# Proposed Habitat Conservation Plan and Incidental Take Permit for the Indiana Bat (*Myotis sodalis*) for the Buckeye Wind Power Project Champaign County, Ohio

*Draft Environmental Impact Statement*
*DES# 12-25*

*Volume II (Appendices)*

Prepared by

US Fish and Wildlife Service
Ohio Ecological Services Field Office
4625 Morse Road, Suite 104
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In cooperation with

U.S. Army Corps of Engineers
Huntington District
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June 2012

*Appendix A*
*OPSB Documents*

VORYS

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May 15, 2012

Ms. Barcy F. McNeal
Docketing Division
Power Siting Board
180 E. Broad Street
Columbus, OH 43215

Re: Ohio Power Siting Board - Case No. 12-0160-EL-BGN

Dear Ms. McNeal:

Accompanying this letter for filing are twenty-five (25) copies of an application by Champaign Wind LLC, a wholly owned subsidiary of EverPower Wind Holdings, Inc. for a Certificate to Construct a Wind-Powered Electric Generating Facility in Champaign County, Ohio. The original application was electronically filed.

In accordance with Rule 4906-5-03 of the Ohio Administrative Code, I would like to make the following declarations:

Name of the applicant:

Champaign Wind LLC
a subsidiary of EverPower Wind Holdings, Inc.
44 East 30th Street, 10th Floor
New York, New York 10016

Name and location of the proposed facility:

Buckeye Wind II project
Goshen, Rush, Salem, Union, Urbana and Wayne Townships,
Champaign County, Ohio

Name of the authorized representative:

M. Howard Petricoff
Vorys Sater Seymour and Pease LLP
52 East Gay Street
Columbus, Ohio 43215
614-464-5414
mhpetricoff@vorys.com

Notarized Statement:

See attached Affidavit of James Spencer
Chief Executive Officer, Champaign Wind LLC

Please note that in our January 6, 2012 pre-application notification letter to the Ohio Power Siting Board, we indicated that the facility is proposed to consist of up to 57 turbines with a maximum generating capacity of 171 megawatts. The application proposes to construct up to 56 turbines with a maximum generating capacity of 140 megawatts.

Sincerely,

M. Howard Petricoff

MHP/drd
Enclosures

## BEFORE THE OHIO POWER SITING BOARD

| | | |
|---|---|---|
| **In the Matter of the Application of Champaign Wind LLC, for a Certificate to Construct a Wind-Powered Electric Generating Facility in Champaign County, Ohio** | ) ) ) ) ) | **Case No. 12-0160-EL-BGN** |

## CHIEF EXECUTIVE OFFICER'S AFFIDAVIT

STATE OF NEW YORK )
) SS:
COUNTY OF NEW YORK )

Now comes James Spencer, Chief Executive Officer of Champaign Wind LLC, a wholly-owned subsidiary of EverPower Wind Holdings, Inc., having been first duly sworn, declares and states as follows:

1. He is the highest ranking executive officer in charge of the Buckeye Wind II project in the Townships of Goshen, Rush, Salem, Union, Urbana and Wayne in Champaign County, Ohio.

2. He has reviewed the Application for a Certificate to Construct a Wind-Powered Electric Generating Facility in Champaign County, Ohio.

3. To the best of his knowledge, the information and statements contained in the Application are true and correct.

4. Save for the items for which a waiver has been requested, the Application is complete.

[signature]
James Spencer
Chief Executive Officer
Champaign Wind LLC, a subsidiary of
EverPower Wind Holdings, Inc.

Sworn to before me and signed in my presence this 8th day of May, 2012.

LISA STUHR
NOTARY PUBLIC-STATE OF NEW YORK
No. 01ST6203840
Qualified in New York County
My Commission Expires April 13, 2013

[signature: Lisa Stuhr]
Notary Public
My Commission Expires 4-13-13

BEFORE

THE OHIO POWER SITING BOARD

| | | |
|---|---|---|
| In the Matter of the Application of Buckeye Wind, LLC for a Certificate to Construct Wind-powered Electric Generation Facilities in Champaign County, Ohio. | ) ) ) ) | Case No. 08-666-EL-BGN |

# OPINION, ORDER, AND CERTIFICATE

The Ohio Power Siting Board (Board), coming now to consider the above-entitled matter, having appointed administrative law judges (ALJs) to conduct the hearings, having reviewed the exhibits introduced into evidence in this matter, and being otherwise fully advised, hereby issues its opinion, order, and certificate in this case, as required by Section 4906.20, Revised Code.

APPEARANCES:

Vorys, Sater, Seymour, and Pease LLP, by M. Howard Petricoff, Stephen M. Howard, Michael J. Settineri, and Gina R. Russo, 52 East Gay Street, P.O. Box 1008, Columbus, Ohio 43216-1008, on behalf of Buckeye Wind LLC.

Richard Cordray, Ohio Attorney General, by Duane W. Luckey, Section Chief, and Werner L. Margard and John H. Jones, Assistant Attorneys General, Public Utilities Section, 180 East Broad Street, 6th Floor, Columbus, Ohio 43215, by Margaret A. Malone and Christina Grasseschi, Assistant Attorneys General, Environmental Enforcement Section, 30 East Broad Street, 25th Floor, Columbus, Ohio 43215, and by Anthony J. Logan, Chief Legal Counsel, Ohio Department of Natural Resources, 2045 Morse Road, Building D3, Columbus, Ohio 43229, on behalf of the staff of the Board.

Van Kley & Walker, LLC, by Christopher A. Walker, 137 North Main Street, Suite 316, Dayton, Ohio 45402, and Jack A. Van Kley, 132 Northwood Boulevard, Suite C-1, Columbus, Ohio 43235, on behalf of Union Neighbors United, Inc., Robert and Diane McConnell, and Julia F. Johnson.

Nick Selvaggio, Champaign County Prosecuting Attorney and Jane Napier, Assistant Prosecuting Attorney, 200 N. North Main Street, Urbana, Ohio 43078, on behalf of The Board of Commissioners of Champaign County and the Boards of Trustees of the Townships of Goshen, Rush, Salem, Union, Urbana, and Wayne.

Brown Law Office, LLC, by Daniel A. Brown, 204 South Ludlow Street, Suite 300, Dayton, Ohio 45402, on behalf of the Urbana Country Club.

Larry Gearhardt, Chief Legal Counsel, Ohio Farm Bureau Federation, 280 North High Street, Columbus, Ohio 43218, on behalf of the Ohio Farm Bureau Federation.

Gil Weithman, Urbana City Law Director, 205 South Main Street, Urbana, Ohio 43078, on behalf of the City of Urbana.

Thompson Hine, LLP, by Carolyn S. Flahive and Sarah Chambers, 41 South High Street, Suite 1700, Columbus, Ohio 43215, on behalf of Champaign Telephone Company.

OPINION:

I. SUMMARY OF THE PROCEEDINGS

All proceedings before the Board are conducted according to the provisions of Chapter 4906, Revised Code, and Chapter 4906, Ohio Administrative Code (O.A.C.).

On June 4, 2008, Buckeye Wind, LLC (Buckeye or applicant), a wholly-owned subsidiary of EverPower Wind Holdings, Inc., filed a copy of the notice to be published, in accordance with Rule 4906-5-08, OA.C., of a public informational meeting regarding an application for a certificate of environmental compatibility and public need (certificate) that it intended to file for the construction of electricity generating wind turbines and electrical substations to be located in southern Logan County and Champaign County, Ohio.[1] The public informational meeting was held on June 10, 2008.

Buckeye filed its application on April 24, 2009, as supplemented on August 28, 2009, and September 1, 2009, for a certificate of environmental compatibility to construct a wind-powered electric generation facility in Champaign County, Ohio. The proposed project consists of 70 wind turbines, access roads, an electric substation, operations and maintenance building, 3 construction staging areas, and an electric collection system over approximately 9,000 acres in the townships of Goshen, Rush, Salem, Union, Urbana, and Wayne, in Champaign County, Ohio.

On April 24, 2009, Buckeye filed a motion for waivers of various aspects of Chapter 4906-13, O.A.C., and the one-year notice requirement contained in Section 4906.06(A)(6), Revised Code. Staff filed its response to the waiver requests on July 20, 2009. By entry issued July 31, 2009, the ALJ granted Buckeye's requests for waiver of the one-year notice period required by Section 4906.06(A)(6), Revised Code; the alternative site information and the formal site selection study required by Rules 4906-13-2(A)(1) and 4906-13-03, O.A.C; the mapping of the proposed facility and utility corridors, as it relates to gas transmission lines, required by Rule 4906-13-04(A)(1)(c), O.A.C.; the mapping of vegetative cover that may be removed during construction and layout of the proposed project in a 1:4,800 scale required by Rules 4906-13-04(A)(3), (A)(3)(g), and (B)(2), O.A.C.; the mapping of a cross-sectional view indicating geological features of the proposed facility site and the location of test borings required by Rule 4906-13-04(A), O.A.C.; the mapping of, among other things, fuel, waste, storage facilities, and water supply and sewage lines for the proposed project; the mapping of the layout including grade elevations where such will be modified during construction as required by Rule 4906-13-

1 We note that the original notice covered both Champaign and Logan Counties. However, the application, subsequently filed with the Board, includes only Champaign County for the siting of the proposed facility.

04(B)(2)(i), O.A.C. Buckeye's requests for waiver of the financial data required by Rule 4906-13-05, O.A.C.; the provision of a ten-year projected population estimate for the communities within a five-mile radius of the proposed project site required by Rule 4906-13-07(A)(1), O.A.C.; the information based on a survey regarding the ecological impact of the proposed facility and a list of major species observed in the area as required by Rule 4906-13-07(B)(1)(b) through (e), O.A.C.; the estimated impact of construction on undeveloped areas as required by Rule 4906-13-07(B)(2)(a); and the mapping of all agricultural land and all agricultural district land required by Rule 4906-13-07(F)(1), O.A.C., were denied.

By letter dated June 23, 2009, the Board notified Buckeye that its application had been found to comply with Rule 4906-1, *et seq.*, O.A.C. On July 7, 2009, and July 16, 2009, Buckeye served copies of the application upon local government officials and filed proof of service of the application, pursuant to Rule 4906-5-06, O.A.C. By entry issued July 31, 2009, the local public hearing was scheduled for October 8, 2009, and the adjudicatory hearing was scheduled to commence on October 13, 2009.

By entry of September 1, 2009, the hearing schedule was modified and the local public hearing rescheduled for October 28, 2009, at Triad High School Auditeria, 8099 Brush Lake Road, North Lewisburg, Ohio 43060, and the adjudicatory hearing was scheduled to commence on October 27, 2009, at the offices of the Public Utilities Commission of Ohio in Columbus, Ohio. The July 31, 2009, entry also directed Buckeye to publish notice in accordance with Rule 4906-5-08, O.A.C. Notice of the application was published in the *Urbana Daily Citizen*, a newspaper of general circulation in Champaign County. Proof of publication of the first notice was filed on September 11, 2009, and proof of publication of the second notice was filed on November 5, 2009.

The ALJ granted the motions to intervene filed by the following: Union Neighbors United, Robert and Diane McConnell, and Julia F. Johnson (jointly UNU); the Ohio Farm Bureau Federation (Farm Bureau); the Urbana Country Club (UCC); the Board of Commissioners of Champaign County, Ohio, along with the Boards of Trustees of the Townships of Union, Goshen, Rush, Salem, Urbana, and Wayne (jointly County); the City of Urbana (Urbana); The Champaign Telephone Company (Telephone Company); and the Piqua Shawnee Tribe (Piqua Shawnee).

All of the parties, including staff, conducted significant discovery and, on October 13, 2009, staff filed a report of its investigation of the proposed facility (Staff Report).

The local public hearing was held on October 28, 2009. The adjudicatory hearing was called and continued on October 27, 2009. The adjudicatory hearing reconvened on November 9, 2009. Initial testimony concluded on November 20, 2009. Rebuttal testimony occurred on December 1-2, 2009. At the hearing, Buckeye presented eight witnesses, UNU presented six witnesses, UCC presented two witnesses, staff presented eight witnesses, the County presented three witnesses, the Telephone Company presented a single witness, and Urbana presented five witnesses. Buckeye also presented three witnesses on rebuttal.

Initial briefs were filed on January 15, 2010, by the Telephone Company and UCC, and on January 20, 2010, by Buckeye, UNU, Urbana, staff, and the County. On February 1, 2010, reply briefs were filed by Buckeye, UNU, the Telephone Company, UCC, staff, and the County.

## II. PROPOSED FACILITY

According to the application, Buckeye proposes to construct 70 wind turbines, access roads, an electric substation, operations and maintenance building, three construction staging areas, and an electric collection system over approximately 9,000 acres in the townships of Goshen, Rush, Salem, Union, Urbana, and Wayne, in Champaign County, Ohio.

Buckeye proposes to install one of three models of turbines, depending on availability at the time the applicant places its order. Each turbine will have a nameplate capacity rating of 1.8 to 2.5 megawatts (MW), depending on the turbine installed. Buckeye expects a capacity factor of approximately 30 percent. Buckeye estimates that the proposed wind facility will have a total generating capacity of 126 MW to 175 MW. The hub height for the turbine will be up to 100 meters (328 feet), with a rotor diameter of up to 100 meters; therefore, the turbine would have a maximum height of 150 meters (492 feet), with the blade tip in its highest position. The electric substation will be located in Union Township adjacent to the existing Urbana-Mechanicsburg-Darby transmission line and will transmit power carried by the 34.5 kilovolt (kV) collection lines serving the wind facility. Buckeye will also have an operations and maintenance building to accommodate operations personnel, equipment, and materials. The applicant expects to purchase or lease an existing structure in the vicinity of the proposed wind project as its operations and maintenance building. However, if the applicant must construct a building for operations and maintenance, according to the application, the building would not exceed 6,000 square feet and will be designed to resemble an agricultural building. As proposed project will require approximately 23.3 miles of new or improved access roads to support the facility, utilizing existing farm lanes to the extent possible. The proposed project will require the use of three construction staging areas to be located on leased private property at Ludlow Road, Perry Road, and Pisgah Road. The purpose of the staging areas is to accommodate material storage, parking for construction workers, and construction trailers (construction trailers will be stored at the Ludlow Road location only). In total, the staging areas will use approximately 12 acres. According to the application, Buckeye plans to commence construction in 2010 and place the facility in-service in mid-2011. (Buckeye Ex. 1 at 2, 12-16; Staff Ex. 2 at 3-5.)

## III. CERTIFICATION CRITERIA

Pursuant to Section 4906.10(A), Revised Code, the Board shall not grant a certificate for the construction, operation, and maintenance of a major utility facility, either as proposed or as modified by the Board, unless it finds and determines all of the following:

(1) The basis of the need for the facility if the facility is an electric transmission line or gas or natural gas transmission line.

(2) The nature of the probable environmental impact.

(3) The facility represents the minimum adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives, and other pertinent considerations.

(4) In the case of an electric transmission line, or generating facility, such facility is consistent with regional plans for expansion of the electric power grid of the electric systems serving this state and interconnected utility systems and that the facility will serve the interests of electric system economy and reliability.

(5) The facility will comply with Chapters 3704, 3734, and 6111, Revised Code, and all rules and standards adopted under those chapters and under Sections 1501.33, 1501.34, and 4561.32, Revised Code.

(6) The facility will serve the public interest, convenience, and necessity.

(7) The impact of the facility on the viability as agricultural land of any land in an existing agricultural district established under Chapter 929, Revised Code, that is located within the site and alternate site of the proposed major facility.

(8) The facility incorporates maximum feasible water conservation practices as determined by the Board, considering available technology and the nature and economics of various alternatives.

The record in this case addresses all of the above-required criteria. In addition, pursuant to Section 4906.20, Revised Code, the Board's authority applies to economically significant wind farms and provides that such entities must be certified by the Board prior to commencing construction of a facility. In accordance with Chapter 4906, Revised Code, the Board promulgated rules which are set forth in Chapter 4906-17, O.A.C., prescribing regulations regarding wind-powered electric generation facilities and associated facilities.

## IV. PROCEDURAL ISSUES

In their briefs, UNU and the County challenge certain procedural rulings made by the ALJ in this proceeding and request that the Board reconsider and reverse each ruling. UNU raises six procedural issues and the County raises one procedural issue.

### A. Waiver of Site Alternatives, Intervenor Standing to Oppose Waivers and to Cross-Examine Applicant on Site Alternatives

On April 24, 2009, along with the application, Buckeye filed a motion for waiver of certain filing requirements set forth in Chapter 4906-13, O.A.C. On May 8, 2009, UNU filed a memoranda contra Buckeye's request for waivers to which Buckeye filed a reply on May 15, 2009. By entry issued July 31, 2009, the ALJ concluded that UNU lacked standing to oppose the applicant's request for waivers of certification application filing requirements in as much as the purpose of the requirements is to obtain sufficient information to enable staff to fulfill its statutory duty to conduct an investigation of the application and file a report of investigation. Nonetheless, each of UNU's arguments was considered, along with staff's position, by the ALJ in making a decision on the waiver request. The July 31, 2009, entry noted that, although the application in this case was filed prior to the effective date of the Board's certification application requirements for wind-powered electric generation facilities set forth in Chapter 4906-17, O.A.C., the discussion of each waiver included the parallel provision in the Board's wind rules in parentheses.

#### 1. UNU Arguments

At this juncture, UNU requests that the Board reverse the ALJ's rulings as to the waiver of Rule 4906-13-03, O.A.C., regarding the submission of site alternatives, and to Rule 4906-17-04, O.A.C., the parallel wind rule. UNU argues that Buckeye only requested waiver of Rule 4906-13-03, O.A.C., not the parallel wind rule and contends that, pursuant to Rule 4906-1-03, the Board or ALJ may only waive any requirement, standard, or rule, for good cause shown, as supported by a motion and supporting memorandum, not *sua sponte*, or on its own motion. (UNU Br. at 99-100.)

UNU further argues that granting Buckeye's request to waive the requirement for site alternatives essentially released Buckeye from its burden to demonstrate that the proposed facility represents the minimum adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives, and other pertinent considerations, as required by Section 4906.10(A)(3), Revised Code. Based on this reasoning, UNU contends that neither the Board nor the ALJ can waive the submission of site alternatives. (UNU Br. at 100.)

UNU posits that an intervenor in a Board proceeding has standing to oppose the waiver of Board rules to the extent that the waiver has the potential to bar the intervenor from conducting discovery and cross-examination on issues relevant to the certification criteria. UNU asserts that the practical effect of the waiver was to preclude intervenors from cross-examination on the basis of the waivers, created the impression that site alternatives were not relevant to the proceeding, and ultimately shifted the burden of proof to the intervenors and foreclosed the intervenors' right to cross-examine witnesses. (UNU Br. at 101- 104.)

2. <u>Buckeye and Staff Arguments</u>

In regard to UNU's standing arguments, Buckeye notes that, unlike the intervenors, staff has a statutory obligation to conduct an investigation of the application and file an investigative report. Buckeye notes that UNU's standing to request discovery and file motions to compel discovery were not affected by the grant of the waivers and no interlocutory appeal was filed by UNU. (Buckeye Reply Br. at 99.)

Further, Buckeye states that UNU's arguments regarding the waiver of Rule 4906-13-03, O.A.C., were addressed and disposed of in the July 31, 2009, entry, and UNU failed to file an interlocutory appeal of the ALJ's entry. Further, Buckeye notes that the June 23, 2009, letter of completeness indicated that sufficient information had been provided to allow staff to commence its investigation in this case. The applicant and staff note that the Board has addressed this issue directly in *In the Matter of the Power Siting Board's Adoption of Chapter 4906-17, and the Amendment of Certain Rules in Chapters 4906-1, 4906-5 and Rule 4906-17*, Case No. 08-1024-EL-ORD, Opinion and Order, at 21 (October 28, 2008) (*Wind Rulemaking Case*). In the *Wind Rulemaking Case*, the Board concluded that an applicant is not required to file information for both a preferred and an alternate site, "only one proposed site is necessary, as with other types of proposed electric generation facilities." Further, Buckeye reasons that Rule 4906-5-04, O.A.C, permits the Board or the ALJ to waive the requirement of fully developed information on the alternative site. Buckeye reasons that UNU misreads the statute at Section 4906.10(A)(3), Revised Code. Section 4906.10(A)(3), Revised Code, requires the Board to find that the proposed project "represents the minimum adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives, and other pertinent considerations." Buckeye reasons that the phrase "of the various alternatives" does not relate to site alternatives but to other alternative technologies considered by the applicant. Buckeye cites *In re American Municipal Power–Ohio, Inc.*, Case No. 06-1358-EL-BGN, Opinion, Order, and Certificate, at 14 (March 3, 2008), in support of its interpretation of the statute by the Board. Thus, Buckeye concludes that UNU's arguments are flawed and should be rejected. (Buckeye Reply Br. at 96-98; Staff Reply Br. at 6.)

3. Board Analysis and Conclusion

The Board agrees that a person or entity, like UNU, may have standing to assert its interest under the jurisdiction of the court or an administrative agency, such as the Board, where the person has, in an individual or representative capacity, some real interest in the subject matter of the action. In this matter, while UNU has a real and direct interest in the Board proceeding and, therefore, its request for intervention was granted, there is no equivalent interest in the certification application filing requirements. The record reveals that UNU exercised its ability to issue discovery requests and to compel discovery. We further note that UNU's request to compel discovery was granted, in part. Based on the record, particularly the extensive transcript in this proceeding, neither UNU nor any other intervenor was foreclosed from cross-examining the applicant's witnesses on site analysis performed for this application. We agree with the ALJ's analysis and ruling as set forth in the July 31, 2009, entry regarding the intervenor's lack of standing to challenge the Board's consideration of a waiver of its certification application filing requirements. Furthermore, we do not find that the ALJ granted a waiver of Rule 4906-17-04, O.A.C., *sua sponte*. The reference to the comparable wind rule and the Board's decision on the issue in the *Wind Rulemaking Case* was an appropriate aspect of the ALJ's analysis. As Buckeye argued, UNU has misinterpreted the statute at Section 4906.10(A)(3), Revised Code, to relate to site alternatives, rather than technological alternatives to the proposed project. Accordingly, the Board affirms the ALJ's ruling.

B. Michael Nissenbaum Testimony by Deposition

1. UNU Arguments

UNU requests that the Board reconsider the ALJ's October 21, 2009, ruling denying UNU's request to admit the deposition of Dr. Nissenbaum in lieu of live testimony at the hearing. UNU argues that Dr. Nissenbaum's testimony responds to the request by the Ohio Department of Health (ODH) for hard scientific evidence on potential health impacts associated with utility scale wind projects. UNU proffers that Dr. Nissenbaum's direct testimony was excluded in error and requests that the hearing be reopened for the purpose of admitting Dr. Nissenbaum's deposition transcript as testimony in this case. UNU also notes that a witness at the public hearing sought to offer the affidavit of Dr. Nissenbaum at the public hearing and the ALJ, at that time, took submission of the affidavit under advisement indicating that the matter would be addressed during the adjudicatory proceeding. (UNU Br. at 105-107.)

2. Buckeye Arguments

Buckeye supports the ruling of the bench. The applicant recalls that, at the public hearing, a witness requested that the affidavit of Dr. Nissenbaum be placed in the evidentiary record (Public Hearing Tr. at 40-41). The applicant contends that, because Dr. Nissenbaum was not present at the public hearing, his affidavit was correctly placed in the correspondence docket and not the evidentiary record. Buckeye notes that UNU offered to make Dr. Nissenbaum available by telephone. Buckeye also argues that UNU should have filed an interlocutory appeal of the ruling on Dr. Nissenbaum's testimony rather than wait until this late stage of the proceeding to request the hearing be reopened. (Buckeye Reply Br. at 105-107.)

3. <u>Board Analysis and Conclusion</u>

The Board has reviewed the circumstances surrounding Dr. Nissenbaum's availability to attend the evidentiary hearing and the submission of his affidavit at the public hearing. We note that his affidavit was included in the correspondence docket, on December 1, 2009, like any other interested person who submits correspondence to the Board. We find that including Dr. Nissenbaum's affidavit in the correspondence docket is appropriate given that he was not at the public hearing and available for cross-examination by the parties to the proceeding. Thus, we affirm that aspect of the ALJ's ruling.

The Board notes that Rule 4906-7-07(E)(13), O.A.C., states:

> Depositions *may* be used in board hearings to the same extent permitted in civil actions in courts of record. Unless otherwise ordered for good case shown, any depositions to be used as evidence must be filed with the board at least three days prior to the commencement of the hearing.

We also recognize that Rule 32(A)(3), Ohio Rule of Civil Procedure (ORCP), states:

> The deposition of a witness, whether or not a party, may be used by any part for any purpose if the court finds: (a) that the witness is dead; or (b) that the witness is beyond the subpoena power of the court in which the action is pending or resides outside of the county in which the action is pending unless it appears that the absence of the witness was procured by the party offering the deposition; or (c) that the witness is unable to attend or testify because of age, sickness, infirmity, or imprisonment; or (d) that the party offering the deposition has been unable to procure the attendance of the witness by subpoena; or (e) that the witness is an attending physician or medical expert, although residing within the county in which the action is heard; or (f) that the oral examination of a witness is not required; or (g) upon application and notice, that such

> exceptional circumstances exist as to make it desirable, in the interest of justice and with due regard to the importance of presenting the testimony of witnesses orally in open court, to allow the deposition to be used.

With these provisions in mind, we reconsider UNU's request and the ALJ's ruling regarding the submission of Dr. Nissenbaum's deposition, in lieu of live testimony at the evidentiary hearing. The Board notes that, according to UNU, Dr. Nissenbaum volunteered his services contingent upon UNU assuring him he would not be required to travel to Ohio to offer testimony in-person. UNU represented that a replacement radiologist must be hired to cover Dr. Nissenbaum's duties and that Dr. Nissenbaum is unable to hire a replacement physician for periods of less than one week. The Board recognizes that UNU presented the testimony of other witnesses (UNU witnesses James, and Taylor) regarding the health affects of wind turbines. Accordingly, the Board finds that it was properly within the ALJ's discretion to require Dr. Nissenbaum to offer live testimony at the evidentiary hearing, like most of the other witnesses to this proceeding.[2] The Board concurs in the rationale and the decisions set forth by the ALJ entry issued October 21, 2009. Accordingly, UNU's request to reverse the decision and to reopen the hearing in this matter is denied.

C. <u>Access to Drafts of the Buckeye Application</u>

By entry issued October 30, 2009, the ALJ considered and rejected UNU's request to compel discovery of Buckeye's drafts and preliminary versions of the application. On brief, UNU argues that draft versions of the application may have provided or led to the discovery of useful relevant information or inconsistent statements. UNU requests that the Board reverse the ALJ's decision, remand the application to allow parties to conduct discovery, and reopen the hearing to the extent necessary to introduce any probative evidence. (UNU Br. at 107.)

Buckeye reiterates that the ALJ rejected this argument in light of the fact that the only application subject to review by the Board is the application docketed with the Board. Further, Buckeye notes that the ALJ also recognized that edits to drafts of the application were the result of the advice of counsel; therefore, the drafts would be protected by the work product doctrine and attorney-client privilege. (Buckeye Reply Br. at 104-105.)

The Board has reviewed UNU's motion to compel discovery, Buckeye's response, and the ALJ's October 30, 2009, entry as discussed above. We affirm the ALJ's decision

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2 The Board notes that the direct testimony and deposition of UNU witness McKew was admitted into the record by Stipulation of the parties as a result of Ms. McKew's unexpected inability to appear at the evidentiary hearing. Counsel for UNU represented that Ms. McKew had been hospitalized for a serious medical condition (Tr. at 1163-1165).

and further find that the request of UNU was overly broad and unduly burdensome. The Board, accordingly, denies UNU's request to reverse the ALJ's decision and remand the case for further proceedings.

D. Testimony of Buckeye Witness Shears

1. UNU, the County, and UCC Arguments

UNU and the County request that the Board reconsider certain of the ALJ's rulings made during the course of the evidentiary hearing. UNU requests that the Board review the ALJ's denial of the intervenors' motion to strike portions of the direct testimony of Buckeye witness Christopher Shears (Buckeye Ex. 4) on the basis that Mr. Shears had not been qualified as an expert (UNU Br. at 108-113). The County also moved to strike 11 exhibits to the application or at least delay admission of the exhibits until Buckeye authenticated the exhibits by an expert (Tr. at 371-372).[3]

UNU argues that Mr. Shears was not qualified as an expert to render opinions on emissions offset, the estimation of jobs to be created as a result of the proposed project, noise impact assessment, property values, shadow flicker, ice shedding, health issues, and the impact of the proposed project on Indiana bats; therefore, UNU moved to strike seven sections of Mr. Shears' direct testimony. UNU states that the subject matter of Mr. Shears' degree was not established on the record and a foundation was not provided for the witness to demonstrate that he possessed the requisite knowledge to offer testimony on the above subjects. The County joined in UNU's motion to strike portions of Mr. Shears' direct testimony. (UNU Br. 108-114; Tr. at 363-370.)

In addition, the County asserts that Mr. Shears had not been qualified as an expert through specialized knowledge, skill, experience, training, or education regarding the subject matter set forth in the testimony or exhibits pursuant to Ohio Rule of Evidence 702(B). The County argues, on brief, that no foundation had been laid for the admission of certain exhibits to the application, namely Exhibits K (Noise Impact Assessment), L (Shadow Flicker), M (Surface Waters, Ecological Communities, and Threatened and Endangered Species Report by Hull & Associates, Inc.), N, O, R (Socioeconomic Report), T (a two-sided, one-page sheet by the American Wind Energy Association entitled "Keep Ohio Competitive for Wind Energy"), U (Cultural Resources Literature Review, and Archaeological and Visual Impact Assessment by ASC Group, Inc. on behalf of Hull & Associates, Inc. for Buckeye), V (Communications Analyses), W (Phase I Route Evaluation Study for Construction by Hull & Associates, Inc.), and X (Summer 2008 Bat Mist-netting Report by Stantec Consulting). (County Reply Br. at 15-19.)

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[3] The Board notes that counsel for UNU subsequently joined in the County's motion and UCC joined in UNU's motion to strike exhibits to the application as to property values, noise, and shadow flicker (Tr. 371-372).

2. Buckeye Arguments

Buckeye responds that Mr. Shears is an officer with Buckeye, has 15 years of experience in the industry, and has been involved with over 60 wind projects. The witness has offered testimony before the British House of Lords and was chairman and vice chairman of the British Wind Energy Association. The applicant also notes that Mr. Shears was subject to cross-examination by all of the intervenors and staff. Buckeye notes that no interlocutory appeal of the ruling was made. On the basis of Mr. Shears' experience and involvement in the wind industry, Buckeye states that the witness has sufficient expertise and insight to offer valuable information on wind power issues. (Buckeye Reply Br. at 105-107; Buckeye Ex. 4 at 2; Tr. at 40-41.)

3. Board Analysis and Conclusion

Initially, the Board notes that Mr. Shears was the applicant's first witness in this proceeding and that, in two instances, the motions to strike refer to the testimony of Buckeye witness Shears in reference to other Buckeye witnesses (Mundt and Hessler) and Shears' opinion of what the other witness' testimony will demonstrate (Buckeye Ex. 4 at 12, 15). As such, it is a permissible introduction of Buckeye's case and the Board will accept the admission of Buckeye witness Shears' testimony as no more than an introduction. We further note that Buckeye presented the testimony of witness Meinke, of Stantec Consulting (Stantec), who supported exhibits to the application, specifically Exhibit N (Fall 2007 Bird and Bat Migration Survey Report by Stantec [formerly known as Woodlot Environmental Consultants]), Exhibit O (Spring, Summer and Fall 2008 Bird and Bat Survey Report by Stantec Consulting), and Exhibit X (Summer 2008 Bat Mist-netting Report by Stantec Consulting). Therefore, the Board will also accept the admission of Buckeye witness Shears' testimony as an introduction of those exhibits to the application.

As for the balance of the exhibits to the application to which UNU and the County object, the Board denies the intervenors request to overturn the ALJ's ruling. The Board notes that it is a long-standing practice in Board proceedings for an applicant to sponsor exhibits to an application through the testimony of a witness that is an officer or experienced employee of the applicant. The Board has admitted the testimony of a witness, and the related exhibits, where the witness demonstrates that the exhibits or studies were performed at the applicant's request, under the witness' direct or indirect supervision, and that the officer is sufficiently knowledgeable about the information in the exhibit or study to offer testimony. We have found this process to be an efficient method by which to introduce large amounts of data necessary to process certificate applications. Further, the Board notes that, pursuant to Section 4906.07, Revised Code, the Board is required to direct an investigation of the application and file a written report of the investigation.

In this instance, we find that Mr. Shears is an officer of EverPower, the parent company of Buckeye, with 15 years of experience in the industry, including 60 wind projects, and has experience offering testimony as the Chairman of the British Wind Energy Association before the government of the United Kingdom. We also note that, in this proceeding, Mr. Shears was extensively cross-examined by both staff and intervenors. (Buckeye Ex. 4; Tr. at 15-359.) Accordingly, the Board affirms the decision of the ALJ to deny intervenors' motion to strike the specified portion of the direct testimony of Buckeye witness Shears and the exhibits to the application.

## V. SUMMARY OF THE EVIDENCE

The Board will review the evidence presented in this case with regard to each of the criteria by which we are required to evaluate this application. Any evidence not specifically addressed herein has still been considered and weighed by the Board in reaching its final determination.

### A. Local Public Hearing

At the local public hearing, 46 people testified. Witness testimony at the public hearing was approximately evenly split between those who oppose and those who support the proposed facility. Testimony from those supporting the project primarily emphasized the potential positive economic impacts of the project, the potential for job growth in Champaign County, and the environmental benefits of wind energy. Several farmers, who would have turbines located on their land if the proposed facility is approved, expressed the importance of receiving the lease payments to the health of their businesses. Testimony in opposition to the proposed facility focused on the potential negative consequences that could result from the siting of turbines with improper setbacks, including: health consequences of the project, the potential noise generated by the proposed facility, and the safety impacts. The potential negative environmental consequences were also discussed, including the potential for negative impacts on wildlife, as well as the potential disruption of the quiet country setting of rural Champaign County.

In addition to the testimony received at the public hearing, the Board has received numerous public correspondence, which is docketed in this case. The public correspondence received raises similar arguments to those expressed at the public hearing. In addition, concerns have been expressed about the potential economic benefits of the project, should the proposed facility receive a special tax status. Additional concerns have been raised by pilots, who fly in and around Champaign County, about the potential impact of turbine siting around two of Champaign County's two airports.

B. Basis of Need - Section 4906.10(A)(1), Revised Code

Staff notes that, as an electric generation facility, pursuant to Section 4906.10(A)(1), Revised Code, the basis of need for the proposed facility is not applicable to this electric generating project (Staff Ex. 2 at 12).

No issues were raised by any party related to the basis of need for the project. The Board recognizes that Section 4906.10(A)(1), Revised Code, specifies that it applies to the Board's determination process only if the facility proposed is exclusively an electric transmission line or a gas or natural gas transmission line. Given that the application in this case is for a wind-powered electric generation facility, the Board finds that Section 4906.10(A)(1), Revised Code, is not applicable.

C. Nature of Probable Environmental Impact and Minimum Adverse Environmental Impact - Sections 4906.10(A)(2) and (3), Revised Code

Staff evaluated the application and supplemental information received from the applicant, and conducted field visits to evaluate the nature of the probable environmental impact and whether the proposed facility represents the minimum adverse environmental impact. As part of the Staff Report, staff discusses 27 factors regarding the nature of the probable environmental impact of the construction and operation of the proposed wind-powered electric generation facility. The factors include the air emissions, the wetlands and streams within the project area, the electric collection lines proposed as part of the application, access roads, the removal of trees and vegetation in the project area, threatened or endangered species, traffic in the project area, cultural resources, residences or other structures that will be removed as a result of the proposed project, projected operational noise levels, turbine setbacks, the composition of the project area, regional development, and jobs associated with the proposed project. (Staff Ex. 2 at 13-19.)

Staff also evaluated the site selection process and the ecological, cultural, and socioeconomic impacts of the construction and operation of the proposed wind-powered electric generation facility in its consideration of whether the proposed facility represents the minimum adverse environmental impact (Staff Ex. 2 at 20-26).

To the extent intervenors have raised an issue regarding the nature of the probable environmental impact or the proposed facility's minimum adverse environmental impact, only the more salient issues are addressed by the Board in this order. If a party raised an issue as to the nature of the environmental impact or to the minimum adverse environmental impact, and the issue is not addressed in this decision, it is hereby denied by the Board.

1. Environmental Impacts

a. Site Selection

Buckeye requested, and was granted, a waiver from providing a complete site alternative analysis due to the unique nature of wind-powered electric generation facilities. Staff reports that Buckeye evaluated the following criteria in siting the proposed facility: adequate wind resources, proximity to electric transmission infrastructure with adequate capacity, accessibility via public roads and railroads that can accommodate delivery of equipment, adequate geotechnical conditions, limited sensitive ecological resources, compatible land use, and landowners who are willing to lease their property for the construction and operation of the facility. (Staff Ex. 2 at 20.)

With respect to the siting of each turbine, according to staff, Buckeye reported the use of additional criteria, including: setbacks from residences, property lines, public right-of-ways, and other features. Within the remaining available area, Buckeye represented to staff that it considered: shadow flicker and noise constraints, slopes and other access road limitations, ecologically-sensitive resources, wind resources and turbine engineering requirements, agricultural impacts, and landowner preferences regarding the placement of the wind turbines. Staff asserts that Buckeye considered numerous potential configurations before presenting the application to the Board. (Staff Ex. 2 at 20.)

The Board finds that the site selection for the proposed facility complies with Section 4906.10(A)(2) and (3), Revised Code, as the probable impact of the site selection has been adequately determined, and the Board is able to determine that the site selection, as presently configured, represents the minimum adverse environmental impacts, provided the certificate issued includes staff's recommendations set forth in the Staff Report and modified in the Conclusion and Conditions Section of this opinion, order, and certificate.

b. Ecological Impacts

To evaluate the potential ecological impacts of the project, Buckeye hired Hull & Associates, Inc. (Hull). In evaluating the proposed project area, Hull identified 12 wetlands within the project area. Buckeye asserts in its application that, although wetlands are present within the project area, the proposed facility has been designed to avoid any permanent or temporary impacts to the wetlands. However, some wetlands are close enough to the proposed facility components that specific avoidance steps will be necessary during construction to prevent any disturbance. These steps may include prominently flagging or temporarily fencing the wetland areas prior to construction to avoid material storage or vehicle traffic within the wetlands. Additional erosion and sediment controls will be utilized around wetlands to prevent disturbance. (Buckeye Ex. 1 at 144-145; Staff Ex. 2 at 13, 20-21; Buckeye Ex. 1A at Table 2.)

Hull also evaluated 21 streams located within the project area. According to the applicant, effective techniques are available and will be used to avoid stream impacts. To prevent erosion and downstream sedimentation, silt fencing and/or straw bales will be used around the work site. Moreover, where possible, cleared tree stumps will be left in place to help maintain soil stability. Existing crossings will be strengthened via placement of a steel plate to allow crossing by heavy equipment and turbine components. After construction, the steel plate will be removed and maintenance vehicles will use the existing crossing without modification. Where there is no existing crossing, in-water work will be avoided and special crossing techniques will be utilized, including: creating permanent bridges or the use of directional boring for buried electrical collection lines. (Buckeye Ex. 1 at 148-149, Ex. M; Staff Ex. 2 at 13-14, 21; Buckeye Ex. 1A at Table 2.)

Staff concludes that there would be minimal tree and vegetation clearing for construction, due to the agricultural nature of the project area. However, it is estimated that 4.1 acres of forested area would need to be cleared to accommodate various project components, representing less than 0.1 percent of the project area. Therefore, the impact on plants and wildlife, due to tree clearing would be minimal. (Staff Ex. 2 at 14, 21.)

The Board finds that the nature of the ecological impacts of the proposed facility have been adequately determined, in compliance with Section 4906.10(A)(2), Revised Code, and that the proposed facility represents the minimum ecological impacts from the proposed facility, provided the certificate issued includes staff's recommendations set forth in the Staff Report and modified in the Conclusion and Conditions Section of this opinion, order, and certificate.

c. Wildlife

In its application, Buckeye states that it hired Hull to conduct a review of the potential impacts of the construction of the proposed facility on wildlife. This review was conducted from 2007 to 2008, and involved numerous onsite studies. Hull identified numerous birds, mammal, and reptiles that typically live in the vicinity of the proposed facility. (Buckeye Ex. 1 at 115-117.)

Buckeye states that it expects construction-related impacts to wildlife to be limited to incidental injury and mortality due to construction activity. Buckeye expects the project to have little impact on any resident species. With respect to permanent displacement, Buckeye states that the proposed facility will be sited away from sensitive habitats, such as forestland, streams, and wetlands, which will minimize the potential impact that the proposed facility will have on wildlife through the risk of permanent displacement. Although the proposed project area covers approximately 9,000 acres, construction of the facility will result in the permanent loss of 0.3 acres of forest habitat, and the conversion of 3.8 acres of forest to successional communities. (Buckeye Ex. 1 at 150-151.)

Additionally, Buckeye asserts that it is taking the proper steps to minimize the impact of the proposed facility on the local ecosystem and wildlife. To minimize the impacts of the proposed facility, Buckeye outlines mitigation measures including: avoidance of sensitive areas, such as wetlands; limiting the area disturbed to the smallest possible area; and reestablishing vegetative cover in disturbed areas. Buckeye asserts that these measures will avoid any significant disruption to local wildlife. (Buckeye Ex. 1 at 152.)

Staff concluded that, based on the field surveys conducted, as well as information contained in the Ohio Department of Natural Resources' (ODNR) Natural Heritage Database, this proposed facility would result in limited impacts on wildlife. Moreover, no significant impacts to reptilian or amphibian species is expected as a result of the construction of the proposed facility. (Staff Ex. 2 at 15.)

i. <u>Avian Species</u>

Buckeye hired a consultant, Stantec, to determine the impact of the potential facility on the avian and bat populations (Buckeye Ex. 1 at 112). Through Stantec, Buckeye conducted numerous surveys under guidelines recommended by ODNR. After conducting a survey of the area, Buckeye noted the presence of several state listed species. Specifically, the surveys included limited sightings of several species of concern: the northern harrier (state endangered); the least flycatcher (state threatened); and the sandhill crane (state endangered) (Buckeye Ex. 1 at 118, 121). However, due to the predominately agricultural nature of the area, Buckeye states that the project area does not provide suitable habitat for many of these species (Buckeye Ex. 1 at 140).

Staff states, in its review of the application, that Buckeye properly consulted with ODNR's Division of Wildlife, as well as the United States (U.S.) Fish and Wildlife Service (USFWS) to determine the impact of the proposed facility on avian species and to develop an adequate preconstruction avian surveying plan. Staff concluded that, based on the results of the avian studies, as well as the location of the proposed facility within a largely agricultural area, significant impacts to bird species were not expected as a result of the proposed project. (Staff Ex. 2 at 14-15.)

However, UNU disagrees with Buckeye's conclusion that the proposed facility will not kill an unacceptable number of birds. Specifically, UNU, argues that Buckeye has provided insufficient data, including the use of only a single radar station to detect migratory birds within the project area and the use of a single observation point to observe raptors passing through the area. Of particular concern to UNU is the possible presence of bald eagles in the project area. UNU avers that Buckeye has not conducted sufficient studies to assure that bald eagles are not nesting in the project area and will not be affected by the construction of the proposed facility. (UNU Br. at 68.)

ii. Bat Species

(a) Buckeye

According to Buckeye's witness Cara Meinke, a consultant with Stantec, of particular concern in the project area is the Indiana bat, a federally endangered species. The witness explained that the Indiana bat is a cave dwelling bat, which hibernates in caves during the winter, and spends the remainder of the year in tree roosts (Tr. at 617-618). Buckeye asserts that, in bat mist-net surveys conducted by Stantec during the fall of 2007 and in the spring, summer, and fall of 2008, Stantec did not capture or identify any Indiana bats in or near the project area. However, in 2009, a survey by another developer resulted in the capture of Indiana bats less than one mile from the proposed project area. (Buckeye Ex. 7 at 3; Tr. at 2289-2291.)

Despite the presence of the Indiana bat near the project area, Buckeye asserts that the proposed facility will not cause an adverse impact on the Indiana bat. Specifically, Buckeye states that it is working with the USFWS and ODNR to develop a Habitat Conservation Plan (HCP), which will include obtaining an Incidental Take Permit (ITP) (Buckeye Br. at 35; Tr. at 2263). According to Buckeye, the HCP and ITP would mitigate any mortality of bats caused by the turbines. In fact, Buckeye asserts that, because of its efforts, there will be no impact to the Indiana bat. (Buckeye Br. at 35; Buckeye Ex. 7 at 7.) In support of this assertion, Buckeye's witness Meinke testified that, in order to obtain an ITP, Buckeye must prepare an HCP that demonstrates that take will be minimized and mitigated to the maximum extent practicable, and the HCP must meet with the approval of the USFWS and comply with the National Environmental Policy Act. Moreover, Ms. Meinke testified that the typical foraging activities of the Indiana bat, among trees, over streams, along habitat edges, and in small clearings in forests, will not be affected by the proposed facility in its present configuration. (Buckeye Ex. 7 at 4-7.)

(b) Staff

Staff states that Buckeye is generally avoiding habitat that is typically identified as suitable habitat for the Indiana bat, which reduces the likelihood of the project impacting the species. In addition, staff indicates that Buckeye consulted with ODNR and the USFWS to assess the potential impact of the proposed facility on the Indiana bat and to develop an appropriate preconstruction surveying plan. Staff supports the implementation of an HCP to assist in the minimization and mitigation of potential impacts to the Indiana bat. Moreover, staff agrees with Buckeye's assertions that location of the proposed facility away from sensitive areas such as wetlands, streams, or wooded areas will minimize the potential impacts of the facility. (Staff Ex. 2 at 15, 22.)

Staff witness Keith Lott also testified as to potential measures that could be included in the HCP. Mr. Lott stated that appropriate setbacks from the edges of forested areas would minimize bat mortality. Additionally, Mr. Lott testified that Buckeye could feather its turbine blades during times of low wind. Feathering occurs where blades are rotated so that they do not catch the wind. Feathering at low wind speeds has been shown to decrease bat mortalities by blade strike by more than 50 percent. Mr. Lott further noted that feathering would protect other bat species as well. (Tr. at 2265-2279.)

(c) UNU and UCC

UNU asserts that the risk of impact on the Indiana bat is greater than the risk estimated by Buckeye or staff. UNU asserts that the state has a duty to protect the bats, which can be harmed in several ways (UNU Br. at 62). First, bats can be attracted to the movement of the turbines and fly into the turbines, as stated by staff witness Lott (Tr. at 2260). Bats, in general, also suffer a risk of barotraumas, where the change in air pressure, created by a turning wind turbine, causes a rapid decompression and a collapsing of their lungs (Tr. at 615). Therefore, according to UNU, bats, including the Indiana bat, will likely be harmed by the proposed facility, which in turn will have an impact on the local ecosystem. Moreover, UNU asserts that Buckeye has not included sufficient information in its application on corrective measures or other recommendations of a protocol for measuring acceptable effects on bats. (UNU Br. at 67-68.)

UNU states that additional conditions must be placed on the proposed facility to protect the Indiana bat. First, UNU recommends that the Board prohibit Buckeye from clearing any suitable habitat of the Indiana bat, including any isolated trees which provide a suitable habitat, as bats may be harmed or killed during tree removal. UNU also recommends that the Board disallow any tree clearing in the habitat area of the Indiana bat between April 1 and November 30, the times of the year during which the Indiana bat is tree roosting. (UNU Br. at 63-64; Tr. at 2281-2282.) Additionally, UNU supports the recommendation that turbine blades be feathered at wind speeds of 5.0 meters per second or less (UNU Br. at 66).

As an additional measure, UNU recommends five-mile setbacks from any bat capture site or roosting location of the Indiana bats (UNU Br. at 64). UNU argues that Mr. Lott stated that ODNR has identified setbacks as an effective method for protecting Indiana bats (Tr. at 2265). Because USFWS has determined that a five-mile setback is appropriate, unless Buckeye goes through a formal consultation process with the USFWS, UNU asserts that turbines should be setback at least five miles from any capture sites or roost locations (Tr. at 648-649; UNU Br. at 64; UNU Ex. 53 at 50). UNU not only supports the inclusion of a certificate condition that would require a five-mile setback from all Indiana bat capture and roost locations, but UNU supports a requirement that, if an Indiana bat roost is subsequently discovered within five miles of an operational turbine, use of the turbine be discontinued until it can be verified that the roost is no longer in use. (UNU Br. at 65.)

