Fowler Ridge Wind Farm, Benton County, Indiana
Indiana Bat Habitat Conservation Plan

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1.0 INTRODUCTION

1.1 Overview and Background

The Fowler Ridge Wind Farm facility (FRWF or Project) consists of four project phases owned by four separate Companies: Fowler Ridge Wind Farm LLC; Fowler Ridge II Wind Farm LLC; Fowler Ridge III Wind Farm LLC; and Fowler Ridge IV Wind Farm LLC. The four Companies have prepared this Habitat Conservation Plan (HCP) in order to apply for an Incidental Take Permit (ITP) under Section 10(a)(1)(B) of the Endangered Species Act, 16 United States Code [USC] § 1531-1599 (1973), 1539(a)(1)(B), (ESA). The four Companies, hereinafter referred to as Fowler Ridge or Permittees, will jointly serve as permittees under the ITP, and are jointly and severally liable for all obligations assigned to them under the ITP, HCP and associated documents such as the Implementing Agreement (IA) and Programmatic Agreement (PA).

The FRWF currently consists of 355 wind turbines constructed through three development phases located in Benton County, Indiana (Figure 1.1). This HCP also includes the development of Phase IV of the Project, which will consist of up to 94 additional turbines. Therefore, impacts associated with the construction and operation of a total of 449 turbines (Phases I, II, III, and IV) with a generating capacity of 750 megawatts (MW) will be assessed in this HCP.

A post-construction monitoring study of birds and bats was conducted within the existing development (Phases I, II and III) during 2009, 2010, and 2011 by Western EcoSystems Technology, Inc. (WEST, Inc., Appendix A). A casualty of an Indiana bat (*Myotis sodalis*), a federally endangered species, was found by FRWF personnel during the fall of 2009, and a second Indiana bat casualty was discovered during the monitoring studies in 2010. Consequently, as a result of these discoveries, Fowler Ridge is applying for an ITP under Section 10(a)(1)(B) of the ESA.

1.2 Purpose and Need

The implementing regulations for Section 10(a)(1)(B) of the ESA (50 Code of Federal Regulations [CFR] 17.22) identify the criteria by which a permit allowing the incidental take of listed species pursuant to otherwise lawful activities may be obtained. The purpose and need for the ITP is to ensure that incidental take resulting from the proposed operation of the FRWF will be minimized and mitigated to the maximum extent practicable and will not appreciably reduce the likelihood of the survival and recovery of the Indiana bat in the wild. The ITP application requires the development and submission of an HCP, which is designed to ensure the continued existence and help in the recovery of the Indiana bat while allowing for the limited incidental take of the species during the operation of the FRWF.

This HCP outlines the anticipated impacts of the proposed taking of the Indiana bat and how those impacts will be minimized and mitigated to the maximum extent practicable. In addition, the HCP identifies how the conservation plan will be monitored and funded, and explores alternatives to the taking that were evaluated during the HCP development.

1.3 Organization

The HCP is divided into nine chapters according to the preceding table of contents and following the US Fish and Wildlife Service (USFWS or Service) HCP guidance (USFWS and National Marine Fisheries Service [NMFS] 1996). Chapter 2 of the HCP provides a description of the Project and the activities for which incidental take coverage is sought. Chapter 3 provides a description of the covered species' biology. Chapter 4 provides a detailed analysis of Indiana bat take that is likely to result from covered activities and the impact of that taking on the species. Chapter 5 describes the conservation plan including the measures the Permittees will implement to minimize and mitigate the impacts of the take to the maximum extent practicable. Chapter 6 describes the funding assurances that the Permittees will provide to ensure implementation of the HCP. Chapter 7 addresses the alternatives to the taking that the Permittees considered, but did not elect to implement. Chapter 8 describes the timing and details of plan implementation, including changed and unforeseen circumstances that could arise over the ITP term and procedures the Permittees will utilize to address changed circumstances. Chapter 9 provides references for the sources of data and information used in the development of the HCP, as well as a glossary with definitions for key words. In addition to the chapters as described, the HCP includes a number of appendices with supporting information, (Appendices A-H; Chapter 11) including the Implementing Agreement (IA; Appendix G) for this HCP.

1.4 Regulatory Framework

1.4.1 Federal

1.4.1.1 Endangered Species Act

The purpose of the ESA is "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved…." (ESA § 2(b), 16 USC 1531(b)). The ESA § 9 prohibits the "take" of any species of fish or wildlife listed under the ESA as endangered or threatened. Under the ESA, the term "take" means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.." *Ibid.* § 3(19), 16 USC 1532(19).

The ESA § 10(a)(1)(B) provides that the Secretary of the Interior (Secretary) may authorize, under certain terms and conditions, any taking otherwise prohibited by the ESA § 9(a)(1)(B) if such taking is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity". To obtain this incidental take authorization, a non-federal landowner or land manager must apply for an ITP, and develop, fund, and implement an USFWS-approved HCP to minimize and mitigate the effects of the proposed taking.

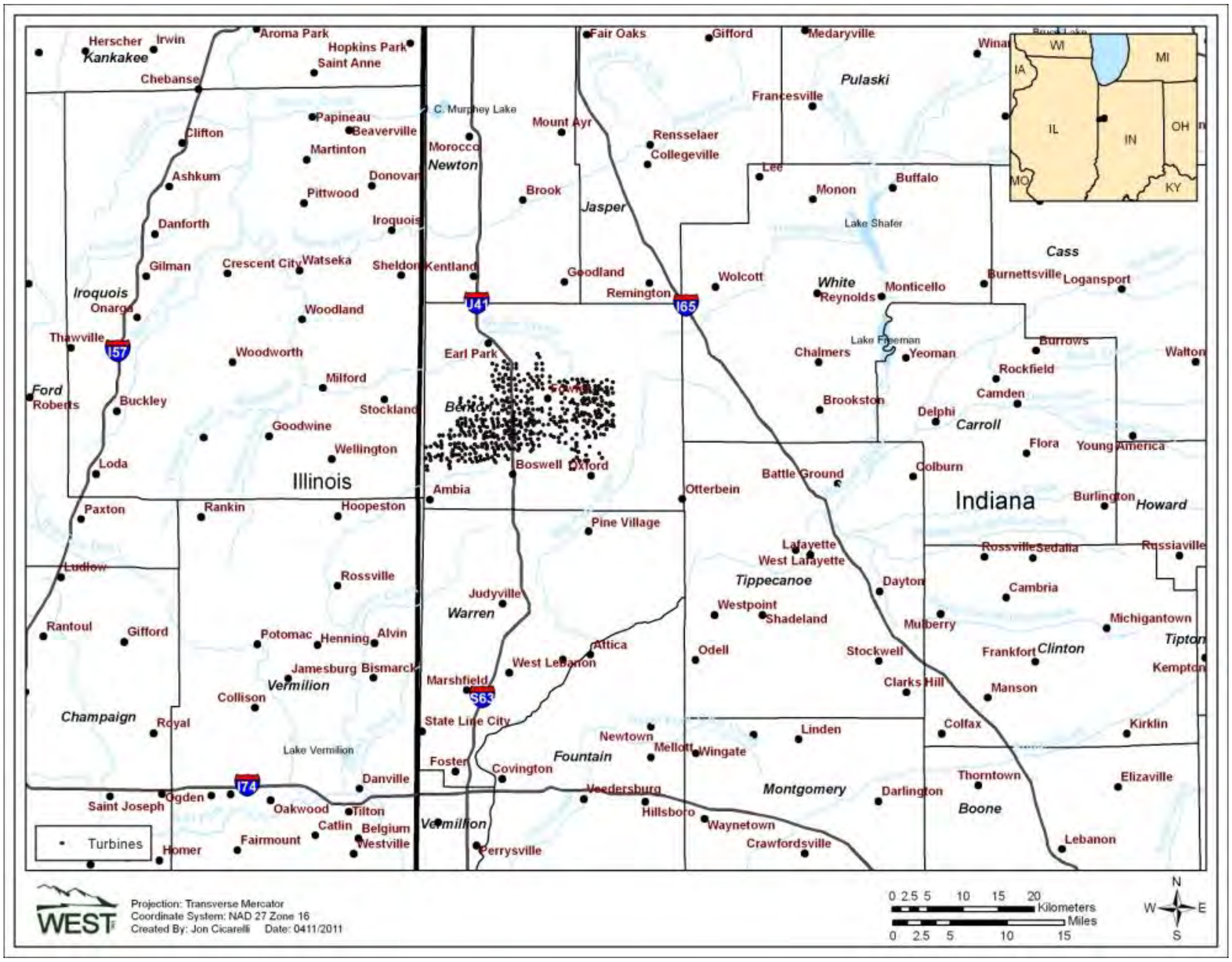

Figure 1.1 Fowler Ridge Wind Farm location showing Phases I, II, III, and IV.

As outlined in the ESA § 10(a)(2)(A) and its implementing regulations at 50 CFR §§ 17.22(b)(1) & 17.32(b)(1), to obtain an ITP the applicant must submit an HCP that specifies:

i. the impact which will likely result from such taking;

ii. the measures the applicant will take to minimize and mitigate such impacts, and the funding that will be available to implement such steps;

iii. what alternative actions to such taking the applicant considered and the reasons why such alternatives are not being utilized; and

iv. such other measures that the Secretary may require as being necessary or appropriate for purposes of the plan.

An ITP will be issued if, after a specified public comment period, it is found that the permit application and the related HCP meets the following *issuance criteria* outlined in the ESA § 10(a)(2)(B) and 50 CFR §§ 17.22(b)(2) & 17.32(b)(2):

i. the taking will be incidental;
ii. the applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking;
iii. the applicant will ensure that adequate funding for the plan will be provided and procedures to deal with unforeseen circumstances will be provided;
iv. the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild;
v. other measures that the Service may require as being necessary or appropriate will be provided; and
vi. the Service has received such other assurances as may be required that the HCP will be implemented.

As stated in the ESA § 10(a)(1)(B), an ITP may be issued only if the proposed take is incidental while carrying out an otherwise lawful activity. For this reason, all other laws must be complied with before the permit can be issued.

In addition, the issuance of the ITP is a federal action that must also comply with the ESA. Section 7 of the ESA provides authority for federal agencies to consult with the USFWS to ensure that actions that the federal agency implements, authorizes, or funds do not adversely affect endangered or threatened species. The purpose of formal consultation is to ensure that any action authorized, funded, or carried out by the federal government is not likely to jeopardize the continued existence of any listed species. Under the Section 7 authority, the USFWS must conduct an internal formal consultation process for issuance of the ITP, a federal action. Formal consultation terminates with preparation of a biological opinion, 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. Intra-Service consultation on issuance of a Section 10 action (approval of the HCP and issuance of an ITP) ensures that issuance of the permit meets ESA standards under Section 7.

1.4.1.2 National Environmental Policy Act (NEPA)

The National Environmental Policy Act, 42 USC § 4321, *et. seq.* (NEPA), passed in 1969, requires federal agencies to examine environmental impacts of their actions and provide for public participation. Issuance of an ITP is a federal action subject to compliance with NEPA. To comply with NEPA, the USFWS must conduct detailed analyses of all direct, indirect, and cumulative impacts of issuing the permit on the human environment, not just on the covered species or resources. If the agency determines that issuance of the permit, as conditioned by the agreed-upon conservation measures to be incorporated into the ITP, does not have significant impacts, then the agency will issue a Finding of No Significant Impact (FONSI). If the agency determines that the Project, including any mitigation or conservation measures, is likely to have a significant impact, then the agency will issue a Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS), which involves a more detailed evaluation of the effects of the federal action and alternatives to mitigate these effects.

1.4.1.3 National Historic Preservation Act (NHPA)

USFWS issuance of an ITP under the ESA § 10(a)(1)(B) is considered an "undertaking" covered by the Advisory Council on Historic Preservation and must comply with Section 106 of the National Historic Preservation Act, 16 USC § 470, *et seq.* (NHPA) and its implementing regulations, 36 CFR pt. 800. The NHPA § 106 requires the USFWS to assess and determine the potential effects on historic properties that would result from the proposed undertaking and to develop measures to avoid or mitigate any adverse effects. The USFWS must consult with the Advisory Council on Historic Preservation, the State Historic Preservation Officer (SHPO), affected Tribes, the applicant, and other interested parties, and make a good-faith effort to consider and incorporate their comments into Project planning.

1.4.1.4 Migratory Bird Treaty Act (MBTA)

The Migratory Bird Treaty Act of 1918, 16 USC § 703, *et seq.* (MBTA), prohibits the take of migratory birds, including any part, nest, or eggs of these birds. A list of birds protected under MBTA implementing regulations is provided at 50 CFR § 10.13. Currently, the MBTA has no permit provisions for take of migratory birds that is incidental to otherwise lawful activities. As with Bald and Golden Eagle Protection Act of 1940 (BGEPA; discussed below), the USFWS has developed draft wind energy guidelines to avoid and minimize potential take of migratory birds from development of wind energy facilities. To avoid and minimize impacts to MBTA-listed species, the Permittees have developed and implemented a Bird and Bat Conservation Strategy (BBCS) to memorialize the measures it has taken to conserve avian species. The BBCS will be in effect through the life of the Project. The Permittees have based their BBCS on the USFWS Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines (USFWS 2003), the USFWS Wind Turbine Guidelines Advisory Committee (WTGAC) Recommendations (USFWS 2010b), and the recent Draft Land-Based Wind Energy Guidelines (USFWS 2011b).

1.4.1.5 Bald and Golden Eagle Protection Act (BGEPA)

The BGEPA, 16 USC § 668, *et seq.*, and its implementing regulations, 50 CFR pt. 22, provides additional protection to bald (*Haliaeetus leucocephalus*) 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, molest, or disturb” 16 USC § 668(c). In September 2009, the USFWS issued a rule to authorize limited take of bald eagles and golden eagles under the BGEPA, where the take to be authorized is associated with otherwise lawful activities (see 74 Federal Regulations 46,836; USFWS 2009). Before this rule there was no regulatory mechanism in place under the BGEPA to permit take of bald or golden eagles comparable to ITPs under the ESA. As with other federal permitting laws, issuance of an ITP is a federal action subject to compliance with the BGEPA. The USFWS is currently developing the permitting procedure for authorizing incidental take under the BGEPA. In the interim, guidelines provided by the USFWS recommend developing an Eagle Conservation Plan (ECP) for projects that may potentially take eagles.

Under the current USFWS BGEPA guidelines, the FRWF is likely categorized as low risk to eagles. However, since the range of bald eagles is virtually nationwide, the Permittees have included a chapter on eagles in their voluntary BBCS that identifies measures the Permittees have taken and other measures that will be implemented for the protection of birds potentially occurring within the FRWF.

1.4.2 State

1.4.2.1 Indiana Nongame and Endangered Species Conservation Act

The Indiana Nongame and Endangered Species Conservation Act (IC 14-22-34) is maintained by the Office of Code Revision Indiana Legislative Services Agency. Any species or subspecies of wildlife whose survival or reproductive parameters are in jeopardy or are likely to be within the foreseeable future and any species or subspecies designated under the federal ESA are deemed endangered species under the Indiana Nongame and Endangered Species Conservation Act (IC 14-22-34-1).

According to 312 IAC 9-10-18, "(a) The department may issue a permit under this section to an individual, organization, corporation, or government agency to take a state endangered species. This permit may only be issued for state endangered species that are either federal proposed species or federal listed species. (b) The permit application under this section shall be made as follows: (1) The applicant must submit a Habitat Conservation Plan. (2) The division of fish and wildlife will supply an outline of information sections that must be included in the Habitat Conservation Plan. This outline will include, but not necessarily be limited to, the following sections: (A) Current status of the endangered species. (B) Description of area of impact. (C) Specific impacts to the species' habitat. (D) Conservation actions to be undertaken to ensure no detrimental effect to the endangered species. (E) Schedule for enacting the conservation actions. (F) Guarantees to ensure those enactment of conservation actions. (c) The permit application has to be available for a minimum of thirty (30) days for public review and comment. The director shall determine whether the permit will be issued after review of comments received during the review and comment period. (d) The permit may be revoked at any time if the provisions of the Habitat Conservation Plan are not enacted according to the schedule in the plan."

1.5 Permit Duration

The proposed term of the ITP is 21 years. This 21-year ITP term provides for a minimum 20-year functional operational life of all turbines in each phase (Phases I, II, III, and IV; Table 1.1). If, at the end of the 21-year term of the ITP, the Permittees decide that they will continue to operate the facility, they will apply for a new permit or for a permit renewal. This continued operation of the Project (re-powering) is considered a foreseeable changed circumstance and is addressed further in Chapter 8 of this HCP below.

Table 1.1 Proposed Incidental Take Permit term for the Fowler Ridge Wind Farm.

Phase	2009	10-12	13	14	15	16	17-28	29	30	31	32	33	34	35
I														
II														
III														
IV														
Term of Permit				1	2	3	4-15	16	17	18	19	20	21	

Construction I, II, III
Construction window IV
Operation
Decommissioning

1.6 Project Area

The proposed Project area includes lands leased by the Permittees for the operation of the Project (Figure 1.2). The wind turbine generators (WTGs) constructed for the Project are the primary component that may cause take of the Indiana bat; therefore, the Project area includes the area in which all 355 of the existing Phases I, II, and III turbines will be located, plus the area in which the proposed locations of the up to 94 additional Phase IV turbines will be located (Figure 1.2). In addition, the Project area includes land leased for other facilities associated with the Project, such as the collection system, switchyard, meteorological tower, and connector lines.

The total area under lease for the FRWF Phases I, II, and III consists of 239 landowners and is approximately 23,310 hectares (ha; 57,600 acres [ac]) in size. The landcover/vegetation type in which the FRWF was constructed is agricultural, primarily corn (*Zea mays*) and soybean (*Glycine max*) fields. All temporarily disturbed areas from construction and all area above underground facilities (e.g., collector lines) for Phases I, II, and III were restored to the agricultural vegetation type, post-construction. Similar in type, an additional 50 landowners and approximately 2,590 ha (6,400 ac) are under lease for Phase IV. All temporarily disturbed areas from construction and all areas above underground facilities will also be restored to pre-construction vegetation after construction. All leases are signed for a duration of 30 years with an option to extend to 50 years, and are recorded with their respective county.

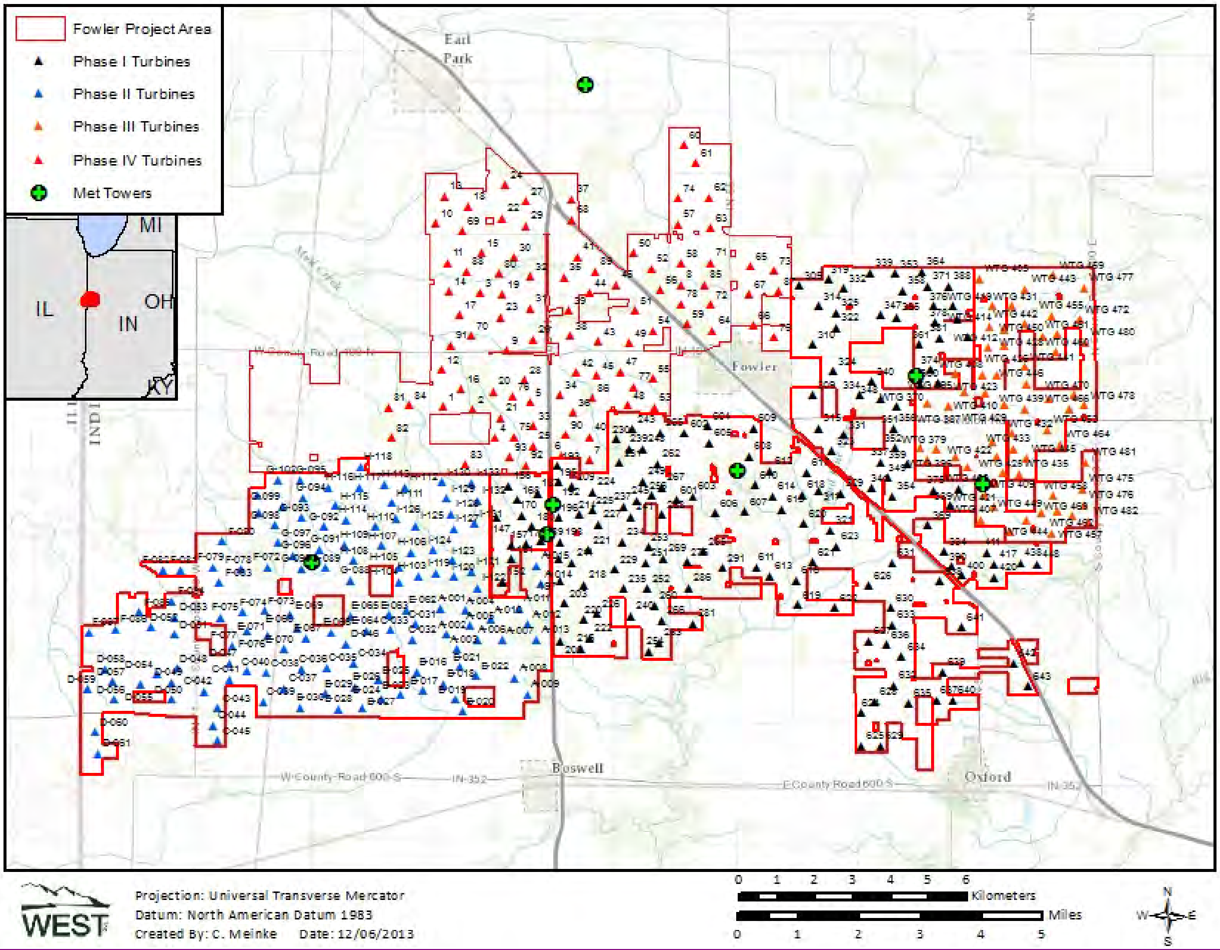

Figure 1.2 Fowler Ridge Wind Farm, Phases I, II, III, and IV.

1.7 Covered Species

The Permittees are applying for an ITP for the Indiana bat for the covered activities as described below. The Indiana bat is currently listed as endangered under the ESA (see USFWS 2012b, 2012e).

Currently no other listed, proposed, or candidate species are known to occur within the Project area. While the following HCP is for the endangered Indiana bat, the conservation plan that will be implemented by the Permittees is likely to be applicable to other species of bats. The potential future listing of additional bat species is considered a changed circumstance and is addressed further in Chapter 8 of this HCP below.

2.0 PROJECT DESCRIPTION AND COVERED ACTIVITIES

2.1 Project Description

The FRWF is being developed in four separate phases for a total of 750 MW (Table 2.1). The Project currently consists of 355 wind turbines in three phases (Phases I, II, and III) in western Indiana in Benton County near the Illinois state line. Up to an additional 94 turbines are currently planned for construction of Phase IV in 2014.

Table 2.1 Fowler Ridge Wind Farm turbines and capacity.

Phase	Operational Date	Capacity (MW)	Turbines	Number of Turbines
I	3/1/2009	301.3 MW	Vestas V82 1.65 MW	122
			Clipper C96 2.5 MW	40
II	12/16/2009	199.5 MW	GE SLE 1.5 MW	133
III	2/27/2009	99 MW	Vestas V82 1.65 MW	60
IV	expected 2015	150.4 MW	GE TC3+ 1.6 MW	Up to 94

2.1.1 Project Components

The Project currently has a total energy capacity of 600 MW (Table 2.1). Phase I consists of 122 Vestas V82 1.65-MW turbines and 40 Clipper C96 2.5-MW turbines for a total of 301 MW of energy capacity. Phase II consists of 133 1.5-MW General Electric (GE) SLE turbines with a total capacity of 199.5 MW. Phase III consists of 60 Vestas V82 1.65-MW turbines (99 total MW of capacity). The turbine towers are approximately 80 meters (m; 262 feet [ft.]) in height and the rotor blade diameters range from 77 to 96 m (253 to 314 ft.). Therefore, the maximum height of the turbines from tower base to highest blade tip is 126 m (416 ft.) above ground. The turbines are arranged throughout the Project area separated by US Highway (HWY) 52, which runs north and south. Phases I and III were constructed in 2008 and became operational during February of 2009. Phase II was constructed in 2009 and became operational by December 31, 2009.

Phase IV, as planned, will consist of up to 94 GE TC3+ 1.6-MW turbines for a total capacity of 150.4 MW. Currently, Phase IV is planned for construction in 2014, with operation beginning in 2015. The turbine towers will be 80 m in height and the rotor diameter 77 m; the maximum height of the turbines from tower base to highest blade tip will be 118.5 m (389 ft.).

Seven permanent un-guyed 80-m tall meteorological towers are located within the Project. The permanent meteorological towers and associated electrical components are situated within 14- x 14-m (46- x 46-ft) chain link fenced and graveled yard areas accessible from Project roads. The Project includes four substations, one for each phase of the wind farm. The substations collectively contain six transformers that feed electricity into an existing 345-kilovolt (kV) electrical tie-in line. Electrical power generated by the WTGs is transformed and collected through a network of underground collection circuits. The underground collection cables total approximately 257 kilometers (km; 160 miles [mi]) and are buried underground to a depth of 1.2 m (4 ft.).

New overhead generation tie-in lines have been constructed as part of the Project. Tie-in and distribution lines are owned and maintained by the Permittees. The tie-in line for the Project consists of roughly 200 poles, and carries electricity approximately 50 km (31 mi) to the Dequine Substation, which is located in Tippecanoe County near Lafayette, Indiana.

2.1.2 Construction of Phase IV

Construction of the first three phases (355 turbines) was completed in December of 2009, and included the generation tie-in lines, substations, operations and maintenance (O&M) building, and most access roads and collection and communications lines. Habitat impacts from construction of these 355 turbines are discussed in Chapter 4. The following chapter discusses the construction of the up to 94 additional turbines for Phase IV of the Project.

Construction of up to 94 additional turbines should take approximately 12 months to complete after issuance of applicable construction permits. Prior to construction of the Phase IV turbines, the Fowler Ridge IV Wind Farm LLC will: 1) order all necessary components, including WTGs, foundation materials, electrical cable, and transformers; 2) complete micrositing[1] of final turbine locations; 3) complete an American Land Title Association (ALTA) survey to establish locations of structures and roadways; and 4) complete soil borings, testing, and analysis for proper foundation design and materials.

Up to 94 turbines will be constructed using standard construction procedures and equipment used for other wind farms and will entail the following activities:

- Road and pad construction;
- Generation tie-in line construction;
- Foundation construction for turbine towers, meteorological towers, and transformers;
- Trenching and placement of underground collection and communications cables;
- Tower erection;
- Nacelle and rotor installation;
- Turbine commissioning; and
- Final road preparation, erosion control, and site restoration.

A construction staging and laydown area, including Project offices, equipment, and employee parking areas, will be developed and will be utilized throughout construction of Phase IV. A temporary concrete batch plant may be located adjacent to the staging area and laydown area.

[1] Although proposed locations of up to 94 turbines have been determined, as shown in Figure 1.2, minor modifications to the locations may occur prior to finalization of construction. Turbine locations will not change by more than 29 m (95 ft) from the currently proposed locations and will not result in greater impacts.

2.1.2.1 Road and Pad Construction

Existing roads may be upgraded and new roads will be constructed in accordance with industry standards for wind project roads and local building requirements. The roads will accommodate all-weather access by heavy equipment during construction and long-term use during O&M. New roads will be located in consultation with the landowner to minimize disturbance, maximize transportation efficiency, and avoid cropland to the extent feasible. All new roads will be constructed for the specific purpose of Project construction, operation, and maintenance. Surface disturbance will be contained within road right-of-ways (ROWs), which will average a width of 12 m (36 ft.) along turbine/crane access roads. The permanent width of access roads will be approximately 5 m (16 ft.). All roads will include road base, surface materials, appropriate drainage, and culverts where necessary. Topsoil removed during road construction will be stockpiled in elongated rows within road ROWs. Topsoil will be re-spread on areas that will be re-vegetated as soon as possible after road construction is complete.

Construction of Phase IV will necessitate construction of temporary crane pads at each turbine site, temporary travel roads for the cranes, temporary turning areas for oversized equipment at certain county and local road intersections, temporary laydown areas around each turbine, trenching for the underground electrical collection and communication system, and temporary storage/stockpile areas. Construction of each turbine will result in temporary impacts of approximately 3 m (10 ft.) on either side of the permanent roadway width, a 20-x 27-m (60-x 80-ft) gravel crane pad extending from the roadway to the turbine foundation, and a 46-m (150-ft) radius rotor laydown area centered around the turbine foundation.

2.1.2.2 Generation Tie-in Line Construction

The 7.2-km (4.5-mi) tie-in line will be constructed on approximately 34 poles spaced approximately 198 to 244 m (650 to 800 ft.) apart. The typical construction sequence includes pole erection, insulator installation, conductor installation, and testing.

2.1.2.3 Foundation Construction for Turbine Towers, Meteorological Towers, and Transformers

Foundations will be constructed by excavating the area, installing forms, and pouring concrete. Anchor bolts will be embedded in the concrete, and the foundations will be allowed to cure prior to tower erection. Up to three additional permanent, unguyed meteorological towers will be erected for Phase IV. Permanent meteorological towers will be 80-m tall and installed on a 1-m (3-ft) diameter pier foundation. Transformer foundations will be constructed using standard procedures by pouring concrete in a shallow slab, or by using a precast structure set on structural fill.

2.1.2.4 Underground Electrical and Communications Cables

Underground collection lines and communications cables will be placed in approximately 1.2-m deep trenches located between turbines and along access roads. Electrical collection lines will be installed first and the trench partially backfilled prior to placement of the communications cables. Trenches will be backfilled and the area re-vegetated during reclamation of other construction areas, if needed.

2.1.2.5 Turbine Tower Erection

Turbine towers will be anchor-bolted to the concrete foundations. Tower bottom sections will be lifted with a crane and bolted to the foundation. The middle and top sections will be lifted into place with a crane and bolted to the section below.

2.1.2.6 Nacelle and Rotor Installation

Rotor construction will occur within the laydown area at each turbine site. Once the tower has been erected, the nacelle will be lifted into place and bolted to the top tower section. Following the nacelle, the rotor will be hoisted into place and bolted to the nacelle.

2.1.2.7 Turbine Commissioning

Turbine commissioning involves mechanical, electrical, and communications inspections to ensure systems are installed and functioning properly. Turbine testing will include checks of each wind turbine and the Supervisory Control and Data Acquisitions (SCADA) system prior to turbine commissioning. Electrical tests of the turbines, transformers, collection system, and transmission system will be performed by qualified electricians to ensure that all electrical equipment is installed in accordance to design specification and is operating within industry and manufacturer standards. Since turbines will be spinning during turbine testing, minimization measures will be taken to avoid take of Indiana bats, which will include conducting turbine testing during the period when Indiana bats are not expected to be in the Project area (between October 16 and July 14), by conducting testing during daylight hours if testing needs to occur during the period from July 15 to October 15, or by implementing other minimization measures approved for operations.

2.1.2.8 Final Road Preparation, Erosion Control, and Reclamation

The existing land use will be restored following construction. Once construction is complete, all disturbed areas will be graded to the approximate original contour. Areas disturbed during construction will be stablized and restored using appropriate erosion control measures, including site-specific contouring, reseeding, or other measures agreed to by the landowner and designed and implemented in compliance with the Project's Storm Water Pollution Prevention Plan (SWPPP). Areas that are disturbed around each turbine during construction will revert to the original land use after construction, except for a 12-m (40-ft) diameter area around each turbine that may be maintained in an herbaceous/shrub state through periodic mowing (see Chapter 2.1.3 for details of maintenance activities).

Final road grading and preparation will include reducing the construction road width to the final five m. Adjacent areas will be reclaimed to current landcover types and surface contours will be directed away from any cut-and-fill slopes and into ditches that discharge to natural drainages as necessary. Typically, SWPPPs include standard sediment control devices to minimize soil erosion during and after construction. Following construction, all unused construction materials and waste will be picked up and removed from the Project area and waste materials will be disposed of at approved and appropriate landfills.

2.1.3 Operations and Maintenance

The Project is designed to be operated both locally from the control room in the O&M building and remotely from Houston, Texas, through a remote operations center. A permanent staff of approximately 60 on-site personnel provides all O&M support activities to the FRWF. Each turbine includes a SCADA operations and communications system that allows automated independent and remote operation of the turbine. The SCADA data provide detailed operating and performance information for each turbine, allowing real-time control and continuous monitoring to ensure optimal operation and identification of potential problems. A local wind technician is either on-site or available on-call to respond in the event of emergency notification or critical outage.

A preventative maintenance and inspection schedule has been implemented for the Project. Typical O&M activities include WTG inspections and routine maintenance activities on WTGs, as required. Some repair activities may require the use of heavy equipment, such as cranes, to assist in the repairs of components such as the rotor, turbine blades, and nacelle components.

Maintenance activities will consist of periodic mowing to retain previously-cleared areas associated with Project infrastructure (roads, transmission lines) and ROWs. Mowing will maintain cleared areas in an herbaceous or shrub-scrub condition. The need for mowing will be evaluated by site operations staff periodically during the growing season and will occur on an as-needed basis during daytime hours. Maintenance will also consist of building inspection and repairs, as needed; periodic grading of roads to restore the road surface or repair of culverts, as needed; and annual inspection and removal of hazards (e.g., downed trees or encroaching branches) on transmission lines.

The WTGs are lit with required Federal Aviation Administration (FAA) lighting (see FAA 2000) on the nacelle of selected WTGs. The O&M facility has outside safety lights that may be operated manually or via motion detectors.

2.1.4 Decommissioning

The projected operating life of the FRWF is 20 years. After the useful life of the turbines is complete, the Permittees will assess the viability of either repowering the Project by installing new or refurbished turbines, or completely decommissioning the Project. In the event that the FRWF will be decommissioned after 20 years, the turbines, infrastructure, and facilities will be removed. All turbines, concrete foundations, and other facilities, with the exception of the underground collection systems, will be removed to a depth of 1.2 m below grade in the event that the FRWF will be decommissioned. The decommissioning process will be similar in scope and duration to the construction process. Most components and materials will be removed, recycled, or disposed of in an approved and appropriate waste management facility.

2.1.4.1 Decommissioning Process

The decommissioning process, which should be completed within 18 months, includes removal of above-ground structures, concrete foundations to a depth of at least 1.2 m below the surface, removal of access roads if required by the landowner, restoration of topsoil, re-vegetation and seeding, and a 3-year monitoring and remediation period. Turbine blades will be permanently pitched into the wind to prevent spinning ("feathering"[2]), locked and de-powered; the potential take of Indiana bats during the period between when the WTGs stop producing electricity and when the turbines are taken down is highly unlikely.

Above-ground structures include the turbines, transformers, substations, maintenance buildings, meteorological towers, transmission lines, and communications equipment. Below-ground structures include turbine foundations, the collection and communication system, drainage structures, and access road sub-base material. The process of removing structures involves evaluating components and materials for reuse, salvage, recycling, and/or disposal. Components and material may be stored on-site in a pre-approved location until ready for transport. The components and material will be transported to appropriate facilities for reconditioning, salvage, recycling, or disposal.

Access roads will be widened as necessary to accommodate movement of cranes or other machinery required for the disassembly and removal of the turbines. Turbine components, control cabinets, electronic systems, and internal cables will be de-energized and removed. The blades, hub and nacelle will be lowered to the ground for disassembly. The tower sections will be disconnected and lowered to the ground where they will be further disassembled as needed into transportable sections.

Foundations (e.g., of turbines, transformers, meteorological towers) will be excavated to a depth sufficient to remove anchor bolts, rebar, conduits, cable, and concrete to a depth of 1.2 m below grade. The excavation will be filled and compacted with clean sub-grade material of a quality and density comparable to the surrounding area. All unexcavated areas compacted by equipment used in decommissioning will be de-compacted to adequately restore the topsoil and sub-grade material to the proper quality and density comparable to the surrounding area.

The collector and communications cables and conduits will be cut back to a depth no greater than 1.2 m. All cable and conduit buried greater than 1.2 m will be left in place and abandoned. Decommissioning of the substation will include removal of fencing, conductors, switches, transformers, and foundations. Substation material and equipment disposal, reconditioning, or reuse will be dependent on condition and market value. Foundations and underground components will be removed to a depth of 1.2 m and the excavation filled, contoured, and re-vegetated.

[2] Feathering is when turbine blades are pitched parallel with the wind direction, causing them to only spin at very low rotation rates, if at all.

After decommissioning of the turbines is completed, access roads and construction pads will be removed, unless the landowner requests that access roads remain in place. Gravel will be removed from access roads and turbine pads and transported to a disposal location or approved stockpile site. Drainage structures integrated with the access roads will be removed and backfilled with sub-grade material, the topsoil replaced, and the surface contoured and re-vegetated. Improvements to local and county roads that were not removed after construction at the request of Benton County will remain in place.

2.1.4.2 Site Restoration

Areas requiring restoration or reclamation will be leveled or re-contoured to match the surrounding area, covered with topsoil, and re-seeded, if needed. Other steps necessary to prevent soil erosion, ensure establishment of vegetation cover, and/or control for noxious weeds and pests will be conducted as necessary. A monitoring and remediation period of approximately three years will follow the completion of decommissioning and restoration activities.

2.2 Covered Activities

According to the Habitat Conservation Planning and Incidental Take Permit Processing Handbook (USFWS and NMFS 1996), an applicant should “include in the HCP a description of all actions within the planning area that: (1) are likely to result in incidental take; (2) are reasonably certain to occur over the life of the permit; and (3) for which the applicant or landowner has some form of control.”

As discussed below, the Permittees have determined which Project-related activities could potentially result in incidental take of Indiana bats, that are reasonably certain to occur, and for which the applicant has control. Therefore, the Permittees are requesting the following activities be considered covered activities under the HCP:

1. Operation of the existing 355 turbines (Phases I, II, and III) over the 20-year operational life-of-phases, started in 2009; and
2. Operation of up to 94 additional turbines (Phase IV) over the 20-year operational life-of-phase, expected to begin in 2015.

The Permittees will implement conservation measures to minimize and mitigate potential take that may occur as a result of Project operations.

Because the FRWF is located in an area of greater than 93% agricultural land, greater than 5% rural development, and less than 1% wooded habitat (see Chapter 3), there is little to no potential for Indiana bat summer (maternity colonies) or winter (hibernacula) habitat to occur in the Project area. Therefore, construction, maintenance, or decommissioning activities will not create potential impacts that will rise to the level of take (S. Pruitt, USFWS, pers. comm.), and are therefore not activities for which the ITP is requested. General maintenance activities for the

FRWF (e.g., turbine maintenance, road grading, maintenance facility upkeep, SCADA upgrades, and grounds keeping) are not expected to lead to impacts that would rise to the level of take. Maintenance of the turbines involves periodic activities typically conducted inside turbines or the O&M building; occasionally maintenance activities may require the use of a crane to access the rotors or nacelles. These types of activities do not present hazards to bats as they occur during daylight hours, and do not generate excessive noise or activity that could lead to disturbance of Indiana bats potentially roosting near the FRWF.

At the end of the operating life of the Project (20 years), the Permittees expect to explore two alternatives. One option is to continue operation through re-commissioning, providing energy under a new contract with a power purchaser. In this case, the Permittees would apply for permit extensions, including an ITP renewal or amendment if necessary, to continue operation or evaluate the need to retrofit the turbines and power system with new technology upgrades, and allowing the Project to continue to produce power for additional years, if and where needed. Re-commissioning of the Project would likely require a permit amendment, which is addressed in Chapter 8.

A second option is to decommission the Project in accordance with landowner easement agreements. Pursuant to the terms of each easement agreement associated with the parcel of land hosting a turbine, the FRWF is obligated to remove the turbine and the concrete foundation to a minimum of 1.2 m below grade (see Chapter 2.1.4). Decommissioning activities are expected to be similar to construction activities, but in reverse order, where the Project facilities are dismantled and removed from the site. Decommissioning activities will occur during daylight hours and similar to construction, and will not create hazards for active bats. Due to the lack of Indiana bat summer or winter habitat at the FRWF, decommissioning of the Project is not expected to create hazards or disturbances to Indiana bats that would rise to the level of take.

2.2.1 Operation of the Project

Commercial operation of the 355 turbines was achieved on December 31, 2009. Commercial operation of the additional Phase IV turbines is anticipated prior to the fall migration season of 2015. The Permittees anticipate that each Phase will operate for a minimum of 20 years, for a total permit term of 21 years for all phases of the Project covered by the ITP. The spinning rotor blades are known to cause injury and mortality of bats through collision or barotrauma (i.e., tissue damage to lungs caused by rapid or excessive pressure changes formed in the wake of rotating turbine blades; Arnett et al. 2008, Baerwald et al. 2008), including Indiana bats. Due to the confirmed mortality of two Indiana bats at the FRWF in 2009 and 2010 (Good et al. 2011), and the potential for additional Indiana bat fatalities from operation of the FRWF, operation of the 449-turbine Project is included as a covered activity in this HCP.

2.2.2 Mitigation Measures

Implementation of the HCP will include measures to mitigate the impacts of the take to the maximum extent practicable. These measures are described in detail in Chapter 5 of the HCP. The mitigation measures are intended to provide conservation benefits to Indiana bats, and thus are not likely to lead to take. However, the authority granted in the ITP includes implementation of mitigation measures and therefore these measures, as described in Chapter 5, are activities covered under the ITP. Specifically, covered mitigation activities include installation of a new bat gate at Wyandotte Cave as well as protection, restoration, and monitoring of summer habitat for Indiana bats.

3.0 AFFECTED SPECIES, ENVIRONMENTAL SETTING, AND BASELINE

3.1 Environmental Setting

The FRWF lies within the Tipton Tall Plain physiographic region that includes much of central Indiana and lies within the Grand Prairie Natural Region that includes a small section of north central Indiana (Whitaker and Mumford 2009). The topography of the FRWF is mostly flat to slightly rolling. Elevations in the Project area range from approximately 213 to 244 m (700 to 800 ft.). Soils in the FRWF are various combinations of silt loam, clay loam, loam, silty clay loam, sandy loams and sandy clays (USDA-NRCS 2006). Much of the area is classified as prime farmland based on soil type. The FRWF is dominated by tilled agriculture, with corn and soybeans being the dominant crops. Of the roughly 29,521 ha (72,947 ac) within 0.8 km (0.5 mi) of Phase I, II, III and IV turbine locations, row crops compose about 93% of the land use for the Project area (Table 3.1, US Geological Survey [USGS] National Land Cover Database [NLCD] 2001). After tilled agriculture, the next most common land type within the FRWF is developed areas (e.g., houses and buildings), which compose 5.2% of the total area, and hay fields/pastures, which compose 1.5% of the total area.

Table 3.1 Land cover types within 0.8 km (0.5 mi) of Phase I, II, III and IV turbines at the Fowler Ridge Wind Farm.

Habitat Type	Hectares	Acres	Percent Composition
Crops	27,363	67,616	92.69
Developed, Low Intensity	850	2,101	2.88
Developed, Open Space	665	1,643	2.25
Hay/Pasture	445	1,100	1.51
Deciduous Forest	116	286	0.39
Developed; Medium Intensity	41	102	0.14
Open Water	15	38	0.05
Herbaceous (Grassland)	12	30	0.04
Developed, High Intensity	7	17	0.02
Barren Land	4	11	0.02
Woody Wetlands	1	3	<0.01
Total	**29,521**	**72,947**	**100**

There are 12 ha (30 ac) of herbaceous habitat (i.e., grasslands) which compose less than 0.1% of the Project area. Grasslands in the Project area are limited primarily to strips along drainages, railroad ROWs, and ROWs along county and state roads. There are also a few grass-lined waterways within cultivated fields in the area. Trees in the Project area occur at homesteads, along some of the drainages and fencerows, and within some small, isolated woodlots. Forested areas are rare within the Project area based on 2001 data (Homer et al.

2004), and the 116 ha (286 ac) of forest compose 0.4% of the total area. Small amounts of barren ground, open water, and woody wetlands are also present.

3.2 Covered Species

As stated in Chapter 1.7, the Indiana bat is the only covered species included in this HCP because at present, no other listed, proposed, or candidate species are known to occur within the Project area.

3.2.1 Indiana Bat

Indiana bat was included on the list of endangered species in 1967 under the Endangered Species Preservation Act of 1966, prior to the enactment of the ESA of 1973. At the time of listing, primary threats to the species were believed to include loss of habitat and human disturbance, especially at winter hibernacula, and a general lack of knowledge about the species' biology and distribution (USFWS 1999). The revised Draft Recovery Plan lists destruction/degradation of hibernation habitat; loss/degradation of summer, migration, and swarming habitat; disturbance of hibernating bats; disturbance of summering bats; disease and parasites; and natural factors and anthropogenic factors as threats to the species (USFWS 2007).

