwartz 1986; Harvey et al. 1999; Laubach et al. 2004). The Pioneer Trail project area provides limited roosting or foraging habitat in the form of woodland or open water. Limited information is available on how bats use agricultural areas in the Midwest; however, species such as the Big Brown and Little Brown Bat will roost, and even overwinter, in attics or large buildings. The farmsteads located in the project area, with their farmhouses and large outbuildings, likely provide suitable roosting locations for species such as these. Likewise, buildings in the towns of Paxton and Loda also likely provide suitable roosting and possibly overwintering sites for species such as the Big Brown and Little Brown Bat.

Bat activity at the stationary survey location (i.e. MET tower location), as measured by number of bat passes, was low when compared to some other wind farm sites in the Midwest. Table 7 provides a comparison of the bat activity at the Pioneer Trail site with activity at other wind farm sites surveyed by Stantec in Iowa, Illinois, Indiana and Wisconsin. The precise explanation for the lower activity is unknown and beyond the scope of this survey; however, landcover, specifically forest cover, in the project area likely plays a major role. Forest cover at the other Midwest sites ranges from 1.2 – 6%, while at Pioneer Trail forest cover comprises <0.01% of the landcover (Table 7).

**Table 7. Comparison of bat activity at wind farms in the Midwest surveyed by Stantec.**

| Wind Farm Site Location | Total # Bat Passes (Mean/Night) Stationary Survey | Total # Bat Passes (Mean/Night) Mobile Survey | Land Use |
|---|---|---|---|
| Northeast Iowa | 2313 (6.0) | 105 (2.8) | 83% Agricultural<br>2% Forest |
| Northwest Illinois | 1905 (4.8) | 196 (2.6) | >90% Agricultural<br>>6% Forest |
| Central Indiana | 1800 (4.5) | 93 (1.0) | 93% Agricultural<br>0.6% Forest |
| Southwest Illinois | 1721 (5.1) | 26 (0.3) | 90% Agricultural<br>1.2% Forest |
| East Central Wisconsin | 1647 (3.9) | 95 (1.5) | 88% Agricultural<br>2% Forest |
| Pioneer Trail Wind Farm | 1269 (3.2) | 58 (0.6) | 96% Agricultural<br><0.01% Forest |
| Central Iowa | 183 (0.4) | 95 (4.5) | 81% Agricultural<br>0.1% Forest |

Based on geographic distribution, nine of the 12 bat species known to occur in Illinois have the potential to be found in the Pioneer Trail project area (Schwartz and Schwartz 1986; Harvey et al. 1999; Batcon.org). Five bat species, the Hoary Bat, Big Brown Bat, Eastern Red Bat, Silver-haired Bat and Tri-colored Bat, were confirmed to be present during the survey. Of the species confirmed in the project area, none are listed as threatened, endangered or as a Species in Greatest Need of Conservation by the Illinois DNR (Table 3).

In addition to the species listed above, calls of species within the genus *Myotis* were also recorded in the project area. Nine confirmed *Myotis* calls were recorded during the stationary and mobile surveys, representing only 0.7% of the total bat passes recorded at the site. Due to overlap in call characteristics between members of the genus *Myotis*, positive classification to species is not possible. However, based on habitat within the project area, it is likely that many of these calls are Little Brown Bats.

The Indiana Bat is known to occur in Ford County, with documented maternity colonies in the county (USFWS 2007). A habitat assessment conducted at the site indicates that no suitable Indiana Bat summer habitat is found within the project area, primarily due to the lack of sufficient forest cover. Nevertheless, habitat impacts are not the only potential impacts to Indiana Bats posed by a wind facility, and migratory risk could exist anywhere within the species' geographic range.

A total of 1269 stationary and 58 mobile bat passes, representing both low and high frequency species were recorded during the survey. On average, low frequency bats were recorded more often than high frequency bats at the stationary detectors. However, because low frequency sound attenuates less quickly than high frequency sound, the receivers may detect low frequency sounds at greater distances; therefore, it is possible that low frequency bats may not be more common in the area, but rather that their calls are being recorded more frequently. Along mobile transects high frequency bats were recorded almost equal to those of low frequency bats.