In addition to the five-mile setback from all roost or capture locations, UNU believes that a 10-mile setback from all hibernacula is necessary. UNU argues that this setback is necessary to protect bats, which may arrive at their hibernacula as early as July, where they remain to buildup fat for hibernation. During this time, prior to hibernation, bats have been known to forage at greater distances, up to 19 miles. (UNU Ex. 53 at 40-42.) UNU argues that a 10-mile setback from all hibernacula is necessary to adequately protect the Indiana bats during autumn swarming prior to hibernation (UNU Br. at 65).

Finally, UNU believes that Buckeye should develop a meaningful post-construction avian and bat mortality plan to prevent excessive bat deaths (UNU Br. at 66). UNU notes that the Staff Report recommends the development of such a plan that is approved by both staff and ODNR (Staff Ex. 2 at 61). However, according to UNU, the condition recommended by staff does not adequately protect bat and avian life, as it only records the number of bats and birds that have died, but will not require Buckeye to reduce unacceptably high mortality numbers. UNU recommends that a meaningful post-construction avian and bat mortality plan would identify the number of bird and bat fatalities deemed to be unacceptably high and would specify the mitigation measures that Buckeye should undertake to reduce avian and bat mortalities, if they reach an unacceptably high number. (UNU Br. at 66-67.)

In addition to the use of setbacks to protect the Indiana bat, testimony by staff witness Lott provided that a colony of Northern Myotis bats was found near the site for Turbine 48 (Tr. at 685, 2260-2261). UNU argues that siting of this turbine may discourage the bats from continuing to use the area and would increase the risk of bat mortality. UNU asserts that some of the mitigation measures used to protect the Indiana bat should also be used to protect other bat species, including disallowing Buckeye from cutting down trees in which bats are currently roosting. (UNU Br. at 66-68.)

UCC also raises additional concerns about the colony of Northern Myotis bats roosting on the southwestern edge of UCC property, near the location of proposed Turbine 48 (UCC Br. at 10). Should the colony of Northern Myotis bats be disturbed, UCC is concerned about the negative impacts on the country club. UCC states that bats are beneficial to the golf course because they naturally reduce the number of flying insects in the area (UCC Br. at 10). Moreover, UCC relies on the testimony of Ms. Meinke that operation of a wind turbine near the golf course might reduce the number of bats foraging for insects around the course (Tr. at 696-697). In its brief, UCC concludes that any disruption of the bat colony located near proposed Turbine 48 could be detrimental to the enjoyment of UCC property due to the presence of additional insects (UCC Br. at 11).

Therefore, UCC is concerned that Buckeye's application offers no mitigation strategy for the impact on the Northern Myotis bats (UCC Br. at 18).

(d) Buckeye Response

Buckeye disagrees with UCC's assertion that the construction of Turbine 48 will disrupt the Northern Myotis bat colony located on UCC's property. Specifically, Buckeye argues that UCC's assumption that construction of Turbine 48, which is located on agricultural land, will disrupt the colony is based solely on speculation (Buckeye Reply Br. at 65-66). Moreover, Buckeye points out that Mr. Lott testified that all of the proposed facility is located on agricultural land which would not impact the habitat or the colony itself (Tr. at 2279).

Additionally, Buckeye disagrees with the assertion of UNU that an HCP and ITP are insufficient, or that additional setbacks are necessary beyond those imposed in the Staff Report or recommended in the HCP obtained from USFWS (Buckeye Reply Br. at 57-63). Instead, Buckeye states that its intention to comply with an HCP and ITP should be sufficient for the Board to determine that the proposed facility will not have an adverse impact on the Indiana bat (Buckeye Reply Br. at 58; Buckeye Ex. 4 at 17-18). Buckeye asserts that intervenors, UNU and UCC, ignore the involvement of staff, ODNR, and USFWS, when they seek to impose additional conditions on the construction of the proposed facility. Buckeye does not believe UNU's proposed additional conditions are necessary, as the HCP will set forth appropriate safeguards (Buckeye Reply Br. at 58). Moreover, Buckeye states that staff's proposed condition that would require Buckeye to have an environmental specialist on site at all times that construction is being performed in or near a sensitive habitat should be sufficient to safeguard local wildlife (Staff Ex. 2 at 60; Buckeye Reply Br. at 59).

Buckeye also takes issue with UNU's proposed requirement that a condition be imposed on the certificate requiring turbines to be feathered at wind speeds of 5.0 meters per second or less (UNU Br. at 65-66). According to Buckeye, both Mr. Lott and Ms. Meinke provided significant testimony indicating that the HCP and ITP would provide assurances against any adverse impact on the Indiana bat (Buckeye Ex. 7 at 7-8; Tr. at 2283). Buckeye asserts that, rather than try to duplicate the efforts contained in the HCP, the Board would be better served to simply require Buckeye to obtain an HCP and comply with the conditions imposed therein (Buckeye Reply Br. at 63).

(e) Board Analysis and Conclusion

The Board has reviewed the record with respect to the conservation of wildlife. Although UNU and UCC believe that additional safeguards are necessary to protect local wildlife, we find that Buckeye has taken adequate steps, and will continue, to avoid, minimize, and mitigate the effects of the proposed facility on local wildlife, including the

Indiana bat. Additionally, because Buckeye is pursuing an HCP and ITP with USFWS, we do not find it necessary for the Board to impose any additional conditions on the certificate, beyond those initially recommended by staff, due to the continued oversight by USFWS that will result from the HCP and ITP.

We believe that the potential bird and bat mortality rates were appropriately addressed on the record by Buckeye and that Buckeye conducted adequate avian studies. Therefore, the Board finds that, with respect to the potential impact on wildlife, the record in this proceeding shows that the nature of the probable environmental impact, as well as the minimum adverse environmental impact, has been determined for the proposed facility, in accordance with Section 4906.10(A)(2) and (3), Revised Code, provided the certificate issued includes staff's recommendations set forth in the Staff Report and modified in the Conclusion and Conditions Section of this opinion, order, and certificate.

2. Cultural Resources and Socioeconomic Impacts

a. Buckeye

The application includes data collected by ASC Group, Inc. concerning the cultural and archaeological resources in the project area. The data was compiled into a cultural resource literature review and impact assessment of such resources within a five-mile radius of the proposed wind project area. (Buckeye Ex. 1 at 180-189, App. Ex. U.)

The application included a cultural assessment of 33 cultural resources listed with the National Register of Historic Places (NRHP), one location with a determination of eligibility for listing with the NRHP, numerous historic inventory, and archaeological inventory, and identified 70 cemeteries (Buckeye Ex. 1 at 180, App. Ex. U).

Buckeye asserts that, based upon the cultural resource study, impacts to archaeological and historic resources and landmarks are likely to be extremely minimal. First, Buckeye contends other structures in Ohio that are similar to turbines, like telecommunications towers, rarely encounter significant archaeological sites given the small amount of ground disturbed to construct the structures and the fact that they are located in upland areas, rather than stream valleys where prehistoric archaeological sites are often found. The likelihood of disturbing archaeological sites, according to Bukeye, is also reduced by the use of farm land, public roads, and exiting utility right-of-ways (ROW) to the extent possible. Construction of the proposed facility is anticipated to disturb a total of approximately 373 acres of soil, of which 301 acres will be temporarily disturbed and approximately 72 acres will be permanently impacted. (Buckeye Ex. 1 at 181, App Ex. U.)

According to the application, there are 34 historical landmarks within five miles of the proposed facility as identified by the Ohio Historic Preservation Office (OHPO). Twenty of the landmarks are located in the village of Mechanicsburg and nine are in the city of Urbana. Buckeye states that the proposed wind facility will not physically destroy, alter, or be located immediately adjacent to any registered or known eligible landmarks. In addition, Buckeye submits that, pursuant to the criteria recognized by the NRHP, the facility will not adversely affect the integrity of the historic landmarks. Buckeye contends that no turbine will be located close to landmarks so as to constitute a visual obstruction, although some turbines may be visible in the distance from some landmarks depending on obstructing terrain, tree lines, or other buildings. The historic district in Urbana is not likely to have a view toward any of the proposed turbines and the listed historic resources in the village of Mechanicsburg are not likely to have significant views of the wind turbines. (Buckeye Ex. 1 at 181-184, Ex. U.)

b. Staff

Staff reviewed Buckeye's assessment of the impacts to cultural resources within five miles of the project area and notes that Buckeye's cultural impact analysis was conducted utilizing a database or literature review of previously recorded elements. Staff concurs that impacts to known cultural resources are likely to be minimal in light of the fact that the project will be located in upland areas, the proposed turbine locations will not be near identified cultural resource sites, and the access roads and electric collection system will be placed along existing roads. (Staff Ex. 2 at 22-24.)

Staff recognizes that there are several sites of archeological interest in the area, including a band of Native American mounds identified to the south of the project area between the city of Urbana and the village of Mechanicsburg. Staff proposes that, to better determine the presence, or absence, of important archeological sites, at a minimum, Phase I testing is appropriate at turbine locations, access roads, and electric collection line locations. (Staff Ex. 2 at 23.)

Staff also discovered several structures of architectural interest in Union Township, in and around the village of Mutual, dating back to the 1800s, which were not inventoried in Buckeye's literature review. On that basis, staff suggests that Buckeye conduct additional architectural surveys and, if warranted, develop a mitigation plan for the staff's review, in coordination with OHPO with input from the Champaign County Historical Society, prior to construction. (Staff Ex. 2 at 23-24.)

As part of its investigation, staff also reviewed the socioeconomic and recreational impacts of the proposed facility. Staff concludes that the proposed wind facility is not likely to have a significant impact to existing land use within the project area, as minimal agricultural land will be permanently lost. Furthermore, staff points out that Buckeye has stated that all damaged drainage tiles from construction activities will be repaired, all construction debris will be removed, and landowners will be compensated for lost crops. (Staff Ex. 2 at 24-25.)

Staff acknowledges the proposed Buckeye wind facility is expected to have a long-term aesthetic impact on residences near the facility, as turbine(s) will be visible from many of the residences in the project area. All of the turbines in the project area are outside the residential setback (914 feet, in this instance), except for Turbine 70. In addition, except for Turbine 57, all of the turbines are outside the property line setback. Staff states that requiring Buckeye to screen the turbines from view is not a practical mitigation measure in most cases. (Staff Ex. 2 at 25.)

Staff lists 14 recreational land uses, two golf courses and one park within one mile of a turbine. The two golf courses are located within one-half mile of a turbine. With regard to shadow flicker, staff notes that shadow flicker has its longest reach during winter months, which is the off season for a golf course. However, staff states that the golf courses in the project area may receive some low intensity shadow flicker in the early morning and late evening. Furthermore, staff advises that both golf courses would be exposed to noise in the 35 dBA range. According to staff, traffic delays due to construction that may impact recreational land uses would be temporary and minimal. (Staff Ex. 2 at 25.)

Staff notes that, according to the application, the population in the townships of Champaign County is projected to grow by approximately 6.5 percent from 2010 to 2020. Staff believes that construction of the wind farm could limit future commercial and residential development in the project area; however, based on the population projections, the project will not limit growth beyond expected levels in the townships where the facility is planned. The proposed electric generation facility is expected to have a positive economic impact in the region by providing an additional source of tax revenue for the participating townships, lease revenues for participating landowners, 131 full-time construction jobs for approximately 12 months, and 12 full-time permanent jobs for facility operations. (Staff Ex. 2 at 25.)

Staff concludes that with the recommended conditions as set forth in the Staff Report, the proposed wind facility would not cause any temporary or permanent impacts to cultural resources. However, staff finds that the proposed facility would cause temporary and permanent social impacts in the project area. To address and minimize the nature of the socioeconomic impacts, staff recommends compliance with several conditions with which Buckeye must comply as part of the issuance of a certificate. Staff believes that, with the recommended conditions, the minimum adverse impacts will be realized in the project area and the surrounding community. (Staff Ex. 2 at 22-26.)

c. <u>UCC</u>

UCC, one of the golf courses in the project area, argues that the application fails to consider the distraction and visual impact proposed Turbines 48 and 49 will have on the golf course, as a result of the turbines appearance, movement on the horizon, and shadow flicker. As proposed, Turbine 48 would be located approximately 2,000 feet from and directly behind the green on the fifth hole and Turbine 49 would be located approximately 2,800 feet south of the green on the fifth hole. For that reason, UCC argues that Buckeye has failed to meet its burden to prove that the nature of the environmental impact has been considered and that proposed Turbines 48 and 49 represent the minimum adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives, and other pertinent considerations that should have been considered. (UCC Br. at 2; Tr. at 246.)

UCC requests that if the Board grants Buckeye a certificate, the Board include as conditions of the certificate the following two additional conditions:

> That the applicant is prohibited from constructing the proposed collector lines on the south side of US Route 36, west of Ault Road and east of Ludlow Road, along the UCC road frontage around Hole No. 11. (Tr. at 230.); and
>
> That Buckeye is prohibited from constructing proposed Turbines 48 and 49. (UCC Reply Br. 2, 4-5.)

d. Board Analysis and Conclusion

First, the Board notes that Buckeye has agreed to UCC's request not to construct the proposed collector lines on the south side of Route 36, along the UCC road frontage (UCC Br. at 2, Buckeye Reply Br. at 93). The Board finds that Buckeye and UCC's agreement not to locate the collector lines on the south side of Route 36, immediately adjacent to UCC, to be reasonable and finds that this condition should be incorporated into the conditions of the certificate as set forth in the Conclusion and Conditions Section of this opinion, order, and certificate. Next, with regard to UCC's concern pertaining to the construction of Turbines 48 and 49, the Board finds that there is sufficient information in the record to determine the nature of the probable environmental impact of Turbines 48 and 49 and that the two turbines represent the minimal adverse environmental impact pursuant to Sections 4906.10(A)(2) and (3), Revised Code. UCC's concerns with shadow flicker and noise are addressed below in Section V.F.6 of this order.

The Board acknowledges that the project may have an impact on various cultural and socioeconomic resources in the area. For purposes of our consideration of the application, with regard to Sections 4906.10(A)(2) and (3), Revised Code, the Board finds that the nature of the probable impact on such resources has been adequately determined and the proposed facility is sited such that it represents the minimum adverse environmental impact on the cultural and socioeconomic resources, provided the certificate issued includes staff's recommendations set forth in the Staff Report, as modified in the Conclusion and Conditions Section of this opinion, order, and certificate.

D. Electric Grid - Section 4906.10(A)(4), Revised Code

Section 4906.10(A)(4), Revised Code, requires that the feasibility and impact of connecting the proposed electric generation facility to the regional electric power grid be determined prior to the issuance of a certificate to the applicant. In order to address this requirement, Buckeye caused studies to be performed. PJM Interconnection (PJM), the applicable regional transmission system operator, prepared the feasibility study (PJM feasibility study) and the system impact study (PJM impact study). A stability and short circuit analysis (PJM stability study) is also included in the PJM impact study. According to the application, the PJM feasibility study identified conditions under which the proposed facility's output could be curtailed. However, the likelihood of curtailment was determined by the study to be slight during the summer peak hours given that several of the curtailment conditions were based on outdated rating data. The remaining congestion issues listed were based on very specific system conditions with a very low probability of occurrence. In addition, Buckeye asserts that the PJM feasibility study found that the curtailment of the proposed facility to something less than full output for a few hours, if the conditions ever exist, should not have an adverse affect on the overall operation of the facility. (Buckeye Ex. 1 at 65-66, Exs. B and C.)

The PJM impact study evaluated a 200 MW interconnection that would be injected along the Givens-Mechanicsburg 138 kV line and be interconnected at a new switching station located along the Dayton Power & Light, Inc. (DP&L) Urbana-Mechanicsburg-Darby 138 kV circuit. The new station will be owned and operated by DP&L and will consist of three 138 kV breakers configured as a ring-bus, a 138 kV revenue meter, and other associated facilities. Compliance with reliability criteria was assessed in the PJM impact study for summer peak conditions expected in 2012. The PJM impact study identified two facilities that would likely experience thermal overloads, and three breakers that would be over-dutied as a result of the proposed facility. To correct the system violations, Buckeye asserts that the study found that the following upgrades are required: the line terminal equipment at the Urbana substation must be replaced; reconductoring of approximately 4.3 miles of circuit; and three 69 kV circuit breakers at Urbana must be replaced. (Buckeye Ex. 1 at 66-67, Exs. B and C.)

The results of the PJM impact study revealed no operating issues other than operating voltage and power factor ranges. Further, PJM concluded that the proposed project would not result in deliverability or transmission system congestion problems. (Buckeye Ex. 1 at 67.)

Staff reviewed the studies regarding interconnection of the proposed project to the existing regional electric transmission system. In the Staff Report, staff notes that Buckeye submitted the proposed project to PJM on December 6, 2006. Staff states that the only study conducted by PJM which had not been released by the issuance of the Staff Report was the PJM facilities study, which identifies engineering design work necessary to begin construction, an estimate of costs that Buckeye will be charged for attachment facilities, local upgrades, and network upgrades, and a timeline for design and construction of facilities and upgrades. According to staff, Buckeye has not yet signed a Construction Service Agreement for the upgrades identified in the studies or an Interconnection Service Agreement with PJM for the proposed facility. The applicant's signature on the Interconnection Service Agreement will need to be obtained before PJM will allow Buckeye to interconnect the proposed facility to the bulk electric transmission system. (Staff Ex. 2 at 27.)

Staff reviewed the PJM impact study, which summarized the network impacts that may occur with the injection of 200 MW of energy (40 MW of capacity) when the proposed facility is connected to the bulk power system. Staff notes that only the 40 MW of capacity can be relied on for the facility to meet capacity obligations, although Buckeye requests a generation injection of 200 MW from PJM and listed 126 to 175 MW in its application to the Board. Both the PJM impact study and the PJM feasibility study revealed that some existing transmission lines would become overloaded with the addition of the proposed generating facility connected to the system under multiple contingency outage conditions. (Staff Ex. 2 at 28.)

The PJM feasibility study and the PJM impact study for the proposed project indicate that, pursuant to the North American Electric Reliability Corporation (NERC) electric transmission system reliability standards, the proposed wind facility would not overload the system with no contingencies or a single contingency, but noted that multiple contingencies would likely lead to outages and equipment failure. Staff notes that these issues can be alleviated by upgrading and reconductoring the line to maintain transmission system integrity. Staff confirmed that the PJM impact study revealed that three circuit breakers, transformer fuses, and holders would need to be replaced. (Staff Ex. 2 at 28-29.)

Staff also verified that, as stated in the application, the PJM stability study showed no stability issues were identified as a result of the proposed electric generation project and no overloads were identified as a result of previous projects or projects in queue prior to the proposed Buckeye project (Staff Ex. 2 at 29-30).

Thus, staff concluded that, with the upgrades identified in the PJM studies, the proposed facility is expected to provide reliable generation to the bulk electric transmission system, the facility is consistent with plans for expansion of the regional power system, and the facility will serve the interests of electric system economy and reliability. Further, staff states that the proposed generation facility will serve the public interest, convenience, and necessity by providing additional electrical generation to the regional transmission grid. (Staff Ex. 2 at 30-31.)

Initially, the Board notes that none of the intervenors to this matter raised any issues regarding the interconnection studies and the conclusions of the applicant and/or the staff based on the studies.

The Board finds that, based on the record in this proceeding, the proposed wind-powered electric generation facility is consistent with the plans for expansion of the regional power grid as set forth in the system impact and interconnection studies performed by the regional system operator and will serve the interest of electric systems economy and reliability. Therefore, the Board concludes that the proposed facility complies with the requirements specified in Section 4906.10(A)(4), Revised Code, provided the certificate issued includes staff's recommendations. (Staff Ex. 1 at 36.)

E. Air, Water, Solid Waste, and Aviation - Section 4906.10(A)(5), Revised Code

1. Air

According to the Staff Report, air quality permits are not required for construction and operation of the proposed facility, but fugitive dust rules adopted pursuant to the requirements of Chapter 3704, Revised Code, may be applicable. Staff notes that Buckeye has indicated an intention to control fugitive dust through the use of several practices. The extent to which areas of construction are disturbed at any given time will be minimized by stabilizing and restoring such areas quickly. Water or calcium carbonate will be used to control dust on unpaved public roads and facility access roads. Some road ways may be temporarily paved with a stone and oil mixture, but this process will not be used in the vicinity of streams or wetlands. Buckeye has reported to staff that it intends to develop a reporting process to monitor for excessively dusty conditions. (Staff Ex. 2 at 32.)

Staff also reports that other construction-related air emissions would result from the use of construction vehicles and equipment. Equipment-related emissions would be controlled by keeping construction equipment in good working condition. Staff concludes that construction and operation of the facility would be in compliance with air emission regulations. (Staff Ex. 2 at 32.)

2. Water

Staff states that neither construction nor operation of the proposed facility will require the use of significant amounts of water; thus, requirements under Sections 1501.33 and 1501.34, Revised Code, are not applicable to this project. (Staff Ex. 2 at 32.)

According to the Staff Report, the application indicates that there are 21 perennial and ephemeral streams and several acres of wetlands in the proposed project area. However, Buckeye has represented that it intends to avoid direct impact to all wetlands in the placement of the facilities and in accessing the facilities during construction and operation. To indicate the presence of protected wetlands, such areas will be flagged or fenced during the construction of the proposed facility and appropriate erosion controls will be implemented in construction areas. Staff reports that many of the streams will need to be crossed by construction equipment or electrical collection lines. However, Buckeye intends to cross streams using methods that do not disturb the streambeds wherever possible. (Staff Ex. 2 at 32-33; Buckeye Ex. 1 at 144-148.)

Additionally, staff reports that Buckeye intends to implement a Storm Water Pollutant Prevention Plan (SWPPP), which would minimize impacts on streams and wetlands. The SWPPP would be developed in association with Buckeye's National Pollution Discharge Elimination System (NPDES) permits for the facility. Staff reports that Buckeye will likely need two separate NPDES construction permits: a construction storm water general permit, and a general permit for storm water discharge for construction activity within the Big Darby Creek watershed. However, staff states that, because of the planned avoidance of streams and wetlands, compliance with Clean Water Act Section 401 or 404 requirements may be achieved under nationwide permits. In conclusion, staff believes that construction of this facility would comply with requirements of Chapter 6111, Revised Code, and the rules and laws adopted under the chapter. (Staff Ex. 2 at 32-33.)

3. Solid Waste

Staff notes that the construction of the facility will result in the creation of solid waste, including plastics, wood, cardboard, metals, packaging materials, construction scrap, and general refuse. However, Buckeye intends to remove construction debris from work areas and dispose of those materials in dumpsters located at the staging areas. A private contractor will be used to remove waste collected in dumpsters. According to staff, Buckeye would also develop and follow Spill Prevention Containment and Countermeasure (SPCC) procedures to prevent the release of hazardous substances, such as petroleum products, into the environment during construction. Any spills of hazardous substances would be reported pursuant to Ohio Environmental Protection Agency (Ohio EPA) and ODNR procedures. (Staff Ex. 2 at 33.)

During operation of the proposed facility, staff reports that Buckeye will generate waste similar to a small business office, which will be disposed of through a solid waste disposal service. Waste oils generated during operation would be disposed of in accordance with state and local regulations. (Staff Ex. 2 at 33.)

With respect to the waste associated with the clearing of vegetation, staff reports that such waste would be cleared, with timber cut into logs and either left for the landowner or removed from the site. Limbs and brush will be chipped, buried, or otherwise disposed of, but will not be left on-site. Staff states that it believes that Buckeye's solid waste disposal plans will comply with solid waste disposal requirements in Chapter 3734, Revised Code, and the rules and laws adopted under that chapter. (Staff Ex. 2 at 33.)

4. Aviation

a. Staff

Two airports are located within the footprint of the proposed facility. Grimes Field, a public use municipal airport, maintains two active runways. Weller Airport, a privately owned, public use airport, maintains a single active runway. Staff states that it contacted the Ohio Department of Transportation, Office of Aviation (ODOT-OA) during its review of Buckeye's application to assess the potential impact of the construction of the proposed facility. ODOT-OA recommended disapproval of 11 of the proposed turbines due to the proposed turbines penetration into protected airspace from the runway centerline of both airports. ODOT-OA notified Buckeye that it was recommending disapproval of those 11 turbines on April 27, 2009. (Staff Ex. 2 at 34-35.)

In accordance with Federal Aviation Administration (FAA) rules, Buckeye filed a FAA Form 7460-1 Notice of Proposed Construction or Alteration. According to staff, any structure that the FAA deems to be dangerous to air travel and/or that it deems would have an adverse physical or electromagnetic interference effect upon navigable airspace or air navigation facilities will receive a presumed hazard designation. Staff additionally states that a presumed hazard designation is effectively a disapproval of a structure's construction. On September 1, 2009, the FAA published the results of its aeronautical studies concerning the proposed facility, giving 38 turbines the designation of presumed hazard. The 11 turbines identified as problematic by ODOT-OA are included within the 38 that were noticed as presumed hazards by the FAA. (Staff Ex. 2 at 34-35.)

According to staff, FAA disapproval does not bar construction; however, if a disapproved structure is built, the FAA will require adjustments at any affected airport. Such adjustments may include raising an airport's minimum descent altitude (MDA). The MDA is the lowest altitude to which descent is authorized on final approach during a nonprecision instrument landing. Instrument flight rule (IFR) landings are conducted at an airport during times of low visibility or if inclement weather prohibits a pilot from making a visual flight rule (VFR) landing. Additionally, some pilots never obtain IFR ratings and always fly using VFR. Raising an airport's MDA creates a steeper glide slope/angle at which a plane must land in poor weather conditions. Additionally, raising an airport's MDA can reduce the amount of air traffic an airport receives relative to the amount of time the airport is under IFR conditions. (Staff Ex. 2 at 34-35.)

Staff explains that, at the time the Staff Report was issued, pending resolution of the issues presented in the initial FAA study, the FAA had determined that the 38 turbines that had received a determination of presumed hazard should not be constructed as proposed. However, staff provided in the Staff Report that Buckeye could still employ an engineer to resurvey the disapproved turbine sites and present those resurveys to the FAA in order to attempt to obtain reversal of the hazard determination (Staff Ex. 2 at 34-35; Urbana Ex. 5 at 1-3.) Staff recommends a condition that turbines that do not satisfy the FAA's requirements should not be constructed (Staff Ex. 2 at 64).

b. Buckeye

Buckeye witness Thaddeus Brys, a consultant hired by Buckeye to evaluate the compliance of the proposed facility with the FAA regulations, testified that, on November 8, 2009, the FAA amended its findings and determined that, of the 38 turbines originally given a designation of presumed hazard, 22 were not hazards (Tr. at 383-384; Buckeye Ex. 25). According to the witness, in determining that 22 of the original 38 turbines presumed as hazards were not hazards, the FAA correctly reapplied the criteria for the VOR Alpha missed approach. The VOR Alpha approach is a circling approach to the airport, in which the pilot approaches the airport from a bearing of 130 degrees to the northwest and can circle to land on either runway (Buckeye Ex. 5 at 3). Therefore, 16 turbines are still presumed hazards to aviation. Of the remaining 16 turbines that are still presumed hazards, seven are considered hazards to Grimes Field, and nine are considered hazards at Weller Airport. (Tr. at 416-419.) With respect to turbines that have received FAA determinations of no hazard, Buckeye witness Brys testified that those turbines would not have any effect on flight operations at Grimes Field or Weller Airport (Buckeye Ex. 5 at 9).

With respect to the Urbana's potential expansion plans already in place for Grimes Field, Buckeye witness Brys testified that, under the proposed plan, the runway would be lengthened 600 feet. However, this expansion would not change the current landing category. Moreover, Mr. Brys stated that the FAA is required to consider any future expansion plans that Grimes Field would have on file with the FAA. Therefore, in rendering the findings of hazard or no hazard, the FAA would have considered any future plans on record, and Mr. Brys stated that he did not believe construction of the proposed facility would affect the future expansion of Grimes Field. (Buckeye Ex. 5 at 8.)

c. Urbana and the County

Urbana asserts that the FAA determinations may not be sufficient to fully protect Grimes Field. In support of its assertion, Urbana argues that construction of any of the proposed turbines will lessen safety around Grimes Field, may limit the number of aircraft choosing to fly into Grimes Field, and may cause certain yearly events that occur at Grimes Field to be canceled or changed. (Urbana Br. at 2-5). The County also stresses the importance of the airport to future local business growth (County Br. at 10).

Urbana witness, Nino Vitale, testified that even with the FAA determination of no hazard, the turbines located around Grimes Field would still present additional issues, including a potential obstacle should a pilot overshoot the runway. Moreover, Mr. Vitale states that in VFR conditions, pilots are trained to be at pattern altitude, approximately 800 feet above ground, within four to five miles of the airport, in order to be able to "see and avoid" other aircraft in the pattern, as there is no control tower. According to Mr. Vitale, flying at this altitude makes it easier to see and identify other aircraft. However, when flying around turbines in Benton, Indiana, at a similar distance above the turbines, Mr. Vitale reported experiencing a feeling of dizziness, due to the unique nature of the turbines, and believes that flying at such an altitude above the proposed project would be unsafe. (Urbana Ex. 2 at 1-5; Tr. at 1536-1537.) Additionally, Mr. Vitale states that, because of the unique nature of the turbines and the inability to illuminate the blades, flying at night becomes increasingly difficult as pilots have to avoid an unlit blade, which increases the necessary altitude and, when placed too close to an airport, forces pilots to increase the descent rate into the airport (Tr. at 1537).

Mr. Vitale also testified that a number of experimental aircraft fly in and out of Grimes Field and these aircraft may not have any type of radio or navigation equipment. Therefore, their only method of safe navigation around the airport is the "see and avoid" method, at pattern altitude, which could be complicated by the desire to fly at a higher altitude due to the presence of turbines. Mr. Vitale testified that the turbines may have different impacts on pilots based on the type of aircraft they fly, and also based on their individual training. IFR pilots are trained to fly in the clouds, VFR pilots are not and, therefore, fly below cloud cover and, potentially, closer to the moving turbines. (Tr. at 1535-1539.) Richard Rademacher, a VFR rated pilot, testifying on behalf of Urbana, also testified to the importance of being in pattern altitude within five miles of approaching an airport to land. According to Mr. Rademacher, when a pilot is approaching an airport without a control tower, being in pattern altitude allows for pilots to visually recognize each other. Once in pattern altitude, Mr. Rademacher asserts that a pilot would not be too far above the tips of the turbine blades, for turbines located within the five-mile radius of the airport and that this would likely be an unsafe distance. (Tr. at 1695.)

Additional testimony established the presence of a number of yearly events occurring at Grimes Field. Urbana witness Vitale testified that some of the various events held at Grimes Field, including the Mid East Regional Fly In (MERFI), requires pilots to be at pattern altitude, at a distance of 4.5 miles from the airport. This event also includes other aviation-related activities, including passenger rides departing from, and flying around, Grimes Field, which occur in the four- to ten-mile area surrounding the airport. The MERFI event involves a large number of aircraft converging on Grimes Field in a short span of time. Mr. Vitale also stated that Grimes Field hosts an Annual Hot Air Balloon Festival, where hot air balloons fly around the airport. Mr. Vitale believes that construction of the proposed facility would likely require the cancellation of the balloon festival and cause the MERFI to be moved. (Urbana Ex. 2 at 3-4.) In sum, Mr. Vitale concludes that a five-mile buffer zone around the airport would be necessary to protect the participants of these events (Tr. at 1543).

Urbana witness John Holland, asserts that the construction of the proposed facility will create a potential hazard for Care Flight operations within the area. Care Flight, an emergency response team that operates out of Champaign County, flies directly from Grimes Field to the scene of an accident or health emergency. However, Mr. Holland testified that, if the proposed facility was constructed, pilots would have to be mindful of the turbines and go around any turbine field, which could increase the amount of time it would take the emergency response team to reach the scene of an accident. (Tr. at 2151-2153.) Mr. Holland testified that construction of the proposed facility would also result in the requirement that any patients to be picked up must be moved a safe distance away from the turbines, so that Care Flight could safely land (Tr. at 2185).

d. Party Responses

With respect to mitigating the effects of the proposed facility on the airports in Champaign County, Buckeye witness Brys testified that a localizer could be installed at Grimes Field, which would help mitigate the effects of the turbines. However, Mr. Brys testified that installation of a localizer would require the consent of the city of Urbana. (Tr. at 439-440.) With respect to the potential of installing a localizer at Grimes Field, Urbana witness Vitale responded that a localizer essentially emits a beam, which pilots then follow to land. However, a localizer would only assist IFR pilots, which according to Mr. Vitale, is only 15 to 20 percent of the pilots that utilize Grimes Field (Tr. at 1541). Urbana witness Marc Skillman testified that a localizer would be of no benefit to VFR pilots (Tr. at 1647). Specifically, Richard Rademacher testified that, as a VFR-only rated pilot, he flies under the "see and avoid" method and tries to stay clear of clouds. According to Mr. Rademacher, a localizer would be of no benefit to him. (Tr. at 1692.)

Buckeye witness Brys also testified that the effects of the turbines on Weller Airport could be minimized and the FAA determinations of hazard could be removed through privatization of the airport. According to Mr. Brys, if the airport was privatized, the proposed turbines near the airport could be built and it would be up to a pilot flying into Weller to see and avoid any potential hazards. (Tr. at 447.) Urbana witness Vitale responded that privatizing Weller Airport would remove any FAA protections it receives as a private airport and also that, as a private airport, citizens would have to get special approval to fly in and out of the airport (Tr. at 1540).

5. Board Analysis and Conclusion

Staff recommends that the Board find that the proposed facility, with the recommended conditions, will comply with the requirements specified in Section

4906.10(A)(5), Revised Code. (Staff Ex. 2 at 56.) No intervenor raised any concerns regarding this criterion as it relates to air, water, and solid waste.

With respect to aviation, the Board finds that this project will not substantially interfere with aviation near the proposed project area, provided the 16 turbines deemed potential hazards to aviation not be constructed as proposed. The Board relies on the findings of both the ODOT-OA and the FAA, which determined that those 16 turbines pose a potential hazard to aviation. The Board is not convinced that the installation of a localizer at Grimes Field and the privatization of Weller Airport would be sufficient to mitigate the FAA's finding that there would be a potential hazard to aviation. Therefore, the Board finds that Turbines 19, 24, 26, 29, 30, 34, 38. 46, 48, 50, 57, 58, 60, 61, 62, and 63 shall not be constructed as proposed. Accordingly the Board finds that the proposed facility, as discussed in this paragraph, complies with the requirements specified in Section 4906.10(A)(5), Revised Code, provided the certificate issued includes staff's recommendations set forth in the Staff Report and modified in the Conclusion and Conditions Section of this opinion, order, and certificate.

F. Public Interest, Convenience, and Necessity - Section 4906.10(A)(6), Revised Code

1. Alternative Energy Portfolio Standards

Buckeye explains that, while the electricity generated by the proposed facility will be available within the PJM regional transmission system, Buckeye expects that the electricity generated will be sold to Ohio electric utilities to assist the utilities with the requirement to meet the Alternative Energy Portfolio Standards (AEPS) of Substitute Senate Bill 221, Section 4928.64, Revised Code. This section of the Revised Code requires each Ohio electric utility to procure or generate .25 percent of its usage from renewable energy resources beginning in 2009 and increasing annually to 12.5 percent of its usage by 2025. (Buckeye Ex. 1 at 20; Buckeye Ex. 4 at 4.)

The Staff Report acknowledges that AEPS requires that a portion of the electricity sold to retail customers in Ohio come from renewable and advanced energy resources beginning in 2009. Pursuant to Section 4928.01(A)(35), Revised Code, renewable energy resources specifically include wind energy. For that reason, staff concludes that it is likely that the proposed facility could contribute to Ohio's electric utilities' requirement to obtain renewable energy resources under Section 4928.64, Revised Code. (Staff Ex. 2 at 37.)

The Board recognizes that Section 4928.64, Revised Code, requires Ohio's electric utilities to procure at least 50 percent of the renewable energy requirement from resources located within the state of Ohio. For this reason the Board recognizes that an electric utility may fulfill a portion of its AEPS requirements by entering into an electric supply contract with the owner of a wind facility, like the proposed project. The Board believes that this potential benefit of the project lends support to a finding that the proposed project is in the public interest, convenience, and necessity as required by Section 4906.10(A)(6), Revised Code.

2. Setbacks

a. Buckeye Proposal

Buckeye states that proposed turbines are sited with setbacks from residential structures and property lines consistent with Rule 4906-17-08(C)(1)(c)(i) and (ii), O.A.C., which provides, in pertinent part, as follows:

> (i) The distance from a wind turbine base to the property line of the wind farm property shall be at least one and one-tenth times the total height of the turbine structure as measured from its tower's base (excluding the subsurface foundation) to the tip of its highest blade.
>
> (ii) The wind turbine shall be at least seven hundred fifty feet in horizontal distance from the tip of the turbine's nearest blade at ninety degrees to the exterior of the nearest habitable residential structure, if any, located on adjacent property at the time of the certification application.

In the present case, the requirements of Rule 4906-17-08(C)(1)(c)(i) and (ii), O.A.C., translate to a required setback of at least 541 feet from nonparticipating property lines, and 914 feet from residential structures. (Buckeye Ex. 1 at 169.) However, Union Township has its own wind ordinance which requires setbacks from property lines of 1.2 times the total height of the turbine, in this case 590 feet. Moreover, the Union Township ordinance requires setbacks of 1,000 feet from residential structures. (Buckeye Ex. 1 at Ex. S.)

Buckeye states that, as proposed, the distance from each turbine to the nearest residential structure ranges from 873 to 4,503 feet, averaging 2,059. Only one turbine is currently sited within the 914 foot setback from a residence. Turbine 70 is currently sited approximately 873 feet from a residence. However, Buckeye represents that it intends to remedy the situation, and that Turbine 70 will not be constructed unless an appropriate waiver is executed or the 914 foot requirement is met. (Buckeye Ex. 1 at 168.)

b. Staff

Staff asserts that two turbines in the proposed facility do not satisfy the minimum setback requirements: Turbine 70 and Turbine 57. According to staff, Turbine 57 is not sufficiently setback from a nonparticipating residence. However, staff states that there appears to be sufficient space on the hosting parcel to accommodate the slight adjustment to the turbine location that would be necessary to meet the minimum setback requirement. (Staff Ex. 2 at 38.)

c. Safety

UNU asserts that the minimum prescribed setbacks contained in Rule 4906-17-08(C)(1)(c), O.A.C. are insufficient. Specifically, UNU argues that the proposed setbacks under Ohio law are arbitrary, unreasonable, and contrary to the health, safety, and well-being of the host communities. (UNU Br. at 86.) In support of its assertion that the proposed setbacks are unsafe, UNU relies on the Nordex micro-sitting guide that suggests that turbines be sited at least 500 meters (approximately 1640 feet) from residences, so as not to disturb residents with noise and shadow flicker (UNU Ex. 12). UNU also cites to other manufacturer guides that recommend greater setbacks than those mandated by Rule 4906-17-08(C)(1)(c), O.A.C. (UNU Ex. 13; UNU Ex. 14).

Buckeye argues that the record does not reflect a need for setbacks beyond those delineated in Rule 4906-17-08(C)(1)(c), O.A.C. (Buckeye Br. at 29). Specifically, Buckeye asserts that UNU's concerns have already been squarely addressed and rejected by the Ohio General Assembly. In addition, Buckeye asserts that UNU failed to prove and has put forth no credible evidence to establish, in this case, that the Rule 4906-17-08(C)(1)(c), O.A.C., requirements are insufficient. Furthermore, Buckeye points out that the proposed facility goes beyond the minimum required setbacks, as the average setback for the proposed facility is over 2,000 feet. (Buckeye Reply Br. at 78-81.)

d. Development

UNU also argues that the setbacks, as currently proposed, will impair the ability of landowners to utilize their property to its highest and best use. According to UNU, this problem is compounded by the measurement of setbacks from residences, as opposed to property lines. Specifically, UNU cites the testimony of UNU witness Sandra McKew, which established that Union Township is zoned R-1 and U-1, which allows for the residential development of one housing unit per two acres. (UNU Br. at 79; UNU Ex. 19A at 10.) Therefore, according to the witness, there may be development issues with respect to larger parcels where setbacks are measured from the property line, with previously developable land rendered unsuitable for development (UNU Ex. 19A at 10; UNU Ex. 66 at 89-90). Based on the potential that future development of adjacent parcels may be impaired, UNU argues that setbacks should be measured from property lines, not residences. Moreover, UNU proposes requiring wind developers to procure a wind conservation easement from each affected nonparticipating property owner. (UNU Br. at 82; UNU Ex. 66 at 101-102.)

UNU also argues that approval of Buckeye's application could result in an unconstitutional taking, both by limiting development on adjacent nonparticipating parcels and by interfering with the wind-development rights of landowners of nonparticipating parcels. With respect to the potential development of adjacent nonparticipating parcels of land, UNU argues that development would be limited by the siting of turbines with only a property line setback of less than 914 feet, because any new residences would be required to be located a sufficient distance from the property line to accommodate the required setback. (UNU Br. at 83-84.)

Regarding UNU's assertion pertaining to the development of adjacent nonparticipating parcels, staff notes that this argument assumes that future development cannot occur without meeting the minimum setback requirements contained in Rule 4906-17-08(C)(1)(c), O.A.C. To the contrary, staff states that nothing contained in Section 4906.20, Revised Code, or Rule 4906-17-08, O.A.C., prohibit an adjacent landowner from developing on their parcels. (Staff Reply Br. at 10-11.) In addition Buckeye points out that Section 4906.20, Revised Code, specifically applies to structures in existence "at the time of the certificate application," not any future structure to be constructed (Buckeye Reply Br. at 68).

With regard to the wind development rights of an adjacent nonparticipating parcel, UNU argues that siting a turbine on one parcel may interfere with such rights because turbines need to be spaced four to five rotor diameters apart in order to minimize wind loss to other turbines (UNU Br. at 85).

In response to UNU's concern, the Board notes that, in the present case, we are to consider the application before us and not hypothetical future applications that may or may not be filed in the future by EverPower, or any other developer. Therefore, the Board will only consider the appropriateness of the siting of these turbines, as described in the application before us.

e. Property Value

In preparing the application, Buckeye engaged Saratoga Associates (Saratoga), who opined that, based on current information, it is difficult to reach a definitive understanding of the impact of wind facilities on property values. The report by Saratoga cites a study by Poletti and Associates (Poletti Study), which examined property sales in Illinois and Wisconsin for both residential and farmland properties in an area close to a wind facility. The study involved a comparison of properties located near a wind farm with similar properties that were not in proximity to a wind farm. The Poletti Study concluded that there was no difference in property values based on proximity to the wind farm. (Buckeye Ex. 1, Ex. R at 93-94.)

Buckeye also cites an additional study out of Bard College (Bard Study) which concluded that there was no difference in property values on homes within a one-mile or five-mile radius of an operating wind farm. The Bard Study further suggested the payments to the community balanced any adverse impacts that the turbines could have had on the community. (Buckeye Ex. 1, Ex. R at 93-94.)

In contrast, UNU raises concerns about the potential effect of inappropriate setbacks on property values and potential property use. UNU asserts that, although included in the application, none of Buckeye's assertions with respect to property value impacts were supported by testimony. UNU maintains that, instead, it presented significant evidence on the potential adverse effects on property values from the proposed facility. (UNU Br. at 70-71.) Thomas Sherick, a real estate appraiser, testified on behalf of UNU stating that construction of the proposed facility would result in a marked decrease in the value of properties within the project area (UNU Ex. 22A at 15). In support of his assertions, Mr. Sherick states that his paired-sale analysis, comparing the sales prices of similar properties, showed that the potential construction of the proposed facility has had a negative impact on residential real estate sales in the proposed project area (UNU Ex. 22A at 12). Mr. Sherick concluded that the construction of the proposed facility would result in a reduction of the value of vacant land in the project area by at least 6.5 percent and the value of parcels for development by as much as 50 percent (UNU Ex. 22A at 15).

In addition to his own findings, UNU's witness Sherick cites the 2009 Wind Turbine Impact Study by Appraisal Group One of Calumet County, Wisconsin (Appraisal Group Study), as a statistically sound study that shows the negative impact of wind turbine construction on property values. The Appraisal Group Study examined two separate wind farms and found that, at one farm, the value of land decreased between 19 and 74 percent, with an average value decrease of 40 percent. At the second wind farm, land values were found to have decreased between 12 and 47 percent, with an average decrease of 30 percent. The witness noted that an additional study site yielded inconclusive results. (UNU Ex. 22A at 9; UNU Ex. 25 at 36, 42.) Mr. Sherick relies on several additional studies, including one that concludes that view loss due to wind turbines is analogous to view loss as created by the proximity to transmission lines, which often results in a loss of value of between 17 and 20 percent (UNU Ex. 22A at 10; UNU Ex. 26 at 8-10). Finally, a study from the Gardner Appraisal Group (Gardner) found that the impact of wind turbines varied based on proximity to property, with an average decrease in value ranging from 25 to 37 percent for property that contains wind turbines to properties within 1.8 miles of a wind turbine (UNU Ex. 22A at 10).

Alternatively, witness Sherick criticized the Bard Study as fundamentally flawed due to a failure to account for changes in the real estate market during the period of the survey. Mr. Sherick additionally referenced criticisms of the Poletti Study as being statistically flawed due to an inadequate sample size and sampling bias. (UNU Ex. 22A at 6-7; UNU Ex. 23 at 12-15.)

UNU proposes that a condition be included in any certificate issued that would require Buckeye to offer nonparticipating landowners price protection in the form of a property value protection agreement for any homes within three-quarters of a mile of any turbine. In addition, UNU would prefer that this condition obligate EverPower to compensate eligible property owners should they be unable to sell their property for a fair market value. UNU argues that requiring wind developers to mitigate property loss is not unheard of in the industry. (UNU Br. at 78-79; UNU Ex. 41 at 5.7.2.2.)

In addressing UNU's concerns, Buckeye relies on the report by Saratoga, stating that the literature addressing the effect of utility-scale wind farms on property values is uncertain at best. Moreover, Buckeye asserts that the Poletti Study considered over 150 sales transactions of both residential and commercial properties within an area close to a wind farm and comparable properties in a controlled area, and found that development was flourishing near the 63-turbine wind farm in Illinois. (Buckeye Reply Br. at 46; Buckeye Ex. 1, Ex. R at 93-94.)

Buckeye also criticized UNU's witness Sherick's observations stating that the observations are based on minimal information, because there are not currently any turbines in Champaign County, which would allow for a true comparison of sales data based on proximity to wind turbines (Tr. at 1322). Buckeye notes that Mr. Sherick's observations were based on a single interaction, with a single real estate professional in Champaign County, and not on any wide sample of opinion. In addition, Buckeye asserts that, because a significant part of Mr. Sherick's testimony was based on an analogy to high voltage transmission lines, it is faulty, as there is no real measure available as to the strength of that comparison. (Buckeye Reply Br. at 48-49; Tr. at 1274, 1276.)

Buckeye also relies on the testimony of its witness, Jud Barce, who stated that, in Benton, Indiana, property with or without a turbine, as well as property with or without an option for a turbine has seen an increase in its value (Buckeye Ex. 27 at 5; Tr. at 2417). Mr. Barce also recalled an appraisal for a residence that was not on a farm that did not appear to have been negatively affected by the proximity of turbines (Tr. at 2431-2432).

UNU challenges the relevance of Buckeye's witness Barce's testimony, stating that Benton County, Indiana is dissimilar to Champaign County, Ohio in terms of population density and growth (UNU Reply Br. at 40). UNU points out that Mr. Barce testified that non-farm residential housing is limited and in his words "sparse," that there are very few residential developments in rural Benton County, Indiana, and that residential populations in that area are mostly limited to the towns. (Tr. at 2431, 2447.) UNU also argues that the composition of residents, in terms of participation in the projects, is vastly different, with, according to Mr. Barce, over 90 percent of the Benton County residents participating as leaseholders (UNU Reply Br. at 40; Tr. at 2449).

f. Board Analysis

Based on our review of the record and the arguments raised by the parties, and in keeping with the statutory requirements set forth in Chapter 4906, Revised Code, the Board concludes that the setbacks for the proposed facility are adequate. The Board believes that, as the record reflects, the minimum setback proposed in the application will address the safety concerns mentioned by UNU. In addition, the Board finds that nothing in Chapter 4906, Revised Code, prohibits adjacent landowners from developing their property regardless of the presence of wind turbines on adjacent property. Moreover, the Board notes that Chapter 4906, Revised Code, and Rule 4906-17-08, O.A.C., which also provides for wind farm setbacks, does not prohibit the construction of residences within the proposed setback, after a wind farm has already been constructed. Finally, with regard to the concern pertaining to the property value of the affected area, the Board acknowledges that various studies have shown that similar projects in other locations have not affected property values in those areas. Therefore, the Board finds that the proposed setbacks adhere to the requirements set forth in the statute and support a finding that the proposed project is in the public interest, convenience, and necessity, provided that Buckeye addresses staff's concerns regarding Turbines 70 and 57.