3.2.1.1 Life History and Characteristics

Indiana bats exhibit life history traits similar to other temperate bat species. Despite the Indiana bats' small size, it is relatively long-lived (Barclay and Harder 2005). Similar to most temperate *Myotis* species, female Indiana bats give birth to one offspring per year (Humphrey et al. 1977, Kurta and Rice 2002). Mating occurs in the vicinity of the hibernacula in late summer and early fall during what is termed the swarming period, and fertilization is delayed until the spring (Guthrie 1933). Timings of parturition and lactation are likely dependent in part on latitude and weather conditions. For example, in Iowa, female bats arrive at maternity roosts at the end of April and parturition is completed by mid-July (Clark et al. 1987); in Michigan, young are born in late June or early July (Kurta and Rice 2002); and in southern Indiana, pregnant females have been documented from May 28 through June 30, while lactation has been recorded from June 10 to July 29 (Whitaker and Brack 2002). Young bats are volant within three to five weeks of birth, at which time the maternity colony begins to disperse and use of primary maternity roosts diminishes (see *Spring, Summer, and Fall Habitat* in Chapter 3.2.1.2 for a description of primary and alternate roosts).

Females and juveniles may remain in the colony area until migration to the hibernacula. It is likely that once the young are born, females leave their pups in the diurnal roost while they forage, returning during the night periodically to feed them (Barclay and Kurta 2007). Females will, however, switch roost trees regularly and during these switches they must carry flightless young. Indiana bat maternity colonies will use several roosts; in Missouri each maternal colony used between 10 and 20 separate roost trees (Miller et al. 2002). In Kentucky, Gumbert et al. (2002) recorded 463 roost switches over 921 radio-tracking days of tagged Indiana bats (predominantly males) - an average of one switch every 2.21 days. Consecutive use of roost trees by individual bats ranged from one to 12 days. There are a number of suggested reasons for roost switching, including: thermoregulation, predator avoidance, and reduced suitability of roost trees - an ephemeral resource that may become unusable if it is toppled by wind, loses large pieces of bark, or is otherwise destroyed (Kurta et al. 2002, Barclay and Kurta 2007).

Indiana bats return to the vicinity of the hibernaculum in late summer and early fall where the bats exhibit a behavior known as “swarming”. This involves large numbers of bats flying in and out of the cave entrances from dusk to dawn, though relatively few of the bats roost in the cave during the day (Cope and Humphrey 1977). During the swarming period most Indiana bats roost within approximately 2.4 km (1.5 mi) of the cave, suggesting that the forests around the caves provide important habitat prior to hibernation (USFWS 2007). It is at this time that bats gain fat stores vital not only for winter survival but also for when mating occurs. While females enter the hibernaculum soon after arrival at the site, males remain active for a longer period and may also travel between hibernacula - both of which may increase mating opportunities (USFWS 2007). Spring emergence from the hibernacula generally occurs from mid-April to the end of May and varies across the range, depending on latitude and weather conditions. Females typically emerge before males, traveling sometimes hundreds of miles to summer habitats (Winhold and Kurta 2006).

3.2.1.2 Habitat Requirements

Indiana bats have two distinct habitat requirements: 1) a stable environment in which to hibernate during the winter, and 2) deciduous woodland habitat for maternity roosts in the summer. These and other, less clearly-defined habitat associations during different periods of the Indiana bat life cycle will be described in the following chapters.

Winter Habitat

Indiana bats generally hibernate between October and April, although this may be extended from September to May in northern parts of their range (USFWS 2007). The majority of hibernacula are located in karst areas of the east-central US; however, Indiana bats are known to hibernate in other cave-like structures, such as abandoned mines, buildings, a railroad tunnel in Pennsylvania, and a hydroelectric dam in Michigan (Kurta and Teramino 1994, Hicks and Novak 2002, Butchkoski and Hassinger 2002a, USFWS 2007). Indiana bats typically require low, stable temperatures (3 to 8°C [37 to 46° F]) for successful hibernation (Brack 2004, Tuttle and Kennedy 2002). Caves with the highest Indiana bat populations are typically large, complex systems that allow air flow, but cave volume and complexity often buffers or slows changes in temperature (Brack 2004). These caves often have large rooms or vertical passages below the lowest entrance that allow entrapment of cold air that is stored throughout the summer, providing bats with relatively low temperatures in early fall (Tuttle and Kennedy 2002). Indiana bats tend to hibernate in large, dense clusters ranging from 300 to 500 bats per 0.09 square m (m^2; 1 ft^2; USFWS 2007, Boyles et al. 2008).

Spring, Summer, and Fall Habitat

Following hibernation, female Indiana bats may travel up to 563 km (350 mi) to summer habitat where they form maternity colonies (Winhold and Kurta 2006). Individuals radio-tracked in the northeastern US appear to travel much shorter distances (less than 68 km [42 mi]; Butchkoski et al. 2008, USFWS 2007). Habitat requirements during migration are not known. Roosting may occur at multiple locations while bats are migrating, or bats may fly directly to summer habitat, rarely stopping to roost along the way (Butchkoski and Turner 2006, Britzke et al. 2006, Hicks et al. 2005). Some male and non-reproductive female Indiana bats do not migrate as far as reproductive females and instead remain in the vicinity of the hibernaculum throughout the summer (Gardner and Cook 2002, Whitaker and Brack 2002).

Members of a maternity colony do not necessarily overwinter in the same hibernacula; individuals from a single maternity colony have been shown to hibernate in locations almost 322 km (200 mi) apart (Kurta and Murray 2002, Winhold and Kurta 2006); though colonies do appear to be highly philopatric, using the same areas and same roosts in successive years (Barclay and Kurta 2007, Callahan et al. 1997, Humphrey et al. 1977).

In the summer, female Indiana bats predominantly roost under slabs of exfoliating bark, preferring not to use tree cavities, such as those created by rot or woodpeckers, but occasionally using narrow cracks in trees (Kurta 2004). Due to their cryptic nature, the first Indiana bat maternity colony was only located in 1971 (Cope et al. 1974, Gardner and Cook 2002); however, since that time, much of the work pertaining to summer Indiana bat habitat has concentrated on identifying and describing maternity colonies. Maternity colonies vary greatly in size in terms of number of individuals and number of roost trees used, with members of the same colony utilizing over 20 trees during one season (Kurta 2004). Roosts are usually located in dead trees, though partly dead or live trees (for example, if the species has naturally peeling bark) may also be used (USFWS 2007).

A meta-analysis of 393 roost trees in 11 states found 33 tree species that were used, with ash (*Fraxinus* spp.), elm (*Ulmus* spp.), hickory (*Carya* spp.), maple (*Acer* spp.), poplar (*Populus* spp.), and oak (*Quercus* spp.) accounting for about 87% of trees documented (Kurta 2004). Roost trees also varied in size. The smallest maternity roost tree recorded was 11 centimeter (cm; 4.0 inches [in]) diameter at breast height (DBH; Britzke 2003). It is more typical, however, for trees greater than 22 cm (9 in) DBH to be utilized (Kurta 2004) and the mean size from the aforementioned meta-analysis was 45 ± 2 cm DBH (18 ± 1 in; range 28 to 62 cm [11 to 24 in]; Kurta 2004, Britzke et al. 2006). Although minimum DBH reported for a tree used by males is 6.4 cm (2.5 in; Gumbert 2001), and for a tree used by females 11 cm (4.3 in; Britzke 2003), such relatively small trees have not been documented as primary roosts. Average diameter of maternity roost trees (primary and alternate) is 62, 55, and 41 cm (24, 22, and 16 in) for Indiana (Whitaker and Brack 2002), Missouri (Callahan et al. 1997), and Michigan (Kurta and Rice 2002), respectively. Differences in average diameter among states likely reflect, in part, differences in species of tree contained in each sample – the Indiana sample was dominated by cottonwood (*Populus* spp.), Missouri by oak and hickory, and Michigan by ash. Site quality and tree age are also important factors affecting tree diameter.

An important characteristic for the location of maternity roost sites is a mosaic of woodland and open areas, with the majority of maternity colonies having been found in agricultural areas with fragmented forests (USFWS 2007). Mean values of canopy cover are highly variable among studies, ranging from less than 20-88% (USFWS 2007). Reports of roost trees in closed-canopy forests may appear to conflict with statements that primary roosts are generally located in areas with high solar exposure (e.g., Gardner et al. [1991] reported that 32 of 48 roost trees examined in Illinois occurred within forests with 80% to 100% canopy closure). There are several points to consider in evaluating this apparent discrepancy. First, some variation undoubtedly was related to differences in methodology, because virtually every study measured canopy cover in a different way. Second, roosts found in closed-canopy forests, particularly primary roosts, were often associated with natural or man-made gaps (e.g., openings created when nearby trees fell, riparian edges, and trail or forest road edges). Although the forest may be accurately described as closed canopy, the canopy in the immediate vicinity of the roost tree may have had an opening that allowed for solar radiation to reach the roost. Indiana bat roosts have been created by the death of a single large-canopy tree (A. King, USFWS, pers. comm., 2007, as cited in USFWS 2007). Further, the absolute height of the roost tree appears to be less important than the height of the tree relative to surrounding trees, with roost trees often extending above the surrounding canopy (Kurta 2004).

There are two types of roost trees that maternity colonies use: primary roosts and alternate roosts. Primary roosts were initially defined by Callahan (1993) in terms of number of bats (i.e. roosts used by more than 30 bats), but may also be defined by the number of bat-days roost tress are used over one maternity season (Kurta et al. 1996, Callahan et al. 1997, USFWS 2007). Primary roosts were used throughout the summer, while alternate roosts were used less frequently and may be important during changing weather conditions (temperature and precipitation), or when the primary roost becomes unusable (Callahan et al. 1997). Primary roosts were also often found near clearings or edges of woodland where the roots received greater solar radiation, a factor that may be important in reducing thermoregulatory costs for reproductive females and their young (Vonhof and Barclay 1996). Female Indiana bats are able to use torpor to conserve energy during cold temperatures; however, torpor slows gestation (Racey 1973), milk production (Wilde et al. 1999), and juvenile growth, and is costly when the reproductive season is short (Hoying and Kunz 1998, Barclay and Kurta 2007). Another factor likely due to energetic constraints is that the majority of maternity colonies have been found at relatively low elevation (less than 900 m [2,953 ft.]), where the temperature and growing season tend to be more favorable for rearing pups.

While the primary roost of a maternity colony may change over the years, it is thought that foraging areas and commuting paths are relatively constant (Barclay and Kurta 2007). For example, members of a maternity colony in Michigan used a wooded fence-line as a commuting corridor for nine years (Winhold et al. 2005). In general, the distance from the roost to foraging areas varied from 0.5 to 8.4 km (0.3 to 5.3 mi; USFWS 2007); this distance may be constrained by the need to return to the roost periodically once the young are born (Henry et al. 2002). Lactating females have been shown to return to the roost two to four times during a night (Butchkoski and Hassinger 2002b, Murray and Kurta 2004). In Michigan, the mean distance from the roost to the nearest edge of an activity center was 2.4 km (1.5 mi; range: 0.5 to 4.2 km [0.3 to 2.6 mi]; Murray and Kurta 2004); in Indiana, 11 females used foraging areas on average 3.0 km (1.9 mi; range: 0.8 to 8.4 km [0.5 to 5.3 mi]) from their roosts (Sparks et al. 2005); and in Pennsylvania, this distance was 2.7 ± 0.9 km (1.7 ± 0.6 mi; range: 1.3 to 5.3 km [0.8 to 3.3 mi]; Butchkoski and Turner 2005).

On average, females switched roosts every two to three days and may have come back to previous roost trees periodically. Roost switching was likely dependent upon factors such as reproductive condition, roost type, roost condition, time of year, and predation (Kurta et al. 2002, USFWS 2007). Individuals from a maternity colony appeared to show fidelity to a general home range within and between years (Sparks et al. 2004, Lacki et al. 2007). In Indiana, mean home range was 145 ± 18 ha (357 ± 45 ac; Sparks et al. 2005), while on the Vermont-New York state-line mean home range was 83 ± 82 ha (205 ± 203 ac; Watrous et al. 2006). Both of these estimates were higher than for a single female in Pennsylvania, whose home range was estimated at 21 ha (51 ac; Butchkoski and Turner 2006). As well as differences in methodology, the range of home ranges estimated likely reflects differences in habitat quality between sites.

Prior to hibernation, both males and females roost in wooded habitat in the vicinity of hibernacula. Few data are available on the roosts used by swarming Indiana bats, but some data are available on roosts used by swarming Indiana bats in Kentucky; bats used similar species of tree as those used during the summer reproductive period, but trees tended to be smaller in size than summer roosts (Kiser and Elliot 1996, Gumbert 2001).

3.2.1.3 Demographics

Very little is known about annual survival rates and background mortality for Indiana bats, either for adults or juveniles (USFWS 2007). It is expected, however, that similar to many other species, survival of Indiana bats is lowest during the first year of life and threats and sources of mortality vary during the annual cycle. During summer months, sources of mortality may include loss of occupied forested habitat, predation, human disturbance, and other man-made disturbances (Kurta et al. 2002, USFWS 2007). Sources of winter mortality may include natural predation, natural disasters that impact hibernacula, disturbance or modifications at the hibernacula and surrounding areas that physically disturb the bats or change the microclimate within the hibernacula, and direct human disturbance during hibernation that leads to disruption of normal hibernation patterns (USFWS 2007). More recently, a condition known as White Nose Syndrome (WNS) has caused unprecedented mortality of cave-hibernating bats, including Indiana bats, and is responsible for the death of millions of hibernating bats in the eastern United States from 2006 to 2011 (USFWS 2012d).

In a study in Indiana, survival rates among male and female Indiana bats ranged from 66% to 76% for six to 10 years after marking, with female longevity being approximately 12 to 15 years and for males being about 14 years (Humphrey and Cope 1977). The oldest known Indiana bat was captured 20 years after the first capture (LaVal and LaVal 1980). Research from banding studies during the 1970s suggests that adult Indiana bat survival during the first six years varies from approximately 70-76% annually (Humphrey and Cope 1977, O'Shea et al. 2004, USFWS 2007). After this period, annual survival varied from 36-66%, and after 10 years, dropped to approximately 4% (Humphrey and Cope 1977). There is less information available on neonatal survival, with one published study suggesting a neonatal survival rate of 92% based on observations at a maternal colony over a single season (Humphrey et al. 1977). More research is needed to accurately define annual survival rates of Indiana bats; however, available information suggests that annual mortality is likely to be between 8% and 64% during the first 10 years of life (USFWS 2007).

O'Shea et al. (2004) summarized survival rates for a number of species, including little brown bat (*Myotis lucifugus*), which is considered a similar species to the Indiana bat in terms of life history. The range of survival rates cited varied considerably from approximately 13-86% (O'Shea et al. 2004). Other *Myotis* species also had variable survival rates, ranging from about 6-89%; however, in general, studies indicated that survival for first-year juveniles was generally lower than for adults.

As with mortality or survival rates for Indiana bats, relatively little is known about recruitment rates for the species; however, female Indiana bats typically give birth to one young per year (Mumford and Calvert 1960, Humphrey et al. 1977, Thomson 1982). The proportion of females in a population that produce young in a year is thought to be fairly high (USFWS 2007). In one study, greater than 90% of the females produced young each year (Humphrey et al. 1977) and in another study, it was estimated that 89% of adult females were reproductively active annually (Kurta and Rice 2002). Location and environmental factors likely influence reproductive rates and there is concern that environmental threats such as WNS may lead to lower reproduction rates (USFWS 2011c). Recruitment in the total Indiana bat population in recent years has been variable by region with the Ozark-Central, Midwest, and Appalachian Recovery Units showing increasing trends from approximately 3%-8% between 2009 and 2011, while the Northeast Recovery Unit experienced a decrease of approximately 54% between 2009 and 2011 (USFWS 2012a).

3.2.1.4 Range and Distribution

The range of the Indiana bat extends throughout much of the eastern US and includes 22 states (Gardner and Cook 2002, USFWS 2007; Figure 3.1). Over the past 40 years, general population trends of Indiana bats appear to be decreasing in the southern and increasing in the northern regions of its range (USFWS 2007, 2010a). Historically, Indiana bat winter range was restricted to areas of cavernous limestone in the karst regions of the east-central US, apparently concentrated in a relatively small number of large, complex cave systems. These included

Wyandotte Cave in Indiana; Bat, Coach, and Mammoth Caves in Kentucky; Great Scott Cave in Missouri; and Rocky Hollow Cave in Virginia.

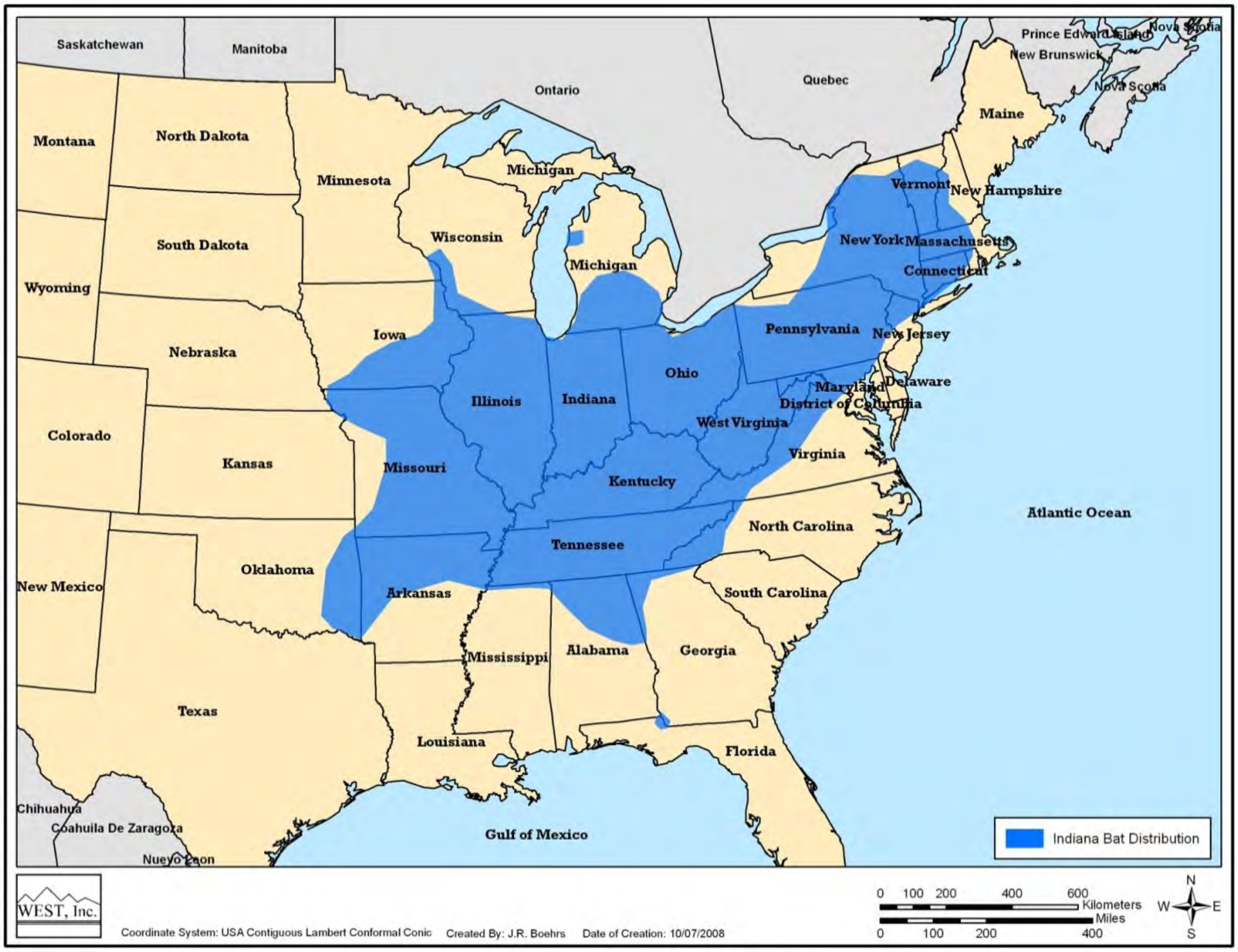

Figure 3.1 Approximate historic range of the Indiana bat in the US.

More recently, increasing numbers of Indiana bats have been found using man-made structures, such as mines, tunnels, and buildings for hibernation, extending their winter range into some caveless parts of the country (Kurta and Teramino 1994). For example, Indiana bats have been found hibernating in several man-made tunnels (Butchkoski and Hassinger 2002a); and in 1993, an Indiana bat was discovered hibernating in a hydroelectric dam in Manistee County, Michigan, 450 km (281 mi) from the closest recorded hibernaculum for Indiana bat in LaSalle County, Illinois (Kurta and Teramino 1994). In 2005, approximately 30% of the population hibernated in man-made structures (predominantly mines) with the rest using natural caves (USFWS 2007). As of November 2006, there were 281 known extant Indiana bat hibernacula in 19 states (USFWS 2007). Over 90% of the population hibernated in just five states: Indiana (45.2%), Missouri (14.2%), Kentucky (13.6%), Illinois (9.7%), and New York (9.1%); with 71.6% hibernating in just 10 caves. Overall, in 2006 approximately 82% of the estimated total population hibernated in 22 of the 23 Priority 1 hibernacula (USFWS 2007).

Relatively little is known about the historic summer range of Indiana bats. It is believed that the historical summer distribution for this species was similar to that of today; however, the first maternity colony was not discovered until 1971 (Cope et al. 1974). As of October 2006, the USFWS had records of 269 maternity colonies in 16 states. This likely represents only about 6-9% of the 2,859 to 4,574 colonies thought to exist based on the estimated total wintering population (Whitaker and Brack 2002, USFWS 2007).

The distribution of Indiana bat summer habitat in the east appears to be less extensive than in the Midwest (see range maps in USFWS 2007), which may be due to the geographic distribution of important hibernacula or to differences in climate and elevation that may limit suitable summer colony sites in the east. Summer temperatures of portions of Indiana bat range in the east are slightly cooler than in the core part of the range in Indiana and Kentucky, which may influence the energetic feasibility of reproduction in eastern areas (Brack et al. 2002, Woodward and Hoffman 1991).

3.2.1.5 Dispersal and Migration

Based on categories described by Fleming and Eby (2005), species can be divided into three movement categories: 1) sedentary species that breed and hibernate in the same local areas and usually move less than 48 km (30 mi) between summer and winter roosts; 2) regional migrants that migrate moderate distances between approximately 100 to 500 km (60 to 310 mi); and 3) long-distance migrants that have developed migratory behavior, sometimes traveling greater than 1,000 km (620 mi) between summer and winter roosts. Dispersal distances of Indiana bats from winter hibernacula to summer roost sites has varied geographically, which categorizes Indiana bats as both a sedentary and regional migrant species, depending on location. In Michigan, 12 female Indiana bats moved an average of 477 km (296 mi) to their hibernacula in Indiana and Kentucky, with one individual migrating as far as 575 km (357 mi; Winhold and Kurta 2006). In contrast, based on a study of more than 100 tagged Indiana bats in New York, dispersal movements were typically less than 60 km (35 mi), and in many cases only a few miles from the hibernacula (A. Hicks, New York State Department of Environmental Conservation [NYSDEC], pers. comm.). In general, however, based on the results of studies to date, the summer range of Indiana bats could be any suitable habitat within approximately 575 km of a known winter hibernaculum.

According to the Draft Recovery Plan (USFWS 2007), the primary spring migration season is from the end of March to late May and the primary fall migration period is from the end of July to mid-October. The actual migration periods may vary by latitude and weather, with spring emergence occurring earlier in more southern areas and fall migration occurring earlier in more northern areas (USFWS 2007). Relatively little is known about behavior of Indiana bats during migration, such as flight heights, echolocation frequency, influence of weather, or whether Indiana bats migrate singly or in groups.

Data regarding the height at which Indiana bats fly during migration are lacking. However, it is clear that at least a portion of myotid bats are flying well above the tree canopy at rotor-swept height during migration, based on the two Indiana bat fatalities documented at the FRWF, as well as the documented mortality of many other myotids at other wind facilities occurring primarily during late summer and fall (USFWS unpublished data, as cited in USFWS 2011e). However, data indicate that these species are probably not flying within the rotor-swept zone as frequently as long-distance migrating tree bats; of all bat mortalities detected at wind power facilities within the range of the Indiana bat, myotids, and tricolored bats (*Perimyotis subflavus*) comprise only about 10% of the total bat fatalities (USFWS unpublished data, as cited in USFWS 2011e).

This assumption is supported by anecdotal and empirical data that suggests that Indiana bats primarily migrate at the tree canopy level (Turner 2006; L. Robbins, Missouri State University [MSU], pers. comm. 2010; C. Butchkoski, Pennsylvania [PA] Game Commission, pers. comm. 2010; C. Herzog NYSDEC, pers. comm. 2011; as cited in USFWS 2011e). Chenger and Turner (J. Chenger, Bat Conservation Management [BCM], and G. Turner, PA Game Commission, pers. comm. 2011, as cited in USFWS 2011e) indicate that Indiana bats migrating in spring in the northeast closely follow topographic features, such as meandering stream corridors and utility ROWs for miles, and over multiple years. Similar findings have been documented in Tennessee, indicating that Indiana bats may be flying near canopy height during migration (Gumbert et al. 2011). However, it is uncertain if the flight heights documented in the northeast would be similar in central and western portions of the species' range, particularly in areas with little tree cover, such as the FRWF. Further, it is unknown whether flight heights during spring and fall migration are similar.

Limited telemetry studies during spring and fall migration indicate that Indiana bats may migrate simultaneously, though perhaps independently (S. Darling, Vermont Department of Fish and Wildlife, pers. comm. 2010, Chenger, pers. comm. 2011, R. Reynolds, Virginia Department of Game and Inland Fisheries, pers. comm. 2010, as cited in USFWS 2011e). Because female Indiana bats are likely cued into the same climatic or environmental stimuli during the spring and fall migration, there may be migratory pulses of Indiana bats moving through an area, and it is reasonable to assume that at least some individuals leave summer colonies together or at least contemporaneously (L. Pruitt, pers. comm. 2011; R. Reynolds, pers. comm. 2010; as cited in USFWS 2011e). However, given that females from the same maternity colony do not all hibernate in the same hibernacula (though some do; Kurta and Murray 2002, Winhold and Kurta 2006), at least some females likely migrate independently.

Evidence from radio-tracking studies in New York and Pennsylvania indicate that Indiana bats are capable of migrating at least 48 to 64 km (30 to 40 mi) in one night (Sanders et al. 2001, Hicks 2004, Butchkoski and Turner 2006). Studies reviewed in the Draft Recovery Plan (USFWS 2007) appear to indicate that Indiana bat migration from winter to summer habitat is fairly linear and short-term, while in the fall it may be more dispersed and varied. In addition, males and females appear to display different dispersal behavior, with females moving relatively quickly between the hibernacula and maternal colonies, while males commonly remain in the proximity of the hibernacula or travel between hibernacula (USFWS 2007).

In terms of the effect of temperature on migration, positive correlations of bat activity and temperatures are common in bat literature, both over an annual time period (O'Farrell and Bradley 1970, Avery 1985, Rydell 1991, as cited in USFWS 2011e) and on a nightly basis (Lacki 1984, Hayes 1997, Vaughan et al. 1997, Gaisler et al. 1998, Shiel and Fairley 1998, as cited in USFWS 2011e). Bat experts consulted by the USFWS (2011e) noted that weather conditions that impair flight, impair the ability to thermoregulate, or reduce insect activity, such as heavy rain, high wind, heavy fog, and cold (some specifically cited temperatures below 10 to 13 °C [50 to 55 °F]), are likely to result in reduced bat activity among all bat species. Data obtained from fatality monitoring at wind facilities also suggests correlations between weather conditions (i.e., temperature, wind speeds, and storm fronts) and bat activity. Although general patterns have been established, the specific environmental thresholds are not yet clearly understood.

3.2.1.6 Species Status and Occurrence

Rangewide

A key component to the survival and recovery of the Indiana bat is maintenance of suitable hibernacula that ensure the over-winter survival of sufficient individuals to maintain population viability. The Draft Indiana Bat Recovery Plan (USFWS 2007) categorizes hibernacula into four groups based on the priority to the species population and distribution. Priority 1 hibernacula are essential to the recovery and long-term conservation of the species and have a current or historically observed winter population of 10,000 or more individuals. Priority 2 hibernacula contribute to the recovery and long-term conservation of the species and have a current or historical population of more than 1,000 but less than 10,000 individuals. Priority 3 sites have a current or historical population of 50-1,000 bats and Priority 4 sites have a current or historical population of fewer than 50 bats.

Since the release of the first Indiana Bat Recovery Plan (USFWS 1983), the USFWS implemented a biennial monitoring program at Priority 1 and 2 hibernacula (USFWS 2007). In 1965, the overall population was estimated to be over 880,000 individuals; however, while variation in the data collection apparently has led to variable estimates, in general, there has been a long-term declining population trend, with approximately 380,000 individuals reported in 2001 (USFWS 2011a). Since then, the population has shown a gradual increase to 467,947 Indiana bats in 2007; however, the estimated population fell to 415,512 bats in 2009, then increased to 424,708 bats in 2011 (USFWS 2012a).

General patterns in the overall population estimates have shown a decreasing trend through the core range of the species in the Midwest and increasing trends on the periphery and more northern states (USFWS 2007). The causes of these population changes are unknown; however, climate change may play a role by negatively affecting hibernacula temperature (USFWS 2007). More recently, populations in the northeastern and eastern US have been affected by WNS, which is having a dramatic effect on some populations, such as on populations in Vermont (Turner et al. 2011). Caused by the fungus *Geomyces destructans*, WNS is estimated to have caused the deaths of over five million bats in the northeastern US, including Indiana bats (USFWS 2012d). The condition is associated with loss of winter fat stores, pneumonia, and the disruption of hibernation and feeding cycles. Indiana bat mortality rates in infected caves have been shown to average 72% in the Northeast (Turner et al. 2011).

Midwest Recovery Unit

The Draft Indiana Bat Recovery Plan divides the species range into four recovery units based on several factors, such as traditional taxonomic studies, banding returns, and genetic variation (USFWS 2007). The Project falls within the Midwest Recovery Unit (MRU) which includes the states of Indiana, Kentucky, Ohio, Tennessee, Alabama, southwestern Virginia, and Michigan (USFWS 2007). According to the 2011 Rangewide Population Estimate (USFWS 2012a), the overall population within the MRU was approximately 320,342 Indiana bats in 2007, 281,909 Indiana bats in 2009 (a decrease of 12.0%), and 305,297 Indiana bats in 2011 (an increase of 8.3%) (Table 3.2). The MRU represents 71.9% of the 2011 rangewide population of Indiana bats (USFWS 2012a). According to the Draft Recovery Plan, there are 190 known Indiana bat hibernacula within the MRU, with 116 being classified as extant (at least one record since 2000; USFWS 2007). There are 12 Priority 1 hibernacula in the MRU – seven in Indiana and five in Kentucky.

Table 3.2 Indiana Bat population estimates for the Midwest Recovery Unit (USFWS 2010a, 2011a, 2012a).

State	2001	2003	2005	2007	2009	2011
Indiana	173,111	183,337	206,610	238,068	213,170	222,820
Kentucky	51,053	49,544	65,611	71,250	57,325	70,329
Ohio	9,817	9,831	9,769	7,629	9,261	9,870
Tennessee	4,192	3,246	3,221	2,929	1,663	1,690
Alabama	173	265	296	258	253	261
SW Virginia	373	430	202	188	217	307
Michigan	20	20	20	20	20	20
Total	**238,739**	**246,673**	**285,729**	**320,342**	**281,909**	**305,297**

Indiana

In 2009 and 2011 respectively, approximately 49% and 52% of the estimated range-wide population of Indiana bats hibernated in Indiana (USFWS 2012a). The long term trend since 2001 has been an increase in the numbers of Indiana bats in Indiana from approximately 173,111 in 2001 to 222,820 individuals in 2011 (Table 3.2; USFWS 2010a, 2011a, 2012a).

There are 37 known Indiana bat hibernacula in the state and of these, 32 have extant winter populations (at least one record since 2000; USFWS 2007). Of the extant Indiana hibernacula, seven are classified as Priority 1 (housing 10,000 or more Indiana bats), one is Priority 2 (1,000-9,999 Indiana bats), 15 are Priority 3 (50-999 Indiana bats), nine are Priority 4 (one to 49 Indiana bats) hibernacula, and two of the hibernacula are unclassified (USFWS 2007). The Priority 1 hibernaculum, Wyandotte Complex[3] in Crawford County, was estimated to have

[3] The Wyandotte Complex is a collection of four caves that are part of the same cave system which includes Bat Wing, Jug Hole, Twin Domes, and Wyandotte Caves.

126,448 Indiana bats in 2007 (USFWS 2008). All of the hibernacula in Indiana are found in the south-central part of the state within the Interior Plateau Ecoregion (USFWS 2007). All of Indiana is located in the MRU for Indiana bat (USFWS 2007).

The summer range of Indiana bats in Indiana is fairly ubiquitous. As of the 2007 Draft Indiana Bat Recovery Plan (USFWS 2007), 51 counties in Indiana (out of 92 total counties) had records of summer maternity colonies. An additional 14 counties had other summer records of Indiana bats and one county had winter records only (USFWS 2007).

Project Site/Local Population

Prior to the FRWF monitoring studies in 2009, there were no records of Indiana bat from Benton County (USFWS 2007). The Project is located in an agricultural setting with greater than 93% of the land cover being crops (Table 3.1). The nearest known winter population is a Priority 2 hibernacula located approximately 169 km (105 mi) away in La Salle County, Illinois (USFWS 2007). Results from monitoring studies conducted at the FRWF provide support for relatively low risk to Indiana bats in the Project area. Of the 1,543 total bat casualties collected at the FRWF in 2009, 2010, and 2011, only 10 *Myotis* casualties were found (seven little brown bats, one northern long-eared bat [*Myotis septentrionalis*], and two Indiana bats; 0.7% of the total; Johnson et al. 2010a, 2010b; Good et al. 2011, 2012). Of the *Myotis* fatalities, only one little brown bat fatality occurred during the spring (on May 5, 2009). Fall migration is likely the period of highest risk for Indiana bats considering that the two Indiana bat casualties were both found in September (one in 2009 and one in 2010), and based on the timing of the other *Myotis* fatalities. In addition, overall bat mortality is significantly higher in the fall than in the spring and differences in migratory behavior of bats between the two seasons support increased risk during the fall migratory period.

Based on the habitat information, results of site monitoring surveys, and distance to the nearest known hibernacula, it is assumed that Indiana bats may occur within the FRWF during the fall migration season. Indiana bats are not expected to be in the Project area during the spring migration season (approximately April to mid-May) or the summer maternity season (approximately mid-May to July).

4.0 IMPACT ASSESSMENT

The expected level of take and the requested amount of take to be covered by the ITP over the life of the Project is 184 Indiana bats. Adaptive management will limit the annual take of Indiana bats (see Chapter 5.4.2). Based on the best available scientific information, the Permittees conservatively[4] estimate that incidental Indiana bat mortality from operation of the Project with minimization measures in place will reduce the amount of take by 50%, compared with operation of the facility with no conservation plan in place. This estimated level of take is approximately nine Indiana bats in Year 1 of the permit when only 355 turbines are operational,

[4] Conservative means that actual Indiana bat mortality is likely to be lower than these estimates.

11 Indiana bats per year during Years 2-17 when 449 turbines are operational, and two Indiana bats per year in Years 18-21 when only 94 turbines are operational (see Chapter 4.1.1.2 - *Estimated Indiana Bat Mortality with Minimization Measures*). Take will be tracked on an annual basis through mortality monitoring and if annual thresholds are exceeded, changes in operational curtailment will be implemented to ensure that take is reduced in future years.

Mitigation will be implemented by the Permittees to offset the impact of take, including lost reproductive capacity of females that are taken by the Project. The estimated reproductive capacity of females taken by the Project is 152 Indiana bats, resulting in a total estimated impact of 336 Indiana bats (see Chapter 4.2 for a discussion of the impact of the taking). Collectively, take from the FRWF and lost reproductive capacity of females represents the loss of approximately 16 Indiana bats per year over the 21-year ITP. This annual loss equates to an approximate 0.005% reduction in the MRU, the population most likely to be impacted. Given that this loss represents a small percentage of the MRU, and a smaller portion of the rangewide population (0.004% of the total population), and that mitigation implemented as part of this HCP is expected to fully offset the impacts of the taking, the Permittees believe the Project will not appreciably reduce the likelihood of survival and recovery of the species in the wild.

4.1 Project Effects

Among the four subtasks described in the HCP Handbook (USFWS and NMFS 1996 Pages 3-10) that must be completed to determine the likely effects of a project on covered species, two subtasks will be described in this chapter: 1) identifying activities proposed in the plan area that are likely to result in incidental take, and 2) quantifying anticipated take levels. In addition to quantifying take, this chapter will also describe potential direct and indirect effects of the Project, as recommended in the HCP Handbook, to assist the USFWS in expediting and satisfying the requirements of the ESA Section 7 process. According to the ESA Section 7 implementing regulations (50 CFR pt. 402.02), “effects” refer to the direct and indirect effects of an action on the covered species or its critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline. Both direct and indirect effects have the potential to result in take of a listed species. This chapter describes direct and indirect effects to Indiana bats that have the potential to result from Project activities that are likely to result in take. Only activities that are likely to result in take are included as covered activities in this HCP.

4.1.1 Direct Effects

Direct effects are the results of a proposed action that occur at the same time as the action. For the purposes of an HCP, direct effects are a proximate consequence of the covered activities proposed under the HCP.

4.1.1.1 Direct Effects of Mitigation

Summer Habitat Mitigation

The only potential direct effect to Indiana bats from protection and/or restoration of summer habitat is human disturbance associated with tree planting and monitoring activities. However, tree planting will take place in the spring prior to the arrival of most Indiana bats at the maternity colonies (i.e., prior to May 15), or during the fall (i.e., after September 1) after most Indiana bats are expected to have migrated. Precautions, including timing restrictions, will be taken to avoid impacts to known roost trees. Monitoring activities, including acoustic monitoring and exit counts, are expected to result in minimal, if any, human disturbance due to the short duration of these activities and the limited time people will be in the vicinity of roosting bats. Therefore, summer habitat mitigation is not expected to have any negative direct effects to Indiana bats.

Winter Habitat Mitigation

Winter habitat mitigation will include activities that have the potential to result in harm or take of Indiana bats, including gate construction. Construction activities will cause short-term surface disturbance at the cave entrance. However, potential direct effects to Indiana bats from noise, vibration, and human activity during construction of the cave gate are not expected because construction will not occur during the winter or fall when Indiana bats are hibernating or swarming. Since there is the potential for a small number of Indiana bats to use the cave during the period when gating would occur, the area in the vicinity of the planned gate installation will be inspected prior to construction activities to evaluate potential effects to non-migrating Indiana bats. Measures will be taken to avoid direct impacts to Indiana bats and other bats that may be in the cave entrance at the time of gating according to guidance and oversight from the USFWS Bloomington Field Office (BFO), but since the bats are not hibernating during this time, limited disturbance is not expected to result in take. Additionally, if air flow is moving into the cave, an air curtain will be installed each day during construction to prevent exposure of bats roosting inside the cave to construction fumes.

Another potential source of direct effects associated with cave gating involves the interaction of bats with the gate after installation. Direct impacts could result if bats collide with gate slats or have to expend extra energy to navigate between gate slats. However, these direct effects are not expected because the cave gates will be modeled after designs of other successful bat gates that have resulted in increased populations of Indiana bats (more information on gate design is provided in Chapter 5). Spacing between gate beams will be sufficient to restrict human access to the cave, but not so tight as to impede bat flight through the gate or to result in collisions.

4.1.1.2 Direct Effects of Operation

Direct effects to migrating Indiana bats from Project operation could occur if the bats are forced to take an alternate route to avoid the wind facility (i.e. displacement). However, empirical data indicate that displacement of bats by wind facilities is not occurring. Observations of bat flight activity using thermal infrared cameras at wind energy facilities have documented bats flying and foraging in close proximity to wind turbines and even investigating spinning turbine blades (Ahlén 2003, Horn et al. 2008). Further, the documented mortality of two Indiana bats at the FRWF and ongoing mortality of bats at many wind facilities across the United States also provide support that avoidance of wind facilities by bats is not occurring. Therefore, displacement is not expected to occur or result in take of Indiana bats.

Wind turbine operation has the potential to result in direct effects to Indiana bats in the form of mortality from collision with spinning turbines or barotrauma for bats that fly in close proximity to spinning turbines. There is a paucity of information regarding the circumstances under which Indiana bats may be at risk of collision with WTGs. The two Indiana bat fatalities recorded at the FRWF in 2009 and 2010 were females and the fatalities occurred during September at turbines located in agricultural fields. With the absence of nearby hibernacula, it is considered unlikely that the two Indiana bat fatalities occurred during active swarming. Therefore, it is believed that the fatalities were of fall migrating bats. Relatively little can be derived from these discoveries other than Indiana bats are vulnerable to collision with wind turbines at the FRWF during the fall migration period. Using these and other data from fatality monitoring studies, the following sections describe the estimated take of Indiana bats that is likely to result from collision/barotrauma with operating turbines.

Previous Studies of Bat Fatalities at the Fowler Ridge Wind Farm (2009-2011)

The conclusions stated in the introduction above are derived from fatality search efforts implemented at the FRWF in 2009, and more rigorously designed and intensive monitoring efforts during 2010 and 2011 after Phases I – III of the Project (355 turbines) were built or in operation. Phase I of the FRWF was monitored during the spring and fall migration seasons of 2009 and Phase III was monitored during the spring and summer of 2009. Phases I, II, and III were monitored during both the spring and fall in 2010 and in the spring and fall of 2011. Work in 2010 and 2011 took place under Scientific Research and Recovery Permits (SRRP) from the USFWS (Permit # TE15075A-0 and TE15075A-2, respectively [Good et al. 2010]). The purpose of the research and the protocols guiding it are summarized in this chapter; methods and results are summarized in Table 4.1. FRWF submitted detailed reports to the USFWS documenting each year of monitoring, which are included in Appendix A.

The monitoring studies conducted at the FRWF were designed to estimate the number of Indiana bats killed at the facility by estimating the number of all bat species killed. To understand this approach, it is essential to recognize that the number of Indiana bat fatalities at the FRWF (and other wind energy facilities) is low relative to other bat species. For this reason and for reasons discussed later in this chapter, documenting Indiana bat fatalities at wind facilities is difficult and even with the most rigorous search protocols in place, most Indiana bat fatalities likely go undetected. The Permittees do not believe that there is a practicable and effective way to survey specifically for Indiana bat fatalities at a facility the size of the FRWF (355 turbines stretching nearly 27 km [17 mi] from east to west and 16 km [10 mi] north to south). Therefore, a sampling approach using all bat fatalities was developed and refined during research efforts in 2010 and 2011 in close cooperation with, and approval by, the USFWS under a 10(a)(1)(A) research permit. Key protocols included: a) number of turbines searched and time of year, b) cleared plots vs. roads and pads (and an associated correction factor), c) searcher efficiency, d) carcass removal rate and search frequency, and e) control vs. conservation treatment. The data gathered from three years of monitoring from 2009-2011 were used to estimate the percentage of all bats killed that were Indiana bats. This relationship of Indiana bats killed to all bats killed is the basis for the estimation of Indiana bat mortality at the FRWF.

Because the FRWF was an operating facility when the first Indiana bat fatality was detected, agreements with landowners concerning land use around turbines were already in place. This, along with the number of turbines in service, made it impractical to conduct cleared plot searches at every turbine. The Permittees implemented a combination of cleared plot and road and pad searches over the monitoring period, including two monitoring seasons when cleared plots and roads and pads were directly compared.

Fatality searches at the FRWF between 2009 and 2011 were conducted as follows. Beginning in 2009[5], Phase I searches were completed at 25 turbines, with nine of those having cleared search areas. In the spring (April 6 – May 21, 2009), carcass searches were conducted weekly at 12 turbines and once every two weeks at 13 turbines. From May 22 – August 15, 2009, all 25 turbines were searched twice per month. All 25 turbines were searched twice per week during the fall migration season (August 16 – October 30, 2009). Phase III searches were completed at 12 turbines. From April 2 – May 15, 2009, carcass searches were conducted once every week with the number of turbines being searched each week ranging from six to 12 turbines. All 12 turbines were searched once every two weeks between May 16 – June 10, 2009 (for complete methodology, see Appendix A).

Phases I, II, and III were monitored during both the spring (April 13 – May 15) and fall (August 1 – October 15) in 2010 and the spring (April 1 – May 15) and fall (July 15 – October 29) of 2011. Casualty searches in 2010 were conducted on two plot types: 1) 80 x 80-m square plots cleared of vegetation at 36 turbines; and 2) roads and gravel pads within 40 m (131 ft.) at 100 turbines[6]

[5] Because 2009 monitoring was not reviewed and approved by the USFWS and was less intensive than in 2010 and 2011, data from these monitoring efforts were used only in establishing the species composition and not in estimating fatality rates. Species composition would not necessarily be expected to vary because of the differences in effort.