Bats were detected less often in the rotor-swept zone (i.e. 58 m height) during the summer season, but more often in the rotor-swept zone during the spring and the fall, corresponding to the spring and fall migration periods. Red Bats, Hoary Bats, Silver-haired Bats and Big Brown Bats were all recorded within the rotor-swept zone, with Red Bats, Hoary Bats and Silver-haired Bats being the most frequently recorded species, accounting for at least 72% of all detections, and 92% of all identifiable calls, at that height.

Post-construction and pre-construction data may not fully predict fatality risks (Cryan 2008). Although considerable variation exists in the data among projects, peaks in bat fatalities associated with numerous wind farms have been reported during late summer and fall (reviewed by Arnett et al., 2008). Bat activity at the Pioneer Trail site was highest during the fall, with a rise in activity at the 58 m height near the end of July through October, coinciding with the fall migration period.

#### 4.1.1. Conclusions

##### 4.1.1.1. Risk to Resident Bats

The results of this survey suggest that the Pioneer Trail Wind Farm site may present a relatively low risk to resident and foraging bats for the following reasons:

1. Natural habitat features, such as woodlands, woodlots and wooded riparian corridors that provide roosting and foraging habitat for bats, are basically non-existent within the project area, with <0.1% of the project area consisting of forest.
2. Due to the lack of forest cover, the project area rates as unsuitable Indiana Bat summer habitat.
3. Overall bat activity at the site, as measured by number of bat passes, was low when compared to other wind farm sites in the Midwest for which data are available (Table 7).

Accordingly, the survey results do not suggest a material risk of impact to Indiana Bats from the Pioneer Trail project. However, it should be noted that currently there are no published reports linking pre-construction activity rates to post-construction fatality rates, and therefore, it is not possible to accurately predict post-construction fatality rates.

##### 4.1.1.2. Risk to Migrating Bats

Little is known about the migration patterns of bats, specifically how they disperse across the landscape during migration. Therefore, it is not possible to accurately predict an individual bat's route during migration. Based on this, migratory risk could exist anywhere within a species' geographic range, and the potential does exist for bats, including Indiana Bats, to migrate through the Pioneer Trail project area. However, the Pioneer Trail project area is located approximately 120 miles from Blackball Mine, the nearest known Indiana Bat hibernaculum. The results of this survey, with only nine confirmed *Myotis* calls, none of which could be positively identified as an Indiana Bat, do not suggest significant Indiana Bat migratory activity within the Pioneer Trail project area during the 2010 activity season.

## 4.2. Limitations of Pre-Construction Bat Activity Surveys

The results of the pre-construction bat activity survey should be viewed with the following limitations in mind:

1. Duration of the Survey – The survey included nightly passive survey events along a vertical transect in one location over the course of one activity season. Fifteen mobile surveys were conducted during this time as well. Because annual bat activity can vary due to weather, the results of this survey of one activity season may not be representative of the full range of bat activity in the project area.

2. Spatial Limitations of Vertical and Mobile Transects – Due to resource limitations, vertical transects, which survey bat activity at the height of the rotor-swept zone, were only conducted in one location. Although mobile surveys were conducted at more locations throughout the project area, it is unlikely that handheld units could detect bats at the height of the rotor swept zone. This pre-construction survey has only assessed bat activity in a small fraction of the overall rotor swept zones that will be occupied by WTGs.

The results of this survey should be used as baseline information regarding bat activity in the area and cannot be used to accurately predict what, if any, bat mortality would occur as a result of operation of the Pioneer Trail Wind Farm. A standard method of determining impacts to bats resulting from operation of a wind energy facility is to perform post-construction monitoring of bat species' presence, activity and mortality. If impacts are determined to be significant, then appropriate mitigation measures can be considered.