3. Aesthetics

Each wind turbine will consist of three major components: the tower, the nacelle, and the rotor. The tower height, or hub height will be up to 328 feet. The nacelle sits at the top of the tower and the rotor hub is mounted on the front of the nacelle. The rotor diameter will be up to 328 feet; therefore, the total turbine height will be up to 492 feet. The towers will be painted an off-white color to increase visibility to aircraft and decrease visibility from ground vantage points. (Buckeye Ex. 1 at 47-48.)

Staff reports that microwave and communication towers were already located within the area. The preexisting towers are readily noticeable in contrast to the surrounding agricultural landscape. Visibility in the project area is reported to be 10 miles; however, staff reports that this value can be exceeded if the observer is elevated above an object or if the object is elevated from the observer and surrounding landscape. (Staff Ex. 2 at 38-39.)

Staff notes that Buckeye conducted an analysis of the project visibility to identify locations within the proposed project area where the turbines could be visible from ground-level vantage points. Staff states that the applicant's analysis illustrated both a worst-case daytime visibility and the nighttime visibility of the turbines, over a five-mile study area. The worst-case analysis showed that the proposed project could potentially be visible within 95.5 percent of the five-mile study area. The analysis further noted that this worst-case scenario indicates where any portion of any turbine could be seen without considering the screening effects of existing vegetation and structures. According to staff, the applicant's analysis reflected that approximately 15 percent of the five-mile study area has the potential for views that include less than 19 turbines. In evaluating potential nighttime visibility, the analysis showed that 92.7 percent of the five-mile study area was found to have nighttime visibility. Furthermore, staff points out that the analysis showed that, when the 40-foot vegetation screen was introduced, visibility values decreased to 84.6 percent for the worst-case analysis. (Staff Ex. 2 at 39-40.)

In addition to the wind turbines, approximately 40 miles of 34.5 kV overhead collection systems may be installed to support the project's energy generation. Staff reports that Buckeye believes these lines would be a combination of over build and new construction, which would generally parallel public roads until they reach the appropriate substation. Staff expects that the visual impacts of these lines will be minimal where the lines can be coordinated with existing lines. (Staff Ex. 2 at 40.)

Staff explains that a newly constructed substation will be located on private land near the intersection of Pisgah Road and Route 56 in the town of Union, adjacent to the Givens to Mechanicsburg section of the Urbana-Mechanicsburg-Darby 138 kV transmission line. The substation will occupy 1.75 acres and will be enclosed by a chain link fence to be accessed by a gravel access road. (Staff Ex. 2 at 40.)

UCC asserts that construction of the proposed facility will have an adverse aesthetic impact on its facility. Specifically, UCC asserts that any visibility of the turbines will be a major distraction to golfers on its course, and that the constant movement of the turbines will create an additional distraction to golfers. (UCC Br. at 9-10.) UNU presented the testimony of Julia Johnson, who stated concern over the industrialization of the community by the constant visual presence of the turbines (UNU Ex. 1A at 14).

While the Board recognizes that construction of the proposed facility would alter the character of the proposed project area, the Board does not believe the impact to be so negative as to make the construction of this facility contrary to the public interest, convenience, or necessity. Accordingly, the Board concludes that the overall benefit of this project outweighs any negative aesthetic consequences that may result from the construction of the proposed facility.

4. <u>Blade Shear</u>

Buckeye states that blade shear occurs when a rotor blade drops or is thrown from the nacelle. Buckeye offers that, although these occurrences are extremely rare, they can be dangerous. However, Buckeye points out that no member of the public has ever been injured as a result of wind turbine blade shear. (Buckeye Ex. 1 at 106.)

Buckeye reports that past instances of turbine collapse or blade throw have generally been the result of design defects, poor maintenance, control system malfunction, or lightning strike. According to Buckeye, evidence suggests that the most common cause of blade failure is human error in interfacing with control systems; however, Buckeye asserts that the chance of such a failure has been reduced by a manufacturer reduction of human adjustments that can occur in the field. (Buckeye Ex. 1 at 107.)

In support of the current application, Buckeye asserts that modern utility-scale turbines are certified according to international engineering standards, including ratings for withstanding hurricane-strength winds. The engineering standards of the turbines under consideration for the proposed facility are of the highest level and, according to Buckeye, meet all federal, state, and local codes, and possess state-of-the-art braking systems, pitch controls, sensors, and speed controls. Turbines proposed for the current facility will be equipped with two independent braking systems that allow the rotor to be manually halted, and these turbines will automatically shutdown at wind speeds over the manufacturers threshold. Moreover, Buckeye asserts that the turbines under consideration for the proposed facility will cease operation if significant vibrations or rotor blade stress is sensed by the monitoring systems. Buckeye argues that all of these technological improvements reduce the risk of catastrophic tower collapse or blade shear. (Buckeye Ex. 1 at 107.)

To mitigate the risk of blade shear, staff recommends a condition that requires Buckeye to provide a formula that supports its consultant's calculations that a blade can be thrown up to a distance of 500 feet. Staff believes that this will allow for appropriate measures to be taken to mitigate the risk of blade shear. (Staff Br. at 20; Staff Ex. 2 at 63.)

UNU asserts that there is insufficient information in the record to assure that the setbacks, as currently configured, are sufficient to protect against blade shear. Specifically, UNU asserts that staff has not received sufficient information from Buckeye to calculate the potential maximum distance for blade throw, making reliance on the statutory minimum faulty. (UNU Reply Br. at 32.) UNU does not believe consideration of this information should be deferred until after the issuance of a certificate and recommends that the Board reopen the evidentiary hearing to further consider the issue (UNU Reply Br. at 34).

The Board recognizes that blade shear is an important issue and believes that staff's recommendation that Buckeye be required to provide a formula that supports the consultant's calculations that a blade can be thrown up to a distance of 500 feet is appropriate and responsive to UNU's concerns. Moreover, the Board notes that Buckeye has sufficiently demonstrated that the setbacks, as currently configured, when combined with advances in wind turbine technology, are sufficient to protect residents from any risk of blade shear. With staff's condition in place, the Board finds that the risk of blade throw has been adequately addressed, and is not so likely that it renders the proposed project contrary to the public interest.

5. Ice Throw

Ice throw is the phenomenon where accumulated ice on the wind turbine blades separates from the blade and falls or is thrown from the blade. According to the applicant, under certain weather conditions, ice builds up on the rotor blades, slowing the rotational speed, and potentially creating an imbalance in the weights of the blades. Buckeye explains that such an imbalance can be sensed by the turbine's computer controls and would typically result in the turbine being shut down until the ice melts. (Buckeye Ex. 1 at 105.)

Buckeye asserts that field observations and studies of ice shedding indicate that most ice shedding occurs as air temperatures rise and the ice on the rotor blades begins to thaw, leading to a tendency for ice to drop off and fall near the base of the turbine. Occasionally, ice can be thrown when it begins to melt and the blades begin to rotate again. However, Buckeye asserts that there have been no reported injuries caused by ice throw. (Buckeye Ex. 1 at 105.)

Staff states that it reviewed Buckeye's assertions and found them to be reasonable. Moreover, staff believes that any potential for ice throw would occur well within the recommended setbacks. However, to minimize the risk of ice throw, Staff recommends a condition requiring training, concerning potential ice hazards, for construction and maintenance personnel. (Staff Br. at 20-21; Staff Ex. 2 at 63.)

UNU asserts that there is insufficient information in the record to assure that the setbacks, as currently configured, are sufficient to protect against ice throw. UNU also voices concern over the failure of staff to recommend a condition that the turbines not operate during icy conditions. UNU does not believe consideration of this information should be deferred until after the issuance of a certificate and recommends that the Board reopen the evidentiary hearing to further consider the issue. (UNU Reply Br. at 33-34.)

The Board finds that the risk of ice throw has been adequately addressed by Buckeye. Specifically, it appears that safeguards, both automatic and manual, will be sufficient to protect those residing in the surrounding area from the risk of ice throw. Additionally, staff's recommendation of a condition that will provide additional training to allow personnel to appropriately recognize ice conditions and the potential for ice throw so that any risk can be mitigated, provides an additional safeguard. Therefore, the Board finds that, with staff's condition in place, the risk of ice throw has been adequately addressed and is not so egregious as to render the construction, operation, and maintenance of the proposed facility contrary to the public interest.

6. Shadow Flicker

a. Buckeye

Buckeye submitted, as part of the application at Exhibit L, a shadow flicker analysis conducted by its consultant, Environmental Design & Research, P.C. Shadow flicker from wind turbines occurs when rotating wind turbine blades move between the sun and the observer. Shadow flicker passing over the window of a structure has the effect of increasing and decreasing the light intensity in the room. Shadow flicker is most noticeable within approximately 1,000 meters of the turbine and becomes more and more diffused as the distance between the turbine and an observer increases. Using a computer model, to input turbine coordinates, turbine specifications, shadow receptor coordinates, wind speed and direction frequency distribution, and monthly sunshine probabilities and height contours, Buckeye determined the theoretical number of hours per year of shadow flicker expected at each receptor. (Buckeye Ex. 1 at 108-111, App. Ex. L.)

The application indicates that there currently are no state or national standards for acceptable frequency or duration of shadow flicker from wind turbines. Buckeye used 30 hours per year as a shadow flicker threshold. Based on the results of the initial shadow flicker analysis, Buckeye's consultant determined that, of the 2,087 residences within 1,700 meters of a proposed turbine, 99.3 percent would experience less than 25 hours of shadow flicker per year. According to the applicant, shadow flicker is expected to approach 30 hours per year at 14 residences. (Buckeye Ex. 1 at 108-111, App. Ex. L.)

Based on the initial shadow flicker analysis, a more detailed greenhouse-mode analysis was conducted in relation to the seven residences predicted to receive shadow flicker in excess of 30 hours per year. Of the seven residences analyzed, one of them is a participating residence. The greenhouse-mode analysis assumes the residences have windows in all directions and no trees or neighboring structures to block shadow flicker. Based on this phase of the shadow flicker analysis, Buckeye anticipates that the six nonparticipating residences are expected to experience shadow flicker between 33.36 and 57.04 hours per year. (Buckeye Ex. 1 at 108-111, App. Ex. L.)

b. Staff

Staff submits that, based on its review and investigation, receptors more than 0.6 miles from wind turbines are unlikely to experience shadow flicker because the wind turbine covers an increasingly smaller portion of the sun. Staff also states that no shadow flicker will be cast when the sun is obscured by clouds or when the turbine is not rotating. According to staff, shadow flicker values rarely exceed 0.6 miles in northern latitudes such as Ohio, but can occur seasonally at sunrise or sunset when lower sun elevation angles are experienced. Staff concurs with Buckeye's statement that any shadow flicker beyond 0.6 miles would be low intensity shadow flicker. (Staff Ex. 2 at 42.)

Staff notes that, while currently there are no state or national standards for acceptable frequency or duration of shadow flicker from wind turbines, international studies and guidelines from Germany and Australia have suggested 30 hours of shadow flicker per year as the threshold of significant impact, or the point at which shadow flicker is commonly perceived as an annoyance. According to staff, the 30-hour standard is used in at least four other states, Michigan, New York, Minnesota, and New Hampshire. Accordingly, staff agrees with Buckeye's use of a threshold of 30 hours of shadow flicker per year for the analysis. (Staff Ex. 2 at 42.)

Staff explains that, because the model used by the applicant applies a minimum solar elevation angle of three degrees and considers the topographic characteristics of the project area, higher elevations may exist outside the modeled boundary which would obstruct the sun at or above the three-degree angle, thus reducing the impact of shadow flicker during dusk or twilight time periods (Staff Ex. 2 at 42-44).

In the Staff Report, staff recognizes that Buckeye's initial shadow flicker analysis indicated that 14 residences were expected to experience nearly 30 hours or more of shadow flicker each year. The shadow flicker expected at the 14 residences ranged from approximately 25 hours to 57 hours per year. Staff acknowledged that incorporating average monthly sunshine probabilities, obtained from the National Climatic Data Center, and representative wind turbine operational hours based on the model specific cut-in speeds from five proposed turbines (Turbines 70, 21, 18, 48, and 16), reduced the number of residences expected to experience annual shadow flicker in excess of 30 hours from 14 residences to seven residences. Of the seven residences expected to experience more than 30 hours of shadow flicker per year, six are nonparticipants. (Staff Ex. 2 at 42-43.)

As part of the Staff Report, staff specifically proposes that approved turbines are subject to mitigation after construction, up to and including removal, if shadow flicker at any nonparticipating receptor exceeds 30 hours per year. Further, staff recommends that the Board find that the proposed facility will serve the public interest, convenience, and necessity, provided any certificate issued include the recommended conditions. (Staff Ex. 2 at 43, 63.)

c. <u>UCC and UNU</u>

UCC argues that Buckeye's shadow flicker analysis fails to appropriately consider the wind turbines' affect on a golf course, is not accurate, and fails to take into account that golfers use the course during the autumn season. More specifically, UCC argues that Buckeye witness Shears' estimation that UCC will conservatively experience approximately 10 hours of shadow flicker per year during the winter months is misguided. UCC, using Buckeye's study, interprets the shadow flicker to occur in October and November when, depending on weather, the club's members and their guests may be playing golf. The country club argues that Buckeye's shadow flicker study reveals that the golf course will experience 10.16 hours of shadow flicker at one receptor but that the actual shadow flicker to be experienced by golfers and others on the golf course will be the total experience for all four shadow flicker receptors, which Buckeye did not provide as part of the application. (UCC Br. at 8-9, 15-16.)

UNU argues that shadow flicker will diminish the value and development of neighboring nonparticipating properties. UNU points out that the country of Denmark imposes a 10-hour per year standard on its wind projects, and that the Board should likewise apply the 10-hour per year standard for all nonparticipating properties not just the residences. Furthermore, UNU requests that the Board prohibit the construction of Turbines 21, 18, 41, and 16, since they have been determined to cause more than 30 hours of shadow flicker per year at a residence. (UNU Br. at 60-61.)

d. Buckeye Response

Buckeye responds that Turbine 48 is over 2,000 feet from the closest point on the golf course and, at such distances, the effects of shadow flicker will be reduced and less pronounced. Buckeye also asserts that the wooded area and trees around the golf course will further diffuse any shadow flicker on the course. Buckeye contends that the majority of the golf course will not be affected by shadow flicker and that shadow flicker will be periodically distracting on two greens, one tee location, two complete holes, and 80 percent of another hole. For these reasons, Buckeye argues that UCC's claims are without merit. (Buckeye Reply Br. at 55; UNU Ex. 45 at 110; Tr. at 940, 956.)

Buckeye retorts that UNU failed to put any evidence in the record to support UNU's 10-hour recommendation or how that level was modeled. Further, Buckeye notes that Denmark is further north of the equator than Champaign County, Ohio, and, therefore, the lower angle of the sun at the higher latitude in Denmark will lead to a greater impact from shadow flicker. For this reason, Buckeye claims that the 10-hour limit on shadow flicker is inappropriate in Ohio. The applicant contends that UNU's request to prohibit the construction of Turbines 21, 18, 41, and 16 overlooks the conservative modeling done by Buckeye to lessen the likelihood of shadow flicker, as well as the other measures that may be taken to reduce the effects of shadow flicker, including planting vegetation or trees, installing window treatments, modifying room lighting or, as a last resort, curtailing turbine operation. (Buckeye Reply Br. at 51-54; Tr. at 126-128, 528-529, 2221-2222.)

e. Board Analysis

The Board is aware that shadow flicker will result from the presence of the turbines, and we find that staff's recommendation that approved turbines should be subject to mitigation after construction, up to and including removal, if shadow flicker at any nonparticipating receptor exceeds 30 hours per year, is appropriate and should be adopted.

The Board does not find UCC's claims that the shadow flicker from Turbine 48 will be a serious distraction to golfers to be persuasive. The Board recognizes that shadow flicker may, at times, be a distraction to a golfer at a particular location on the golf course; however, because golf in Ohio during the late autumn months is dependent upon the weather, and given the intermittent nature of shadow flicker, it is unreasonable to conclude that the location of Turbine 48 is problematic to the point where Turbine 48 is not in the public interest.

Similarly, we find the request of UNU to prohibit the construction of Turbines 21, 18, 41, and 16 on the basis that construction of the turbines is not in the public interest, convenience, or necessity as a result of shadow flicker to be unreasonable in light of the intermittent nature of shadow flicker, the available mitigation measures, and staff's recommendation that approved turbines are subject to mitigation after construction, up to and including removal, if shadow flicker at any nonparticipating receptor exceeds 30 hours per year. Further, the Board notes the complaint process has been expanded to include more than noise as discussed in the Conclusion and Conditions Section of this opinion, order, and certificate. Therefore, the Board finds that, with staff's condition in place, the concern about shadow flicker has been adequately addressed and is not so excessive as to render the project contrary to the public interest as required pursuant to Section 4906.10(A)(6), Revised Code.

7. Safety Manuals

According to staff, although Buckeye has not yet chosen a turbine model for the proposed facility, Buckeye has stated that it will install the Nordex N100, Nordex N90, or RePower MM92. Included in the application is a copy of the safety manual for each of the turbines, which address, among other topics: personal rescue, ascent and fall protection, protection against falling objects, material transport using the onboard crane, lighting, protection against noise, handling of hazardous substances, and electrical equipment. Staff asserts that it has reviewed the safety manuals and believes that they are adequate. Moreover, staff supports a condition requiring Buckeye to comply with the safety manuals and maintain a copy of the manual onsite for the model of turbine selected for the project. (Staff Ex. 2 at 45.) The Board finds that staff's recommendation should be adopted and believes that maintaining a copy of the manual onsite for the turbine model selected is sufficient to assure the protection of the public interest.

8. Noise

a. Construction Noise

Buckeye recognizes that noise from the construction of the proposed wind turbines will impact the surrounding residences and businesses in the project area. The impact to individual residences and businesses will last a few days to several weeks. Specifically, noise associated with the equipment used for construction and the construction of access roads, electrical interconnect line trenching, site preparation, turbine foundation installation, material subassembly delivery, and turbine erection will affect the community. (Buckeye Ex.1 at 87-90.)

Staff reviewed the applicant's noise assessment study and determined that the noise level experienced during construction will be considerably higher than during operation of the proposed facility. Staff points out that, as stated in the application, noise during construction will be intermittent and temporary with noise levels in the range of 85 to 92 A-weighted decibels (dBA) at individual property boundaries over a period of several weeks. According to the Staff Report, in order to mitigate the effects of construction noises, Buckeye will limit general construction activity to normal daytime working hours and follow best management practices (BMPs) for noise abatement during construction. Staff recommends that the Board find that noise associated with the construction of the proposed facility has been determined and will not be so excessive that it is contrary to the public interest, provided that any certificate issued includes the conditions specified in the Staff Report. (Staff Ex. 2 at 17, 19, 45-46, 53.) None of the intervenors raise any issues with regard to construction noise.

The Board concludes that, based on the record, Buckeye has properly evaluated and minimized the adverse noise impacts associated with the construction of the proposed wind facility. With staff's conditions in place, the Board finds that the issue of construction noise has been adequately addressed, thus, supporting a finding that the construction of the proposed project is in the public interest.

b. Operational Noise

i. Buckeye

Buckeye contracted with Hessler and Associates to conduct the noise impact assessment for the proposed project. The purpose of the noise impact assessment was to evaluate ambient sound levels and perform a computer modeling analysis of projected turbine sound levels. (Buckeye Ex. 1 at Ex. K.) David Hessler, an acoustical consultant, offered direct and rebuttal testimony on behalf of Buckeye (Buckeye Exs. 8, 26).

Buckeye states that its design goal for the proposed wind-powered electric generation facility is based on turbine placement whereby turbine noise at wind speeds creating the largest differential between background noise and turbine noise output would not exceed background levels by 5.0 dBA. To determine background sound levels at various wind speeds, Buckeye placed six monitors and two anemometers at 40 meters in the project area. Buckeye determined that the anemometers' readings were representative of the typical average wind speed over the area. Buckeye then used the average wind speed at 40 meters and estimated the speeds at 10 meters, in accordance with International Electrotechnical Commission Standard (IEC) 61400-11 requirements, to compare wind turbine manufacturers' sound levels for turbines as a function of wind speeds at 10 meters. The background sound levels were compared to the turbine sound levels and Buckeye witness Hessler determined that the "worst-case scenario" occurred at six meters per second (m/s) during the day and at five m/s at night. By adding 5.0 dBA to the sound level exceeded during 90 percent of the measurement interval (L90) daytime and nighttime background sound level, Buckeye established the design goal for the turbines at nearby residences of 40 dBA during the daytime and 34 dBA at night.[4] However, Buckeye witness Hessler claimed that the L90 background noise level is only useful as a design goal, not a regulatory standard, because it is nearly impossible to achieve in rural areas with scattered residences under critical wind speed conditions. (Buckeye Ex. 26 at 2; Tr. at 848; Buckeye Ex. 1, Ex. K at 9, 24.) Mr. Hessler testified that, based on his experience in actual communities, not the recommendation of the World Health organization (WHO), the 40 dBA guideline design goal avoids sleep disturbance and does not result in "very many and not very serious annoyance" (Buckeye Ex. 18; Tr. at 846-847, 2391-2392). Buckeye witness Hessler further asserted that, in his experience, there will always be some complaints if the project is audible, but that he could only recall a few instances where a sound level of less than 45 dBA was considered a significant problem (Buckeye Ex. 26 at 4).

Buckeye witness Hessler claims to have conservatively modeled the sound of the turbines. The witness makes this claim based on, among other factors, his use of: (1) a ground absorption coefficient of 0.5 (i.e., the ground absorption coefficient of water is 0 and for agricultural fields it is 1); (2) wintertime conditions, when environmental sound levels are normally the lowest; (3) estimated sound levels at the exterior of residences; and (4) an assumption that a downwind sound level existed from every turbine. (Buckeye Ex. 1, Ex. K at 26, 28.)

Mr. Hessler testified that, as conservatively modeled, a number of residences exceed the 34 dBA nighttime design goal at the residence, but only five nonparticipating residences are predicted to experience sound levels in excess of 40 dBA in the nighttime at the exterior of the home. Of those five nonparticipating residences, four are predicted to experience no more than a 41 dBA and the other residence no more than 42 dBA. (Tr. at

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4 Buckeye states that use of the L90 sound level has the quality of filtering out sporadic, short-duration noise events essentially capturing the quiet lulls between such events (Buckeye Ex. 1, Ex. K at 1).

2387-2388.) Buckeye emphasizes that the operational noise levels at all residences are predicted to be below the average sound level measurement interval plus 5.0 dBA. As modeled, a sound level of 50 dBA will be experienced at some participating properties. Where a turbine is proposed to be sited near the property boundary, the modeled sound level, sometimes exceeds 50 dBA, by no more than a few decibels for a short distance into the neighboring property. (Buckeye Ex. 1, Ex. K at 27; Buckeye Ex. 26 at 4.)

In order to provide the Board with a perspective of what 50 to 60 dBA sounds like, Buckeye witness Hessler claims that noise levels for conversational speech range from 50 to 60 dBA and emphasizes that the predicted sound levels are measured to the exterior of the residence. Buckeye estimates the sound level to be 10 to 20 dBA lower inside the residence. (Tr. at 900; UNU Ex. 45 at 108; Buckeye Ex. 1, Ex. K at 26.) Buckeye admits that noise from wind turbines is perceptible to most people below the 5.0 dBA over the background noise because of the blade "swish," also known as amplitude modulation (Buckeye Ex. 1 at 92-93, Ex. K at 21, 28).

Buckeye notes that the Board has considered operational noise levels on other types of electric generation facilities where the applicant's noise assessment revealed estimated operational noise levels which exceed the 40 to 42 dBA, estimated in this proceeding. Buckeye lists proceedings where the Board has approved applications for electric generation facilities with operational noise impact estimates of below 55 dBA at the fence line of the proposed facility to 75 dBA at the property line of the facility, and at or below 56 dBA at 1,000 feet from the facility. See, *In re American Municipal Power-Ohio, Inc.*, Case No. 06-1358-EL-BGN, Opinion, Order, and Certificate at 24, 29-30 (March 3, 2008); *In re PG&E Dispersed Generating Company, LLC*, Case No. 00-922-EL-BGN, Opinion, Order, and Certificate at 10 (February 12, 2001); *In re Duke Energy Hanging Rock, LLC*, Case No. 01-175-EL-BGN, Opinion, Order, and Certificate at 9; (September 17, 2001); *In re Aquila Fulton County Power, LLC*, Case No. 01-1022-EL-BGN, Opinion, Order, and Certificate at 12 (May 20, 2002) (*Aquila*); and *In re Columbiana County Energy, LLC*, Case No. 01-803-EL-BGN, Opinion, Order, and Certificate at 10 (May 20, 2002) (*Columbiana*). Buckeye specifically notes that, in *Aquila* and *Columbiana*, the operational noise levels measured at nearby residences were estimated to be 59 dBA, and 39 dBA to 54 dBA, respectively. (Buckeye Br. at 17-19.)

ii. Staff – Operational Sound Level

Based on its investigation, staff concludes that Buckeye's noise assessment is based on a conservative evaluation of the operational noise levels likely to be experienced in the project area. Staff determined that the noise assessment level was conservative based on Buckeye's use of: (1) the turbine with the higher sound power level of the two types of turbines under consideration at the time that the study was conducted; (2) modeling at the wind speed that produces the greatest incremental noise levels; (3) a background noise level at low wintertime sound levels; and (4) a ground absorption coefficient in its model that underestimates noise absorption occurring through interaction with surface features. Further, staff emphasizes that Buckeye's noise assessment is moderated because Buckeye ignored any sound reduction occurring inside residential structures and assumed wind direction blowing toward every sensitive receptor at all times. (Staff Ex. 2 at 17, 19, 46.)

Staff believes that, while the applicant's operational noise assessment reveals operational noise will likely be below normally detectable levels during typical daytime and nighttime conditions, periodically, environmental conditions during the night will cause the turbines to be audible at numerous residences. To address noise complaints, staff recommends that Buckeye, as proposed in its application, develop a noise complaint resolution procedure, for the staff's review and approval, as a condition of any certificate issued by the Board for this facility. (Staff Ex. 2 at 17, 19, 46, 59.)

The Staff Report also specifically recognized, in its discussion of setbacks, that there exists "a lack of hard scientific evidence on potential health impacts associated with utility scale wind projects" and, therefore, ODH acknowledged that a setback from nonparticipating residences greater than the minimum included in Chapter 4906-17, O.A.C., may be warranted. Staff noted in its report that it expected this issue to be addressed at the hearings in this case and that the final record in this case should provide sufficient evidence to determine if a greater setback is needed. (Staff Ex. 2 at 38.) However, as of the issuance of the Staff Report, staff recommended that, based on its review of the application and investigation, Buckeye had properly evaluated and minimized any adverse impact associated with operational noise anticipated for the proposed wind facility. Staff recommends that, prior to the preconstruction conference, Buckeye provide staff with its complaint resolution process, to address all types of complaints not just noise. (Staff Ex. 2 at 46, 59; Staff Reply Br. at 26-27.)

iii. UCC – Turbines 48 and 49

UCC argues that noise from proposed Turbines 48 and 49 will be heard by UCC guests and affect the tranquil setting golfers and guests of the club have come to expect. Turbine 48 is proposed to be located 2,000 feet from, and directly behind, the green of the fifth hole and Turbine 49 is proposed to be located approximately 2,800 feet south of the green of the fifth hole (UCC Exs. B-2 and B-3).

Further, UCC claims that Buckeye did not satisfy its burden to provide the Board adequate information regarding the impacts of noise and shadow flicker on a golf course and; therefore, the business operations of the country club. UCC contends that, proposed Turbines 48 and 49 should not be constructed because of the negative impact on the golf course and the UCC. (UCC Br. at 14; UCC Reply Br. at 4-5.)

iv. Buckeye Response to UCC - Turbines 48 and 49

Buckeye notes that Turbine 48 is over 2,000 feet from the nearest point on the golf course and Turbine 49 is over 2,800 from the nearest point on the golf course at the fifth hole green (UCC Ex. 1, Exs. B-2, B-3). Buckeye argues that, based on the modeled sound contours, at over 2,000 feet, turbine operational noise will not be noticeable on the golf course. Buckeye states that Plot 2D, which models the sound from turbines at five m/s, reveals that only a small portion of the golf course will experience sound levels between 34 to 35 dBA at night and an even smaller portion between 35 to 40 dBA, with the balance of the course below 34 dBA. (Buckeye Ex. 1, Ex. K at Plot 2D.) In comparison, based on Plot 1D of Exhibit K to the application, Buckeye claims that at six m/s the turbine operational noise level is modeled at well below 40 dBA far from the nearest point on the golf course (Buckeye Ex. 1, Ex. K at Plot 1D). Buckeye retorts that the noise levels on the golf course are modeled to be below conversational levels, mowers on the course, cars traveling down the road, or tractors harvesting in nearby fields. Thus, Buckeye argues that modeled operational noise levels from Turbines 48 and 49 will not have an impact on the UCC golf course or golf play. (Buckeye Reply Br. at 50-51.)

v. Board Analysis

UCC claims that Buckeye failed to adequately analyze the noise impact on the UCC golf course as required pursuant to Section 4906.10(A)(2), Revised Code. We find UCC's claims to be without merit. We note that UCC is specifically recognized in the application and the effect of noise on the facility evaluated, consistent with the provisions of Rule 4906-13-07(D)(5), O.A.C., which requires that the applicant "describe the identified recreational areas within one mile of the proposed site" and "estimate the impact of the proposed facility on identified recreational areas within one mile of the proposed site and describe plans to mitigate any adverse impact."

The Board recognizes that Turbines 48 and 49 will emit some noise when operating. Based on Buckeye's noise impact assessment, at worst, a relatively small portion of the golf course will be exposed to noise in the range of 35 to 40 dBA, intermittently. In light of the staff's recommendation, that the facility operate within such parameters, and the intermittent nature of the noise impact, the Board finds that it is unreasonable to conclude that noise from the proposed facility is so egregious as to not be in the public interest. Thus, based on the record in this case as to the anticipated effect Turbines 48 and 49 will have on UCC and the UCC golf course, the Board does not find the effects so adverse that the proposed facility is not in the public interest.

c. Background Sound Evaluation

i. UNU

On the issue of noise, UNU presented the testimony of Richard R. James, an acoustical engineer with 40 years of experience (UNU Ex. 31). According to Mr. James, acoustical engineers regard an increase of 5.0 dBA or less from a new noise source as an acceptable impact (UNU Ex. 31A at Ans. 2). Mr. James explained that acoustical engineers generally believe that sound increases below the 5.0 dBA threshold usually are unnoticed to tolerable and, therefore, prevent complaints and nighttime sleep disturbance (UNU Ex. 31A at Ans. 25, 34-35).

To perform the background sound evaluation, Buckeye's consultant Hessler placed nine sound recording instruments on a post, pole, or tree (Buckeye Ex. 1, Ex. K at 2-7).[5] UNU asserts that there were significant errors made in the background noise assessment. First, UNU points out that, pursuant to American National Standards Institute (ANSI) S12.9, entitled Quantities and Procedures for Description and Measurement of Environmental Sound, Part 3, sound measurement devices should not be placed on reflecting objects with small dimensions such as trees, posts, or bushes and should not be positioned within 1.5 meters of such reflective objects (Tr. at 732-739; UNU Ex. 55 at 4). Further, UNU argues that Buckeye witness Hessler inappropriately placed his sound recording equipment where the sounds of livestock, birds chirping, or vehicular traffic could increase sound readings (UNU Br. at 20-21; Tr. at 733, 735, 737, 740, 742).

Second, UNU argues that Buckeye witness Hessler did not appropriately correlate wind speed at ground elevation, where the sound measurements were taken, to the wind speed at hub height, to allow Buckeye witness Hessler to postulate that noise from the wind and wind turbines would be masked by the noise experienced at ground level (UNU Br. at 21-22). ANSI S12.18, entitled Procedures for Outdoor Measurement of Sound Pressure Level, prescribes that "no sound level measurement shall be made when the average wind velocity exceeds 5 m/s when measured at a height of 2 ± .02 m above the ground" (UNU Ex. 61 at 5-6). UNU interprets this standard to require that sound measurements taken where the wind speed is greater than five m/s distort the sound recording and, therefore, should be discarded (UNU Br. at 23; UNU Ex. 61 at 5-6). UNU reasons, therefore, that it was essential that the wind speed at ground elevation be measured where the noise recordings were taken (UNU Br. at 21-23).

Third, UNU points out that, as Buckeye admits in the application, noise from wind turbines is different from the natural nighttime sounds of its host community because of the fluctuation in sound (due to wind gusts) and the turbines tonality or impulsiveness

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5 The Board recognizes that only six of the nine sound recording instruments were located within the project area for this application (Tr. 746-747).

character (Buckeye Ex. 1 at 92, Ex. K at 21, 28; UNU Br. at 15-16). For this reason, UNU argues that Buckeye's comparison of wind turbine noise to consistent sources of noise, such as conversational speech or refrigerators, is unfair. UNU witness James concluded that the background sound level in the project area is actually 27 dBA (UNU Ex. 31A, Ans. 37).

ii. Buckeye

Buckeye challenges the limit requested by UNU. Buckeye states that UNU's request to limit turbine noise to 5.0 dBA over UNU's calculation of the background noise of 27 dBA is extreme and mischaracterizes Buckeye witness Hessler's testimony. According to Buckeye, Mr. Hessler testified that UNU's requested design goal is not typically practical to use ... as a regulatory limit or standard for wind projects in rural areas with scattered residences because it is seldom, if ever, possible to limit project noise to less than 5.0 dBA above the near minimum background level, at least at critical wind speeds, and would preclude the development of wind-powered electric generation facilities east of the Mississippi River (Buckeye Ex. 26 at 2; Buckeye Ex. 8 at 7; Tr. at 848). The applicant reminds the Board that it previously rejected UNU's request and the request of its witness, Mr. James, to implement a similar standard in the *Wind Rulemaking Case*, Order at 39-40 (Buckeye Reply Br. at 15, 42-43).

As to UNU's arguments regarding the alleged errors in the noise impact assessment, Buckeye notes that UNU's arguments that significant errors were made are exaggerated. The applicant notes that UNU's witness James placed his sound monitors between bird feeders where the recordings could be influenced by birds chirping and traffic and based his background sound measurements on brief visits to the project area, short-term recordings of the background sound levels, and extremely selective sound samples (Buckeye Exs. 14-15; UNU Ex. 31A at 12; Tr. at 1409, 1413). Buckeye also asserts that Mr. James selected the quietest 10-minute periods over his seven-hour recording period (Buckeye Ex. 14 at 8). Buckeye's sound levels were recorded over a 14-day period (Buckeye Ex. 1, Ex. K at 7). Nonetheless, Buckeye argues that UNU's determination of the background sound level at L90 was 27 dBA, a difference of only two dBA from Buckeye's background sound level (Buckeye Reply Br. at 16-19).

Buckeye also responds to UNU's claim that Mr. Hessler asserted that wind noise will mask the noise from the turbines (UNU Br. at 21; Buckeye Reply Br. at 19-21). Buckeye asserts that UNU mischaracterizes Mr. Hessler's testimony. The applicant reiterates that Mr. Hessler never claimed that the background sound level would be a perfect masking source for turbine noise, but that it would provide some masking (Tr. at 802). The critical wind speed determination, according to Buckeye, allows the evaluator to determine where the greatest difference between the power sound level from the turbine and background sound level is and, thus, to establish the worst-case scenario for modeling the project (Buckeye Ex. 1, Ex. K at 24).

Temperature inversions, as Mr. Hessler refers to the phenomenon, happen when the temperature in the atmosphere is warmer above the surface with light wind conditions than it is near the ground. Temperature inversions change the way sound propagates through the air. Mr. Hessler admits that temperature inversions occur, but are site specific. (Tr. at 829-830.) Buckeye notes that temperature inversions were recognized and explained in the application in relation to the wind speed profile (Buckeye Ex. 1, Ex. K, at 20-21). Buckeye claims there is no way to calculate this phenomenon into the model (Tr. at 829; Buckeye Reply Br. at 22-23).

For these reasons, among others, Buckeye believes that UNU's opposition to the background sound component of Buckeye's noise impact assessment are not well-found. The applicant retorts that its background noise assessment provides sufficient evidence to determine the background noise level for the proposed project area. (Buckeye Reply Br. 22-24.)

iii. Board Analysis

Upon consideration of the arguments raised by UNU regarding the background sound evaluation conducted by Buckeye and the response to these concerns by Buckeye, the Board finds that Buckeye's evaluation was reasonable. We are convinced primarily by the fact that, despite the alleged errors in the background evaluation cited by UNU, UNU's determination of the background noise level is so close to Buckeye's determination of the background noise level. Accordingly, the Board finds that the applicant's determination of the ambient noise level in the project area was reasonable.

d. Modeling of Noise Impact Assessment

i. UNU

UNU asserts that Buckeye skews the noise assessment levels by comparing the modeled sound level of the proposed project to the average sound level (Leq) (UNU Br. at 18-19; UNU Ex. 31A, Ans. 55; Buckeye Ex. 26, Ans. 13; Tr. at 726, 824). Further, UNU argues that Buckeye's lack of commitment to a particular type of turbine invalidates the noise impact assessment, if any model other than the model used for the study is installed (Br. 29-30; Tr. at 767, 772-773). UNU witness James argued that Buckeye's noise impact assessment failed to take into account the manufacturer's sound measurement error. According to Buckeye's witness, the manufacturer's sound measurement error is 1.4 db to 1.6 db; however, UNU argues that the manufacturer's sound measurement error is 2.0 db (Tr. at 776, 1394-1395).

UNU also contends that the turbines were modeled as point sources (turbines scattered throughout an area), rather than a line source (turbines in a row), at a height of

80 meters above ground elevation, but Buckeye failed to recognize the uncertainty factor of at least ± 3.0 db for noise sources above 30 meters as recommended by International Standards Organization (ISO) 9613-2, entitled Acoustics – Attenuation of Sound During Propagation Outdoors (Buckeye Ex. 1, Ex. K at 26; UNU Ex. 57 at 14; Tr. at 751-752, 1396). UNU witness James admits, however, that ISO 9613-2 was not intended for wind turbines and its use for noise sources taller than 30 meters makes its use for wind turbines questionable (UNU 31A, Ans. 51-52; UNU 60; Tr. at 1455-1456).

UNU posits that the range of error of the noise impact assessment is ± 5.0 dBA. Further, UNU witness James testified that, to avoid subconscious bias, the individual who models the project should not also be the individual that subsequently field verifies the measures modeled after the project is constructed as Buckeye witness Hessler has done in this case (Tr. at 761, 751-753, 1391; Buckeye Ex. 8 at 10).

UNU argues that, based on the errors UNU alleges in the noise assessment, which total 14.4 dBA at night and 12.4 dBA to 13.4 dBA during the daytime, excluding evaluating the turbines as a line source, many homes will be exposed to excessive noise (UNU Br. at 13-35). Therefore, UNU requests that the Board direct Buckeye to revise its noise impact assessment to correct the issues UNU raised and, once the noise impact assessment is revised, the hearing process should be reopened to adjudicate the accuracy of the new noise impact assessment. Further, UNU asks the Board to limit turbine noise from this proposed project to no more than a 5.0 dBA increase over background noise. Furthermore, UNU requests that, if the Board elects not to impose such a limit on the proposed project, the Board include as a condition of the certificate that the turbines not increase the noise above the 27 dBA background levels in the community by more than 5.0 dBA at any nonparticipant's property line. (UNU Br. at 34-35.)

Buckeye claims that modern wind turbines of the type proposed in this application do not generate low frequency or infrasonic noise to any significant extent (Buckeye Ex. 1, Ex. K at 29-30). UNU retorts that the applicant has overemphasized the high frequency (A-weighted) noise that wind turbines generate to avoid the low frequency (C-weighted, dBC) noise generated by wind turbines. UNU offers that low frequency noise travels further with less attenuation over distances than higher frequency sounds (UNU Exs. 31A, Ans. 62, 64, 66; UNU Ex. 49 at 9). Further, UNU offered evidence which states that low frequency noises are not effectively attenuated by the walls of most homes and is more likely to be heard by residents and, therefore, more likely to be annoying (UNU Exs. 31A, Ans. 62, 64, 66; UNU Ex. 49 at 9). For this reason, UNU proposes that the Board incorporate a low frequency noise standard limiting operational noise to a C-weighted decibel limit (LCeq) at the receiving property line of no more than 20 dB above the measured dBA (LA90) preconstruction long-term background sound level + 5.0 dB or an absolute limit of 60 dBC. (UNU Ex. 32 at 15; UNU Br. at 49-55.)

ii. Buckeye

Buckeye admits that the noise impact assessment was performed utilizing the RePower MM92, a turbine model under consideration at the time the assessment was conducted. Buckeye witness Shears states that the applicant is committed to selecting a turbine that will operate within the noise profiles set forth in the application (Tr. at 284-285). Buckeye offers that staff's recommended condition that Buckeye operate the facility within the noise parameters set forth in the noise study referenced in the application ensures Buckeye's commitment to a comparable model (Buckeye Reply Br. at 26).

Buckeye witness Hessler admits that wind turbine noise is variable and, with atmospheric conditions, will fluctuate ± 5.0 dBA, about the mean predicted level for short periods of time during unusual wind conditions (Buckeye Ex. 8 at 10). While Mr. Hessler admits that the range of error could be ± 5.0 dBA, he qualifies the accuracy of the noise impact assessment in this case by comparing it to his modeling accuracy in other projects in relation to actual sound levels at those same wind projects. The witness claims that the variation in the wind turbine noise is not due to the calculation method; rather, it is due to variability in the turbine sound. (Tr. at 761, 752-753.) In regard to the manufacturer's margin of error, Mr. Hessler believes that the manufacturer's sound pressure power levels are highly controlled so that the errors are very small (Tr. at 774-775).

Buckeye contends that the National Aeronautics and Space Administration (NASA) technical paper on which UNU relies for its basis of concern that turbine should be modeled as line sources rather than point sources is based on a 20-year old theoretical study of small turbines with 15 meter rotors, assumed to be in an infinite line, with 30 meters between the blade tips of each turbine. Mr. Hessler claimed that the NASA study was a desktop mathematical evaluation as opposed to a field measurement study. In comparison, the representative turbine models presented in this case have a rotor diameter of up to 100 meters (Buckeye Ex. 1 at 14). Buckeye witness Hessler claims that modeling turbines as point sources is based on a study he conducted where he found the uncertainty factor of at least ± 3.0 db for noise sources above 30 meters. (UNU Ex. 60; Tr. at 914-915.)

Buckeye states that there is no evidentiary basis for UNU's requested noise standards for low frequency noise at nonparticipating property lines (Buckeye Reply Br. at 42-46). Modern turbines, according to Buckeye, do not generate any significant low frequency noise (Buckeye Ex. 1 at 29-30). According to Buckeye, UNU witness James admitted that he did not focus on and did not propose a low frequency noise level in this proceeding (Tr. at 1486-1487). Buckeye states that, as explained by Mr. Hessler, amplitude modulation (the swishing sound of the turbine rotors) is sometimes confused with "low frequency" noise. Mr. Hessler also conducted a wind tunnel test and published an article on the issue which is cited in the application. Mr. Hessler's test revealed that "wind-induced false-signal noise occurs only in the low frequencies, making the A-weighted sound level relatively insensitive to this effect." Furthermore, according to Mr. Hessler's testing, skewing of the A-weighted sound level only began to occur at wind speeds of around 15 m/s to 20 m/s, which is above the range for a wind project. (Buckeye Ex. 1, Ex. K at 7.) Mr. Hessler testified that his firm has found that, when examining low frequency noise complaints in other contexts, the low frequency sound emanated from wind turbines is inconsequential and difficult to differentiate from the background sound level in rural communities. Buckeye recognizes that older downwind rotors emitted a low frequency pulse with each rotation but such is not the case with upwind rotor designs. Mr. Hessler claimed that C-weighted sound levels cannot accurately be measured in windy conditions and that artificially high C-weighted sound levels and A-C differentials of 20 dB or more are commonly found during preconstruction background sound surveys when no turbines are obviously present. Further, Buckeye witness Hessler testified that the threshold for C-weighted perceptible vibrations is between 75 to 80 dBC. According to Mr. Hessler, at 1,000 feet, a wind facility typically produces a C-weighted sound level in the range of 58 to 60 dBC and is completely imperceptible above the background noise level. For these reasons, Buckeye argues that UNU's reliance on low frequency noise levels emanated from wind turbines as a basis for requesting that the Board adopt two low frequency noise standards and a 1.25 mile setback is unfounded. (Buckeye Ex. 8 at 7-9; Buckeye Ex. 26 at 2; Buckeye Reply Br. at 42-46.)

iii. <u>Board Analysis</u>

UNU raises numerous concerns that the modeling of the expected noise generated by the proposed project was not conducted properly and, as a result, the actual noise level experienced in the community will be greater than the levels stated in the application. Based on Buckeye's noise impact assessment, five nonparticipating residences will experience 40 to 42 dBA in the nighttime at the exterior of the residence. According to Buckeye, the sound level should be reduced by 10 to 20 dBA inside the residence, to a range between 20 to 32 dBA. We find that, in conjunction with the staff recommendations as revised and set forth in the Conclusion and Conditions Section of this opinion, order, and certificate, based on our review of the record, and the arguments raised by UNU and Buckeye's responses, the noise impact assessment conducted by Buckeye was reasonable.

e. <u>Health Affects</u>

i. <u>UNU</u>

UNU notes that, as the project is proposed, 1,004 homes will be located within 1,000 meters (1 kilometer or .62 mile) from a Buckeye wind turbine (UNU Ex. 43 at 5). UNU proposes strict noise levels based on the belief that noise from wind turbines cause humans residing in the vicinity annoyance, serious discomfort, sleep deprivation, and other health issues. Admitted into evidence, at the request of UNU, are several studies, surveys, presentations, or literature reviews on the health impacts of wind turbines (UNU Exs. 44, 45, 47, 48, 49, 51). In addition, UNU also offered into evidence one article on the effects of sleep restriction (UNU Ex. 46). Two of the exhibits, studies by Eja Pedersen, an epidemiologist in Sweden, reveal that persons living near wind farms may be annoyed by the sound from the wind turbines. More specifically, one Pedersen study revealed that six percent of persons exposed to wind turbine noise of 35 dBA reported being highly annoyed and another six percent reported being rather annoyed. The study further indicates that, with wind turbine noise at 37.5 dBA to 40 dBA, 20 percent of exposed residents report being very annoyed and eight percent report being rather annoyed. The same study concluded that, at noise levels greater than 40 dBA, 36 percent of residents reported being highly annoyed and another eight percent reported being rather annoyed. (UNU Ex. 47 at 3465-3467.) UNU argued that the results of this study are supported by two other Pedersen studies where 50 percent of the people surveyed (22 of 45 people) reported being annoyed when exposed to noise over 40 dBA (UNU Ex. 49 at 17).[6]

UNU witness James testified that several studies suggest that humans have an increased sensitivity to wind turbine noise in comparison to other types of noise, such as road traffic, because of the "swishing, whistling, pulsating/throbbing" characteristic of wind turbine noise (UNU Ex. 31A, Ans. 35; UNU Ex. 47 at 3469). UNU asserts that the most significant health problem caused by wind turbine noise is sleep deprivation (UNU Ex. 46). UNU emphasizes that the WHO has determined, based on evidence available at the time of the study, that there is sufficient evidence for biological effects of noise during sleep to cause an increase in heart rate, arousals, sleep stage changes, and awakening. Further, WHO determined that there is sufficient evidence that night noise exposure causes self-reported sleep disturbance, an increase in medicine use, an increase in body movements, and environmental insomnia. WHO also concluded, among other things, that there is limited evidence that disturbed sleep causes fatigue, accidents, and reduced performance (Buckeye Ex. 18 at XI-XII).[7]

Accordingly, UNU requests that, if the Board grants Buckeye a certificate for the proposed project, the certificate include a condition prohibiting the turbines from exceeding a noise level of 35 dBA at any nonparticipating property line. Consequently, UNU requests a setback of 1.25 miles from any nonparticipating residence to avoid considerable annoyance, sleep disturbance, and health effects. (UNU Br. at 45-47.)