[6] Only 92 turbines were searched in the spring because road construction had not been completed at all of the turbines planned for searches.

Table 4.1 Summary of bat casualty studies conducted at the Fowler Ridge Wind Farm from 2009-2011.

	Fowler III (Johnson et al. 2010b)		**Fowler I (Johnson et al. 2010a)**							
Survey Period	April 2 - May 15, 2009	May 16 - June 10, 2009	April 6 – May 21, 2009	April 6 – May 21, 2009	May 22 - Aug 15, 2009	May 22 - Aug 15, 2009	May 22 - Aug 15, 2009	Aug 16 - Oct 30, 2009	Aug 16 - Oct 30, 2009	Aug 16 - Oct 30, 2009
Search Methods										
Search Interval	Weekly	Once Every Two Weeks	Weekly	Once Every Two Weeks	Once Every Two Weeks	Once Every Two Weeks	Once Every Two Weeks	Twice a Week	Twice a Week	Twice a Week
Turbines Searched	6 - 12	12	12	13	1	8	16	1	8	16
Plot Size	160 m x 160 m	160 m x 160 m	160 m x 160 m	160 m x 160 m	160 m x 160 m	w/in 80 m of turbines	160 m x 160 m	160 m x 160 m	w/in 80 m of turbines	w/in 80 m of turbines
Clearing Methods	Fully Searched	Fully Searched	Fully Searched	Fully Searched	Cleared (after July 3)	Mowed Transects (after July 3)	Fully Searched	Cleared	Mowed Transects	Road & Pad Only
Searcher Efficiency										
	51.0		56.0							
Carcass Removal Rate										
	11.93 (SB Surrogate)		9.93							
Adjusted All Bat Fatality Rate (fatalities per turbine per study period) [7]										
Shoenfeld	3.03 (0.71 - 6.58)		15.03 (10.89 - 20.52)							
Empirical	NA		NA							
Indiana Bat Fatalities	**0**		**1**							

* Adjusted for area outside 80 x 80-m square plot

[7] Fatality rates in 2010 and 2011 were calculated from control turbines only.

Table 4.1 (*continued*) Summary of bat casualty studies conducted at the Fowler Ridge Wind Farm from 2009-2011.

	Fowler I, II, III (Good et al. 2011)				**Fowler I, II, III (Good et al. 2012)**		
Survey Period	April 13 - May 15, 2010	April 13 - May 15, 2010	Aug 1 - Oct 15, 2010	Aug 1 - Oct 15, 2010	April 1 - May 15, 2011	July 15, - Oct 29, 2011	July 15 - Oct 29, 2011
Search Methods							
Search Interval	Weekly	Daily	Weekly	Daily	Every 6 days	Once Every Two Days	Daily
Turbines Searched	92	36	100	36	177	9	168
Plot Size	w/in 40 m of Turbines	80 x 80 m	w/in 40 m of Turbines	80 x 80 m	w/in 80 m of Turbines	80-m radius circles	w/in 80 m of Turbines
Clearing Methods	Road & Pad Only	Cleared	Road & Pad Only	Cleared	Road & Pad Only	Cleared	Road & Pad Only
Searcher Efficiency							
	84.62	31.79	84.62	31.79	73.8	29.2	80.8
Carcass Removal Rate							
	11.83	10.34	11.83	10.34	15.1	13.02	15.1
Adjusted All Bat Fatality Rate (fatalities per turbine per study period)							
Shoenfeld	*23.95 (16.32 - 33.94)				25.78 (22.51 - 32.37)		
Empirical	*32.03 (21.61 - 47.16)				34.10 (28.64 - 41.37)		
Indiana Bat Fatalities	**1**				**0**		

* Adjusted for area outside 80 x 80-m square plot

(see Appendix B for a discussion of correction for carcasses outside the 80 x 80-m square plots). Carcass searches were completed daily at the 36 cleared plots and weekly at the roads and pads. All turbines were operating under normal parameters (3.5 m per second [m/s; 11.5 feet per second (ft/s)] cut-in speed[8]) during the spring. Beginning in the fall, the 36 cleared plot turbines were assigned to one of two control groups (3.5 m/s cut-in speed) or one of two treatment groups altering the cut-in speed (5.0 and 6.5 m/s [16.4 and 21.3 ft/s]). Nine turbines used as a control group had no treatments. Treatments for cut-in speed adjustment and control turbines were rotated on a weekly basis between the remaining 27 turbines, with nine turbines assigned to each group (for complete methodology see Appendix A).

Casualty searches in 2011 were conducted on two plot types: 1) 80-m radius circular plots cleared of vegetation; and 2) roads and pads within 80 m of turbines. Carcass searches were completed at 6-day intervals during the spring on 177 roads and pads. During the fall, 168 turbines were sampled on roads and pads daily, and nine cleared plots were searched once every two days. Beginning in the fall, nine turbines were randomly selected from the 36 cleared plots searched in 2010 and were considered a control sample because they had no treatments for the duration of the study. Treatments for blade feathering and a second of control turbines were rotated on a nightly basis between the remaining 168 turbines where only roads and pads were searched, with 42 turbines assigned to each group. The treatments included turbines with blades feathered below 3.5 m/s, below 4.5 m/s (14.8 ft/s), below 5.5 m/s (18.0 ft/s), and a control group with no feathering (for complete methodology see Appendix A).

Bat carcasses are small and difficult to locate, even with trained searchers. For this reason, and because there is some removal of carcasses (i.e., scavenging) even with daily searches, both searcher efficiency and carcass removal rate were estimated. The following is a summary of the protocols used to estimate these key factors.

The efficiency rates of observers and removal rates of carcasses by scavengers were quantified to adjust the estimate of total bat fatalities for detection bias. Bias trials were conducted throughout the entire monitoring period. Only freshly killed bats conclusively identified as non-*Myotis* bat species were used for carcass removal trials and searcher efficiency trials. The field crew leader gathered all bat carcasses and redistributed bat carcasses that were intact at predetermined random points within any given turbine's searchable area. Carcass placement was stratified by the number of days before the next search of any given turbine (e.g. placed six, five, four, three, two, and one days before the next search and on the day of the search). This stratification ensured an unbiased empirical estimate of the probability that a carcass remained in the field and was found by a searcher, given that fatalities could occur on any day preceding a casualty search. Data recorded for each trial carcass prior to placement included date of placement, species, turbine number, and the distance to and the direction from the turbine. Small, black zip ties were placed on the wing or legs of each bat to distinguish it from other fatalities landing nearby, or if scavengers moved the trial bat away from its original random location.

[8] Cut-in speed is the wind speed at which turbines begin generating power and sending it to the grid.

For the scavenger removal trial, each trial bat was left in place for up to 28 days, or until the carcass was removed by scavengers. Trial bats were checked by the field crew leader or an observer not involved with carcass searches on days one, two, four, six, eight, 10, 14, 21, and 28. Trial bats were also used for estimating searcher efficiency bias. Observers conducting carcass searches did not know when or where the bat carcasses were placed for bias trials. Carcasses placed by the field crew leader were available and could potentially be found multiple times unless the carcasses were previously removed by a scavenger. The day that each bat was initially found by an observer was recorded. When a bat carcass was found, the observer inspected the carcass to determine if a bias trial carcass had been found. If so, the observer contacted the field crew leader and the bat was left in place for the carcass removal trial, as described above.

Estimated Indiana Bat Mortality without Minimization Measures

Data from the monitoring studies conducted at the FRWF were used in the following analysis to calculate take of Indiana bats that is likely occurring on an annual basis at the FRWF in the absence of minimization measures that will be implemented as part of this HCP. Over the course of three years of mortality monitoring during the spring and fall migration seasons, one Indiana bat was found outside of a scheduled carcass search in September 2009, and a second Indiana bat was found during a scheduled carcass search in September 2010, for a total of two documented Indiana bat fatalities over three years of monitoring.

In 2010, the same monitoring protocols were implemented at the same turbines during the spring and the fall monitoring periods[9]. A total of 36 bat carcasses were found during searches April 13 – May 15 at Phases I, II, and III, with an estimated mean fatality rate of 0.74 bats/turbine/season (Appendix A). In the fall, a total of 651 bats were found during searches from August 1 – October 15 at Phases I, II, and III, with an estimated mean fatality rate of 29.80 bats/turbine/season (Appendix A). Adjusting the seasonal fatality rates for the differing number of search days in each season (33 days in spring and 76 days in fall) results in a daily estimated fatality rate of 0.02 bats/turbine/day and 0.39 bats/turbine/day in the spring and fall, respectively. Based on these directly comparable data, the bat fatality rate in fall is nearly 20 times higher than the bat fatality rate in the spring at the FRWF.

The 2010 results are supported by data collected during the spring and summer of 2009, and data and fatality estimates from the spring of 2011. During spring and summer surveys at Phases I and III in 2009, a total of 26 bat carcasses were found from April 2 - July 28[10] (Appendix A). During spring 2011 surveys at Phases I, II, and III, a total of 16 bat carcasses were found from April 1 – May 15, with an estimated mean fatality rate of 0.66

[9] As noted previously, only 92 turbines were searched in the spring because road construction had not been completed at all of the turbines planned for searches.

[10] Separate fatality estimates by season were not calculated in 2009. The mean fatality rate for Phase I was 8.09 bats/MW during the entire study period of April 6 – October 30, 2009. The mean fatality rate for Phase III was 1.84 bats/MW during the study period of April 2 – June 10, 2009.

bats/turbine/season (Appendix A). In the fall 2011, a total of 463 bats were found during searches from August 1 – October 15 at Phases I, II, and III, with an estimated mean fatality rate of 30.54 bats/turbine/season (Appendix A).

Based on the greatly reduced number of fatalities found during the spring and summer compared to the fall during three years of monitoring, risk to Indiana bats at the FRWF occurs during the fall and is unlikely to occur during the spring and summer months. Therefore, to estimate unobserved Indiana bat fatalities and the annual number of Indiana bat casualties that are estimated to occur at the FRWF in the future, a 2-step process was used that was based on the species composition documented during the fall monitoring seasons from 2009-2011, and total estimated bat mortality that occurred at the FRWF during the fall monitoring seasons in 2010 and 2011.

The first step was to calculate the species composition of bat fatalities documented during monitoring in the fall migration seasons from 2009-2011[11]. A total of 132, 651, and 463 bat casualties were recovered during the fall (August 1 to October 15[12]) seasons in 2009, 2010, and 2011 respectively, for a total of 1,246 bats over the three years of study (Table 4.2). Of these 1,246 bats found over three years, the two documented Indiana bat casualties composed 0.16% of all bat carcasses found.

Table 4.2 Species composition of bats found during fall (August 1 to October 15) mortality monitoring studies at the Fowler Ridge Wind Farm.

		Phase I	**Phase I, II, III**			**Percent**
Species	**Scientific Name**	**Fall 2009**	**Fall 2010**	**Fall 2011**	**Total**	**Comp.**
eastern red bat	*Lasiurus borealis*	49	419	248	716	57.46
hoary bat	*Lasiurus cinereus*	47	112	120	279	22.39
silver-haired bat	*Lasionycteris noctivagans*	28	91	75	194	15.57
big brown bat	*Eptesicus fuscus*	3	24	12	39	3.13
little brown bat	*Myotis lucifugus*	2	2	1	5	0.40
tricolored bat	*Perimyotis subflavus*	0	2	3	5	0.40
Seminole bat	*Lasiurus seminolus*	0	0	3	3	0.24
Indiana bat	*Myotis sodalis*	1	1	0	2	0.16
evening bat	*Nycticeius humeralis*	0	0	1	1	0.08
northern long-eared bat	*Myotis septentrionalis*	1	0	0	1	0.08
unidentified *Lasiurus*		1	0	0	1	0.08
Total		**132**	**651**	**463**	**1,246**	**100**

[11] Species composition was based on all bats found at FRWF I-III between August 1 and October 15 in 2009, 2010, and 2011. Even though 2009 data is not used elsewhere in the HCP (as described previously, see Footnote 4), fatalities found during 2009 were used to calculate species composition since this is when the first Indiana bat fatality occurred.

[12] Note that bat fatalities were also documented to have occurred prior to August 1 and after October 15. However, to focus the analysis on the period of greatest risk to Indiana bats (i.e. fall migration), the dates selected for species composition analysis were August 1 to October 15, consistent with the Draft Indiana Bat Recovery Plan (USFWS 2007). Also there were no known fatalities of Indiana bats and the total number of bat fatalities was very low before August 1 and after October 15.

The second step was to develop a reliable estimate of all bat mortality during the fall migration period to determine the proportion of fatalities that were likely to have been Indiana bats. Because the data collection methods and sampling intensity in 2010 and 2011 were most appropriate for developing a robust estimate of mortality, annual mortality was based on cleared plot searches at control turbines in 2010 and 2011, and 2009 results were not included. All bat mortality in 2010 and 2011[13] was estimated using the number of fatalities that were found during searches at cleared plots, and by adjusting this number to account for bat fatalities that occurred in unsearched areas in 2010.

After applying the estimated adjustment factor of 23.4% for fatalities that occurred outside of the 80 x 80-m plots (see Appendix B), the estimate of bat mortality that occurred during the fall migration period at the FRWF in 2010 and 2011 was 30.17 (90% confidence interval [CI] = 24.60 – 37.13) bats per turbine per year, for an estimated total of 10,710 (90% CI 8,733 – 13,179) bat fatalities per year for 355 turbines. This estimate was based on a simple average of the 2010 and 2011 fatality estimates (Table 4.3; see Appendix A for methodology used to develop empirical fatality estimates). This was more conservative than using a weighted average because there were more cleared plots in 2010, which had a lower fatality estimate that would have resulted in a lower overall fatality estimate.

Table 4.3 Estimated all bat fatality rates for 2010 and 2011 at the Fowler Ridge Wind Farm.

Fall Period (August 1 - October 15)	Number of Cleared Plots	Number of Carcasses Found	Empirical Fatality Estimates		
			Estimate	Lower Limit	Upper Limit
Fall 2010 80 x 80-m square cleared plot *	18	265	29.80	23.80	36.80
Fall 2011 80-m radius circular cleared plot	9	149	30.54	25.40	37.45
Overall	**27**	**414**	**30.17**	**24.60**	**37.13**

* Adjusted for fatalities that may have fallen outside of 80 x 80-m square plots (2011 data estimated 23.4% of fatalities fell outside of 80-m square plots)

To estimate the annual number of Indiana bat fatalities that occurred in 2010 and 2011, the percentage of Indiana bat fatalities (Table 4.2) was multiplied by the total number of bat fatalities that were estimated to have occurred. Multiplying the total annual bat fatality estimate (10,710 bats) by the percent composition of Indiana bats (0.16%) results in an estimate of 17.1 (90% CI = 14.0 – 21.1 bats) Indiana bat fatalities per year for Phases I, II, and III, or 0.05 Indiana bats/turbine/year (90% CI = 0.04 – 0.06 bats/turbine/year) without the minimization measures that will be implemented as part of this HCP.

[13] The estimate of all bat mortality is based on control turbines only because this gives the most accurate indication of the number of fatalities occurring at a facility under normal operation. Treatment turbines that had increased cut-in speeds were not included because the number of fatalities found at these turbines was significantly reduced and this would not have provided an accurate estimate of all bat mortality. Control turbines were spinning under normal operational parameters (3.5 m/s cut-in speed without feathering); while treatment turbines were operating at various cut-in speeds and with (2011) or without feathering (2010).

This estimated Indiana bat mortality only applies to the 355-turbine Project and will change when Phase IV becomes operational, and again after Phases I, II, III are decommissioned. When accounting for a 20-year operational life for each phase of the Project, the entire Project is expected to have a total operational life of 21 years (Table 1.1). Using the estimate of 0.05 Indiana bats/turbine/year, the estimated annual Indiana bat mortality for Phases I, II, III, and IV (i.e., 449 turbines) is 22.5 Indiana bats (90% CI = 18.0 – 26.9), or for Phase IV only (i.e., 94 turbines), the estimated annual mortality is 4.7 Indiana bats (90% CI = 3.8 – 5.6) without the minimization measures that will be implemented as part of this HCP (Table 4.4). Estimated Indiana bat mortality with minimization measures in place is described in the following section.

Table 4.4 Estimated annual Indiana bat take for each operational phase of the Fowler Ridge Wind Farm without minimization measures in place.

		Estimated Annual Indiana Bat Take		
Phase	**Turbines**	**Lower 90% CI**	**Mean**	**Upper 90% CI**
Phase I, II, III	355	14.0	17.1	21.1
Phase I, II, III, IV	449	18.0	22.5	26.9
Phase IV	94	3.8	4.7	5.6

Estimated Indiana Bat Mortality with Minimization Measures

The above analysis represents Indiana bat mortality that can be expected under operating conditions that do not include operational adjustments that eliminate or reduce rotation of turbine blades at low wind speeds. However, several operational adjustments will be made as a condition of this HCP and the associated ITP to minimize take of Indiana bats. These measures are expected to substantially reduce annual Indiana bat mortality.

Several recent operational adjustment experiments have documented significant reductions in bat mortality that can be achieved by reducing or eliminating the movement of turbine blades below cut-in speed, a strategy known as “feathering”, and/or increasing the wind speed at which turbines become operational, or their “cut-in speed” (Table 4.5). Turbines are designed to operate in a manner where the rotors/blades are allowed to spin freely during low winds so they can cut-in very quickly to generate electricity when the wind speed increases. Currently, the FRWF is composed of three different turbine types: 182 Vestas V82 1.65-MW turbines; 40 Clipper C96 2.5-MW turbines; and 133 1.5-MW General Electric (GE) SLE Turbines. The rotor speed for these turbines under normal operating parameters was plotted over wind speeds from approximately 0 to 10 m/s (0 to 33 ft/s; Figure 4.1). While there are differences in the rotor speed for each turbine type, the blade tip speed for all three models ranges from approximately 121 to 161 km per hour (kph; 75 to 100 mi per hour [mph]) at the normal 3.5 m/s cut-in speed. Depending on the typical operating procedures and without feathering, turbine rotors may be turning at up to eight or nine revolutions per minute (rpm; tip blade speed of up to approximately 169 kph [105 mph] for blades with a rotor radius of 50 m [164 ft]) before they reach the normal cut-in speed (see Figure 4.1).

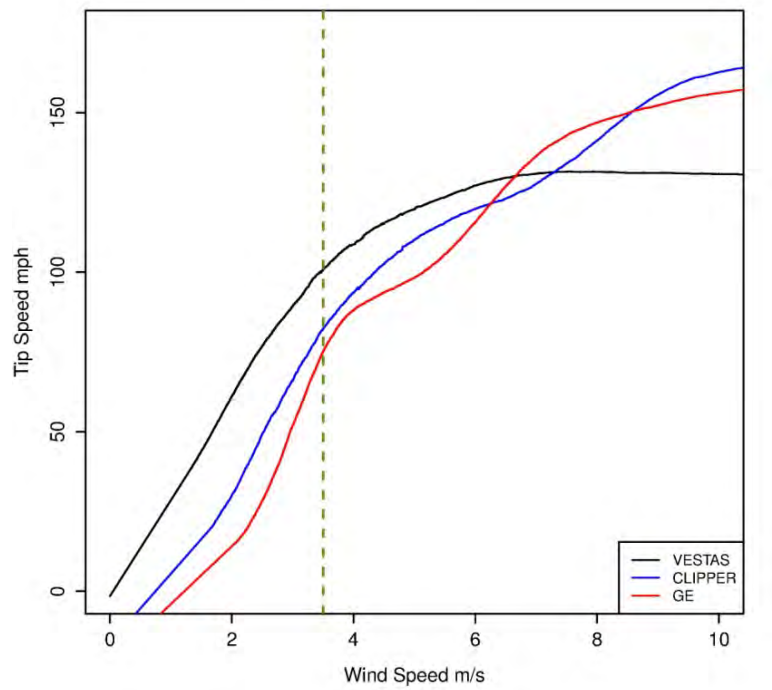

Figure 4.1 Estimated blade tip speed by wind speed for the GE, Clipper, and Vestas wind turbines recorded during the Fowler Ridge Wind Farm 2010 carcass monitoring. The dashed vertical line represents the 3.5 m/s designed cut-in speed for the three turbines.

As bat mortality has an inverse relationship with wind speed (Arnett et al. 2005), raising cut-in speeds and feathering turbine blades below cut-in, during periods of low wind, in the late-summer through early-fall can have a significant effect on rates of bat mortality, as evidenced in the studies included in Table 4.5; these studies, including all monitoring of curtailment at the FRWF, typically focus on the period of fall migration when bats have been shown to be at greatest risk from turbine operation. All studies except Good et al. 2011 (Appendix A) feathered turbines below cut-in speed. While different operational parameters of turbine types and models varied somewhat among studies, the results from these curtailment effectiveness studies can be used to estimate what can be expected from minimization measures that will be implemented as part of this HCP. Further, the results of these studies are important because they confirm that raising cut-in speeds and feathering turbine blades at low wind speeds can substantially reduce bat mortality.

Table 4.5 Results from publicly available curtailment effectiveness studies.

Study Name	Cut-in Speed (m/s)	Mean Percent Reduction in Mortality	Mean Percent Reduction in Mortality Per Cut-in Speed	Source
FRWF 2011	3.5	36	36	Good et al. 2012
Mount Storm[a]	4	35	47	Young et al. 2011
Summerview	4	58		Baerwald et al. 2009
FRWF 2011	4.5	57	57	Good et al. 2012
Casselman 2008	5	82	68	Arnett et al. 2010
Casselman 2009	5	72		Arnett et al. 2010
FRWF 2010[b]	5	50		Good et al. 2011
Summerview	5.5	60	67	Baerwald et al. 2009
FRWF 2011	5.5	73		Good et al. 2012
Casselman 2008	6.5	82	78	Arnett et al. 2010
Casselman 2009	6.5	72		Arnett et al. 2010
FRWF 2010[b]	6.5	79		Good et al. 2011

[a] Based on the average reduction of 47% and 22% from first and second halves of the night; note that an average reduction of 61% (72% and 50% from first and second halves of the night) was realized when comparing only nights when treatments were in place (32% and 40% of the time for the first and second halves of the night) to nights when treatments were not in place

[b] Study did not include feathering below cut-in speed

Over two years of experimental study during the peak fall migration period at the Casselman wind facility in Pennsylvania, total bat fatalities at turbines at which cut-in speed was raised from 3.5 m/s to 5.0 m/s and 6.5 m/s were estimated to be 82% less in 2008 (95% CI = 52% to 93%), and 72% less in 2009 (95% CI = 44% to 86%) than fully operational turbines. There was no statistical difference in fatality reductions at the two cut-in speeds, although the authors noted that the average wind speed at the site was between 5.0 and 6.5 m/s (wind speeds during which the two curtailment treatments were operationally distinct) only 10% of the study period, which may have explained in part why they found no statistically significant difference in bat fatalities between the two treatments (Arnett et al. 2010). In addition to raising the cut-in speed, turbines used in the study were essentially motionless below cut-in speed (i.e., effectively feathered).

A similar curtailment study at the Summerview wind facility in southern Alberta, Canada used two different operational techniques, and both were found to substantially reduce bat mortality (Baerwald et al. 2009). For one experimental group of turbines, cut-in speed was increased from 4.0 m/s (13.1 ft/s) to 5.5 m/s, with turbines idle and motionless (i.e., feathered) at lower wind speeds. This resulted in a 60.0% reduction in bat mortality at treatment turbines compared with normally operating turbines (Table 4.5). For the second experimental group, the cut-in speed was not increased from normal (i.e., 4.0 m/s), but an operational adjustment strategy was used in which turbines were effectively feathered below cut-in speed so that they were motionless in low wind speeds. Feathering of turbines below the 4.0 m/s cut-in speed resulted in a 58% reduction in bat mortality when compared to normally operating turbines (Baerwald et al. 2009) (Table 4.5).

A study at the Mount Storm wind facility in West Virginia tested the effectiveness of feathering turbine blades from July 15 to October 15 on nights when wind speeds were predicted, based on local weather forecasting, to be below a cut-in speed of 4.0 m/s (Young et al. 2011). The Mount Storm study also compared the effects of feathering blades during different portions of the night. When considering the whole study period, turbines that were feathered during the first half of the night had approximately 47% less bat mortality (all species combined) when compared to normally operating turbines, whereas turbines that were feathered for the second half of the night had approximately 23% less bat mortality (Young et al. 2011). The effect of feathering the blades was much greater when considering bat mortality only on nights when treatments were in place. On average, when comparing nights when treatments were in effect, bat mortality was reduced by approximately 61% (Young et al. 2011).

Although differences in turbine size among studies likely influenced overall mortality rates (Baerwald et al. 2009), and the methods by which turbine blades were feathered differed among studies, the consistency of little to no movement of turbine blades below cut-in speed means that patterns in bat mortality reductions can be compared among studies that included feathering below the same cut-in speed. Some studies did not increase cut-in speed above the manufacturer's recommended settings (i.e., Baerwald et al. 2009, Young et al. 2011), which provided information on the effectiveness of feathering turbines at low wind speeds (e.g., 4.0 m/s). Regardless of whether or not the cut-in speed was increased beyond the manufacturer's settings, patterns of reduction in bat mortality are considered comparable for these studies because they included feathering below the same cut-in speed. The results of the Summerview (Baerwald et al. 2009) and Mount Storm (Young et al. 2011) studies are particularly insightful because they confirm that significant reductions in bat mortality can be achieved by feathering turbines at low wind speeds (i.e., 4.0 m/s), and that turbines which are "hunting" or "seeking" the wind (i.e., unfeathered) at low wind speeds pose a risk to bats.

Perhaps the most meaningful study for understanding reductions in bat mortality that are likely to be achieved by feathering turbine blades below a cut-in speed of 5.0 m/s is from research conducted at the FRWF in 2010 and 2011. Bat fatalities were reduced by a mean of 50% when cut-in speed was increased from 3.5 m/s to 5.0 m/s (90% CI = 38% - 60%), and by 79% when cut-in speeds were increased to 6.5 m/s (90% CI = 71% - 85%; Appendix A). However, turbines in the 2010 study were not feathered below cut-in. To test whether or not additional reductions could be achieved by feathering blades below the cut-in speed of 3.5 m/s, turbines in the 2011 study were feathered below cut-in speeds of 3.5, 4.5, and 5.5 m/s, which resulted in reductions of 36% (90% CI = 12% - 54%), 57% (90% CI = 39% - 70%), and 73% (90% CI = 60% - 83%) in bat mortality, respectively, compared with normally operating turbines (i.e., unfeathered below a cut-in speed of 3.5 m/s). Based on these results, between 57% and 73% reductions would have been achieved by feathering blades below a cut-in speed of 5.0 m/s in 2011 (Appendix A).

However, it is unclear if operational adjustments will be equally effective at reducing mortality among different species or species groups. Three species of long distance migratory bats have been killed in the largest proportions at wind facilities in North America: the foliage-roosting hoary bat (*Lasiurus cinereus*) and eastern red bat (*Lasiurus borealis*), and the cavity-roosting silver-haired bat (*Lasionycteris noctivagans*; Kunz et al. 2007, Arnett et al. 2008). Collectively, these species comprised approximately 75% of documented fatalities and hoary bats made up about half of all fatalities at 19 wind facilities reviewed by Arnett et al. (2008) in 2008. Fatalities of cave-dwelling species, including little brown, northern long-eared, and big brown bats (*Eptesicus fuscus*) were relatively low (from 0% to 13.5%) at the 19 facilities reviewed by Arnett et al. (2008), with the exception of Castle River, Alberta, and Top of Iowa, Iowa, where little brown bats made up nearly 25% of the total fatalities (Brown and Hamilton 2002, Jain 2005).

More recent post-construction studies also documented higher rates of *Myotis* mortalities than the majority of studies reviewed by Arnett et al. (2008). Gruver et al. (2009) reported a higher percentage (28.7%) of little brown bat fatalities at the Blue Sky Green Field facility in Wisconsin during fall 2008 and spring 2009. Similarly, post-construction mortality studies at three facilities in Clinton and Wyoming Counties, New York documented higher proportions of *Myotis* fatalities than those in the Arnett et al. (2008) review, with *Myotis* fatalities ranging from 33.3% to 55.9% of the total (Jain et al. 2009a, 2009b, 2009c), as did studies at Cohocton/Dutch Hill and Munnsville wind facilities in central New York, with *Myotis* fatalities making up 59.4% and 20.0% of the total, respectively (Stantec 2009, 2010). These data suggest a possible trend of *Myotis* fatalities occurring in greater numbers at some facilities situated within largely agricultural habitats, compared with the average of *Myotis* fatalities reported for the 19 facilities reviewed by Arnett et al. (2008). However, it should be noted that *Myotis* fatalities made up a very small percentage (less than 1%) of the total fatalities at the FRWF from 2009-2011 (Table 4.2).

Table 4.6 Estimated annual Indiana bat take with minimization for each operational phase of the Fowler Ridge Wind Farm.

		Estimated Annual Indiana Bat Take		
Phase	**Turbines**	**Lower 90% CI**	**Mean**	**Upper 90% CI**
Phase I, II, III	355	7.0	8.6	10.6
Phase I, II, III, IV	449	8.8	10.9	13.4
Phase IV	94	1.9	2.3	2.8

At this time it is unclear if feathering turbines below raised cut-in speeds will be as effective in reducing *Myotis* mortality as it is in reducing mortality of other species of bats. However, it is plausible based on their morphology and flight behavior that smaller species of bats, such as *Myotis,* may be less active at higher wind speeds compared to larger species of bats that typically forage in more open habitats, and especially in the rotor-swept area of turbines. If this hypothesis is true, then response by smaller bats to turbine curtailment as wind speeds increase would likely be less compared to the response of larger species. Conversely, if *Myotis* species are more active on low wind speed nights, and less active as wind speed increases (which is considered plausible given their small size and typical behavior of not foraging in large open areas, where winds would typically be greater) then feathering turbine blades to reduce blade movement at the lowest wind speeds would likely be most effective at reducing *Myotis* mortality.

Given the uncertainty with regard to reductions in Indiana bat mortality specifically, as well as uncertainty in the estimated reductions in bat mortality (90% CI range from 39% to 83% for 4.5 to 5.5 m/s cut-in speeds), and potential year to year variation, the Permittees conservatively estimate that feathering turbines blades below a cut-in speed of 5.0 m/s during the fall migration season would reduce all bat mortality, including Indiana bat mortality, by at least 50%. Table 4.6 shows estimated annual Indiana bat mortality for each phase of the Project based on an assumed 50% reduction in the estimates derived from the FRWF curtailment effectiveness studies. Based on the number of years each phase of the Project is expected to be operational, the total estimated Indiana bat take over the 21-year ITP term is 184 Indiana bats (Table 4.7). Indiana bat take estimates are considered conservative, meaning that actual Indiana bat mortality is likely to be lower than these estimates, because the estimates were based on the minimum reductions in mortality that were observed in studies using similar operational adjustments.

Table 4.7 Operational phases, number of turbines, and estimated Indiana bat mortality with minimization over the 21-year operational life of the Fowler Ridge Wind Farm.

Permit Year	Operational Phase	Calendar Year	Number of Turbines	Annual Mortality*
Research Year	Phase I, II, III	2010	355	Research Year
Research Year	Phase I, II, III	2011	355	Research Year
Research Year	Phase I, II, III	2012	355	Research Year
Research Year	Phase I, II, III	2013	355	Research Year
1	Phase I, II, III	2014	355	9
2	Phase I, II, III, IV	2015	449	11
3	Phase I, II, III, IV	2016	449	11
4	Phase I, II, III, IV	2017	449	11
5	Phase I, II, III, IV	2018	449	11
6	Phase I, II, III, IV	2019	449	11
7	Phase I, II, III, IV	2020	449	11
8	Phase I, II, III, IV	2021	449	11
9	Phase I, II, III, IV	2022	449	11
10	Phase I, II, III, IV	2023	449	11
11	Phase I, II, III, IV	2024	449	11
12	Phase I, II, III, IV	2025	449	11
13	Phase I, II, III, IV	2026	449	11
14	Phase I, II, III, IV	2027	449	11
15	Phase I, II, III, IV	2028	449	11
16	Phase I, II, III, IV	2029	449	11
17	Phase IV	2030	94	2
18	Phase IV	2031	94	2
19	Phase IV	2032	94	2
20	Phase IV	2033	94	2
21	Phase IV	2034	94	2
21-Year Take Limit				**184**

*Values have been rounded from those reported in Table 4.6

Proposed Take Limit

No Indiana bat take is expected to occur during construction, maintenance, decommissioning, or mitigation activities. The only Project activity expected to result in Indiana bat take is operation of the wind facility during the fall migration period. The Permittees request a take limit of 184 Indiana bats based on the cumulative estimated average annual take over all operational phases of the Project (Table 4.6). As a result of natural stochasticity (i.e., fluctuations) in variables that lead to changes in mortality over time, annual mortality can be expected to differ from year to year. To facilitate responsiveness in management actions that will ensure that the 21-year take limit is not exceeded, this HCP includes annual fall monitoring and annual and within-year adaptive management take thresholds, which are described in detail in Chapter 5. An expanded timeframe for take compliance will allow changes to be made to the minimization strategy that will ultimately ensure that take will not exceed the cumulative limit of 184 Indiana bats. A cumulative record of calculated annual Indiana bat mortality will be kept throughout the 21-year operational life of the Project.

4.1.2 Indirect Effects

Implementing regulations of the ESA (50 CFR Part 402.02) define indirect effects as "those that are caused by the proposed action and are later in time, but still are reasonably certain to occur." For the purposes of an HCP, the indirect effects in question must be reasonably foreseeable, a proximate consequence of the covered activities proposed under the HCP, and must rise to the level of take (USFWS and NMFS 1996) if they are to be included as a covered activity. Indirect effects of the FRWF are not likely to result in take of Indiana bats.

4.1.2.1 Indirect Effects of Mitigation

Summer Habitat Mitigation

No indirect effects to Indiana bats from protection and/or restoration of summer habitat are expected.

Winter Habitat Mitigation

Indirect effects of cave gating could include increased predation by owls, snakes, raccoons (*Procyon lotor*), feral cats (*Felis cattus*), or other predators if the gate slows down the flight of bats as they move in and out of the cave opening, or if gates direct bats' flight paths towards an area where predators can more easily access them. Predation at the entrances of hibernacula is a relatively common and natural phenomenon at caves with large populations of bats. However, the gate will be designed so that spacing between gate slats will be sufficient to restrict human access to the cave, but not so narrow as to hinder or slow bat flight through the gates. This should minimize predators' abilities to capture bats as they are moving in and out of the cave. Further, during gate construction, special attention will be paid to removing or modifying any potential overhangs, nearby branches, or other perches or structures that might provide easier access to predators. Since there is currently a gate at Wyandotte Cave that has apparently not negatively affected population growth, it is not expected that predation associated with the new gate will have negative effects. Other indirect effects of mitigation are not expected. Therefore, indirect effects that might rise to the level of take are not expected from winter habitat mitigation.

4.1.2.2 Indirect Effects of Operation

Indirect effects from operation of a wind facility could include secondary development if operation of the facility increased employment opportunities, which in turn induced housing or urban development in previously undeveloped areas used by Indiana bats. Negative indirect effects to Indiana bats from secondary development are not expected because the economic benefits from the Project are likely to enable farmers to maintain agricultural operations and existing land uses. In the unlikely event that the Project resulted in increased housing or urban development, these are likely to be located in previously disturbed or agricultural habitat, primarily because Benton County and surrounding counties are characterized by expansive, open fields of agriculture. Therefore, indirect effects of Project operation from secondary development or other factors are not expected and are not likely to result in take of Indiana bats.

4.2 Impacts of the Taking

Determining the significance of potential take on a species or population requires an understanding of population demographics, and in particular the annual survival and mortality rates, as well as a definition of the population being impacted. The two Indiana bat fatalities found at the FRWF were females found during the fall migration period (September). The Draft Indiana Bat Recovery Plan (USFWS 2007) states that there are no known hibernacula within Benton County or any of the counties in Indiana or Illinois adjacent to Benton County[14]. There are no known hibernacula for Indiana bats within 161 km (100 mi) of the FRWF; the nearest known winter population is a Priority 2 hibernacula located approximately 169 km (105 mi) away in La Salle County, Illinois (USFWS 2007). This information and the timing of the fatalities suggest that the impacts were to fall migrants.

The origins of the Indiana bats found in the FRWF mortality monitoring studies are unknown (i.e., what geographic area the bats were migrating from), but based on information from banding studies, it is believed that Indiana bats can travel up to 575 km (357 mi) during migration (Winhold and Kurta 2006). Based on data from genetic, banding, and telemetry studies, it is highly likely that Indiana bats migrating through the Project area belong to the MRU (USFWS 2007). Thus, the impacts of the taking are evaluated as they pertain to the MRU population in the following chapter. Also, impacts are evaluated at the rangewide population level (i.e., over the total range of the species). When evaluating the impacts of take from the FRWF, it is also important to consider indirect effects of the take. Because take of Indiana bats is expected to occur only during the fall migration season and not the spring migration season or summer maternity season (Appendix D), the loss of a female would not directly result in the loss of a dependent juvenile from starvation or other causes related to the absence of the female prior to juvenile volancy. Loss of juveniles during migration is accounted for in the take estimate and is explained in Appendix C. However, loss of a female during the fall would have a greater impact to the overall population than loss of a male, because it results in lost reproductive potential.

It is unclear based on available scientific information if there are sex-related factors that might influence collision risk during migration. The following evidence points to females potentially being at higher risk during migration at the FRWF; both Indiana bat casualties at the FRWF were adult females. Adult males often remain close to hibernacula during the summer (Gardner and Cook 2002, Whitaker et al. 2002) and the closest Indiana bat hibernaculum is over 161 km away (USFWS 2007). Summer mist-netting studies conducted from 1978 to 2002 in southern Michigan showed that only 11% of the adult Indiana bats captured were males (Kurta and Rice 2002).

These data indicate that migrating individuals passing through the Project area may be more likely to be females. However, Kurta and Rice (2002) cautioned that the proportion of adult

[14] A 1-county buffer around Benton County includes Newton, Jasper, White, Tippecanoe, and Warren counties in Indiana and Vermilion, Iroquois, and Kankakee counties in Illinois.

males in the summer population may have been underestimated because mist-netting preferentially occurred near maternity roosts (Kurta et al. 1996, Kurta and Rice 2002), and male Indiana bats often do not roost with females during the maternity period (Gardner et al. 1991). Another study documented males that likely migrated over 400 km (249 mi) from hibernacula in Indiana and Kentucky to Michigan (Kurta and Murray 2002). If we assume that there are more female adults in the fall migratory population (males are less likely to be more than 161 km from the nearest hibernaculum) and if we assume that the migrating juveniles occur at a 1:1 sex ratio, although the exact proportion of females to males is unknown, the Permittees believe that a 3:1 ratio of females to males is a reasonable assumption. Therefore, approximately 75% of the individuals that are taken by the FRWF are expected to be reproductive females.

The Permittees estimate a total of 184 Indiana bats will be taken during the 21-year ITP term. Approximately 75% of the incidental take is expected to be attributed to females, for a total of 138 female Indiana bats taken over the operational life of the Project.

The estimate of the impacts of the taking relied on the following assumptions for Indiana bats in the MRU based on best available science (see Appendix C):

- Survival rate = 0.91;
- Fecundity rate = 0.60;
- Summer habitat of taken bats remains functional on landscape; and
- Maternity colony persists with additive mortality from the FRWF.

Based on these assumptions, it is expected that the reproductive capacity of the 138 females that would be taken by the Project would have resulted in the production of an additional 152 bats by Year 21 of the Project. Thus, the total impact of the taking would be the loss of 336 Indiana bats (i.e., estimated take of 184 bats, plus the loss of 152 bats from the reproductive loss of taken female bats). Mitigation actions, therefore, will have a target increase of 336 Indiana bats, or 16 bats per year on average, to account for this lost reproductive capacity.

In terms of the impacts of this population loss on the MRU, the loss of 16 Indiana bats per year equals a loss of 0.005% of the estimated 2011 population of 305,297 Indiana bats in the MRU (USFWS 2012a). The loss to the rangewide population would be 0.004%, based on the 2011 estimated population size of 424,708 Indiana bats (USFWS 2012a). These losses represent small fractions of the total estimated populations in the MRU and rangewide populations. Given the expected minimal impact of take from the FRWF to overall population levels, and because mitigation actions are expected to fully offset the impacts of take as well, FRWF does not expect the Project to have a significant effect on either the MRU or rangewide populations of the species at the current population levels. If the population of Indiana bats in the MRU were substantially reduced as a result of WNS or other factors, the Permittees will take corresponding action as described in Chapter 8.

5.0 CONSERVATION PLAN

ESA § 10(a)(2)(A)(ii) states that the conservation plan submitted in support of an ITP application must describe, among other things, "what steps the applicant will take to minimize and mitigate such impacts;…." As described in the HCP Handbook (USFWS and NMFS 1996), mitigation actions under HCPs usually take one of the following forms: 1) avoiding the impact (to the extent practicable), 2) minimizing the impact, 3) rectifying the impact, 4) reducing or eliminating the impact over time, or 5) compensating for the impact. For example, project effects can be: 1) avoided by relocating project facilities within the Project area; 2) minimized through timing restrictions and buffer zones; 3) rectified by restoration and re-vegetation of disturbed Project areas; 4) reduced or eliminated over time by proper management, monitoring, and adaptive management; and 5) compensated for the impact by habitat restoration or protection at an on-site or off-site location (USFWS and NMFS 1996; Page 3-19). In practice, HCPs often use more than one strategy simultaneously or consecutively. Finally, the level of mitigation provided in an HCP must be commensurate to the impact of take estimated for the covered activities.

The following conservation plan focuses on minimizing potential impacts to Indiana bats within the FRWF to the maximum extent practicable (MEP), and mitigating for any unavoidable impacts to Indiana bats to the MEP through protection of a Priority 1 hibernaculum and summer maternity colony habitat located in the MRU (USFWS 2007). Monitoring will be implemented as part of this HCP to provide the information necessary to assess ITP compliance, Project impacts, and verify progress towards meeting the biological goals and objectives. The monitoring program will include both compliance and effectiveness monitoring for all aspects of the conservation plan. Adaptive management will be used to address uncertainties identified in the HCP including the effectiveness of proposed minimization and mitigation measures.

5.1 Biological Goals and Objectives

As described in the Five Point Policy (65 Fed. Reg. 35242-35257, June 1, 2000, an addendum to the HCP Handbook; USFWS and NMFS 1996, Page 35250), biological goals and objectives are inherent to the HCP process and as such explicit goals and objectives clarify the purpose and direction of the HCP's operating conservation program. They create parameters and benchmarks for developing conservation measures, provide the rationale behind the HCP's terms and conditions, promote an effective monitoring program, and, where appropriate, help determine the focus of an adaptive management strategy. While conservation or recovery of a listed species is not required under Section 10 of the ESA, the biological goals and objectives of this HCP are consistent with actions to promote the recovery of the Indiana bat, as identified in the 2007 Draft Recovery Plan, and will contribute toward conservation of the species. The biological goals and objectives of this HCP are as follows.

Goal 1: Maintain the integrity of Indiana bat migration through the Project area.

Objective to achieve Goal 1: Implement an operational strategy that will decrease fall bat mortality by at least 50% compared to levels documented at control turbines during

2010 and 2011 mortality monitoring, and thereby decrease mortality of all bats and Indiana bats to no more than 184 Indiana bats over the 21-year operational life of the Project.

Goal 2: Protect a vulnerable wintering population of Indiana bats in a Priority 1 hibernaculum, thereby promoting the security of a critical component of the Indiana bat population in the MRU.

Objective to achieve Goal 2: Implement a mitigation project that will remove the current gate and install a new gate at Wyandotte Cave, a Priority 1 hibernaculum.

Goal 3: Increase survival and reproductive capacity of Indiana bats on their summer range, thereby promoting population growth of Indiana bat maternity colonies in the MRU.

Objective to achieve Goal 3: Implement a mitigation project that will protect and restore 97 ha (240 ac) of summer habitat in blocks with a minimum size of 24 ha (60 ac) within the range of extant maternity colonies in the 8-digit Hydrologic Unit Code (HUC) of the FRWF, and subsequently monitor restoration success and presence/probable absence of the local maternity colony/colonies.

Goal 4: Increase understanding of the factors that contribute to increased risk to Indiana bats at wind power facilities.

Objective to achieve Goal 4: Conduct a mortality monitoring program for which the primary goal is to ensure compliance with the ITP, but that will also increase scientific understanding about impacts to Indiana bats from wind turbines. Specifically, the Project will increase understanding of the following factors:

- Timing of Indiana bat mortality within the fall migratory period;
- Effectiveness of operational adjustments, including increasing cut-in speed and operational feathering below cut-in speed;
- Variation in mortality with respect to weather characteristics (wind speed, temperature, barometric pressure, and humidity); and
- Proximity of fatalities to landscape variables (e.g. distance to water features, shelterbelts, or surrounding crop types).