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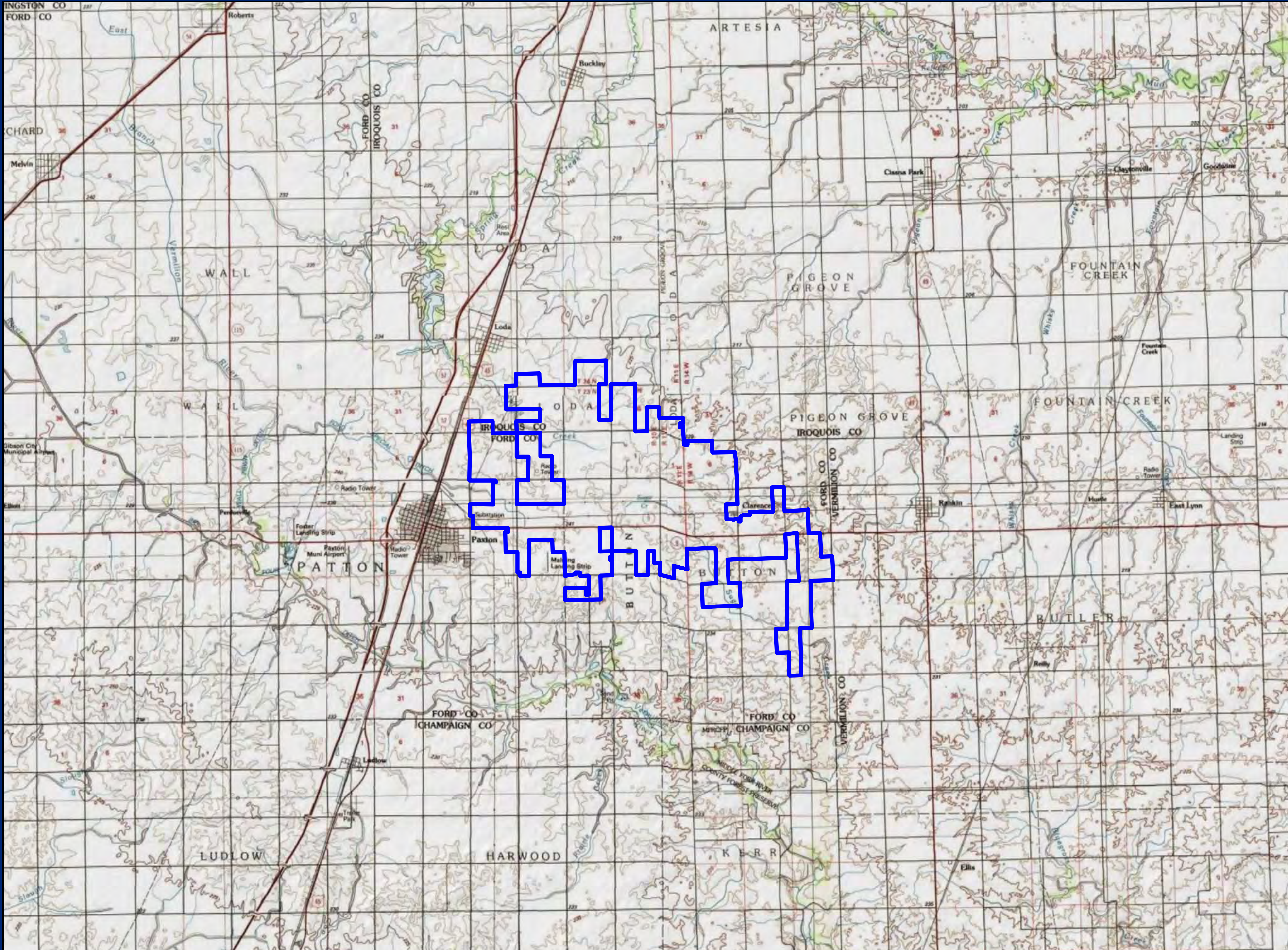
# Figure 1.
# Project Location and Topography
## Pioneer Trail Wind Farm