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6 The Board recognizes that three Pedersen studies are actually referenced in the Minnesota literature review, (UNU Ex. 49 at 17); however, only two of the Pedersen studies are included in the record in this proceeding, UNU Exs. 47 and 48.

7 Buckeye Ex. 18, entitled, "Night Noise Guidelines for Europe" defines "sufficient evidence" as "a causal relation has been established between exposure to night noise and a health effect. In studies where coincidence, bias, and distortion could reasonably be excluded, the relation could be observed. The biological plausibility of the noise leading to the health effect is also well established." "Limited evidence" is defined as "a relation between the noise and the health effect has not been observed directly, but there is available evidence of good quality supporting the causal association. Indirect evidence is often abundant, linking noise exposure to an intermediate effect of physiological changes which lead to the adverse health effects." (Buckeye Ex. 18 at XI.)

ii. Buckeye

Buckeye claims that UNU's noise limit and setback requests are extreme and unwarranted based on any alleged health affects or damage to property. As to the potential health affects associated with wind turbines, Buckeye offered the testimony of Dr. Kenneth A. Mundt, an epidemiologist with 20 years of experience. According to Dr. Mundt, there is no reason to believe, based on the available evidence, that human health will be harmed, given the proposed setback from turbines to residence. According to the witness, there may be a variety of nonhealth reasons to recommend specific minimal setbacks, including those unrelated to health concerns; however, based on the available scientific evidence, those setbacks proposed in the application appear to adequately protect human health, as well as reduce the level and frequency of annoyance. (Buckeye Ex. 6 at 16.) According to Buckeye witness Mundt, epidemiological evidence is key to determining the causal relationship, if any, between various risk factors and the occurrence of disease. Further, the witness concluded that "[b]ased on my review of the relevant published peer-reviewed scientific literature, I found no consistent or well-substantiated association between residential proximity to industrial wind turbines and any serious health effects." Dr. Mundt admits that residents living near wind turbines will intermittently, depending on a number of factors, experience noise associated with the operation of the turbines, but nonetheless concluded that "exposure to turbine noise or shadows, while potentially distracting or irritating to some people, are not known to harm human health." (Buckeye Ex. 6 at 5-7.) Buckeye argues that Dr. Mundt's testimony, as to the lack of adverse health impacts, should carry significant weight as the only expert testimony on the topic. Further, Buckeye reasons that the record demonstrates sufficient evidence for the Board to conclude that a setback greater than that proposed in the application is not necessary. (Buckeye Br. at 34.)

Buckeye asserts that UNU's request to limit the wind turbine noise to this level for human health is undercut by UNU's request for the standard to apply to nonparticipants only (Buckeye Reply Br. at 13). As to the health issues raised, Buckeye notes that UNU witness James is not qualified to opine on medical judgments as the witness admitted (Tr. at 1428-1429). Buckeye also challenges the validity of several of the studies, articles, and testimony offered by UNU regarding the effects of wind turbines on human health (Buckeye Reply Br. at 30-42).

Buckeye notes that the 2004 Pedersen and Waye article cited by UNU does not actually support UNU's claims that wind turbine noise leads to higher annoyance at lower levels of sound exposure than road noise. Buckeye points out that, as stated in the article, the results for annoyance from transportation noise are based on a large amount of data, where the results for annoyance from wind turbines is based on only one study. For this reason, the author cautions that "interpretations should be done with care." Buckeye also notes that the level of annoyance for wind turbine noise was formed when spending time outdoors and the annoyance with sound pressure levels for transportation noise as perceived indoors. Buckeye emphasizes that Pedersen and Waye acknowledge in the study that "a low number of respondents were annoyed indoors by wind turbine noise." In response to the study, Buckeye witness Hessler noted that the number of actual respondents to the survey that were annoyed is very small. Of the 627 surveys distributed in the Pedersen and Waye study, 351 responded. Further, the witness noted that, of the 351 respondents, seven households reported being rather or very annoyed at 35 to 37.5 dBA and four households reported being rather or very annoyed at 37.5 to 40 dBA based on annoyance perceived when spending time outside. The study concluded that "the number of respondents disturbed in their sleep, however, was too small for meaningful statistical analysis, but the probability of sleep disturbances due to wind turbine noise can not be neglected at this stage." Therefore, Buckeye reasons that the 2004 Pedersen and Waye study does not support UNU's claims. (UNU Ex. 47 at 3461-3462, 3467-3468; Tr. at 2350-2351; Buckeye Reply Br. at 30-32.)

Buckeye alleges that UNU also misinterprets the WHO 2009 Night Noise Guidelines for Europe (Buckeye Ex. 18). Buckeye points out that the WHO recommends an $L_{night,\ outside}$ of 40 dBA which is equivalent to the lowest observed adverse effect level for night noise based on a long-term A-weighted average (Buckeye Ex. 18 at XVII). Buckeye contends that the WHO recommendation undercuts UNU's request for a 35 dBA standard at the nonparticipant's property line and for a 1.25 mile setback (Buckeye Reply Br. at 34-35). Buckeye reiterates that Mr. Hessler used 40 dBA as a design goal for the noise impact assessment based on Mr. Hessler's experience that 40 dBA would avoid sleep disturbance and complaints of serious annoyance (Tr. at 847, 2391-2392).

Buckeye proffers that, despite UNU's representations to the contrary, the Minnesota Department of Health literature review (UNU Ex. 49), the 2007 Pedersen and Waye study (UNU Ex. 48), and the testimony of UNU witness James do not support UNU's claims that noise that exceeds 35 dBA causes "unacceptable sleep disturbance, annoyance, discomfort, and health problems (UNU Br. at 43; Buckeye Reply Br. at 36-42). Buckeye opines that the Minnesota Department of Health review ultimately recommended that wind turbine noise estimates include the cumulative impact of all wind turbines using 40 to 50 dBA, not below 40 dBA (UNU Ex. 49 at 26; Buckeye Reply Br. at 36-42). Buckeye witness Dr. Mundt, declared that Dr. Amanda Harry's study (UNU Ex. 44) Wind Turbines, Noise and Health, dated February 2007, was of no scientific value to the decision-making process at issue, in light of the fact that it was a survey provided to persons that were known to be suffering from problems which the person believed was due to their proximity to wind turbines (UNU Ex. 44 at 3; Tr. at 498). Accordingly, Buckeye concludes that the results and recommendations are scientifically questionable (Buckeye Br. at 36-37). As to the health issues raised, Buckeye notes that UNU witness James is an acoustical engineer, but he is not qualified to opine on medical judgments, as the witness admitted in another proceeding (Tr. at 1428-1429). Further, Buckeye interprets Mr. James testimony to, in fact, be contradicted by the two Pedersen and Waye studies (Tr. at 2349-2350; UNU 47). Buckeye offers that the presentation of Dr. Nissenbaum, which UNU introduced through UNU witness James, does not constitute a sound epidemiological study and, therefore, no valid conclusion can be drawn from it (Buckeye Ex. 5 at 13). Buckeye concludes that the testimony of its expert is that "based on the available scientific evidence, those [setbacks] proposed in the application appear to be adequate to protect health, as well as to reduce levels in frequency of annoyance factors" (Buckeye Ex. 6 at 16).

UNU requests that, in light of the alleged errors in Buckeye's noise impact assessment and the potential health affects posed by exposure to excessive noise, the Board direct Buckeye to revise its noise impact assessment based on the issues UNU raised and once the noise impact assessment is revised, the hearing process reopened to adjudicate the accuracy of the new noise impact assessment. Further, UNU would ask the Board to limit the low frequency noise from the proposed project to an absolute limit of 60 dBC and no more than 20 dB above the measured dBA (LA90) preconstruction long-term background sound level + 5.0 dBA. Further, UNU requests a 1.25 mile setback from residences (UNU Br. at 49).

iii. Board Analysis on Health Impacts

As noted in the Staff Report, in regard to setbacks, the ODH recognized that there exists "a lack of hard scientific evidence on potential health impacts associated with utility scale wind projects" (Staff Ex. 2 at 38). Accordingly, ODH deferred to the record evidence presented in this case. As summarized above, the parties presented extensive record information on the potential health impacts of the proposed wind-powered electric generation facility. The Board has thoroughly considered the record in this case with particular attention to the issue of operational noise from the turbines and the health impacts of noise.

The Board finds the Nissenbaum power point presentation (UNU Ex. 51) and the survey by Harry (UNU Ex. 44) to reflect intrinsic bias as a result of the survey process used in each case. For this reason, the Board concludes that such exhibits cannot be relied on as "hard scientific evidence" of the potential health impacts associated with wind turbines. In regard to the balance of the evidence presented in this case, we find the claims of the other studies on which UNU relied to make noise associated health claims to affect such a small portion of the available population, inconclusive, or based on self-reported claims as to be an insufficient basis on which to make a decision that serious health impacts will result from the proposed project. Thus, the Board finds that the record evidence in this case is insufficient to demonstrate potential health impacts associated with wind turbines. However, the Board acknowledges that the record demonstrates that wind turbine noise can be annoying to humans depending on the distance from the turbine and other background noise. The studies also reveal, as supported by the testimony of the lay witnesses to this case, that the level of annoyance perceived is directly correlated to the person's perception of the turbines.

While we believe the record in this case demonstrates that the operation of the wind turbines may be annoying to some nonparticipating residents, there is insufficient "hard scientific evidence" in the record to support the conclusion that wind turbines are a direct cause of health impacts to humans, sufficient to justify setbacks from residences greater than proposed in the application and required by law. For these same reasons, we reject UNU's request to implement noise levels, particularly absolute noise levels, at nonparticipating property lines.

We recognize that the noise impact assessment predicted nighttime dBA generally is within the range of WHO's recommendations. WHO guidelines state:

> Below the level of 30 dB $L_{night, outside}$, no effects on sleep are observed except for a slight increase in the frequency of body movements during sleep due to night noise. There is no sufficient evidence that the biological effects observed at the level below 40 dB $L_{night, outside}$ are harmful to health. However, adverse health effects are observed at the level above 40 dB $L_{night, outside}$, such as self-reported sleep disturbance, environmental insomnia, and increased use of somnifacient drugs and sedatives.

(Buckeye Ex. 18 at XVI.)

Based on the information presented, noise below 40 dBA is not likely to result in health impacts, is unlikely to result in significant annoyance, and, we believe not likely to cause numerous serious noise complaints.

The Board notes that two of the recommended conditions in the Staff Report attempt to address the issues raised by UNU and the health impacts of wind turbine noise. First, the staff recommends that any certificate granted to Buckeye requires Buckeye to operate the facility within the noise parameters as set forth in the noise study presented in the application. Further, staff recommends that the applicant be required, at least 30 days prior to the preconstruction conference, to provide the staff, for review and acceptance, a complaint resolution procedure. (Staff Ex. 2 at 57-59.) With these conditions in place, the Board finds that UNU's concerns regarding the noise level and health issues have been addressed.

iv. Board Analysis and Conclusion of Noise

As stated previously, the Board believes that, with the requirement in place that Buckeye operate the facility within the noise parameters as set forth in the noise impact assessment presented in the application, along with the expansion of the complaint resolution process to include not only noise complaints but any type of complaint, any remaining concerns regarding the noise of the facility will be appropriately mitigated. For this reason while the Board is aware that operational noise from the proposed project will intermittently be audible to the community in the project area, and may be annoying, to some, at times, we find that staff's recommendations address the alleged errors in the noise impact assessment raised by UNU and the alleged health impacts. Accordingly, the Board finds that, with these conditions, the proposed project is not so adverse to the public interest that the operational noise expected from the proposed project rises to a level sufficient to override the construction of the proposed project.

Furthermore, the Board finds that the record does not support the adoption of absolute noise levels as requested by UNU. We expect that the proposed project will reasonably operate within the noise parameters presented in the application and recognize that, depending on weather conditions, the wind turbines may, for limited periods, operate at sound levels above that modeled in the application.

9. Communications Systems Interference

a. Buckeye

Buckeye hired a contractor, Comsearch, to conduct analyses of off-air television reception, AM/FM broadcast station operations, microwave paths, and cellular personal communications services (PCS) in the vicinity of the project area (Buckeye Ex. 1 at 192).

Off-air television stations transmit broadcast signals from terrestrially-located facilities that can be received directly by a television receiver or house-mounted antenna. According to Buckeye, the results of the study of off-air television stations indicated that there are 180 off-air television stations within 100 miles of the project area. However, stations most likely to produce off-air coverage to Champaign County are those at a distance of 40 miles or less. Within 40 miles of the project area, there are 41 licensed off-air stations, with 22 of those stations being fully operational. Six of the operating stations are translators, or stations that transmit at low power, with limited range, and limited programming. (Buckeye Ex. 1 at 192.)

Buckeye notes that the study revealed that there are five full-power analog television stations and four full-power digital television stations operating in the area. Additionally, there were three lower-power analog television stations with full programming and four full-power digital television stations operating on temporary

Special Transmit Authority from the Federal Communications Commission (FCC). (Buckeye Ex. 1 at 192.)

According to Buckeye, Comsearch expects that some channels may suffer some degradation of off-air television signal reception once the proposed facility is constructed. This degradation would be the result of television signal attenuation or reflection caused by one or more of the turbines. This affect is due to the relative locations of the off-air television antenna, the wind turbines, and the point of reception. However, any effect is unable to be predicted with certainty, but effects could include noise generation, reduced picture quality, and signal interruption. Furthermore, Buckeye points out that an FCC mandate required all off-air television broadcasts to transition from analog signals to digital signals by June 12, 2009, and this transition to digital will reduce the likelihood of impacts to television reception. (Buckeye Ex. 1 at 192-193.)

Comsearch also concluded, according to Buckeye, that there is a good selection of off-air television available to local communities in the proposed project area, since there are an adequate number of full-power digital channels available; therefore, it is likely that off-air television is an important method of reception for communities in the area based on the number of off-air television channels available. Some communities may see no effect on off-air television from the construction of the proposed facility, while others may have multiple channels affected. Buckeye states that, if the proposed facility has any impacts to existing off-air television coverage, Buckeye will address and resolve each individual problem as commercially practicable. (Buckeye Ex. 1 at 193.)

The analysis further showed that there are six AM radio stations and 16 FM stations within 20 miles, as measured from the approximate center of the project area. Two of the AM stations each have two database records because they operate at two distinct transmittal powers, meaning that there are actually only four AM radio stations in the area. Buckeye submits that, because the separation distance of the closest AM station antenna from the center of the proposed facility is approximately 14.83 miles, no degradation of AM broadcast coverage is expected due to the presence of the wind turbines. (Buckeye Ex. 1 at 193.)

Buckeye explains that, of the 16 FM radio stations, ten are licensed and operational, with the remainder being nonoperational or under application. Two of the operational FM stations are full-power stations, two are medium-power stations, and six are very low-power stations. Of the six nonoperational stations, one will likely be a full-power station, and the other five are expected to be very low-power stations. According to Buckeye, very low-power FM stations are typically designed for limited coverage of less than 0.5 miles, and should be unaffected by the proposed facility, as long as turbines are installed at distances greater than the coverage of the stations. For full- and medium-power stations, a separation distance of 2.5 miles is recommended to allow the station to maintain normal operation and coverage. In addition, Buckeye states that all of the FM stations' antennas are located at distances greater than 10 miles from the center of the project area; therefore, no degradation of FM radio broadcast coverage is anticipated. (Buckeye Ex. 1 at 193-194.)

Microwave telecommunication systems are wireless point-to-point links that communicate between two antennas and require clear line-of-sight conditions between each antenna. Buckeye identified 14 microwave paths in the vicinity of the proposed facility. To assure uninterrupted communications, a microwave link should be clear, not only at the axis between the center point of each antenna, but also within a mathematical distance around the centre axis. Buckeye calculated a worst-case scenario for each of the 14 microwave paths identified and analyzed digital files of each for potential interference. Based on this analysis, only Turbine 37 was shown to cause any potential interference. Buckeye states that Turbine 37 could be shifted slightly or eliminated to avoid any interference; therefore, Buckeye insists that no degradation of the microwave telecommunications system is anticipated. (Buckeye Ex. 1 at 194.)

Finally, with regard to the telephone communications in the cellular and PCS frequency bands, Buckeye avers that they should be unaffected by wind turbine presence and operation. According to Buckeye, signal blockage caused by the wind turbines would not degrade the telephone network because of the way these systems operate, allowing a signal to reach another tower if the nearest tower is unavailable. (Buckeye Ex. 1 at 194-195.)

b. Telephone Company

The Telephone Company owns two towers located within the project area, which are utilized to provide internet connectivity to its customers. Those towers communicate through wireless point-to-point links utilizing a frequency of 5.8 gigahertz (GHz) or a microwave. According to the Telephone Company, interference could occur if one of the proposed turbines is placed between the two towers or if one of the turbines is placed too close to either tower. Furthermore, the Telephone Company states that interference with the signal could cause a weak signal resulting in intermittent outages, fluctuations or variations in download speed, or complete outages. (Telephone Co. Ex. 1 at 2-3; Telephone Co. Br. at 2.)

The Telephone Company asserts that any interference with the signal will hinder the quality of service it provides to its customers. Moreover, the Telephone Company states that, in some of its service areas, it is the only provider of internet connectivity and, if service is interrupted due to turbine placement, those customers would have no options for internet connectivity. (Telephone Co. Br. at 3.)

To prevent any interference, Telephone Company witness Timothy Bolander testified that the distance between a proposed structure and either of the Telephone

Company's towers must be at least as great as the total height of the proposed turbine structure. Mr. Bolander testified that with this buffer, as long as there are no structures between the Telephone Company's towers, there will be no interference. (Telephone Co. Ex. 1 at 4.)

c. Responses

Upon cross-examination, Mr. Shears agreed that Buckeye would accept a condition on its certificate prohibiting it from placing a turbine in any location that would cause interference with the signals sent and received from either of the Telephone Company's towers (Tr. at 272). Likewise, staff recommends a condition be placed on the certificate which would prohibit Buckeye from locating a turbine such that it would interfere with the internet signals from the Telephone Company's towers (Staff Br. at 27).

In response to staff's proposed condition, Buckeye asserts that it does not oppose such a condition. However, Buckeye responds that the condition should be written to include Mr. Bolander's specific description of how interference can be avoided, which included not only the formula based on the height of the proposed structure, but also the specific longitudinal and latitudinal locations of the towers. (Buckeye Reply Br. at 92-93.)

The Telephone Company also expresses concern with staff's proposed condition, as it characterizes the signals sent and received from the towers as internet signals, which is a mischaracterization of the signals transmitted between the towers. Therefore, the Telephone Company requests that staff's recommended condition be revised to prohibit the location of a turbine in a location that would contribute to the interference of the signals transmitted to and/or from the Telephone Company's towers. (Telephone Co. Reply Br. at 2-3.)

d. Board's Analysis

The Board is cognizant of the necessity that the proposed project not unduly interfere with the off-air television reception, AM/FM broadcast station operations, microwave paths, PCS, and internet service in the vicinity of the project area. Upon consideration of the proposed conditions set forth by the Telephone Company, Buckeye, and staff, the Board finds that it is appropriate to prohibit Buckeye from locating a proposed turbine in a location that would contribute to the interference of the signals transmitted to and/or from the Telephone Company's two existing towers, the locations of which were detailed by Telephone Company witness Bolander. In addition, as promised by Buckeye, the Board expects that if the proposed facility has any impacts to existing off-air television coverage, Buckeye will address and mitigate each individual problem. Accordingly, the Board concludes that, with these conditions in place, this project will have minimal impact on local communications systems and, therefore, it will not negatively impact the public interest or convenience.

10. Local and Long Range Radar Interference

According to staff, wind turbines have the potential to interfere with civilian and military radar. The potential interference occurs when wind turbines reflect radar waves and cause ghosting or shadowing on receiving monitors. Staff explains that radar interference raises national security and safety concerns. Staff states that Buckeye submitted written notification to the National Telecommunications and Information Administration (NTIA) of the U.S. Department of Commerce on February 13, 2008. NTIA responded on July 24, 2008, notifying Buckeye that no concerns regarding blockage of communication systems were identified; however, NTIA prescribed notification of the FAA. As of the date of the Staff Report, the applicant was waiting for the FAA to determine whether radar interference is expected to be an issue. (Staff Ex. 2 at 50-51; Buckeye Ex. 1 at 195-196.)

The Board finds that, based upon the information provided on the record, the project will not have a detrimental effect on local or long range radar according to NTIA. Therefore, based upon the record, the Board finds that the construction and operation of the proposed facility will not interfere with local or long range radar. The Board believes that this determination supports a finding that the facility will serve the public interest, convenience, and necessity. We also find that, upon receipt of the FAA's response pertaining to radar interference, Buckeye should immediately provide staff with a copy of the response.

11. Traffic and Transportation

According to Buckeye, the project area will be accessible through numerous highway, state, and local roads, which will experience an increase in traffic due to the delivery of turbine components, concrete, gravel, and heavy equipment to each turbine site. Buckeye explains that a designated experienced transportation provider, to be determined, will obtain all necessary permits from ODOT and the Champaign County Engineer prior to the commencement of any transportation of the components. (Buckeye Ex. 1 at 196-198.)

Buckeye explains that temporary turn-outs, as well as reinforcement of roads, bridges and/or culverts, will be completed prior to the movement of any heavy equipment. Gravel access roads will also be constructed prior to the delivery of any heavy equipment and will be repaired if damaged. According to Buckeye, all areas where clearance needs to be considered will be identified prior to the transportation of heavy equipment and turbine components. Buckeye offers that all damage will be repaired or replaced, with documentation of conditions and restoration of any impacts performed in conjunction with state and local permitting.[8] In addition, Buckeye attests that all construction signs and flagging will be coordinated with ODOT and the corresponding townships. (Buckeye Ex. 1 at 196-198.)

Due to the numerous access points to the project, Buckeye maintains that any road closures should not cause significant impacts to the transportation network or to the limited number of nearby residents, as alternative routes are readily available. Finally, Buckeye states that the project is not expected to have any significant impact on the rail network. (Buckeye Ex. 1 at 196-198.)

While the Board recognizes that construction of the proposed facility will affect traffic and transportation in the area, the Board does not believe the impact to be so negative as to make the construction of this facility contrary to the public interest, convenience, or necessity. Accordingly, the Board concludes that the overall benefit of this project outweighs any negative consequences relating to traffic and transportation that may result from the construction of the proposed facility.

12. Landowner Leases

Buckeye indicates that voluntary lease agreements will accommodate the majority of the project facilities, with the possible exception of portions of the collection system, which will be constructed in public ROWs. Buckeye explains that the term of the lease agreements will be for a period of 20 years from the initial date of operation, with a bilateral option for a 20-year extension. According to Buckeye, the amount of the lease payments would be based on annual generation production levels and power purchase agreements. Overall, Buckeye estimates that, initially, the lease payments would total approximately $1.5 to $2 million per year. The lease payments would be distributed among participating landowners that host a wind turbine. (Buckeye Ex. 1 at 5, 68.)

The Board believes that the fact that Buckeye will be entering into lease agreements with participating landowners and paying these participants for the use of their land is a positive outcome from this project. We conclude that this benefit of the project supports a finding that the proposed project is in the public interest, convenience, and necessity.

13. Road Repair

The County asserts that increased traffic, as well as the type of traffic, on local roads will likely result in damage to local roadways beginning with construction through decommissioning (County Br. at 9; Buckeye Ex. 1 at 196). According to the County, if

8 Bonding to assure that sufficient funds are available to repair of any damage to roads or bridges that occurs during construction, operation, or decommissioning is discussed in the Decommissioning section of this order.

Buckeye is unable, or unwilling, to repair the damage to local roadways, local government will be obligated to complete and finance the repairs. Therefore, the County believes that a bond that provides for road repair should be in place prior to the commencement of construction. (County Br. at 9.) In support of its assertion, the County relies on the testimony of Buckeye witness Leon Cyr, a county commissioner in Benton, Indiana, who stated that his county has a bond for road repairs and that he believes that a bond would be in the best interest of any county in a similar situation (Tr. at 2473). With respect to the amount of financial assurance necessary to assure adequate protection for local roadways, the County asserts that the County Engineer would have the expertise to establish the correct amount of financial assurance sufficient to cover the cost of the damage to the roads due to construction and decommissioning (County Br. at 10).

Staff agrees that an additional condition should be included in the certificate, which would require Buckeye to procure a bond to provide adequate funds to repair any damage to public roads resulting from either erection or decommissioning of the proposed project (Staff Br. at 30). UNU supports this condition, as it asserts that nothing else in staff's recommendations addresses how Buckeye will compensate the local community if its roads are damaged during construction or decommissioning. (UNU Br. at 98.)

Buckeye does not dispute that the County should get some assurance that the roadways will not go unrepaired during the erection and decommissioning of the proposed facility. However, Buckeye recommends that, as opposed to requiring a decommissioning bond, the Board adopt a condition requiring it to follow the rules and procedures for permitting and bonding as required in Champaign County for bringing heavy equipment on the roads and bridges. Buckeye further states that it would not object to having ODOT or staff participate in the process of setting road bonds, so long as Buckeye does not receive disparate treatment from any other party bringing heavy equipment on the local roads. (Buckeye Reply Br. at 88-89.)

Recognizing the potential damage to the local roads that may occur due to the increase of construction traffic, through the decommissioning stages of this project, the Board agrees that, as a condition of the certificate, Buckeye should procure a bond in order to provide adequate funds to repair any damage to the public roads. Accordingly, the Board concludes that, with this condition in place, the County's concern has been addressed and the public interest, convenience, and necessity will be served.

14. <u>Decommissioning</u>

a. <u>Plan for Decommissioning</u>

According to Buckeye, utility-scale wind turbines have a typical life-span of 20 to 25 years, with the current trend being to replace or repower older wind energy projects by upgrading older equipment to more efficient turbines. However, Buckeye recognizes that, if a turbine is not upgraded or if a turbine is nonoperational for an extended period of time, the turbine will need to be decommissioned. Buckeye proposes a decommissioning plan with two primary aspects: removal of facility components and improvements, and bonding. (Buckeye Ex. 1 at 199.)

With respect to the removal of the facility components and improvements, Buckeye will dismantle and remove improvements and other above-ground property at the termination of the lease. Buckeye proposes that below-ground structures, such as turbine foundations and buried interconnect lines should be removed to a minimum depth of 36 inches, and any underground infrastructure at a greater depth will remain in place. After removal to 36 inches, Buckeye will regrade disturbed areas, restoring them to their original grade, to the extent possible. Buckeye states that, at the request of the landowner, it may consider allowing roads, foundations, buildings, structures, or other improvements to remain in place, but it is not obligated to do so. (Buckeye Ex. 1 at 199.)

Staff recommends, in evaluating Buckeye's decommissioning plan, some additional requirements. With respect to the time for decommissioning, staff recommends that the facility be decommissioned: within 12 months of the end of the useful life of the facility or an individual turbine; if no electricity is generated for a continuous 12-month period for an individual turbine or the entire facility; or if the Board deems the facility or turbine to be in a state of disrepair warranting decommissioning, the facility or turbine will be presumed to have reached the end of its useful life. Staff also recommends a greater depth than was proposed by Buckeye for the removal of the foundation of each turbine; specifically, staff recommends that the foundation be removed to a depth of 60 inches. (Staff Ex. 2 at App. 1.) Additional conditions were recommended in the Staff Report that were accepted by Buckeye and those conditions are set forth below in the Conclusion and Conditions Section (Buckeye Br. at 58).

Buckeye responds to staff's recommendations by stating that it is not necessary to require the foundation for each wind turbine to be removed to a depth of 60 inches. Buckeye witness Shears testified that there would be no practical difference between 36 and 60 inches, in terms of the potential future use of the land, but that the additional removal may result in greater ground disturbance. (Buckeye Br. at 58-59; Tr. at 198-200.) Moreover, Mr. Shears states that most potential leaseholders have been satisfied with the removal of the foundation to between 36 and 48 inches (Buckeye Ex. 4 at 23-24). However, staff still maintains that removal to a minimum of 48 inches is necessary (Staff Reply Br. at 22). The Board agrees with staff's recommendation that removal of the foundation should be to a minimum depth of 48 inches.

Upon consideration of Buckeye's decommissioning plan, as well as staff's recommendations, the Board finds that, with the inclusion of the necessary conditions on

Buckeye's decommissioning plan, as proposed by staff, the plan will be reasonable and will serve the public interest, convenience, and necessity.

b. Financial Assurance

i. Buckeye

With respect to the provision of a financial assurance, Buckeye proposes that, by the fifth anniversary of the commercial operation date of the project, Buckeye will provide a surety bond, letter of credit, or other security in a form reasonably acceptable to landowners, in an amount sufficient to cover the costs of removal and disposal of the facility improvements and costs of restoration, minus the salvage value. The initial amount of the bond or undertaking will be based on a study undertaken by an independent certified engineer that will determine the estimated costs of removal and decommissioning, and the salvage value of the improvements, with the amount of the bond or other undertaking to be reviewed every fifth year from the commercial operation date. If the estimate of decommissioning costs increase, so will the amount of the bond or undertaking. The cost of the independent certified engineer will be paid for by Buckeye. (Buckeye Ex. 1 at 199-200.)

In support of its decommissioning plan, Buckeye witness Christopher Shears testified that he found it inconceivable that the proposed facility would not operate during the first five years, such that decommissioning would be required prior to the five-year point. The only scenario Mr. Shears could imagine that would hinder the first five years of the project would be financial difficulties on the part of Buckeye; however, Mr. Shears asserted that, in the event of such a financial failure, another entity would almost surely begin operating the project. (Tr. at 192-193.)

ii. Staff

To review Buckeye's proposal, staff researched how other wind farms provide financial assurances and found that the wind farms researched all required a performance bond, surety bond, letter of credit, escrow account, corporate guarantee, or other form of financial assurance. Other states had varying timelines for when the financial assurance should be in place; however, all utilized independent engineers to determine the amount of potential decommissioning costs. Staff also asserts that all states have a set time period for nonoperation, after which the company is required to begin decommissioning; typically, that period varies from 12 to 18 months. Under the regulations operating in other states, if the company does not begin decommissioning when required, the state may take necessary action to begin decommissioning, including requiring forfeiture of the bond. At least one state requires state approval of all decommissioning efforts before the bond is released. (Staff Ex. 2 at 53.)

Staff recommended an additional condition, which provides for the determination of decommissioning costs and the recommendation of a bond amount for decommissioning. Specifically, staff recommends that, subject to approval of staff, an independent and registered professional engineer, licensed to practice engineering in the state of Ohio, shall be retained by Buckeye to provide two estimates: an estimate of the total cost of decommissioning in current dollars without regard to salvage value of the equipment (decommissioning costs); and the cost of decommissioning net salvage value of the equipment (net decommissioning costs). Staff also provided a detailed recommendation as to what should be included in the analysis of costs, including a provision for the inclusion of a certain amount of contingency costs. According to staff, the estimate should be on a per turbine basis and should be submitted for staff review and approval after one year of facility operation and every fifth year thereafter. (Staff Ex. 2A.)

Staff also recommends that, after one year of facility operation, Buckeye should post and maintain decommissioning funds in an amount equal to net decommissioning costs; provided that at no point shall the net decommissioning funds be less than 25 percent of the decommissioning costs. Furthermore, staff submits that the decommissioning funds (financial assurance) should be in a form approved by staff, should be payable to the Board, and should be conditioned on the faithful performance of all requirements and conditions of this application's approved decommissioning and reclamation plan. (Staff Ex. 2A.)

In its brief, staff modified its recommendations to include a provision that decommissioning estimates be reviewed every three years, rather than every five years. Staff also removed the condition that financial assurance be payable to the Board, and has included the use of a performance bond as an alternative mechanism for financial assurance. (Staff Br. at 31.)

iii. <u>Buckeye Response to Staff</u>

In response to staff's recommendations, as modified in staff's brief, Buckeye responds that it is agreeable to the recommendation that financial assurance be put in place within one year of operation. Buckeye also agrees to an estimation of decommissioning costs occurring every three years. (Buckeye Reply Br. at 90.)

In response to the remainder of staff's proposed conditions, Buckeye agrees, generally, to the conditions. However, Buckeye requests that the conditions be modified in two respects. First, Buckeye proposes that the conditions be modified to assure that Buckeye does not have to post multiple bonds with multiple parties. Buckeye explains that, as a condition of Buckeye's leases, it is required to post bonds with the landowners as a party to the bonds. In the condition, as proposed by staff, Buckeye would have to enter a separate bond with the Board. To rectify this situation, Buckeye proposes that any bond required to be posted with the Board be reduced by the amount of any bond posted on behalf of any landowners, if Buckeye provides appropriate evidence of the existence of such a bond. (Buckeye Br. at 59-60; Tr. at 195.)

Second, Buckeye disagrees with the requirement that the minimum bond amount be set at 25 percent of decommissioning costs. Buckeye asserts that it is highly unlikely that the project will be decommissioned in the first few years of operation; furthermore, the salvage value of the proposed facility would be significant as the turbines will still be under warranty. (Buckeye Br. at 60; Tr. at 194.) Additionally, Buckeye asserts that there is no reason for the requirement that 25 percent of decommissioning costs be posted. According to Buckeye, staff could only testify that the amount was taken from another state's wind ordinance and staff did not have rationale to support the requirement (Buckeye Br. at 60; Tr. at 2117). Instead, Buckeye recommends that any bonding requirement should be related to the decommissioning cost relative to the salvage value to avoid unnecessary bonding costs; therefore, Buckeye recommends that the required bond be equal to the decommissioning costs minus 75 percent of the salvage value, as estimated by an independent and registered professional engineer (Buckeye Br. at 60).

iv. UNU and the County

In response to Buckeye and Staff's consensus that financial assurance should occur within one year of operation, UNU asserts that the risk of facility abandonment is not an unreasonable concern, even at the beginning of construction (UNU Ex. 27A at 4). UNU also argues that financial assurance for decommissioning should be required for the entire life of the project, as it is not inconceivable that Buckeye could go bankrupt before the construction of the facility is even completed. UNU supports this condition and recommends an additional condition requiring Buckeye to demonstrate, well in advance of the expiration of any bond procured, a renewal or replacement of the bond, to assure that a bond cannot lapse before the decommissioning process occurs. (UNU Br. at 97).

Although Buckeye asserts that equipment warranties, insurance, or potential equipment resale value will cover the cost of decommissioning in the first few years of operation, according to UNU, none of those options protect the community if decommissioning is necessary before financial assurance is required. (UNU Br. at 97-98.) Moreover, UNU argues that the cost of decommissioning can be as much as $300,000 per turbine for the decommissioning of an entire wind farm, and can be much higher if only a single turbine is being decommissioned; therefore, appropriate financial assurance is important (Tr. at 1118). The County also asserts that financial assurance should be in place upon commencement of construction of the proposed facility (County Br. at 11).

In addition, UNU asserts that staff did not adequately consider the necessary amount of a decommissioning bond. According to UNU witness John Stamberg, prices for scrap metal fluctuate greatly; therefore, it is important to consider this fluctuation to assure necessary funds for decommissioning are available throughout the life of the proposed facility. (UNU Ex. 27A at 8.) Although staff's recommended condition contains a consideration of contingency costs, those costs are capped and staff was unsure as to whether those costs would be sufficient to cover fluctuations in the cost of scrap (UNU Br. at 92; Tr. at 2210; UNU Ex. 29). UNU also expresses concern over the 25 percent of decommissioning costs that must be maintained, as UNU does not believe this provides sufficient financial assurance to cover decommissioning over the life of the proposed facility given the nature of the scrap market fluctuations (UNU Br. at 93).

With respect to the recommended bond amount, UNU argues that neither Buckeye nor staff's recommended bond amounts will be sufficient to cover decommissioning costs. With respect to staff's recommendation that a surety bond of no less than 25 percent of decommissioning costs is sufficient, UNU asserts that this amount does not adequately protect the community's interests and is not supported by any underlying rationale. With respect to Buckeye's approach, which would calculate the bond amount as decommissioning costs minus 75 percent of salvage value, UNU argues that this approach is also not supported by any justification. (UNU Reply Br. at 41-42; UNU Br. at 92-93.)

UNU also argues that, if Buckeye is allowed to use a surety bond for financial assurance, the bond must be payable to the Board, in order to facilitate the Board's enforcement of the decommissioning requirements (UNU Reply Br. at 42; UNU Ex. 27A at 16). In the alternative, UNU witness Stamberg testified that the county engineer could be named as holder or coholder of the bond (UNU Ex. 27A at 16).

UNU also concurs with staff's recommendation that the decommissioning estimate be prepared by an independent professional engineer whose selection is approved by staff. In addition, UNU believes that a community representative should be given the opportunity to review and provide comments or objections to the selection of the independent engineer (Tr. at 1127-1128). UNU suggests that the Champaign County Engineer would most likely be the appropriate community member to review the selection (UNU Br. at 96).

UNU witness Stamberg recommends two means of curing what he views as a defect in staff's recommendations. First, the witness recommends a performance bond, which would eliminate the need for periodic review by staff and place the risk of performance directly on the bond issuer. Second, Mr. Stamberg states that a surety bond, set at double the estimated decommissioning costs, as estimated by a Board-approved professional engineer would be sufficient to insure against fluctuations in the scrap market. Mr. Stamberg believes that this would not double the cost of the bond, but would likely result in a percentage premium of something less than total the double cost of decommissioning; therefore, it would not place an undue burden on Buckeye. (UNU Ex. 27A at 14-15.)

v. Buckeye Response to UNU and the County

Initially, Buckeye asserts that financial assurance upon construction would be an unnecessary requirement, as the value of the turbines at that time, would far outweigh any potential cost of decommissioning (Buckeye Reply Br. at 87). Furthermore, Buckeye agrees to a provision that provides for a representative of the community to help select the engineer, as long as final estimate approval rests with Staff (Buckeye Reply Br. at 90).

In response to UNU's recommendation that Buckeye be required to procure a performance bond, Buckeye asserts that a performance bond is not a viable alternative to a financial bond. Buckeye asserts that finding a financial institution that will have the face value of the bond available over the next few decades to cover decommissioning is a much smaller risk than finding a firm that will agree to perform decommissioning, if called upon to do so, sometime in the next few decades. According to Buckeye, performance bonds are not typical for wind farms and a performance bond will not alleviate any risk, as a bonding agent still may not be financially able to perform decommissioning. (Buckeye Reply Br. at 84-85; Tr. at 1122.) Buckeye also argues that a surety bond, set at double the estimated decommissioning costs is impractical and appears calculated to inflict a maximum degree of financial stress on the project (Buckeye Reply Br. at 86). Buckeye still recommends its initial proposal of financial assurance equal to the decommissioning costs minus 75 percent of the salvage value, as estimated by an independent and registered professional engineer (Buckeye Br. at 60; Buckeye Reply Br. at 91).

vi. Board Analysis

The Board agrees that decommissioning and the associated financial assurance is an important issue that must be evaluated in our consideration of the proposed project. Having thoroughly reviewed the concerns and proposals raised by the parties on this issue, the Board believes that some financial assurance is appropriate upon construction and we have set forth such a requirement in the Conclusion and Conditions Section of this opinion, order, and certificate. The necessary conditions include those recommended by staff, as summarized above and detailed further below, as well as the requirement requested by UNU that a representative of the community assist in selecting the independent engineer, with the final selection decision resting with staff. Accordingly, the Board concludes that, with these conditions for decommissioning and financial assurance in place, public interest will be protected.

15. Conclusion

Initially, the Board notes that in considering whether this project is in the public interest, convenience, and necessity, the Board has taken into account that the renewable energy generated by this facility will benefit the environment and consumers. In addition we note this project will assist Ohio's electric utilities in meeting their renewable energy benchmarks required pursuant to statute. Moreover, upon review of the record, we find that this project has been designed to have minimal aesthetic impact on the local community. With respect to safety and health concerns, such as setbacks, blade shear, ice throw, shadow flicker, and noise, the Board finds that these concerns have been adequately addressed, both in the initial application, as well as in staff's proposed conditions and, ultimately, in the conditions contained in the Conclusion and Conditions Section of this order.

The Board also notes that, with respect to communications, radar interference, traffic, and transportation, we believe that based on the record this project has been designed to avoid any alteration of the resources available to the community. Specifically, Buckeye has studied the potential for interference with communications systems, and local and long-range radar. The results of these analyses have lead to a project that is configured to have the minimum impact on these resources. With respect to traffic, road repair, and decommissioning, the potential impacts have been ascertained, and the conditions contained in the Conclusion and Conditions Section of this order require the appropriate financial assurances to make certain that the community is not harmed by those aspects of the project. Accordingly, based on our consideration of all of the issues noted in the proceeding sections, the Board finds that this project is appropriately tailored to serve the public interest, convenience, and necessity in accordance with Section 4906.10(A)(6), Revised Code, provided the conditions set forth in the Conclusion and Conditions Section are adhered to by the applicant.

### G. Agricultural Districts - Section 4906.10(A)(7), Revised Code

Staff explains that classification as agricultural district land is achieved through an application and approval process that is administered through local county auditors' offices. Staff notes that, based upon parcel information obtained from the Champaign County Auditor's records, Buckeye has stated that 43 agricultural district parcels are located within the project area. The project facilities will directly impact 25 of the 43 agricultural parcels in the project area. Staff has also evaluated potential impacts on agricultural production and notes that Buckeye has indicated that the project would disturb 372 acres of agricultural land, of which 303.5 acres would be temporarily disturbed during construction, and the remaining 68.5 acres would be permanently disturbed and taken out of production. (Staff Ex. 2 at 54.)

According to staff, construction-related activities, such as vehicular traffic and materials storage, could lead to temporary reductions in farm productivity caused by direct crop damage, soil compaction, broken drainage tiles, and reduction of space available for planting. However, staff reports that Buckeye has indicated that it intends to take precautionary steps in order to address such potential impacts to farmland, including: repairing or replacing damaged drainage tiles to the landowner's satisfaction, subsoil de-compaction, and rock picking prior to respreading of topsoil in disturbed areas. Buckeye also states that the value of any crops damaged by construction activities or by soil compaction will be reimbursed to the landowner. Staff further states that, after construction, only the agricultural land associated with the turbine locations, the substation, and access roads will be removed from production. (Staff Ex. 2 at 54.)

In sum, staff concludes that there would be no significant permanent impacts from the construction or maintenance of this proposed electric generation facility on agricultural districts. Further, staff states that construction and maintenance of this proposed facility will not impact the viability of any agricultural district farmland, as only 68.5 acres would be removed from agricultural production. (Staff Ex. 2 at 54.) Therefore, it is staff's conclusion that the Board should find that the impact of the proposed facility on the viability of existing farmlands and agricultural districts has been determined and will be minimal. (Staff Ex. 2 at 56.) No intervenor raised any concerns regarding this criterion.

The Board finds that, in accordance with Section 4906.10(A)(7), Revised Code, the impact of the proposed facility on the viability of existing farmland and agricultural districts has been determined and the impact will be minimal.

H. Water Conservation Practice - Section 4906.10(A)(8), Revised Code

Staff reports that the proposed facility involves the utilization of numerous wind turbines to generate electricity. Wind-powered electric generating facilities do not utilize water in their process of electricity production; therefore, water consumption associated with the proposed electric generation equipment is not an issue warranting conservation efforts. However, portable water will be needed for personal use by employees at the facility's operation and maintenance building, but those needs are expected to be minimal. Therefore, staff recommends that the Board find that the proposed facility will comply with Section 4906.10(A)(8), Revised Code. (Staff Ex. 2 at 56.) No intervenor raised any concerns regarding this criterion. Accordingly, the Board finds the proposed facility complies with Section 4906.10(A)(8), Revised Code.

I. Other Issues

1. Complaint Resolution Procedure

According to staff, the proposed facility must be constructed, operated, and maintained in conformity with the certificate issued by the Board, including any terms, conditions, and modifications contained therein. Staff recommends that any certificate issued to Buckeye include a condition that would require Buckeye to submit to staff, for review and acceptance, a completed complaint resolution procedure at least 30 days prior to the preconstruction conference, which would cover complaints on issues such as noise, shadow flicker, and decommissioning, etc. and would require notification to staff of any complaint submitted to Buckeye. (Staff Ex. 2 at 58-59; Staff Br. at 35.) Buckeye witness

Shears testified that he supports the creation of a complaint resolution process for the proposed facility and he believes the Board is the appropriate entity to put the procedure in place (Tr. at 130). Buckeye supports the creation of a complaint resolution process, as it will allow complaints to be addressed and mitigated as they arise, instead of through the imposition of extreme conditions on the certificate (Buckeye Reply Br. at 54).

Staff states that it believes any remedies available to parties utilizing an informal complaint process with Buckeye would be limited to mitigation and performance. However, if a complaining party wished to pursue a formal process for a certificate violation, it would do so under Section 4906.97, Revised Code, and Rule 4906-9-01, O.A.C. Under these provisions, a party would request that the Board initiate a proceeding to investigate whether the facility is operating in compliance with its certificate. Pursuant to Section 4906.97, Revised Code, if a violation is found using this formal process, the Board would have the option of assessing a forfeiture that would be deposited in the state treasury of not more than $5,000 for each day of the violation, not to exceed an aggregate of $1 million. Other penalties may also apply. However, staff notes that relief such as monetary or injunctive relief could not be obtained from the Board, but instead would have to be pursued in an action before a court of common pleas with jurisdiction over the matter. (Staff Br. at 36-37.)

Therefore, staff recommends a two-tiered complaint process to address complaints regarding any aspect of the proposed facility, with informal complaints being resolved with Buckeye, which may lead to a more efficient resolution, and formal complaints being resolved through the process with the Board. More formal complaints, those not satisfied through the informal complaint process, can be pursued by the formal process already provided in Section 4906.97 and 4906.98, Revised Code, and Rule 4906-9-01, O.A.C. (Staff Br. at 37.)

In response to staff's recommendation, UNU asserts that the Board should require Buckeye to submit a proposed complaint procedure as part of the application, so that public input can be provided to increase its effectiveness. UNU also recommends that the certificate require Buckeye to provide staff with funds necessary to retain a consultant answerable only to staff to investigate any complaints because UNU believes that the Board will inevitably need to hire a consultant to deal with the wide variety of complaint topics. Furthermore, UNU offers that, if the complaint resolution procedure involves Buckeye receiving and investigating complaints, Buckeye should be required to forward a detailed record of each complaint to the Board, so as to allow the public to monitor the adequacy of Buckeye's response, as well as the number of complaints arising out of the operation of the proposed facility. (UNU Reply Br. at 29-30.)

Specifically, with respect to noise, UNU asserts that any complaint resolution procedure is meaningless without an objective standard to evaluate the merits of noise complaints; therefore, UNU requests that the certificate identify a decibel level that is too high, in order to provide a numeric standard by which to judge whether a complaint is valid. In addition to a numeric noise limit, UNU argues that the certificate should also require Buckeye to submit a plan to reduce noise levels if they are found to be higher than the limit, in order to make the complaint resolution procedure as effective as possible. (UNU Reply Br. at 30-31.)

The Board is mindful of the need for a complaint resolution process that is both effective and offers an efficient resolution of complaints. Therefore, the Board agrees with staff's proposal for both an informal complaint resolution process conducted through Buckeye, with notification to staff, as well as the formal process, already in place, for any alleged certificate violation. With regard to UNU's proposal that the Board require that the certificate be conditioned on Buckeye providing the Board with funds to hire a consultant, the Board finds such a condition unnecessary. As for setting a specific decibel noise limit, the Board addressed UNU's concerns with noise previously in this order.

2. Surveillance Cameras

UNU witness James stated that other wind farms use surveillance cameras on their turbines (UNU Ex. 31A at 21). Although Buckeye has not expressed an intent to install surveillance cameras as part of the proposed facility, UNU recommends a condition which would prohibit the installation of surveillance cameras on the turbines within the proposed facility (UNU Br. at 90).