Goal 5: Optimize electrical output of the Project to realize the environmental benefit of wind energy. Specifically, increased generation from wind energy facilities has the potential to offset demand for other energy generation technologies that produce carbon emissions that have been shown to contribute to global climate change, identified as a potential risk to Indiana bats (USFWS 2007).

Objective to achieve Goal 5: Implement an operational strategy at the FRWF that maximizes output of non-carbon-emitting, renewable energy that also minimizes incidental take of Indiana bats to the MEP.

Measures that will be used to meet these goals and objectives, and the criteria that will be used to evaluate their success, will be described in detail in the following sections.

5.2 Measures to Minimize Take

During the Project planning and construction stages, the Permittees implemented measures that were intended to avoid and minimize potential environmental impacts from the Project. Since these measures were included prior to operation of the Project and application for the ITP, they are considered part of the Project description, but also have long term conservation benefits by having avoided potential impacts during project development and construction (see discussion in Chapter 2).

5.2.1 Minimization through Project Design and Planning

Available data on the land use and land cover (see Chapter 3) indicate that the Project site does not contain wintering or summer habitat for Indiana bats. Based on the lack of suitable summer habitat in the Project area, and an assessment of the Project by the USFWS (S. Pruitt, pers. comm.), the Indiana bat is considered absent from the Project area during the summer (see Appendix D for the USFWS assessment). The site encompassing the four phases is more than 98% agriculture and rural development and has a very low potential for summer or winter occurrence of Indiana bat (see Chapter 3). Based on this information, and concurrence from the USFWS (S. Pruitt, pers. comm.), the Permittees concluded that Project construction and operation presented a very low risk to Indiana bats.

Following the useful life of the project facilities and infrastructure, the Permittees have the option to decommission the assets. While decommissioning actions are not likely to affect Indiana bat (see Chapter 2.1.4), decommissioning of the project minimizes long term impacts (when compared with re-commissioning or re-powering the project) by removing turbines from the site and restoring the site to the existing land use and vegetation communities.

5.2.2 Minimization through Project Operations

The Permittees will minimize potential take of Indiana bats from operations of the Project by implementing seasonal turbine operational adjustments. For the term of the ITP, the Permittees will: 1) raise the turbine cut-in speed to 5.0 m/s during fall migration at the FRWF (as discussed in Chapter 5 and documented in Appendices A and D, Indiana bat fatalities are not expected during spring migration, summer, or after October 15); and 2) adjust the turbine operational parameters so that the rotation of the turbine rotors below cut-in wind speed is minimized (the blades are “feathered”). Increasing cut-in speed and feathering of turbine blades below cut-in wind speed will be implemented on a nightly basis from sunset to sunrise, adjusted for sunset/sunrise times weekly, from August 1 to October 15 annually. Turbines will be monitored and controlled based on wind speed on an individual basis (i.e., the entire facility will not alter cut-in speed at the same time, rather operational changes will be based on wind speed conditions specific to each turbine). Turbines will begin operating under normal conditions when the 5- to 10-minute rolling average wind speed is above 5.0 m/s; turbines will be feathered again if the 5- to 10-minute rolling average wind speed goes below 5.0 m/s during the course of the night.

The sunset to sunrise timeframe is considered appropriate since the Permittees expect bat activity in the Project area would be minimal during the crepuscular periods (i.e., dawn and dusk).This assumption is based on the lack of suitable summer roosting habitat in the Project area and therefore it will take time for bats emerging from roosts prior to or after sunset to reach the Project area during traveling or foraging bouts. Similarly, bats needing to return to diurnal roosts would have to leave the Project area well before sunrise to arrive back at their roosts by sunrise or shortly thereafter. In addition to the lack of summer habitat, this assumption is further supported by acoustic data collected from July 15 to October 18, 2010, in the Project area that shows that while bat activity was recorded over the course of an evening, no bat activity was recorded within the period from a half-hour before to a half-hour after sunset[15]; no bat activity was recorded within the period from sunrise to a half-hour after sunrise; and only one bat pass was recorded in the period between sunrise and a half-hour before sunrise (as shown in Figures 5.1a and 5.1b). A full discussion of acoustic monitoring is provided in Appendix A.

The only exception to feathering turbines below a cut-in speed of 5.0 m/s would occur on nights when temperatures are below 10°C (50˚ F) from August 1 to October 15. Turbines will be allowed to operate at full capacity below these temperatures. Turbines will be monitored and controlled based on temperature on an individual basis (i.e., the entire facility will not alter cut-in speed at the same time, rather operational changes will be based on temperature conditions specific to each turbine). Turbines will begin operating under normal conditions when the 5- to 10-minute rolling average temperature drops below 10˚ C; raised cut-in speeds will be resumed if the 5- to 10-minute rolling average temperature goes to 10˚ C or above during the course of the night.

[15] Bat activity was monitored at 10 fixed sampling locations on a total of 95 nights during the fall period of July 15 through October 18, 2010. Passive sampling occurred at the base and on top of nacelles of four turbines searched daily. Detectors were set to turn on at 18:00 hours, which is at least 30 minutes before sunset on survey dates between July 15 and October 2, 2010. Detectors turned on less than 30 minutes before sunset from October 3, 2010, to the completion of the surveys on October 17, 2010. Detectors were set to turn off at 08:00 hours, which is at least 30 minutes after sunrise for all survey dates.

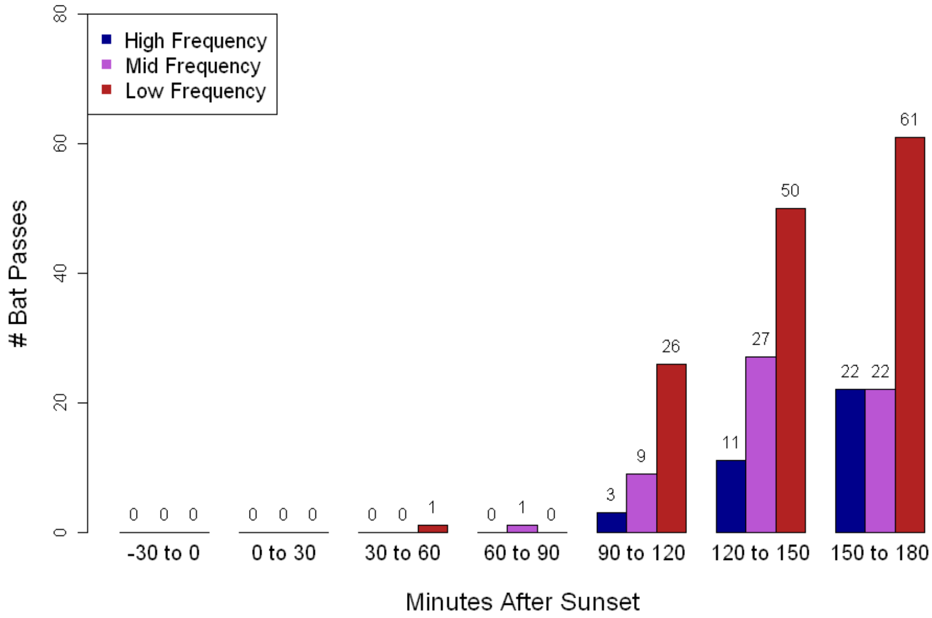

Figure 5.1a Bat passes recorded minutes after sunset at the Fowler Ridge Wind Farm from July 15 to October 17, 2010.

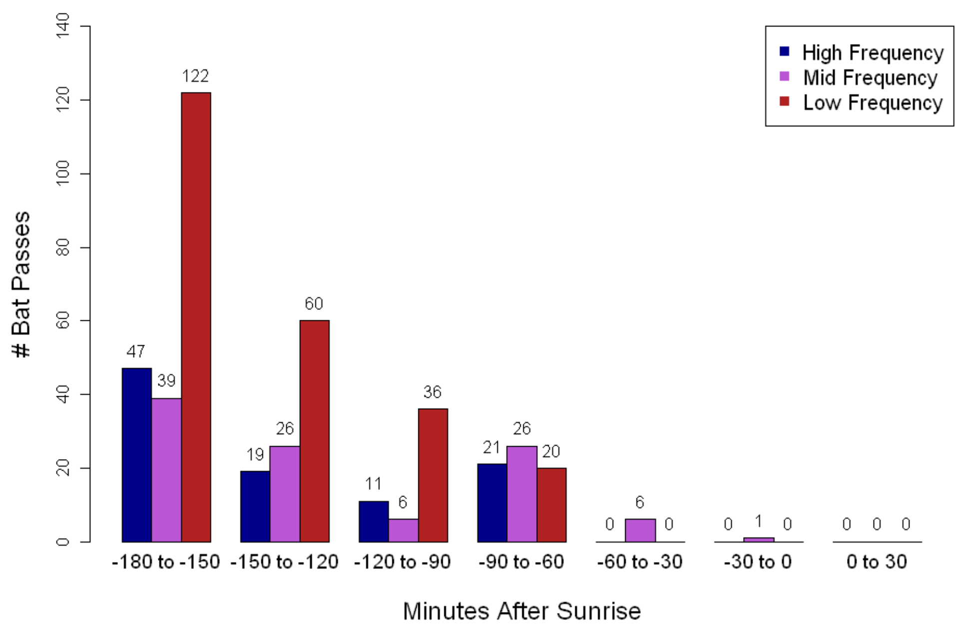

Figure 5.1b Bat passes recorded minutes after sunrise at the Fowler Ridge Wind Farm from July 15 to October 17, 2010.

The 10˚ C temperature threshold is based on results from post-construction mortality monitoring at the FRWF and nightly temperatures measured at 10-minute increments derived from turbine SCADA data between the hours of 20:00 and 08:00 from August 1 to October 15, 2010-2012. These data show that the proportion of fresh bat fatalities that occurred when average nightly temperatures were above 10 ˚C was 99.7% (285 fatalities out of 286; range in nightly temperatures in this group of fatalities was 42.8˚F to 88.9˚F [6.0˚C to 31.6˚C]) in 2010, 99.0% (307 fatalities out of 310; range in nightly temperatures in this group of fatalities was 44.4˚F to 85.6˚F [6.9 ˚C to 29.8˚C]) in 2011, and 98.2% (55 fatalities out of 56; range in nightly temperatures in this group of fatalities was 44.1˚F to 100.4˚F [6.7˚C to 38.0˚C]) in 2012. Average nightly temperatures that were below 10˚ C occurred about 4.1%, 2.7% and 9.5% of the time in 2010, 2011, and 2012, respectively.

Given the relatively small proportion of time temperatures are expected to be below 10˚ C, and the relatively large proportion of fatalities that occurred above 10˚ C during both years of study, feathering turbine blades below 5.0 m/s when temperatures are above this temperature threshold is expected to adequately minimize risk to bats and achieve at least a 50% reduction in all bat mortality from 2010/2011 levels. However, if greater than 10% of documented fatalities occur on nights when average temperature is below 10˚ C in any given year, as determined through analysis of mortality data at the conclusion of the fall monitoring period, then turbine operational adjustments (i.e., turbines feathered up to a cut-in speed of 5.0 m/s) will be resumed for the entire night during the fall, regardless of temperature, in future years. Should the Permittees be required to disable the temperature-controlled cut-in speed adjustment parameter, the turbine control software would be reconfigured remotely and rolled out to each individual turbine. Currently this task would require one to three days to implement, but user interfaces are improving which could accelerate implementation time in the future.

In addition to raising cut-in speeds to 5.0 m/s and feathering turbines below this cut-in speed, the Permittees will implement an adaptive management plan that includes raising cut-in speeds in 0.5 m/s (1.6 ft/s) increments, if needed, to assure compliance with authorized annual thresholds.

5.3 Measures to Mitigate the Impact of the Taking

As described above, the Permittees will implement operational practices that are expected to reduce mortality of Indiana bats to the MEP. However, some level of unavoidable, incidental mortality may still occur. As described in Chapter 4, the estimated level of Indiana bat mortality with minimization measures in place is expected to be less than or equal to 184 Indiana bats over the 21-year ITP term. To mitigate for the impacts of this unavoidable take, the Permittees will coordinate and provide funding for mitigation that will result in an increase to the population of Indiana bats in the MRU by at least 336 bats by Year 21 of the permit term.

The Indiana Bat Draft Recovery Plan (USFWS 2007) includes proposed recovery actions based on four broad categories: 1) population monitoring actions; 2) conservation and management of habitat (hibernacula, swarming, summer); 3) further research essential for the species' recovery;

and 4) public education and outreach. The 2007 Recovery Plan identifies Priority 1 actions that are most important and effective for recovery or reclassification of the Indiana bat. Hibernacula- and summer habitat-related recovery actions were identified as Priority 1 actions and those “that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future” (USFWS 2007; Page 172).

Therefore, the Permittees will mitigate for the unavoidable impacts of the taking of Indiana bats by coordinating, providing funding for, and monitoring the protection and restoration of both summer habitat *and* winter habitat (Appendix C). The Permittees will: 1) preserve and restore summer maternity habitat in the vicinity of existing maternity colonies in Putnam County, Tippecanoe County, Vermillion County, or Warren County, Indiana; and 2) protect winter habitat by installing a new bat gate near the entrance of a Priority 1 hibernaculum, Wyandotte Cave, in Crawford County, Indiana. All mitigation measures follow guidance outlined in the *Bloomington Field Office Draft Indiana Bat (*Myotis sodalis*) Mitigation Guidance for Wind Energy Habitat Conservation Plans* provided by the USFWS BFO (hereafter USFWS BFO Draft Mitigation Guidance; Appendix C). The actual take over the life of the permit at the FRWF is estimated at 184 Indiana bats and the estimated impact of that taking is 336 Indiana bats. Mitigation measures will be designed and implemented to compensate for this level of impact. Summer habitat mitigation is expected to compensate for 34% of the estimated impact of take (114 bats) and winter habitat mitigation is expected to compensate for 66% of the estimated impact of take (222 bats).

5.3.1 Measures for Mitigation of Summer Habitat

The Permittees will protect and restore lands within the home range (approximately 3,263 ha; 8,064 ac) of an extant Indiana bat maternity colony or colonies (USFWS 2007, USFWS BFO 2011). To determine the amount of habitat to be protected and/or restored, the Permittees followed the guidelines laid out in the USFWS BFO Draft Mitigation Guidance. The USFWS BFO evaluated 36 maternity colonies within Indiana using Indiana Gap Analysis land-cover data (Indiana State University 2006). The maternity colonies examined included those in the heavily forested areas of southern Indiana and those in the less forested landscapes of the central part of the state; there is relatively little data available for colonies in northern Indiana. To estimate the summer habitat needed to support a single Indiana bat, the USFWS BFO estimated the number of forested acres within a 3.2-km (2.0-mi) radius area centered on each maternity colony, as established by known primary roost trees. All forested classes (i.e., woodland, deciduous forest, evergreen forest, mixed forest, palustrine forest, and palustrine woodland) were included.

The average acreage of forest cover used by each of the 36 maternity colonies was approximately 1,845 ha (4,560 ac). Assuming an estimated maternity colony size of 80 Indiana bats (Whitaker and Brack 2002), this equates to approximately 23.0 ha (57 ac) of forested habitat used by each female Indiana bat (increased to 24.2 ha [60 ac] for the mitigation calculation to compensate for uncertainty in the data and analysis). The USFWS estimates that 24.2 ha of forest supports 1.55 Indiana bats per year, or a total of 39 bats over 25 years (i.e., the minimum amount of time that maternity colonies are expected to persist, according to the USFWS BFO). This is based, in part, on a demographic model currently under development by the USFWS and the USGS and is explained in the following paragraphs.

The USFWS/USGS model assumes a stable Indiana bat population over the last two decades, which is supported by biennial winter survey data over the same period. The parameters of the USFWS/USGS model assuming a stable population are as follows: adult winter survival (0.96); adult summer survival (0.95); adult propensity to breed (0.78); and adult breeding success (0.77; USFWS, unpublished data). There is generally good agreement (i.e., a relatively low amount of variability around the means) by the experts concerning these four parameters. Therefore, the USFWS BFO assumes that based on the estimates above, there is a high probability (0.55) that a female bat survives both the winter and summer and produces one pup during the breeding period. In their model, the USFWS BFO uses the simplifying and conservative assumption that maternity habitat is not shared among adult females. Data from geographic information system (GIS) analysis of known maternity colonies in Indiana suggest that each female requires approximately 24.2 ha to reproduce and the demographic model parameters (above) estimate the probability of reproduction at 0.55 (0.96 x 0.95 x 0.78 x 0.77 = 0.55).

Indiana bats exhibit strong fidelity to maternity colony sites. Although there was virtually nothing known about the reproductive ecology of Indiana bats before the 1970s, it is now known that maternity colonies can inhabit the same area for more than 20 years when the habitat remains suitable (L. Pruitt, pers. comm.). Therefore, the USFWS BFO 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. As such, the USFWS BFO assumes each 24.2-ha block of summer habitat would result in 0.55 pup per year for 25 years. In addition, the 24.2 ha of summer habitat also supports the adult female during the reproductive period. Therefore, while not strictly adding additional bats to the population, the mitigation provides habitat for one adult female every year and increases the carrying capacity of that colony every year. Thus, 0.55 pup per year x 25 years equates to 14 pups born over the 25 years, plus one adult female occupying the 24.2 ha each of the 25 years, for a total of 39 bats for each 24.2-ha block of maternity colony habitat protected and restored. According to this formula, 73 ha (114/39 = 2.9, rounded up to 3, multiplied by 24.2 ha = 72.6 ha) of summer habitat need to be protected and restored to compensate for the take of 114 bats. However, the Permittees will protect and restore an additional 24.2 ha of summer habitat to provide additional conservation benefits to Indiana bats. Therefore, a total of 97 ha of summer habitat will be protected and restored.

As previously stated, lands targeted for protection and restoration will be within the home range of an extant Indiana bat maternity colony. In addition, summer mitigation efforts will occur within Indiana counties with 30% or less forested habitat as determined by the National Landcover Dataset 2006 (Fry et al. 2011) and within the local 8-digit HUC (05120108) that is roughly equivalent to the local watershed of the FRWF. Publically-owned lands will not be eligible for summer habitat mitigation for a number of reasons. In Indiana, most maternity colonies are on private land and therefore private land has the most opportunity for mitigation. In addition, there is generally less threat to existing summer habitat when land is publicly owned and therefore more conservation benefit is derived from mitigating on private land. Last, publicly owned lands are often already suitable habitat (forest) and there is less opportunity for restoration. Under specific circumstances which would have to include an opportunity for acceptable mitigation (e.g., the publicly owned land harbors an existing maternity colony and the land is not being managed for Indiana bats) public land can be recommended for summer habitat mitigation.

The USFWS has provided guidance on criteria for summer habitat mitigation (Appendix C). Based on these conditions, summer mitigation efforts will focus on 24.2-ha or larger habitat blocks associated with extant maternity colonies in Putnam County, Tippecanoe County, Vermillion County, or Warren County. Protected lands will have a minimum size of 24.2 ha, except in the following case. Less than 24.2-ha parcels can count towards the total mitigation requirement of 97 ha if they are functionally connected to an area of existing suitable Indiana bat habitat, and together the parcels total at least 24.2 ha. The USFWS will have final approval as to whether or not the land parcel selected for mitigation is part of a functional 24.2-ha unit.

Female Indiana bats typically form summer maternity colonies under the exfoliating bark of large-diameter snags and live trees (greater than 39 cm [15 in] DBH; Britzke et al. 2003, USFWS 2007, Carter 2006, Timpone et al. 2010). Indiana bat maternity roosts have been documented in a variety of habitats, including upland forest, bottomland forest, riparian forest, and woody wetlands. However, the general consensus among researchers is that riparian and bottomland forests are the preferred roosting habitats for this species (Menzel et al. 2005, USFWS 2007, Carter 2006, Timpone et al. 2010). Carter (2006) showed that most large and persistent maternity colonies are found in hydric habitats, such as riparian forest, floodplains, bottomlands, and woody wetlands. Several studies have documented that Indiana bats forage in riparian and upland forest and rely to some extent upon riparian corridors or wooded corridors to move between roosts and foraging areas (LaVal et al. 1977, Murray and Kurta 2004, Menzel et al. 2005, Sparks et al. 2005). Efforts to protect summer habitat will focus on lands with: 1) relatively low forest cover (less than 30%), 2) relatively large forest blocks (more than 8.1 ha [20.0 ac]), and 3) known roosting habitat. Within these focal areas, restoration efforts will focus on enlarging existing habitat patches and restoring riparian and non-riparian travel corridors between habitat patches. Components of summer habitat mitigation are based on guidance provided in the USFWS BFO Mitigation Guidance (Appendix C).

The quality of habitat patches proposed for summer mitigation will be evaluated by the USFWS BFO based on several key factors, including level of existing threat to the habitat, potential for habitat restoration, percent forest cover, size of forest blocks protected, potential to decrease forest fragmentation, and availability of known roosting habitat. Habitat patches must exceed a minimum quality threshold to be considered as viable mitigation options. High-value habitat patches will be afforded a full mitigation credit (i.e., 24.2 ha = 39 bats), whereas lower quality habitat patches will receive only partial mitigation credit (e.g., 26-28 ha [65-70 ac] = 39 bats; see Appendix C for criteria that defines high and lower value habitat).

5.3.1.1 Mitigation Bank Option

There are multiple wind power projects currently being proposed within the Indiana bat range and there are efforts underway to establish an Indiana bat mitigation bank to offset Indiana bat take from these projects. A mitigation bank would generally consist of blocks of habitat that are beneficial to Indiana bats and suitable for offsetting the impacts of take. A mitigation bank could provide a more effective mitigation strategy than the individual mitigation effort planned for the FRWF, since resources from multiple sources could be combined to create a more substantial benefit to Indiana bats in the MRU.

As an alternative to performing mitigation on 97 ha that are selected by the Permittees and approved by the USFWS BFO as described above, the Permittees have the option to utilize any mitigation bank that has been set up and approved by the USFWS for mitigation of Indiana bats in the MRU that includes lands within Indiana. The Permittees may have the option to contribute to the mitigation bank at a level sufficient to offset the impacts of taking 114 Indiana bats. A mitigation bank would only be considered if all of the following conditions are true: 1) the mitigation bank is established prior to when summer habitat mitigation is needed; 2) use of the mitigation bank has been approved by USFWS; 3) the mitigation bank includes lands within Indiana, unless otherwise approved by the USFWS; and 4) the mitigation bank has established a ratio of Indiana bat habitat required to offset the impact of 114 Indiana bats, and such ratio is approved by the USFWS BFO. If the mitigation bank has not established such a relationship, the Permittees and the USFWS may agree upon a number of acres within the mitigation bank that could be used to offset the take of 114 Indiana bats.

5.3.2 Measures for Mitigation of Winter Habitat

The 2007 Recovery Plan cites disturbance during hibernation as a major impact to Indiana bat populations and a leading cause of decline in the species (USFWS 2007). Protection of hibernacula was further emphasized as being a priority recovery action in the USFWS (2009; Page 23) 5-Year Review of the Indiana bat: “It is...apparent from this Review that additional attention should be placed on securing permanent/long-term protection of both Priority 1 and Priority 2 hibernacula. Several Priority 1 hibernacula would satisfy Reclassification Criterion 1 if their cave/mine entrances were gated or if appropriate buffer zones were delineated and protected.” Consistent with USFWS recovery objectives for the Indiana bat, a new bat-friendly gate will be constructed at the entrance of Wyandotte Cave, a Priority 1 hibernaculum in Crawford County, Indiana. Wyandotte Cave is one of the largest known Indiana bat hibernaculum, with an estimated population of 61,618 bats in 2011 (L. Pruitt, pers. comm.).

The bat-friendly angle-iron gate will be constructed in a non-restricted portion of Wyandotte Cave as near to the entrance as possible. Cave gates have evolved a great deal over the past few decades (Powers 1985, 1993; Currie 2002). Early flat-bar or round-bar designs restricted airflow into and out of the cave, a critical factor controlling cave microclimate. These designs could also be breeched fairly easily with simple tools (Currie 2002). Angle-iron designs were a significant improvement as they were stronger and did not restrict airflow at cave entrances (Powers 1993; Currie 2002). Gates too close to cave entrances attract attention and can also increase bat predation. Predators such a raccoons, feral cats, and snakes are able to prey upon bats concentrated or slowed down by gates. Gates placed in cave restrictions (i.e. cave sections with the smallest cross-sectional area) tend to impede the ability of bats to fly through the gate and may lead to bats abandoning the roost or enhanced predation (Powers 1985, 1993, 1996). Standard cave gates now use the angle-iron design so as not to impede the flow of air and have maximized the space between bars so as not to impede the movement of bats (Pugh and Altringham 2005). Also, cave gates are typically constructed within the cave and avoid cave restrictions in order to minimize impacts to the bats the gates are intended to protect.

The portion of the cave outside of where the current gate sits has a thermal profile that is suitable for hibernating Indiana bats (although temperatures are probably more variable than those further inside the cave) and has been used by several thousand Indiana bats over the last decade (S. Pruitt, pers. comm.). The purpose of moving the gate closer to the cave entrance is to protect Indiana bats that are currently and have consistently over the past several years hibernated between the current gate and the location of the proposed gate from human disturbance or vandalism. Human disturbance causes increased frequency of arousal in hibernating Indiana bats which in turn causes premature depletion of energy reserves during the winter. When this occurs bats will emerge from hibernation with fewer energetic resources for migration and reproduction and will likely have reduced survivorship and/or reproductive success. Human disturbance can also have more extreme effects. Excessive disturbance in the form of noise, human traffic, or fire can cause bats to abandon roosting areas or hibernacula, whereas a single instance of vandalism can lead to the death of tens to hundreds of Indiana bats.

Installation of the new gate will occur between May 15 and July 31, 2013. Hibernating or swarming Indiana bats will not be present at the hibernaculum during this time of year; therefore, potential disturbance-related impacts to Indiana bats will be minimized and limited to male Indiana bats using the cave during the summer. The gate will be approximately 2.4 X 9.1 m (7.9 X 30 ft) wide and be made out of steel. The construction period is expected to last two to three weeks. Cave gating will be planned and coordinated by Bat Conservation International (BCI), with general oversight and project management performed by BCI in cooperation with O'Bannon Woods State Park (OWSP) and the IDNR. Road access to the Wyandotte Cave will facilitate transport of gate-building materials and construction workers to the cave entrance. The area near the cave entrance will be used as a staging area for construction of the gate. Construction activities may cause short-term surface disturbance to the staging area and cave entrance. In winter 2011, WNS was confirmed on bats hibernating in Wyandotte Cave (L. Pruitt, pers. comm.). To prevent the spread of *Geomyces destructans,* the current USFWS decontamination protocol will be followed during gate construction (USFWS 2012f).

The IDNR, in cooperation with the USFWS, has installed and maintained speloggers and dataloggers in Wyandotte Cave for over 20 years as part of Indiana bat recovery efforts. Those efforts will continue for the extent of the ITP and beyond and that data will be available to the Permittees. However, if the IDNR or the USFWS cannot continue those monitoring efforts, the Permittees will receive authorization and be required to provide funding and personnel to complete that monitoring effort.

The objective of re-gating Wyandotte Cave is to protect the vulnerable population of bats that hibernate between the existing gate and the location of the proposed gate. Bats hibernating in this portion of the cave are considered to be under imminent threat from human visitation, disturbance, and vandalism because the cave entrance is well-known and very easy to access (S. Pruitt, pers. comm.). Any threat to Wyandotte Cave could have an impact on the species, because Wyandotte Cave represents a significant population of hibernating Indiana bats (61,618 bats in 2011; L. Pruitt, pers. comm.), which equates to about 15% of the total rangewide population in 2011 (424,708 bats; L. Pruitt, pers. comm.). While re-gating is not necessarily intended to increase population size of Indiana bats within the cave, it is expected to greatly reduce the potential for direct take and decreased survivorship and reproductive success associated with human vandalism and disturbance.

There is currently no standard approach for measuring how much Indiana bat take is mitigated for with the installation of a gate. Speloggers and monitoring of human trash and other evidence of human visitation can be used to determine the amount of human visitation (Johnson et al. 1998) that might have been prevented by installation of a gate, but it is difficult to understand and quantify the impact of potential unauthorized visits. Even minimal disturbance can cause arousal of hibernating bats which can deplete fat reserves and reduce overwinter survival (Thomas 1995). Additionally, human visitation to a cave can result in injury and death of bats if hibernaculum visitors were to act maliciously (USFWS 1983, 2007; Barbour and Davis 1969). For example, there are documented cases of vandals setting roosting bats on fire. In extreme cases, these types of disturbances could result in mortality of large numbers of bats and lowered survival for bats not killed directly. Therefore, it is reasonable to conclude that human visitation to Indiana bat hibernacula negatively impacts some number of vulnerable (those potentially affected by the visit) Indiana bats.

In cases where a large vulnerable population of Indiana bats is under imminent threat of human disturbance at a hibernaculum, the USFWS will accept gating as mitigation for the impact of taking. Conversely, if there is not a large, vulnerable population, or if threat is not of sufficient urgency, gating will not be a viable mitigation strategy. In the case where a large vulnerable population is under imminent threat, the USFWS BFO Draft Mitigation Guidance assumes a gating project would avert a marginal baseline impact, equating to a loss of 1% of that vulnerable population. Increased survival of 1% is a benefit that the USFWS BFO assumes has a high probability of accruing over the life of the cave gating project, provided the necessary baseline conditions for a cave gating project (vulnerable population and imminent threat) are in place. If the vulnerable population of hibernating bats is more likely to be impacted because of the presence of the following specified conditions, the USFWS BFO will assign additional marginal credit as specified in the USFWS BFO Draft Mitigation Guidance and below:

1) Physical accessibility of cave entrance(s) to humans - technical/vertical caving gear not required = +0.5% of vulnerable bats;
2) Average ceiling height of 90% of the vulnerable hibernating bats is less than 3 m (10 ft) = +0.5% of vulnerable bats; and
3) The majority of vulnerable bats occur in one or a few discrete roosting areas that are in close proximity of one another (i.e., they have a highly clumped distribution) = +0.5% of vulnerable bats.

Although significantly more bats could achieve increased survival over the life of a cave gating project than the percentages estimated by the USFWS BFO[16], it is not possible to monitor, or in any other way determine, how many bats would have increased survival. Because of this, the mitigation credit for this action is valued at the low end of the continuum of its potential benefit to the Indiana bat (i.e., a maximum of 2.5% of the vulnerable population). Of the above conditions for mitigation credit identified by the USFWS BFO, the first and third conditions are applicable to the Wyandotte Cave gating project; the cave entrance is physically accessible to humans, and the bats in the cave entrance have a highly clumped distribution. Therefore, based on the mitigation valuation system developed by the USFWS BFO, the Wyandotte Cave gating project is expected to equate to a mitigation credit equal to 2% of the vulnerable population. Based on the most recent winter census (2010-2011), the number of bats vulnerable to human disturbance, which are those that roost on the entrance side of the current cave gate, was estimated at 11,076 bats (L. Pruitt pers. comm.). Therefore, the Wyandotte Cave gating project will compensate for 222 bats, or 2% of the total number of vulnerable bats prior to gating (2010-2011; Appendix C).

5.4 Monitoring and Adaptive Management

The monitoring program that will be implemented as part of this HCP will provide the information necessary to assess ITP compliance, Project impacts, and verify progress towards meeting the biological goals and objectives identified in Chapter 5.1. There are two components to the monitoring program: 1) take limit compliance monitoring, and 2) mitigation effectiveness monitoring. The goal of take limit compliance monitoring is to ensure compliance with the terms of the ITP, while the goal of mitigation effectiveness monitoring is to ensure the success of mitigation efforts at offsetting the impacts of unavoidable take of Indiana bats from the FRWF. Based on information derived from monitoring, adaptive management will be used to make modifications to the proposed minimization and mitigation measures, if the measures have been ineffective at meeting the authorized annual take levels as well as biological goals and objectives of the HCP.

[16] In a worst case scenario, 11,000 bats would be removed from the population were the new gate not installed. This protection will accrue indefinitely (as long as the gate functions).

Adaptive management is broadly defined as a method for examining alternative strategies for meeting biological goals and objectives. From these alternatives, the management strategy that best meets the biological goals and objectives of the HCP is selected, or if necessary, future management actions are adjusted according to what is learned from monitoring studies. Specifically, for projects that may pose a risk to a species, but at the time the ITP is issued there are significant data/information gaps that make identification of the impacts uncertain, an adaptive management strategy should be applied to address those uncertainties.

5.4.1 Take Limit Compliance Monitoring

The purpose of take limit compliance monitoring is to ensure that incidental Indiana bat take does not exceed the take limit permitted by the ITP. Take compliance monitoring will provide the information necessary to calculate incidental take of Indiana bats, based on the assumptions described in Chapter 4. The take limit compliance monitoring will provide the basis for adaptive management decisions related to turbine operational changes, the primary minimization measure implemented as part of this HCP.

5.4.1.1 Monitoring Phases and Schedule

Take compliance monitoring for the HCP will be conducted in three phases: the Evaluation Phase, Implementation Phase, and Re-Evaluation Phase. Because risk to Indiana bats and the effectiveness of minimization measures are uncertain, monitoring will be most intensive during the first two years of Project operation, during the Evaluation Phase. Two years of intensive monitoring will be conducted that will add to the four years of research monitoring that was conducted during 2010, 2011, 2012, and 2013.

Similar to the 2010 and 2011 monitoring, the 2012 and 2013 monitoring efforts, developed in coordination with and approved by the USFWS, was also conducted under a 10(a)(1)(A) research permit (Permit # TE73598A-0). In 2012, the majority of the facility (346 out of 355 turbines) was operating with the same operational and monitoring protocols that would have been implemented if the HCP were in place; turbines were feathered under a cut-in speed of 5.0 m/s and fatality monitoring conducted at 118 turbines followed the methods for Evaluation Phase monitoring described in this chapter. In 2013, 352 out of 355 turbines operated with the same operational and monitoring protocols that would have been implemented if the HCP were in place. Additional research was conducted in 2012 and 2013 at the FRWF at the other nine and three turbines respectively, to test if facilities operation management strategies were effective at reducing *Myotis sodalis* and other bat fatalities at wind farms[17].

During the first two fall migration periods following issuance of the ITP, Evaluation Phase mortality monitoring will be conducted. It is expected that the Evaluation Phase, along with the

[17] This was accomplished by determining the best combination of methods for detecting and observing bat interactions with operating wind turbines; assessing whether or not bats are attracted to operating wind turbines and whether blade rotation influences activity; and understanding the environmental conditions under which fatalities are most likely to occur and discover the underlying cause(s) of fatalities, with the ultimate goal of minimizing or eliminating bat fatalities at turbines.

five years of mortality monitoring conducted from 2009-2013, will provide sufficient information to accurately assess the level of risk to Indiana bats by confirming the effectiveness of the operational curtailment.

After completion of two years of Evaluation Phase mortality monitoring, provided the results confirm at least the estimated 50% reduction in mortality calculated from the fall 2010 and 2011 data, the Permittees will implement less intensive Implementation Phase monitoring every year for the rest of the permit duration. A stepped-down approach to monitoring will be adopted during the Implementation Phase that will be sufficient to continue monitoring bat mortality and to detect year-to-year changes in bat mortality that may occur. The Implementation Phase will remain in effect for the remainder of the operational life of the Project, unless less than 50% reduction in all bat mortality (indicating less than a 50% reduction in Indiana bat mortality, which equates to the adaptive management threshold) from 2010 and 2011 levels is observed. If this occurs, operational changes in accordance with the adaptive management framework described below in Chapter 5.4.2 would be made, and two years of Re-Evaluation Phase monitoring will be conducted following the operational change to confirm the altered operational changes' effectiveness at reducing bat mortality by at least 50% from 2010 and 2011 levels. Methods and sampling intensity during the Re-Evaluation Phase will be the same as those used during the Evaluation Phase.

5.4.1.2 Sample Size and Search Interval

There are two main objectives of take limit compliance monitoring:

1) To conduct monitoring that provides an accurate estimate of all bat mortality that can be used to reliably determine the annual take of Indiana bats and confirm take does not exceed the permitted level ; and
2) To detect changing trends in bat mortality over time.

Factors that are important in meeting the first objective are: 1) searching a sufficient number of turbines to be able to collect enough carcasses to provide statistical power for comparison with 2010-2011 results, 2) having sufficient spatial coverage to ensure that potential differences in mortality rates among turbines are captured and results are representative of facility-wide mortality, and 3) having adequate searcher efficiency. The first two factors, statistical power and adequate spatial coverage, are important in determining the number of turbines to be searched.

Statistical power for detecting differences in overall mortality is dependent on the number of fatalities found during monitoring, and is therefore dependent on the number of turbines searched. A power analysis was conducted based on a monitoring plan that includes searches at 33% of turbines during Evaluation Phase monitoring, and 20% of turbines during Implementation Phase monitoring, to see if there is sufficient statistical power to be able to detect a 50% reduction in bat mortality (Table 5.1).

Table 5.1 Power of chi-squared test of proportions between the baseline observed fatality rate at roads and pads (2.08 bats/turbine) and hypothetical observed fatality rate, given percent decreases of 10% to 70% for search sample sizes of 118, 90, 75, and 20 turbines.

Percent Decrease in Observed Fatality Rate	Hypothetical Observed Fatality Rate	Power Given Number of Turbines Searched			
		118	90	75	20
10%	1.87	0.29	0.27	0.25	0.16
20%	1.66	0.73	0.67	0.63	0.33
30%	1.46	0.97	0.94	0.92	0.57
40%	1.25	>0.99	>0.99	0.99	0.79
50%	***1.04***	***>0.99***	***>0.99***	***>0.99***	***0.92***
60%	0.83	>0.99	>0.99	>0.99	0.98
70%	0.62	>0.99	>0.99	>0.99	>0.99

As shown in Table 5.1, searching 33% of turbines during Evaluation Phase monitoring (118 turbines out of 355) results in a statistical power of greater than 0.99. In other words, if 33% of turbines were searched, there is a 99% chance of detecting a 50% decrease in the observed fatality rate from the 2010 road and pad observed fatality rate, if it occurred. Power to detect a significant difference in observed fatality rates, given decreases in mortality greater than 40%, is 0.79 or larger, when 20 or more turbines are searched (Table 5.1). Searching 20 or more turbines would result in power of 0.92 or greater to detect the target 50% decrease in bat mortality.

Although searching 20 turbines in all phases of the project would result in sufficient statistical power, to achieve the goal of having sufficient spatial coverage to capture potential differences in mortality among turbines, the number of turbines searched will be increased to 33% of turbines (i.e., 118 turbines) for Evaluation Phase monitoring and approximately 20% of turbines during Implementation Phase monitoring (i.e., 75, 90, and 20 turbines during the 355-, 449-, and 94-turbine phases, respectively). This proposed sampling intensity will result in both sufficient power to detect differences in mortality and adequate spatial coverage to minimize the potential for biases due to search location. Table 5.2 summarizes the differences in sampling intensity for each phase of monitoring.

Table 5.2 Permit year and sample size for each phase of monitoring at the Fowler Ridge Wind Farm, conducted annually from August 1 to October 15.

Monitoring Phase	Permit Year	Number of Turbines Searched		
		Phase I, II, III (355 turbines)	Phase I, II, III, IV (449 turbines)	Phase IV (94 turbines)
Evaluation Phase	Years 1	118	N/A	N/A
Evaluation Phase	Year 2	NA	150	NA
Implementation Phase	Years 3-21, with the exception of 2 years following any operational change	75	90	20
Re-Evaluation Phase	2 Years following any operational change	118	150	31

Turbines selected for searches will be based on a systematic grid with a random start and stratified by turbine type to ensure sampling locations are representative of the entire FRWF.

Turbines searched will be randomly selected each year to minimize potential bias due to sampling. Search turbines will be distributed among turbine types in proportion to the turbines' relative occurrence in the Project area.

The search interval for each year of monitoring will be based on the average carcass removal rate[18] determined during the previous year's monitoring effort. This ensures that if the carcass removal rate changes during the term of the ITP from, for example, due to an increase in scavengers at the site, this will be factored in to the survey protocols as follows:

- Weekly (i.e., each turbine will be searched once per week), if mean carcass removal is more than seven days;
- Semiweekly (i.e., each turbine will be searched twice per week), if mean carcass removal is more than three days and less than seven days; or
- Daily (i.e., each turbine will be searched once per day), if carcass removal is less than three days.

During the first year of mortality monitoring for the HCP, a weekly search interval will be used, based on mean carcass removal times of 9.93, 10.34, and 13.02 days observed during monitoring at the FRWF in 2009, 2010, and 2011, respectively (Appendix A). Searches on any given monitoring day will begin after 7:00 AM each morning, and will be completed by sunset. Most searches will be completed by mid-afternoon on any given search day.

To achieve the second objective of being able to detect changing trends in bat mortality over time, it is important to conduct monitoring frequently enough to detect these potential changes. This will be achieved by conducting monitoring annually throughout the life of the Project. During all phases of monitoring, searches will be conducted from August 1 to October 15, which encompasses the fall migration period for Indiana bats, as outlined in the Draft Indiana Bat Recovery Plan (USFWS 2007) and the USFWS' *Indiana Bat Section 7 and Section 10 Guidance for Wind Energy Projects* (USFWS 2011d), the period of highest bat mortality at the FRWF during 2009 to 2011, and the period in which both Indiana bat fatalities occurred at the FRWF (see Chapter 4.1.1.2 and Appendix A).

5.4.1.3 Search Area

To achieve the third objective of having adequate searcher efficiency to develop reliable estimates of bat mortality, only roads and pads will be searched during monitoring. The Permittees, in coordination with the USFWS, conducted studies during 2010 and 2011 specifically to determine the relationship between the numbers of bats found on roads and pads versus those found in cleared plots. Searcher efficiency estimates at the level of effort employed are significantly higher on the roads and pads (about 85%) compared to cleared plots containing

[18] The carcass removal rate is the length of time a carcass remains in the field before it is removed by a scavenger. For example, an average carcass removal rate of seven days means a carcass remains in the study area and is available to be detected for an average of seven days before it will be scavenged.

areas away from roads and pads (about 32%; Appendix A). Higher search detection will result in more precise estimates of mortality. The Permittees believe that road and pad searches are the only practical way to search this facility.

See Chapter 5.4.1.5 for explanation of methods used to adjust for fatalities that fall outside of searched road and pad areas.

5.4.1.4 Data Collection

Independent observers trained in proper search techniques will conduct the carcass searches. All bat and bird carcasses will be recorded, although casualty rates will only be calculated for bats[19]. Searches will occur within all roads and pads located within 80 m of turbines selected for the study. Observers will walk at a rate of approximately 45 to 60 m per minute (about 148 to 197 ft per minute) scanning the ground out to 2 to 3 m (7 to 10 ft) on either side of the transect for casualties. Transects will be spaced at a maximum of 5-m intervals, allowing for some visual overlap of search area between transects to help maximize carcass detection.

The condition of each casualty found will be recorded using the following categories:

- Live/Injured – a live or injured bat or bird.
- Intact - a carcass that is completely intact, is not badly decomposed, and shows no sign of being fed upon by a predator or scavenger.
- Scavenged - an entire carcass, which shows signs of being fed upon by a predator or scavenger, or a portion(s) of a carcass in one location (e.g., wings, skeletal remains, portion of a carcass, etc.), or a carcass that has been heavily infested by insects.
- Feather Spot (for bird carcasses only) - 10 or more feathers at one location indicating predation or scavenging.

Fresh bat carcasses found, except for *Myotis* species, will be collected, identified, and utilized during searcher efficiency and carcass removal trials (see below for more details). Bats not used for searcher efficiency and carcass removal trials may be provided to researchers if permissible within the conditions of the state salvage permit. Tissue and hair samples will be collected from all dead bats throughout the life of the Project. Older or scavenged bat carcasses, except those already positively identified as non-*Myotis*, will be identified, labeled with a unique number, and then bagged and frozen for future reference and species identification testing (e.g. deoxyribonucleic acid [DNA] analysis). A copy of the data sheet for each casualty will be maintained, bagged with the carcass, and kept with the carcass at all times. For all casualties found, data recorded will include species, sex and age determination

[19] Given the very low numbers of bird fatalities documented during mortality monitoring at the FRWF (Appendix A), and the likelihood for low bird fatality rates in the future, it is not possible to develop a road/pad correction factor specifically for birds that could be used to derive an adjusted bird fatality estimate. However, since bird carcasses will be collected, it will be possible to monitor for changes in patterns of bird mortality or to document large fatality events, if they were to occur.