## Location

Iroquois and Ford Counties, IL

0 1 2 Miles

N

**Project Information**

Project Number : 0010-0034-01/193700126

Modified December 21, 2010

**Legend**

Project Boundary

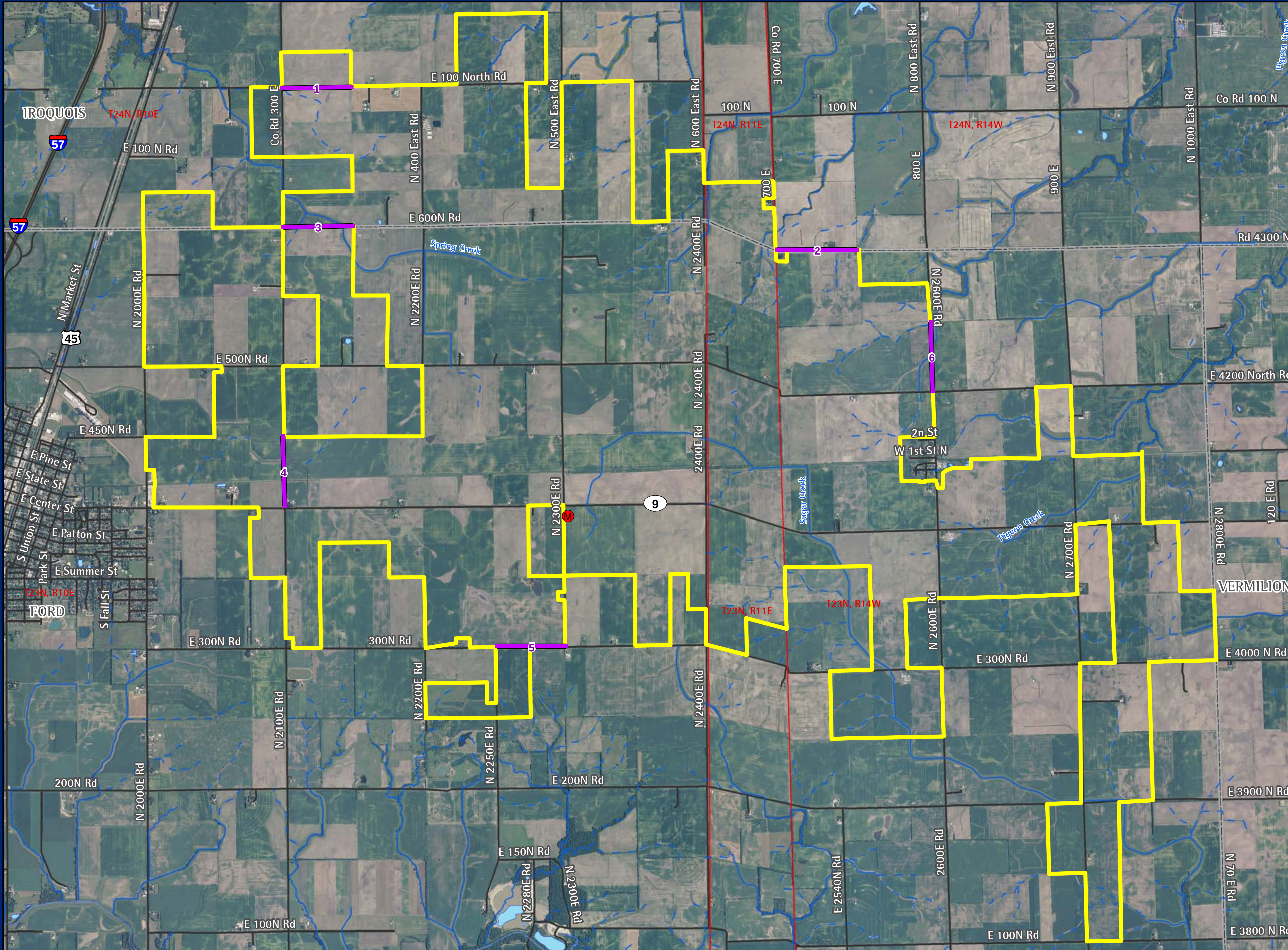
Data Sources include USGS 30'x60' Topographic Quadrangles; Fairbury, Champaign, Watseka and Danville

NRC Natural Resources Consulting, Inc.