In response to UNU's concern, Buckeye witness Shears testified that he had never been aware of the installation of surveillance cameras on wind turbines and could not understand the need for such measures. However, when asked if he would object to a condition in the certificate prohibiting the installation of surveillance cameras, Mr. Shears stated that he was skeptical of why that would be required as a condition, but stated that it sounded sensible. (Tr. at 150-152.)

Therefore, the Board finds that a condition prohibiting the installation of surveillance cameras on turbines, as a routine practice as part of the proposed facility is appropriate. Should a reasonable, justifiable need arise to install surveillance cameras, Buckeye must first seek approval from staff.

3. Taxation

With respect to the possible tax benefits the construction of the proposed facility could have on the surrounding community, the County asserts that any potential benefits are uncertain (County Br. at 16; Tr. at 1676-1677). Given recent efforts in the Ohio General Assembly, as well as the potential for Buckeye to obtain financing through the Ohio Air Quality Development Authority, the Board is unable to determine, at this time, the amount of any additional tax revenue that local governments would receive if the proposed facility were constructed and operated as proposed in the application.

4. Changes in conditions after certificate issuance

UNU opposes eight of the staff's recommended conditions, as well as three other conditions proposed by Buckeye that require Buckeye to present information for staff's review and acceptance or approval after the Board has granted Buckeye a certificate to construct the proposed facility (UNU Reply Br. at 43-46; Staff Ex. 2 at 57-66; Staff Br. 16-18, 20, 26; Buckeye Br. 15-17).[9] Generally, the conditions which UNU opposes relate to the submission of certain information at least 30 days prior to the preconstruction conference, including; the final electric collection system plan; the tree clearing plan; the site-specific geotechnical report and final turbine foundation design; the fire protection and medical emergency plan; the complaint resolution process; the development of a post-construction avian and bat mortality survey; development of an HCP and securing the ITP; blade shear information specific to the turbine model selected; compliance with FAA and ODOT-OA requirements; performance of a Fresnel zone analysis; notice of and compliance with the turbine selection criteria; specifics of a decision regarding the relocation of Turbines 57 and 70, if constructed; and the establishment of shadow flicker monitoring and testing complaint procedures.

UNU argues that the referenced conditions either allow the proposed project to be revised based on information that was not presented at the public information meeting, in the application or at the evidentiary hearing, or to defer steps that should be taken before the Board issues a certificate. UNU argues that issuing a certificate with such conditions relieves Buckeye of its burden of proof, permits the arbitrary circumvention of the rights of public notice and participation as set forth in Chapter 4906, Revised Code, and deprives the intervenors of procedural due process. UNU requests that the Board eliminate the above-referenced conditions, direct Buckeye to file all the information required pursuant to the above-referenced conditions and that the evidentiary hearing be reopened to allow for the "full evidentiary exchange by all parties regarding the new information," prior to the Board issuing Buckeye a certificate to construct the proposed wind-powered electric generation facility. (UNU Reply Br. at 43-46.)

The Board notes that it is the Board's long-standing policy to require the applicant to hold a preconstruction conference with the staff, to demonstrate compliance with the associated requirements of other state and federal agencies, and other specific particulars

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9 UNU opposes staff's proposed and revised conditions as set forth in the Staff Report and modified in the staff's brief, conditions 8(e), (f), (h), (i) and (j), (15), (16), (33), (36), (40), (45), (46) and (50), as well as Buckeye's requested revisions to staff's recommended conditions (31), (45), and (50). The conditions of the certificate have been modified as set forth in the Conclusion and Conditions Section of this opinion, order, and certificate.

of construction after the certificate is issued for efficiency of the certificate process, and the use of Board resources. The certificate conditions also require the applicant to demonstrate that the final construction plans for the facility comply with the Board's opinion, order, and certificate, and the conditions thereof, as adopted by the Board. The certificate conditions also may require the applicant to have in place certain procedures, like the complaint procedures proposed in this case, that the Board finds appropriate for the construction of the project or to address public interest concerns without unduly delaying the certification process. Further, the Board's certificate conditions recognize and incorporate into the certificate, and to some extent the Board's certificate to construct, operate, and maintain the proposed project, the requirements of other state and federal agencies to construct the electric generation facility.

We find UNU's claims regarding the Board's process requiring the submission of information, as set forth in the conditions of a certificate, to be unfounded. Any party to a certificate application has an opportunity, as UNU has done in this matter, to oppose staff's recommended conditions or to propose additional conditions. Furthermore, the Board notes that, in accordance with Section 4906.07, Revised Code, the Board is required to hold a hearing in the same manner as on the application, where the amendment of a certificate involves any material increase in any environmental impact or substantial change in the location of all or a portion of the facility. Therefore, we find that, given the safeguard under Section 4906.07, Revised Code, which would require Buckeye to file an amendment to the certificate, we find UNU's arguments to be without merit.

CONCLUSION AND CONDITIONS:

The Board has considered the record in this proceeding, and the interests and arguments of each party. Based upon the record, the Board finds that all of the criteria established in accordance with Chapter 4906, Revised Code, are satisfied for the construction, operation, and maintenance of the facility as described in the application filed with the Board on April 24, 2009, as supplemented on August 28, 2009, and September 1, 2009, subject to certain conditions proposed by staff and other parties, and modified herein. In addition, upon review of the record and certain issues raised in this case, the Board finds that certain requirements delineated in this order, while not conditions on the certificate, are appropriate. To the extent that a request to amend a particular condition or to supplement the conditions is not discussed or adopted in the conditions set forth below, it is hereby denied. Accordingly, the Board approves the application and hereby issues a certificate to Buckeye for the construction, operation, and maintenance of the proposed facility, subject to the conditions set forth below.

(1) The facility shall be installed at Buckeye's proposed site as presented in the application filed on April 24, 2009, and as further clarified by supplemental filings.

(2) Buckeye shall utilize the equipment and construction practices as described in the application, and as clarified in supplemental filings, and recommendations in the staff report, as modified herein.

(3) Buckeye shall implement the mitigative measures described in the application, any supplemental filings, and recommendations in the staff report, as modified herein.

(4) Buckeye shall obtain and comply with all applicable permits and authorizations as required by federal and state entities prior to the commencement of construction and/or operation of the facility, as appropriate.

(5) A copy of each permit or authorization, including a copy of the original application, if not already provided, and any associated terms and conditions, shall be provided to the staff within seven days of issuance or receipt by Buckeye.

(6) Buckeye shall operate the facility within the noise parameters as set forth in its noise study and presented in its application.

(7) Buckeye shall conduct a preconstruction conference prior to the start of any project work, which staff shall attend, to discuss how environmental and other concerns will be satisfactorily addressed.

(8) At least 30 days prior to the preconstruction conference, Buckeye shall provide the following documents to staff for review and acceptance:

(a) A final equipment delivery route and transportation routing plan.

(b) One set of detailed drawings for the proposed project so that the staff can confirm that the final project design is in compliance with the terms of the certificate.

(c) A stream crossing plan including details on specific streams to be crossed, either by construction vehicles and/or facility components (i.e., access roads, electric collection lines), as well as a specific discussion of proposed crossing methodology for each stream crossing and post-construction site restoration. The stream crossing plan shall be based on final plans for the access roads and electric collection system.

(d) A detailed frac-out contingency plan for stream crossings that are expected to be completed via horizontal directional drill. Such contingency plan can be incorporated within the stream crossing plan herein.

(e) A final electric collection system plan, specifically identifying the planned location of all lines, indicating whether the lines will be buried or overhead, describing the types of construction method(s) to be used for installing the lines, showing all construction access points, and explaining how impacts to all sensitive resources (e.g., streams, wetlands, trees, steep slopes, etc.) in and along the planned electric collection line routes will be avoided or minimized during construction, operation, and maintenance.

(f) A tree clearing plan describing how trees and shrubs around turbines, along access routes, in electric line corridors (buried and overhead), at laydown areas, and in proximity to any other project facilities will be protected from damage during construction, and, where clearing cannot be avoided, how such clearing work will be done so as to minimize removal of woody vegetation. Priority should be given to protecting mature trees throughout the project area and all woody vegetation in wetlands and riparian areas, both during construction and during subsequent operation and maintenance of all facilities.

(g) A final access plan, including both temporary (construction) and permanent (operation) access routes for all facilities, as well as the measures to be used for restoring all temporary segments and any long-term stabilization required along permanent access routes.

(h) A site-specific geotechnical report and the final turbine foundation design for each turbine location.

(i) A fire protection and medical emergency plan developed in consultation with the fire department having jurisdiction over the area.

(j) A completed informal complaint resolution procedure, including, at a minimum, a process to periodically inform staff of the number and substance of complaints received by Buckeye.

(9) Buckeye shall properly install and maintain erosion and sedimentation control measures at the project area in accordance with the following requirements:

(a) During construction, seed all disturbed soil, except within cultivated agricultural fields that will remain in production following project completion, within seven days of final grading with a seed mixture acceptable to the appropriate County Cooperative Extension Service. Denuded areas, including spoils piles, shall be seeded and stabilized within seven days, if they will be undisturbed for more than 21 days. Reseeding shall be done within seven days of emergence of seedlings as necessary until sufficient vegetation in all areas has been established.

(b) Inspect and repair all such erosion control measures after each rainfall event of one-half of an inch or greater over a 24-hour period and maintain controls until permanent vegetative cover has been established on disturbed areas.

(c) Obtain NPDES permits for storm water discharges during construction of the facility. A copy of each permit or authorization, including terms and conditions, shall be provided to the staff within seven days of receipt. Prior to construction, the construction SWPPP and SPCC procedures shall be submitted to the staff for review and acceptance.

(10) Buckeye shall employ the following construction methods in proximity to any watercourses:

(a) All watercourses, including wetlands, shall be delineated by fencing, flagging, or other prominent means.

(b) All construction equipment shall avoid watercourses, including wetlands, except at specific locations where staff has approved construction.

(c) Storage, stockpiling, and/or disposal of equipment and materials in these sensitive areas shall be prohibited.

(d) Structures shall be located outside of identified watercourses, including wetlands, except at specific locations where staff has approved construction.

(e) All stormwater runoff is to be diverted away from fill slopes and other exposed surfaces to the greatest extent possible and directed instead to appropriate catchment structures, sediment ponds, etc., using diversion berms, temporary ditches, check dams, or similar measures.

(11) Buckeye shall employ BMPs when working in the vicinity of environmentally-sensitive areas. This includes, but is not limited to, the installation of silt fencing (or similarly effective tool) prior to initiating construction near streams and wetlands. The installation shall be done in accordance with generally accepted construction methods and shall be inspected regularly.

(12) Buckeye shall dispose of all contaminated soil and all construction debris in approved landfills in accordance with Ohio EPA regulations.

(13) Buckeye shall have an environmental specialist on site at all times that construction, including vegetation clearing, is being performed in or near a sensitive area such as a designated wetland, stream, river, or in the vicinity of identified

threatened/endangered species or their identified habitat. The environmental specialist shall be familiar with water quality protection issues and able to field identify potential threatened/endangered species of plants and animals that may be encountered during project construction.

(14) Buckeye will immediately contact staff, ODNR, and/or USFWS if threatened or endangered species are discovered on-site during construction or operation.

(15) Buckeye shall develop and implement a post-construction avian and bat mortality survey plan that is approved by staff and members of ODNR-DW.

(16) Buckeye shall develop an HCP and obtain the associated ITP from USFWS regarding the potential take of Indiana bats.

(17) Buckeye shall implement all avoidance, minimization, and mitigation measures to protect the Indiana bat that are identified in an HCP and ITP as described in said documents.

(18) Buckeye shall not dispose of gravel or any other construction material during or following construction of the facility by spreading such material on agricultural land unless otherwise agreed to by the landowner. All construction debris shall be promptly removed and properly disposed of after completion of construction activities.

(19) Buckeye shall avoid, where possible, or minimize to the maximum extent practicable, any damage to field tile drainage systems and soils resulting from construction, operation, and maintenance of the facility in agricultural areas. Damaged field tile systems shall be promptly repaired to at least original conditions at Buckeye's expense. Excavated topsoil will be segregated and restored upon backfilling. Severely compacted soils will be plowed or otherwise decompacted, if necessary, to restore them to original conditions.

(20) Prior to construction, Buckeye shall prepare a Phase I cultural resources survey program for archeological work at turbine locations, access roads and auxiliary lines acceptable to staff. If the resulting survey work discloses a find of cultural or archaeological significance, or a site eligible for inclusion on the NRHP, then Buckeye shall submit an amendment,

modification, or mitigation plan for staff's acceptance. Any such mitigation effort, as appropriate, shall be developed in coordination with the OHPO with input from the Champaign County Historical Society and submitted to staff for review and acceptance.

(21) Prior to the commencement of construction, Buckeye shall conduct an architectural survey of the project area. Buckeye shall submit to staff a work program that outlines areas to be studied, with the focus on crossroad towns and villages in Champaign County that are located in the study area between the city of Urbana and the village of Mechanicsburg. If the architectural survey discloses a find of cultural or architectural significance, or a structure that is eligible for inclusion on the NRHP, then the applicant shall submit an amendment, modification, or mitigation plan for staff's acceptance. Any such mitigation effort, as appropriate, shall be developed in coordination with the OHPO with input from the Champaign County Historical Society and submitted to staff for review and acceptance.

(22) Buckeye shall not commence construction of the facility until it has a signed interconnection service agreement with PJM, which includes construction, operation, and maintenance of system upgrades necessary to reliably and safely integrate the proposed generating facility into the regional transmission system. Buckeye shall provide a letter stating that the agreement has been signed or a copy of the signed interconnection service agreement to the staff.

(23) Any permanent road closures, road restoration, or road improvements necessary for construction and operation of the proposed facility shall be coordinated with the appropriate entities, including but not limited to, the Champaign County Engineer, ODOT, local law enforcement, and health/safety officials.

(24) At its expense, Buckeye shall promptly repair all impacted roads and bridges following construction to at least their condition prior to the initiation of construction activities.

(25) General construction activities shall be limited to daylight hours Monday through Saturday. On Sunday, general

construction activities shall be limited to the hours between 8:00 a.m. and 5:00 p.m. Impact pile driving operations shall be limited to the hours between 8:00 a.m. to 5:00 p.m., Monday through Friday. Construction activities that do not involve noise increases above background levels at sensitive receptors are permitted when necessary.

(26) No commercial signage or advertisements shall be located on any turbine, tower, or related infrastructure.

(27) The turbines shall be numbered on two opposing sides consisting of 12-inch block numerals, eight feet up from the tower base. These numerals shall be painted in silver reflective paint outlined by a one-half inch black painted border to facilitate both night and day visibility.

(28) Each turbine tower will be placarded with a 24-hour emergency telephone number for Buckeye.

(29) If vandalism (i.e. spray painted graffiti) should occur, Buckeye shall remove or abate the damage immediately as to preserve the visual aesthetics of the project. Any abatement is subject to approval by staff.

(30) Buckeye will work with the property owner(s) adjacent to, and the owner of Fairview Cemetery in Mutual, Ohio, to develop a screening plan to be reviewed and accepted by staff. This screening plan shall, at the least, screen along the west and north sides of the chain link fence that serves as a property boundary between the two parcels.

(31) Approved turbines are subject to mitigation after construction, up to and including removal, if they exceed 30 hours per year of shadow flicker at any nonparticipating receptor. At least 30 days prior to the preconstruction conference, Buckeye shall provide staff with its informal complaint process to be used in shadow flicker complaints. The informal process shall include, at a minimum, testing procedures and monitoring duration when Buckeye is contacted with a shadow flicker complaint and a process to periodically inform staff of the number and substance of shadow flicker complaints received by Buckeye.

(32) All structures shall be lit in accordance with FAA circular 70/7460-1 K Change 2, Obstruction Marking and Lighting,

white paint/synchronized red lights- Chapters 4, 12 & 13 (Turbines), or as otherwise prescribed by the FAA. Strobing shall be prohibited unless specifically required by the FAA.

(33) Prior to the preconstruction conference, Buckeye shall provide staff with both the maximum potential distance for a blade shear event from the three turbine models under consideration and the formula used to calculate the distance.

(34) Buckeye shall conduct appropriate training to instruct construction and maintenance workers on potential hazards of wind turbines, including ice conditions.

(35) Buckeye shall provide all local fire and emergency management service personnel with turbine layout maps, tower diagrams, schematics, turbine safety manuals, and an emergency 24-hour toll-free phone number for Buckeye.

(36) Buckeye shall not construct Turbines 19, 24, 26, 29, 30, 34, 38, 46, 48, 50, 57, 58, 60, 61, 62, and 63 due to the hazard to aviation. Buckeye must also meet all recommended and prescribed FAA and ODOT-OA requirements to construct an object that may affect navigable airspace. This includes the nonpenetration of any FAA Part 77 surface, unless authorized to do so by the FAA. Turbines that do not satisfy FAA and ODOT-OA requirements shall not be constructed.

(37) At least 90 days prior to any construction, Buckeye shall notify in writing any airport owner, whether public or private, whose operations, operating thresholds/minimums, landing/approach procedures, and/or vectors are altered, or are expected to be altered by the construction, operation, maintenance, or decommissioning of the proposed facility.

(38) Buckeye shall meet all recommended and prescribed FCC and federal agency requirements to construct an object that may affect communications, and mitigate any effects or degradation caused by wind turbine operation, up to and including removal of afflicting turbine(s).

(39) If the facility's operation results in any impacts to existing off-air television coverage, cellular/PCS, or AM/FM reception, Buckeye shall address and resolve (i.e. mitigate) each

individual problem as commercially practicable and that mitigation shall be subject to staff approval.

(40) Buckeye shall conduct an in-depth vertical Fresnel-Zone analysis to determine if Turbine 37 will cause microwave interference. Pursuant to staff review and approval, Buckeye shall shift the location of, or eliminate, Turbine 37 based on the results of the aforementioned study.

(41) Buckeye shall maintain the turbine manufacturer's safety manual onsite at the operations and maintenance building, and shall comply with the safety manual.

(42) At the discretion of the landowner, Buckeye shall install gates at access roads to prohibit public access. Such gates shall include appropriate warning signs.

(43) Buckeye must meet all recommended and prescribed FAA and federal agency requirements to construct an object that may affect local/long-range radar, and mitigate any effects or degradation caused by wind turbine operation, up to and including removal of afflicting turbine(s).

(44) If, at a later date, it is determined that a turbine, or a turbine's operation, causes interference with existing radar installations, Buckeye must immediately notify the staff and the afflicting turbine would be subject to mitigation up to and including removal.

(45) Buckeye shall not construct Turbine 70, as proposed. If Buckeye elects to modify the location of proposed Turbine 70, Buckeye shall provide staff a hard copy of the geographically-referenced electronic data, all changes in relation to the proposed relocation of Turbine 70, and any associated facilities. All changes will be subject staff review and approval prior to construction and shall comply with the conditions set forth in this opinion, order, and certificate.

(46) Buckeye shall propose an adjusted location for Turbine 57 so that it complies with the minimum property line setback, pursuant to Rule 4906-17-08(C)(1)(c), or, in the alternative, obtains waiver of the setback by the affected property owner.

(47) Buckeye shall comply with all setback requirements as prescribed by the Board.

(48) Buckeye shall establish, maintain, and manage a toll-free phone number for public contacts regarding the facility's operation. Buckeye shall exercise reasonable efforts to inform local communities of the existence of this phone number. Buckeye shall further maintain records of contacts and share these records with staff upon request.

(49) At least 60 days prior to construction, Buckeye shall file a letter with the Board that identifies which of the three turbine models listed in the application has been selected. If Buckeye selects a turbine model other than one of the three models listed in the application, in addition to the letter, Buckeye shall also: file copies of the safety manual for the turbine model selected and manufacturer contact information; and provide assurances that no additional negative impacts would be introduced by the model selected.

(50) Within 30 days after completion of construction, Buckeye shall submit to staff a copy of the as-built plans and specifications.

(51) Buckeye shall provide staff the following information, as it becomes known: the date on which construction will begin; the date on which construction was completed; and the date on which the facility began commercial operation.

(52) The certificate shall become invalid if Buckeye has not commenced a continuous course of construction of the proposed facility within five years of the date of journalization of the certificate.

(53) Buckeye shall be prohibited from locating a proposed turbine where: (1) the distance from the turbine to either of two towers owned by the Champaign Telephone Company located at 10955 Knoxville Road, Mechanicsburg, Ohio 43044 (LAT: 40-0-30.16 N; LONG: 83-35-14.39 W) and at 2733 Mutual Union Road, Cable, Ohio 43009 (LAT: 40-9-26.0 N; LONG: 83-37-52.0 W) is less than the total height of the turbine above ground level or (2) the turbine would be in the direct line of sight between the two towers.

(54) Buckeye will not construct the proposed collector lines on the south side of Route 36, west of Ault Road and east of Ludlow Road, along the UCC road frontage around Hole No. 11.

(55) Buckeye will not locate surveillance cameras on or around the turbines, absent a showing of good cause, and approval by staff.

(56) Prior to the commencement of construction, Buckeye shall secure a road bond(s), or other similar surety, through the Champaign County Engineer's Office to provide adequate funds to repair any damage to public roads resulting from the construction or decommissioning of the proposed facility. Buckeye shall submit proof of the bond or other similar surety, for staff's approval in coordination with ODOT.

(57) Buckeye shall, at its expense, complete decommissioning of the facility, or individual wind turbines, within 12 months after the end of the useful life of the facility or individual wind turbines. If no electricity is generated for a continuous period of 12 months, or if the Board deems the facility or individual turbine to be in a state of disrepair warranting decommissioning, the facility or individual wind turbine will be presumed to have reached the end of its useful life.

(58) Decommissioning of the facility shall include the removal of all physical material pertaining to the facility to a depth of at least 36 inches beneath the soil surface and restoration of the disturbed area to substantially the same physical condition that existed immediately before construction. The foundation for each wind turbine shall be removed beyond the aforementioned depth of 36 inches to the greater depth of 60 inches, unless the landowner consents to the removal of 48 inches of the foundation. The decommissioning shall include removal of wind turbines, buildings, cabling, electrical components, roads, and any other associated facilities.

(59) During decommissioning, the disturbed earth shall be regraded, reseeded, and restored to substantially the same physical condition that existed immediately before construction.

(60) If Buckeye does not complete decommissioning within the period prescribed in Condition 57, the Board may take action as

necessary to complete decommissioning, including requiring forfeiture of financial assurance. The entry into a participating landowner agreement constitutes agreement and consent of the parties to the agreement, their respective heirs, successors, and assigns, that the Board may take action that may be necessary to implement the decommissioning plan, including the exercise by the Board, staff, and contractors of the right of ingress and egress for the purpose of decommissioning the facility.

(61) The escrow agent shall release the decommissioning funds when Buckeye has demonstrated, and the Board concurs, that decommissioning has been satisfactorily completed, or upon written approval of the Board in order to implement the decommissioning plan.

(62) Prior to construction, a determination of the probable hydrologic consequences of the decommissioning and reclamation operations, both on and off the project area, with respect to the hydrologic regime, providing information on the quantity and quality of the water in surface and groundwater systems including the dissolved and suspended solids under seasonal flow conditions and the collection of sufficient data for the site(s) and surrounding areas so that cumulative impacts of all actions in the area upon the hydrology of the area and particularly upon water availability be provided to staff for review and approval. This determination shall be required in addition to the hydrologic information of the general area prior to construction.

(63) Prior to construction, Buckeye shall identify lands in the application that a reconnaissance inspection suggests may be Prime Farmlands, a soil survey shall be made or obtained according to standards established by the Secretary of the U.S. Department of Agriculture and/or Ohio Department of Agriculture in order to confirm the exact location of the Prime Farmlands, if any. The results of this study shall be submitted to staff for review and approval. Any confirmed Prime Farmlands should be reclaimed to such standards after site decommissioning and reclamation.

(64) Prior to construction, Buckeye shall indicate the future use that is proposed to be made of the land following reclamation, including information regarding the utility and capacity of the

reclaimed land to support a variety of alternative uses and the relationship of the proposed use to existing land use policies and plans. This shall be submitted for staff review and approval.

(65) Prior to construction, Buckeye shall provide staff the engineering techniques proposed to be used in decommissioning and reclamation and a description of the major equipment; a plan for the control of surface water drainage and of water accumulation; and a plan, where appropriate, for backfilling, soil stabilization, compacting and grading. This plan shall be subject to review and approval by staff.

(66) Prior to construction, Buckeye shall provide staff with a detailed timetable for the accomplishment of each major step in the decommissioning/reclamation plan; the steps to be taken to comply with applicable air and water quality laws and regulations and any applicable health and safety standards; and a description of the degree to which the decommissioning/reclamation plan is consistent with the local physical, environmental, and climatological conditions. This timetable shall be subject to staff review and approval.

(67) During construction, operation, and decommissioning, all recyclable materials salvaged and nonsalvaged shall be recycled to the furthest extent possible. All other nonrecyclable waste materials shall be disposed of in accordance with state and federal law.

(68) Buckeye shall leave intact any improvements made to the electrical infrastructure, pending approval/acceptance by the concerned utility.

(69) Prior to construction of each turbine, Buckeye shall post and maintain financial assurance for said turbine in the amount of $5,000. This financial assurance shall be in place until such time that the facility has been operational for one year.

(70) With regard to financial assurance after the first year of operation of the facility, the following shall apply: Subject to approval by staff, an independent and registered professional engineer, licensed to practice engineering in the state of Ohio, shall be retained by Buckeye to estimate the total cost of

decommissioning in current dollars (decommissioning costs), without regard to salvage value of the equipment, and the cost of decommissioning net salvage value of the equipment (net decommissioning costs). Said estimate shall include: an analysis of the physical activities necessary to implement the approved reclamation plan, with physical construction and demolition costs based on ODOT's Procedure for Budget Estimating and RS Means material and labor costs indices; the number of units required to perform each of the activities, and an amount to cover contingency costs (not to exceed 10 percent of the above-calculated reclamation cost). Said estimate should be on a per turbine basis and shall be submitted for staff review and approval after one year of facility operation and every third year thereafter, until the facility is decommissioned. The Board reserves the right to hire its own expert, at the generation facility's expense, to evaluate any of the periodic reports. After one year of facility operation, Buckeye shall post and maintain decommissioning funds in an amount equal to the net decommissioning costs, provided that at no point shall the net decommissioning funds be less than 25 percent of the decommissioning costs. Buckeye shall adjust the funds, if necessary, based on the updated estimate within 90 days after notice of staff's approval of the estimate. The decommissioning funds (financial assurance) shall be in a financial instrument mutually agreed upon by staff and Buckeye, and conditioned on the faithful performance of all requirements and conditions of the approved decommissioning and reclamation plan. Alternatively, Buckeye may use a performance bond in lieu of the 25 percent requirement. Decommissioning funds shall be in a form approved by staff.

FINDINGS OF FACT AND CONCLUSIONS OF LAW:

(1) Buckeye is a corporation and a person under Section 4906.01(A), Revised Code.

(2) The proposed Buckeye wind-powered electric generation facility project is a major utility facility under Section 4906.01(B)(1), Revised Code.

(3) On June 4, 2008, Buckeye filed notice of the present case and attached a copy of the notice to be published for the informational public meeting held on June 10, 2008, at Triad

High School, 8099 Brush Lake Road, North Lewisburg, Ohio 43060.

(4) On April 24, 2009, as amended and supplemented on August 28, and September 1, 2009, Buckeye filed an application for a certificate to site a wind-powered electric generation facility in excess of 50 MW in Champaign County, Ohio.

(5) On June 23, 2009, the Board notified Buckeye that its application had been found to be complete pursuant to Chapter 4906, *et seq.*, O.A.C.

(6) On July 7, 2009, and July 16, 2009, Buckeye served copies of the application upon local government officials and filed proof of service of the application pursuant to Rule 4906-5-06, O.A.C.

(7) By entry issued July 31, 2009, the ALJ granted Buckeye's requests for waiver of the one-year notice period required by Section 4906.06(A)(6), Revised Code; the alternative site information and the formal site selection study required by Rules 4906-13-2(A)(1) and 4906-13-03, O.A.C; the mapping of the proposed facility and utility corridors, as it relates to gas transmission lines, required by Rule 4906-13-04(A)(1)(c), O.A.C.; the mapping of vegetative cover that may be removed during construction and layout of the proposed project in a 1:4,800 scale required by Rules 4906-13-04(A)(3), (A)(3)(g), and (B)(2), O.A.C.; the mapping of a cross-sectional view indicating geological features of the proposed facility site and the location of test borings required by Rule 4906-13-04(A), O.A.C.; the mapping, of among other things, fuel, waste, and other storage facilities, and water supply and sewage lines for the proposed project; and the mapping of the layout including grade elevations where such will be modified during construction as required by Rule 4906-13-04(B)(2)(i), O.A.C. Buckeye's requests for waiver of the financial data required by Rule 4906-13-05, O.A.C.; the provision of a ten-year projected population estimate for the communities within a five-mile radius of the proposed project site required by Rule 4906-13-07(A)(1), O.A.C.; the information based on a survey regarding the ecological impact of the proposed facility and a list of major species observed in the area as required by Rule 4906-13-07(B)(1)(b) through (e), O.A.C.; the estimated impact of construction on undeveloped areas as required by Rule 4906-

13-07(B)(2)(a); and the mapping of all agricultural land and all agricultural district land required by Rule 4906-13-07(F)(1), O.A.C., were denied.

(8) The ALJ granted motions to intervene filed by UNU, the Farm Bureau, UCC, the County, Urbana, the Telephone Company, and the Piqua Shawnee.

(9) On October 13, 2009, as supplemented on November 18, 2009, staff filed a report of the investigation of Buckeye's application.

(10) A local public hearing was held on October 28, 2009, at Triad High School, North Lewisburg, Ohio.

(11) On October 27, 2009, the adjudicatory hearing was called and continued until November 9, 2009. The hearing reconvened on November 9, 2009, and continued each business day through November 20, 2009. Rebuttal testimony was taken on December 1 and 2, 2009.

(12) On September 11, 2009, and November 5, 2009, Buckeye filed its proofs of publication of the hearing notice.

(13) The ALJ's rulings are reasonable and shall be affirmed.

(14) Adequate data on the Buckeye wind-powered electric generation facility has been provided to make the applicable determinations required by Chapter 4906, Revised Code, and the record evidence in this matter provides sufficient factual data to enable the Board to make an informed decision.

(15) Buckeye's application filed on April 24, 2009, as amended and supplemented on August 28, and September 1, 2009, complies with the requirements of Chapter 4906-13, O.A.C.

(16) The record establishes that the basis of need, under Section 4906.10(A)(1), Revised Code, is not applicable.

(17) The record establishes that the nature of the probable environmental impact of the facility has been determined and it complies with the requirements in Section 4906.10(A)(2), Revised Code, subject to the revised conditions set forth in this opinion, order, and certificate.

(18) The record establishes that the proposed facility represents the minimum adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives, and other pertinent considerations under Section 4906.10(A)(3), Revised Code, subject to the conditions set forth in this opinion, order, and certificate.

(19) The record establishes that the facility is consistent with regional plans for expansion of the electric power grid and will serve the interests of electric system economy and reliability, under Section 4906.10(A)(4), Revised Code, subject to the conditions set forth in this opinion, order, and certificate.

(20) The record establishes, as required by Section 4906.10(A)(5), Revised Code, that the facility will comply with Chapters 3704, 3734, and 6111, Revised Code, and Sections 1501.33 and 1501.34, Revised Code, and all rules and standards adopted pursuant thereto and under Section 4561.32, Revised Code.

(21) The record establishes that the facility will serve the public interest, convenience, and necessity, as required under Section 4906.10(A)(6), Revised Code, subject to the conditions set forth in this opinion, order, and certificate.

(22) The record establishes that the facility will not adversely impact the viability of any land in an existing agricultural district, under Section 4906.10(A)(7), Revised Code.

(23) The record establishes that the facility will comply with water conservation practices under Section 4906.10(A)(8), Revised Code.

(24) Based on the record, the Board shall issue a Certificate of Environmental Compatibility for the construction, operation, and maintenance of the Buckeye wind-powered electric generation facility in Champaign County, Ohio, subject to the conditions set forth in this opinion, order, and certificate.

ORDER:

It is, therefore,

ORDERED, That, UNU's, UCC's and the County's requests to reverse the ALJ's rulings are denied as set forth in Section IV of this opinion, order, and certificate. It is, further,

ORDERED, That a certificate be issued to Buckeye for the construction, operation, maintenance, and decommissioning of the proposed wind-powered electric generation facility, as modified pursuant to this opinion, order, and certificate. It is, further,

ORDERED, That the certificate contain the conditions as set forth in the Conclusion and Conditions Section of this opinion, order, and certificate. It is, further, ORDERED, That a copy of this opinion, order, and certificate be served upon each party of record and any other interested persons of record.

THE OHIO POWER SITING BOARD

Alan R. Schriber, Chairman of the Public Utilities Commission of Ohio

Lisa Patt-McDaniel, Board Member and Director of the Ohio Department of Development

Sean Logan, Board Member and Director of the Ohio Department of Natural Resources

Alvin Jackson, M.D., Board Member and Director of the Ohio Department of Health

Christopher Korleski, Board Member and Director of the Ohio Environmental Protection Agency

Robert Boggs, Board Member and Director of the Ohio Department of Agriculture

Board Member and Public Member

GNS/KLS/vrm

Entered in the Journal

MAR 2 2 2010

Reneé J. Jenkins
Secretary

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3846-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B40 |
| Location: | Urbana, OH |
| Latitude: | 40-07-18.75N NAD 83 |
| Longitude: | 83-41-25.13W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3846-OE.

**Signature Control No: 627211-147732539** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3841-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B35 |
| Location: | Urbana, OH |
| Latitude: | 40-07-27.97N NAD 83 |
| Longitude: | 83-41-33.05W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3841-OE.

**Signature Control No: 627206-147732537** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3807-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B1 |
| Location: | Urbana, OH |
| Latitude: | 40-10-46.51N NAD 83 |
| Longitude: | 83-40-34.68W |
| Heights: | 492 feet above ground level (AGL) |
| | 1659 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3807-OE.

**Signature Control No: 627172-147732535** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3808-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B2 |
| Location: | Urbana, OH |
| Latitude: | 40-10-27.25N NAD 83 |
| Longitude: | 83-40-47.55W |
| Heights: | 492 feet above ground level (AGL)<br>1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3808-OE.

**Signature Control No: 627173-147732541** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3809-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B3 |
| Location: | Urbana, OH |
| Latitude: | 40-10-03.03N NAD 83 |
| Longitude: | 83-40-47.65W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3809-OE.

**Signature Control No: 627174-147732533** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3810-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B4 |
| Location: | Urbana, OH |
| Latitude: | 40-10-03.11N NAD 83 |
| Longitude: | 83-40-18.70W |
| Heights: | 492 feet above ground level (AGL) |
| | 1648 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3810-OE.

**Signature Control No: 627175-147732530** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3811-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B5 |
| Location: | Urbana, OH |
| Latitude: | 40-09-51.56N NAD 83 |
| Longitude: | 83-40-38.41W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3811-OE.

**Signature Control No: 627176-147732527** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3812-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B6 |
| Location: | Urbana, OH |
| Latitude: | 40-09-40.86N NAD 83 |
| Longitude: | 83-40-29.92W |
| Heights: | 492 feet above ground level (AGL) |
| | 1650 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3812-OE.

**Signature Control No: 627177-147732529** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3813-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B7 |
| Location: | Urbana, OH |
| Latitude: | 40-09-32.88N NAD 83 |
| Longitude: | 83-37-33.48W |
| Heights: | 492 feet above ground level (AGL) |
| | 1806 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3813-OE.

**Signature Control No: 627178-147732261** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3813-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B7 |
| Location: | Urbana, OH |
| Latitude: | 40-09-32.88N NAD 83 |
| Longitude: | 83-37-33.48W |
| Heights: | 492 feet above ground level (AGL) |
| | 1806 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3813-OE.

**Signature Control No: 627178-147732261** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3814-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B8 |
| Location: | Urbana, OH |
| Latitude: | 40-09-21.20N NAD 83 |
| Longitude: | 83-38-40.53W |
| Heights: | 492 feet above ground level (AGL) |
| | 1804 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3814-OE.

**Signature Control No: 627179-147732528** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3815-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B9 |
| Location: | Urbana, OH |
| Latitude: | 40-09-09.13N NAD 83 |
| Longitude: | 83-40-16.92W |
| Heights: | 492 feet above ground level (AGL) |
| | 1665 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3815-OE.

**Signature Control No: 627180-147732546** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3816-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B10 |
| Location: | Urbana, OH |
| Latitude: | 40-09-16.57N NAD 83 |
| Longitude: | 83-34-20.94W |
| Heights: | 492 feet above ground level (AGL) |
| | 1631 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3816-OE.

**Signature Control No: 627181-147732244** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3817-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B11 |
| Location: | Urbana, OH |
| Latitude: | 40-09-13.19N NAD 83 |
| Longitude: | 83-35-47.20W |
| Heights: | 492 feet above ground level (AGL) |
| | 1714 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3817-OE.

**Signature Control No: 627182-147732247** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3818-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B12 |
| Location: | Urbana, OH |
| Latitude: | 40-09-08.88N NAD 83 |
| Longitude: | 83-34-14.10W |
| Heights: | 492 feet above ground level (AGL)<br>1624 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3818-OE.

**Signature Control No: 627183-147732263** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3819-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B13 |
| Location: | Urbana, OH |
| Latitude: | 40-08-55.07N NAD 83 |
| Longitude: | 83-40-18.82W |
| Heights: | 492 feet above ground level (AGL)<br>1659 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3819-OE.

**Signature Control No: 627184-147732532** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3820-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B14 |
| Location: | Urbana, OH |
| Latitude: | 40-09-01.06N NAD 83 |
| Longitude: | 83-34-07.09W |
| Heights: | 492 feet above ground level (AGL) |
| | 1619 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3820-OE.

**Signature Control No: 627185-147732245** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3821-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B15 |
| Location: | Urbana, OH |
| Latitude: | 40-09-00.07N NAD 83 |
| Longitude: | 83-34-41.24W |
| Heights: | 492 feet above ground level (AGL) |
| | 1654 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3821-OE.

**Signature Control No: 627186-147732246** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3822-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B16 |
| Location: | Urbana, OH |
| Latitude: | 40-08-54.74N NAD 83 |
| Longitude: | 83-35-41.30W |
| Heights: | 492 feet above ground level (AGL) |
| | 1724 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3822-OE.

**Signature Control No: 627187-147732255** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3823-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B17 |
| Location: | Urbana, OH |
| Latitude: | 40-08-24.11N NAD 83 |
| Longitude: | 83-40-15.88W |
| Heights: | 492 feet above ground level (AGL)<br>1655 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3823-OE.

**Signature Control No: 627188-147732544** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3824-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B18 |
| Location: | Urbana, OH |
| Latitude: | 40-08-27.89N NAD 83 |
| Longitude: | 83-35-41.37W |
| Heights: | 492 feet above ground level (AGL)<br>1718 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3824-OE.

**Signature Control No: 627189-147732250** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3826-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B20 |
| Location: | Urbana, OH |
| Latitude: | 40-08-11.64N NAD 83 |
| Longitude: | 83-36-23.09W |
| Heights: | 492 feet above ground level (AGL) |
| | 1730 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3826-OE.

**Signature Control No: 627191-147732262** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3827-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B21 |
| Location: | Urbana, OH |
| Latitude: | 40-08-08.26N NAD 83 |
| Longitude: | 83-35-43.38W |
| Heights: | 492 feet above ground level (AGL) |
| | 1708 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3827-OE.

**Signature Control No: 627192-147732249** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3828-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B22 |
| Location: | Urbana, OH |
| Latitude: | 40-08-08.16N NAD 83 |
| Longitude: | 83-34-42.40W |
| Heights: | 492 feet above ground level (AGL) |
| | 1667 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3828-OE.

**Signature Control No: 627193-147732258** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3829-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B23 |
| Location: | Urbana, OH |
| Latitude: | 40-08-02.09N NAD 83 |
| Longitude: | 83-36-13.81W |
| Heights: | 492 feet above ground level (AGL) |
| | 1717 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3829-OE.

**Signature Control No: 627194-147732260** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3831-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B25 |
| Location: | Urbana, OH |
| Latitude: | 40-07-55.58N NAD 83 |
| Longitude: | 83-36-37.98W |
| Heights: | 492 feet above ground level (AGL) |
| | 1731 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3831-OE.

**Signature Control No: 627196-147732254** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3833-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B27 |
| Location: | Urbana, OH |
| Latitude: | 40-07-43.20N NAD 83 |
| Longitude: | 83-41-20.94W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3833-OE.

**Signature Control No: 627198-147732531** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3834-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B28 |
| Location: | Urbana, OH |
| Latitude: | 40-07-44.20N NAD 83 |
| Longitude: | 83-37-35.30W |
| Heights: | 492 feet above ground level (AGL)<br>1766 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3834-OE.

**Signature Control No: 627199-147732538** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3837-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B31 |
| Location: | Urbana, OH |
| Latitude: | 40-07-35.11N NAD 83 |
| Longitude: | 83-41-09.13W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3837-OE.

**Signature Control No: 627202-147732542** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3837-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B31 |
| Location: | Urbana, OH |
| Latitude: | 40-07-35.11N NAD 83 |
| Longitude: | 83-41-09.13W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3837-OE.

**Signature Control No: 627202-147732542** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3837-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B31 |
| Location: | Urbana, OH |
| Latitude: | 40-07-35.11N NAD 83 |
| Longitude: | 83-41-09.13W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3837-OE.

**Signature Control No: 627202-147732542** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3838-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B32 |
| Location: | Urbana, OH |
| Latitude: | 40-07-34.14N NAD 83 |
| Longitude: | 83-39-06.37W |
| Heights: | 492 feet above ground level (AGL) |
| | 1769 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3838-OE.

**Signature Control No: 627203-147732534** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3839-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B33 |
| Location: | Urbana, OH |
| Latitude: | 40-07-34.91N NAD 83 |
| Longitude: | 83-37-34.27W |
| Heights: | 492 feet above ground level (AGL) |
| | 1746 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3839-OE.

**Signature Control No: 627204-147732540** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3842-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B36 |
| Location: | Urbana, OH |
| Latitude: | 40-07-25.13N NAD 83 |
| Longitude: | 83-40-58.30W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3842-OE.

**Signature Control No: 627207-147732543** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3843-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B37 |
| Location: | Urbana, OH |
| Latitude: | 40-07-25.11N NAD 83 |
| Longitude: | 83-39-36.77W |
| Heights: | 492 feet above ground level (AGL) |
| | 1720 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3843-OE.

**Signature Control No: 627208-147732536** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3845-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B39 |
| Location: | Urbana, OH |
| Latitude: | 40-07-23.25N NAD 83 |
| Longitude: | 83-39-07.68W |
| Heights: | 492 feet above ground level (AGL)<br>1764 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3845-OE.

**Signature Control No: 627210-147732545** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3845-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B39 |
| Location: | Urbana, OH |
| Latitude: | 40-07-23.25N NAD 83 |
| Longitude: | 83-39-07.68W |
| Heights: | 492 feet above ground level (AGL) |
| | 1764 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3845-OE.

**Signature Control No: 627210-147732545** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3847-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B41 |
| Location: | Urbana, OH |
| Latitude: | 40-07-18.67N NAD 83 |
| Longitude: | 83-39-33.27W |
| Heights: | 492 feet above ground level (AGL) |
| | 1717 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3847-OE.

**Signature Control No: 627212-147732549** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3847-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B41 |
| Location: | Urbana, OH |
| Latitude: | 40-07-18.67N NAD 83 |
| Longitude: | 83-39-33.27W |
| Heights: | 492 feet above ground level (AGL) |
| | 1717 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3847-OE.

**Signature Control No: 627212-147732549** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3848-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B42 |
| Location: | Urbana, OH |
| Latitude: | 40-07-12.76N NAD 83 |
| Longitude: | 83-41-49.73W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3848-OE.

**Signature Control No: 627213-147732552** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3850-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B44 |
| Location: | Urbana, OH |
| Latitude: | 40-07-11.05N NAD 83 |
| Longitude: | 83-39-09.40W |
| Heights: | 492 feet above ground level (AGL) |
| | 1743 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3853-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B47 |
| Location: | Urbana, OH |
| Latitude: | 40-06-52.90N NAD 83 |
| Longitude: | 83-37-20.65W |
| Heights: | 492 feet above ground level (AGL)<br>1710 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3853-OE.

**Signature Control No: 627218-147732257** ( EXT -WT )
Michael Blaich
Specialist

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3850-OE.

**Signature Control No: 627215-147732566** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3855-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B49 |
| Location: | Urbana, OH |
| Latitude: | 40-05-32.66N NAD 83 |
| Longitude: | 83-39-03.81W |
| Heights: | 492 feet above ground level (AGL) |
| | 1676 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3855-OE.

**Signature Control No: 627220-147732570** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3857-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B51 |
| Location: | Urbana, OH |
| Latitude: | 40-05-22.50N NAD 83 |
| Longitude: | 83-35-00.55W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3857-OE.

**Signature Control No: 627222-147732256** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3858-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B52 |
| Location: | Urbana, OH |
| Latitude: | 40-05-09.46N NAD 83 |
| Longitude: | 83-38-55.77W |
| Heights: | 492 feet above ground level (AGL) |
| | 1664 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3858-OE.

**Signature Control No: 627223-147732571** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3859-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B53 |
| Location: | Urbana, OH |
| Latitude: | 40-05-12.92N NAD 83 |
| Longitude: | 83-34-57.95W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3859-OE.

**Signature Control No: 627224-147732253** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3860-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B54 |
| Location: | Urbana, OH |
| Latitude: | 40-05-04.65N NAD 83 |
| Longitude: | 83-36-13.50W |
| Heights: | 492 feet above ground level (AGL)<br>1771 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3860-OE.

**Signature Control No: 627225-147732248** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3861-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B55 |
| Location: | Urbana, OH |
| Latitude: | 40-05-00.18N NAD 83 |
| Longitude: | 83-38-49.03W |
| Heights: | 492 feet above ground level (AGL) |
| | 1660 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3861-OE.

**Signature Control No: 627226-147732573** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3862-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B56 |
| Location: | Urbana, OH |
| Latitude: | 40-05-03.53N NAD 83 |
| Longitude: | 83-34-35.81W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3862-OE.

**Signature Control No: 627227-147732251** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3862-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B56 |
| Location: | Urbana, OH |
| Latitude: | 40-05-03.53N NAD 83 |
| Longitude: | 83-34-35.81W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3862-OE.

**Signature Control No: 627227-147732251** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3865-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B59 |
| Location: | Urbana, OH |
| Latitude: | 40-04-45.07N NAD 83 |
| Longitude: | 83-39-03.10W |
| Heights: | 492 feet above ground level (AGL) |
| | 1646 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3865-OE.

**Signature Control No: 627230-147732574** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3870-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B64 |
| Location: | Urbana, OH |
| Latitude: | 40-04-16.42N NAD 83 |
| Longitude: | 83-35-33.04W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3870-OE.

**Signature Control No: 627235-147732259** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3871-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B65 |
| Location: | Urbana, OH |
| Latitude: | 40-04-08.47N NAD 83 |
| Longitude: | 83-35-27.80W |
| Heights: | 492 feet above ground level (AGL) |
| | 1640 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3871-OE.

**Signature Control No: 627236-147732252** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3872-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B66 |
| Location: | Urbana, OH |
| Latitude: | 40-03-44.51N NAD 83 |
| Longitude: | 83-43-00.01W |
| Heights: | 492 feet above ground level (AGL) |
| | 1635 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3872-OE.

**Signature Control No: 627237-147732575** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3873-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B67 |
| Location: | Urbana, OH |
| Latitude: | 40-03-32.15N NAD 83 |
| Longitude: | 83-36-19.60W |
| Heights: | 492 feet above ground level (AGL) |
| | 1614 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3873-OE.

**Signature Control No: 627238-147732285** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3874-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B68 |
| Location: | Urbana, OH |
| Latitude: | 40-03-09.78N NAD 83 |
| Longitude: | 83-42-48.84W |
| Heights: | 492 feet above ground level (AGL) |
| | 1618 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

This extension is subject to review if an interested party files a petition on or before September 14, 2011. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and should be submitted in triplicate to the Manager, Airspace Regulations & ATC Procedures Group, Federal Aviation Administration, Airspace Regulations & ATC Procedures Group, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This extension becomes final on September 24, 2011 unless a petition is timely filed. If so, this extension will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3874-OE.