(when possible), turbine identification number, date and time collected, global positioning system (GPS) location, condition (live, injured, intact, scavenged, feather spot), and distance from turbine, as well as any comments that may indicate cause of death for fatalities. For casualties where the cause of death is not apparent, the assumption that the casualty is due to wind turbine collision will be made for the analysis. All casualties located will be photographed as found and plotted on a detailed map of the Project area showing the location of the wind turbines and associated facilities.

All *Myotis* carcasses will be identified within seven days of collection by biologists trained in the identification of *Myotis* species, including Indiana bat, and approved by the USFWS. In order to verify field identifications, skin samples from carcasses too decomposed for positive identification will be sent to J. Zink at the Portland State University or other suitable laboratories for identification via DNA analysis. All *Myotis* carcasses will be delivered to the USFWS within seven days of collection, for concurrence on species identification.

Casualties found outside the formal search area by observers or by FRWF personnel will be treated following the above protocol as closely as possible. Casualties found in non-search areas (e.g., near a turbine not included in the sample of search turbines) will be coded as incidental discoveries and will be documented in a similar fashion as those found during standard searches.

In addition to carcasses found, all injured bats and birds observed will be recorded and treated as a casualty. Injured animals found during carcass searches will be captured and transported to the nearest wildlife rehabilitation center, or arrangements will be made for a wildlife rehabilitator to pick up the injured animal from the site, where possible. Appropriate wildlife salvage permits will be obtained from the IDNR. Dissemination of data (e.g., to the USFWS Special Agent and/or other agency representatives) will be as needed or according to permit conditions.

5.4.1.5 Bias Correction

The efficiency rates of observers and removal rates of carcasses by scavengers will be quantified to adjust the estimate of total bat fatalities for detection bias. Bias trials will be conducted throughout the entire monitoring period each year. The study reports included in Appendix A provide details of the field bias trial protocols. In summary, only freshly killed bats conclusively identified as non-*Myotis* bat species will be used for carcass removal trials and searcher efficiency trials. The field crew leader will gather all bat carcasses and redistribute bat carcasses that are intact at the predetermined random points within any given turbine's searchable area prior to that day's searches. Data recorded for each trial carcass prior to placement will include date of placement, species, turbine number, and the distance to and the direction from the turbine. Small, black zip ties will be placed on the wing or legs of each bat to distinguish it from other fatalities landing nearby or if scavengers move the trial bat away from its original random location. For the scavenger removal trial, each trial bat will be left in place and checked by the field crew leader or an observer not involved with carcass searches for up to 24 days, or until the carcass is removed by scavengers. Trial bats will be checked on days one, two, four, six, eight, 10, 12, 18, and 24.

Trial bats will also be used for estimating searcher efficiency bias. Observers conducting carcass searches will not know when or where the bat carcasses will be placed for bias trials. Carcasses placed by the field crew leader will be available and may potentially be found multiple times unless the carcasses are previously removed by a scavenger. The day that each bat was found by an observer will be recorded to determine the amount of time the carcass remained in the scavenger removal trial. When a bat carcass is found, the observer will inspect the carcass to determine if a bias trial carcass had been found. If so, the observer will contact the field crew leader and the bat will be left in place for the carcass removal trial as described above.

To adjust for fatalities that fall outside of searched road and pad areas, a correction factor will be used that is based on the double sampling approach used in 2010 and 2011. During each study, fatality estimates were adjusted for carcasses not detected due to scavenger removal and lack of detection by searchers, as described above. To adjust fatality estimates at plots where only the road and pad was searched, the locations of casualties found at control plots that were cleared of vegetation were marked as being on or off roads and pads, and the ratio of bat fatalities within cleared plots to the number of bats falling at road and pads of the same plot was determined. However, an adjustment was needed to account for the difference in ease of locating carcasses in road/pad areas compared with the rest of the cleared plot (i.e., it is easier for searchers, and potentially scavengers, to spot carcasses on roads and pads). An adjusted fatality estimate was calculated for the road/pad area only using searcher efficiency and carcass removal times for the road and pad portion of the fully cleared plots. This road/pad fatality estimate was then compared to the fatality estimate for the entire cleared plot to develop a road and pad correction factor.

Separate correction factors were developed in 2010 and 2011. In 2010, estimates of overall bat fatality were based on data collected from two independent sets of turbines: 100 turbines searched weekly at roads and pads only, and 36 turbines searched daily at 80 x 80-m cleared plots. Two estimates were generated, one based on data collected during carcass searches at the 100 road and pad turbines, and a second estimate based on data collected during carcass searches at the 36 cleared plot turbines. The fatality estimates generated from these two independent estimation methods, one using roads and pads and one based on cleared plots, yielded very similar estimates of overall bat fatalities with significantly overlapping confidence intervals. The estimates were 24.17 bats/turbine (90% CI 19.50 – 30.02) for the cleared plots and 20.96 bats/turbine (90% CI 17.52 – 28.78) for road and pad searches. More details regarding the calculation of the estimates can be found in Table 17 of the 2010 report (Appendix A). The 2010 study also confirmed that carcass distribution was not random in regard to distance from turbine within the cleared study plot and that there is no strong evidence of unequal sampling based on orientation of roads (Appendix E). Thus, the results of the 2010

FRWF study support the use of road and pad searches for generating unbiased overall bat fatality estimates that are comparable to estimates for the entire 80 x 80-m cleared plot.

The 2011 study resulted in a similar road/pad correction factor (7.54) as the 2010 study (6.17), with an average road and pad correction factor of 6.56 for the two years (Table 5.3). Applying this correction factor to fatality estimates developed from road/pad searches in the future provides the best opportunity for developing accurate fatality estimates because searcher efficiency estimates are significantly higher on roads/pads than in cleared plots in areas outside of roads and pads (85% vs. 32%; Appendix A). This method also allows for a more randomized and representative sample of search locations, maximizes efficiency, and provides more spatial coverage by searching a much larger sample of individual turbines than could be accomplished with cleared plot searches.

The 2011 study cannot be used to further support the comparability of fatality estimates derived from road/pad searches with those developed from full cleared plot data because cut-in speed treatments were rotated nightly in 2011, rather than weekly as was done in 2010. If fatality estimates were developed for turbines where only roads/pads were searched, only fresh fatalities that were estimated to have died the night preceding the search could have been used, which would have resulted in a fatality estimate biased low. Therefore, fatality estimates at control plots where only road/pad searches were conducted were not calculated in 2011 and cannot be compared to estimated fatality at turbines where the entire plot was searched.

5.4.1.6 Statistical Methods for Bat Mortality Estimation

Statistical methods for estimating all bat mortality will be the same for all phases of monitoring. Estimates of facility-related bat mortality will be calculated based on:

1) Observed number of bat carcasses found during standardized searches during the monitoring period;
2) Non-removal rates, expressed as the estimated average probability a bat carcass is expected to remain in search areas and be available for detection by the observers during removal trials; and
3) The area adjustment factor for bat carcasses landing outside of searched roads and pads.

Upon completion of each monitoring year, data will be analyzed using the same statistical methods for calculating overall bat mortality (casualty rate) employed during the 2010 and 2011 FRWF studies, namely the empirical measure of carcass availability. This empirical estimate is based on the overall ratio of trial carcasses found by searchers to the number placed and does not separate out the influence of scavenging versus searcher detection (for full methodology see Appendix A).

5.4.1.7 Disposition of Data and Reporting

The Permittees will prepare data sheets and report templates for monitoring that will be reviewed and approved by the USFWS prior to initiation of the first year of monitoring. During active monitoring, raw data forms will be stored on site and at the offices of the independent monitoring contractor. Individual carcasses collected will be housed in a freezer located at the FRWF O&M facility. Raw data forms will be made available to the USFWS upon request. The following information will be maintained for each fatality in a database that will be provided to the USFWS annually or upon request: date and time of collection, species, Universal Transverse Mercator (UTM) coordinates, closest turbine number, and, if available, temperature and wind speed for the night preceding *a Myotis* fatality.

Table 5.3 Correction factors for bats that likely fell outside of searched roads and pads in 2010 and 2011 at the Fowler Ridge Wind Farm.

	Study Year (Plot Size)								
	2010 (80 x 80-m square)			2011 (80-m radius circle)					
	Count	Empirical Adjustment Factor	Adjusted Fatalities	Count	Empirical Adjustment Factor	Adjusted Fatalities	Overall Adjusted Fatalities		
Number of bats within cleared plots	342	0.58	590.4	150	0.52	289.7	880.0		
Number of bats on road & pad of cleared plots	67	0.7	95.7	32	0.83	38.4	134.1		
Road & Pad Correction Factor		**90% Bootstrap CI**			**90% Bootstrap CI**			**90% Bootstrap CI**	
	Ratio	**ll**	**ul**	**Ratio**	**ll**	**ul**	**Ratio**	**ll**	**ul**
	6.17	**3.82**	**8.79**	**7.54**	**5.30**	**11.14**	**6.56**	**4.49**	**8.66**

All *Myotis* species and any unknown bat carcasses will be delivered to the USFWS within seven days of collection, for concurrence or determination of species identification. The final disposition of individual casualties will be based on direction from the appropriate salvage permits (as per the IDNR and the USFWS), the legal status of individual casualties, and the direction of the USFWS Law Enforcement Agent in Charge. In addition, the USFWS and the IDNR will be notified (by email and/or phone) within 24 hours if any eagles or federally or state threatened or endangered species casualties are discovered.

An annual report describing methods and results of take compliance monitoring will be prepared following completion of the field surveys and data analysis for each year of monitoring. Annual reports will include:

- Results from monitoring, including results of bias corrections (i.e., searcher efficiency trials, scavenger removal trials, and searchable area adjustments) and estimates of total bat and Indiana bat mortality;
- Adaptive management changes that were implemented in response to observed and/or estimated bat mortality, if necessary;
- Raw data sheets from take compliance monitoring (that include all bat and bird fatalities); and
- Spreadsheets showing the timing and actual speeds at which the turbines were operational and feathered during the minimization period.

The annual report will be prepared and submitted to the USFWS by January 31 following completion of the field surveys. A weekly summary of bats found during monitoring will also be provided to the USFWS, which will be used to evaluate whether a trigger has been met that would require an adaptive management response, as described in Chapter 5.4.2.

5.4.2 Adaptive Management for Take Compliance

Based on best available science, it is assumed that minimization measures (i.e., raising cut-in speeds to 5.0 m/s and feathering turbines below cut-in) will result in at least a 50% reduction in all bat mortality during the fall from that estimated from 2010 and 2011 mortality monitoring, including Indiana bat mortality. However, scientific understanding of the effects of wind turbine operation on bat behavior and mortality is evolving rapidly. New information is continually being developed and there is uncertainty in the means by which to optimally reduce bat mortality, in particular for species such as the Indiana bat. This HCP, therefore, will include an active adaptive management approach that will facilitate responsiveness in management actions based on results from annual take compliance monitoring to ensure permit compliance.

The general adaptive management approach includes raising cut-in speeds in 0.5 m/s increments if mortality thresholds are met during the fall monitoring period, or at the conclusion of the monitoring year. Adaptive management thresholds within any given year are based on the upper 75th percentile for estimated fall bat mortality in 2010 and 2011 at control turbines with minimization measures in place. Adaptive management thresholds at the end of any given year are based on the upper bound of the 90% CI (or upper 95th percentile) for estimated fall bat mortality in 2010 and 2011 at control turbines with minimization measures in place (Table 4.7).

Within-Season Adaptive Management

Within-season adaptive management thresholds will be calculated to serve as an early indicator that adjustments to minimization efforts are necessary before the conclusion of the monitoring year. Within-season adaptive management thresholds will be based on the predicted number of bat carcasses that would be found[20] that would equal the upper quartile (i.e., 75th percentile) of estimated fall bat mortality in 2010 and 2011 at control turbines with minimization measures in place: 9.5, 12.0, or 2.5 Indiana bats per year for the 355-, 449-, or 94-turbine Project, respectively. The 75th percentile was used instead of the 95th percentile (which is the adaptive management threshold at the end of the year) as a conservative way to ensure that the adaptive management threshold is not reached at the end of the year. To determine the number of bat carcasses of all species found that would equate to this level of Indiana bat mortality, bias correction factors (i.e., unsearched areas, scavenger removal, and carcass removal) from the previous year's monitoring results will be applied.

For the first year of the ITP only, the bias correction estimator from the 2010 monitoring study (i.e., empirical PI = 0.51[21]) will be used since road and pad search frequency (i.e., once per week) in 2010 is identical to the proposed search frequency (Table 5.4). The number of bat fatalities (of all species) that would be expected to be found during Year 1 monitoring (when 118 turbines are searched) that would equate to take of 9.5 Indiana bats would be 153 over the entire fall monitoring period (Table 5.4). This number is based on an estimated all bat fatality rate of 16.7 bats per turbine, back-calculated for the number of carcasses that would be found based on the empirical PI estimate (estimated probability of carcass being available and detected based on FRWF 2010 bias trials at weekly road/pad searches) and the road/pad correction factor (estimated based on number of bats found on roads and pads of cleared plots in relation to the total number of bats found at cleared plots in 2010 and 2011). The predicted number of bats that would be found per turbine is based on the estimated fatality rate per turbine (16.7), multiplied by the empirical PI (0.51), and divided by the road/pad correction factor (6.56), or 16.7 * 0.51 / 6.56 = 1.30 bats/turbine. The total number of bats found at all turbines is determined by simply multiplying the predicted per turbine rate of carcasses found (1.30) by the total number of turbines searched in Year 1 (118), or 1.30 * 118 = 153 bats at all turbines. If 153

[20] Cumulative counts of bat carcasses found during each fall monitoring period will be tallied on a weekly basis.

[21] This is the empirical estimate of the probability of carcass availability and detection. In 2010, 222 total carcasses were placed with 77 carcasses placed on turbines where roads and pads only were searched. Carcasses were allowed to remain where placed for up to 28 days and the date when searchers found the carcasses was noted. Of the 77 carcasses placed on road and pad search turbines, 39 carcasses were found, equating to a 0.51 probability of a carcass being available and detected.

bat carcasses are found at any point during monitoring, the Permittees will increase cut-in speeds by 0.5 m/s[22].

Table 5.4 Road and pad estimated observed bat fatalities based on adaptive management threshold for 355 operational turbines at the Fowler Ridge Wind Farm (Phases I, II, III).

Parameter	Value	Description of Where Data Came From
Adaptive Management Threshold for Indiana Bats - Phase I, II, III	9.5	Upper quartile (i.e., 75th percentile) of estimated fall bat mortality in 2010 and 2011 at control turbines with minimization measures in place
Percent of All Fatalities that are Indiana Bats	0.16	Percentage based on total number of Indiana bats found during searches over total bats found
All Bat Mortality Count	5,938	Calculated – 9.5 / 0.0016
Number of Turbines	355	Fowler Phases I, II, III
Estimated All Bat Fatality Rate Per Turbine	16.7	Calculated – 5,938 / 355
Empirical PI Estimate	0.51	Estimated probability of carcass being available and detected based on Fowler 2010 empirical bias trials from weekly road/pad searches; will be adjusted annually for subsequent years
Road & Pad Correction Factor	6.56	Estimated based on number of bats found on roads and pads of cleared plots in relation to the total number of bats found at cleared plots in 2010 and 2011
Predicted Number of Bats Found per Searched Turbine	1.30	Predicted based on estimated fatality rate per turbine (16.7), multiplied by empirical PI (0.51), divided by road/pad correction factor (6.56); will be adjusted annually for subsequent years
Total Bats Found in One Fall Season Based on 118 Turbines Searched (one-third of 355)	153.4	Predicted based on estimated number of bats found per turbine (1.30) multiplied by the number of turbines searched (118). Calculated value represents Adaptive Management Threshold for Year 1; will be adjusted annually for subsequent years

Table 5.5 presents estimated total bat fatalities found during fall monitoring efforts under all possible operational schemes and associated monitoring strategies. However, within-season adaptive management thresholds for all years past Year 1 Evaluation Phase monitoring are hypothetical, since subsequent within-season adaptive management thresholds will be defined based on the previous year's bias correction results. If an additional number of bat carcasses (of any species) are found during compliance monitoring within the same season that equate to one additional Indiana bat after cut-in speeds have been increased, cut-in speeds will again be increased by 0.5 m/s.

For the first year of the ITP, the number of bats that equates to one additional Indiana bat equals 16 based on the correction factors shown in Table 5.4. Cut-in speeds will be increased by 0.5 m/s each time a number of bat carcasses that equates to one additional Indiana bat are found within the same season.

[22] Note that if within-year operational changes are needed based on adaptive management criteria, the Permittees will require up to one business day to make the necessary cut-in speed changes to the turbine SCADA systems.

,**Table 5.5** Road and pad estimated observed bat fatalities based on within-season adaptive management thresholds for each operational scheme and monitoring strategy. The estimated all bat fatality rate per turbine (16.7), empirical PI estimate (0.51), road & pad correction factor (6.56), and predicted number of bats found per searched turbine (1.30) remain the same regardless of the number of turbines operational and searched.

Monitoring Strategy	Operational Scheme	Number of Turbines Searched	Predicted Total Bats Found in One Fall Season
Evaluation Phase	Phases I, II, III (355 turbines)	118	153
	Phases I, II, III, IV (449 turbines)	150	195*
Implementation Phase	Phases I, II, III, IV (449 turbines)	90	117*
	Phase IV (94 turbines)	20	26*
Re-Evaluation Phase	Phases I, II, III (355 turbines)	118	153*
	Phases I, II, III, IV (449 turbines)	150	195*
	Phase IV (94 turbines)	31	40*

*Hypothetical, based on 2010 bias correction results; actual within-season thresholds will be based on previous year's bias correction results.

Note that any operational changes made based on within-season numbers of carcasses found may be adjusted before the start of the next fall season based on the final estimated all bat mortality for the full fall season. Because within-season triggers are conservatively based on the 75th percentile rather than the 95th percentile, the end of the year mortality may in fact be below the 95th percentile annual adaptive management trigger. Also, because the within-season adaptive management thresholds are based on the previous year's bias correction results, the actual annual mortality estimate determined at the conclusion of the monitoring year (based on that year's bias correction trials) may be lower than the 95th percentile.

A set of control turbines (i.e., turbines that remain feathered up to a cut-in speed of 5.0 m/s) will be used to determine whether or not the adaptive management trigger was reached at the end of the monitoring period. If the within-season adaptive management trigger is met, cut-in speeds will not be raised at 20 turbines among those selected for monitoring (cut-in speeds will be raised at all other turbines in the wind facility). Control turbines allow for an accurate assessment of the effectiveness of the initial cut-in speed when triggering the within-season adaptive management threshold results in raising the cut-in speed for the remainder of the monitoring period. If no turbines remain at the initial cut-in level, there is no way to evaluate whether or not mortality is below the 95th percentile as a result of raising cut-in speeds, or whether it would have been below the 95th percentile even if cut-in speeds had not been raised. A sample size of 20 was determined to be adequate based on modeling done to determine the chance of the Permittees finding that the end-of-year adaptive management threshold was triggered (Appendix F).

The 20 turbines will be apportioned among the turbine types at the FRWF according to the proportional representation of each turbine type group (Table 5.6). The location of control turbines will be selected using a systematic sample with a random start. The randomization process will be conducted for each turbine type group. Once turbines have been selected using the randomization method, selected control turbines will be reviewed to make sure that they are representative of conditions found at turbines across the facility and are not biased as a result of road/pad orientation.

Table 5.6 Number of control turbines in each turbine group for verification of the within-season adaptive management threshold response.

			Phase I, II, III		Phase I, II, III, IV		Phase IV	
Phase	**Turbine Type**	**Total Number of Turbines**	**Proportion of Turbines**	**Number of Control Turbines**	**Proportion of Turbines**	**Number of Control Turbines**	**Proportion of Turbines**	**Number of Control Turbines**
I, III	Vestas V82	182	51%	10	41%	8	0%	0
I	Clipper C96	40	11%	2	9%	2	0%	0
II	GE SLE	133	37%	7	30%	6	0%	0
IV	GE TC3+	94	0%	0	21%	4	100%	20

End-of-Year Adaptive Management

End-of-year adaptive management thresholds for any given year are based on the upper bound of the 90% confidence interval (or upper 95th percentile) for estimated fall bat mortality in 2010 and 2011 at control turbines with minimization measures in place. The adaptive management threshold will differ depending on the number of turbines that are in operation in a given year: 10.6, 13.4, or 2.8 Indiana bats per year for the 355-, 449-, or 94-turbine Project, respectively (Table 4.6). This is based on Monte Carlo simulations that showed that over 1,000 21-year periods using the adaptive management strategy described below, the mean number of Indiana bat fatalities was 170, with a corresponding 90% CI of 157 to 183 fatalities, assuming a conservative 50% reduction in fatality when feathering blades below a 5.0 m/s cut-in speed. Given that a 57% (90% CI = 39% - 70%) reduction in bat fatality was achieved by feathering blades below a 4.5 m/s cut-in speed in the 2011 FRWF study, a more realistic reduction in bat mortality of 60% by feathering blades below 5.0 m/s was also simulated. Using the same simulation methods (i.e., 1,000 21-year periods that assumed the adaptive management described herein), an average of 144 Indiana bat fatalities over a 21 year period with a 90% CI of 129 to 160 total Indiana bat fatalities could occur, assuming a 60% reduction in all bat mortality when blades are feathered below 5.0 m/s.

At the end of each monitoring year, if within-season thresholds were not triggered (i.e., there were no control turbines), mortality will be estimated and management decisions will be made for the following year based on results from all searched turbines. If within-season thresholds were triggered, mortality will be estimated from the 20 control turbines that operated at the same cut-in speed throughout the monitoring period.

If mortality estimated from the 20 control turbines exceeded the end-of-year adaptive management threshold (i.e., 95th percentile of estimated Indiana bat fatality with 50% reduction), the raised cut-in speed that was implemented within-season will be maintained in the subsequent year. Conversely, if mortality estimated from the 20 control turbines at the end of the year is below or equal to the end-of-year threshold, the within-season cut-in speed increase will not be maintained in the subsequent year and cut-in speeds will be resumed at 5.0 m/s (or as determined at the end of year response in the previous year) at the beginning of the subsequent fall monitoring season. If estimated Indiana bat take at the 20 control turbines is equal to or less than the lower bound of the 90% CI (i.e., 5th percentile) at the end of a given monitoring year, cut-in speeds will be reduced by 0.5 m/s, but only if cut-in speeds have been increased above 5.0 m/s as a result of previous adaptive management decisions (i.e., cut-in speeds will not go below 5.0 m/s under any circumstance).

If an operational change was made in response to either the 95th percentile or 5th percentile being met or exceeded, two years of Re-Evaluation Phase monitoring (i.e., 33% of turbines searched weekly from August 1 to October 15) will be conducted to ensure that operational adjustments were sufficient to minimize take and comply with the terms of the ITP.

Table 5.7 summarizes the framework that will be used to make adaptive management decisions related to minimization measures and monitoring, both within-season and at the end of the monitoring period. The Permittees will consult with the USFWS annually after each year of take compliance monitoring to interpret the results of the monitoring surveys, evaluate new available data (e.g., from other wind monitoring studies), and if needed, adjust turbine operations to ensure the level of Indiana bat take does not exceed authorized levels.

5.4.2.1 Adaptive Management Simulation to Ensure Take Compliance

To ensure the effectiveness of the adaptive management plan in keeping estimated Indiana bat take below 184 Indiana bats over the 21-year life of the ITP, a simulation study was conducted using the proposed adaptive management process. All bat mortality was simulated for each year of the ITP by sampling from the distribution of the fall cleared plot fatality rate estimated during 2010 and 2011 fatality monitoring studies at the FRWF (30.17 bats/turbine, [24.55-37.21]). Annual estimates of Indiana bat take were then calculated based on the proportion of observed Indiana bat fatalities at the FRWF to date (0.0016), the number of turbines in operation during the corresponding ITP year (355, Year 1; 449, Years 2-16; and 94, Years 17-21), and reduction in fatality due to altered cut-in speeds.

Table 5.7 Adaptive management thresholds and responses for the Fowler Ridge Wind Farm Habitat Conservation Plan.

Monitoring Year	Project Operations Action	Adaptive Management Thresholds and Responses: Within-year (August 1 – October 15)	Adaptive Management Thresholds and Responses: End of Year
Years 1 (355 Turbines)	Cut-in speed of 5.0 m/s with blades feathered below cut-in (sunset to sunrise, August 1 – October 15) AND Monitoring of 33% of turbines weekly, roads and pads only, August 1 – October 15	If cumulative count of bat carcasses (i.e. ≥153 in Year 1, ≥195* in Year 2) found suggests Indiana bat fatality is greater than the 75th percentile based on previously collected carcass removal and searcher efficiency data at any point during the monitoring period, cut-in speeds will be increased to 5.5 m/s and blades feathered below cut-in (sunset to sunrise, thru October 15) at all but 20 control turbines AND If a number of bat carcasses equal to one additional Indiana bat is found after the initial cut-in speed increase, cut-in speed will again be increased by 0.5 m/s with blades feathered below cut-in (sunset to sunrise, thru October 15); each time this occurs within season, cut-in speed will be increased by 0.5 m/s with blades feathered below cut-in (sunset to sunrise, thru October 15)	If annual Indiana bat mortality estimated from all searched turbines or from control turbines (if within-season AM trigger was met) is ≤ 10.6, continue cut-in speed of 5.0m/s with blades feathered below cut-in Year 2 OR If annual Indiana bat mortality estimated from all searched turbines or from control turbines (if within-season AM trigger was met) is > 10.6, increase cut-in speed to 5.5 m/s in Year 2
Year 2 (449 Turbines)	Cut-in speed of 5.0m/s with blades feathered below cut-in (sunset to sunrise, August 1 – October 15) OR As determined in previous year's end of year response AND Monitoring of 33% of turbines weekly, roads and pads only, August 1 – October	If cumulative count of bat carcasses (i.e. ≥195* in Year 2) found suggests Indiana bat fatality is greater than the 75th percentile based on previously collected carcass removal and searcher efficiency data at any point during the monitoring period, cut-in speeds will be increased by 0.5 m/s and blades feathered below cut-in (sunset to sunrise, thru October 15) at all but 20 control turbines AND If a number of bat carcasses equal to one additional Indiana bat is found after the initial cut-in speed increase, cut-in speed will again be increased by 0.5 m/s with blades feathered below cut-in (sunset to sunrise, thru October 15); each time this occurs within season, cut-in speed will be increased by 0.5 m/s with blades feathered below cut-in (sunset to sunrise, thru October 15)	If annual Indiana bat mortality estimated from all searched turbines or from control turbines (if within-season AM trigger was met) is ≤ the lower bound of the 90% CI (i.e., 5th percentile), reduce cut-in speed by 0.5 m/s (but only if cut-in speeds have been increased above 5.0 m/s from a previous adaptive management response) OR If annual Indiana bat mortality estimated from all searched turbines or from control turbines (if within-season AM trigger was met) is ≤13.4, continue feathering turbines below the initial year cut-in speed in subsequent year OR If annual Indiana bat mortality estimated from all searched turbines or from control turbines (if within-season AM trigger was met) is >13.4 increase cut-

Table 5.7 Adaptive management thresholds and responses for the Fowler Ridge Wind Farm Habitat Conservation Plan.

Monitoring Year	Project Operations Action	Adaptive Management Thresholds and Responses	
		Within-year (August 1 – October 15)	**End of Year**
	15		in by 0.5 m/s increment in subsequent year with blades feathered below cut-in speed AND If cut-in speed adjustments are made, perform two years of Evaluation Phase monitoring at 33% of turbines, once per week, roads and pads only, from August 1 – October 15 during the following two years
Years 3-21 (449, or 94 Turbines)	Cut-in speed of 5.0m/s with blades feathered below cut-in (sunset to sunrise, August 1 – October 15) OR As determined in previous year's end of year response AND Monitoring of 20% of turbines weekly, roads and pads only, August 1 – October 15	If cumulative count of bat carcasses found (# based on previous' years bias correction results) suggests Indiana bat fatality is greater than the 75th percentile based on previously collected carcass removal and searcher efficiency data at any point during the monitoring period, cut-in speeds will be increased by 0.5 m/s and blades feathered below cut-in (sunset to sunrise, thru October 15) at all but 20 control turbines AND If a number of bat carcasses equal to one additional Indiana bat found after the initial cut-in speed increase, cut-in speed will again be increased by 0.5 m/s with blades feathered below cut-in (sunset to sunrise, thru October 15); each time this occurs within season, cut-in speed will be increased by 0.5 m/s with blades feathered below cut-in (sunset to sunrise, thru October 15)	If annual Indiana bat mortality estimated from all searched turbines or from control turbines (if within-season AM trigger was met) is ≤ the lower bound of the 90% CI (i.e., 5th percentile), reduce cut-in speed by 0.5 m/s (but only if cut-in speeds have been increased above 5.0 m/s from a previous adaptive management response) OR If annual Indiana bat mortality estimated from all searched turbines or from control turbines (if within-season AM trigger was met) is ≤ 10.6 (355 turbines), ≤13.4 (449 turbines), or ≤2.8 (94 turbines), continue feathering turbines below the initial year cut-in speed in subsequent year OR If annual Indiana bat mortality estimated from all searched turbines or from control turbines (if within-season AM trigger was met) is > 10.6 (355 turbines), >13.4 (449 turbines), or >2.8 (94 turbines) increase cut-in by 0.5 m/s increment in subsequent year with blades feathered below cut-in speed AND If cut-in speed adjustments are made, perform two years of Evaluation Phase monitoring at 33% of

Table 5.7 Adaptive management thresholds and responses for the Fowler Ridge Wind Farm Habitat Conservation Plan.

Monitoring Year	Project Operations Action	Adaptive Management Thresholds and Responses	
		Within-year (August 1 – October 15)	**End of Year**
			turbines, once per week, roads and pads only, from August 1 – October 15 during the following two years

*Hypothetical, based on 2010 bias correction results; actual within-season thresholds will be based on previous year's bias correction results.

Fatality reduction due to altered cut-in speeds was simulated using a conservative 50% reduction in all bat mortality when feathering blades below a cut-in speed of 5.0 m/s. A more likely, but still conservative, 60% reduction in fatality was also simulated, based on the 57% (90% CI = 39% - 70%) reduction in bat fatality achieved in the 2011 FRWF study by feathering blades below a 4.5 m/s cut-in speed.

Since reduction in fatality is a random variable, for each year of the ITP, the estimated reduction in fatality due to that year's cut-in speed level was simulated based on the mean and variability observed during the 2010 and 2011 curtailment studies at the FRWF. An additional 10% mean reduction in fatality was simulated for every 0.5 m/s increase in cut-in speed that occurred during the adaptive management process. This percent increase was selected based on the 2011 FRWF study of feathered turbines in which three cut-in speeds with turbine blades feathered below cut-in were tested. Percent decreases of 35.6, 58.5 and 75.2 were observed for 3.5, 4.5, and 5.5 m/s cut-in speeds, respectively. Thus, a 22.9% and 16.6% increase in fatality reduction from normal operation was observed with increases of 1.0 m/s in cut-in speed. This approximates to an average increase in fatality reduction of 10% per every 0.5 m/s increase in cut-in speed.

One thousand 21-year periods were simulated based on the adaptive management strategies described above. Assuming a conservative 50% reduction in fatality when blades are feathered below a 5.0 m/s cut-in speed, the mean number of Indiana bat fatalities was 170, with a corresponding 90% CI of 157 to 183 fatalities from estimated 5th and 95th percentiles of simulated results[23]. A 60% reduction in all bat mortality when blades are feathered below 5.0 m/s resulted in an average of 144 Indiana bat fatalities over a 21 year period with a 90% CI of 129 to 160 total Indiana bats (Table 5.8; Figure 5.2).

Table 5.8 Simulated mean overall estimated take of Indiana bats over the 21-year period with corresponding 90% Monte Carlo confidence interval.

% Reduction in Fatality due to Cut-in Speed	Estimated total Indiana Bat Fatalities after 21 years		
		90% Confidence Interval	
	Mean	Lower Limit	Upper Limit
50%	170	157	183
60%	144	129	160

[23] More commonly known as a Monte Carlo simulated confidence interval.

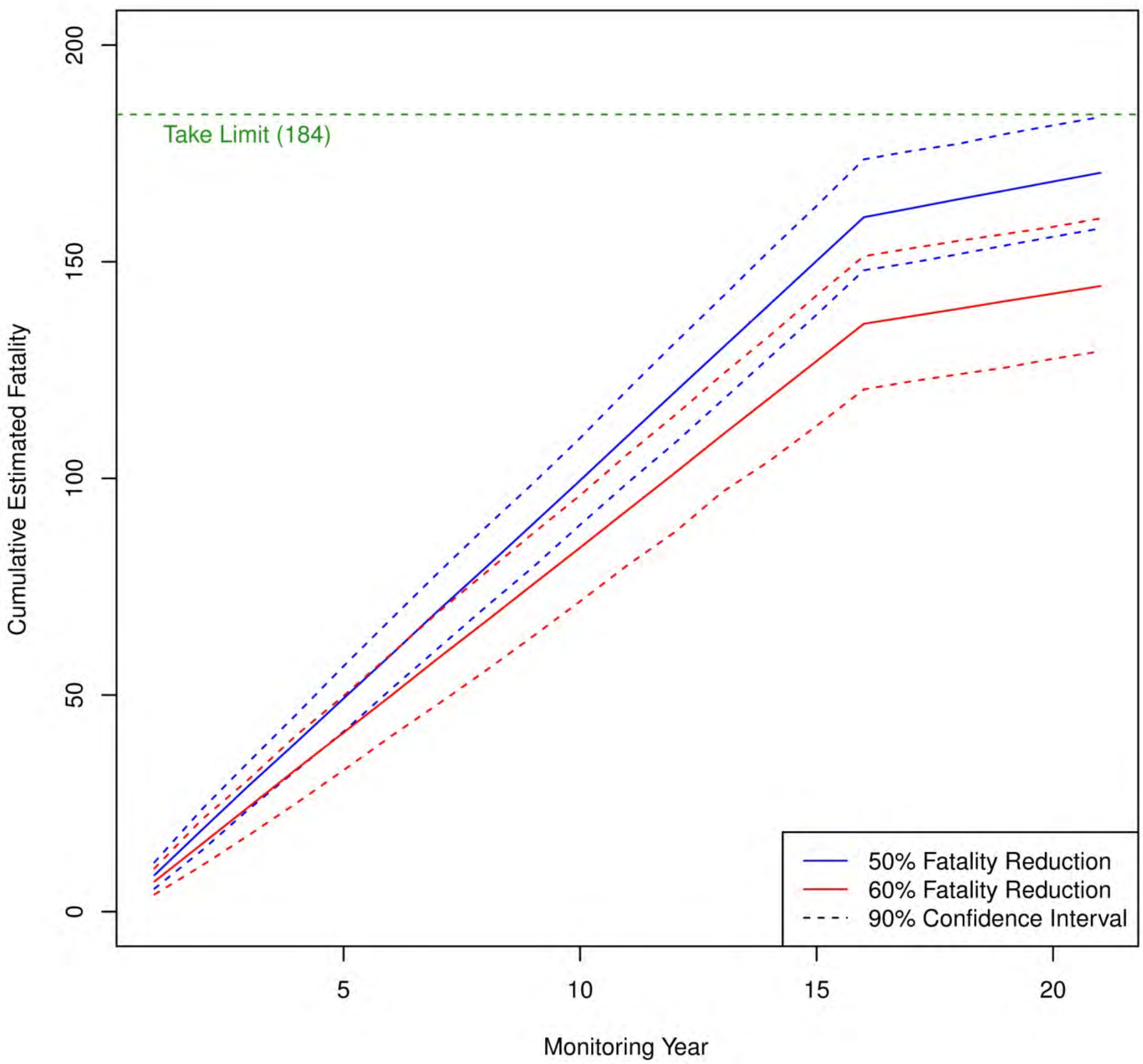

Figure 5.2 Simulated mean cumulative estimated Indiana bat fatality with corresponding 90% confidence intervals under the proposed adaptive management plan at the Fowler Ridge Wind Farm, assuming baseline 50% and 60% reductions in fatality when turbines are curtailed below 5.0 m/s, with an additional 10% reduction in fatality for every 0.5 m/s increase in cut-in speed.

5.4.3 Mitigation Monitoring

5.4.3.1 Summer Habitat Mitigation Monitoring

Compliance and effectiveness monitoring will be conducted on all protected, preserved, and restored summer habitat. Suitability criteria that will be used to guide this decision making process is described in the Draft 2007 Recovery Plan (USFWS 2007) and outlined in the

USFWS BFO Draft Mitigation Guidance (Appendix C)[24]. In general, success criteria for summer habitat mitigation are based upon two factors: a) the habitat has been effectively protected (e.g., conservation easement in place) and restored (e.g., trees have been planted and survived); and b) an Indiana bat maternity colony is extant where the mitigation occurred (Appendix C).

To meet the first criterion, existing habitat and any additional protected habitat will be surveyed biennially after habitat has been acquired and protected (first mitigation land acquisition targeted to occur in Year 10 of the ITP) using aerial satellite imagery to confirm that habitat is being preserved and protected. Therefore, the first aerial survey will occur in Year 12 of the ITP and will be conducted biennially thereafter. Additionally, prior to initiating summer mitigation measures, a habitat assessment will be conducted to determine if existing Indiana bat habitat slated for protection is mutually agreed to be, or have the potential to be, suitable roosting and/or foraging habitat by the Permittees and the USFWS. To meet the second criterion, only lands known to be occupied by Indiana bat maternity colonies as determined through surveys in Years 9 and 13 and approved by the USFWS BFO prior to when mitigation is to be implemented will be selected for mitigation. Surveys to confirm the persistence of maternity colonies will be conducted every three years following implementation of summer habitat mitigation.

Any restored habitat will require additional monitoring to determine that restoration efforts are successful and are not being hindered by invasive species. Specifically, restored habitat will be surveyed three years after initial planting to confirm a minimum 70% survival rate of planted tree species and seven years after initial planting to confirm that stand density is a minimum of 70% of planted density. A survey of invasive plant species will also be conducted at Year 7 of the summer mitigation project. Any invasive species that threaten the success of the summer habitat mitigation will be controlled or removed between Year 7 and 10 of the summer mitigation project. If forest restoration efforts fail to meet these compliance criteria, then the Permittees will follow guidelines in the summer mitigation adaptive management plan in Chapter 5.4.5.1.

Lands targeted for summer mitigation measures in Putnam, Tippecanoe, Vermillion, or Warren County will be surveyed regularly for persistence of Indiana bat maternity colonies throughout the life of the Project. Surveys will be conducted by a USFWS-approved and permitted contractor who will follow the USFWS protocol for determining Indiana bat presence that is recommended at the time summer habitat mitigation is implemented. Surveys will be conducted every three years after implementation of the summer mitigation project for the remainder of the life of the Project.

5.4.3.2 Winter Habitat Mitigation Monitoring

Post-Installation Gate Monitoring

To monitor whether or not the newly installed gate is affecting egress/ingress and/or swarming behavior of bats, the entrance of the cave will be monitored with night-vision equipment during fall migration/swarming. Thermal cameras will be placed in the cave and will record bat behavior throughout the night. The cave entrance will be monitored for multiple nights during this critical

[24] Any updates to these documents would also be considered when conducting the habitat assessment.

period. During monitoring, the timing, frequency and duration of abnormal flight behaviors during egress and ingress (e.g., bats landing on the cave gate or crawling, rather than flying, through the gate) will be recorded. In addition, all potential predators and any observed predation events will be recorded. This work will be conducted by the IDNR, in cooperation with the USFWS. Additionally, the security of the gate will be checked by OWSP staff throughout the term of the ITP to verify that the lock is intact and to document any evidence of tampering with the gate. Upon any reported breaches in gate security, FRWF will deploy a team to repair the gate or repair damage around the gate within 24 hours. However, if the OWSP staff cannot continue gate security monitoring efforts, the Permittees will receive authorization and be required to provide funding and personnel to complete that monitoring effort.

Monitoring Cave Visitation and Microclimate

Speloggers and dataloggers installed within the Wyandotte Cave entrance will be checked annually in the spring. Data from speloggers will be downloaded, batteries changed, and general observations of conditions at the cave entrance will be recorded. Digital photographs will be taken of the cave entrance and gate to provide an annual record of damage, graffiti, trash, and signs of WNS at the cave entrance. This work will be conducted by the IDNR in cooperation with the USFWS on an annual basis from Years 1 to 12 of the mitigation project, which should be an adequate amount of time to determine the gate was installed correctly and continues to function properly. Because of the nature of this mitigation, there is no reason to expect that it will not continue to function effectively through its operational life. In addition, because Wyandotte Cave is owned by the IDNR and will be regularly surveyed for the foreseeable future, informal evaluation of the gate will occur after the formal monitoring has been completed. The IDNR will ensure the gate is in place and no unauthorized human visitation will be permitted during the winter for the life of the permit (Appendix I). However, if the IDNR or the USFWS cannot continue those monitoring efforts, the Permittees will receive authorization and be required to provide funding and personnel to complete that monitoring effort.

5.4.4 Mitigation Reporting

Reports will be prepared that describe the methods and results of both summer and winter habitat mitigation. Reports for summer habitat mitigation will include the number of acres purchased and/or restored, as well as the details of all restoration actions taken and measurements of success criteria. Details of summer habitat mitigation will be included in the annual report submitted to the IDNR and the USFWS by January 31 following each calendar year that mitigation actions or monitoring is actively conducted.

For winter habitat mitigation, the IDNR, in cooperation with USFWS, will complete annual reports in Years 1 through 12 of the mitigation project. The reports will evaluate the effectiveness of the new gate (this will involve evaluation at the time of installation to determine that bats are not impeded by the gate in their passage into and out of the cave) in Year 1 only and will discuss trends in human visitation and microclimate data and make appropriate management recommendations regarding these data. To ensure that any required management actions can be taken prior to the upcoming hibernation period, the winter habitat mitigation report will be submitted to the Permittees annually by June 30.

5.4.5 Adaptive Management for Mitigation

For mitigation to be effective at offsetting the impacts of the taking from the FRWF, it is essential that mitigation efforts are successful. Should mitigation efforts be ineffective, the mitigation would no longer serve to offset the impacts of take. A number of foreseeable changed circumstances that have the potential to reduce the effectiveness of the mitigation projects, and corresponding corrective actions, are described in Chapter 8. However, these are not the only circumstances which could lead to the mitigation project failure. Should proposed mitigation fail to fully compensate for the impact of the unavoidable take due to these other reasons, corrective action will be implemented by the Permittees.

5.4.5.1 Adaptive Management for Summer Habitat Mitigation

Adaptive management for the summer habitat mitigation will ensure that the mitigation is working as intended and is offsetting the impact of the take. The objectives of summer mitigation adaptive management are to ensure that: 1) a viable mitigation project is selected, 2) that habitat protection and restoration are initiated and maintained, and 3) the long-term viability of the mitigation project is evaluated at several points during the term of the ITP. Compliance criteria defined in Chapter 5.4.3.1 set the standard requirements to fulfill these objectives. If summer mitigation efforts fail to meet compliance criteria, then the Permittees will implement adaptive management to take corrective actions and follow management recommendations from the USFWS BFO and other appropriate land management agencies, as described in Table 5.9.

5.4.5.2 Adaptive Management for Winter Habitat Mitigation

An adaptive management approach will be used over the ITP term to maintain the new gate at Wyandotte Cave and to evaluate the success of the mitigation project. Although re-gating the entrance of Wyandotte Cave is not expected to have a negative impact on Indiana bats hibernating near the entrance passage, monitoring egress/ingress and/or swarming behavior of bats in the vicinity of the gate during Year 1 will be used to determine if bats have accepted the new gate. If bats are able to maintain uninterrupted flight through the cave gate (i.e., bats are flying freely through the gate and are not hitting the gate slats or having to land and crawl to get through the gate) then it will be deemed that the gate is accepted. If the gate is accepted, it is expected that bats will continue to roost in the entrance passage of Wyandotte Cave and their numbers should be comparable to censuses from the previous decade. If the gate is not accepted, adaptive management actions described in Table 5.9 will be taken.

Table 5.9 Adaptive management framework for monitoring of summer mitigation projects. Project year refers to schedule of the mitigation project and is independent of the Incidental Take Permit (ITP) or the Fowler Ridge Wind Farm schedules. To mitigate for the take of Indiana bats, the summer mitigation project will be implemented at least five years prior to the first season summer habitat will be required (approximately Year 10 in the ITP term).