Stantec


209 Commerce Parkway
P.O. Box 128
Cottage Grove, WI 53527-0128
phone: 608-839-1998
fax: 608-839-1995
www.Stantec.com

# Figure 2.
## Mobile Bat Survey Transects and Met Tower Locations
### Pioneer Trail Wind Farm





## Location

Iroquois and Ford Counties, IL

0 1,750 3,500 Feet

N

**Project Information**

Project Number : 0010-0034-01/193700126

Modified December 21, 2010

**Legend**

- Project Boundary
- Mobile Bat Transects
- County Line
- Township Line

**National Hydrography Data**

- Perennial Stream
- Intermittent Stream
- Waterbody

Data Sources include USCB, ESRI, USFWS and 2010 NAIP Orthophotography

NRC Natural Resources Consulting, Inc.

Stantec


209 Commerce Parkway
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Cottage Grove, WI 53527-0128
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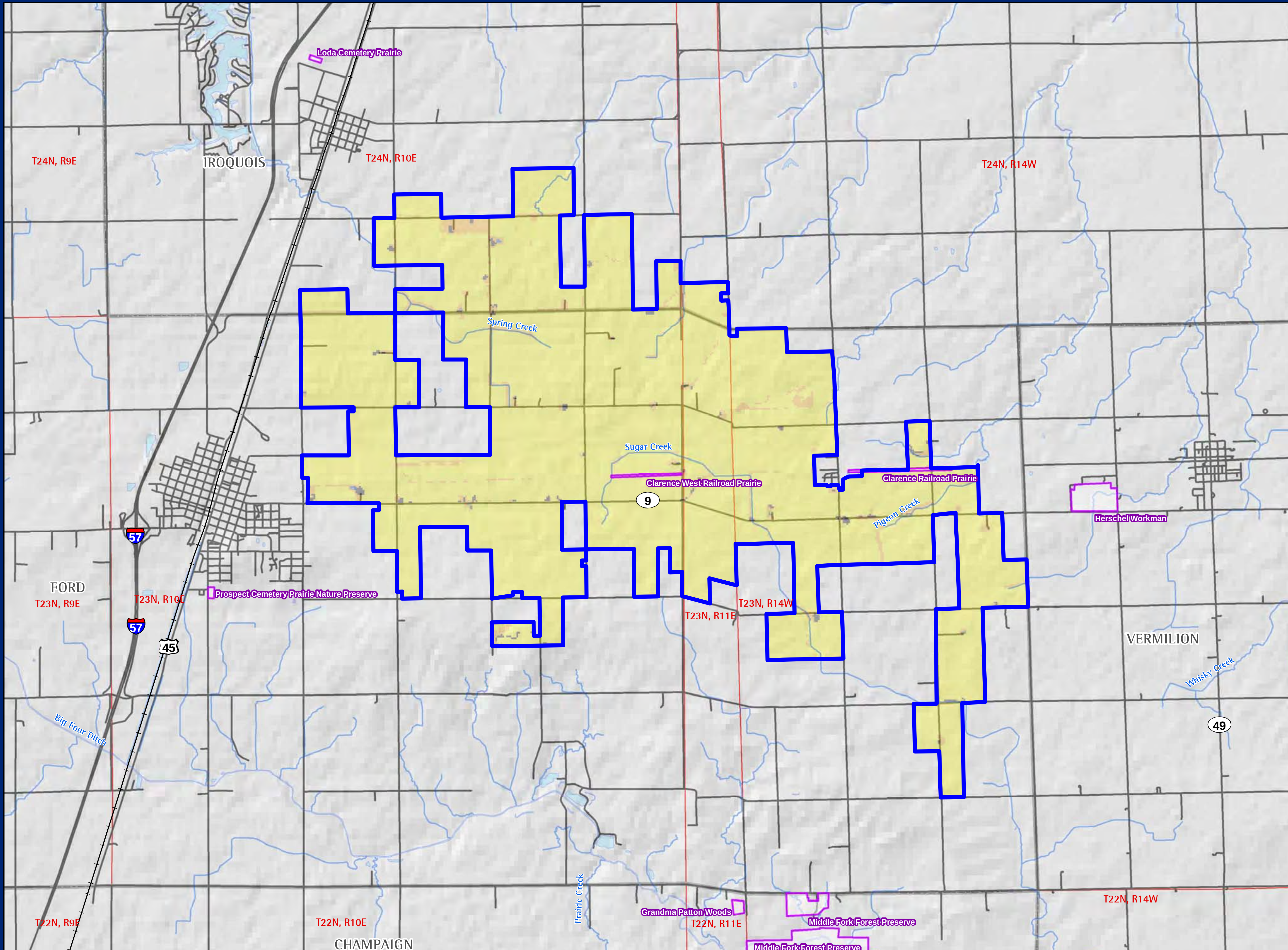
# Figure 3.
# GAP Landcover Data
## Pioneer Trail Wind Farm