**Signature Control No: 627239-147732582** ( EXT -WT )

Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3875-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B69 |
| Location: | Urbana, OH |
| Latitude: | 40-03-15.75N NAD 83 |
| Longitude: | 83-37-18.39W |
| Heights: | 492 feet above ground level (AGL) |
| | 1607 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3875-OE.

**Signature Control No: 627240-147732289** ( EXT -WT )
Michael Blaich
Specialist

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2009-WTE-3876-OE

Issued Date: 08/15/2011

Michael Speerschneider
Buckeye Wind, LLC
44 East 30th Street
10th Floor
New York, NY 10016

**** Extension ****

A Determination was issued by the Federal Aviation Administration (FAA) concerning:

| | |
|---|---|
| Structure: | Wind Turbine B70 |
| Location: | Urbana, OH |
| Latitude: | 40-03-07.89N NAD 83 |
| Longitude: | 83-38-03.04W |
| Heights: | 492 feet above ground level (AGL)<br>1574 feet above mean sea level (AMSL) |

In response to your request for an extension of the effective period of the determination, the FAA has reviewed the aeronautical study in light of current aeronautical operations in the area of the structure and finds that no significant aeronautical changes have occurred which would alter the determination issued for this structure.

Accordingly, pursuant to the authority delegated to me, the effective period of the determination issued under the above cited aeronautical study number is hereby extended and will expire on 02/15/2013 unless otherwise extended, revised, or terminated by this office.

This extension issued in accordance with 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerns the effect of the structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTE-3876-OE.

**Signature Control No: 627241-147732291** ( EXT -WT )
Michael Blaich
Specialist

# *Appendix B*
# *HCP*

# DRAFT BUCKEYE WIND POWER PROJECT HABITAT CONSERVATION PLAN

*Pre-decisional Work Product*

## June 2012

Prepared for:

Buckeye Wind LLC
44 East 30th Street – 10th Floor
New York, NY 10016

Prepared By:

Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME 04086

Stantec

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**LIST OF ACRONYMS**

| | |
|---|---|
| ABPP | Avian and Bat Protection Plan |
| ac | acres |
| AEPS | Alternative Energy Portfolio Standard |
| agl | above ground level |
| APLIC | Avian Power Line Interaction Committee |
| b/n/n | bats per net per night |
| BBSH | big brown/silver-haired bat guild |
| BBSHHB | big brown bat/silver-haired bat/hoary bat guild |
| BCI | Bat Conservation International |

| | |
|---|---|
| BCM | Bat Conservation and Management |
| BFO | Bloomington Field Office (USFWS) |
| BGEPA | Bald and Golden Eagle Protection Act |
| BO | Biological Opinion |
| C | Celsius |
| CBD | Center for Biological Diversity |
| CECPN | Certificate of Environmental Compatibility and Public Need |
| CFR | Code of Federal Regulations |
| cm | centimeters |
| CRP | Conservation Reserve Program |
| CWA | Clean Water Act |
| dbh | diameter-at-breast height |
| DOE EIA | Department of Energy: Energy Information Administration |
| DOF | Division of Forestry |
| DOW | Division of Wildlife |
| DPL | Dayton Power and Light |
| DU | Ducks Unlimited |
| EA | Environmental Assessment |
| EDR | Environmental Design and Research |
| EIS | Environmental Impact Statement |
| EPA | Environmental Protection Agency |
| ESA | Endangered Species Act |
| ESI | Environmental Solutions and Innovations |
| F | Fahrenheit |
| FAA | Federal Aviation Administration |
| FONSI | Finding of No Significant Impact |
| Fed. Reg. | Federal Register |
| FRCC | Fire Regime Condition Class |
| ft | feet |
| GIS | Geographic Information System |
| ha | hectares |
| HB | hoary bat guild |
| HCP | Habitat Conservation Plan |
| HHEI | Headwaters Habitat Evaluation Index |
| I-70 | Interstate 70 |
| in | inch |
| IPCC | Intergovernmental Panel on Climate Change |
| ITP | Incidental Take Permit |
| km | kilometers |
| km/hr | kilometers per hour |
| kV | kilovolt |
| m | meters |
| m/s | meters per second |
| MCP | minimum convex polygon |
| MET | meteorological |
| mi | miles |
| mm | millimeters |
| mph | miles per hour |
| MTM/VF | mountaintop mining with valley fills |

| | |
|---|---|
| MW | megawatt |
| MWh | megawatt hour |
| MYSP | *Myotis* guild |
| NCDC | National Climatic Data Center |
| NE1 | Northeast 1 |
| NE2 | Northeast 2 |
| NEPA | National Environmental Policy Act |
| NLCD | National Land Cover Database |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| NOI | Notice of Intent |
| NPDES | National Pollutant Discharge Elimination System |
| NRC | National Research Council |
| NWF | National Wildlife Federation |
| NWI | National Wetlands Inventory |
| O&M | operations and maintenance |
| ODA | Ohio Department of Agriculture |
| ODNR | Ohio Department of Natural Resources |
| ODOD | Ohio Department of Development |
| ODOH | Ohio Department of Health |
| ODOT | Ohio Department of Transportation |
| OEPA | Ohio Environmental Protection Agency |
| OHPO | Ohio Historic Preservation Office |
| OMNR | Ontario Ministry of Natural Resources |
| OPSB | Ohio Power Siting Board |
| P1 | Priority 1 hibernaculum |
| P1A | Priority 1A hibernaculum |
| P1B | Priority 1B hibernaculum |
| P2 | Priority 2 hibernaculum |
| P3 | Priority 3 hibernaculum |
| P4 | Priority 4 hibernaculum |
| PHDI | Palmer Hydrological Drought Index |
| PCM | Post-construction monitoring |
| PUCO | Public Utilities Commission of Ohio |
| RBTB | eastern red bat/tri-colored bat guild |
| RC | Revised Code |
| rpm | rotations per minute |
| RU | Recovery Unit |
| s/d/n | sequences per detector per night |
| SMCRA | Surface Mining Control and Reclamation Act |
| SR | State Route |
| Stems/ac/PA | Stems per acre, on average, per Planting Area |
| SWPPP | Stormwater Pollution and Prevention Plan |
| TIR | thermal infrared |
| UNKN | unknown guild |
| USACE | United States Army Corps of Engineers |
| USAF | United States Air Force |
| USC | United States Code |
| USDA | United States Department of Agriculture |

| | |
|---|---|
| USDA-SCS | United States Department of Agriculture: Soil Conservation Service |
| USFWS | United States Fish and Wildlife Service |
| USGS | United States Geological Survey |
| WNS | White-Nose Syndrome or White Nose Syndrome |
| WQC | Water Quality Certification |

## LIST OF PREPARERS

This Habitat Conservation Plan (HCP) was primarily prepared by the following Stantec staff members: Cara Meinke, Kristen Watrous, Elizabeth Annand, Terry VanDeWalle, Janice Huebner, Quintana Baker, Jess Costa, James Kiser, Jeff Brown, Jon Ryan, Trevor Peterson, and Gino Giumarro. Dr. Bill Warren-Hicks of EcoStat Inc. was a co-author of the Collision Risk Model. The following third party reviewers provided comment on this HCP and/or its appendices: Dr. Allen Kurta of Eastern Michigan University provided scientific oversight and comments on the HCP and all appendices; Dr. Tim Carter of Ball State University provided an independent review of the HCP and all appendices; Dr. John Hayes of the University of Florida provided an independent review of the Appendix A – the Collision Risk Model; and an internal panel of statisticians at the U.S. Fish and Wildlife Service also provided an independent review of Appendix A. Regulatory, scientific, and technical oversight and guidance were provided by Megan Seymour, Melanie Cota, Keith Lott, Mary Knapp, Lisa Mandell, TJ Miller, and Rick Amidon (among many others) at the U.S. Fish and Wildlife Service, and Jennifer Norris at the Ohio Department of Natural Resources Division of Wildlife. The contribution of these individuals is gratefully acknowledged. While these individuals and organizations have provided extensive input to the document, the HCP is the product of Buckeye Wind LLC. The acknowledgement of the above contributors should not be interpreted as approval of the document as a whole by those individuals or the organizations they represent.

The format and style for this document generally followed the *Journal of Wildlife Management Guidelines* (Chamberlin and Johnson 2008).

# 1.0 INTRODUCTION

## 1.1 Overview and Purpose of the HCP

Buckeye Wind LLC, a wholly owned subsidiary of EverPower Wind LLC, (EverPower; hereafter referred to as Buckeye Wind) has prepared this Habitat Conservation Plan (HCP) in order to apply to the United States Fish and Wildlife Service (USFWS) for an Incidental Take Permit (ITP) under section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (ESA; 16 United States Code [USC] §§ 1531-1544, 1539). The purpose of the ITP is to allow incidental take of the federally endangered Indiana bat (*Myotis sodalis)* as a result of actions associated with the proposed Buckeye Wind Power Project (Project). This HCP analyzes potential impacts to the Indiana bat from construction, operation, maintenance, and decommissioning of the Project and describes how the Project will meet the criteria for issuance of an ITP set forth in section 10(a)(2) of the ESA and the implementing regulations, 50 Code of Federal Regulations (CFR) 17.22. Conservation actions and impact analyses for other non-federally listed bats and migratory birds are detailed in the Buckeye Wind Environmental Impact Statement (EIS) and Avian and Bat Protection Plan (ABPP; Stantec 2011a).

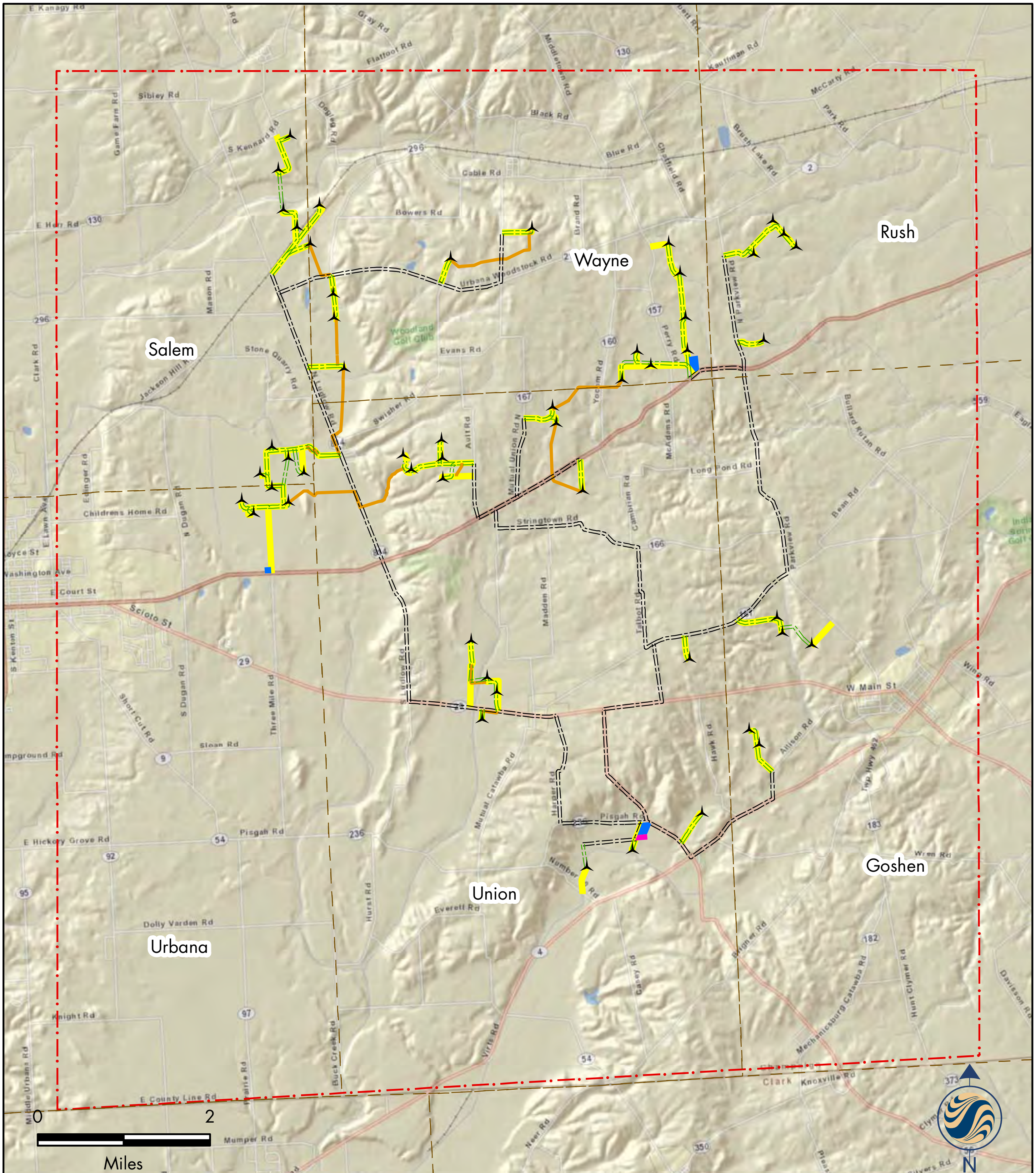
Summer resident Indiana bats are known to occur within the vicinity of the Project. Mist-netting conducted in Champaign County during summer 2009 for an unrelated project resulted in the capture of 5 Indiana bats in the current Action Area. Therefore, Buckeye Wind, together with the USFWS, has determined that actions associated with the Project have the potential to incidentally take Indiana bats, listed as federally endangered under the ESA. Indiana bats could be injured or killed by colliding with or coming in close proximity to operational turbines. Section 10 of the ESA allows for incidental take of ESA listed species through the completion of a USFWS-approved HCP and subsequent issuance of an ITP by the USFWS.

The Project will be situated within an approximately 32,395 hectares (ha; 80,051 acres [ac]) area that includes portions of Union, Wayne, Urbana, Salem, Rush, and Goshen Townships in Champaign County, OH (referred to hereafter as the Action Area; Figure 1-1). Within the Action Area, the permanent footprint (the area of permanent disturbance) for the entire Project will be no more than 52.5 ha (129.8 ac), or 0.16% of the total Action Area. Development of the Project will include installation of up to 100 wind turbine generators (turbines), each with a nameplate capacity rating of 1.6 megawatt (MW) to 2.5 MW, resulting in a total generating capacity of up to 250 MW. The Project will also include development of service roads, electricity collection lines, staging areas, and an operations and maintenance (O&M) facility. While only 52 turbine locations are known at this time, the HCP will address impacts to Indiana bats from the construction and operation of the full 100-turbine Project with expected lifespan of 30 years from construction through decommissioning (ITP Term; see Section 2.4 – ITP Duration). The location of the additional 48 turbines will not significantly change the net effect on the species and the level of authorized take described in this HCP will not be greater.

The design evaluated as the primary option in this HCP includes approximately 113.5 kilometers (km; 70.5 miles [mi]) of 34.5 kilovolt (kV) interconnect lines that are to be built above ground on rebuilt poles in existing public road right-of ways. The lines would be over-hung on poles used by the local electric utilities to distribute power to local residences and businesses. Buckeye Wind has identified a possible re-design of the Project collection system that would allow a more efficient infrastructure that would result in greater ease of construction but would not significantly change the net effect on the Indiana bat and would not result in a higher level of take described in this HCP. The potential redesign would move a portion of those lines to an underground system located on private land under easement ("Redesign Option"). This Redesign Option is under consideration and would require various state and local permits and amendments to those permits. As such, it is offered here as an optional Project design that would be implemented at Buckeye Wind's discretion. While the exact design is not known at this time, the Redesign Option would include 95.4 km (59.3 mi) of 34.5 kV interconnect lines. A maximum estimate of impacts for the 100-turbine Project with the Redesign Option is presented in this document. No turbine locations would be altered except as otherwise required as part of normal project micro-siting (see Section 7.3.2 – Additional Turbines). Throughout this document, impacts associated with the Redesign Option are presented where applicable. Unless indicated otherwise, the impacts and discussion in this HCP would apply to either collection system design that is contemplated.

It is anticipated that development of the 100-turbine project will include the following (also see Table 2-1):

- 64.4 km; (40.0 mi) of new service roads that will connect wind turbines to existing access roads;
- 113.5 km (70.5 mi) of 34.5 kV electrical interconnect lines that will connect individual turbines to the substation, of which,
    - 56.7 km (35.2 mi) will be installed underground with the majority (approximately 84%) installed parallel to Project access roads, requiring no additional clearing or soil impacts beyond those required for access road construction, and
    - 56.8 km (35.3 mi) will be installed overhead in public road right-of-ways (mostly co-located with existing electric distribution facilities);
- Under the Redesign Option, there would be 95.4 km (59.3 mi) of 34.5 kV electrical interconnect lines that will connect individual turbines to the substation, of which;
    - 86.4 km (53.7 mi) will be installed underground with about 32% installed parallel to Project access roads.
    - 9.0 km (5.6 mi) will be installed overhead;
- Temporary crane paths totaling approximately 22.7 km (14.1 mi);
- Up to 4 temporary construction staging areas, occupying a cumulative area of approximately 9.2 ha (22.9 ac);
- 1 substation that will allow connection with the existing transmission line, occupying an area of approximately 2.0 ha (5.0 ac);
- 1 O&M facility and associated storage yard (likely to be refurbishment of existing facility); and
- Up to 2 concrete batch plants occupying a cumulative area of 2.4 ha (6.0 ac).




Prepared For:

Buckeye Wind, LLC

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Legend:

- Proposed Turbines
- Township
- HCP Action Area
- Proposed Substation
- Staging Areas
- Buried Inteconnect
- Overhead Interconnect
- Crane Paths
- Access Roads

Source: Buckeye Wind, LLC

Figure: 1-1

# BUCKEYE WIND PROJECT ACTION AREA AND COMPONENTS

Areas where trees will be temporarily or permanently removed are anticipated to comprise approximately 6.5 ha (16.1 ac) for the 100-turbine Project, or 0.2% of the 2,744 ha (6,779 ac) of forested habitat available in the Action Area (6.8 ha [16.8 ac] for the Redesign Option)[1].

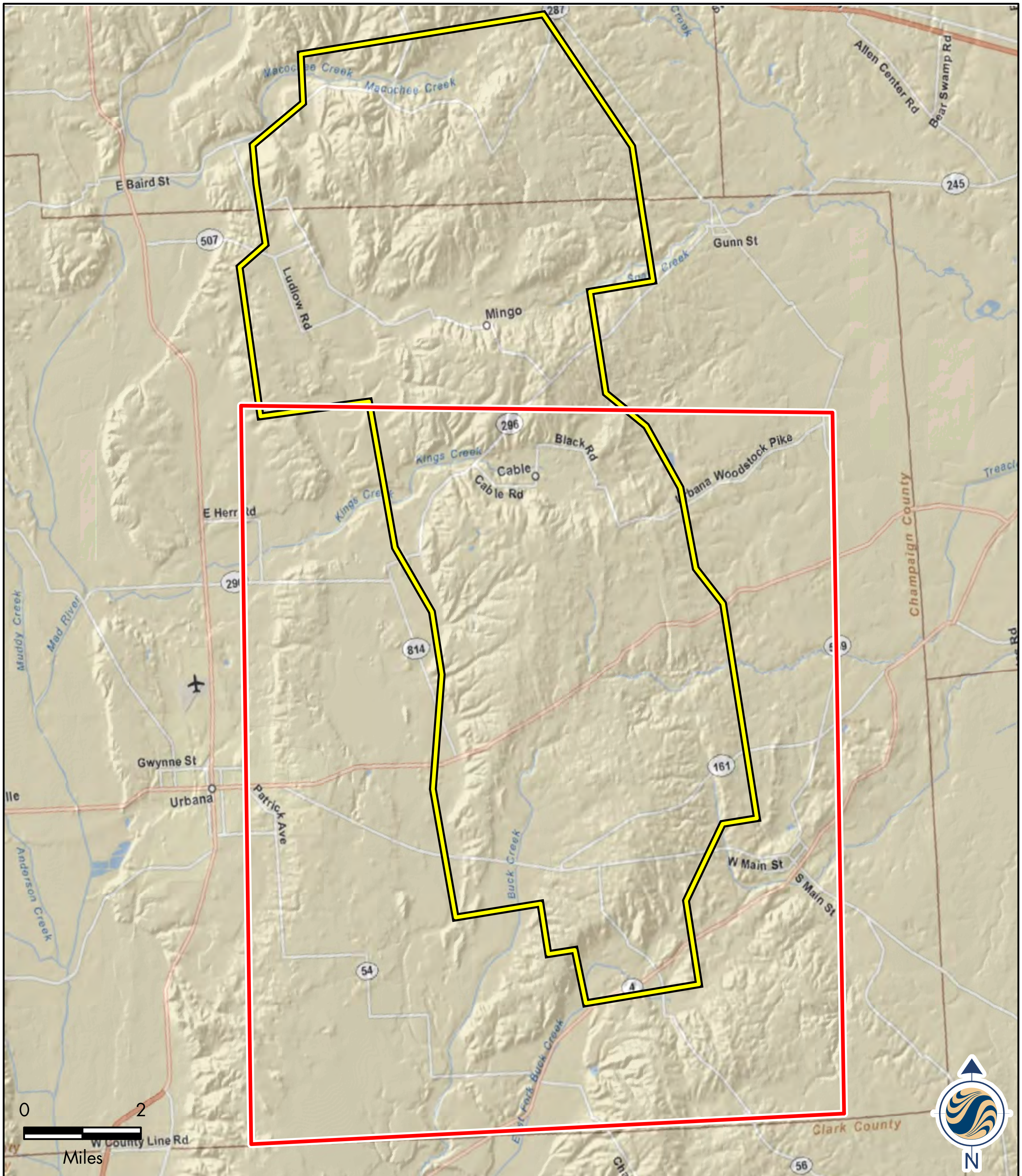
Actions associated with the Project (i.e., Covered Activities; see Section 2.3 – Covered Activities) have the potential to incidentally take Indiana bats, listed as federally endangered under the ESA. Indiana bats could be injured or killed by colliding with or coming in close proximity to operational turbines. Additionally, suitable Indiana bat habitat will be impacted during construction activities. Direct effects of habitat loss will be completely avoided and any indirect effects are expected to be insignificant and discountable and will not constitute "take" (i.e., killing, harming, or harassing) under Section 9 of the ESA (16 USC 1538). A full assessment of the potential impacts of the Covered Activities is included in Chapter 5 of this document. Section 10 of the ESA allows for incidental take of ESA listed species through the completion of a USFWS-approved HCP and subsequent issuance of an ITP by the USFWS.

Besides the general issuance criteria listed in 50 CFR 13.21(b), an HCP must fulfill the following requirements as established under 50 CFR 17.22(b)(2)(i): "(A) The taking will be incidental; (B) The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such takings; (C) The applicant will ensure that adequate funding for the conservation plan and procedures to deal with unforeseen circumstances will be provided; (D) The taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild; (E) The measures if any, required under paragraph (b)(1)(iii)(D) of this section will be met; and (F) He or She [the Director] has received such other assurances as he or she may require that the plan will be implemented."

Activities covered by an ITP must also not result in adverse modification of "critical habitat", in accordance with Section 7 of the ESA. Critical habitat consists of "the specific areas within the geographical area occupied by the species, at the time it is listed … on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection" (§ 1532 (5)(A)(i)). No designated critical habitat for Indiana bats or other ESA listed species exists within the Action Area.

Though no known Indiana bat hibernacula are located within the Action Area, summer resident Indiana bats are known to occur within the Action Area and vicinity. Bat mist-netting surveys were conducted in the summer of 2008 within an area that included the current Action Area in Champaign County and an area to the north extending into Logan County ("initial study area"; see Figure 1-2). These surveys documented the presence of Indiana bats approximately 7.8 km (4.8 mi) to the north of the current Action Area. Two reproductive adult female and 1 non-reproductive adult male Indiana bats were captured as part of the 2008 survey. The initial study area was revised to be at least 8 km (5 mi) from the 2008 Indiana bat capture and roost locations and then further expanded, creating the current Action Area. The current Action Area also avoids caves supporting other species of bats (not Indiana bats) during hibernation (see Section 3.2.3 – Pre-Construction Bat Surveys Conducted).

[1] Note that much of this area is located along the edges of woodlots or along thin/sparse tree lines separating parcels, resulting in a conservative estimate. Avoidance and minimization measures described in Section 6.0 will likely reduce the area of tree removal to less than the estimated 6.5 ha (16.1 ac), or 6.8 ha (16.8 ac) for the Redesign Option, based on construction needs, landowner preference, and quality of habitat.

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Legend:

Action Area

Initial Study Area

Figure: 1-2

BUCKEYE WIND POWER INITIAL STUDY AREA AND ACTION AREA

Mist-netting conducted in Champaign County during summer 2009 for an unrelated project resulted in the capture of 5 Indiana bats in the current Action Area. Of those 5 Indiana bats, 3 adult female Indiana bats and 1 Indiana bat of unknown sex (it escaped the net before identification was completed) were captured in the same mist-net on a single night in the northernmost portion of the Action Area. The 3 females were radio-tracked to determine their roost locations and home ranges. Based on roost tree use, all 3 females were determined to be from the same maternity colony. The area encompassing the home ranges of all 3 females comprised approximately 3% of the total Action Area size. An additional adult female was captured in summer 2009 in the central portion of the Action Area and was tracked to her roost tree located outside of the Action Area, approximately 2.3 km (1.5 mi) to the east of the eastern boundary.

In addition to the 8 Indiana bats captured in 2008 and 2009 in southern Logan and Champaign Counties, an additional 18 adult Indiana bats (17 females and 1 male) were captured during summer mist-netting surveys during 2008 and 2009 outside of the Action Area in nearby northern Logan and Hardin Counties, OH. Based on simultaneous emergence counts conducted at known Indiana bat roost trees within or near the Action Area, a minimum Indiana bat population size of 99 individuals was documented in summer 2009 (See Appendix A, Section 2.1.1). Using a combination of these site-specific, empirical data, models predicting and quantifying suitable habitat within the Action Area, and conservative assumptions based on relevant literature and professional judgment, the number of Indiana bats estimated to use the Action Area during summer ranged from 10.1 to 2,271.4 Indiana bats (details of analysis included in Appendix A).

In addition to their known presence in the Action Area during the summer maternity season (approximately 1 Jun to 31 Jul), Indiana bats are presumed to fly through the Action Area during migration in spring (approximately 1 Apr to 31 May) and fall (approximately 1 Aug to 31 Oct) as they travel to and from hibernacula. Based on data from 2009 hibernacula surveys compiled by the USFWS and assumptions based on relevant literature and professional judgment, approximately 5,800 Indiana bats are estimated to fly through the Action Area during spring and fall migration (details of analysis included in Appendix A).

Steps taken by Buckeye Wind to avoid and minimize impacts to Indiana bats include early and ongoing consultation with the USFWS and the Ohio Department of Natural Resources Division of Wildlife (ODNR DOW), pre-construction planning, and multiple years of pre-construction field studies. Based on 2008 pre-construction mist-netting, Buckeye Wind adjusted the Project boundary to avoid an area of known Indiana bat use. Buckeye Wind incorporated the recommendations of resource agencies and the findings of on-site field studies into the design, construction, and decommissioning plan to minimize and avoid impacts to Indiana bats, as well as other birds and non-federally listed bats and their habitats. For example, included in this HCP are provisions for restricting tree clearing to the non-active period (1 Nov to 31 Mar) for Indiana bats, avoiding impacts to wetland areas, avoiding and minimizing impacts to streams where possible, and siting turbines largely in agricultural areas that require minimal tree clearing. During construction, a Natural Resource Specialist[2] knowledgeable on Indiana bats and their habitat requirements will be present at the time of tree clearing and any potential roost trees observed within the clearing zone will be flagged. Prior to finalization of the detailed design of Project components, Buckeye Wind will make all reasonable efforts to offset the clearing radii around turbines or adjust roads/interconnects to preserve potential roost trees that have been flagged. Additionally, Buckeye Wind has worked with the USFWS to

[2] The Natural Resource Specialist will serve various roles during project construction, including monitoring for Indiana bat, breeding bird, and massasagua rattlesnake habitat and resources. Throughout the HCP, the functions and roles of the the Natural Resource Specialists is described. The functions of the Natural Resource Specialist will be filled by one or more biologists qualified in the specific tasks decribed and approved by the USFWS and the ODNR DOW.

conduct a field habitat assessment characterizing the quality of these areas for Indiana bat foraging and roosting activities and identifying potential roost trees.

As a result of effective avoidance and minimization efforts by Buckeye Wind during siting, construction, maintenance and decommissioning, operation of the Project is the only activity covered by this HCP that is expected to result in take of Indiana bats. As such, the primary method to minimize impacts to Indiana bats will be turbine feathering, whereby the wind speed at which turbines begin rotating and producing power (i.e., the cut-in speed) is increased from the manufacturer's specified cut-in speed (e.g., 3.0 meters per second [m/s]; 6.7 miles per hour [mph]). For the purposes of this HCP, the term "feathering" or "feathered" will be used to indicate conditions whereby turbine cut-in speed is increased above the manufacturing cut-in speed, and turbines are not rotating below the increased cut-in speed. In contrast, "curtailing" or "curtailment" will refer to turbines whose cut-in speed is increased above the manufacturing cut-in speed, but turbine blades may still rotate to some degree below the increased cut-in speed.

Operational adjustments will vary according to seasonal patterns of Indiana bat activity and based on patterns of mortality documented in bat mortality studies at wind facilities across the United States. Because there have been very few documented Indiana bat fatalities due to collision with wind turbines, it is hypothesized that Indiana bat mortality patterns will follow general seasonal patterns seen across all bat species. As such, there will be 3 periods that will have unique feathering strategies (collectively, the "active period"):

- Spring emergence and migration, or "spring" (1 Apr to 31 May);
- Summer habitat use, or "summer" (1 Jun to 31 Jul), and
- Late summer and fall migration, or "fall" (1 Aug to 31 Oct).

Initially, feathering will be applied to turbines using variable cut-in speeds, with the most restrictive cut-in speeds applied to turbines and to seasonal periods that are expected to present the greatest risk to Indiana bats (see Section 6.2.3 – Feathering Plan Phases).

Seasonal Indiana bat mortality from collision with turbines or barotrauma (i.e., tissue damage to lungs caused by rapid or excessive pressure changes formed in the wake of rotating turbine blades) was estimated using a collision risk model (Appendix A). The model used empirical data, relevant literature, expert opinion, and professional judgment to inform assumptions about Indiana bat flight height, activity under certain temperatures and wind speeds, potential movement through the turbine array, and survival probability. For the full 100-turbine Project, annual mortality of Indiana bats from collision with turbines and/or barotrauma, without feathering, was estimated to range from 6.9 Indiana bats to 25.4 Indiana bats per year, with 51% to 65% of mortality expected to occur during the fall migration period.

Reductions in bat mortality observed over 2 years in the operational adjustment study conducted at the Casselman wind facility in PA indicated that feathering at 5.0 and 6.5 m/s would reduce bat mortality to between 44% and 93% of that at turbines operating at the manufacturer's specified cut-in speeds (Arnett et al. 2010). Data from a study conducted at the Fowler Ridge wind facility in IN indicated that curtailing up to 5.0 m/s would reduce bat mortality to between 38% and 68% of that at turbines operating at the manufacturer's specified cut-in speeds, and curtailing up to 6.5 m/s would reduce bat mortality to between 71% and 85% (Good et al. 2011). Since Buckeye Wind proposes to use similar cut-in speeds as those used in the Casselman and Fowler Ridge studies, employing operational feathering at the Buckeye Wind Project is expected to reduce Indiana bat mortality to between 0.5 Indiana bat and 14.2 Indiana bats per year, with an average take of 5.2 Indiana bats per year (see Section 5.1.2.5.3 – Estimated Take With Feathering).

To account for this uncertainty in estimated take, as well as fluctuations in annual mortality resulting from natural stochasticity, this HCP proposes that multi-year levels of take be authorized over the ITP Term. Accordingly, the average annual mortality estimated by the collision risk model was used to develop 5-year and 25-year take limits. A maximum level of mortality of 26.0 Indiana bats is proposed for the mortality authorized under the ITP over any 5-year period, and 130 individuals taken over the ITP Term (see Section 5.1.2.5.3 – Estimated Take with Feathering). While annual take levels provide a benchmark for the monitoring of take and will enable implementation of adaptive management actions to appropriately reduce annual take, the 5-year limit is expected to more closely reflect the average annual mortality that will result from the Project (i.e., 5.2 Indiana bats on average per year). If estimated take exceeds 5.2 Indiana bats in any given year, Buckeye Wind will implement adaptive management as outlined in Section 6.5 – Monitoring and Adaptive Management.

To mitigate for take of Indiana bats that cannot be avoided, Buckeye Wind will dedicate funds to compensate for the impacts of the take to be used for habitat restoration and preservation to enhance the reproductive potential and survival probability of Indiana bats or purchase credits from a USFWS approved Indiana bat mitigation bank. Based on best available information, it is estimated that preservation and enhancement of 87.8 ha (217.04 ac) of habitat within 11.2 km (7 mi) of a Priority 2 Indiana bat hibernaculum in OH will effectively mitigate for take of 130.0 Indiana bats over the ITP Term (see Section 6.3 – Mitigation Measures for more details).

Because there is a lack of information regarding risk to Indiana bats from collision and/or barotrauma, there is a need for research on Indiana bat-wind interaction to be conducted at wind facilities. Filling these data gaps will help ensure that future avoidance, minimization, monitoring and mitigation measures are as effective as possible. To help fill these data gaps, Buckeye Wind will provide funding for the implementation of conservation measures that will increase scientific knowledge regarding Indiana bat behavior as it relates to wind power. This will serve to reduce uncertainty and increase the effectiveness of minimization techniques applied to the Project and potentially other wind power projects (See Section 6.4 – Conservation Measures).

This HCP includes monitoring and adaptive management plans that will provide a mechanism to ensure all biological goals and objectives are met by: 1) ensuring that the authorized level of Indiana bat take is not exceeded, 2) evaluating the effectiveness of feathering and minimization techniques, and 3) ensuring success of mitigation. Adaptive management will allow effective management decisions to be made in the face of uncertainty by refining minimization measures over time, as understanding about impacts to Indiana bats from the Project increases.

## 1.2 Biological Goals and Objectives of the HCP

The biological goals of an HCP are the broad, guiding principles for the operating conservation program and the rationale behind minimization and mitigation strategies. The biological objectives of an HCP are the different components or measurable targets needed to achieve the biological goals.

While this HCP is not required to result in the recovery of an ESA-listed species or contribute to the recovery objectives outlined in the *Indiana Bat (Myotis sodalis) Draft Recovery Plan: First Revision* (hereafter 2007 Draft Recovery Plan; USFWS 2007), both the biological goals and objectives of this HCP will be consistent with actions to promote the recovery of the Indiana bat as identified in the 2007 Draft Recovery Plan and the HCP will not preclude recovery of the species.

In order for the USFWS to approve this HCP, the USFWS must determine that the HCP meets issuance criteria listed in Section 10(a)(2) of the ESA (see Section 1.4.1 – Federal Endangered Species Act). Two of the statutory criteria are that the take resulting from the proposed activity, as described in the HCP, will not appreciably reduce the likelihood of survival and recovery of the species in the wild, and that the Applicant will minimize and mitigate to the maximum extent practicable the impacts of the taking. The biological goals and objectives will be used to help translate the statutory and regulatory criteria or standards into meaningful biological measures, specific to this particular HCP situation and in a manner that will facilitate monitoring (Notice of Availability of a final Addendum to Handbook for HCP, 65 Federal Register [Fed. Reg.] 35242, June 1, 2000).

The biological goals of this HCP are to minimize take of Indiana bats to the maximum extent practicable and to promote the health and viability of Indiana bat populations both locally and in the Midwest Recovery Unit (RU)[3]. The biological objectives that will be implemented to achieve these goals are:

Objective 1: Implement an operational feathering strategy that will limit mortality of Indiana bats due to collision with turbines or barotrauma resulting from near collisions with moving blades to no more 26 Indiana bats over any 5-year period beginning in any year in which more than the Expected Average Mortality of 5.2 Indiana bats is estimated[4], and not more than 130.0 Indiana bats over the 30-year ITP Term;

Objective 2: Mitigate for the impacts of the incidental taking of 130.0 Indiana bats over the 30-year ITP Term through the purchase or easement acquisition and subsequent restoration and/or enhancement (if necessary), with permanent preservation, of 87.8 ha (217.0 ac) of suitable Indiana bat habitat within 11.2 km (7 mi) of a Priority 2 Indiana bat hibernaculum in OH, or purchase credits from a USFWS approved Indiana bat mitigation bank (see Section 6.3 – Mitigation Measures for more details);

Objective 3: Enhance understanding of the factors that contribute to increased risk of Indiana bat collisions and barotrauma resulting from near collisions with moving blades and tailor the conservation program to meet the biological goals. Specific factors that will be considered include:

- Seasonal variation in mortality;
- Variation in mortality with respect to turbine location and habitat; and
- Variation in mortality with respect to weather characteristics (wind speed, temperature, barometric pressure, and humidity).

Objective 4: Maximize operational output of the project, such that the environmental benefits of wind energy are maximized, thereby reducing potentially harmful effects of other energy

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[3] Based on information from band returns and genetic studies, the range of the Indiana bat has been divided into RUs, each representing a distinct Indiana bat population (USFWS 2007, see Section 4.4.3.2 – Migration Direction and Behavior). Since the Project is located in the Midwest RU, Project-related impacts are expected to occur in the Midwest RU. Therefore, discussion of the Indiana bat and Project impacts will focus on the Midwest RU in this HCP.

[4] The five year take limit can only be calculated beginning in the first year of above expected average take. In this way, the 130.0 lifetime take limit is assured and it avoids a situation where above expected average take in the 5$^{th}$ year of a 5-year period that has otherwise seen expected average take would result in violation of the 5-year take limit, with no opportunity for Adaptive Management.

products. In particular, increased generation from wind energy facilities will offset carbon emissions from other electric generation technologies. Carbon emissions contribute to global climate change, which has been identified as a potential risk to Indiana bats (USFWS 2007). Other environmental benefits are also associated with wind energy (see Section 1.3.1 – Fossil Fuel Offsets and Reductions, and Section 5.4 – Potential Beneficial Effects of Wind Energy on Indiana bats).

An in-depth discussion of the measures that will be used to meet these objectives, and the criteria that will be used to evaluate their success, will be provided in Section 6.0 – Conservation Program.

## 1.3 Purpose and Need for the Project

The purposes and needs of the Buckeye Wind Project are to:

- Develop a renewable source of energy to reduce the reliance on energy sources that emit carbon dioxide and that contribute to global climate change;
- This need has been legislated through Ohio's Alternative Energy Portfolio Standard (AEPS) and stipulated through Executive Order 13212 (dated 18 May 2001) and "Barack Obama and Joe Biden: New Energy for America" plan (Obama for America 2008);
- Provide a domestic source of energy that will help to increase energy security in OH and the United States;
- Cost-effectively generate ample, clean, renewable wind energy that will help meet the OH AEPS;
- Locate wind facilities in areas where adequate wind resources are available to make commercial wind development possible;
- Construct wind facilities with turbines of adequate size and number to be operated in a manner that allows them to be economically viable.

### 1.3.1 Fossil Fuel Offsets and Reductions

The atmospheric buildup of carbon dioxide and other greenhouse gases is largely the result of human activities, such as the burning of fossil fuels (Environmental Protection Agency [EPA] 2009a). In the United States, more than 90% of greenhouse gas emissions come from the combustion of fossil fuels, which has increased by approximately 40% in the last 150 years (i.e., since large-scale industrialization began). According to the EPA (2009a), scientists know with "virtual certainty" that increasing greenhouse gas concentrations are warming the planet and that rising temperatures may, in turn, produce changes in precipitation patterns, storm severity, and sea level, commonly referred to as "climate change."

According to the Intergovernmental Panel on Climate Change (IPCC) (2007), the earth's climate has warmed between 1.1° Fahrenheit (F) and 1.6°F over the past century, and most of the observed increase in globally averaged temperatures since the mid-20th century is "very likely due to the observed increase in anthropogenic greenhouse gas concentrations." Combustion of fossil fuels also produces air pollutants such as nitrogen oxides, sulphur dioxide, volatile organic compounds, and heavy metals. Of all fossil fuels used to provide electricity in the United States, coal has the highest carbon dioxide content per unit of electricity produced (United States Department of Energy, Energy Information Administration [DOE EIA] 2007). Approximately 71% of the United States' electricity is generated from fossil fuels, with 49% produced from coal. The state of OH depends heavily upon coal for its electrical generation. As shown in Table 1-1, OH relies more heavily on fossil fuels than the national average, with 86% of electricity generated from coal (Public Utilities Commission of Ohio [PUCO] 2008). Ohio was the fourth largest contributor of carbon dioxide emissions from fossil fuel combustion in the United States in 2007 (267.67 million metric tons), behind PA, CA, and TX (in increasing order; EPA 2009a).

**Table 1-1.** Percent of electric generation by energy source in OH (PUCO 2008).

| Energy generation source | Percent of OH fuel mix |
|---|---|
| Coal | 86 |
| Nuclear | 10 |
| Natural & other gases | 2 |
| Petroleum | 1 |
| Hydroelectric & other renewable | 1 |
| **Total** | **100** |

In addition to well documented negative environmental and health effects, fossil fuels generating facilities have higher operating costs due to the costly and changeable price of fuels (Jacobson and High 2008). Historically, oil prices have fluctuated based on ever-changing supply and demand, as well as political conditions in fuel-producing countries. Such instability increases the economic vulnerability of the United States and jeopardizes the ability of Americans to successfully carry out activities that are essential to their security and livelihood. Reducing the proportion of United States' energy portfolio that comes from fossil fuels would potentially reduce unpredictable energy cost fluctuations.

Electricity generated by the Project has the potential to displace electricity generated at fossil-fueled plants and thereby reduce energy production from inefficient and environmentally harmful sources of power. The emissions values shown in Table 1-2 are representative of potential fossil fuel emissions that could be displaced by a 250 MW wind power facility (assuming a 30% capacity factor and based on emissions rates for electricity used in OH).

**Table 1-2.** Estimated annual displacement (tons) of fossil fuels by the 100-turbine Buckeye Wind Project, Champaign County, OH (Abraxas Energy 2009, Leonardo Academy 2008).

| | **Estimated annual displacement in tons**[a] |
|---|---|
| **Pollutant** | **250 MW project 100 turbines (657,000 megawatt hours [MWh])** |
| $CO_2$ (carbon dioxide) | 593,600 |
| $NO_x$ (nitrogen oxides) | 2,267 |
| $SO_2$ (sulfur dioxide) | 5,223 |
| Mercury compounds | 5,283 |
| Lead compounds | 9,323 |

[a] This table is meant to approximate the potential emissions reductions from the project based on a typical capacity factor (30%) for the wind regime at the site. Depending on the final turbine selected, impacts of operational feathering, final capacity of turbines installed and other site-specific factors, the actual reductions could be more or less than those presented here. With the Feathering Plan proposed in this HCP, capacity factor is expected to be above 30% and therefore the numbers here can be considered a minimum estimate.

### 1.3.2 State and Federal Policies

Another important need for the Project is reflected in the OH AEPS, signed into law by Governor Strickland on 1 May 2008 (49 ORC 4928.64). The law mandates that by 2025, at least 25% of all electricity sold in OH comes from alternative energy resources. At least half of that standard, or 12.5% of electricity sold, must be generated by renewable resources[5], and at least half of this renewable energy must be generated in-state. Buckeye Wind anticipates selling the power to OH entities, helping to satisfy the AEPS. Regardless of where and to whom the power is sold, the Project's power will provide renewable energy benefits to the environment and offset fossil fuel emissions. In addition, the project will provide an economic boost to the region, creating jobs and investment in the surrounding communities (see discussion in the EIS).

Federal policy also has promoted increased renewable energy generation in the United States. The Project is consistent with Executive Order 13212 (dated 18 May 2001), which states:

> "The increased production and transmission of energy in a safe and environmentally sound manner is essential to the well being of the American people. In general, it is the policy of this Administration that executive departments and agencies shall take appropriate actions, to the extent consistent with applicable law, to expedite projects that will increase the production, transmission, or conservation of energy."

The Obama-Biden administration affirms this goal within its comprehensive "Barack Obama and Joe Biden: New Energy for America" plan, which includes in its objectives the creation of 5 million new jobs over 10 years and ensuring that 10% of our electricity comes from renewable sources by 2012, and 25% by 2025 (Obama for America 2008). Consistent with these state and federal policies, the Project would help fulfill the need for the production and transmission of renewable energy, which would serve the public interest. The Project will maximize its energy production from wind resources in order to deliver clean, renewable, low cost electricity. The electricity generated by the Project will be transferred to the transmission grid operated by PJM Interconnection for sale in the wholesale market.

### 1.3.3 Project Viability

Quality of wind resource, proximity to the bulk power transmission system, and availability of land are the primary factors driving the initial site selection of any wind power project. In addition to these factors, wind energy facilities also require an adequate number of appropriately-sized turbines to produce sufficient power to provide an economic return. The manner in which these turbines are operated also affects a wind facility's economic viability; increases to the manufacturer's specified cut-in speeds can impact annual power production and revenue.

## 1.4 Regulatory and Legal Framework

### 1.4.1 Federal Endangered Species Act

Section 9 of the ESA in 50 CFR Section 17.31(a) prohibits take of any fish or wildlife species listed as endangered or threatened under the ESA unless an exemption is granted under Section 7 or Section 10 of the ESA or a special rule is promulgated for a threatened species under Section 4(a) of the ESA and 50 CFR § 17.40 to 17.48. Take is defined under the ESA as "to harass, harm, pursue, hunt, shoot, wound, kill,

[5] The additional 12.5% of the overall 25% standard can also be met through alternative energy resources such as third-generation nuclear power plants, fuel cells, energy efficiency programs, and clean coal technology that can reduce or prevent carbon dioxide emissions.

trap, capture, or collect" listed species (16 U.S.C. § 1532(19)). Harm, in this case, means an act that actually kills or injures wildlife and may include significant habitat modification or degradation that "actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering" (50 CFR 17.3). To harass means to perform an "intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (50 CFR 17.3).

Section 7(a)(2) of the ESA states that each federal agency shall ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of ESA listed species or result in destruction or adverse modification of designated critical habitat (16 U.S.C. §1536 (a)(2)). A federal action is defined as "…all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas" (50 CFR § 402.02). Actions of federal agencies that are not likely to jeopardize the continued existence of ESA listed species or result in destruction or adverse modification of their designated critical habitat, but that could adversely affect the species, or result in a take, must be addressed under Section 7 (16 U.S.C. §1536 (a)(2)).

Section 10 of the ESA allows, under certain terms and conditions, for the incidental take of ESA listed species by non-federal entities that would otherwise be prohibited by Section 9 of the ESA. Incidental take is defined by the ESA as take that is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity" (16 U.S.C. §1539(a)(1)(B)). Under Section 10, incidental take may be approved through the successful completion of a USFWS-approved HCP that demonstrates that the impacts of incidental take have been minimized and mitigated to the maximum extent practicable. Incidental take may be permitted through the issuance of an ITP if the following 6 criteria of 50 CFR 17.22(b)(2) and 50 CFR 17.32 (b)(2) are met.

- All takings must be incidental;
- Impacts of such taking must be minimized and mitigated "to the maximum extent practicable;"
- There must be both adequate funding for the plan and provisions to address "unforeseen circumstances;"
- The taking must "not appreciably reduce the likelihood of the survival and recovery of the species in the wild;"
- The Applicant must ensure that additional measures required by the Secretary will be implemented; and
- Federal regulators must be assured that the HCP can and will be implemented.

An ITP can only be issued if the HCP addresses all of these requirements. Per 50 CFR 17.22 (b) (1), in order to demonstrate that all 6 requirements have been adequately addressed, the HCP must document and describe:

- Impacts likely to result from the proposed taking of the species for which ITP coverage is requested;
- Measures the Applicant will undertake to monitor, minimize, and mitigate such impacts;
- Funding that will be made available to undertake such measures;
- Procedures to deal with unforeseen circumstances;
- Alternatives the Applicant considered that would not result in incidental take, and the reasons why such alternatives are not being utilized; and
- Other necessary and appropriate measures the USFWS may require as necessary or appropriate for purposes of the plan.