Project Year	Input Data	Data Result	Adaptive Management Response
Prior to initiating project	Indiana Bat Habitat Assessment	Suitable Indiana bat summer mitigation habitat available.	Initiate mitigation project to protect and restore Indiana bat summer habitat within the home range of a known maternity colony.
		Suitable Indiana bat summer mitigation habitat not available.	Areas targeted for summer habitat mitigation are mutually considered unsuitable by the USFWS BFO and the Permittees. Select alternative areas for summer mitigation.
Every two years for the life of the ITP, after implementation of the summer mitigation project	Aerial Photo Survey or Report from Land Managing Agency	Indiana bat habitat protection and restoration is viable[25].	No action taken.
		Indiana bat habitat protection and restoration is not viable.	Personnel from the USFWS, FRWF, and land managing agency will meet to determine cause of failure and consider the viability of the mitigation project. If project is determined not to be viable by the USFWS, the Permittees will fund and begin to implement a USFWS-approved alternate mitigation project within one year of the determination.
Every three years for the life of the ITP, after implementation of the summer mitigation project	Maternity colony persistence surveys	Indiana bat maternity colony present.	No action taken.
		Indiana bat maternity colony not present.	Personnel from the USFWS, FRWF, and land managing agency will meet to consider the viability of the mitigation project. If project is determined not to be viable by the USFWS, the Permittees will fund and begin to implement a USFWS-approved alternate mitigation project within one year of the determination.

[25] Viability is defined as meeting the criteria established in the BFO Mitigation Guidance. In sum, the project must remain protected and suitable (e.g., forested or minimum survival if restoration and provide roosting or foraging habitat) and the Indiana bat maternity colony must be present.

Table 5.9 Adaptive management framework for monitoring of summer mitigation projects. Project year refers to schedule of the mitigation project and is independent of the Incidental Take Permit (ITP) or the Fowler Ridge Wind Farm schedules. To mitigate for the take of Indiana bats, the summer mitigation project will be implemented at least five years prior to the first season summer habitat will be required (approximately Year 10 in the ITP term).

Project Year	Input Data	Data Result	Adaptive Management Response
Year 3, after implementation of the summer mitigation project	Tree Survival in Restored Areas	Survival rate of planted trees is ≥ 70%	No action taken.
		Survival rate of planted trees is < 70%	Additional trees and/or land area will be planted within one year to address the mitigation failure. Personnel from the USFWS, FRWF and land management agency will meet to determine cause of mitigation failure and make management recommendations.
Year 7, after implementation of the summer mitigation project	Stand Density in Restored Areas	Stand density is ≥ 70% of planted density	No action taken.
		Stand density is < 70% of planted density	Additional trees and/or land area will be planted within one year to address the mitigation failure. Personnel from the USFWS, FRWF and land management agency will meet to determine cause of mitigation failure and make management recommendations.
Year 7, after implementation of the summer mitigation project	Invasive Species Survey in Restored Areas	No invasive species that threaten the success of the mitigation project are documented	No action taken.
		One or more invasive species that threaten success of the mitigation project are documented	Invasive species will be removed or threat posed by invasive species will be controlled using best management practices between Years 7 and 10 of the mitigation project.

Re-gating the entrance of Wyandotte Cave is expected to prevent the impending threat resulting from accessibility of humans to the vulnerable population of hibernating Indiana bats that roost outside the current gate. Wyandotte Cave is typically closed to unauthorized visitation during the hibernation period (September 1 to April 1), although the cave is now closed year-round due to WNS. The desired level of unauthorized visitation at Wyandotte Cave during the hibernation period is zero. Visitation rates at other gated caves are typically less than one unauthorized visit/year (Johnson et al. 2002). Regular gate monitoring and the use of speloggers will document unwanted human visitation to the cave, and adaptive management actions will be taken, as described in Table 5.10 if the cave gate is breached.

In addition to monitoring of gate acceptance by bats, gate security and human visitation, data on predation activity and cave microclimate will also be used to evaluate success of the mitigation project (Table 5.10). Results from these monitoring efforts will provide the basis for adaptive management decisions related to protection and enhancement of conditions at Wyandotte Cave.

Table 5.10 Adaptive management framework for determining the response of hibernating Indiana bats to re-gating the Wyandotte Cave entrance.

ITP Year	Input Data	Data Result	Adaptive Management Response
Year 1	Observational data from post-installation gate monitoring	No abnormal flight behaviors or predation observed indicating new gate is accepted.	No action taken.
		Abnormal flight behaviors and/or predation observed indicating new gate may not be accepted.	Personnel from the OWSP, the IDNR, the USFWS, and FRWF will meet to discuss observational data to determine if further monitoring is needed or if the gate needs to be modified, re-positioned, or removed. The USFWS will make final determination on the appropriate action. If immediate action is required, then the Permittees will implement action immediately. Otherwise, the Permittees will implement action within one year.
Year 2	Temperature and humidity	No difference in cave microclimate is detected	No action taken.

Table 5.10 Adaptive management framework for determining the response of hibernating Indiana bats to re-gating the Wyandotte Cave entrance.

ITP Year	Input Data	Data Result	Adaptive Management Response
	data from dataloggers	Differences in cave are detected	Personnel from the OWSP, the IDNR, the USFWS, and FRWF will meet to determine if changes in microclimate could be due to installation of new gate. If it is determined that gate installation was the cause of microclimate changes, the above parties will decide if the gate needs to be modified, re-positioned, or removed. The USFWS will make final determination on the appropriate action. If immediate action is required, then the Permittees will implement action immediately. Otherwise, the Permittees will implement action within one year.
Annually from Years 1-12 for Spelogger Download; Weekly from September 1 to April 1 for Security Monitoring	Observational data from gate security monitoring and data from speloggers	Unauthorized visitation at a rate of < 1 visit/year; no observed damage to gate	No action taken.
		Unauthorized visitation at a rate of ≥ 1 visit/year and/or gate is damaged	Personnel from the OWSP, the IDNR, the USFWS, and FRWF will meet to determine appropriate management actions (e.g. gate repairs or modifications, installation of video surveillance, or installation of a real-time cave visitation alarm) and if further monitoring is needed. The USFWS will make a final determination of the appropriate action. If immediate action is required, then the Permittees will implement the action immediately. Otherwise, the Permittees will implement action within one year.

6.0 FUNDING

The ESA § 10(a)(2)(B)(iii) provides that the USFWS shall issue an ITP if, among other things, it finds that "the applicant will ensure that adequate funding for the plan will be provided". By entering into an IA with the USFWS, the Permittees provide assurances that funding will be available to implement the HCP as well as any actions that mitigate the impact of the proposed taking of Indiana bats. The Permittees' history of funding costly wind power project development, including pre- and post-construction studies, demonstrates their capability and commitment to continue such funding. The Permittees will generate sufficient income each year through its routine operations over the 21-year life of the permit to ensure that all costs associated with funding the conservation plan are included in its annual budget.

The Permittees will provide funding assurance for the HCP in the form of a Surety acceptable to the USFWS (e.g., an escrow account, bond, or cash). Although the Permittees will have the ability to directly undertake all required actions described in this HCP, FRWF will establish a Surety into which the Permittees will make scheduled payments to reflect the levels of assurance discussed in this chapter. The Surety will be funded through a reduction and/or expenditure of a portion of the Permittees' earned revenue. The Surety will provide funds for monitoring, mitigation, annual meetings, reporting, and contingencies for adaptive management and changed circumstances in advance of the time at which they are needed. The Surety will be administered by an independent financial institution and will contain sufficient funds to assure the Permittees' performance under this HCP. Any independent company providing bonding under this HCP shall have a Best's credit rating of not less than A minus.

Costs for each element of the HCP were based on 2012 or 2013 estimates that were adjusted for future increases due to inflation based on the average annual changed Consumer Price Index over the past 25 years (2.9%; US Department of Labor Bureau of Labor Statistics 2012). Funding for each element of the HCP is described in the following sections.

6.1 Project Design and Planning

The Permittees have implemented and funded avoidance and minimization measures included in Project design and planning through the construction of the Project. These measures included siting the Project in agricultural fields where Indiana bat habitat would not be impacted. Costs associated with these measures were included, and paid for, as part of the Project development budget prior to the commercial operation of each phase of the FRWF. No further funding requirements for Project design and planning measures are anticipated.

6.2 Project Operations

The Permittees will implement a turbine operations protocol that is intended to reduce potential impacts to Indiana bats by limiting turbine rotation during periods when Indiana bats are considered at highest risk – fall migration on nights with low wind speeds (see Chapter 5). The lost revenue associated with these operational adjustments will be absorbed in the annual operation and maintenance budgeting process.

6.3 Mortality Monitoring

For the life of the HCP, the Permittees will conduct mortality monitoring studies within the Project area using methods described in Chapter 5. Following the initial two years of Evaluation Phase monitoring, the Permittees will conduct annual Implementation Phase monitoring for the life of the ITP. Estimated costs for fatality monitoring are detailed in Table 6.1, which were estimated based on 2012 costs and increased by 2.9% annually to account for estimated inflation. Costs of mortality monitoring will be self-funded through the annual operation and maintenance budget. It is important to note that since take is directly tied to operation and occurs in discreet yearly increments, if operation stops, take ceases. As further assurance that funds will be in place to conduct monitoring, the Permittees will place funding in the Surety in an amount sufficient to cover the costs of monitoring required for the upcoming year. The Surety will be made payable to the independent consultant selected by FRWF, and approved by USFWS, to conduct the monitoring.

The amount of mortality monitoring needed will be determined on a yearly basis and will be based on the prior year's monitoring results and any adaptive management. For example, based on the adaptive management procedures detailed in Chapter 5, Re-Evaluation Phase monitoring may be needed if an adaptive management threshold is triggered and an operational change is made. Since the cost of Re-Evaluation Phase monitoring is greater than Implementation Phase monitoring, which is the baseline that was planned for in Table 6.1, the Permittees will deposit additional funds to bring the total up to what is required for the next year. Likewise, if the balance in the account exceeds what is required for the following year, the Permittees will withdraw funds such that the balance reflects commitments for the next year.

At the end of each survey year, the annual report will include a description of the level of monitoring needed for the subsequent year, based on the results of the prior year's monitoring phase and any adaptive management. The Permittees will also obtain a proposal from an independent consultant for the mortality monitoring deemed necessary for the upcoming year. The Surety will be updated as necessary to reflect the amount set forth in the independent consultant's proposal, and the balance in the Surety will change each year depending on the funds required for the next year's monitoring. The Permittees will deposit or withdraw funds from the Surety to reflect the appropriate level of financial assurance for the following year. Evidence of the Surety will be provided to the USFWS by March 1 of each year during the ITP Term. To provide further assurance that mortality monitoring will occur, the Permittees will submit to the USFWS by March 1 of each monitoring year of the ITP a letter signed by a responsible corporate official that the Permittees have executed a contract(s) with a qualified party(s) to complete the required monitoring activities.

6.1 Mitigation

To address unavoidable impacts to Indiana bats from the Project, the Permittees will provide funding for a cave gating project and summer habitat preservation and restoration (including monitoring and reports associated with these projects). These projects will mitigate the unavoidable impacts of taking Indiana bats by contributing to the long term conservation of the Indiana bat population and assisting in meeting recovery objectives (Chapter 5). Estimated costs for mitigation are detailed in Table 6.1. Costs were estimated based on 2012 costs and increased by 2.9% annually to account for estimated inflation.

6.1.1 Winter Habitat Mitigation

The Permittees have received cost estimates for the cave gating required for the winter habitat mitigation from an environmental consulting firm experienced in performing these activities and familiar with the Wyandotte Cave system. Included in the cost estimate, which is detailed in Table 6.1, is the cost of gating Wyandotte Cave.

Table 6.1 Habitat Conservation Plan implementation budget for the Fowler Ridge Wind Farm (note, all costs furnished are 2012 or 2013 estimates and actual costs may vary).

Task	Years	Item	Estimated Cost: Cost in 2012 or 2013[a]	Estimated Cost: Total Over ITP Term[b]	Descriptions/Major Assumptions[c]
Meetings					
Meetings	6	Meetings	$501		Meeting with USFWS in Bloomington, IN following completion of monitoring in Years 1, 2, 6, 11, 16, and 21. Cost based on 2012 estimate (airfare and rental car - $501), adjusted for inflation (2.9%/year).
		Total		$4,062	
Meeting Subtotal				***$4,062***	
Mortality Monitoring					
Evaluation Phase Monitoring & Reporting	1	Mortality monitoring and reporting - Year1 Phase I,II,III	$51,066		Mortality monitoring of 118 turbines. Cost includes labor for carcass searches ($25,584), bias trials ($11,852), and data analysis, reporting, and project management ($13,630). Cost based on 2012 cost adjusted for inflation (2.9% per year).
	1	Mortality monitoring and reporting - Year 2 (Phase I, II, III, IV)	$66,608		Mortality monitoring of 150 turbines. Cost includes labor for carcass searches ($33,370), bias trial ($15,459), and data analysis, reporting, and project management ($17,778). Cost based on 2012 cost adjusted for inflation (2.9%/year).
		Total		$126,643	
Implementation Phase Monitoring & Reporting	14	Mortality monitoring and reporting - Years 3-16; Phase I,II,III,IV	$44,386		Mortality monitoring of 90 turbines. Cost includes labor for carcass searches ($24,394), bias trials ($11,152), and data analysis, reporting, and project management ($8,840). Cost based on 2013 estimate and adjusted for compounded inflation (2.9% per year).
		Total		$820,726	
Implementation Phase Monitoring & Reporting	5	Mortality monitoring and reporting - Years 17-21; Phase IV	$21,858		Mortality monitoring of 20 turbines. Cost includes labor for carcass searches ($8,238), bias trials ($8,260), and data analysis, reporting, and project management ($5,360). Cost based on 2013 estimate and adjusted for compounded inflation (2.9% per year).
		Total		$188,293	
Mortality Monitoring Subtotal				***$1,135,662***	

Table 6.1 Habitat Conservation Plan implementation budget for the Fowler Ridge Wind Farm (note, all costs furnished are 2012 or 2013 estimates and actual costs may vary).

Task	Years	Item	Estimated Cost: Cost in 2012 or 2013[a]	Estimated Cost: Total Over ITP Term[b]	Descriptions/Major Assumptions[c]
Winter Mitigation					
Wyandotte Cave Gating Project	1	Cave gating - Year 1	$48,399		One-time cost to be spent in 2013. Cost includes BCI personnel salaries and wages ($6,000); contract labor for welding and install ($19,760); materials - steel, welding rods, fuel, drill bits etc. ($7,725); travel expenses (mileage, hotel, per diem ($8,601); BCI Indirect costs (15% - $6,313). Cost based on 2013 estimate.
		Total		**$48,399**	
Winter Mitigation Subtotal				***$48,399***	
Summer Mitigation					
Summer Habitat Acquisition (97.1 ha [240 ac])	2	Land acquisition of 48.6 ha (120 ac) - Year 10 & Year 14	$420,000		Two one-time costs targeted to be completed in Year 10 (48.6 ha [120 ac]) and Year 14 (48.6 ha [120 ac]) of the ITP - cost based on 2013 cost of $8,649/ha ($3,500/ac) adjusted for compounded inflation (2.9% per year).
		Total		**$1,185,696**	
Summer Habitat Restoration & Maintenance	1	Tree installation - Year 10	$318,000	$435,508	A planting bed grid will be laid out using a GPS or other suitable survey method resulting in 2.4- x 3.0-m (8- x10-ft) plant spacing. 65,280 bare-root trees will be mechanically installed, 1-2 years in age with a minimum of 20 cm (8 in) in height. A minimum of three tree species will be planted and species composition will be determined based on site suitability and availability at the time of planting. A total of 1,344 trees will be installed per ha (544 trees/ac). Cost based on 2012 estimate ($6,437/ha [$2,605/ac]) adjusted for compounded inflation (2.9% per year).
	1	Native grass seed and temporary cover crop installation - Year 10	$48,000	$65,737	A low diversity, short stature native grass mix will be planted with an appropriate temporary cover crop. Seed will be spread with a broadcast seeder or other suitable method based on site Conditions. Cost based on 2012 estimate ($988/ha [$400/ac]) adjusted for compounded inflation (2.9% per year).

Table 6.1 Habitat Conservation Plan implementation budget for the Fowler Ridge Wind Farm (note, all costs furnished are 2012 or 2013 estimates and actual costs may vary).

Task	Years	Item	Estimated Cost: Cost in 2012 or 2013[a]	Estimated Cost: Total Over ITP Term[b]	Descriptions/Major Assumptions[c]
	5	Site management (mowing) - Years 11-15 & 18	$11,810	$196,698	Two mowing events will be conducted per year for Years 1 – 5 following installation. Mowing will occur between tree rows to reduce competition from herbaceous weeds and invasive shrub establishment. Additionally, one mowing event will be conducted between Years 7 and 10 following installation when determined necessary (estimated to occur 8 years following planting). Cost based on 2012 estimate ($11,810/mowing event) adjusted for compounded inflation (2.9% per year).
	1	Site management (invasive species control) - Year 18	$15,000	$25,822	Hand cutting and cut-stump herbicide application to invasive shrubs will be conducted following the final year of mowing between Years 7-10 following planting. Invasive shrub control is estimated to occur on half (24.3 ha [60 ac]) of restored land and estimated to occur eight years following planting. Cost based on 2012 estimate ($37,066/24.3 ha [$15,000/60 ac]) adjusted for compounded inflation (2.9% per year).
		Total		**$723,765**	
Summer Mitigation Monitoring & Reporting	2	Habitat suitability survey - Year 9 & 13	$3,894	$10,992	The year prior to acquiring summer habitat, a habitat suitability survey will be conducted to determine if habitat slated for protection is mutually agreed to be, or has the potential to be, suitable roosting and/or foraging habitat. Cost includes time to survey habitat (1.6 ha/hr [4.0 ac/hr]), travel costs, per diem, and project management based on 2012 estimates adjusted for compounded inflation (2.9% per year).

Table 6.1 Habitat Conservation Plan implementation budget for the Fowler Ridge Wind Farm (note, all costs furnished are 2012 or 2013 estimates and actual costs may vary).

Task	Years	Item	Estimated Cost: Cost in 2012 or 2013[a]	Estimated Cost: Total Over ITP Term[b]	Descriptions/Major Assumptions[c]
	2	Restoration success / invasive species surveys - Year 13 & 17	$10,250	$32,442	Includes two habitat surveys: one three years after restoration to check 70% survival rate; and one seven years after restoration to check 70% survival rate and to document the presence of invasive species that may pose a threat to the establishment of Indiana bat habitat; specifically the presence of invasive shrub species. Tree density determinations will be based on sample plot counts. Restoration success surveys assume half of the 97,1 ha (240 ac) will need to be surveyed (i.e., the restored areas) for restoration success. A summary report describing the restoration status of the site will be prepared following the two monitoring events. Cost includes survey time, travel expenses, report preparation, and project management. Cost based on 2012 estimate adjusted for compounded inflation (2.9% per year).
	5	Aerial photography survey - Years 12, 14,16, 18, 20	$12,200	$96,693	Targeted to begin two years after restoration was implemented (Year 12) and occur every other year thereafter (five total aerial photo surveys). Costs included labor, expenses, and production and digital delivery of photography based on 2012 estimates ($154/ha [62.50/ac]) adjusted for compounded inflation (2.9% per year).
	2	Colony presence surveys - Year 9 & 13	$35,071	$99,008	Includes two surveys in the year prior to summer habitat acquisition to confirm maternity colony presence and document home range (defined as the 3.2 km (2.0-mi) radius area around a primary roost tree); assumes four net sites needed per survey, each with two net locations surveyed for two nights each. Cost assumes three Indiana bats will be fitted with transmitters and tracked for five nights. Costs include labor, expenses (travel and per diem), equipment (mist nets, transmitters, tracking equipment), and project management based on 2012 estimates and adjusted for compounded inflation (2.9% per year)

Table 6.1 Habitat Conservation Plan implementation budget for the Fowler Ridge Wind Farm (note, all costs furnished are 2012 or 2013 estimates and actual costs may vary).

Task	Years	Item	Estimated Cost: Cost in 2012 or 2013[a]	Estimated Cost: Total Over ITP Term[b]	Descriptions/Major Assumptions[c]
	2	Colony persistence monitoring - Years 17 & 20	$22,262	$77,820	Includes surveys every three years after all summer habitat mitigation has been implemented to confirm maternity colony persistence; assumes four net sites needed per survey, each with two net locations surveyed for two nights each. Cost of $22,262 per survey includes labor, expenses (travel and per diem), equipment (mist nets), and project management based on 2012 estimates and adjusted for compounded inflation (2.9% per year)
	11	Reporting - Years 9-18, & 20	$6,400	$108,865	Targeted to occur every year a mitigation action or monitoring takes place. Cost includes 32 hr for data entry and analysis; 24 hr for writing; and 8 hr for technical edit and review (@$100/hr) adjusted for compounded inflation (2.9% per year).
		Total		**$425,821**	
Summer Mitigation Subtotal				***$2,335,282***	
Contingency					
Contingency Funds	2	Changed circumstance fund	NA	$1,331,153	Equal to the cost of replacing the winter habitat mitigation project and replacing 48.6 ha (120 ac) of summer habitat mitigation, including acquisition, restoration, maintenance, and invasive species management.
	1	Contingency fund	NA	$67,622	Equal to the 5% of one year of inflation-adjusted costs for all mitigation components
Contingency Subtotal				***$1,398,775***	
Total HCP Costs				**$4,922,180**	

[a] All costs are based on 2012 estimated costs except the costs for Implementation Phase Monitoring, Cave Gating, and Land Acquisition, which are based on 2013 costs.
[b] Totals are based on Year 1 occurring in 2014 Average Annual Inflation of 2.92% was used based on average national annual increase from US Department of Labor Bureau of Labor Statistics (2012) Consumer Price Index from 1987 to 2011.
[c] Costs are estimated based on best available information but could vary based on mitigation areas selected and approach.

Funding for winter habitat mitigation will be guaranteed by increasing the cash balance of the Surety to an amount equal to the funding required to complete these activities at least one year before they are required. Since these activities are planned for the first year of the ITP, funding would be placed in the Surety prior to the start of the HCP permit term, or in Year 0.

6.1.2 Summer Habitat Mitigation

The Permittees have received estimates for summer habitat mitigation from an environmental consulting firm with experience in habitat restoration. According to the USFWS BFO's mitigation guidance (Appendix C), not all land acquired for mitigation requires restoration; some areas selected are likely to already meet the criteria defined in the mitigation guidance (e.g., habitat protection in an area with less than 10 % forest cover, that includes a primary roost, in a location with a demonstrable threat score). Accordingly, the Permittees expect to target a variety of mitigation lands for protection, including those that will require restoration and those that are already suitable habitat for Indiana bats that meet the criteria defined in USFWS BFO's mitigation guidance. The Permittees estimate that approximately half of the total land selected for mitigation will require restoration or 48.6 ha (120 ac). Further, the Permittees do not expect that all restored habitat will require invasive species management, and for the purposes of budgeting costs for the HCP, has assumed that approximately half of the total restored area (24.3 ha [60 ac] will require invasive species management.[26]

Therefore, costs for summer habitat mitigation, which are detailed in Table 6.1, include acquisition of 48.6 ha of forested habitat (expected to require restoration) in Year 10 (i.e., five years before they are required to offset take), acquisition of the remaining 48.6 ha (which are not expected to require restoration) in Year 14 (one year before they are required to offset take), restoration and maintenance of 48.6 ha of the total acquired habitat, and invasive species management on half of the restored mitigation land (24.3 ha) seven to 10 years after planting. These estimates include an assumed 2.9% annual increase to account for inflation.

Funding for land acquisition and restoration for summer habitat mitigation will be guaranteed by increasing the cash balance of the Surety to an amount equal to the funding required to complete the mitigation at least one year before the mitigation is required. Funding for acquisition of 48.6 ha of summer habitat will be placed in the Surety in Year 9, one year before it is needed. Since habitat acquired in Year 10 of the ITP will require restoration, the funding placed in the Surety in Year 9 includes the estimated cost of land acquisition, plus the costs of restoration and maintenance. Funding for the acquisition of the remaining 48.6 ha of land (expected to be forested and functionally suitable Indiana bat habitat) will be placed in the Surety in Year 13, one year before it is needed.

Costs for required monitoring for summer habitat mitigation include costs for habitat suitability surveys in Years 9 and 13; restoration success surveys in Years 13 and 17; biennial aerial

[26] However, if more than 48.6 ha require restoration, or more than 24.3 ha require invasive species management to meet mitigation goals, FRWF will provide funds necessary to restore and manage the additional mitigation lands.

surveys starting in Year 12 to ensure that mitigation land is being protected and adequately restored; colony presence surveys in Years 9 and 13; colony persistence monitoring every three years starting in Year 17; and reporting in any year in which a mitigation action or monitoring occurs (see Table 6.1 for a breakdown of costs and Table 6.2 for funding timing). All costs were estimated based on either 2012 or 2013 estimated costs and increased by 2.9% annually to account for estimated inflation.

Funding for monitoring (including surveys and reporting for habitat suitability, tree survival, restoration success, and colony presence/persistence) of summer habitat mitigation will be self-funded through the annual operation and maintenance budget, although, similar to mortality monitoring, funding for one year of mitigation monitoring will be placed in the Surety in advance of the year it is needed. Refer to Table 6.1 for annual costs estimated for each monitoring activity. Because of the staggered nature of monitoring activities, the amount placed in the Surety will vary each year depending on the funds required for the next year's activities (Table 6.2). The Permittees will deposit, or withdraw, funds from the Surety to reflect the appropriate level of financial assurance. To provide further assurance that mitigation monitoring will occur, the Permittees will submit to the USFWS by March 1 of each monitoring year of the ITP a letter signed by a responsible corporate official that the Permittees have executed a contract(s) with a qualified party(s) to complete the required monitoring activities.

Table 6.2 Estimated costs and timeline for funding assurance for each obligation of the Fowler Ridge Wind Farm Habitat Conservation Plan (funding assurance provided by a Surety for all items).

HCP Obligation For Which Assurance is Required	Estimated First Year or Total Cost[ab]	Year Deposited into Surety[c]
Annual Meetings	$530	0
Annual Mortality Monitoring & Reporting	$54,071	0
Wyandotte Cave Re-Gating Project	$48,399	0
Summer Habitat Land Acquisition - Year 10	$558,989	9
Summer Habitat Land Acquisition - Year 14	$626,707	13
Summer Tree and Cover Crop Installation	$501,245	9
Site Management (Mowing)	$33,286	10
Site Management (Invasive Species Control)	$25,822	17
Habitat Suitability Survey	$5,182	8
Aerial Survey	$117,193	11
Restoration Success Survey	$15,295	12
Colony presence survey	$46,677	8
Colony persistence monitoring	$37,243	16
Summer Habitat Mitigation Reporting	$8,518	8

Table 6.2 Estimated costs and timeline for funding assurance for each obligation of the Fowler Ridge Wind Farm Habitat Conservation Plan (funding assurance provided by a Surety for all items).

HCP Obligation For Which Assurance is Required	Estimated First Year or Total Cost[ab]	Year Deposited into Surety[c]
Changed Circumstance	$1,331,153	Deposited into Surety in Years 1 ($48,399) and 13 ($1,282,754). Balance to be held in Surety until the permit expires.
Contingency	$67,622	Deposited into Surety in Year 0. Balance to be held in Surety until the permit expires.

[a] Totals are based on the first year the action needs to be implemented. Values have been adjusted for 2.9% annual inflation from 2012 or 2013 estimated costs.
[b] Amount to be adjusted annually based on next year's commitment and previous year's spending.
[c] Funds are deposited into a Surety one year before they are estimated to be needed.

6.2 Changed Circumstances Fund

Reasonably foreseeable circumstances described in Chapter 8 could prompt the need to restore or replace one or more mitigation projects. Due to the uncertainty surrounding future impacts from changed circumstances and effective measures to rectify them, the Permittees will provide a Surety in order to assure that funds will be in place for future restoration actions directly related to degradation of mitigation land from changed circumstances.

In the case that a changed circumstance response is triggered, activities described in Chapter 8 will be implemented to restore and enhance the affected mitigation lands. Potential responses to changed circumstances include repairing the Wyandotte Cave gate or implementing a different cave gating project if the Wyandotte Cave gate is ineffective, or replanting trees if fire or other natural disasters damage summer habitat.

The costs associated with changed circumstances are difficult to predict because they are dependent on unknown future events. Although it is reasonably foreseeable that some changed circumstances will occur over the life of the ITP, it is very unlikely that multiple changed circumstance events would occur that would result in mitigation failure. The Permittees consider it unlikely that changed circumstances will destroy the winter habitat mitigation more than once. Similarly, the Permittees consider it unlikely that a single changed circumstance event will deforest all 97.1 ha (240 ac) of mitigation land because mitigation land will likely be made up of disjunct parcels (with a minimum size of 24.3 ha [60 ac]), and also because most of the changed circumstance events identified in Chapter 8 that could destroy summer habitat are rare in Indiana.

Therefore, the Permittees will create a changed circumstance Surety in the amount equal to the cost of the original winter habitat mitigation project in Year 1 of the ITP ($48,571) to provide assurance that the winter habitat mitigation project could be replaced if needed. Should changed circumstances destroy the winter habitat mitigation more than once, the Permittees will commit the appropriate funds necessary to replace the mitigation and the annual operating budget will be the funding source for the additional funds needed.

Additionally, the changed circumstance Surety will contain funds sufficient for replacement of half of the total summer habitat mitigation (i.e., 48.6 ha) as a result of a single changed circumstance event, because that is all that is expected to be lost. The cost estimate for funds placed in the Surety for changed circumstances is based on acquisition of 46.8 ha in Year 10 (at an estimated cost of $8,649/ha [$3,500/ac]) in 2013 (and adjusted for inflation at 2.9% per year –total of $558,989) and restoration and maintenance in subsequent years ($723,765 – see Table 6.1 for breakdown of costs for restoration and maintenance), for a total changed circumstance Surety of $1,331,153. Note that this amount is an estimate, and the Surety would be updated at the time of the changed circumstance to reflect the true cost of replacement. Evidence of the Surety will be provided to the USFWS in Year 13 of the ITP (one year prior to all summer mitigation land being protected). Should a changed circumstance event deforest the entire mitigation area (i.e., 97.1 ha of mitigation lands), the Permittees will commit the appropriate funds necessary to restore, monitor, and manage the entire 97.1 ha area. The annual operating budget will be the funding source for these additional funds. Since monitoring of the newly restored mitigation land will be dependent upon the timing of the changed circumstance event, these costs will be estimated at the time of the changed circumstance and funding necessary for each year of monitoring will be placed in the Surety one year before it is needed.

The Surety will be made payable to the independent contractor or consultant selected to conduct the restoration/enhancement, maintenance, and monitoring associated with the changed circumstance. Application of changed circumstances funds towards corrective measures will occur when a changed circumstance trigger, identified in Chapter 8, has been met. Should changed circumstances result in the need for the Permittees to expend additional funds than those estimated here, the Permittees will increase the cash escrow commensurate with the costs for such actions as determined at that time. If a changed circumstance triggers a response and the Surety is depleted to fund the response, the Surety will be maintained or replenished at an amount equal to half of the mitigation value within 6 months of the Surety being depleted to fully fund any future changed circumstances events that may occur during the ITP Term.

6.3 Contingency Fund

The purpose of this contingency amount is to provide a reasonable “buffer” if costs estimated in this chapter are higher than anticipated. The Contingency Fund takes 5% of the annual base costs that will be placed in a Surety to provide funding assurance (Table 6.3). Note that the estimated first year costs are different from those reflected in Table 6.1 because they have been adjusted for inflation from 2012 estimated costs, according to the year in which the action is anticipated to be implemented.

Consequently, this equals a total contingency base of $1,352,449; 5% of which equals $67,622. This total will change year to year as the assured funding is revised based on year-ahead monitoring estimates, mitigation lands actually purchased and conserved (thereby eliminating the need for funding assurance), adjustments for inflation, and other factors. Every five years, the changed circumstances Surety and the resulting changed circumstances contingency Surety will be re-evaluated for current land values and inflation.

Table 6.3 Estimated first year costs for each mitigation requirement and 5% that will be placed in a contingency fund Surety for the Fowler Ridge Wind Farm Habitat Conservation Plan.

Item	Estimated First Year Cost[a]	5%
First annual meeting	$530	$27
Year 1 mortality monitoring	$54,071	$2,704
Winter mitigation and monitoring	$48,399	$2,420
Acquisition of 120 acres in Year 10	$558,989	$27,949
First year tree installation	$435,508	$21,775
First year cover crop installation	$65,737	$3,287
First year mowing	$33,286	$1,664
First year invasive species control	$25,822	$1,291
First year habitat suitability survey	$5,182	$259
First year aerial survey	$17,193	$860
First year restoration success survey	$15,295	$765
First year colony presence survey	$46,677	$2,334
First year colony persistence monitoring	$37,243	$1,862
First summer mitigation report	$8,518	$426
Total	**$11,352,449**	**$67,622**

[a] Values have been adjusted for 2.9% annual inflation from 2012 or 2013 estimated costs, based on the first year in which the action is anticipated to be implemented.

7.0 ALTERNATIVES

ESA implementing regulations and USFWS guidance for developing HCPs require that a conservation plan submitted in support of an ITP application must detail among other things, “alternative actions the applicant considered that would not result in take, and the reasons why such alternatives are not being utilized” (USFWS and NMFS 1996, Page 3-1). As such, the Permittees evaluated alternatives that would avoid take of Indiana bats. Additionally, FRWF evaluated other alternatives to the proposed action that would result in varying levels of Indiana bat take, to ensure that a thorough analysis of all alternative actions was conducted. In evaluating potential alternatives, the ESA § 10(a)(2)(B)(ii) provides that the USFWS shall issue an ITP if, among other things, it finds that “the applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such [incidental] taking.” These criteria were considered when evaluating the following three alternatives analyzed in this HCP:

1) Operation of the Project without an ITP that includes operational adjustments that avoid Indiana bat take;
2) Operation of the Project with an ITP with minimization that includes feathering below a cut-in speed of 4.0 m/s and off-site mitigation; and

3) Operation of the Project with an ITP with minimization that includes feathering below a cut-in speed of 5.0 m/s and off-site mitigation (proposed action).

A description of these alternatives follows, including the reasons why each was, or was not, chosen.

Action Alternative 1: Operation of the Project without an ITP – Complete Operational Curtailment to Avoid Indiana Bat Take; No Off-Site Recovery Plan-Based Mitigation Measures

Under this alternative, take of Indiana bats would be completely avoided by curtailing turbines during the period when Indiana bats are likely to be at risk of collision with turbines. Based on the best available scientific information and results from the on-site monitoring (see Chapter 5.2.2 and Appendix A), this would include the period from sunset to sunrise during the fall migration season, August 1 to October 15 (USFWS 2007). Complete nightly curtailment of the wind turbines (i.e., turbines feathered and non-operational) during fall migration is expected to eliminate the risk of take for Indiana bats migrating through the Project area. Because no take would be expected, no mitigation would be implemented. Therefore, this alternative would include complete operational curtailment and would not result in off-site Recovery Plan-based mitigation measures.

This alternative was not chosen by the Permittees for the following reasons: 1) it would not meet the purpose and need for the Project; and 2) the negative effects on the Permittees would be significant and the Project would not be economically feasible.

The purpose of the FRWF is to maximize energy production using reliable sources of wind energy that in turn advances the national renewable energy objectives. The Project will also improve local economic opportunities, while minimizing short- and long-term environmental impacts associated with greenhouse gas emissions and carbon output. The Project companies have already guaranteed the availability of the facility to the off-takers in their Renewable Energy Purchase Agreements. Availability is the ratio, expressed as a percentage, of the minutes the wind turbines are available to operate over the total number of minutes in a year. Completely curtailing the WTGs during night time hours of the fall migration season reduces annual availability by approximately 9%, which has potential contractual consequences that would result in the project not being economically viable. Should actual availability fall below the guarantee, the Project companies would not meet their availability obligations.

The complete curtailment alternative would not achieve the availability requirements for the Project and would render it economically infeasible. Additionally, the Permittees have entered into contractual agreements after early coordination with the USFWS prior to construction (Appendix D). The contractual agreements for the Project, including availability, were based in part on the early coordination, which indicated that there was little concern over potential impacts to Indiana bats considering the project location. Thus, operational adjustments that affect availability were not expected to be needed and not factored into the contractual obligations.

Action Alternative 2: Operation of the Project with an ITP – On-site Minimization (Feathering Below 4.0 m/s Cut-In) and Off-site Mitigation for Indiana Bat Take

This alternative would include feathering turbines below a cut-in speed of 4.0 m/s from sunset to sunrise during the fall migration period (August 1 to October 15). This alternative would also include off-site Recovery Plan-based mitigation measures to compensate for expected Indiana bat take. Results from two publicly available curtailment effectiveness studies (refer to Chapter 4.1.1.2 for detailed description of studies and Table 4.5 for a summary) indicate that this would result in an average 61% reduction in bat mortality (Table 4.5).

This Alternative was considered because it met the purpose and need of providing clean, renewable energy, advancing national renewable energy objectives, and minimizing short- and long-term environmental impacts associated with greenhouse gas emissions and carbon output. This alternative also allows for an economically viable project for the Project companies and participating land owners, thus improving local economic opportunities. This alternative would allow Project companies to meet their Renewable Energy Purchase Agreements and guarantees with regards to the availability of the facility to off-takers.

This Alternative was not selected because, although current data suggests that cut-in speeds of 4.0 m/s and higher substantially reduce bat mortality (61% on average; Table 4.5), the findings are based on a limited number of studies (only two studies tested the effectiveness of curtailing turbines at 4.0 m/s; Baerwald et al. 2009, Young et al. 2011) and are not yet definitive. In addition, although implementing curtailment above a cut-in speed of 4.0 m/s materially increases costs, the Permittees selected a different alternative that provides even greater protection to the Indiana bats.

Action Alternative 3: Operation of the Project with an ITP – On-site Minimization (Feathering Below 5.0 m/s Cut-In) and Off-site Mitigation for Indiana Bat Take (Proposed Action)

This alternative is the proposed action and considers: 1) the commercial operation of the Project for a period of 21 years; 2) on-site minimization through turbine operational changes that are projected to reduce take by at least 50% during the fall migration period (average reduction in bat mortality achieved from raising cut-in speeds to 5.0 m/s in publicly available curtailment effectiveness studies was higher; 68% Table 4.5); 3) funding to support Recovery Plan-based off-site mitigation; and 4) the use of adaptive management to evaluate whether future additional measures may be necessary or practicable to minimize unexpected levels of Indiana bat take. Considering the value of both minimization measures and Recovery Plan-based mitigation to Indiana bat viability and recovery, the Permittees propose this alternative is the best approach for meeting the adequacy, maximum extent (Appendix J), and practicability cost considerations for minimizing and mitigating estimated Indiana bat take from the Project.

8.0 PLAN IMPLEMENTATION / CHANGED AND UNFORESEEN CIRCUMSTANCES

8.1 Plan Implementation

The Permittees will implement the HCP upon issuance of the ITP and according to the IA (Appendix G). The Permittees will be solely responsible for meeting the terms and conditions of the HCP, the ITP, and the IA, and will allocate sufficient personnel and resources to ensure the effective implementation of the HCP, in coordination with the USFWS and the IDNR. A BPWENA Environmental Manager, who will act as an HCP Coordinator, will be identified by the Permittees in coordination with the USFWS. The role of the HCP Coordinator will be to oversee the HCP implementation, plan and coordinate all meetings with Project stakeholders, organize necessary training of management staff, oversee allocation of funding for mitigation, monitoring, and changed circumstances, and ensure timely delivery of all reports to the USFWS and the IDNR.

It is anticipated that the ITP will be issued in 2014, prior to the fall migration period for Indiana bats. The Permittees will immediately implement the HCP upon receipt of the ITP, which will include implementation of minimization measures in the form of turbine feathering below a cut-in speed of 5.0 m/s starting on August 1, 2014 and continuing through October 15, 2014, on a nightly basis from sunset to sunrise, as described in Chapter 5.

Take compliance monitoring studies will start on August 1, 2014 and continue until October 15, 2014. Monitoring will be conducted during the Evaluation Phase in Years 1-2 and during the Implementation Phase in Years 3-21, unless Re-Evaluation Phase monitoring is required due to a change in project operation triggered by adaptive management. Annual monitoring for both phases will be conducted from August 1 to October 15. Take compliance monitoring will be carried out by USFWS-approved third party contractors with expertise in conducting avian and bat fatality studies at wind facilities. The WIRS will be in place for the life of the Project and will be conducted by FRWF O&M staff and overseen by the HCP Coordinator.

Take compliance will be determined by tallying the annual estimated Indiana bat fatality rates to derive a cumulative take that occurred over the 21-year operational life of the Project. If the within-season adaptive management trigger is reached in a given year, annual take for that year that will count towards the life of Project total will be based on both control and non-control turbines (i.e., those that were subject to increased cut-in speeds). Note that this is different than the fatality rate based on only the 20 control turbines that will be used to determine whether or not the end of season adaptive management trigger has been reached (i.e., the 95th percentile has been exceeded and cut-in speeds of all turbines need to be increased by 0.5 m/s in the subsequent year). In other words, the fatality rate based on control and non-control turbines will be used to determine actual take that has occurred in a given year, but only the 20 control turbines will be used as the basis for adaptive management decisions during years when the within season adaptive management trigger has been reached.

Mitigation measures, namely summer habitat protection, summer habitat restoration, and hibernaculum gating, will be in place from their inception for the duration of the ITP, and both are expected to be in place and functioning for years after the permit has expired. One component of mitigation, re-gating of the Wyandotte Cave, will be implemented during the first year of the permit term after issuance of the ITP. Installation of the bat gate will be carried out by an experienced independent contractor, under the direction of BCI.

Biennial surveys of the Wyandotte Cave will be carried out by IDNR and USFWS personnel as part of their standard biennial monitoring of the species' status, which will begin during the first or second winter (depending on the schedule for USFWS biennial monitoring after the mitigation action is implemented), and will continue every two years thereafter for the life of the permit. Ongoing monitoring of the cave gate and cave environment with speloggers and dataloggers installed within the Wyandotte Cave entrance will be conducted by the IDNR, in cooperation with the USFWS, on an annual basis from Years 1 to 12 of the mitigation project, as described in Chapter 5.4.3.2. However, if the IDNR or the USFWS cannot continue those monitoring efforts, the Permittees will receive authorization and be required to provide funding and personnel to complete those monitoring efforts.

The second component of mitigation for incidental take, protection and restoration of summer habitat, will stay at least five years ahead of the estimated take over the life of the ITP. Winter habitat mitigation will offset the impacts of 66% of the total estimated take from the Project. Sixty-six percent of the 21-year permit term equates to approximately 14 years, whereas summer habitat mitigation will account for the remaining 34% of the take, which equates to approximately seven years of the 21-year permit term. To make sure that habitat is protected and any restoration efforts have adequate time to mature and begin providing mitigation value, the summer mitigation land in need of restoration (48.6 ha) will be acquired no later than five years before it is needed to offset take (i.e., Year 15), which would be Year 10. The remaining 48.6 ha of summer mitigation land (that will not require restoration because it will be suitable for Indiana bat use in its current condition) will be implemented in Year 14, one year before it is required to offset take. Pre-construction assessments and ongoing effectiveness monitoring for the summer mitigation plan will be carried out by third party contractors with expertise in Indiana bat survey techniques and behavior. The Permittees will submit to the USFWS by March 1 of each monitoring year of the ITP a letter signed by a responsible corporate official that the Permittees have executed a contract(s) with a qualified party(s) to complete the required monitoring activities.

Further details for implementing the HCP are provided in the IA (Appendix G).

8.2 Meetings

The Permittees will implement the monitoring program in compliance with this HCP and in consultation with the USFWS. As part of this coordination, annual meetings will be held with the USFWS sometime between December and February during Years 1 and 2 of Project operations. Meetings will be held every five years thereafter (Years 6, 11, 16, 21) and on an as-needed basis during in-between years. The primary objectives of meetings will be to:

- Review the results of the previous years' compliance and mitigation monitoring;
- Evaluate the effectiveness of the minimization plan and mitigation projects;
- Discuss changes to the minimization, mitigation, or monitoring plans, as appropriate; and
- Discuss new information or research that may be relevant to the ongoing implementation of the minimization and monitoring plan.

Meetings between the USFWS and the Permittees will also provide the opportunity to review the population status of Indiana bats in response to WNS or changed circumstances, the listing status of other bats or birds potentially in the Project area, and advances in technology that could supplement or replace existing minimization measures to reduce Indiana bat mortality. The USFWS can also decide that no meeting is necessary, if the monitoring and mitigation program is on track.

8.3 "No Surprises" Assurances

The Federal "No Surprises" Rule, 63 FR 8859 (February 23, 1998; codified at 50 CFR §§ 17.3, 17.22(b)(5), 17.32(b)(5)) provides assurances to the permittee, provided that the permittee has properly implemented the HCP, ITP, and IA. The "No Surprises" policy states, in part (50 C.F.R. 17.22(b)(5)):

(ii) Changed circumstances not provided for in the plan. If additional conservation and mitigation measures are deemed necessary to respond to changed circumstances and such measures were not provided for in the plan's operating conservation program, the Director will not require any conservation and mitigation measures in addition to those provided for in the plan without consent of the permittee, provided the plan is being properly implemented.