## Location

Iroquois and Ford Counties, IL

0 0.5 1 Miles

N

### Project Information

Project Number : 0010-0034-01/193700126
Modified December 21, 2010

### Legend

- Project Boundary
- Conservation Areas
- County Line
- Township Line
- Perennial Stream
- Waterbody

GAP Landcover Data

- Agriculture (12081.3 ac)
- Grassland (477.88 ac)
- Upland Forest (3.58 ac)
- Forested Wetland (0.92 ac)
- Open Water (1.55 ac)
- Developed (75.87 ac)

Data Sources include USGS, USFWS, USCB, ESRI and Ducks Unlimited


NRC Natural Resources Consulting, Inc.
Stantec

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Paxton Landcover.mxd Map Created by S. Foster

**Appendix E: USFWS Technical Assistance Letter**

# United States Department of the Interior

FISH AND WILDLIFE SERVICE
Rock Island Field Office
1511 47th Avenue
Moline, Illinois 61265
Phone: (309) 757-5800 Fax: (309) 757-5807


IN REPLY REFER TO:
FWS/RIFO

March 29, 2012

Mr. Paul Bowman
E.ON Climate & Renewables
353 North Clark Street
Floor 30
Chicago, Illinois 60654

Re: Pioneer Trail Wind Farm, Ford and Iroquois Counties, Illinois

Dear Mr. Bowman:

The purpose of this letter is to acknowledge and respond to Pioneer Trail Wind Farm (PTWF), LLC's March 16, 2012 e-mail request for a new technical assistance letter concerning the effects of the above-referenced project on Endangered Species Act (ESA)-listed species under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS).

Section 9(a)(1)(B) of the ESA, 16 U.S.C.§ 1538 (a)(1)(B), makes it unlawful for any person to "take" an endangered species. Take of threatened species is prohibited pursuant to 50 C.F.R. § 17.31, which was issued by the USFWS under the authority of Sections 4(d) and 9(a)(1)(G) of the ESA, 16 U.S.C. §§ 1533(d) and 1538(a)(1)(G), respectively. "Take" is defined by the ESA as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct" 16 U.S.C. § 1532(19).

The USFWS has reviewed the information you have provided regarding the presence of Indiana bats and other ESA-listed species and their habitat in the vicinity of the PTWF, LLC site, and the measures that PTWF, LLC will implement to avoid any potential take of such species and their habitat. Specifically, PTWF, LLC has agreed to curtail operation of wind turbine generators including feathering of turbine blades until a wind speed of 6.9 meters per second is reached, between one half hour before sunset to one half hour after sunrise during the Indiana bat's fall migratory period, August 15 – October 15, has sited all wind turbine generators at least one thousand feet from suitable summer habitat, and has agreed to at least two years' post construction monitoring with follow up monitoring every five years thereafter as described in its March 2012 Avian and Bat Protection Plan ("ABPP"). Based on USFWS' review of this information, no incidental take permit is recommended. The USFWS reached this conclusion through coordination and ongoing discussions with PTWF, LLC including its written commitment, in the ABPP, that proven avoidance measures will be implemented while PTWF, LLC pursues an incidental take permit and until an incidental take permit is obtained for the PTWF, LLC. We understand that construction of the project began in summer 2011, and the project began commercial operations in January 2012, subject to the terms of the May 13, 2011 technical assistance letter previously issued by this office. The terms of this technical assistance letter replace the terms of the original May 13, 2011 letter.