The issuance of an ITP is a federal agency action under Section 7(a)(2) of the ESA; therefore, USFWS must comply with the requirements of Section 7. In order to issue an ITP, the USFWS is required under Section 7 of the ESA to prepare a Biological Opinion (BO) that evaluates the impacts of the proposed action (i.e., issuance of an ITP) and establishes an overall effect determination. Section 7 of the ESA requires that analysis of the direct and indirect effects of a proposed action, the cumulative effects of other future non-Federal activities within the Action Area, and effects of the action on critical habitat demonstrate that the authorized action "is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification" of designated critical habitat (16 U.S.C. §1536(a)(2)).

In addition to these necessary HCP elements, the Five-Point Policy (65 Fed. Reg. 35242-35257, June 1, 2000), an addendum to the *Habitat Conservation Planning and Incidental Take Permit Processing Handbook* (USFWS and National Oceanic and Atmospheric Administration [NOAA] 1996) describes 5 clarifying components that should be included in an HCP. Each of these HCP elements is discussed briefly in the sections below.

**Biological Goals and Objectives**

According to the Five-Point Policy, HCPs should include a clear description of the biological goals of the plan, including the broad guiding principles and the rationale behind strategies for minimization and mitigation. The desired outcome for species covered under the HCP and their habitat will be described in terms of the objectives to be achieved through implementation of the HCP. For each biological goal, the specific biological objectives must be described in terms of measurable targets for achieving the goals in the HCP (USFWS and NOAA 1996).

**Adaptive Management**

Adaptive management is a process of iterative decision making, with the aim to reduce uncertainty over time through monitoring. Thus, adaptive management is a method for examining alternative strategies that can be used to meet measurable biological goals and objectives, and if necessary, altering future management actions based on what has been learned (USFWS and NOAA 1996).

The Five-Point Policy encourages the development of an adaptive management plan for the HCP that identifies the uncertainty inherent in the HCP's existing assumptions, develops experimental strategies to answer questions relating to that uncertainty, and integrates information from a monitoring program into future management actions. This creates an information feedback loop that links implementation and monitoring to a decision making process about appropriate changes in management. This adaptive management strategy should ultimately achieve the biological goals of the HCP (USFWS and NOAA 1996).

**Monitoring**

Monitoring is a mandatory component of all HCPs under the Five-Point Policy. The monitoring plan must describe how compliance with the HCP will be evaluated, identify how biological goals and objectives of the HCP will be met, and provide information that will inform the adaptive management strategy (USFWS and NOAA 1996).

**ITP Duration**

The Five-Point Policy specifies that HCPs should clearly define the desired duration the ITP will be in effect and include a discussion about the factors considered in determining the length of the ITP. In making its decision as to the appropriate ITP duration, the USFWS will consider the expected positive and negative effects on species covered under the HCP, the length of time necessary to implement and achieve the benefits of the operating HCP, the availability and quality of scientific and commercial data used to develop the HCP, and the extent to which the HCP incorporates adaptive management strategies (USFWS and NOAA 1996).

**Public Participation**

The Five-Point Policy expanded the public comment period for most HCPs. The addendum indicates that most HCPs will be provided to the public for a 60-day comment period, but that large, complex HCPs require a 90-day public comment period (USFWS and NOAA 1996).

### 1.4.2 National Environmental Policy Act

The issuance of an ITP by the USFWS constitutes a federal action subject to National Environmental Policy Act (NEPA) compliance and review (42 USC §§ 4321-4347, as amended). The purpose of NEPA is to ensure that the potential environmental impacts of any proposed federal action are fully considered and made available for public review. The scope of the NEPA analysis considers the effects of proposed and alternative actions on the human environment, which includes biological resources as well as non-biological resources, such as water quality, air quality, and cultural resources.

To evaluate the environmental effects of a proposed action, the USFWS typically prepares and provides for public review an Environmental Assessment (EA). If the USFWS finds that significant impacts to the human environment are not expected as a result of the proposed action, then a Finding of No Significant Impact (FONSI) is issued. If significant impacts are anticipated, then a comprehensive EIS is prepared and distributed for public review. After the USFWS completes their review of an EA/FONSI or EIS, they issue a Record of Decision of their findings. The USFWS can issue an ITP only after the NEPA review process has been completed.

### 1.4.3 State Endangered Species Legislation

Ohio Revised Code (RC) 1531.25 grants the chief of the ODNR DOW, with the approval of the wildlife council, the authority to adopt rules, modify and repeal rules restricting the taking or possession of native wildlife that is threatened with state-wide extinction. These rules may only provide for the taking of species for zoological, educational and scientific purpose, and for propagation in captivity to preserve the species. In OH, animals and plants listed as threatened or endangered receive regulatory protection under RC § 1518.01–99; 1531.25, 1531.99. At this time, the ODNR DOW does not have the explicit authority to authorize take for any listed-species, including Indiana bats, for commercial or business purposes such as the construction and operation of the Project.

### 1.4.4 Major Utility Facility Review

The OPSB has regulatory authority over all proposed wind power projects in OH capable of generating 5 or more MW of electricity. Prior to issuance of a Certificate of Environmental Compatibility and Public Need (CECPN) by the OPSB, wind developers must demonstrate that their wind facility complies with a variety of requirements to ensure that potential impacts to the human environment, including natural resources, have been adequately addressed. The Project has already received conditional CECPN for the first 52 turbines.

A separate OPSB application for a Certificate for Environmental Compatibility and Public Need (CECPN; see Section 1.4.4 – Major Utility Facility Review) has been submitted for the Buckeye II Wind Project (see Section 2.1 – Applicant Background and Project History). This application has been submitted by Champaign Wind LLC, a seperate EverPower subsidiary. Construction of any of the additional turbines will not commence until the CECPN for Buckeye II Wind Project is issued. Due to the timelines for developing the OPSB application and HCP and uncertainty of the outcome of the CECPN process, the level of detail provided in the OPSB application and HCP are not identical. However, ample information has been included in this HCP to adequately assess the potential impacts to the Indiana bat (see Chapter 5.0 – Impact Assessment) from the full 100-turbine Project. The assessment in the HCP includes a reasonable worse case estimate of possible impacts for the 100 turbine Project and all 100 turbines will be constructed within the Action Area described in the HCP. The additional turbines, as described in the Buckeye II Wind Project OPSB application, will not result in a greater impact to the Indiana bat than what is described and analyzed in this HCP.

Buckeye Wind will fully comply with all commitments, terms, and conditions associated with the CECPN issued for the first 52 turbines and any future CECPN that may be issued for the Buckeye II Wind Project.

### 1.4.5 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) of 1918 decreed that all migratory birds and their parts (including eggs, nests, and feathers) were fully protected (16 U.S.C. 703). A migratory bird is any individual species or family of birds that crosses international borders at some point during their annual life cycle to live or reproduce. The MBTA implements 4 treaties that prohibit take, possession, transportation, and importation of all migratory, native birds (plus their eggs and active nests) occurring in the wild in the United States except for House Sparrow, European Starling, Rock Pigeon, any recently listed unprotected species in the Federal Register and non-migratory upland game birds, except when specifically authorized by the USFWS. In total, more than 1,000 bird species are protected by the Act, 58 of which can be legally hunted with a permit as game birds. The MBTA addresses take of individual birds, not population level impacts. Failure to comply with the MBTA can result in criminal penalties.

Although the MBTA does not include a provision authorizing incidental take of migratory birds, the USFWS recognizes that some level of mortality of migratory birds at wind projects can occur even if all reasonable measures to avoid mortality are implemented (USFWS 2010a). The USFWS has and continues to provide wind power project developers guidance in making a good-faith effort to comply with the MBTA. The USFWS has indicated that the Department of Justice has exercised discretion in enforcing provisions of the MBTA regarding companies who have made good faith efforts to avoid the take of migratory birds. Buckeye Wind has developed an ABPP to address the MBTA.

### 1.4.6 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (BGEPA) affords specific legal protection to bald eagles and golden eagles. Under this Act, it is a violation to "…take, possess, sell, purchase, barter, offer to sell, transport, export or import, at any time or in any manner, any bald eagle commonly known as the American eagle, or golden eagle, alive or dead, or any part, nest, or egg, thereof…." This Act defines take as pursuing, shooting, shooting at, poisoning, wounding, killing, capturing, trapping, collecting, molesting, and disturbing. "Disturb" is defined in regulation 50 CFR 22.3 as "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle, (2) a decrease in its productivity by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

In fall 2009, USFWS implemented 2 rules (50 CFR 22.26 and 22.27) authorizing limited legal take of bald and golden eagles "when the take is associated with, but not the purpose of an otherwise lawful activity, and cannot practicably be avoided" (USFWS 2010). Failure to comply with the BGEPA can result in criminal penalties.

Although take permits may be issued under these new rule, Buckeye Wind is not seeking a "non-purposeful eagle take" permit under the BGEPA at this time since the Project is not expected to result in activities that would incidentally take (harm or harass) eagles (refer to Section 5.7 of the EIS and Section 4.1.5.1 of the ABPP for further details on eagle use in the Action Area).

# 2.0 PROJECT DESCRIPTION

## 2.1 Applicant Background and Project History

Buckeye Wind was created for the purpose of developing, constructing, owning, and operating a new wind generation facility in Champaign County, OH, and is a wholly owned subsidiary of EverPower. EverPower has become a leader in the renewable energy industry by partnering with local landowners and communities to maximize the environmental and economic benefits of generating renewable, clean, wind power. With offices in New York City, NY, Pittsburgh, PA, and Bellefontaine, OH (and field representatives in other locations) and over 1,500 MW of wind power projects under development across the country, EverPower's development team has experience in all aspects of financing, constructing, managing, and operating large wind power projects. The Project was the first application submitted to the OPSB for a large-scale commercial wind powered electric generation facility in OH.

The Project has been in the planning and development phase since 2006. Acquisition of land rights for the Project began in 2006 and continued through early 2009. Over 60 private landowners are voluntarily participating in the Project. A public information meeting was held on 28 June 2008 at Triad High School in North Lewisburg, OH, to facilitate public interaction with Buckeye Wind and expert consultants. Information on visual, aesthetic, and ecological studies and wind turbine technology were presented at the meeting. Pre-Application meetings with OPSB staff were conducted on 20 November 2008 and 23 February 2009. The OPSB Application for a CECPN for a 70-turbine facility was submitted by Buckeye Wind in April 2009 and a Certificate for 54 turbines was approved on 22 March 2010, conditional upon Buckeye Wind successfully obtaining an ITP for potential incidental take of Indiana bats, among other conditions.

Buckeye Wind proposes to construct and operate 100 turbines, although the locations of only 52 turbines and their associated infrastructure are currently known. During the OBSP evaluation process, 16 turbines were prohibited due to unresolved Federal Aviation Administration (FAA) obstruction violations and 2 additional turbines became unviable due to costs associated with collection line construction and operation. As a result, 18 turbines were omitted from the original OPSB Application layout and 52 turbines are currently certificated by the OPSB.

Champaign Wind LLC, a separate EverPower subsidiary, has initiated the OPSB application procedure for the Buckeye II Wind Project, consisting of approximately 56 turbines (no more than 100 total turbines will be constructed for the Buckeye Wind and Buckeye II Wind projects combined). The Buckeye II Wind Project will be transferred to Buckeye Wind prior to construction. A public information meeting for Champaign Wind LLC was held on 24 January 2012. Champaign Wind LLC's record of public interaction is available through the PUCO Docketing Information System[6].

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[6] http://dis.puc.state.oh.us/CaseRecord.aspx?CaseNo=12-0160-EL-BGN.

A separate OPSB application for a Certificate for Environmental Compatibility and Public Need (CECPN; see Section 1.4.4 – Major Utility Facility Review) has been submitted for the Buckeye II Wind Project (see Section 2.1 – Applicant Background and Project History). This application has been submitted by

Impacts to Indiana bats for a 100-turbine layout have been estimated by extrapolating from the known 52-turbine layout or from analyses conducted for a 70-turbine layout presented in the OPSB Application for a CECPN (see Section 1.4.4 – Major Utility Facility Review). As such, effects on Indiana bats presented in this HCP are evaluated using the data specific to the current 52-turbine layout plus a reasonable estimate for the remaining 48 turbines, resulting in evaluation of worst-case scenario effects for the full 100-turbine project presented in this HCP.

## 2.2 Project Components

Development of the Project will include installation of up to 100 turbines, each with a generating capacity of 1.6 MW to 2.5 MW. Based on an analysis of the wind resource data measured at the site, the Project is expected to operate at an average annual capacity factor of about 30%, resulting in approximately 657,000 MWh of electricity generation per year. In addition to turbines, the Project will include construction of access roads, underground and overhead electricity collection lines, a substation, up to 4 temporary construction staging areas, and an O&M facility (Figure 1-1 depicts the project layout for the known 52 turbines and associated facilities). The energy generated by the Project will collect to a substation and be delivered to an existing transmission line in Union Township in Champaign County. Each of these Project components is described in the following sections.

**Table 2-1.** Impact assumptions and calculations based on a 100-turbine layout and associated components of the Buckeye Wind Project[A], Champaign County, Ohio (EDR 2009).

| Components | Typical area of vegetation clearing | Area of soil disturbance (temporary and permanent) | Area of permanent disturbance (fill/structures) |
|---|---|---|---|
| Wind turbines and workspaces (100) | 61 m (200 ft) radius per turbine | 61 m (200 ft) radius per turbine | 0.08 ha (0.2 ac) pedestal plus crane pad |
| Access roads (64.4 km [40.0 mi]) | 16.8 m (55 ft) wide | 12.2 m (40 ft) wide | 6.1 m (20 ft) wide |
| Buried electrical interconnects (except where located parallel to access roads) (56.7 km [35.2 mi], 86.5 km [53.7 mi] with Redesign Option) | 7.3 m (25 ft) wide | 7.3 m (25 ft) wide | None |

Champaign Wind LLC, a seperate EverPower subsidiary. Construction of any of the additional turbines will not commence until the CECPN for Buckeye II Wind Project is issued. Due to the timelines for developing the OPSB application and HCP and uncertainty of the outcome of the CECPN process, the level of detail provided in the OPSB application and HCP are not identical. However, ample information has been included in this HCP to adequately assess the potential impacts to the Indiana bat (see Chapter 5.0 – Impact Assessment) from the full 100-turbine Project. The assessment in the HCP includes a reasonable worse case estimate of possible impacts for the 100 turbine Project and all 100 turbines will be constructed within the Action Area described in the HCP. The additional turbines, as described in the Buckeye II Wind Project OPSB application, will not result in a greater impact to the Indiana bat than what is described and analyzed in this HCP.

**Table 2-1.** Impact assumptions and calculations based on a 100-turbine layout and associated components of the Buckeye Wind Project[A], Champaign County, Ohio (EDR 2009).

| Components | Typical area of vegetation clearing | Area of soil disturbance (temporary and permanent) | Area of permanent disturbance (fill/structures) |
|---|---|---|---|
| Overhead electrical interconnects (maximum of 1,000 poles, 200 poles with Redesign Option) | clearing restricted to existing right-of-ways | < 0.01 ha (.03 ac) per pole | 0.00008 ha (0.0002 ac), .00002 ha (.00005 ac) for Redesign Option |
| Crane paths (22.7 km [14.1 mi]) | 16.8 m (55 ft) wide | 12.2 m (40 ft) wide | None |
| O&M building and associated storage yard (1) | 1.2 ha (3 ac) | 1.2 ha (3 ac) | 1.2 ha (3 ac) |
| Staging areas (up to 4) | 9.2 ha (22.9 ac) total | 9.2 ha (22.9 ac) total | None |
| Substation (1) | 2.0 ha (5 ac) | 2.0 ha (5 ac) | 2.0 ha (5 ac) |
| Permanent MET Towers (4) | 0.4 ha (1 ac) | < 0.01 ha (.03 ac) per tower | 0.0008 ha (0.002 ac) |
| Concrete batch plant (2) | 1.2 ha (3.0 ac) per plant | 1.2 ha (3.0 ac) | None |
| **Total Impacts for 100-turbine Project** | | **220.9 ha (545.8 ac), or 219.9 ha (543.6 ac) for Redesign Option** | **52.2 ha (128.9 ac), or 52.5 ha (129.8 ac) for Redesign Option** |

[A] The impact assumptions here are given as approximate or average values. The actual impact for a particular component or portion of the Project will depend on site specific factors. The maximum total Project impact is given in this table and in more detail in Tables 5-14 and 5-15.

Construction of the Project will begin as soon as practicable upon issuance of the ITP. Construction of access roads, underground and overhead collection system lines, and concrete turbine foundations will begin first, followed by turbine erection. Timing of construction for the first 52 turbine locations and the subsequent 48 turbines will depend on a number of factors, including the OPSB certificate process, landowner negotiations and final Project planning. Table 2-1 presents construction impact assumptions for each Project component based on values observed from recently constructed wind projects and engineering needs (Environmental Design and Research [EDR] 2009). Concrete batch plants used for Project construction may use existing, developed facilities located off-site, which would require no new vegetative clearing or soil disturbance. If new batch plants are required within the Action Area, they will be located in previously disturbed or agricultural areas that will not impact trees, streams, wetlands or Conservation Reserve Program (CRP) land. Operation and permitting of the plant will be handled by the sub-contractor selected to supply the Project construction.

### 2.2.1 Turbines

The specific turbine model to be used for the Project has not yet been selected. Final selection depends on a number of factors including cost, performance, availability, wherewithal of the manufacturing, and other site specific factors. Recent trends in the supply market have made it more practicable and efficient to delay capital commitments (i.e., turbine purchase agreements) until later in the Project development process. Commercially available turbine models being considered for the Project are essentially uniform in terms of dimensions, appearance, and electrical output design. Any variation among turbine models selected for the

Project will be small to insignificant (i.e., ranging from approximately 2 meters [m] to 5 m [7 feet (ft) to 16 ft] difference in total height).

Although the final turbine model has not yet been selected, the Project description uses a generic turbine to illustrate the turbine design characteristics. The generic turbine model represents a reasonable estimate of the worst-case scenario in terms of potential mortality to Indiana bats based on post-construction monitoring data that suggest bat fatalities increase with increased turbine heights and/or greater rotor swept area (Johnson et al. 2003a, Johnson et al. 2004, Barclay et al. 2007, Fiedler et al. 2007). The generic turbine model includes the tallest turbine with the largest rotor swept area of those being considered for the Project and was used in the collision risk model (Appendix A) to estimate potential mortality to Indiana bats. While other turbines may have slightly different dimensions in terms of rotor diameter, hub height, and tip height, mortalities due to collision with all turbines in this range are expected to be substantially similar, and none would have a total turbine height (tower plus ½ the rotor diameter) greater than 150 m (492 ft)[7].

Figure 2-1 provides an illustration of the turbine dimensions contemplated for this Project. Turbine characteristics are summarized in Table 2-2. Each turbine will consist of 3 major components: tower, nacelle, and rotor, each described below. The Project may not utilize the same turbine model for all 100 turbines. In any case, any turbine model used will be of similar dimensions.

**Table 2-2.** Characteristics of a representative wind turbine generator.

| | |
|---|---|
| Power Generation | 2.5 MW per turbine |
| Hub Height | 100 m (328 ft) |
| Rotor Diameter | 100 m (328 ft) |
| Total Tower Height (Hub + ½ Rotor) | 150 m (492 ft) |
| Height of Lowest Rotor Blade Reach | 50 m (164 ft) |
| Rotor Swept Area | 7,823 $m^2$ (84,206 $ft^2$) |
| Rotor Speed (*range possible*) | 9.6-14.9 rotations per minute (rpm) |
| Rotor Tilt Angle Blade Cone Angle | 5° 3.5° |
| Wind Speed of Generator Initiation (Cut-in) | 3 meters/second (m/s; 7 mile/hour [mph]) |
| Wind Speed of Generator Cessation (Cut-out) | 20 m/s (45 mph) |
| Maximum Tip Speed | 77 m/s (172 mph) |
| Rated Wind Speed (Unit Reaches Maximum Output) | 12.5 m/s (28 mph) |

## Tower

The tubular towers used for MW-scale turbines are conical steel or concrete structures manufactured in multiple sections. Each tower will have an access door and internal lighting, along with an internal ladder and mechanical lift to access the nacelle. The nacelle is expected to be approximately 100 m (328 ft) above ground level (agl; i.e., hub height). The towers will be painted off-white in accordance with FAA regulations designed to make the structures more visible to aircraft when viewing from above, as light colors contrast sharply against the dark-colored ground. This also has the benefit of reducing visibility from ground vantage points, which are generally viewed against the background of the sky.

[7] The CRM (see Appendix A) used a 100 m rotor diameter for modeling predicted take of the 100 turbine Project. If larger rotor diameter would result in a higher take estimate, adaptive management will maintain actual take numbers at the level requested in this HCP. No amendment to the take limit will be sought if a rotor diameter larger than 100 m is used for any portion of the Project.

**Nacelle**

The main mechanical components of the wind turbine, including the drive train, gearbox, and generator, are housed in the nacelle. The nacelle is housed in a steel reinforced fiberglass shell that protects internal machinery from the environment and dampens noise emissions. The housing is designed to allow for adequate ventilation to cool internal machinery. The nacelle is equipped with an external anemometer and a wind vane that signals wind speed and direction information to an electronic controller. Attached to the top of some of the nacelles will be an aviation warning light. These lights are anticipated to be flashing red strobes (L-864) that operate only at night and in accordance with FAA guidelines (Advisory Circular 70/7460-1K). The nacelle is mounted on a bearing that allows it to rotate ("yaw") into the wind to maximize wind capture and energy production.

**Rotor**

A rotor assembly is mounted to the nacelle to operate upwind of the tower. Each rotor consists of 3 composite blades that will be up to 50 m (164 ft) in length, with a total rotor length of up to 100 m (328 ft). The rotor attaches to the drive train at the front of the nacelle. Hydraulic motors within the rotor hub feather each blade according to wind conditions, which enables the turbine to operate efficiently at varying wind speeds. The rotor can spin at varying speeds to operate more efficiently. Depending on the turbine model selected, the wind turbines will begin generating energy at wind speeds as low as 3 m/s to 3.5 m/s (6.7 mph to 7.8 mph), and cut out when wind speeds reach 20 m/s to 25 m/s (44.7 mph to 55.9 mph). The maximum rotor speed is approximately 15 rpm.

### 2.2.2 Access Roads

The Project will require the construction of new or improved roads to provide access to the proposed turbine and substation sites. The proposed location of access roads for the known 52-turbine Project is shown on Figure 1-1. The total length of access road required to service the100-turbine Project is approximately 64.4 km (40.0 mi), some of which will be upgrades to existing farm lanes. The road will be gravel-surfaced and typically 5 m (16 ft) in finished width; however, to assure a worst-case analysis and to account for side slope grading, a maximum finished width of 6 m (20 ft) was assumed for purposes of impact calculation.

### 2.2.3 Collection Lines and Substation

The Project will have an electrical system that consists of 2 parts: (1) a system of 34.5 kV shielded and insulated cables that will collect power from each wind turbine, and (2) a substation that will transfer the power from the 34.5 kV collector cables to existing transmission lines and the regional power grid. The wind turbine transformer will raise the voltage of electricity produced by the turbine generator up to the 34.5 kV voltage level of the collection system. From the transformer, cables will join the collector circuit and turbine communication cables to form the electrical interconnect system. Locations of underground and overhead collection lines for the currently known 52-turbine Project are depicted in Figure 1-1. For the 100-turbine Project, the total estimated length of 34.5 kV collection lines carrying electricity to the substation will be approximately 113.5 km (70.5 mi), or 95.4 km (59.3 mi) in the Redesign Option. It is anticipated that approximately 56.8.0 km (35.3 mi), or 9.0 km (5.6 mi) in the Redesign Option, of the 34.5 kV interconnects will be above ground (on rebuilt distribution poles in existing public road right-of-ways) and approximately 56.6 km (35.2 mi), or 86.4 km (53.7 mi) for Redesign Option, will be buried underground.

The substation will be located near the intersection of Pisgah Road and Route 56 in the Town of Union, adjacent to the Givens to Mechanicsburg section of the Urbana Mechanicsburg Darby 138 kV transmission line. The substation will step up voltage from 34.5 kV to 138 kV to allow connection with the existing transmission. The substation will include dead-end structures, circuit breakers, air break switches, metering units, relaying, communication equipment, and a control house. Construction of the substation will permanently impact an approximately 2.0 ha (5 ac) area. The substation will be enclosed by a chain link fence and accessed from Pisgah Road by a new gravel-surfaced road approximately 0.2 km (0.1 mi) in length.

### 2.2.4 Meteorological Tower

In order to record weather data to ensure turbine output is maximized, the Project layout will include 4 permanent meteorological test towers (MET towers). The permanent MET towers will support equipment used to measure wind speed (anemometers), wind direction (wind vanes), temperature and other pertinent weather data. The final locations of the permanent MET towers will be determined by turbine engineers. Permanent MET towers will be placed in open fields, so that turbulence from trees and other structures do not interfere with equipment readings. The permanent MET towers will be non-guyed, free standing structures.

### 2.2.5 Staging Areas

It is currently anticipated that Project construction will require the development of up to 4 construction staging areas (Figure 1-1 depicts the staging areas to support construction of the known 52 turbine locations). Staging areas will only be located on previously disturbed or agricultural lands. These sites will accommodate material storage, parking for construction workers, and construction trailers enclosed by fencing (at 1 site only). Development of the staging areas is anticipated to temporarily disturb an area of approximately 9.2 ha (22.9 ac), including a site for trailers. No lighting of staging areas is currently proposed, but could be added if vandalism or similar problems are experienced.

### 2.2.6 Operations and Maintenance Building

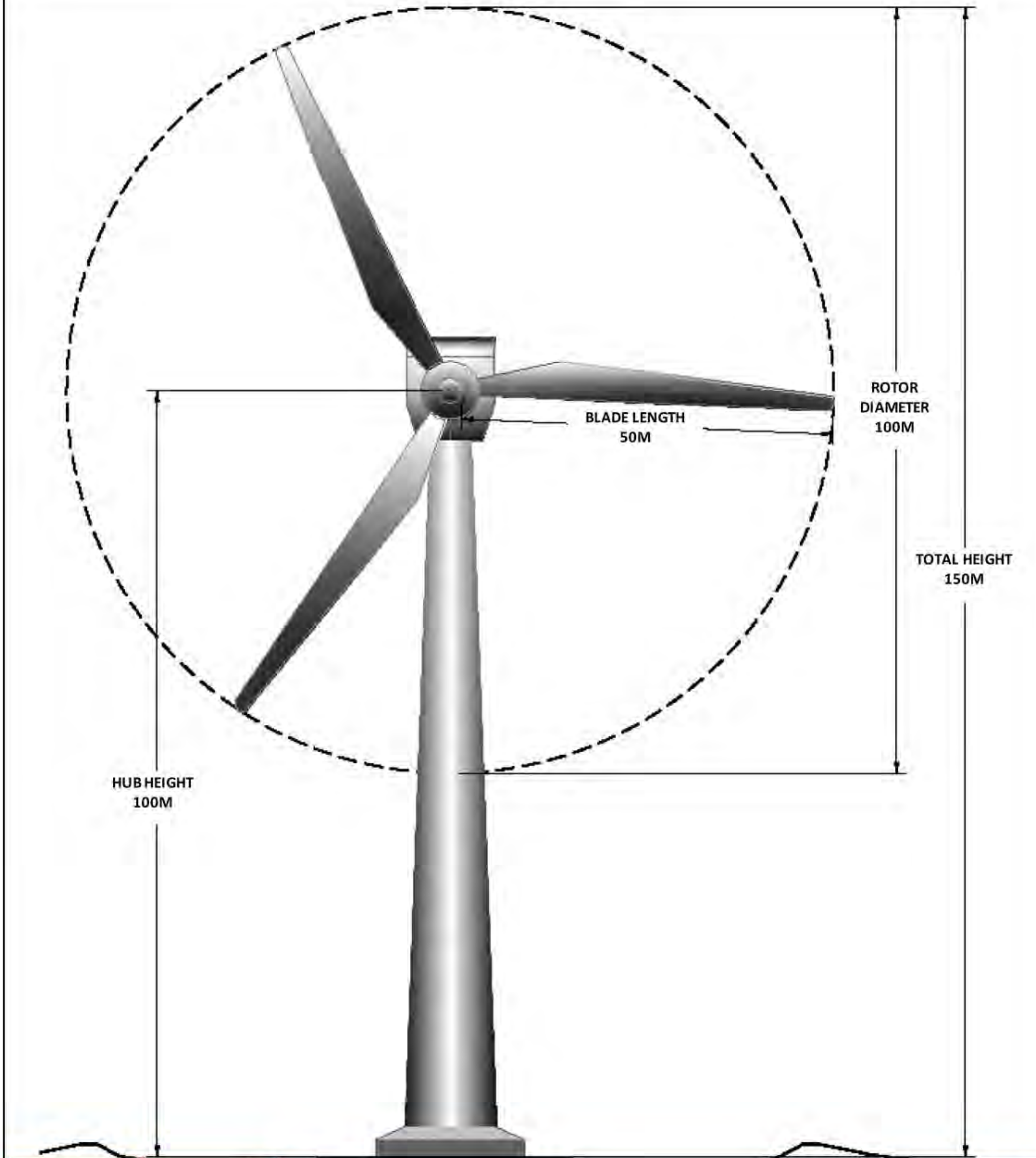
An O&M building and associated storage yard will be required to house operations personnel, equipment, and materials, and to provide operations staff parking. It is anticipated that an existing structure in the vicinity of the Project will be purchased or leased and refurbished for O&M activities. If a new building is needed, it is expected to permanently disturb an area of no greater than 1.2 ha (3.0 ac), and will be designed to resemble an agricultural building similar in style to those found throughout the area. If a new building is required, it will be located on previously disturbed or agricultural land.

### 2.2.7 Concrete Batch Plant

Up to 2 concrete batch plants will be required to construct the 100-turbine Project. Concrete batch plants are expected to be located at existing, developed facilities located off-site from the Action Area that would require no vegetation clearing or soil disturbance. If a new batch plant(s) is required within the Action Area, it will be located in previously disturbed areas that will not impact trees, streams, or wetlands. Vegetation clearing and soil disturbance no greater than 1.2 ha (3.0 ac) would be required for each new batch plant, for a total temporary impact for 2 batch plants of 2.4 ha (6.0 ac), with no permanent impacts. Operation and permitting of the plant(s) will be handled by the sub-contractor selected to supply the Project construction.

### 2.2.8 Crane Paths

A large erection crane will set the tower segments on the foundation, place the nacelle on top of the tower, and place the rotor onto the nacelle. The erection crane(s) will move from one turbine site to another along access roads or temporary crane paths. To complete construction of the 100-turbine Project, approximately 22.7 km (14.1 mi) of temporary crane paths will be utilized. Temporary crane paths will require vegetation clearing 16.8 m (55 ft) wide and will result in no permanent soil disturbance.




Prepared For:
Buckeye Wind, LLC

Prepared By:
Stantec Consulting Services Inc.
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Legend:
Rotor Swept Area

Source: Figure derived from various turbine diagrams produced by Nordex, RePower, and GE and should be considered approximate

Figure: 2-1

DIAGRAM OF PROPOSED WIND POWER TURBINE FOR THE BUCKEYE WIND POWER PROJECT

## 2.3 Covered Activities

### 2.3.1 Project Construction

Buckeye Wind proposes to begin construction as soon as practicable contingent upon approval of the HCP, issuance of an ITP, and securing acceptable financing terms from qualified lenders. Construction activities will regularly move from place to place within the Action Area. The Project, including all 100 turbines, will be constructed within 1 to 2 construction phases, each phase expected to continue for 12 to 18 months. The exact timing of the 2 construction periods is not known and may overlap. Timing is dependent upon several factors such as turbine availability, OPSB certification, and economic considerations. The Project will be constructed using standard construction practices, including erosion and sediment control best management practices to minimize impacts on the existing environmental conditions and habitat. Per OPSB CEPCN conditions, an environmental specialist must be present during vegetation clearing in or near sensitive areas or in the vicinity of threatened and/or endangered species and their habitat. That role will be filled by the Natural Resource Specialist who will also be knowledgeable of Indiana bats and their habitats. Construction of access roads, underground and overhead collection system lines, and concrete turbine foundations will begin first, followed by turbine erection. As turbines arrive at the site, they will be set individually in concrete foundations. General construction equipment will include pick-up trucks, cranes, tractor-trailers, bulldozers, compaction equipment, and graders.

Because of the nature of the construction activities and the avoidance and minimization measures described in this HCP (see Chapter 6.0), Buckeye Wind anticipates that no Indiana bats will be taken prior to a turbine becoming operational (in this document, "operational" means any time that the turbine is spinning and producing electricity). It is not anticipated that noise, vibration, or disturbance associated with construction will result in harm of Indiana bats and therefore the direct effects from these construction activities are insignificant or discountable and take is not likely to occur (see Section 5.1.1.1 – Noise, Vibration, and Disturbance). No direct effects to Indiana bats are expected during Project construction because no known roost tree will be cut, and any potential roost trees that cannot be avoided will only be cut during the non-active period for Indiana bats. Vehicular collisions associated with construction are not anticipated to result in harm or mortality of Indiana bats and therefore the direct effects from this activity are insignificant or discountable and take is not likely to occur (see Section 5.1.1.2 – Collision with Vehicles). It is not anticipated that any habitat loss or displacement will result in take of Indiana bats and therefore indirect effects are insignificant or discountable (see Section 5.2.1 – Indirect Effects – Construction and Decommissioning). However, the ITP should cover Project construction in the extremely unlikely event that Indiana bat(s) is/are taken during construction activities.

As a component of this HCP, Buckeye Wind will employ the avoidance and minimization measures more fully described in Section 6.1 – Avoidance Measures and Section 6.2 – Minimization Measures and generally including:

- Planning and Project design that specifically avoids and minimizes impacts to wooded areas, streams, wetlands and other sensitive habitat features;
- All tree clearing will be conducted between 1 Nov and 31 Mar to avoid potential direct impacts to Indiana bats;
- Natural Resources Specialist on-site who is knowledgeable on Indiana bats; and,
- Clear demarcation of clearing zones and flagging of potential Indiana bat roost trees to ensure impacts are avoided to the maximum extent practicable.

### 2.3.3 Project Operation and Maintenance

Buckeye Wind anticipates owning and operating the Project for its operational life, which is expected to be 25 years. The HCP will cover a 30-year ITP Term (see Section 2.4 – ITP Duration), which includes the operational life and the construction and decommissioning periods. The ITP is anticipated to be in effect for a 30 year period when take could occur.

Project maintenance activities during Project operation include turbine maintenance as needed, vegetative control if necessary, periodic re-grading, and reviewing the site drainage plans. Project maintenance activities in and of themselves will have similar or lesser impacts as compared to construction activities and will employ all applicable avoidance and minimization measures employed during construction (see Chapter 5.0 – Impact Assessment). Buckeye Wind anticipates the risk of take to Indiana bats from Project maintenance activities will be insignificant or discountable.

Project operation will include operating wind turbines that may result in take of Indiana bats. Project operation is the primary reason behind the need for an ITP because it is anticipated that all Indiana bat takings will occur during this period. The impacts of project operation are described and evaluated fully in Chapter 5.0 – Impact Assessment.

As a component of this HCP, Buckeye Wind will employ the avoidance and minimization measures more fully described in Section 6.1 – Avoidance Measures and Section 6.2 – Minimization Measures and generally including:

- Siting of Project components that avoid impacts to sensitive habitat areas, including wooded areas and riparian areas,
- Seasonal clearing of wooded areas,
- Operational adjustments (feathering) that will increase the wind speeds at which the turbines begin to operate, thereby reducing Indiana bat mortality; and,
- Any vegetative controls (See Section 5.2.2.1 –Vegetative Control) performed by Buckeye Wind will be completed during non-active periods for Indiana bats.

### 2.3.4 Project Decommissioning

Megawatt-scale wind turbine generators typically have a life expectancy of 20 to 25 years. After that time or if turbines are non-operational for an extended period (such that there was no expectation of their returning to operation), they will be decommissioned. Decommissioning will be performed under a decommissioning plan approved by the OPSB that would address removal of Project components/improvements as well as site/land reclamation. The OPSB has included a number of conditions related to decommissioning in its decision to issue a CEPCN to construct the Project. As such, decommissioning of the Project or individual wind turbines will be completed within 12 months after the end of the useful life of the Project or of individual wind turbines. Additionally, the areas disturbed during decommissioning will be re-graded, reseeded, and restored. Decommissioning activities will have similar or lesser impacts as compared to construction and will apply all applicable avoidance and minimization measures employed during construction. Buckeye Wind anticipates that risk of take to Indiana bats and other ESA threatened or endangered species will be insignificant or discountable during decommissioning (see Chapter 5.0 – Impact Assessment). However, the ITP should cover Project decommissioning in the extremely unlikely event that Indiana bat(s) is/are taken during decommissioning activities.

### 2.3.5 Mitigation and Monitoring Actions

The ITP will cover mitigation actions that will be conducted for the HCP to offset the effects of Indiana bat take anticipated from the Project. Mitigation actions will include habitat protection into perpetuity, restoration and enhancement (if necessary) and monitoring. Habitat management could involve tree/native species plantings, controlling for invasive species and girdling to create potential roost trees. Mitigation will result in benefits to Indiana bats, non-federally listed bats, birds and other wildlife. These types of restoration projects would not be expected to result in take of Indiana bats. Take will be avoided by conducting invasive species control and tree girdling during non-active period for the Indiana bat. However, the ITP should cover Project mitigation in the extremely unlikely event that Indiana bat(s) is/are taken during mitigation activities.

Post-construction mortality monitoring will occur during the ITP Term to ensure compliance with the ITP (see Section 6.0 – Conservation Program). During mortality monitoring all injured or dead Indiana bats will be collected. Injured Indiana bats will be sent to a licensed rehabilitator. If the rehabilitator determines the injured Indiana bat cannot be rehabilitated, it will be euthanized. Dead Indiana bats will be turned over the USFWS. The ITP will cover collection of both Indiana bat carcasses as well as injured Indiana bats during monitoring and euthanasia of injured Indiana bats that cannot be rehabilitated.

## 2.4 ITP Duration

Buckeye Wind anticipates the HCP to be in effect for a 30-year term including construction, operation, maintenance, decommissioning and mitigation. This HCP will establish specific avoidance, minimization and mitigation measures that will be implemented during construction, operation, and decommissioning of the Project. The 30-year period (ITP Term) will include construction and decommissioning periods, in which take is unlikely, and a 25-year operation term during which take is likely to occur.

At the close of the 30-year term, the ITP may be extended with the approval of the USFWS if the authorized take limit is not reached (see Section 7.3.1 – Extension of ITP Term).

## 2.5 Covered Lands

As described in Section 1.1 – Overview and Purpose of the HCP, the Action Area includes 32,395 ha (80,051 ac) located within portions of Union, Wayne, Urbana, Salem, Rush, and Goshen Townships in Champaign County, OH (Figure 1-1). This HCP and its associated ITP will cover the entire Action Area, including all areas in which Project construction, maintenance, operation, and decommissioning activities will occur.

This HCP/ITP will also cover areas located outside of the Action Area, where mitigation actions will take place. Mitigation actions will take place within 7 miles of a Priority 2 (P2) Indiana bat hibernaculum in OH (see Section 4-1 – Species Status, for definition of Priority 2, and see Figure 2-2 for a map of known hibernacula in the United States).

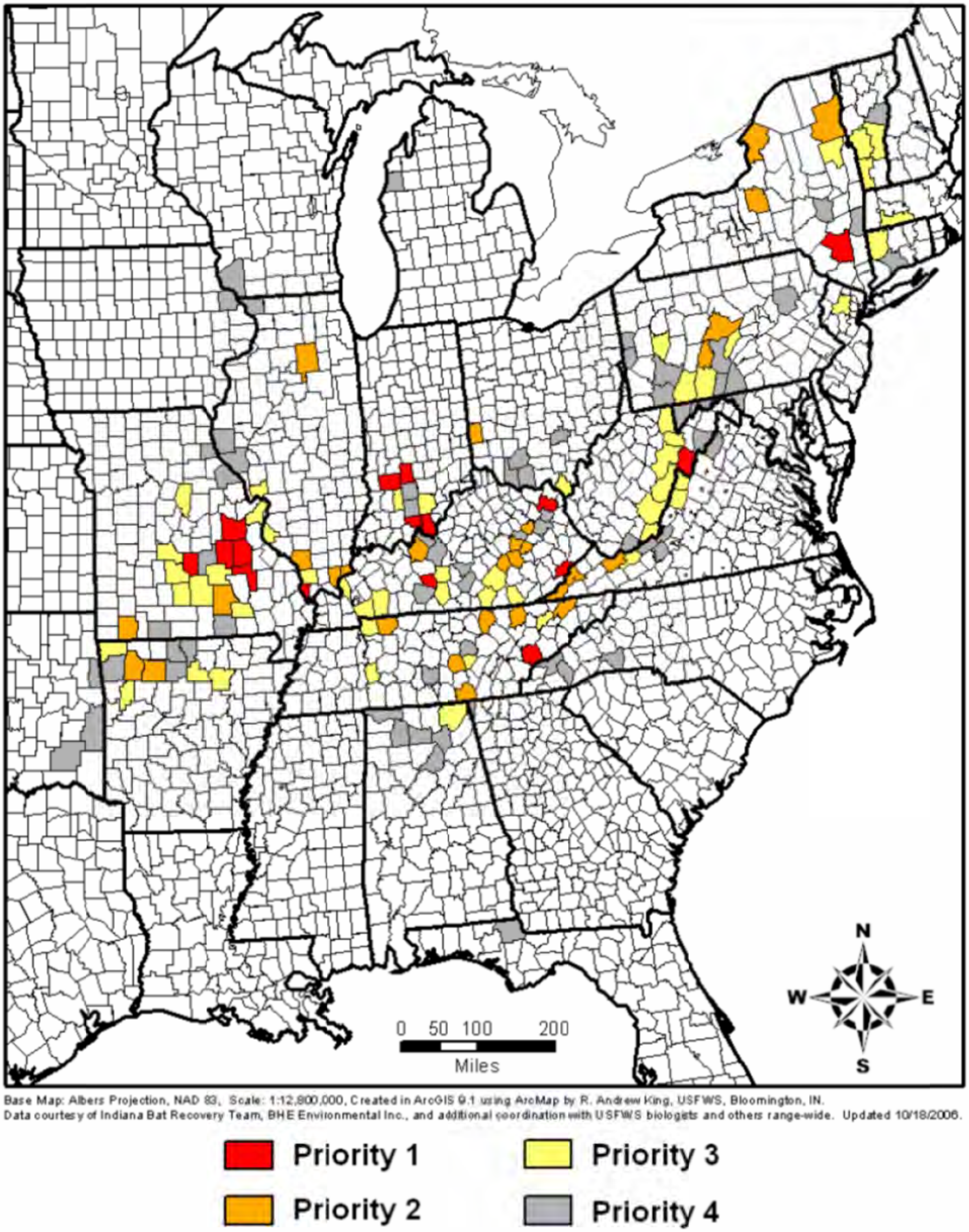


**Figure 2-2.** Distribution of counties with known Indiana bat hibernacula records and their current priority numbers. Note: For counties with multiple hibernacula with different priority numbers, only the color of the highest priority hibernacula is shown. From USFWS 2007.

## 2.6 Alternatives Considered

### 2.6.1 Criteria

In accordance with the ESA [Section 10(a)(2)(A)] and federal regulation [50 CFR 17.22(b)(1), 17.32(b)(1), and 222.22], the following sections describe alternative actions that were considered by Buckeye Wind to reduce impacts to Indiana bats. These sections also set forth the reasons why the Proposed Alterative was selected over other alternatives. The Habitat Conservation Planning Handbook (HCP Handbook; USFWS and National Marine Fisheries Service [NMFS] 1996) states that at least 2 types of alternatives are commonly included in HCPs:

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

In addition to the No-Action alternative, Buckeye Wind evaluated 2 action alternatives that would avoid and minimize incidental take of Indiana bats. Alternatives were identified and selected in cooperation with the USFWS. Alternative selection was also guided by the biological goals and objectives of the HCP (see Section 1.2) and the purpose and need of the Project (see Section 1.3). Alternatives were evaluated based on the criteria described in the following sections. Evaluation of alternatives' impacts on other aspects of the natural and human environment is described in the EIS.

#### *2.6.1.1 Conservation of the Indiana Bat*

When developing avoidance, minimization, mitigation, and conservation measures associated with each alternative, Buckeye Wind consulted with the USFWS and referred to the 2007 Indiana Bat Draft Recovery Plan to develop measures consistent with the USFWS's recovery goal. Measures that were not consistent with the USFWS's goal for Indiana bat recovery were dropped from further consideration, including those that did not adequately minimize and mitigate incidental take of Indiana bats or enhance scientific understanding of the impacts to Indiana bats from wind development.

#### *2.6.1.2 Effectiveness and Costs of Mitigation and Conservation Measures*

Mitigation and conservation measures associated with each alternative were evaluated based on their anticipated effectiveness at offsetting the impact of incidental take of Indiana bats as well as providing measurable and significant conservation benefits to Indiana bats. Funds required to implement mitigation (i.e., land protection and enhancement) and conservation measures (i.e., scientific research on Indiana bats and wind power development) were also considered in the evaluation of alternatives.

#### *2.6.1.3 Effects to Other Wildlife Resources*

Avoidance, minimization, mitigation, and conservation measures associated with each alternative were evaluated for their potential to positively affect other bat and avian species at risk from wind development. Long distance migratory bats have been found to be most at risk of collision with wind facilities, particularly during fall migration (NWCC 2010). Avian mortality from collision with wind turbines also has been high at some wind facilities, particularly among nighttime migrating passerines (NWCC 2010). Thus, alternatives were evaluated based on the extent to which they avoided and minimized risks to other bat and avian species (Stantec 2011a).

#### *2.6.1.5 Effects to Wind Project Viability*

When considering alternatives to the Project, economic viability is an important evaluation criterion. One of the more important factors that has the greatest influence on project viability includes operational capacity. Based on current technology and scientific knowledge, feathering appears to be an effective method to significantly reduce bat mortality at operating wind facilities. Therefore, alternatives that did not incorporate some amount of feathering were not considered. However, the cut-in speeds used for feathering and the timing of feathering (on both a nightly and seasonal basis) can add significant costs to the project and influence project viability.

Similarly, location has a large influence on project viability. The site selection process used by Buckeye Wind to meet the requirements of the OPSB was based on several constraints, including reducing impacts to sensitive resources, maximizing energy production, and accommodating existing land uses. Buckeye Wind conducted an intensive, science-driven process (detailed in the OPSB CECPN and EIS) to identify a location for its Project that would meet the siting criteria and comply with environmental constraints. Of particular importance in the screening process was the Project's location relative to adequate wind resources, electric transmission lines, land parcels that could accommodate OPSB-defined setback distances, existing land uses, and other environmental restrictions. Alternatives were evaluated based on their ability to meet the conditions of this screening process.

### 2.6.2 Alternatives Considered but Not Selected

#### *2.6.2.1 No Action No Build Alternative*

Under the No Action Alternative, the Project would not be developed, an ITP for Indiana bats would not be issued, this HCP would not be implemented, and existing land uses would be maintained at the sites of proposed turbines and other Project appurtenances. This alternative would not result in incidental take of the Indiana bat or removal of Indiana bat habitat. However, benefits to the species would not be realized without implementation of the conservation measures that are a part of this HCP. No research would be funded to further our understanding of the impacts to Indiana bats and other bats from wind development. The results of such research could be used to increase the effectiveness of minimization and mitigation measures that are a part of this HCP, as well as other HCPs developed for Indiana bats, with the net end result of enhancing the survival probability of the species. Thus, although the No Action Alternative would not result in incidental take of Indiana bats and would reduce future potential impacts to the Indiana bat and its habitat, it also would not result in increased scientific understanding of Indiana bat behavior related to wind power development.

The Project's purpose and need of serving the public interest by providing ample, clean, and renewable energy also would not be met under this alternative. The No Action alternative fails to meet the purpose, intent, and goal set forth by the Ohio AEPS, signed into law by Governor Strickland in May 2008 (49 ORC 4928.64), that mandates that at least 25% of all electricity sold in OH comes from alternative energy resources by 2025. At least half of that standard, or 12.5% of electricity sold, must be generated by renewable resources, and at least half of this renewable energy must be generated in-state. The No Action alternative also fails to meet Executive Order 13212 (dated 18 May 2001), which promotes production and transmission of energy in a safe and environmentally sound manner and mandates that executive departments and agencies take appropriate actions to expedite projects that will increase the production, transmission, or conservation of energy.