(iii) Unforeseen Circumstances

(A) In negotiating unforeseen circumstances, the Director will not require the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources beyond the level otherwise agreed upon for the species covered by the conservation plan without the consent of the permittee.

(B) If additional conservation and mitigation measures are deemed necessary to respond to unforeseen circumstances, the Director may require additional measures of the permittee where the conservation plan is being properly implemented, but only if such measures are limited to modifications within conserved habitat areas, if any, or to the conservation plan's operating conservation program for the affected species, and maintain the original terms of the conservation plan to maximum extent possible. Additional conservation and mitigation measure will not involve the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources otherwise available for development or use under the original terms of the conservation plan without the consent of the permittee.

"Properly implemented" means that the commitments and the provisions of the HCP, ITP, and IA have been or are being fully implemented by the Permittees. (50 CFR § 17.3). The "No Surprises" Rule has two primary components: changed circumstances and unforeseen circumstances, which will be described in the following sections.

8.4 Changed Circumstances

Under established HCP guidance, changed circumstances refer to a variety of changing circumstances that may occur over the life of an ongoing HCP that can reasonably be anticipated and that can be planned for (HCP Handbook [USFWS and NMFS 1996, p.3-28]). Examples of changed circumstances provided by the HCP guidance include: the listing of new species, modifications in the project or activity as described in the original HCP, or modifications in the HCP's monitoring program. The HCP should discuss measures developed by the applicant to address foreseeable changed circumstances over time, possibly by incorporating adaptive management procedures for the covered species within the HCP. The HCP should identify potential changed circumstances and develop specific strategies for dealing with them. The intent of addressing changed circumstances is to provide a means for adjusting the conservation plan as necessary, to provide the best opportunity for its continued success over time and to minimize the need for an HCP/ITP amendment.

The Permittees believe the following are foreseeable changed circumstances warranting planning consideration: 1) climate change, 2) drought, 3) flooding; 4) fire, 5) tornadoes, and 6) WNS or other diseases. Each of these potential changed circumstances is addressed in the following sections, along with descriptions of triggers that will indicate the circumstances have occurred and responses that can be implemented and measured for effectiveness. For each of these triggers, the observed change must be based on objective, scientifically sound data. Based on these data, the Permittees and the USFWS will make a determination as to whether or not a changed circumstance has occurred.

Pursuant to the "No Surprises" Rule and regulations, if the USFWS determines that additional conservation and mitigation measures are necessary and they have been addressed in this HCP, implementation is required (50 CFR 17.22(b)(5)(i)). If the USFWS determines that additional conservation and mitigation measures are necessary, but they were not provided for in the plan, such conservation and mitigation measures will not be required of the permittee without their consent (50 CFR 17.22(b)(5)(ii)). If additional measures are deemed necessary to respond to an unforeseen circumstance, additional conservation and mitigation measures will not involve the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources without the consent of the permittee (50 CFR 17.22(b)(5)(iii)).

8.4.1 Climate Change

Global climate change is the observed increase in mean global temperature due to an increase in greenhouse gas emissions, primarily carbon dioxide, as a result of human industrialization (Intergovernmental Panel on Climate Change [IPCC] 2007). According to IPCC (2007), the earth's climate has warmed between 0.61 and 0.89 °C (1.1 and 1.6 °F) over the past century. Over the past 30 years, temperatures have risen more rapidly in winter than in any other season, with average winter temperatures in the Midwest and northern Great Plains rising more than 3.9° C (7 °F). Some of the changes have been faster than previous assessments had suggested (US Global Change Research Program [USGCRP] 2009).

Global climate change is also predicted to include secondary global effects, such as sea-level rise and changing weather patterns; rainfall patterns, storm severity, snow and ice cover, and sea level appear to be changing already (US Environmental Protection Agency [USEPA] 2009). As a consequence of these changes, flood, drought, and fire regimes are likely to be altered in frequency and intensity in the future. Many climate change-related impacts to wildlife are likely to manifest through species' life history changes. Species with highly specialized habitat needs, narrow environmental tolerances, that are dependent on specific climatic triggers or cues, and with limited or no ability to disperse and/or colonize new or more suitable areas are likely to be the most susceptible to climate change-related impacts.

Indiana bats have many of these life-history attributes and are, therefore, likely to be affected by climate change. However, very limited information currently exists to assess potential impacts of climate change on Indiana bats. Although the manifestations of climate change are expected to be complex and widely varied, several potential negative impacts to Indiana bats may occur and will be described in the following sections. The below sections will discuss climate change as it relates to the accelerated rate of warming, while other potential consequences of climate change will be addressed individually as other changed circumstances.

Warmer Temperatures Alter Indiana Bat Dispersal/Migration Period

Temperature increases associated with climate change may disrupt annual or seasonal events important to bats by altering seasonal cues that trigger behaviors such as mating and migration (Weller et al. 2009). A recent analysis of 866 studies on global warming's effects on wildlife found that nearly 60% of species evaluated were already showing shifts in the timing of specific seasonal events, such as migrations, at an average rate of 2.3 days per decade (Parmesan and Yohe 2003). Based on these findings, climate change has the potential to trigger changes to Indiana bat dispersal and migration periods.

The Permittees have agreed to operational restrictions during times that coincide with fall migration of Indiana bats (i.e., August 1 to October 15; see Chapter 5). If the timing of these activities shift in response to climatic warming, minimization methods included in this HCP could be less effective at minimizing take of Indiana bats. Although the timing of spring migration could also be affected by climate change, the behavior of Indiana bats during spring migration is thought, based on USFWS biologists' professional opinion, to be different than fall migration, putting them at lower risk in the spring (S. Pruitt, pers. comm.). In addition, fatality data from the Project indicates all bat fatalities are significantly lower in spring as compared to fall (see Chapter 4.1.1.2 and Table 4.1). For these reasons, the timing of the migration is not expected to put spring migrating Indiana bats at greater risk and take of Indiana bats in the spring is not expected.

Within six months of publication, the Permittees will review all newly released material by the USFWS on the status of the Indiana bat, including 5-year status reviews and revisions to recovery plans, to determine if there has been an observed change to any Indiana bat life-history periods that may necessitate the need to alter the timing of operational restrictions. Since shifts in timing of bat dispersal and migration would likely be apparent in the timing of bat fatalities at wind facilities, the Permittees will also use data from post-construction monitoring studies at wind facilities in the Midwest to document potential shifts in the timing of bat fatalities from current conditions.

Trigger – The trigger for corrective action (i.e., changes to the timing of operational restrictions) is if the USFWS designates the fall migration period for Indiana bats in the MRU as occurring prior to August 1 or after October 15, as a result of climate change. USFWS designation of a shift in Indiana bat seasonal periods could be announced in an official USFWS document, such as a revised recovery plan, 5-year status review, or in a public announcement such as the Region 3 Indiana bat website (USFWS 2013), or an updated draft of "Indiana Bat Section 7 and Section 10 Guidance for Wind Energy Projects" (USFWS 2011d). The USFWS designation of new seasonal periods would be based on credible data, including data on Indiana bats from mist-netting and telemetry studies in the region and from mortality monitoring at the FRWF and elsewhere in the Midwest.

The USFWS designation of new seasonal periods could also be determined through information contained in the Information, Planning, and Consultation System (IPaC), an on-line tool currently under development by the USFWS for federal action agencies, applicants, and other project proponents to use during project development and assessment (USFWS 2012c). The IPaC will allow project proponents to obtain ecological information, bibliographic references, and recommended conservation measures for incorporation into project designs, among other things. The IPaC, once fully functional, will provide the most current ecological information and will have the specific, approved avoidance, minimization, and mitigation measures for different construction activities. Therefore, any shifts in Indiana bat seasonal periods that would affect the timing of regional construction activities should be available in the IPaC.

Response – Based on a USFWS-documented change in the timing of fall migration from climate change, and in coordination with the USFWS, the Permittees will modify the timing of operational restrictions such that they are applied over the full duration of the newly established fall migration period. Changes to the timing of operational restrictions will be implemented during the first full calendar year after changes in activity patterns have been documented.

Warmer Temperatures Alter Indiana Bat Range

Temperature increases associated with climate change may influence northward range shifts. Such shifts have already been noted for Indiana bats (Clawson 2002, USFWS 2007; although Meretsky [as described in USFWS 2007, p. 100] noted confounding factors were involved) and have been predicted for little brown bats (Humphries et al. 2002). Humphries et al. (2002) developed a bioenergetic model for the closely related little brown bat that predicted a pronounced northward range expansion of hibernating little brown bats within the next 80 years. This model may also provide insight into potential winter distribution shifts of Indiana bats that could result from climate change. If there is a shift in the migratory population of Indiana bats, it could result in increased exposure to the FRWF, which could result in increased collision/barotrauma risk and Indiana bat fatalities. Conversely, range shifts due to climate change could result in decreased numbers of bats that will be exposed to collision/barotrauma risk from the Project if Indiana bat winter and summer populations move completely north of the Project area.

Trigger – If the following triggers are met with respect to Indiana bat range shifts in response to climate change, corrective action will be required: available acoustic data from regional pre- and post-construction monitoring studies at wind power projects indicate any increase in *Myotis* activity during the fall migration period, and other metrics of Indiana bat migratory activity (e.g., band returns collected during summer mist-netting and winter censuses, and spring emergence or fall migration telemetry studies) may indicate range shifts that result in increases in migratory activity through the Project area.

In the case of range shifts in response to climate change that result in Indiana bat winter and summer populations moving completely north of the Project area which would result in decreased exposure of Indiana bats to collision/barotrauma at the FRWF, the following triggers would have to be met for corrective action to be taken: 1) no Indiana bat fatalities are documented during the course of monitoring at the FRWF over a 2-year period; 2) biennial census data from the USFWS show that all wintering populations are north of the Project area; and 3) available data (e.g., band returns collected during summer mist-netting and winter censuses, and spring emergence or fall migration telemetry studies) show that bats in the MRU migrate northward to summer areas.

Response – In the case of the first triggers which indicate an increase in exposure of Indiana bats, the Permittees would conduct two additional years of monitoring with level of effort and sampling intensity comparable to monitoring studies conducted at the FRWF in 2010/2011 (Chapter 4.1.1.2, Appendix A) to adjust the species composition ratio (0.16%; Chapter 4.1.1.2, Table 4.2). The adjusted species composition ratio could change the estimated incidental Indiana bat take from the Project. If the newly estimated ratio based on two years of data indicates that adaptive management thresholds as defined in Chapter 5 (9, 11, or 2 Indiana bats, depending on the number of turbines in operation) are likely to be exceeded under operational restrictions in place, the Permittees will modify operational restrictions according to the adaptive management methods described in Chapter 5 and summarized in Table 5.1. If an operational change is made, two additional years of Evaluation Phase monitoring will be conducted to confirm that the new operational procedures are effective at minimizing take below the annual levels defined in Chapter 5.

In the second scenario where populations shift north of the Project, prior to normal operations (i.e., cut-in speed of 3.5 m/s) being resumed, two years of monitoring with level of effort and sampling intensity comparable to monitoring studies conducted at the FRWF in 2010/2011 (Chapter 4.1.1.2, Appendix A) would be conducted to confirm that no risk to Indiana bats exists. Two additional years of monitoring at the same intensity would be conducted after normal operations were reinstated to confirm that exposure risk has been eliminated (i.e., no Indiana bat fatalities are documented). No changes to operational restrictions would be made without the consent of the USFWS.

Warmer Temperatures Affect Winter Habitat Mitigation Project

One component of the mitigation for the FRWF is protection of a Priority 1 hibernaculum through gating. However, warming induced by climate change has the potential to adversely impact hibernacula and render them unsuitable for wintering bats by altering hibernacula temperature and moisture regimes. Similarly, protection of occupied summer habitat, the second component of mitigation for the FRWF, could be affected by climate change. However, warmer temperatures alone are unlikely to force Indiana bats to abandon summer roosts. Other factors associated with climate change, such as drought and/or increased fire frequency, have potential to make roosting conditions unsuitable. Because these factors associated with climate change are addressed in subsequent sections, summer habitat mitigation will not be addressed further in this chapter.

If warmer temperatures associated with climate change negatively affect Wyandotte Cave, bats may not be able to meet basic life history requirements and the bats may be forced to disperse to more suitable hibernacula. Dispersing bats could have limited chances for survival if the newly occupied hibernaculum is not protected from other threats. Should the Indiana bat population currently occupying Wyandotte Cave be forced to abandon it in the future due to warmer temperatures, the mitigation would no longer serve to offset the impacts of take by the FRWF.

Trigger – The trigger for FRWF to implement corrective action where temperature increases adversely affect Indiana bats at Wyandotte Cave is any increase of the average annual and seasonal air temperature within the hibernaculum due to climate change, and a 25% or more reduction in the total number of Indiana bats wintering in Wyandotte Cave (i.e., the wintering population) between any two consecutive biennial surveys. The population decrease within the hibernaculum must be attributed to any documented temperature increases in the cave and must coincide with regional increases in winter temperatures that are attributed to climate change. For this changed circumstance to be triggered, the decrease in the bat population cannot be a product of other impacts to the hibernacula that could result in changes in internal temperatures or other external factors, such as WNS. The Permittees expect that in the absence of changed or unforeseen circumstances, mitigation actions will lead to an increase in the Indiana bat population at the mitigation site over time, but a 25% reduction is provided to allow for some background variation in the population or in census results as a product of observer bias or other factors[27].

Response – In response to increased hibernaculum temperature due to climate change and confirmed reduction of the population by 25% or more at the mitigation site, the Permittees will either develop a hibernacula restoration plan to restore the hibernaculum to the level necessary to support hibernating Indiana bats, or identify an alternate mitigation site. Restoration actions at the original hibernaculum will be implemented within one year of determining the initial mitigation project failed. In the second scenario, the Permittees, in coordination with the USFWS, will identify several alternate hibernacula suitable for mitigation that have relatively stable Indiana bat populations (i.e., have fluctuated less than 25% during consecutive USFWS biennial surveys). Temperature and moisture regimes in alternate hibernacula must be suitable for Indiana bat hibernation (see USFWS 2007 for suitable conditions). Selected alternate hibernacula must also meet the condition of being a Priority 1 (i.e., current and/or historic population of more than 10,000 bats, among other criteria) or Priority 2 (i.e., population

[27] The USFWS BFO compared the results of traditionally derived ocular survey estimates to those derived from counting Indiana bats in digital photographs of the same hibernating clusters of Indiana bats (Meretsky et al. 2010; A. King, USFWS, pers. comm., as cited in Stantec 2012). This cluster-by-cluster comparison revealed that the traditional survey estimates had significantly underestimated the total number of Indiana bats hibernating in several of the largest Indiana bat hibernacula in Indiana (including Wyandotte Cave) in 2009 and subsequently exaggerated the decline of Indiana bats in the MRU since 2007 to some degree (USFWS 2010a; A. King, USFWS, pers. comm.). The USFWS BFO's analysis indicated that a significant proportion of the observed decline in the MRU between 2007 and 2009 was directly attributable to error inherent with the traditional survey techniques employed at hibernacula in Indiana. In addition, cave environments prove challenging to survey since the bats can be located in areas which may be inaccessible to humans. For example, bats may hibernate in small cracks or crevices that prevent them from being seen or photographed and thus not counted. As a result of these difficult surveying conditions, a population estimate for any given hibernaculum can fluctuate from season to season while the actual population of bats within that hibernaculum remains constant.

more than 1,000 but less than 10,000) site. Together with the USFWS, the Permittees will identify among these alternatives a suitable alternate hibernaculum to be protected within six months of USFWS approval of the new mitigation site and corresponding protection plan. Mitigation actions at the alternate hibernaculum would be completed within one year of determining that the initial mitigation project failed.

If no suitable alternate hibernaculum are available for mitigation either because they have been protected or would not yield results needed to fully mitigate the impacts of the take, the Permittees, in coordination with the USFWS and its partners, will identify an alternate mitigation project to account for the unmitigated balance that could include protection and/or restoration (if needed) of additional summer habitat. A plan for the alternate mitigation project will be identified and developed within one year of mitigation failure, and the alternate mitigation project will be implemented within one year after development of the plan.

8.4.2 Drought

“Drought is a condition of moisture deficit sufficient to have an adverse effect on vegetation, animals, and man over a sizeable area” (Warwick 1975, as cited in USGS 2012). Given the diverse geographical and temporal distribution of drought, and the many scales drought operates on, it is difficult to develop a definition to describe drought or an index to measure it. Common to all types of drought is the fact that they derive from a lack of precipitation resulting from an abnormal weather pattern. If the weather pattern lasts a relatively short time (i.e., a few weeks or months), the drought is considered short-term. Conversely, if the weather pattern is persistent and the precipitation scarcity lasts for several months to several years, the drought is considered to be a long-term drought. Several quantitative measures of drought have been developed in the United States, depending on the aspect of the environment affected, the region being considered, and the particular application. The Standardized Precipitation Index (SPI) is an index based on the probability of recording a given amount of precipitation, and the probabilities are standardized so that an index of zero indicates the median precipitation amount (half of the historical precipitation amounts are below the median, and half are above the median). The index is negative for drought and positive for wet conditions. As the dry or wet conditions become more severe, the index becomes more negative or positive (National Climatic Data Center [NCDC] 2009).

Two climate models for the Midwest region[28] developed for the USGCRP in 2001 (National Assessment Synthesis Team [NAST] 2001) predicted inconsistencies in future drought conditions through 2100 in response to climate change. Observed changes in soil moisture calculated from the Palmer Drought Severity Index indicate moderate to very strong increases in wetness in the eastern portions of the region. In one climate model (i.e., the Hadley scenario), even with predicted temperature increases, there is a strong enough increase in precipitation to outweigh increased evaporation, which leads to small positive changes of soil moisture content by 2100. However, in another climate model (i.e., the Canadian scenario), despite the increase

[28] Defined as OH, MI, IN, IL, MO, IA, WI, and MN

in annual precipitation, a reduction in summer precipitation, coupled with the larger increase in temperature relative to the Hadley scenario, leads to increased evaporation and reduced soil moisture content, especially during summer. In other words, the frequency and intensity of droughts by 2100 increase in the Canadian scenario, but decrease slightly in the Hadley scenario (NAST 2001).

A study examining historic climate patterns (1916–2007) in Indiana and Illinois found that although the occurrence of drought was a common phenomenon, the occurrence of exceptional drought (i.e., SPI less than -2.0), and extreme drought (i.e., SPI between -1.6 and -1.9) was reduced greatly from 1970 to 2009, and was related to an observed increasing trend in precipitation (Mishra et al. 2010). This study also found that the areal extent of exceptional and extreme droughts decreased in recent decades. Mishra et al. (2010) expected this trend to continue in the coming decades, with predicted increases in soil moisture, precipitation, and runoff as a result of future climate changes. Although future increases in the minimum and maximum temperatures were expected to result in increased water loss to the atmosphere through evapotranspiration, an associated increase in the number of months in drought within a 30-year period was only found for the mid-century period (2039–2068). During the observed climate period (1916–2007), major drought spells were identified as 1916–1921, 1934–1936, 1940–1945, 1953–1957, 1960–1966, 1971/1972, 1976/1977, and 1987–1989. Based on the analysis, Mishra et al. (2010) predicted that the duration of drought was expected to be about the same as in the last 30 years, except for under the highest emission scenario evaluated, for which there was the potential for a small increase in drought duration by the end of the current century.

Based on the aforementioned climate models, it is unlikely that extreme drought conditions will increase in the future, and instead it is more likely that extreme drought will decrease relative to historic conditions. However, if extreme drought occurs in the future, it has the potential to affect the success of summer habitat restoration efforts.

Drought Affects Summer Mitigation Project

Drought can impact the establishment and maintenance of protected herbaceous and wooded habitat. Based on predictions for drought as described above, and the fact that droughts are a recurrent feature in the Midwest, the Permittees have planned for droughts that could affect Indiana bats, including droughts (a negative SPI) lasting five consecutive years or less based on historic drought conditions over the past 30 years and predicted drought conditions over the 22-year permit term (Table 7 in Mishra et al. 2010) in Indiana (Mishra et al. 2010). Droughts lasting longer than five consecutive years will be considered unforeseen. Additionally, if a mitigation effort fails (defined in Trigger section below) as a result of drought three or more times in a 5-year period[29], the failure will be considered to be due to an unforeseen circumstance.

[29] A response will occur after the first two droughts in a 5-year period, but not on the third drought in a 5-year period; the clock will start running again in Year 6.

Trigger – The trigger for the Permittees to implement corrective action where drought affects the protection and/or establishment of wooded habitats is survival of less than 70% of the planted vegetation density (trees per acre) in any year after the third growing season of the mitigation concurrent with negative SPI values for three consecutive growing seasons (note establishment requirements are in effect for a restoration site during the first three growing seasons [refer to Chapter 5.4.3.1 for details of establishment requirements and monitoring to ensure that they are achieved). In the event that fewer than 50% of the planted trees are alive after the first year of implementation of the project, the mitigation efforts for that growing season will be deemed a failure and corrective action under changed circumstances will be required during the next growing season. If by the third growing season, greater than 70% of planted vegetation survives, but an experienced professional (e.g., an International Society of Arboriculture-certified arborist) determines that greater than 50% will be permanently impaired (e.g., inordinately subject to disease, blow-down, etc.), corrective action will also be required.

Response – In the event the preceding triggers occur, the Permittees will implement one of the following corrective actions within one calendar year from the date that the mitigation effort is deemed to have failed as a result of drought:

1) Restore or replace the existing mitigation on-site (a new 3-year cycle will be triggered to reach the 70% goal); or
2) Reestablish the original level of mitigation (equivalent tree planting on the same number of acres) at a new site (an additional year will be allowed if this option is selected to acquire the necessary easement).

8.4.3 Flood

Average annual precipitation in Indiana was 101.9 cm (40.1 in) from 1901 to 2000 and ranged from approximately 76 to 107 cm (30 to 137 in; National Climate Data Center [NCDC] n.d.).Floods in Indiana generally occur during the winter and early spring (NCDC 2012) as a result of high precipitation and ground saturation, which can be made more extreme by melting snow in the spring. In terms of flood history in counties where summer mitigation will be focused, the NCDC Storm Events database (NCDC 2012), which reports data from 1950 to 2012, was used to determine the frequency of past flood events. Based on 1,139 flood events in Indiana from 1995 to 2012, the average duration of flooding is six days (minimum was one day and maximum was 30 days, as determined from reported flood event begin and end dates reported in the database). Eighty-one percent of floods occurred between the months of January and June, with the majority (22%) occurring in the month of March and 66% of the flood events occurred during 2007-2008.

The NCDC Storm Events database lists five flood events that occurred in Putnam County (occurring over the years 2008 to 2010). Damages ranged from no damage to $12,000 in property damage and $500 in crop damage; no human fatalities or injuries were reported.

Tippecanoe County had many more flood events: 36 flood events were reported (occurring over the years 2006 to 2012), with property and crop damages ranging from $0 to $500,000 (property) and $5,000 (crop) and no injuries or fatalities. Similarly, Vermillion County had 45 flood events (occurring over the years 2006 to 2009), with property and crop damages ranging from $0 to $100,000 (property) and $8,000 (crop) and no injuries or fatalities. Warren County had 29 flood events (occurring over the years 2006 to 2010), with property and crop damages ranging from $0 to $100,000 (property) and $5,000 (crop) and no injuries or fatalities. Although flooding appears to have been fairly frequent in the counties where mitigation will be focused during the past several years, the floods have caused minimal damage and appear to have not been severe enough to cause damage to mitigation lands. However, as a result of climate change, it is likely that flood frequency and intensity may increase in Indiana in the future.

During the past 50 years, the greatest increases in heavy precipitation in the United States occurred in the Northeast and the Midwest (USGCRP 2009). For the Midwest region, both summer and winter precipitation have been above average for the last three decades, the wettest period in a century, and heavy downpours are now twice as frequent as they were a century ago (USGCRP 2009). The Midwest has experienced two record-breaking floods in the past 15 years (NCDC 2009). In the Midwest, precipitation is projected to increase in winter and spring, and to become more intense throughout the year. This pattern is expected to lead to more frequent local and regional flooding.

It is difficult to predict flood events, since flooding depends on rainfall patterns across a wide area, stream capacity, runoff potential, and other factors. The Federal Emergency Management Agency (FEMA) defines a 100-year flood as a flood having a 1% chance of occurring in any given year. Thus, over time it is expected that this type of flood would occur once every 100 years, on average. However, due to the unpredictability of flooding the frequency of this magnitude of flood could be more than once in 100 years. In contrast, FEMA defines a 1-year flood as having a 100% chance of occurring each year, on average, even though in the short term, flooding does not necessarily occur every year.

Land cover within the mitigation area consists mostly of cultivated crops and developed areas, interspersed with fragmented parcels of forest (which are the focus of the mitigation measures) and limited areas of pasture and grassland. There are a number of intermittent and perennial streams and rivers within the four summer mitigation counties. The Wabash River runs through Tippecanoe and Warren counties, the Vermillion River runs through Vermillion County, which is also bordered by the Wabash River, and Big Walnut Creek and Raccoon Creek run through Putnam County. Although FEMA flood maps were only available for Tippecanoe County, the general pattern for that county, as well as other counties in the region, is that the 100-year flood hazard areas are limited to the immediate proximity of streams and rivers.

Since mitigation will likely focus on riparian habitats within these counties, mitigation lands may be susceptible to flooding under high-water conditions. However, the extent of flooding and damage to planted or established trees will depend on the rate at which water levels rise, topographic and soil conditions, and many other factors.

Flooding Affects Mitigation Site

Flooding is a natural event in stream systems and has both beneficial and detrimental effects on natural communities. Beneficial effects of flooding include thinning of undergrowth, distributing nutrients to surrounding floodplains, and promoting suitable Indiana bat roosting conditions in trees, such as sloughing bark and snag development. However, detrimental effects could result if flooding rendered a hibernaculum unsuitable for roosting bats, or if suitable roost trees were taken down by flooding in an area occupied by a maternity colony. Inundation of a hibernaculum could drown bats, alter the configuration of the hibernaculum opening that could change future temperature and airflow conditions, or increase moisture in the cave. Although flooding is a well-known issue for some Indiana bat hibernacula which have been designated as Ecological Traps in the 2007 Recovery Plan (USFWS 2007), flooding at Wyandotte Cave would be considered unforeseen due to the physical location of the cave, the topography of the surrounding area, and the lack of surface water due to the karst bedrock that characterizes the region (J. Kennedy, BCI, pers. comm.). Therefore, changed circumstances related to flooding will be addressed for summer habitat mitigation only.

> **Trigger** – The trigger for the Permittees to implement corrective action is if a severe flood (i.e., a 50-year flood, or a flood having a 2% chance of occurring in any given year) removes established trees or those planted during restoration efforts, and it is determined that the flood was the cause of adverse effects to the mitigation site(s). Even though a 50-year flood event could occur more than once during a 50-year period, as described above, it would be considered unforeseen for more than two of these severe flood events to occur over a 5-year period. Therefore, if replanting of trees in summer mitigation areas is required as a result of severe flooding more than two times in any 5-year period, the third flooding event will be considered an unforeseen circumstance. Although only severe floods are expected to have the magnitude to damage summer mitigation lands, if floods of less severity damage mitigation lands, those floods will trigger a response as well.
>
> **Response** – If flooding (sever or otherwise) removes trees protected or planted for mitigation, the Permittees would replant areas affected by the flood. A one-year time frame for development and approval of a restoration plan will be allowed in the year following the flood. Restoration actions will be implemented in the year immediately following approval of the restoration plan. The USFWS provides guidelines for summer habitat restoration (Appendix C) but generally a successful restoration will require tree planting of diverse species including native hardwoods, softwoods, and cottonwoods at a density of 544 trees per ac (2.4 m X 3.0 m [8 ft X 10 ft] spacing; USDA-NRCS 2006). A viable mitigation site will have seedling survival of 70% or more at the end of the first three growing seasons and stand density of 70% from that point on, which will allow for inevitable loss (and volunteering) of some trees, but result in a restored site providing

appropriate habitat for Indiana bats. Invasive species that threaten the success of the summer habitat mitigation will be controlled or removed between seven and 10 years after implementation of the project. If restoration efforts fail to meet these compliance criteria, then the Permittees will follow guidelines in the adaptive management plan detailed in Chapter 5.4.5.1.

Flooding Affects Compliance Monitoring

If flooding were to occur at the FRWF, there is potential that access could be restricted to some or all search turbines during take compliance monitoring.

Trigger – In the case of flooding that restricts access to some or all search turbines, monitoring would be postponed until flood waters have receded and normal monitoring activities can resume. However, if flooding prevents monitoring activities from being conducted, corrective action will be taken. Restriction in access for monitoring activities must exclusively be the result of flooding, and not due to other unforeseen factors.

Response – If flooding affects access to turbines selected for monitoring, the Permittees will immediately select alternate turbines to be searched that are not affected by flooding. Monitoring will continue throughout the regularly scheduled monitoring period, regardless of how many turbines are available to be searched. At the conclusion of the monitoring period, a decision will be made as to the adequacy of monitoring for the purposes of developing a reliable take estimate. This will be dependent upon the number of turbines that were able to be searched and the portion of the monitoring period that may have been missed due to inaccessible turbines. If it is determined by the Permittees, with concurrence by the USFWS, that sample sizes were insufficient to develop a reliable take estimate, the estimate of annual take will be assumed to be the same as that determined from the previous year's monitoring results. If sample sizes were insufficient to calculate a reliable take estimate during the flood year, monitoring in the year following the flood would be conducted with the same sampling regime as that scheduled for the year during which flooding occurred. In other words, if flooding restricted access for monitoring during an Evaluation Phase monitoring year, then Evaluation Phase monitoring would be repeated the following year.

8.4.4 Fire

Fire is a naturally occurring component of most ecosystems. In reviewing data on historic natural fire regimes (Fire Sciences Laboratory 2000), there is a range of historic fire return rates and severity for the Midwest. Most of the Midwest, being largely agricultural, was categorized as Agriculture/Non-Vegetative Areas, however, for areas with natural vegetation fire frequencies were commonly categorized as occurring every 35-100 years and having mixed severity. Some portions of most Midwest states, including Indiana, historically had more frequent fires (every 0-35 years), with some of stand replacement severity. Limited information is available to understand the potential changes in fire frequency as a result of climate change. With increased drought, there is an increased chance of more frequent and intense fires. Given the uncertainty and variability in increased drought conditions in the Midwest throughout the remainder of the twenty-first century, it is not possible to predict changes in fire frequency and intensity over the 22-year operational life of the Project. However, given that there is potential for fire to reduce or eliminate the effectiveness of mitigation efforts, the Permittees will take corrective action to restore or replace mitigation efforts should they be affected by fire.

Fire Affects Mitigation Site

Fires have the potential to adversely impact hibernating Indiana bats or those roosting in a forest. If a fire is in close enough proximity to a hibernaculum and of sufficient intensity, smoke from fires may injure or kill Indiana bats at hibernacula. Fires can also destroy swarming and/or summer habitat. Fires could destroy Indiana bat roosts and kill pups and adults, as well as significantly reduce the survival of protected and/or planted vegetation in wooded habitats, thereby making these habitats unsuitable for the basic life history requirements of the species.

> **Trigger** – In the case of winter habitat mitigation, corrective action will be taken if: 1) a stand-replacing fire[30] occurs that damages greater than 30% of the wooded habitat within 16 km (9.9 mi) of Wyandotte Cave[31], 2) the population of Indiana bats hibernating in Wyandotte Cave subsequently decreases by 25% or more as documented during the first biennial census following the fire, and 3) no other impacts are documented that could have caused the population decline. the Permittees expect that in the absence of changed or unforeseen circumstances, mitigation actions will result in a stable or increasing Indiana bat population at the mitigation site over time, but a 25% reduction is provided to allow for some background variation in the population or in census results as a product of observer bias or other factors.
>
> In the case of summer habitat mitigation, the trigger for the Permittees to implement corrective action is if fire adversely affects any portion of lands protected or restored for summer habitat mitigation. Fires that damage or destroy forested areas outside of Wyandotte Cave or at summer mitigation areas three or more times within a 5-year period will be considered an unforeseen circumstance and will not require a response from the Permittees .
>
> **Response –** The corrective action that will be taken if fire destroys more than 30% of the wooded habitat within 16 km of the hibernaculum (and the other triggers for winter

[30] "Fire that kills all or most of the living upper canopy layer (in a forest or woodland, the overstory trees) and initiates succession or regrowth" (National Wildfire Coordinating Group, Incident Operations Standards Working Team 1996, as cited in USDA Forest Service 2012).

[31] This is based on the mitigation success standards defined by the USFWS BFO (Appendix C), which state that at least 70% success of planted trees is required to establish suitable summer Indiana bat habitat. While swarming habitat serves a different purpose than summer habitat, Indiana bats use both of these areas to forage and commute between roosting and foraging areas and thus habitat requirements are assumed to be similar. The 16-km radius around the cave was chosen to represent the area most important to Indiana bat overwinter survival and that is likely to be most intensively used by swarming bats, although Indiana bats have been documented traveling over 31 km (19 mi) from the Wyandotte Cave during the fall swarming period (Hawkins et al. 2005).

mitigation are met), is to restore the areas affected by the fire or to select an alternate mitigation site. A two-year time frame[32] following the fire will be allowed for confirmation that the wintering population has been reduced by at least 25% and for approval of a restoration plan or an alternate mitigation project

The corrective action that will be taken if fire destroys any of the wooded habitat in summer mitigation areas is to replant areas affected by the fire. A one-year time frame for development and approval of a restoration plan will be allowed in the year following the fire. Restoration actions will be implemented within one year following approval of the restoration plan. The USFWS provides guidelines for summer habitat restoration (Appendix C) but generally a successful restoration will require tree planting of diverse species including native hardwoods, softwoods, and cottonwoods at a density of 544 trees per ac (2.4 m X 3.0 m spacing; NRCS 2006). A viable mitigation site will have seedling survival of 70% or more at the end of the first three growing seasons and stand density of 70% from that point on, which will allow for inevitable loss (and volunteering) of some trees, but result in a restored site providing appropriate habitat for Indiana bats. Invasive species that threaten the success of the summer habitat mitigation will be controlled or removed between seven and ten years after implementation of the project. If restoration efforts fail to meet these compliance criteria, then the Permittees will follow guidelines in the adaptive management plan detailed in Chapter 5.4.5.1.

8.4.5 Tornadoes

A tornado is a “narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground” (NOAA National Severe Storms Laboratory 2012). Tornadoes are naturally occurring phenomena which occur most frequently in the United States in the region between the Rocky and Appalachian Mountains. In Indiana, tornados occur most frequently in the late spring and early summer. In terms of tornado history in counties where summer mitigation will be focused, the NCDC Storm Events database (NCDC 2012), which reports data from 1950 to 2012, was used to determine the frequency of past tornadoes. Based on 1,500 tornadoes that occurred in Indiana from 1950 to 2012, 60% occurred between the months of April and June. The average number of tornadoes that occurred annually in Indiana from 1950 to 2012 was 24 (range from two to 69).

Then NCDC Storm Events database lists 16 tornadoes that occurred in Putnam County (occurring over the years 1961 to 2003) with property and crop damages ranging from $0 to $250,000 (property) and $5,000 (crop), 10 injuries, and one fatality (in 1990). Tippecanoe County had many more tornadoes: 40 tornadoes were reported (occurring over the years 1953 to 2011), with property and crop damages ranging from $0 to $300,000 (property) and $2,000 (crop), 87 injuries, and three fatalities (all in 1994). Vermillion County had 12 tornadoes reported (occurring over the years 1963 to 2011), with property damages ranging from $0 to $250,000,

[32] This time frame is required to allow for completion of population surveys which occur biennially. Surveys during a non-survey year would not be completed even if the changed circumstance occurs to prevent additional disturbance of the hibernating bats.

no crop damage, 8 injuries, and no fatalities. Warren County had 10 tornadoes (occurring over the years 1953 to 2008), with property and crop damages ranging from $0 to $250,000 (property) and $2,000 (crop) and no injuries or fatalities.

Tornadoes occurred sporadically over the 62-year period over which they were recorded in the counties where mitigation will be focused. Tornadoes varied in intensity as well, although Tippecanoe County had the most frequent and severe tornadoes among the four counties. Given the loss of life and injury associated with some of the tornado events, it is possible that they could have been of an intensity that would adversely affect mitigation lands. Climate change may also cause tornado frequency and intensity to increase in Indiana in the future. Because there is potential for tornadoes to reduce or eliminate the effectiveness of mitigation efforts, the Permittees will take corrective action to restore or replace mitigation efforts should they be affected by tornadoes.

Tornado Affects Mitigation Site

Tornadoes can impact swarming and/or summer habitat by removing trees used for roosting, rendering foraging areas unsuitable for use by Indiana bats, and reducing the survival of trees planted as part of restoration efforts.

> **Trigger** – In the case of winter habitat mitigation, corrective action will be taken if: 1) a tornado occurs that damages greater than 30% of the wooded habitat within 16 km of Wyandotte Cave, 2) the population of Indiana bats hibernating in Wyandotte Cave subsequently decreases by 25% or more as documented during the first biennial census following the tornado, and 3) no other impacts are documented that could have caused the population decline. The Permittees expect that in the absence of changed or unforeseen circumstances, mitigation actions will result in a stable or increasing Indiana bat population at the mitigation site over time, but a 25% reduction is provided to allow for some background variation in the population or in census results as a product of observer bias or other factors.
>
> In the case of summer habitat mitigation, the trigger for the Permittees to implement corrective action is if tornadoes adversely affect any portion of lands protected or restored for summer mitigation (the exception is initial planting survival to three years, which must be at least 70%).
>
> Tornadoes that damage or destroy forested areas outside of Wyandotte Cave or at summer mitigation areas three or more times within a 5-year period will be considered an unforeseen circumstance and will not require a response from the Permittees.
>
> **Response** – The corrective action that will be taken if a tornado destroys more than 30% of the wooded habitat within 16 km of the Wyandotte Cave (and the other triggers for winter mitigation are met), is to restore the areas affected by the tornado or to select an alternate mitigation site. A 2-year time frame following the tornado will be allowed for

confirmation that the wintering population has been reduced by at least 25% and for approval of a restoration plan or an alternate mitigation project.

The corrective action that will be taken if a tornado destroys any of the wooded habitat within summer mitigation areas is to replant areas affected by the tornado. A one-year time frame for development and approval of a restoration plan will be allowed in the year following the tornado. Restoration actions will be implemented in the year immediately following approval of the restoration plan. The USFWS provides guidelines for summer habitat restoration (Appendix C) but generally a successful restoration will require tree planting of diverse species including native hardwoods, softwoods, and cottonwoods at a density of 544 trees per ac (2.4 to 3.0-m spacing; NRCS 2006). A viable mitigation site will have seedling survival of 70% or more at the end of the first three growing seasons and stand density of 70% from that point on, which will allow for inevitable loss (and volunteering) of some trees, but result in a restored site providing appropriate habitat for Indiana bats. Invasive species that threaten the success of the summer habitat mitigation will be controlled or removed between seven and ten years after implementation of the project. If restoration efforts fail to meet these compliance criteria, then the Permittees will follow guidelines in the adaptive management plan detailed in Chapter 5.4.5.1.

8.4.6 WNS or Other Disease

WNS is a disease that is responsible for the deaths of one million or more cave hibernating bats in the eastern United States since it was first discovered in 2007 (USGS National Wildlife Health Center 2012), including Indiana bats. WNS is associated with a psychrophilic (cold-loving) fungus (*Geomyces destructans*) that grows on exposed tissues (i.e., noses, faces, ears, and/or wing membranes) of the majority of affected bats. Infected bats exhibit aberrant behavior such as chronic arousals, leading to premature loss of critical fat reserves which, in turn leads to starvation prior to spring emergence (Frick et al. 2010).

WNS was first documented in bats in New York in the winter of 2006-2007. WNS spread to newly affected states in each winter since the disease was first documented and it is now estimated that greater than five million bats have perished from Vermont to Tennessee. By the winter of 2010-2011, WNS was known or suspected to occur in a total of 19 states[33] in the Northeast, Southeast, and Midwest (White-Nose Syndrome.org. 2012). In Canada, WNS was documented in southern Ontario and Quebec in 2010 (Ontario Ministry of Natural Resources [OMNR] 2010). The origin of WNS remains uncertain, although anthropogenic introduction of the disease, via commerce or travel from Europe has been presented as a plausible hypothesis (Frick et al. 2010). WNS has been detected in European bats (Puechmaille et al. 2010, Wibbelt et al. 2010) with no associated mass casualties (Puechmaille et al. 2010, Wibbelt et al. 2010), leading researchers to believe that European bats potentially coevolved with the fungus (Wibbelt et al. 2010).

[33] CT, DE, IN, KY, MA, MD, ME, MO, NH, NJ, NY, OH, OK, PA, RI, TN, VA, VT, and WV

WNS is causing unprecedented mortality among at least six species of hibernating bats in North America: eastern small-footed bat (*Myotis leibii*), little brown bat, northern long-eared bat, tricolored bat, big brown bat, and Indiana bat (Frick et al. 2010). Gray bat (*M. grisescens*), a federally endangered species, has also been affected. Infected hibernacula are experiencing population decreases of approximately 88% throughout eastern North America, ranging from declines of approximately 12% in eastern small-footed bat populations to declines of approximately 98% in northern long-eared bat populations (Turner et al. 2011).

In an effort to better understand the underlying causes of WNS and potential solutions to stop or curb the disease from spreading, federal and state agencies, as well as academic and conservation organizations, have been monitoring the geographical spread of the disease and levels of mortality at infected hibernacula. Specimens of infected bats have been provided to research laboratories to help determine the proximate cause of death, hibernacula have been closed to public access, protocols for decontamination procedures for cavers and bat handlers have been established, and the public has been educated about WNS. Despite these efforts, to date little to no progress has been made to slow the spread of the disease.

WNS was detected in Indiana bats hibernating in the Midwest during the winter of 2009-2010. The extent to which WNS will affect Indiana bats in the MRU is uncertain. To date, only a small number of hibernacula in three states in the MRU have documented WNS: Indiana, Kentucky, and Ohio. Given that the impacts of WNS are reasonably foreseeable, but the magnitude and extent of the effects is uncertain, it is also considered a changed circumstance in this HCP.

If WNS continues to impact Indiana bats in the MRU and the potential for catastrophic decline of the Indiana bat population increases, it is likely that fewer Indiana bats will be exposed to the FRWF in the future, which will likely reduce the number of bats that will be taken by the Project than has been estimated by this HCP. However, as WNS has a larger impact on the range-wide population of the species, the importance of each individual bat to maintaining or restoring the population becomes more important. This is especially true if surviving Indiana bats have been unaffected by the disease because the bats may have a genetic resistance to WNS (if any genetic resistance exists) that can be passed on to future generations. However, the mitigation project that will be implemented as part of this HCP was designed not only to offset the impacts of the taking from the FRWF, but to provide a net conservation benefit to Indiana bats within the MRU by reducing or removing the threat of human disturbance at a Priority 1 hibernaculum, per the restoration priorities described in the Draft Indiana Bat Recovery Plan (USFWS 2007). In the presence of WNS, the importance of protecting hibernacula that host large populations of wintering bats increases, as larger hibernacula may be the most important to long term survival of the species in the event of major population declines (E. Arnett, BCI, pers. comm.).

Although WNS is outside of the control of the Permittees and the Project does not contribute to WNS, if WNS adversely affects the mitigation site, the Permittees will implement corrective action to remediate the circumstance as much as possible. Additionally, since the impacts of the taking will potentially be greater if the range-wide population is substantially reduced, additional avoidance and/or minimization measures may be implemented, as described below.

It should be noted that other diseases may also impact the Permittees' operating conservation program for Indiana bats, in which case triggers and responses similar to those provided below for WNS will be implemented for other diseases that may reduce populations at the mitigation site, MRU, or range-wide levels.

WNS Affects Mitigation Site

If WNS significantly reduces or eliminates the wintering population of bats at the mitigation site, the mitigation will be ineffective at offsetting the impacts of the take from the FRWF.

Trigger – The trigger for the Permittees to implement corrective action is if WNS causes a reduction of 25% or more in the wintering population of Indiana bats at the mitigation site, as measured between any two consecutive biennial surveys. For this changed circumstance to be triggered, the following three conditions must occur: 1) Indiana bats from the hibernaculum must be infected by *Geomyces destructans* confirmed by genetic testing, 2) the population of Indiana bats subsequently decreases by 25% or more, and 3) no other impacts are documented that could have caused the population decline. The Permittees expect that in the absence of changed or unforeseen circumstances, mitigation actions will lead to an increase in the Indiana bat population at the mitigation site over time, but a 25% reduction is provided to allow for some background variation in the population or in census results as a product of observer bias or other factors.