The USFWS recognizes that, notwithstanding this conclusion, PTWF, LLC is currently pursuing an incidental take permit for the PTWF, LLC. When an incidental take permit (ITP) is successfully obtained, the avoidance measures that PTWF, LLC has committed to implement as the basis for this letter will be replaced by the avoidance, minimization, and mitigation measures set forth in a Habitat Conservation Plan upon which the ITP is based.

This office is not authorized to provide guidance regarding the USFWS Office of Law Enforcement (OLE) investigative priorities involving federally listed species. However, we understand that OLE carries out its mission to protect ESA-listed species through investigation and enforcement, as well as by fostering relationships with individuals, companies, and industries that have taken effective steps to avoid take of listed species, and by encouraging others to implement measures to avoid take of listed species. It is not possible to absolve individuals or companies from liability for unpermitted takes of listed species, even if such takes occur despite the implementation of appropriate take avoidance measures. However, the OLE focuses its enforcement resources on individuals and companies that take listed species without identifying and implementing all reasonable, prudent, and effective measures to avoid such takes. As of this date, the USFWS Rock Island Ecological Services Field Office concludes that the project will not or is unlikely to result in take of ESA listed species as currently proposed.

We appreciate PTWF, LLC's efforts to coordinate with our office in determining what measures could be implemented to avoid take of any ESA-listed species or their habitat at the project site. Should any new information become available, we request that you promptly notify this office. If new information becomes available to us that other measures could be implemented to avoid take that would not require additional commitment by your company, such as wind speeds shown to preclude foraging by Indiana bats, we will notify you as soon as possible.

Sincerely,

Richard C. Nelson
Field Supervisor

cc: Locke Lord LLP (Cowan)

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**Appendix F: Table F-1. Comparison of Bird Mortality at Existing Wind Farms in Midwestern U.S.**

**Appendix F Table F-1.** Comparison of bird mortality at existing wind farms in Midwestern U.S.

| Site | Habitat type (no. turbines) | Dates surveyed | Search interval | No. birds found in surveys (incidentally) | Estimated mortality, birds per turbine per year (total individuals per year) | Reference |
|---|---|---|---|---|---|---|
| Buffalo Ridge, Minnesota (Phase I) | agricultural, grassland (73) | Apr 1994 - Dec 1995 | 30-50 weekly | 7 | 0.33-0.66 (36) | Osborn, R.G., K.F. Higgins, R.E. Usgaard, C.D. Dieter, and R.D. Neiger. 2000. Bird mortality associated with wind turbines at the Buffalo Ridge Wind Resource Area, Manitoba. American Midland Naturalist. 143: 41-52. |
| Buffalo Ridge Wind Resource area; Minnesota (Phase I-III) | agricultural, grassland (354) | Mar 15 - Nov 15, 1996-1999 | 21 every 14 days | 55 | 0.50-4.45 (177-1575) | Johnson, G.D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, and D.A. Shepherd. 2000. Avian monitoring studies at the Buffalo Ridge, Minnesota Wind Resource Area: results of a 4-year study. Prepared for Northern States Power Company. Western EcoSystems Technology, Inc., Cheyenne, Wyoming, USA.<br>Johnson, G.D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, D.A. Shepherd, and S.A. Sarappo. 2002. Collision mortality of local and migrant birds at the large-scale wind power development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 30: 879-887. |
| Kewaunee County, Wisconsin | agricultural (31) | 1999 - 2001 | n/a | 25 | 1.29 (40) | Sagrillo, M. 2003. Wind energy technical info: bats and wind turbines. American Wind Energy Association, Washington, DC.<br>Sagrillo, M. 2007. Wind turbines and birds - putting the situation in perspective in Wisconsin. Wisconsin Focus on Energy REN-2033-020. <focusonenergy.com>. |
| Top of Iowa, Iowa | agricultural (89) | Apr 15 – Dec 15, 2003 | 26 every 2-3 days | 2 | 0.44 (39) | Koford, R., A. Jain, G. Zenner, and A. Hancock. 2004. Avian mortality associated with the Top of Iowa Wind Power Project, Progress Report 2003. Prepared for Iowa Department of Natural Resources. Iowa State University, Ames, Iowa, USA. 28 February. |
| Top of Iowa, Iowa | agricultural (89) | Mar 24- Dec 10, 2004 | 26 every 3-days | 5 | 0.90 (80 total) | Koford, R., A. Jain, G. Zenner, and A. Hancock. 2005. Avian mortality associated with the Top of Iowa Wind Farm progress report 2004. Iowa State University, Ames, Iowa, USA. 2 February. |
| Blue Sky Green Field Wind Project, Wisconsin | agricultural (88) | Jul 21-Oct 31, 2008<br>Mar 17 - Jun 6, 2009 | 10 daily, 20 every 4-6 days | 40 (3) | 11.83 (1041) | Gruver, J., M. Sonnenburg, K. Bay, and W. Erickson. 2009. Post-construction bat and bird fatality study at the Blue Sky Green Field Wind Energy Center, July 21, 2008 – October 31, 2008 and March 15, 2009 – June 4, 2009. Western EcoSystems Technology, Inc., Cheyenne, Wyoming, USA. |