Response – In response to reductions in the population of Indiana bats at the mitigation site from WNS by 25% or more, the Permittees, in coordination with the USFWS, will identify an alternate hibernaculum suitable for mitigation in an area that either has not yet been infected by WNS, or that has shown stabilized populations after having documented WNS in the hibernaculum for five or more years. In this case a stable population is one that has fluctuated by 25% or less during two consecutive biennial surveys. For example, if a hibernaculum experienced a 70% decline from pre-WNS levels in the first year following infection, but that population level was maintained (i.e., less than 25% change between consecutive surveys) for at least four years thereafter, that hibernaculum would be considered stable with respect to WNS and would be an appropriate mitigation site. Any alternate hibernaculum that is selected must compensate for the remaining impact of take that has not already been mitigated for by the original mitigation project.

If no suitable alternate mitigation sites are available due to WNS, the Permittees will work with the USFWS and its partners to identify additional recovery techniques. Due to the uncertainties around impacts and solutions to WNS, effective actions that could be taken and the timeframes for their implementation are difficult to predict, but could potentially include captive recovery programs, artificial cave creation, cave fumigation or heating strategies, or other technological or scientific advancements that may become available in the future to combat WNS or restore surviving populations. The Permittees will contribute financially to these recovery strategies to such an extent that the recovery achieved by the alternate strategy is commensurate with the amount of take needing to be mitigated at the time (i.e., whatever amount of take is left when the changed circumstance occurs), irrespective of funding that has already been spent on the failed mitigation efforts. That funding amount will be put forward by the Permittees for WNS within one year following the determination that mitigation efforts have failed due to WNS. Refer to Chapter 6 – Funding for a detailed description of mitigation funding.

WNS or Other Disease Affects Indiana Bat Populations within Midwest Recovery Unit and/or Range-wide

Avoidance and minimization measures included as part of this HCP may need to be reevaluated, should impacts from WNS result in the reduction of the MRU or the species' overall range-wide population, to determine whether covered activities may jeopardize the continued existence of the species.

Trigger – The USFWS is currently developing a demographic model with assistance from the USGS that can be used to determine whether or not WNS and additional sources of mortality have the potential to result in jeopardy to the continued existence of the species. The Permittees will meet and confer with the USFWS annually during the first three years of the Project, and on an as needed basis in the remaining years of the permit duration to determine if the authorized level of take is likely to lead to jeopardy of the species. The intent of the meetings will be to evaluate existing information related to the population decline, evaluate the best available data at the time regarding impacts from wind power projects, and to determine if any additional avoidance or minimization strategies might be needed to ensure that incidental take at the FRWF would not jeopardize the species.

Response – In response to a significant identified change in Indiana bat populations within the MRU and/or range-wide as a result of WNS, the USFWS will evaluate whether or not continued take from the Project would cause jeopardy of the species to occur appreciably sooner than it would if the Project were not in operation. If it is determined that the Project would result in jeopardy of the species, the USFWS will determine how much the take authorized by the ITP needs to be reduced. The USFWS will work with the Permittees to determine which avoidance and minimization measures need to be modified to comply with the reduced take allowance. Additional minimization measures that could be evaluated to help address this changed circumstance include increased operational restrictions and implementation of new technologies that further minimize impacts to Indiana bats, such as bat deterrents or advanced warning systems that integrate data on climatic conditions and Indiana bat biology to target increased operational restrictions during limited times when bats are most at risk. Given the rapidly advancing state of technology and knowledge of Indiana bat behavior as it relates to risk from wind energy facilities, it is not possible to identify specific measures at this time. However, the

Permittees in consultation with the USFWS will continue to monitor the population effects due to WNS to determine if future action is necessary if incidental take from the Project is likely to jeopardize the continued existence of Indiana bats.

8.5 Unforeseen Circumstances

Unforeseen circumstances are defined as changes in circumstances affecting a species or geographic area covered by an HCP that could not reasonably have been anticipated by the applicant and the USFWS at the time of the development of the HCP, and that result in a substantial and adverse change in the status of the covered species (50 CFR § 17.3). The USFWS bears the burden of demonstrating that unforeseen circumstances exist and must use best available scientific and commercial data in evaluating unforeseen circumstances (50 CFR §§ 17.22(b)(5)(iii)(C) and 17.32(b)(5)(iii)(C)). In deciding whether unforeseen circumstances exist which might warrant additional mitigation from an HCP permittee, according to the HCP Handbook, the USFWS shall consider, but not be limited to, the following factors: a) size of the current range of affected species, b) percentage of range adversely affected by the HCP, c) percentage of range conserved by the HCP, d) ecological significance of that portion of the range affected by the HCP, e) level of knowledge about the affected species and the degree of specificity of the species' conservation program under the HCP, f) whether the HCP was originally designed to provide an overall net benefit to the affected species and contained measurable criteria for assessing the biological success of the HCP, and g) whether failure to adopt additional conservation measures would appreciably reduce the likelihood of survival and recovery of the affected species in the wild (HCP Handbook [USFWS and NMFS 1996]; pages 3-31).

“In negotiating unforeseen circumstances, the Director will not require the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources beyond the level otherwise agreed upon for the species covered by the conservation plan without the consent of the permittee” 50 CFR 17.22(b)(5)(iii)(A). In spite of these assurances, nothing in the “No Surprises” Rule “will be construed to limit or constrain the Services, any Federal, State, local, or Tribal government agency, or a private entity, from taking additional actions at its own expense to protect or conserve a species included in a conservation plan. (50 CFR §§ 17.22(b)(6) and 17.32(b)(6)).

8.6 Permit Amendment

HCP guidance indicates that an ITP should be amended when the permittee significantly modifies the covered activities, the Project, or the conservation plan as described in the original HCP. Such modifications may include changes in the Project area, changes in funding, addition of species to the ITP that were not addressed in the original HCP, or adjustments to the HCP due to strategies developed to address unforeseen circumstances. Depending on the circumstances, these could require either a major amendment or a minor amendment, as described below.

8.6.1 Major Amendment

A major permit amendment follows the same process as the original permit application, including an amendment to the HCP addressing the new circumstances, NEPA compliance, and ESA Section 7 consultation. A major amendment would be completed if the effect on the listed species involved and level of take resulting from the amendment is different from that analyzed under the original HCP.

8.6.1.1 Additional Species Listings

Currently, the USFWS has been petitioned to list two additional bat species under the ESA: eastern small-footed bat and northern long-eared bat (Center for Biological Diversity [CBD] 2010). Pursuant to 16 USC § 1533(b)(3)(B), the USFWS has initiated a status review of these two species. In addition, a request has been made to the USFWS to emergency list the little brown bat as a threatened or endangered species. The eastern small-footed bat's range does not overlap the Project area and future potential declines of this species would not have direct relevance to operational adjustments that will be made to minimize take of Indiana bats. The northern long-eared bat's range does overlap the Project area and this species does have the potential to be impacted by the Project, although data from post-construction monitoring studies indicate that they are one of the species least susceptible to collision/barotrauma mortality at wind facilities (Arnett et al. 2008) and only one northern long-eared bat was found in mortality monitoring studies at the FRWF from 2009 to 2011. The mitigation project could have beneficial impacts to northern long-eared bats, if these species hibernate at the selected mitigation site.

In the event that the northern long-eared bat, or any other species of bat or bird with the potential to be incidentally taken by the Project, receives a "warranted" finding for listing under the ESA by the USFWS during the 21-year life of the Project, the Permittees will take action. In response to a finding of "warranted" for federal listing, the Permittees will evaluate the potential for the Project to result in incidental take of the species. The evaluation will consider the known occurrence of the species within the Project area and results of mortality monitoring studies, as well as available data from other wind facilities. If this evaluation concludes that the Project is likely to result in incidental take of the species, the Permittees will initiate consultation with the USFWS and pursue a major permit amendment for the additional species.

The amendment will include a supplement to the HCP that analyzes the potential for take of the species, a description of how existing minimization, mitigation, and conservation measures will offset the impacts of the taking of the newly listed species, and any additional measures that may be needed to offset the impacts of the taking. It is important to note that the avoidance, minimization, and mitigation measures that will be implemented for the Indiana bat as part of this HCP are predicted to result in similar minimization of impacts and benefits to the northern long-eared bat and other bats that share similar life history characteristics, roosting and foraging behavior, and habitat with the Indiana bat. If the amendment to the HCP demonstrates that take of the warranted species is minimized and mitigated to the maximum extent practicable, and is not likely to jeopardize its continued existence, the Permittees would seek to amend the ITP prior to federal listing of the species. If it is determined by the Permittees in consultation with the

USFWS that take of the newly listed species is not likely, the HCP and the ITP will not be amended. Alternatively, in the event of a candidate species designation, the Permittees will consider preparation of a Candidate Conservation Agreement and discuss this option with the USFWS.

8.6.2 Minor Amendment

Some amendments to an HCP/ITP commonly needed over the life of a permit are minor and the amendment process may be expedited. According to HCP guidance, minor amendments include corrections/changes in land ownership; minor revisions to surveys, monitoring, or reporting procedures; or minor changes in the conservation land that result in no net loss of reserve land and do not alter the effectiveness of the HCP. Minor amendments can be incorporated into the HCP in one of two ways.

First, the HCP and permit can be formally amended. However, documentation requirements are often less for minor amendments than for the original permit application. For example, the NEPA analysis for amendment can be tiered off the NEPA analysis for the original permit (40 CFR 1502.20), or the original NEPA analysis can be incorporated by reference into the amendment's supporting documents (CFR 1502.21). Also, where an original permit application required an EIS, the amendment application might require an EA only. Where appropriate, a permit amendment can be treated as a low-effect HCP, which is categorically excluded from NEPA (HCP Handbook [USFWS and NMFS 1996]; pages 3-33).

Minor amendments to the HCP/ITP may also be amended administratively without the need for formal amendment of the permit. This type of expedited amendment procedure may be followed only when: 1) the amendment has the unanimous consent of the permittee and the USFWS; 2) the original HCP established specific procedures for incorporating minor amendments so that the public had the opportunity to comment on the process, and such amendments are consistent with those procedures; 3) the original HCP defines what types of amendments are considered minor; 4) the net effect on the species involved and level of take resulting from the amendment is not higher from that analyzed under the original HCP and the USFWS' decision documents; and 5) a written record of any such amendments is prepared (HCP Handbook [USFWS and NMFS 1996]; pages 3-33).

For all potential minor amendments, the USFWS will review all necessary and available information at the time of the amendment proposal to determine if a minor amendment is appropriate or if a major amendment will be needed.

8.6.2.1 Alternative Minimization Technologies

The Permittees will pursue a minor amendment if minimization techniques become available that best available science indicates would result in equal or greater minimization of bat mortality, and that would result in less cost to Project operations than operational curtailment. The state of scientific understanding regarding bat behavior and wind power generation is relatively new, but is rapidly evolving. Technologies may become available in the future and may be used to supplement or replace current minimization methods, if new technologies are equally or more effective at reducing bat mortality. For example, acoustic bat deterrents hold promise as an effective tool for minimizing bat mortality (Szewczak and Arnett 2008, Horn et al. 2008), but issues with sound attenuation, cost, and other factors currently limit the potential for widespread use of the devices. However, future technological advances may overcome current limitations and similar or greater effectiveness at reducing bat mortality may ultimately be achieved by the use of acoustic deterrents at the FRWF. In this case, acoustic deterrents may be a preferred minimization technique if the deterrents allow normal project operations to be resumed (i.e., reverting to a cut-in speed of 3.5 m/s). Similarly, changes in turbine blade design or operational capabilities of turbines may allow for equal or greater minimization that also allow for maximum wind energy production.

In response to new information, guidance, or published studies that document improved or equally effective, but less costly minimization methods, the Permittees will evaluate the potential for the Project to incorporate such technology. The evaluation will consider available data from other wind facilities that have used the new technologies and any published results that describe their effectiveness. The evaluation will also consider potential effects to Indiana bats, and whether or not the new technology has the potential to result in increased incidental take of Indiana bats. If this evaluation concludes that the new technology is not expected to result in a change in impacts to Indiana bats as outlined in the HCP, or any change in potential impacts would be beneficial, the permittees will request a minor amendment to the ITP. If it is determined that the new technology may result in adverse effects to Indiana bats that have the potential to result in significant changes to this HCP, and the Permittees elect to pursue the use of the new technology, the Permittees will seek a major permit amendment.

8.7 Permit Renewal

Upon agreement of the USFWS and the Permittees and compliance with all applicable laws and regulation, including but not limited to 50 CFR 13.22, the ITP term may be extended beyond its initial term in accordance with USFWS regulation in force on the date of the renewal. If the Permittees desire to renew the ITP term, they will notify the USFWS at least thirty (30) days before the then-current term is scheduled to expire. Extension of the ITP term constitutes extension of the HCP for the same amount of time, subject to any modifications that the USFWS may require at the time of the renewal.

9.0 GLOSSARY

Above-ground structures: any components of the wind farm that are above ground, including turbines, access roads, transformers, substations, maintenance buildings, meteorological towers, transmission lines, and communications equipment

Acoustic bat deterrent: a device that emits randomized and continuous ultrasonic noise that is intended to cause bats to avoid the area over which the acoustic sound is broadcast as a result of acoustical confusion

Activity: an element of work that is usually has an expected duration and outcome

Adaptive management: a structured, repeating process of optimal decision making by system monitoring, with an aim to reduce uncertainty over time

American Land Title Association (ALTA) survey: An ALTA survey is a boundary survey prepared to a set of minimum standards that have been jointly prepared and adopted by the ALTA/ American Congress on Surveying and Mapping.

Anthropogenic: being human-caused or -created

Area adjustment factor: a mathematical correction factor based on empirical data from searched areas that is extrapolated to estimate mortality in unsearched areas

Arousal: the stage between hibernation and active states in hibernating animals, or a period where the animal awakes for a brief period of time before returning to a state of hibernation; arousal is typically characterized by an increased heart rate and body temperature

Bald and Golden Eagle Protection Act: a federal act that provides protection for eagle species, including their nests, eggs, and parts, from take, possession, or commerce, excepting under certain specific conditions

Barotrauma: tissue damage to lungs caused by expansion of air that is not accommodated by exhalation, and that affects bats that fly in close proximity to spinning wind turbines

Bat activity: bats in active flight; in the case of acoustic detection studies, activity often refers to bat passes per detector night

Bat pass: typically defined as continuous series of two or more call notes produced by an individual bat with no pauses between call notes of more than one second

Bias correction factors: mathematical correction factors based on empirical data from searcher efficiency and carcasses removal trials that are used to adjust mortality estimates to account for ineffective searches or carcass removal by scavengers

Bias: a systematic distortion of a statistic, or of data that are used to derive the statistic, due to sampling methods

Biennial census: a census of a population performed every other year (once every two years)

Bioenergetic: referring to the energy used by living organisms, particularly the study of energy transformation in living systems

Biological goal: the broad, guiding principles for an HCP and the rationale behind minimization and mitigation strategies.

Biological objective: the different components or measurable targets needed to achieve the biological goals of an HCP

Biological Opinion: a document prepared by the USFWS that provides their 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

Bird and Bat Conservation Strategy: a voluntary plan prepared by a wind power developer that outlines steps that will be taken to avoid, minimize, and mitigate impact to birds and bats.

Buffer zone: a zone or area surrounding a single turbine, a turbine string, or an entire wind energy facility that separates the area directly impacted by the turbine or facility from areas that are unlikely to be impacted

Candidate Conservation Agreement: voluntary conservation agreements between the USFWS and one or more public or private parties that identify threats to candidate species, plan the measures needed to address the threats and conserve these species, identify willing landowners, develop agreements, and design and implement conservation measures and monitor their effectiveness

Candidate species: a species determined by the Service to be listed as a threatened or endangered species and that is supported by information on biological vulnerabilities or threats, but that is not currently listed as the action is precluded, or a species that is currently undergoing review by the Service and may potentially be listed as an endangered or threatened species

Canopy: the branches and foliage that form one or more layers near the top of the forest or of a single tree

Canopy cover: a measure of area covered by either the canopy of an individual plant or the area covered by many plants

Canopy height: the general height of a forest's canopy

Carcass availability: the number of carcasses that are placed and are available to be found during carcass removal trials

Carcass: the dead body of an animal

Casualty: a bird or bat that is bodily harmed or otherwise injured and killed

Catastrophic decline: One or more related losses whose consequences are extremely harsh in their severity with respect to population decline

Cave gate: a gate to exclude or restrict people from caves or cave-like structures (e.g., mine openings) without restricting the natural airflow; installed to prevent trespass, protect sensitive caves, prevent vandalism or damage to the cave, or exclude people from caves deemed to be dangerous

Changed circumstances: changes in circumstances that are foreseeable and are likely to occur over the permit term of a given HCP

Climate change: long-term changes to the Earth's climate, particularly in reference to increasing atmospheric temperature attributed to greenhouse gasses

Collection cables/connector lines: cables that collect electricity from wind turbines and transport the electricity to the transformer at the substation

Collection system: the electrical system within the wind energy facility, including the turbines, the collector cables, and the transformer (contrast transmission system)

Collision: the strike of a bird or bat with a turbine structure, particularly with rotating blades

Commercial operation: activity that generates revenue for the commercial entity by manufacturing or producing a good or service that can be sold

Commuting corridor/path: the habitat an animal travels along periodically, such as during its daily or nightly activities, particularly where the animal habitually travels to and from foraging and resting areas

Compliance: adherence or conformance to a law, regulation, or policy

Compliance monitoring: a review or assessment of actions taken to determine if there was a conformance to the regulation, policy, or law

Conservation benefit: an action that results in positive effects to a listed species, such as may result from reduction of fragmentation and increasing the connectivity of habitats, maintaining or increasing populations, insuring against catastrophic events, enhancing and restoring habitats, buffering protected areas, and creating areas for testing and implementing new conservation strategies

Construction permit: a permit required in most jurisdictions for new construction, or adding on to pre-existing structures issued by the relevant oversight authority, often a state or local agency, that specifies terms of compliance with national, regional, and local building codes.

Contingency funds: funds set aside that may be used in the context of adaptive management if minimization or mitigation is found to be ineffective at offsetting the impacts of the taking of Indiana bats

Covered activity: an activity that has the potential to result in incidental take of a listed species that is covered by an Incidental Take Permit

Crane pad: a 20-m x 27-m (60-ft x 80-ft) gravel pad extending from the roadway to the turbine foundation upon which the crane will operate during construction of the turbine

Crepuscular periods: dawn and dusk, particularly as a reference to when certain animals are active

Critical habitat: specific habitat or features that are essential or important to the conservations of a listed species and which may warrant special management considerations; areas legally designated as critical habitat by federal regulations

Critical outage: an outage of part of the facility (can be an individual turbine, substation, etc.) which requires more immediate attention.

Cryptic: having an ability to avoid detection or to effectively be concealed due to color, behavior, etc.

Cumulative impact: incremental impacts combined with the impacts of past, present, and reasonably foreseeable future actions

Curtailment: to reduce or decrease turbine operations to prevent or reduce impacts to bats (and possibly birds); methods include reductions in cut-in speed, turning turbines off or feathering them during high-risk periods, etc.

Cut-in speed: the wind speed at which turbines begin generating power and sending it to the electrical grid

Datalogger: an electronic device that records data (e.g., humidity, temperature) over time with sensors

Decommissioning: the removal of the above-ground structures and below-ground structures (to a depth of at least 4 ft. [1.2 m] below the surface) at the end of the Project's operational life, including the removal of access roads if required by the landowner, followed by restoration of topsoil, re-vegetation and seeding, and a three-year monitoring and remediation period

Designated critical habitat: habitat deemed to be critical to the conservation of a listed species and legally designated as such by federal regulation

Diameter at breast height (DBH): the diameter of a tree's trunk taken at a distance of approximately breast height (about 4.5 ft. or 1.4 m) above the forest floor on the uphill side of the tree; used to calculate tree growth, among other metrics

Direct effects: the results of a proposed action that occur at the same time as the action

Dispersal: the movement of organisms away from their parent organisms and/or natal region

Displacement: when an animal is forced out of its normal range due to a disrupting influence, such as construction noise or vibration

Distribution line: electrical lines that lead from transmission lines to the consumer

Disturbance: a change, usually transient, to environmental conditions and structures that produces a change in the ecosystem

Drought: an extended period of months or years during which a region experiences a deficiency in its water supply

Due diligence: reasonable steps taken to satisfy or otherwise comply with a legal requirement

Echolocation: the biological sonar used by several kinds of animals to locate and identify objects during navigation or foraging. Echolocating animals emit calls out to the environment and listen to the echoes of those calls that return from various objects near them.

Ecological trap: where organisms settle in poor-quality or less-optimal habitat due to changing environmental cues, particularly when the attractiveness of the habitat is not proportional to the value of the habitat for reproduction and survival

Economically feasible: Determining that something is economically achievable after conducting a cost/benefit analysis to determine the benefits and savings that are expected from a candidate system compared to the costs.

Ecosystem: an ecological community and its habitat

Ecoregion: a geographic region defined by its ecological aspects (e.g., as climate, vegetation, landforms, soil types, etc.)

Emergence: the period when Indian bats leave the hibernacula, usually from mid-April to the end of May

Empirical bias trial: a trial that is conducted to measure searcher efficiency and carcass persistence that results in empirical data that is used to adjust for bias in estimating bird and bat mortality at a wind power facility

Endangered species (federal): any species, subspecies, or population that is in danger of becoming extinct in all or a significant portion of its range; danger of extinction may be due to a low population, being threatened by changing environmental parameters, and/or increased mortality due to disease, predation, or other impacts

Endangered Species Act: a federal act providing the means where endangered and threatened species, or the ecosystems upon which the species depend, may be conserved

Endangered Species Preservation Act: a federal act that authorized the Secretary of the Interior to list endangered species, allowed the Service to purchase habitat for endangered species, and instructed federal agencies to preserve the habitat of endangered species; no stipulation was made regarding the trade of endangered species or their parts; this act was the replaced by the Endangered Species Act

Energetic constraints: factors which are affected by the energetic needs of a particular animal, such as geographic distribution, reproductive behavior, and timing and duration of activity

Environmental Impact Statement: an analysis required by the National Environmental Policy Act that evaluates environmental risks for all major federal actions

Environmental impact: possible adverse effects caused by development or by changes made in the environment due to a project

Environmental tolerances: the ability of an organism to endure or otherwise weather adverse environmental conditions

Exfoliating bark: bark that is peeling, loose, or flaking, usually in thin layers

Exposure: the state of being at risk of harm, attack, or death

Extant: to be in existence or present

Fall migration period (Indiana bats): primarily from the end of July to mid-October

Fatality monitoring: at wind facilities, conducting standardized searches to document bird and bat mortality resulting from the project

Fatality: death, generally due to a specific cause

Fatality rate: a measure of the number of deaths in a population

Feathering: when turbine blades are pitched parallel with the wind direction, causing them to only spin at very low rotation rates, if at all

Federal action: any activity entirely or partly financed, assisted, conducted, regulated, or approved by federal agencies; new or revised agency rules, regulations, plans, policies, or procedures; and legislative proposals

Federal agency: an administrative unit of the federal government

Federal Aviation Administration (FAA) lighting: lighting that is compliant with the Federal Aviation Administration's standards for marking and lighting structures to promote aviation safety

Federally endangered species: see Endangered species

Finding of No Significant Impact: a document prepared in compliance with NEPA and briefly presents why federal agency/agencies have determined a federal action (e.g., issuance of an Incidental Take Permit) will not result in significant impacts

Five Point Policy: an addendum to the Habitat Conservation Planning and Incidental Take Permit Processing Handbook (USFWS and NOAA 1996) that describes five clarifying components that should be included in an HCP

Flight height: the height of a flying bird or bat above ground level

Flight path: the course a flying animal takes while flying

Flood: a natural event in stream systems where water temporarily covers land not normally covered by water, and that has both beneficial and detrimental effects on natural communities

Foraging bout: a discrete period of time in which an organism gathers and consumes food; may include collecting, hunting/pursuit, and prey preparation in addition to the actual consumption

Foraging habitat: the habitat used for foraging by an animal

Foreseeable event: an event that is reasonably expected to occur

Gating: installing cave gates at caves or cave-like structures to exclude people

Generating capacity: the amount of power a given electrical generation facility is capable of producing

Generation tie-in line: a sole-use facility constructed by an electric generator to interconnect and transmit its power to the electrical grid.

Genetic resistance: some type of genetic predisposition that would make an organism less likely to die from a condition

Geomyces destructans: a psychrophilic fungus found on the exposed tissues (wings, faces, ears, and muzzles) of bats afflicted with White-Nose Syndrome

Gestation: duration of or state of pregnancy in mammals

Global warming: see climate change

Greenhouse gas: an atmospheric gas that is implicated in climate change (“global warming”) and whose absorption of solar radiation is implicated in atmospheric warming; examples include carbon dioxide, ozone, fluorocarbons, and methane

Habitat: the living and non-living aspects of an organism’s environs (e.g., air, water, topography, and other communities of animals and plants)

Habitat Conservation Plan/ Conservation plan: a planning document that is a mandatory component of an Incidental Take Permit application that can be issued under Section 10 of the Endangered Species Act

Habitat impact: adverse impact to an animal’s habitat

Habitat need: a specific need that an animal has related to its habitat (e.g., bats that hibernate in caves can only winter in areas with appropriate caves)

“Harm”: an act "which actually kills or injures" listed wildlife, and may include habitat modification or degradation to where wildlife is affected, by impairment of essential behavior patterns, such as mating, foraging, or sheltering

“Harass”: the act of annoying of disturbing wildlife to such an extent that injury is done to said wildlife by disrupting normal behavior (including mating, foraging, or sheltering)

Hibernaculum (plural, hibernacula): the physical structure (often a cave or mine in the case of bats) in which hibernating animals spend the winter

Hibernation habitat: habitat required for hibernation, e.g., undisturbed cave systems for bats

Hibernation: the act of spending the winter in a dormant condition, usually in some sort of shelter

Home range: the geographic area where an organism carries out its activities during all of part of the year

Hub: the portion of the turbine corresponding to the center of the rotors and the front of the nacelle

Human industrialization: the process in which a society transforms itself from a primarily agricultural society into one based on the manufacturing of goods and services.

Impact: the result of an action or lack of action that affects a species or critical habitat, and may be a direct impact, an indirect impact, and/or a cumulative impact

Implementing Agreement: a legally-binding agreement that determines the requirements and responsibilities of the permittee's conservation plan and permits

Incidental take: take of any federally listed species that is incidental to otherwise lawful activities and is not the purpose of said activities

Incidental Take Permit (ITP): exempts a permittee from the prohibition of take under the Endangered Species Act, if all conditions are met and the take is incidental to otherwise lawful activities

Indirect effects: effects that are caused by a proposed action at a later time, but still are reasonably certain to occur

Industry: refers to the production of an economic good or service within an economy

Infrastructure: the basic physical and organizational structures needed for the operation of a society or enterprise, or the services and facilities necessary for an economy to function

Invasive species: a non-native species that has been introduced to an ecosystem and whose introduction is causing or may cause economic or environmental harm

Inverse relationship: whereby one variable decreases as another variable increases in direct proportion

Issuance criteria: as outlined in the Endangered Species Act, the standards and measures by which an Incidental Take Permit may be issued if the criteria are met

Karst: irregular limestone geology that is characterized by fissures, caverns, and sinkholes caused by erosion

Lactation: milk production in mammals

Lawful activity: consistent with other Federal, state, and local laws

Life history: the natural changes an organism undergoes during its lifetime

Listed species (federal): a species, subspecies, or distinct population determined to be endangered or, threatened under the federal Endangered Species Act, and may also include candidate species for listing

Long-distance migrant species (bats): bat species that have developed migratory behavior and sometimes travel greater than 620 miles (1,000 km) between summer and winter roosts

Man-made structures (roosting): structures such as mines, abandoned houses, chimneys, and other structures that may be utilized by roosting bats

Maternity colony: where female bats congregate to birth and raise young and where pregnant and nursing bats assemble

Maternity habitat: habitat utilized by female bats that are raising young, including habitat for foraging and maternity roots

Maternity roost: roosts where female bats birth and raise their young, particularly for colonial bat species

Megawatts: one million (1,000,000) watts

Meteorological tower: typically a tubular or lattice tower with devices for measuring wind speed, wind direction, temperature, and with the devices set at more than one height

Microclimate: a localized climate in an area that may be as small as a few square feet and that differs from the surrounding climate in adjacent areas

Midwest Recovery Unit (MRU): the recovery unit that includes the states of Indiana, Kentucky, Ohio, Tennessee, Alabama, and Michigan, and southwestern Virginia

Migrant: a migrating animal, particularly one currently exhibiting migration behavior

Migration: the process of moving from one region or climate, especially periodically and when triggered by environmental cues, or the act of migratory movement

Migratory bat: any species of bat that exhibits seasonal migratory behavior

Migratory Bird Treaty Act: a federal act that prohibits the take of migratory birds, including any part, nest, or eggs of these birds

Migratory bird: any species of bird that exhibits seasonal migratory behavior

Migratory pulse: a distinct, rapid, and transient passage of migrants through or over an area

Minimization measures: measures to reduce the chance of take of Indiana bat, including operational restrictions during the period when Indiana bats are expected to be in the Project area

Mitigation measures: measures or activities that are to moderate, reduce, or alleviate impacts, or to somehow provide compensation for impacts; in this case, actions that will have a conservation benefit for Indiana bats (but also have the potential to result in harm or take of Indiana bats during their implementation)

Monitoring and remediation period: the period where the project and actions are analyzed to compare performance to anticipated results and to make necessary corrections if necessary

Morphology: the form and structure of an organism or its parts

Mortality: death, generally due to a specific cause

Mortality rate: a measure of the number of deaths in a population

Myotid: of or relating to bats belonging to the genus *Myotis*

Myotis bats: bats of the genus *Myotis*, or informally, “mouse-eared” bats

Nacelle: the portion of the turbine that houses the generator and brake assembly

Native: an organism that is normally found in and thrives in a specific ecosystem, particularly those organisms that developed or evolved with the habitat or ecosystem

Natural drainages: the natural removal of surface and sub-surface water from an area

Negative impact: an adverse impact, or a detrimental effect to the desired outcome or the baseline state

Neonatal survival: survival of newborns

No Surprises Assurance/No Surprises Rule: provides an HCP applicant with regulatory certainty and calls for the Services to assist with correcting any unforeseen circumstance that may arise. This means that in the face of unforeseen circumstances, the FWS and NMFS will not require additional mitigation in the form of additional lands or funds from any permittee who is adequately implementing or has implemented an approved HCP. The policy also protects the permittee from other forms of additional mitigation except in cases where "extraordinary circumstances" exist

Notice of Intent (with respect to NEPA): an official announcement made by a federal agency that is published for public review in the federal register.

Noxious weeds: an undesirable and often invasive plant, particularly one that can directly or indirectly harm crops, livestock, the environment, or other natural resources

Operating life: the period over which a wind power project is commercially operational

Operation: the state of a wind power facility when its turbines are rotating and producing power that is transmitted to the electrical grid

Operations and maintenance (O&M) building: a building where equipment, supplies, and staff necessary for the successful operation of a wind power facility are located

Physiographic regions: broad-scale subdivisions based on terrain texture, rock type, and geologic structure and history

Pitch: the angle of the rotor or blade to the wind

Population demographics: statistical characteristics of a population, such as birth rate and death rate

Post-construction monitoring: monitoring at a wind power facility that consists of searchers walking beneath turbines looking for bird and bat fatalities

Potential take: situations or conditions that may result in harm or death of an individual

Precipitation: moisture formed by condensation of water vapor in the atmosphere (e.g., rain, dew, and snow)

Predation: the act of capturing and feeding upon an animal

Priority 1 hibernacula: hibernacula essential to the recovery and long-term conservation of the species and have a current or historically observed winter population of ≥10,000 individual bats

Priority 2 hibernacula: hibernacula that contribute to the recovery and long-term conservation of the species and have a current or historical population of >1,000 but <10,000 individual bats

Priority 3 hibernacula: hibernacula that have a current or historical population of 50-1,000 individual bats

Priority 4 hibernacula: hibernacula that have a current or historical population of fewer than 50 individual bats

Priority recovery action: actions that have been identified as being the most important for recovery of the Indian bat population

Psychrophilic: an organism, especially a bacterium or fungus that engages in optimal growth at lower temperatures

Purpose and Need: the reasons a project is being implemented

Radio-tracking: see telemetry

Range: the geographic area where a population of organisms carries out its activities during all of part of the year

Re-commissioning: providing energy under a new contract with a power purchaser, and may include permit extensions, including an ITP renewal or amendment if necessary, to continue operation or evaluate the need to retrofit the turbines and power system with new technology upgrades, and allowing the Project to continue to produce power for additional years, if and where needed

Recovery unit: geographic units in which recovery actions are focused that are based on a combination of preliminary evidence of population discreteness and genetic differentiation, differences in population trends, and broad-level differences in macrohabitats and land use. Recovery Units serve to protect both core and peripheral populations and ensure that the principles of representation, redundancy, and resiliency are incorporated

Recovery: restoration of a population of federally listed species to self-sustaining levels; criteria for reclassification and delisting are specified in the Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision (USFWS 2007).

Recruitment rate: generally defined as the number of young added to the population in the fall from that year's breeding effort (i.e., the population increase after that year's natality and mortality have been accounted for)

Recruitment: the addition of young, particularly of a given age, that are added to the population as a result of past breeding effort (e.g., juvenile recruitment, sub-adult recruitment, and young adult recruitment)

Regime: a natural, periodic event, typically on a landscape scale (wind, flood, fire, drought, etc.)

Remediation: the action of remedying something, especially the reversal or stopping of damage to the environment

Renewable Energy Purchase Agreements/Power Purchase Agreement: contract between two parties, one who generates electricity for the purpose of sale (the seller) and one who is looking to purchase electricity (the buyer)

Renewable energy: energy generated from naturally replenished resources, such as sunlight, tides, wind, and geothermic heat

Repowering: process of replacing older power stations with newer ones that either have a greater nameplate capacity or more efficiency which results in a net increase of power generated

Reproductive capacity: the relative ability of a species to reproduce itself under optimal conditions

Reproductive fitness: ability of an organism to reproduce measured by the number of offspring that it has that survive and reproduce in turn

Reproductive potential: a population's maximum reproductive output if it had no limitations; if all essential factors, such as food, space, shelter, mates etc. were readily available

Restoration actions: tree planting, girdling of existing trees of sufficient dbh, and clearing of understory vegetation

Restoration: practice of renewing and restoring degraded, damaged, or destroyed ecosystems and habitats in the environment by active human intervention and action, within a short time frame

Right-of-ways (ROWs): a strip of land and any potential easements granted for transportation purposes (examples include roads and rail lines)

Risk: the possibility or probability of injury or fatality occurring to an individual or a population

Robust sample: a sample data set that results in estimators that are not unduly affected by small departures from model assumptions

Roost: a place where bats rest, shelter, and/or sleep

Roost trees: trees used as roots by bats, especially during the summer; typically, the roost trees will have loose bark or crevices for the bats to shelter in or under

Rotor laydown area/laydown area: the area near the turbine tower where the rotor construction occurs

Rotor: the blades of a wind turbine, collectively

Rotor-swept height (RSH): the area that is swept by the blades when the rotor is turning, with the lower limit of the RSH being the height of the tip of the blade from the ground at the 6 o'clock position and the upper limit being the height of the tip of the blade from the ground at the 12 o'clock position

Scavenger removal trials: controlled trials conducted during post-construction mortality monitoring at a wind power facility that use sample carcasses to determine the average length of time carcasses persist before being consumed or removed by a scavenger

Scavenger removal: the removal of a carcass by a scavenger feeding on the carcass or the carrying away of said carcass by a scavenger

Scavenger: an animal that feeds on carrion (e.g., carcasses)

Scientific research and recovery permit (SRPP): a Section 10(a)(1)(A) permit issued by the USFWS for scientific research on a listed species or activities to enhance a listed species propagation or survival. Examples include, but are not limited to: abundance surveys, genetic research, relocations, capture and marking, and telemetric monitoring

Scientific understanding: knowledge derived from scientific investigations

Search plot: a designated area of a specific size and shape at the base of a turbine in which fatality searches are conducted during post-construction mortality monitoring at a wind power facility

Searchable area adjustment: a mathematical adjustment based on empirical data from searched areas that is extrapolated to estimate mortality in areas that could not be searched due to topography, vegetation, safety or other issues

Searcher efficiency trials: controlled trials conducted during post-construction mortality monitoring at a wind power facility that use sample carcasses to determine the effectiveness of searchers

Sedentary species (bats): bat species that breed and hibernate in the same local areas and usually move less than 30 miles (50 km) between summer and winter roosts

Solar exposure: how much solar energy or solar radiation a roost is exposed to

Spelogger: a device that measures and tabulates cave visitation by people

Spring migration season (Indiana bats): primarily from the end of March to late-May

Stochasticity: the state of lacking any predictable order

Storm Water Pollution Prevention Plan (SWPPP): a document that is prepared in order to obtain National Pollution Discharge Elimination System (NPDES) permit coverage from the Environmental Protection Agency for their stormwater discharges. A SWPPP identifies structural and non-structural controls that will be put in place to minimize negative impacts, caused by offsite storm water discharges, to the environment

Substation: a power station where electrical power is converted (e.g., from DC to AC power)

Summer habitat: habitat utilized by summering animals

Summer range: where a species may be found in the summer

Summering: for an animal to spend the summer in a particular locale

Supervisory Control and Data Acquisitions (SCADA) system: generally refers to industrial control systems (ICS): computer systems that monitor and control industrial, infrastructure, or facility-based processes

Surface disturbance: disturbance of habitat at the ground surface, such as grading of roads

Survival rates: indicating the percentage of animals that are alive after a given event that has the potential to harm or kill members of the population, such as disease

Swarming behavior: behavior exhibited by mating bats in the fall at the entrances of hibernacula whereby large numbers of bats fly in and out of the cave entrances from dusk to dawn, but relatively few bats roost inside the cave during the day

Swarming period: the period from late summer and early fall where Indiana bats return to the vicinity of a hibernaculum and exhibit swarming behavior; also the period when mating occurs

Switchyard: a facility where electricity from the electrical generator is transferred to the electric grid, usually enclosed and located in an area close to the power generating facility or plant.

Take (Bald and Golden Eagle Protection Act): to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb eagles

Take (Endangered Species Act): to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct

Take compliance: to comply with the terms of an Incidental Take Permit

Take limit: a specified number of individuals or acres of habitat that may be incidentally taken according to the terms and conditions of an associated Incidental Take Permit

Telemetry: the tracking of an animal by radio waves emitted from a device attached to the animal's body

Temporary impact: an impact that is expected to be of a limited duration

Thermoregulation: regulation of body temperature

Thermoregulatory costs: the energetic expenditure of thermoregulation

Threat: something or some aspect that may cause injury or death to a species of interest or to an individual

Threatened species (federal): a species or population that is vulnerable to becoming endangered in the near future

Tie-in line: see Generation tie-in line

Topography: the description or representation of geographic surface features, especially in regards to location and elevation

Torpor: dormancy in a hibernating or estivating animal

Tower: the cylindrical portion of a wind turbine generator to which the nacelle and rotor are attached

Transmission system: the electrical system outside the wind energy facility that includes the transmission lines (contrast collection system)

Travel corridor: a pathway used by animals to travel from one habitat to another

Travelling: movement from one location to another

Trenching: the digging of long, narrow excavations, as for the burial of underground electrical lines

Tribes: viewed historically or developmentally, consist of a social group existing before the development of, or outside of, states

Trigger: a specific action or set of conditions that invoke a response

Turbine commissioning: the mechanical, electrical, and communications inspections that ensure systems are installed and functioning properly

Turbine foundation: A steel base plate or concrete foundation that is necessary to adequately support a wind tower

Turbine maintenance activities: repairs and maintenance of the turbine itself and the associated infrastructure (e.g., roads, transmission lines, road surfaces and culverts), including mowing activities and building inspections and repairs

Turbine pad: flat, well graded and compacted areas constructed of crushed rock at the base of the wind turbine

Turbine/crane access roads: roads constructed or used for transportation of turbine parts or cranes

Unavoidable take: harm or death of listed species that cannot be avoided as a result of otherwise lawful activities

Unforeseen circumstances: changes in circumstances that are not expected or foreseen to occur over the permit term of a given HCP

Volant: having the ability to fly

White-Nose Syndrome (WNS): a disease in bats characterized with high fatality rates (from 30 to 99% mortality) in bats, and associated with the presence of the fungus *Geomyces destructans*, particularly on the exposed tissues (e.g., muzzles, faces, ears, and wings) of affected bats, and where infected bats exhibit aberrant behavior (such as chronic arousals) leading to loss of winter fat stores, pneumonia, starvation, and the disruption of hibernation and feeding cycles

Wind energy/ wind power: renewable energy generated by wind turbines at a wind energy facility

Wind facility/wind farm: the turbines and associated structures and infrastructure that produce electricity from wind

Wind turbine/wind turbine generators: a device that converts kinetic energy from the wind into mechanical energy

Winter census: a census of a population performed during the winter; for bats, a census of the hibernating populations

Winter range: where a species may be found in the winter

Wintering: for an animal to spend the winter in a particular locale

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10.2 Laws, Acts, and Regulations

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40 Code of Federal Regulations (CFR) 1502. Title 40 - Protection of Environment; Chapter V - Council on Environmental Quality; Part 1502 - Environmental Impact Statement; Section (§) 1502.20 - Tiering. 40 CFR 1502.20.

40 Code of Federal Regulations (CFR) 1502. Title 40 - Protection of Environment; Chapter V - Council on Environmental Quality; Subchapter a - Accidental Release Prevention Requirements; Risk Management Programs under the Clean Air Act Section 112(R)(7); Distribution of Off-Site Consequence Analysis Information; Part 1502 - Environmental Impact Statement; Section (§) 1502.21 - Incorporation by Reference. 40 CFR 1502.21.

50 Code of Federal Regulations (CFR) 10. 1973. Title 50 - Wildlife and Fisheries; Chapter I -United States Fish and Wildlife Service, Department of the Interior; Subchapter B Taking, Posession, Transportation, Sale, Purchase, Barter, Eportation, and Importation of of Wildlife and Plants; Part 10 - General Provisions; Subpart B - Definitions; Section (§)10.13. List of Migratory Birds. 50 CFR 10.13; 38 Federal Register (FR) 22015, August 15, 1973, as amended 50 FR 52889, December 26, 1985.

50 Code of Federal Regulations (CFR) 13. Title 50 - Wildlife and Fisheries; Chapter I - United States Fish and Wildlife Service, Department of the Interior; Subchapter B - Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife and Plants; Part 13 - General Permit Procedures; Subpart C - Permit Administration; § 13.22 - Renewal of Permits. 50 CFR 13.22.

50 Code of Federal Regulations (CFR) 17. 1975. Title 50 - Wildlife and Fisheries, Chapter I -United States Fish and Wildlife Service, Department of the Interior, Part 17 - Endangered and Threatened Wildlife and Plants. Subparts A-I, §§17.1-17.95. 40 FR 44415, September 26, 1975, as amended at 42 FR 10465, February 22, 1977.

50 Code of Federal Regulations (CFR) 17. 1985. Title 50 - Wildlife and Fisheries; Chapter I -United States Fish and Wildlife Service, Department of the Interior; Subchapter B - Taking, Posession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of of Wildlife and Plants; Part 17 - Endangered and Threatened Wildlife and Plants; Subpart D - Threatened Wildlife; Section (§)17.32 - Permits-General. 50 CFR 17.32; 50 Federal Register (FR) 39689, September 30, 1985, as amended.

50 Code of Federal Regulations (CFR) 17. 1985. Title 50 - Wildlife and Fisheries; Chapter I -United States Fish and Wildlife Service, Department of the Interior; Subchapter B - Taking, Posession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of of Wildlife and Plants; Part 17 -Endangered and Threatened Wildlife and Plants; Subpart C - Endangered Wildlife; Section (§)17.22 - Permits for Scientific Purposes, Enhancement of Propagation or Survival, or for Incidental Taking. 50 CFR 17.22; 50 Federal Register (FR) 39687, September 30, 1985, as amended.

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50 Code of Federal Regulations (CFR) 402. 1986. Title 50 - Wildlife and Fisheries; Chapter IV- Joint Regulations (United States Fish and Wildlife Service, Department of the Interior and National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce); Endangered Species Committee Regulations; Subchapter a; Part 402 - Interagency Cooperation-Endangered Species Act of 1973, as Amended; Subpart a - General; Section (§) 402.02 - Definitions. 50 CFR 402.02; 51 Federal Register (FR) 19957, June 3, 1986, as amended 73 FR 76286, Dember 16, 2008, 74 FR 20422, May 4, 2009.

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11.0 APPENDICES