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|---|---|---|---|---|---|---|
| NPPD Ainsworth, Nebraska | grassland (36) | Mar 13 - Nov 4, 2006 | 36 every 14 days | 26 (1) | 2.69 | Derby, C., A. Dahl, W. Erickson, K. Bay, and J. Hoban. 2007. Post-construction monitoring report for avian and bat mortality at the NPPD Ainsworth Wind Farm. Prepared for Nebraska Public Power District. Western EcoSystems Technology, Inc., Cheyenne, Wyoming, USA. |
| Forward Energy Center, Wisconsin | agricultural (86) | Jul 15 - Oct 15, 2008<br>Oct 15 – Nov 15, 2008<br>Apr 15 - May 31, 2009<br>Jul 15 - Oct 15, 2009 | 29, proportioned every 1, 3, and 5 days | 13 | not calculated | Drake, D., J. Garvin, S. Grodsky, and M. Watt. 2010. Post-construction bird and bat monitoring at the Forward Energy Center second interim report. Prepared for Forward Energy LLC. University of Wisconsin, Madison, Wisconsin, USA. |
| Cedar Ridge, Wisconsin | agricultural (41) | spring and fall 2009 | 20 of 41 every 1-4 days | 31 (11) | 10.82 (444) | BHE. 2010. Post-construction birds and bat mortality study Cedar Ridge Wind Farm, interim report. Prepared for Wisconsin Power and Light. BHE Environmental, Inc., Cincinnati, Ohio, USA. |
| Crescent Ridge, Illinois | agricultural (33) | Sept - Nov 2005<br>Mar-May 2006<br>Aug 2006 | 33 every 5 days | 10 | 0.49 in fall<br>0.47 in spring | Poulton, V. 2010. Summary of post-construction monitoring at wind projects relevant to Minnesota, identification of data gaps, and recommendations for further research regarding wind-energy development in Minnesota. Prepared for State of Minnesota Department of Commerce. Western EcoSystems Technology, Inc., Cheyenne, Wyoming, USA. |
| Fowler Ridge Phase I, Indiana | agricultural (162) | Apr 6 - Oct 30, 2009. | 25 turbines 50% weekly, 50% biweekly in spring, 25 2x/month to Oct | 28 | 5.26 | Johnson, G. D., M. Ritzert, S. Nomani, and K. Bay. 2010. Final report bird and bat fatality studies Fowler Ridge I Wind-Energy Facility. April 6 – October 30, 2009. Prepared for BP Wind Energy North America, Inc. Western EcoSystems Technology, Inc., Cheyenne, Wyoming, USA. |