Thus, the No Action alternative fails to reduce the dependence of OH on non-renewable energy sources such as coal and imported oil. The No Action Alternative also would fail to provide economic benefit through the creation of jobs. The No Action Alternative would not contribute towards meeting the goals of the "Barack Obama and Joe Biden: New Energy for America" plan, which includes the creation of 5 million new jobs over 10 years and ensures that 10% of our electricity comes from renewable sources by 2012, and 25% by 2025 (Obama for America 2008). Economic benefit also would not be realized by the participating land owners that would receive ongoing income from lease agreements throughout the ITP Term. Refer to Section 1.3 – Purpose and Need for the Project for more information on the economic and environmental benefits of the Project in OH and beyond.

Because the broad economic and environmental benefits would be foregone by not constructing the Project, and because a net conservation benefit for the Indiana bat would not be realized without the implementation of conservation measures that will further the recovery of the species, the No Action Alternative was not considered further.

#### *2.6.2.2 Minimally Restricted Operations Alternative*

Under the Minimally Restricted Operations Alternative, the Project would include construction of 100 turbines within the Action Area as described in Section 2.0 – Project Description. However, operational adjustments (i.e., feathering) would be used to reduce incidental take of Indiana bats, such that the speed at which turbines become operational (i.e., cut-in speed) would be increased from manufacturer's setting of 3.0 m/s to 5.0 m/s for all 100 turbines. This cut-in speed would be applied to turbines for the hours of the night during which *Myotis* have been documented to be most active (i.e., the first 1 hr to 6 hr after sunset), during the fall migration period (1 Aug to 31 Oct), which has consistently been the period in which the highest total bat mortality has been documented in post-construction monitoring studies (see Table 4-4).

This Alternative was considered because it met the purpose and need of providing clean, renewable energy to OH and contributed toward meeting the goals of the OH AEPS, Executive Order 13212, and the "Barack Obama and Joe Biden: New Energy for America" plan. This alternative also allowed for an economically viable project for Buckeye Wind and participating land owners.

This Alternative was not selected because, although current data suggest that cut-in speeds of 5.0 m/s and higher substantially reduce bat mortality (between 38% and 93% reductions in bat mortality from that documented at turbines operating at the manufacturer's specified cut-in speeds [Baerwald et al. 2009, Arnett et al. 2010, and Good et al. 2011]). The findings are related to general bat mortality numbers and not specific to Indiana bats. Given the uncertainty that still remains regarding which cut-in speeds are most effective at minimizing mortality of Indiana bats, the USFWS recommended that Buckeye Wind take a more conservative approach and select an alternative that employed higher cut-in speeds, particularly at turbine locations and seasonal periods that the current data suggest are a higher risk to Indiana bats.

Additionally, applying operational adjustments only during the fall migratory period may not provide adequate protection to Indiana bats. To date, the only 3 documented Indiana bat fatalities at a wind facility have occurred during the fall migratory period (Sept 2009 and Sept 2010 at Fowler Ridge, IN [Good et al. 2011] and Sept 2011 at Allegheny Ridge, PA[8]). Thus, the results of post-construction monitoring studies to date indicate that the fall migratory period may represent the period of highest risk to Indiana bats, as it does for long-distance migratory bats and other bat species more commonly found in post-construction mortality studies. However, data suggest there is some level of risk to *Myotis* species during the summer reproductive period (see Section 4.5.5 – Collision Mortality at Wind Facilities and Section 5.1.2.5 – Collision/Barotrauma Mortality for further details).

[8] http://www.fws.gov/northeast/pafo/, accessed November 20, 2011.

Risks to Indiana bats during the summer are also uncertain because no wind facilities have yet been constructed within 8 km (5 mi) of known Indiana bat maternity colonies. Given that Indiana bats are generally thought to fly between 2 m (6.6 ft) and 30 m (98.4 ft) while foraging (LaVal et al. 1976, Humphrey et al. 1977, Russell et al. 2008), it is expected that risks to Indiana bats during the summer are very low. However, until this relationship is more clearly documented, it cannot be assumed that applying feathering during the fall migratory period alone will provide sufficient protection of the Indiana bat. Therefore, this alternative was not selected as the preferred approach to minimize take of Indiana bats.

#### 2.6.2.3 Maximally Restricted Operations Alternative

Under the Maximally Restricted Operations Alternative, the Project would include construction of 100 turbines within the Action Area as described in Section 2.0 – Project Description. However, operational adjustments would be used to eliminate take of Indiana bats, such that all 100 turbines would be non-operational from sunset to sunrise during the entire period over which Indiana bats are active (1 Apr to 31 Oct).

This Alternative was considered because it met the biological objective of avoiding take of Indiana bats. However, because this Alternative would eliminate take of Indiana bats, an ITP would not be necessary and the HCP would not be implemented. Without the HCP, there would be no positive contribution to the recovery of the species through collection of post-construction mortality data, funding of research on bat and wind energy interactions, or protection and enhancement of Indiana bat habitat. Additionally, due to the significant reduction in energy production, this alternative did not meet the purpose and need of the Project to generate ample clean and renewable energy and allow for an economically viable Project. For a discussion of costs of this alternative compared to the proposed alternative, please see Section 6.6.2 – Practical Implementation by Buckeye Wind. For these reasons, this alternative was not selected as the preferred method to reduce take of Indiana bats.

#### 2.6.2.4 The Proposed Alternative

Under the Proposed Alternative, the Project would include construction of 100 turbines within the Action Area as described in Section 2.0 – Project Description. Operational adjustments would be used to minimize take of Indiana bats, such that the operation of all 100 turbines would be restricted using a scientifically informed and risk-based approach that would increase cut-in speeds as a function of the location of the turbines relative to Indiana bat habitat and the time of year. Monitoring and adaptive management would be implemented to ensure take is minimized to the maximum extent practicable and to address uncertainties relative to use of cut-in speeds for minimizing impacts to Indiana bats. This feathering plan is more fully detailed in Section 6.2 – Minimization Measures and was developed in consultation with the USFWS and using the best available science, including published reports on the observed reductions of bat mortality resulting from various levels of operational curtailment and feathering. All Conservation Measures included in Chapter 6.0 were informed by experts at USFWS and Stantec Consulting Services Inc. (Stantec), as well as leading experts in the field of Indiana bat biology and wind turbine interactions, including Dr. Allen Kurta, Dr. Bill Warren-Hicks, Dr. Tim Carter, and Dr. John Hayes.

The Proposed Alternative was selected because it best met the goals of effectively avoiding, minimizing, and mitigating for take of Indiana bats (as described in the previous sections) and the Biological Goals and Objectives of this HCP (See Section 1.2 – Biological Goals and Objectives of the HCP). The Proposed Alternative was also selected because it met the purpose and need of providing clean, renewable energy to OH and the surrounding region and contributed toward meeting the goals of the OH AEPS, Executive Order 13212, and the "Barack Obama and Joe Biden: New Energy for America" plan. This alternative allows for an economically viable project for Buckeye Wind and provides a positive economic and environmental benefit for the community and surrounding region. Refer to Section 1.3 – Project Purpose and Need for more information on the renewable energy and economic goals of the Project.

## 2.7 Public Participation

Public participation is similar and parallel to the public participation opportunities for the NEPA process and is described in the EIS. Scoping for the NEPA process was first initiated in the Notice of Intent (NOI) to conduct a 30-day scoping period for a NEPA decision on the proposed HCP and ITP and request for comments published in the Federal Register on 29 January 2010 (75 Fed. Reg. 4840-4842). Formal scoping began for the NEPA analysis on 26 May 2010 when the NOI to prepare an EIS was published in the Federal Register (75 Fed. Reg. 29575-29577). The USFWS also conducted outreach by press releases and public notification to inform interested parties or those in the Action Area or potentially affected by the Proposed Action and requested comments on the scope of the NEPA analysis. Comments resulted in the identification of a number of issues related to the Project and the associated HCP.

This Draft HCP will be published and circulated for public review in accordance with NEPA requirements set forth in 40 CFR 1500-1508; 42 USC 4321-4347. Public comments will be accepted during a 90-day period following publication of the Federal Register Notice of Availability. At least 1 public information meeting will take place during the comment period. Comments received will be taken into account in assessing Project impacts and potential mitigation. Following the end of the comment period, responses to substantive comments will be prepared and a Final HCP will be completed.

During the Project development phase and the OPSB application process, Buckeye Wind consulted with state and federal agencies to identify missing information on sensitive resources, including water, wetlands, wildlife, and cultural resources. Agencies consulted to obtain guidance on pre-construction surveys, site assessments, and OPSB process requirements included USFWS, FAA, ODNR DOW, Ohio Historic Preservation Office (OHPO), Ohio Department of Transportation (ODOT), Ohio Environmental Protection Agency (OEPA), Ohio Department of Agriculture (ODA), Ohio Department of Development (ODOD), and Ohio Department of Health (ODOH).

Prior to filing the OPSB application, Buckeye Wind was required to hold a public informational meeting to advise potentially affected persons of the Project. Public input and concerns were gathered to aid in preparation of the OPSB application. Once the application had been submitted and deemed complete, it then was sent to local public officials and made available in area libraries for public viewing; legal notices also were published in area newspapers. At this time, interested parties had the opportunity to be recognized as interveners in the case.

Buckeye Wind held a public informational meeting on 10 June 2008. On 24 April 2009, Buckeye Wind filed its application for a CECPN with the OPSB. A public hearing was held on 27 October 2009, and evidentiary hearings began 28 October 2009.

The Buckeye Wind Project's record of public interaction relative to the OPSB application process is available through the PUCO Docketing Information System.[9]

[9] http://dis.puc.state.oh.us/CaseRecord.aspx?Caseno=08-0666&link=DI

In addition, Champaign Wind LLC, a separate EverPower subsidiary, has initiated the OPSB application procedure for the Buckeye II Wind Project, consisting of 56 turbines (no more than 100 total turbines will be constructed for the Buckeye Wind and Buckeye II Wind projects combined). The Buckeye II Wind Project will be transferred to Buckeye Wind prior to construction. A public information meeting for Champaign Wind LLC was held on 24 January 2012. Champaign Wind LLC's record of public interaction is available through the PUCO Docketing Information System[10].

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[10] http://dis.puc.state.oh.us/CaseRecord.aspx?CaseNo=12-0160-EL-BGN

# 3.0 ENVIRONMENTAL SETTING AND BIOLOGICAL RESOURCES

## 3.1 Project Setting

The Action Area is located in the west-central portion of OH, in the Bellefontaine Uplands physiographic region, a sub-region of the Central Ohio Till Plains. This region is characterized by low to moderate relief hills formed by glacial processes. The Action Area is characterized by flat and rolling terrain that is comprised largely of active agricultural lands (producing mostly corn and soybean crops) and pastures, collectively comprising approximately 82% of the Action Area. These areas are interspersed with relatively small, scattered, stands of mixed hardwood forest that have an average size of approximately 4 ha (9 ac) (deciduous forest comprises approximately 8% of Action Area), as well as areas of low to medium intensity developed lands (approximately 1.5% of Action Area) (Homer et al. 2004). A brief summary of the Action Area is provided below.

### 3.1.1 Land Use

Construction of the Project will involve the leasing of private land in the Action Area predominantly zoned for agricultural purposes. Other current land uses in the Action Area include residential, urban, manufacturing, commercial, transport, recreational, and utilities. Residential development within and around the Action Area consists almost entirely of single-family homesteads along rural roads.

Various registered historic sites are also present within the Action Area. Registered landmarks of historic, religious, archaeological, scenic, natural, or other cultural significance include those districts, sites, buildings, structures, and objects that are recognized by, registered with, or identified as eligible for registration by the national registry of natural landmarks, the Ohio Historical Society, or the ODNR DOW. At least 34 such landmarks within 8 km (5 mi) of the Action Area have been identified. Twenty of these landmarks are in the village of Mechanicsburg, and 9 are in the city of Urbana. The remaining 5 landmarks are located outside of incorporated communities and include landmarks such as Elmwood Place, The Fort, The Piatt Houses, The Carl Potter Mound and the Mount Tabor Church.

### 3.1.2 Topography

The Action Area is located in the glaciated Till Plains Section of the Central Lowland Physiographic Province. The topography is characterized by gently rolling hills and moderate slopes with elevations ranging from 396 m to 548 m (1,300 ft to 1,800 ft) above mean sea level. Typical of west-central OH, the area experienced both the Illinoian and Wisconsinan glaciers and the surface topography is the result of glacial end moraine deposits (i.e., the Cable and Springfield Moraine complexes; EDR 2009).

### 3.1.3 Geology

The flat, nearly featureless glaciated till plains of western OH are abruptly interrupted by a hilly area in Logan County and northern Champaign County created by a feature the ODNR, Division of Geological Survey, Ohio Seismic Network described as the "Bellefontaine Outlier Faults." These deep seismic structures are located within the granitic basement rock beneath portions of the Action Area. Campbell Hill, located 20 km (12 mi) north of the Action Area in Logan County, is underlain by the Bellefontaine Outlier and marks the highest point in OH at 472 m (1,549 ft) above mean sea level. This region of OH is referred to locally as the "Bellefontaine Ridge" as a result of these geologic features.

Throughout much of the Action Area, the uppermost bedrock is composed of limestone and dolomite. Some portions of the Action Area are underlain by karst geological features, which are formed by the dissolution of layers of soluble bedrock that create subterranean drainages, caves, and sinkholes.

### 3.1.4 Soils

Based on the Soil Survey for Champaign County (United States Department of Agriculture Soil Conservation Service (USDA-SCS; USDA-SCS 1971), soils in the Action Area are primarily composed of Celina, Fox, and Miami silt loams. Celina and Miami silt loams are well drained with depth to the water table being 61 centimeters (cm) to 91 cm (24 in to 36 in) below the surface. The Fox silt loams are well drained with depth to the water table being more than 203 cm (80 in) below the surface. All 3 of these soils satisfy the USDA criteria that make up prime farmland (Hull 2009).

### 3.1.5 Hydrology

The Action Area lies within the Upper Scioto River and Upper Great Miami River drainages, both of which drain to the Ohio River (United States Geological Survey [USGS] 2003). Perennial streams and ditches within the Action Area are generally small; larger streams with deep pools include Dugan Run and the East Fork of Buck Creek (refer to EIS Section 4.4 for further detail on streams in the Action Area).

The Action Area also contains a number of wetlands identified in the National Wetlands Inventory (NWI) database that was updated based on current (i.e., 2005 to 2007) aerial photos by Ducks Unlimited (DU; DU 2009). There are approximately 668.1 ha (1,651 ac) of DU-identified wetlands in the Action Area; most of these are emergent wetlands, characterized by low-lying herbaceous vegetation, or open water. A surface water delineation conducted for the Project (Hull 2009) provided ground-based information on wetlands within 305 m (1,000 ft) of Project components, including the 52 known turbine locations and workspaces, access roads, buried electrical interconnects, overhead electrical interconnects, O&M buildings, storage yard, staging areas, and substation. Hull (2009) documented 8 wetlands totaling roughly 3.0 ha (7.3 ac) in these areas. The EIS Chapter 4.4 provides detailed information on the wetlands in the Action Area delineated by Hull (2009). During the planning and design phases of the additional 48 turbines and associated facilities, similar delineations will be performed. Built components of the Project, including wind turbines, staging areas, the O&M building, and the substation, will be sited to completely avoid wetlands for all 100 turbines and their associated facilities. While wetland impacts can be avoided, it is likely that streams crossings will be required; see Section 5.2.1.2 of the HCP and Section 5.4 of the EIS for a more complete discussion of stream impacts. To the extent they are necessary, stream impacts will stay within the parameters of Nationwide Permit(s) requirements of the United States Army Corps of Engineers (USACE).

### 3.1.6 Landcover

Prior to European settlement, the state of OH was approximately 95% forested; rapid settlement in OH resulted in a steady decline of forest cover to a low of 12% in 1940 (ODNR DOW 2011). OH's forestland has been increasing since 1940 and in 2001 it comprised approximately 33% of the state's land area. The amount of forest cover varies widely among the geographic regions of the state. Most counties in the western glaciated farmland region, in which the Action Area is located, are less than 15% forested, with much of the forest occurring in small, isolated patches of 8 ha (20 ac) or less. The northeastern glaciated region has approximately 30% forest cover, with most counties heavily urbanized. The east-central, southeastern, and south-central unglaciated counties (hill country) are the most heavily forested, ranging from 35% to 80% (ODNR DOW 2011).

Based on the National Land Cover Database (NLCD; Homer et al. 2004), summarized in a Geographic Information System (GIS; ArcGIS 9.2, ESRI Redlands, California), the majority (69%) of vegetation in the

Action Area is comprised of the *Cultivated Crop* landcover type (producing mostly corn and soybean crops), 13% is comprised of *Pasture/Hay*, 9% is comprised of *Deciduous Forest*, and 6% is comprised of *Developed Open Space* (Homer et al. 2004). Remaining native landcover types, such as *Grassland/Herbaceous* (i.e., old fields, CRP lands), and *Developed, Low Intensity* each makes up approximately 1% of the Action Area, while *Evergreen Forest*, *Mixed Forest*, and *Emergent Herbaceous Wetlands*, each make up less than 0.1% of the Action Area (Table 3-1, Figure 3-1).

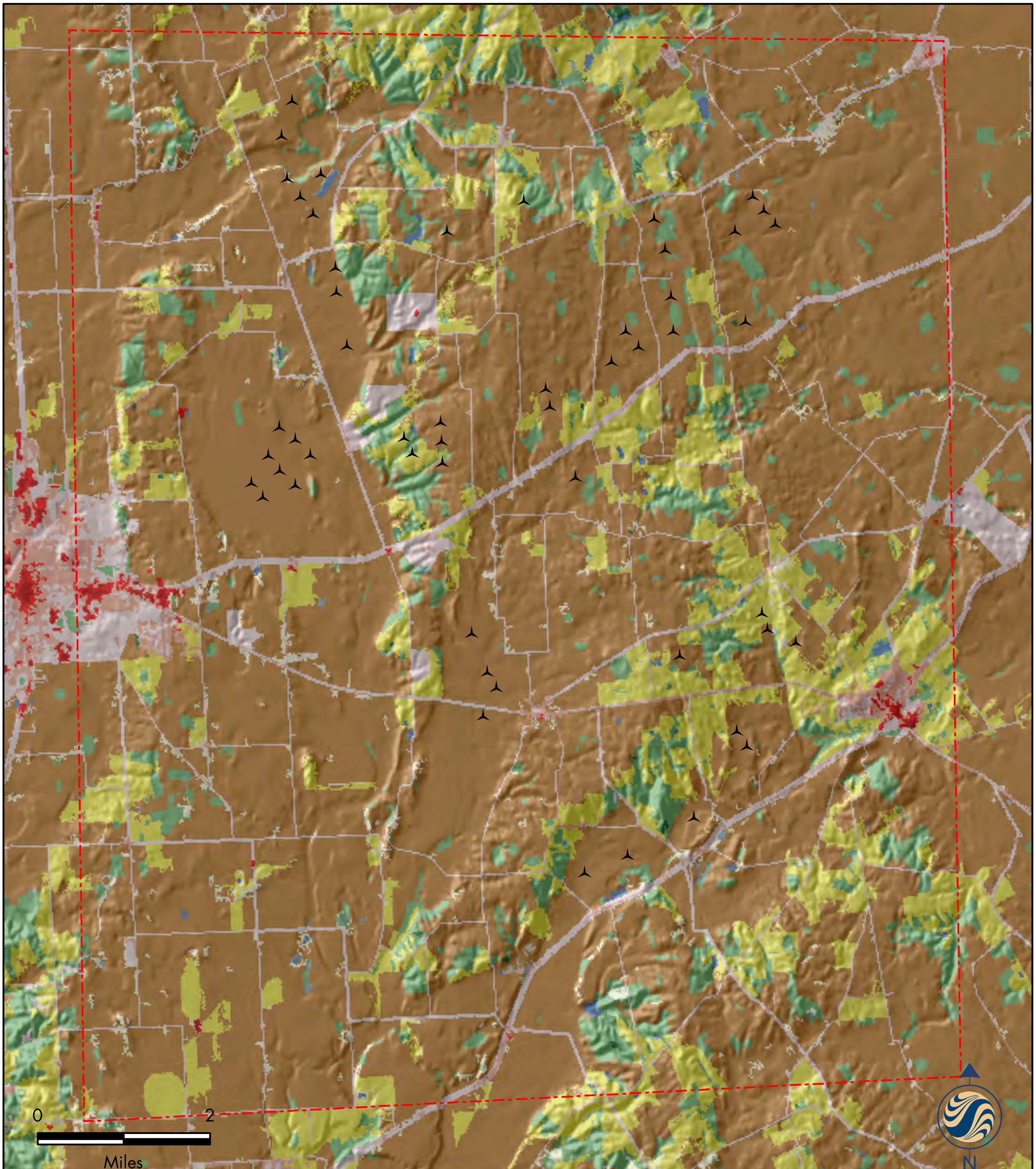
Based on the 2001 NLCD, there are approximately 766 distinct forest patches in the Action Area[11] that average 3.6 ha ± 10.0 ha (9.0 ac ± 24.7 ac) in size and vary from 0.1 ha to 106.47 ha (0.2 ac to 263.09 ac). Eighty-two percent of the forest patches were 4 ha (10 ac) or smaller and only 2% (n=13) were 40 ha (100 ac) or more. The deciduous forest habitat in the Action Area includes mature stands and early-successional scrub-shrub, primarily bordered by agricultural fields, generally even-aged, and dominated by oaks (*Quercus* spp.), maples (*Acer* spp.), hickories (*Carya* spp.), and ash (*Fraxinus* spp.), as determined during the course of the 2008 bat mist-netting surveys in the Action Area (Stantec 2008b) and during ground-based habitat assessments conducted by Buckeye Wind in conjunction with the USFWS in November 2010.

**Table 3-1.** NLCD landcover types and size (ha and ac) identified in the Buckeye Wind Project Action Area, Champaign County, OH.

| Landcover type | Hectares | Acres | Percent of Action Area |
|---|---|---|---|
| Cultivated crops | 22,408 | 55,372 | 69% |
| Hay/pasture | 4,163 | 10,287 | 13% |
| Deciduous forest | 2,744 | 6,779 | 9% |
| Developed, open space | 1,962 | 4,849 | 6% |
| Grassland/herbaceous | 445 | 1,099 | 1% |
| Developed, low intensity | 422 | 1,042 | 1% |
| Open water | 84 | 208 | <0.1% |
| Developed, medium intensity | 55 | 135 | <0.1% |
| Emergent herbaceous wetlands | 40 | 100 | <0.1% |
| Evergreen forest | 31 | 76 | <0.1% |
| Developed, high intensity | 26 | 65 | <0.1% |
| Barren land (rock/sand/clay) | 13 | 33 | <0.1% |
| Mixed forest | 2 | 6 | <0.1% |
| Totals | 32,395 | 80,051 | 100% |

Source: Homer et al. 2004

[11] Excluding portions of 6 forest patches that only partially overlap the Action Area, totaling 0.4 ha (0.9 ac).




Prepared For:

Buckeye Wind, LLC

Prepared By:

Stantec Consulting Services Inc.

www.stantec.com

Legend:

- Proposed Turbines
- HCP Action Area

Landcover

- Barren Land
- Cultivated Crops
- Deciduous Forest
- Developed, High Intensity
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, Open Space
- Emergent Herb. Wetlnds
- Evergreen Forest
- Hay/Pasture
- Herbaceuous
- Mixed Forest
- Open Water

Figure: 3-1

LANDCOVER IN THE BUCKEYE WIND POWER PROJECT ACTION AREA

Source: 2001 National Land Cover Database; Homer et al. 2004

## 3.3 Other Wildlife in the Action Area

Vertebrate animals likely to use the Action Area are represented by those often detected in highly fragmented landscapes dominated by agriculture. Many of the animal species expected to occur are common and widely distributed throughout OH. Section 5.6 of the EIS will evaluate impacts from the Project to all wildlife species, both aquatic and terrestrial, and to their habitats. Most of the known biological effects of wind facilities relate to flying animals, i.e., birds and bats. The Buckeye Wind ABPP (Stantec 2011a) will provide details on bird and bat pre-construction surveys and how impacts to bird and non-federally listed bat species will be avoided, minimized, and mitigated.

### 3.3.1 Federal Threatened, Endangered, and Candidate Species

The Project lies within the range of several federally listed or proposed freshwater mussels, including: the clubshell mussel (*Pleurobema clava*), a federal and OH endangered species; the rabbitsfoot (*Quadrula cylindrica cylindrica*), a federal candidate and OH endangered species; and the snuffbox (*Epioblasma triquetra*), a federal and OH endangered species. The clubshell, rabbitsfoot, and snuffbox were once suspected to potentially occur in the Action Area in the Little Darby Creek. However in January 2011 the USFWS removed these 3 species from the list of federally listed or proposed species potentially present in Champaign County because current distribution and habitat data for the Little Darby Creek within Champaign County indicate it is not suitable for these species. Therefore, because no suitable habitat for these 3 mussel species exists within Champaign County and no suitable habitat will be impacted, this Project will have no effect on these species and they will not be considered further in this HCP (see EIS Section 5.7). The mitigation site lies within the range of the snuffbox mussel; however, the distribution of this species does not include the mitigation area. Therefore, there will be no effect on this species (M. Seymour, USFWS, personal communication).

The Action Area lies within the range of the rayed bean (*Villosa fabalis*), a freshwater mussel species currently listed as federally endangered (USFWS 2012b) and OH endangered. Suitable habitat for the rayed bean is still thought to be present in Champaign County. The rayed bean is generally known from smaller, headwater creeks but records exist in larger rivers. They are usually found in or near shoal or riffle areas of rivers and in the shallow, wave-washed areas of lakes. They occur only in water bodies that provide perennial water flow. Substrates typically include gravel and sand. The rayed bean is often associated with, and buried under the roots of vegetation such as water willow (*Justicia americana)* and water milfoil (*Myriophyllum* spp.).

The rayed bean is known from the Big Darby Creek watershed, of which the Little Darby Creek is a tributary. Portions of the Little Darby Creek that could be impacted by road and utility line crossings associated with the Project are ephemeral and do not contain features necessary to support mussel populations (Hull 2010). A field assessment in November 2008 found the Little Darby Creek crossing point to be dry (Hull 2009). The stream reach for this part of the Little Darby Creek was scored as 46 using the Headwaters Habitat Evaluation Index (HHEI), indicating that the reach is Class II intermittent headwaters habitat and the substrate is dominated by cobble and sand. Thus, the required perennial base flow and the preferred substrates of the rayed bean are not present in this reach of Little Darby Creek. Additionally, the rayed bean is often associated with the root masses of aquatic plants, which are not present in this reach (Hull 2009).

The rayed bean has the potential to occur in other perennial streams with suitable habitat within the Action Area. For perennial stream corridors that have the required base flow and substrate to support rayed bean mussels and will be crossed by access roads, crane paths and/or collection lines, a survey may be performed to detect the presence or absence of the rayed bean mussel. If rayed bean are determined to be present, in-water work will be avoided either through directional drilling, access road re-routing, arched bridge structures or temporary crossings (see Section 5.2.1.2 – Impacts to Aquatic Habitats). Additionally, Buckeye Wind will directionally drill beneath or otherwise avoid in-water work for any Ohio designated Exceptional Warmwater Habitat or Cold Water habitat streams[12] in the Action Area (i.e., underground crossings for electric collection lines) to avoid and minimize impacts to aquatic habitats. If no survey is performed, presence will be assumed and in-water work will be avoided as if rayed bean was determined to be present. If a survey is performed and no presence is detected, the stream will be crossed in accordance with the approaches outlined in Section 5.2.1.2 – Impacts to Aquatic Habitats.

Buckeye Wind has undertaken several steps to prevent adverse effects to water quality. An erosion and sediment control plan and Stormwater Pollution and Prevention Plan (SWPPP) will be developed and implemented for the entire Project, which will control potential sedimentation, siltation, and run-off that could negatively affect mussels and other aquatic life. Most mussel species require good water quality and erosion and sediment control measures implemented through the NPDES permit will preserve the existing water quality level. The SWPPP plan is developed and implemented by the general contractor and has not been developed, so it is not possible to know exactly where certain erosion and sediment control practices will be utilized. However, based on previous wind farm construction experience, typical erosion and sediment control best management practices may include: silt fences, filter socks, swales, temporary and permanent, mulching and seeding, infiltration berms, inlet and outlet protection, construction entrances, and orange construction fencing to protect wetlands located near disturbance areas. The ODNR Division of Soil and Water Resources' Rainwater and Land Development Manual will be used as a guide to determine the appropriate erosion and sediment control measures and the post-construction storm water practices to be used at the Project. The NPDES permit will also include restoration measures that will ensure that disturbed ground is stabilized, preventing ongoing erosion and sedimentation of storm water run-off. These restoration measures consist of revegetation (typically using native species; and depending upon the land use), regrading and permanent swales or catch basins as needed.

In summary, as a result of the avoidance measures and erosion and sediment control measures that will be implemented by Buckeye Wind and enforced by its NPDES permit during construction and decommissioning to avoid and minimize impacts to wetlands and streams, impacts to aquatic habitat will be minimal. There will be no effect on the rayed bean from construction, operation, maintenance, or decommissioning of the Project.

Similarly, mitigation lands are located within the range of the rayed bean. Streams that support suitable habitat for rayed bean mussel as described above will not be subjected to in-water disturbance, clearing of forested riparian vegetation, or other disturbance to the bed or banks of streams. Mitigation actions involving tree planting and invasive species control along stream corridors that provide suitable rayed bean habitat will be conducted using hand tools so as not to disturb the stream bank. If crossings of streams are

[12] According to Ohio Revised Code 3745-1-07, Exceptional Warmwater Habitat streams are capable of maintaining an exceptional or unusual community of warmwater aquatic organisms with the general characteristics of being highly intolerant of adverse water quality conditions and/or being rare, threatened, endangered or species of special status. This is the most protective use designation assigned to warmwater rivers and streams in Ohio. A Coldwater Habitat stream is capable of supporting populations of coldwater aquatic organisms on an annual basis and/or put-and-take salmonid fishing. These water bodies are not necessarily capable of supporting the successful reproduction of salmonids and may be periodically stocked with these species. Both are afforded special protections under Ohio's CWA provisions.

required at mitigation sites for vehicle access, arched bridge structures or temporary crossings that do not impact the stream bed or bank will be implemented or existing crossings will be used. Road building, earth grading and other activities that would result in ground disturbance and resulting soil erosion and sedimentation will not occur for mitigation activities. Thus, suitable habitat for rayed bean will not be impacted, there will be no effect on this species, and the rayed bean will not be addressed further in this HCP.

Additional information on these species and other state listed and sensitive species that occur in the Action Area and mitigation area will be discussed in detail in Section 5.7 of the EIS and in Appendix A, Table 1 of the ABPP (Stantec 2011a).

#### *3.3.1.1 Eastern Massasauga Rattlesnake*

The Action Area also lies within the range of the eastern massasauga rattlesnake (*Sistrurus catenatus*), a federal candidate species and OH endangered species. Eastern massasaugas use both upland and wetland habitat at different times during the year and therefore require wetland areas immediately adjacent to upland grassland. Early successional herbaceous or scrub-shrub wetlands are used primarily during the fall, winter, and spring. During the winter, massasaugas hibernate in low wet areas, primarily in crayfish burrows, but may also use other structures. The presence of a water table at or near the surface is an important component of a suitable hibernation area. During the summer, male and non-gravid female massasaugas use open, upland grassland or prairie habitat that may be intermixed with scattered trees or shrubs. Adjacent lowland and upland habitat, with variable elevations between, are critical as the snakes travel back and forth seasonally between habitats.

There are no known occurrences of eastern massasauga rattlesnakes in the Action Area (M. Seymour, USFWS, personal communication). However, the species is known to occur outside of the Action Area within Champaign and Clark counties (M. Cota, USFWS, personal communication). Therefore, a desktop habitat assessment was conducted using recent aerial photographs, NWI wetland mapping, and field delineated wetland boundaries to determine if suitable habitat for the massasauga is present within the Action Area. Specifically, emergent or scrub-shrub wetlands located immediately adjacent to upland grassland (e.g., native grassland, pasture, hayfield) were identified as potential habitat. Potential habitat areas identified during the desktop assessment were field-verified to determine if suitable habitat is present in the Action Area. The desktop assessment revealed that the majority of the small number of wetlands present in the Action Area do not have any adjacent grassland, and at those sites that do, the grassland present is very limited. Furthermore, while wetlands are present within the Action Area, there are no wetland impacts proposed as a result of construction, operation and decommissioning of the Project (refer to EIS Section 5.4 for further information on avoidance of wetland impacts). The only potential suitable habitat was a 20 ac wetland in the western portion of the Action Area. A habitat evaluation was conducted by USFWS and OH state eastern massasauga experts on 10 January 2012. It was determined that this 20 ac wetland contains suitable habitat for the eastern massasauga. Project activities and infrastructure will completely avoid this wetland and no loss of habitat would occur as a result of the Project. Additionally, Buckeye Wind worked with USFWS and ODNR DOW to relocate an access road that was previously located in close proximity to the wetland.

In order to avoid potential impacts to the eastern massasauga, a presence/absence survey approved by the USFWS and ODNR DOW may be conducted at the wetland. The survey would be conducted by a USFWS and ODNR DOW permitted and approved eastern massasauga herpetologist. If no eastern massasaugas are detected during the survey, no further avoidance and minimization measures will be necessary to be implemented for the Project. If presence is detected, or if a survey is not conducted before Project construction, presence will be assumed and the following measures will be implemented:

*Construction*

- To the extent practicable, all construction and decommissioning activities will be conducted between 15 Nov and 1 Mar.
- Any temporary ground disturbance for construction activities, as well as any construction of crane paths or buried or overhead interconnect will occur at least 50 ft from the delineated wetland.
- Buried silt fences will be installed between the planned Project facilities and the eastern massasauga habitat. These silt fences will be located at least 40 ft from the wetland.
    - An USFWS and ODNR DOW approved and state permitted herpetologist will survey for snakes during installation of the silt fencing to ensure there are no eastern massasauga present that could be impacted. If installation of the silt fencing occurs between 15 Nov and 1 Mar, the ODNR DOW permitted herpetologist will not be present.
    - When active construction activities are nearby, the buried silt fencing will be evaluated daily and maintained in a good upright condition until all construction activities in the area are complete.
- Speed limits within ½ mile around suitable habitat will be maintained at 10 mph.
- Wildlife crossing signs approved by the USFWS and ODNR DOW will be posted within ½ mile of the wetland. The signs will alert drivers to be aware of potential for road encounters with wildlife.
- Gates will be installed at the entrance points from public roads onto the access roads in proximity to the wetland.
- Construction personnel shall be made aware of the possible presence of eastern massasauga in the Action Area, that the eastern massasauga is protected by OH Revised Code (ORC), and that the snake is venomous and should not be handled. Personnel will be provided information on how to identify the eastern massasauga, including at minimum photos and description of defining features. Any snake that cannot be positively identified as not being an eastern massasauga should be completely avoided.
- If an eastern massasauga is encountered or suspected in the Action Area during construction, all work in or near the location of the eastern massasauga encounter should stop and the permitted and approved herpetologist should be immediately notified to ensure no potential risk to the snake occurs. ODNR DOW and USFWS should be contacted immediately for further direction.

*Operation and Maintenance*

- Speed limits within ½ mile around the wetland will be maintained at 10 mph.
- Wildlife crossing signs approved by USFWS and ODNR DOW will be posted within ½ mile of the wetland. The signs will alert drivers to be aware of potential for road encounters with wildlife.
- Gates will be installed at the access point from public roads onto the access roads in proximity to the wetland.
- O&M personnel shall be made aware of the possible presence of eastern massasauga in the Action Area, that the eastern massasauga is protected by ORC, and that the snake is venomous and should not be handled. Personnel will be provided information on how to identify the eastern massasauga, including at minimum photos and description of defining features. Any snake that cannot be positively identified as not being an eastern massasauga should immediately be reported to the site manager.
    - If an eastern massasauga is encountered, and at risk of impact from operation or maintenance activities, an ODNR DOW permitted herpetologist that is approved by the USFWS and ODNR DOW, will be enlisted to remove the snake from risk. The USFWS and ODNR DOW will be contacted within 24 hours.

*Decommissioning*

- Silt fencing will be installed between the wetland and decommissioning activities in the same way as during construction. All other avoidance measures implemented during construction will also be implemented during decommissioning.
    - An USFWS and ODNR DOW approved and state permitted herpetologist will survey for eastern massasauga during installation of the silt fencing to ensure there are no snakes present that could be impacted. If installation of the silt fencing occurs between 15 Nov and 1 Mar, the ODNR DOW permitted herpetologist will not be present.
    - When active decommissioning activities are nearby the buried silt fencing will be evaluated daily and maintained in a good upright condition until all decommissioning activities in the area are complete.

If at any point during the construction, operation, or decommissioning of the Project an eastern massasauga is observed, it will be photo documented if possible and the OH field office of the USFWS and the ODNR DOW will be notified immediately or within 24 hours. If the species is encountered, Buckeye Wind will work with the USFWS and ODNR DOW to determine if any other avoidance and minimization measures are needed.

The mitigation area lies within the range of the eastern massasauga; however, the distribution of the species does not include the mitigation area and no impacts are anticipated.

With implementation of the avoidance and minimization measures outlined above, including relocation of an access road near the wetland, Buckeye Wind believes that construction, operation maintenance and decommissioning of the Project is not likely to adversely affect the eastern massasauga. Any potential impacts to this species would likely be insignificant and discountable and this species will not be evaluated further in this HCP.

### 3.3.2 Other Sensitive Species

#### *3.3.2.1 Non-federally listed bats*

The Indiana bat is the only federally endangered or threatened species likely to be incidentally taken by the Project, and is therefore the only species to be covered by the ITP issued in association with this HCP. For information on non-federally listed bats, including long-distance migratory bat species, see Chapter 4.0 of the ABPP (Stantec 2011a) and Section 4.6 of the EIS.

One additional bat species that occurs in the Action Area has been petitioned for federal listing: the northern long-eared bat (*Myotis septentrionalis*, petitioned by the Center for Biological Diversity [CBD] 2010). Further, a status assessment of the little brown bat (*M. lucifugus*) is being completed to determine if threats to the species warrant listing. Proposed listing considerations for both species center around concern related to the potentially devastating effects of white-nose syndrome (WNS) on these species. While the eastern small-footed bat (*M. leibii*) was also petitioned for federal listing by the CBD, this species was not detected during mist net surveys in the tri-county area, and suitable habitat for the species does not exist within the Action Area; therefore, no potential impacts are anticipated for this species. The northern long-eared bat and eastern small-footed bat were added to the USFWS Region 3 federal list of Species of Concern, an informal term indicating species which Region 3 feels might be in need of conservation activities. The northern long-eared bat, eastern small-footed bat, and little brown bat are all listed as Species of Concern by ODNR DOW.

Both the northern long-eared bat and little brown bat were documented in the Action Area during summer mist-netting and fall swarming surveys conducted in 2009 (see Section 3.2.3 – Pre-construction Bat Surveys

Conducted). The big brown and tri-colored bats, which are listed by OH as Species of Concern, were also captured in pre-construction surveys (see the ABPP for further discussion of non-federally listed bat species). Although the northern long-eared bat, little brown bat, big brown bat and tri-colored bat are not included as covered species under this HCP, avoidance and minimization measures implemented to reduce impacts to Indiana bats, as described in Section 6.1 – Avoidance Measures and Section 6.2 – Minimization Measures, are expected to also substantially reduce mortality of these and other cave-hibernating bat species. Mitigation and conservation measures, as outlined in Section 6.3 – Mitigation Measures and Section 6.4 – Conservation Measures, that will be implemented as part of the HCP are also expected to offset potential take and enhance the reproductive potential and survival of species that share hibernacula, summer foraging, and roosting areas with the Indiana bat, including the northern long-eared bat and little brown bat. Additionally, conservation measures implemented under the HCP, including research on bat-wind interactions, may increase the effectiveness of avoidance and minimization measures and decrease risk to cave-hibernating bat species over time.

While the USFWS has suggested that Buckeye Wind consider including the northern long-eared bat and little brown bat as covered species in this HCP, Buckeye Wind has determined that such coverage is not feasible at this time. Should the northern long-eared bat, little brown bat, or other species likely to be impacted by the Project be proposed to be listed as an endangered or threatened species under the ESA during the 30-year ITP Term, Buckeye Wind will immediately enter into discussion with the USFWS to determine if an HCP amendment is appropriate. If take of these proposed species is likely, Buckeye Wind will seek to amend the HCP and ITP to include coverage for those proposed species, or other avenues for take coverage will be explored (see Section 7.2.1.1 – Listing of New Species under ESA for additional information on the HCP amendment process). Criteria for establishing take limits will be dependent on population information, mortality rates, and data on the effectiveness of various management actions available at the time that the species is determined to be listed.

Buckeye Wind also anticipates that 2 factors will contribute greatly to assessing impacts of the Project to the northern long-eared bat and/or little brown bat. First, Buckeye Wind is aware that USFWS is supporting efforts to develop a Regional HCP for the Indiana bat and other ESA threatened and endangered species and may also include the northern long-eared bat and the little brown bat. The approaches established in that Regional HCP process could offer useful input to the assessment of impacts to currently non-federally listed species. In addition, Buckeye Wind anticipates that post-construction monitoring results from this Project will provide data pertaining to the level of impact this Project might have on northern long-eared bats and little brown bats and how much the minimization measures implemented for Indiana bat impacts might reduce impacts to those species. Buckeye Wind expects that consultation with the USFWS would benefit from input derived from the Regional HCP and/or Project-specific post-construction monitoring results, and that this information could inform a HCP amendment process.

In the case that the northern long-eared bat or little brown bat is listed before an amendment is obtained, or before other take coverage is authorized, Buckeye Wind will take the appropriate actions pursuant to the ESA to avoid take.

#### *3.3.2.2 Bald and Golden Eagles*

Although "non-purposeful" take permits for bald eagles (OH threatened) or golden eagles may be issued under a new BGEPA take permit rule (50 CFR § 22.26 and § 22.27), Buckeye Wind is not pursuing this permit at this time because the Project is not expected to result in eagle take. Effects on bald and golden eagles are fully addressed within the ABPP and EIS.

Low numbers of migrating eagles were observed during pre-construction surveys; 1 bald eagle and 1 golden eagle were observed during each fall and spring 2008 raptor migration survey, and none was observed during the fall 2007 survey (i.e., 2 total bald eagles, 2 total golden eagles). The USFWS provided Buckeye Wind with documentation that private landowners observed 2 juvenile eagles within the southwestern portion of the Action Area during the spring and summer 2011. Additionally, a local newspaper reported and ran a photo of an adult bald eagle within the Action Area during fall 2009. The USFWS further investigated specific areas from the local reports of bald eagle activity and potential nests by conducting an on-site visual field inspection. No bald eagle nests or activity were observed (M. Cota, USFWS, personal communication).

Based on the best available scientific information, there is low potential for harm to breeding or nesting eagles as a result of the Project. Bald eagle nesting sites often occur in mature riparian habitat near lakes, large rivers, or sea coasts (USFWS 2009c), which do not occur in the Action Area. Features influencing nest location include distance to nearest water; diversity, abundance, and vulnerability of prey base; and absence of human development and disturbance. No bald eagles or golden eagles were observed during breeding bird surveys conducted at 90 observation points located within and in the vicinity of the Action Area and these points were each sampled 4 times during May, June, and July 2008. No known eagle nests occur within the Action Area and the nearest known eagle nest site is approximately 15.3 km (9.5 mi) from the Project boundary in Logan County along the Mad River (M. Seymour, USFWS, personal communication). Migrant and winter bald eagles also favor aquatic habitats with abundant food sources and roost in forested areas (USFWS 2009c). Habitat in the Action Area is not likely to attract significant numbers of eagles during the non-breeding season. In the Avian Knowledge Network database, no winter bald eagle records were found for Champaign County for December through February from 1991 to 2011 (Munson et al. 2011). However, should new information regarding eagle use of the Action Area become available from post-construction Breeding Bird surveys conducted by Buckeye Wind in accordance with ODNR Protocol, or from other verifiable information from public agencies during the 30-year term of the ITP, Buckeye Wind will work with USFWS to determine if potential risk exists and if an ITP under BGEPA is appropriate.

Recent post-construction monitoring studies at wind facilities (other than the Altamont Pass Wind Resource Area, CA) indicate that mortalities of eagles are very low; no bald or golden eagle mortality has been documented at wind projects in the eastern United States to date, though there have been reports of bald eagle fatalities in Ontario, Canada, MT and 2 in WY.

Buckeye Wind has taken steps to proactively avoid or minimize impacts to eagles. These measures are summarized briefly below and are described in more detail in Chapter 5.0 of the ABPP (Stantec 2011a). Collector lines will be buried where feasible, which will minimize the potential risk of electrocution and collision to eagles and other birds. It is anticipated that approximately 50.0% of the estimated 113.5 km (70.5 mi) of 34.5 kV interconnects for the 100-turbine Project will be buried underground. Under the Redesign Option, approximately 90.5% of the estimated 95.4 km (59.3 mi) of 34.5 kV electrical interconnect lines would be buried underground. Above-ground collector lines will be equipped with insulated and shielded wire to avoid electrocution of eagles and other birds. All above-ground electrical facilities will be designed in accordance with the Avian Power Line Interaction Committee (APLIC) guidelines developed jointly with the USFWS (APLIC 2006), where possible and as dictated by Dayton Power and

Light (DPL) construction guidelines[13]. New distribution poles, where possible and as dictated by DPL construction guidelines, will be designed and maintained so that they are insulated in order to protect eagles from electrocution for, at least, the duration of the ITP. Should insulating of lines associated with new poles not be possible, perch deterrents will be installed to prevent eagle perching activity. Measures will be implemented to avoid and reduce scavenging opportunities for raptors and eagles around the turbine locations.

The mitigation site is within the range of the bald eagle. However, no nests are currently known to occur within the mitigation site. Additionally, migrating or wintering bald eagles that pass through the mitigation area are not likely to be taken by mitigation activities. Therefore, no effect on bald eagles is expected from mitigation activities.

#### *3.3.2.3 Migratory Birds*

The construction and operation of wind facilities can result in both direct (immediate) and indirect (separate in time) impacts to migratory birds, which are protected by the MBTA. Bird mortality at wind facilities is well documented by recent studies, with some facilities resulting in greater impacts to particular species or species groups than others. The majority of avian fatalities at wind turbines have primarily involved nocturnally migrating songbirds, although mortality at wind facilities has been much lower than that caused by other tall man-made structures and other sources of anthropogenic avian mortality (Erickson et al. 2005). In addition to direct impacts, bird species may be indirectly affected by wind facilities as a result of displacement caused by habitat alteration, habitat loss, or human disturbance (Dewitt and Langston 2006).

In order to evaluate potential effect on migratory birds within the Action Area, a series of pre-construction studies were designed based on work plans developed in consultation with the USFWS and ODNR DOW to evaluate bird resources in the Initial Project Area. Study work plans were discussed and shared with the USFWS and ODNR DOW beginning in fall 2007. Several meetings were held in 2007 and 2008 to receive and discuss agency comments, several field visits were conducted with agency representatives, and members of both the ODNR DOW and the USFWS participated in several of the field studies. Agency comments and feedback were subsequently incorporated into final study protocols.

The following baseline migratory bird studies were conducted, which are included as appendices to the EIS:

- Radar studies to document nocturnally migrating birds and bats in fall 2007;
- Diurnal raptor migration surveys in fall 2007 and spring and fall 2008;
- Breeding bird surveys in spring and summer 2008; and
- Sandhill crane (*Grus canadensis*) migration surveys in fall 2008.

These baseline studies were completed to characterize the distribution, relative abundance, behavior, and site use of species of migratory birds. As part of the Tier Three evaluations these baseline studies were used to identify to what extent, if any, the development of the Project would expose these species to risk and

[13] While Buckeye Wind would own the wires that carry electricity from the turbines, the above-ground collection lines, including distribution poles, will be owned and maintained by DPL and subject to DPL construction guidelines. While it is likely that DPL will utilize APLIC guidelines, or similar, and Buckeye Wind will encourage the use of APLIC guidelines, it is not possible for Buckeye to commit to such measures. In the Redesign Option, above-ground collection lines will not be used, except for in very limited circumstances (see Section 1.1 – Overvew and Purpose of the HCP).

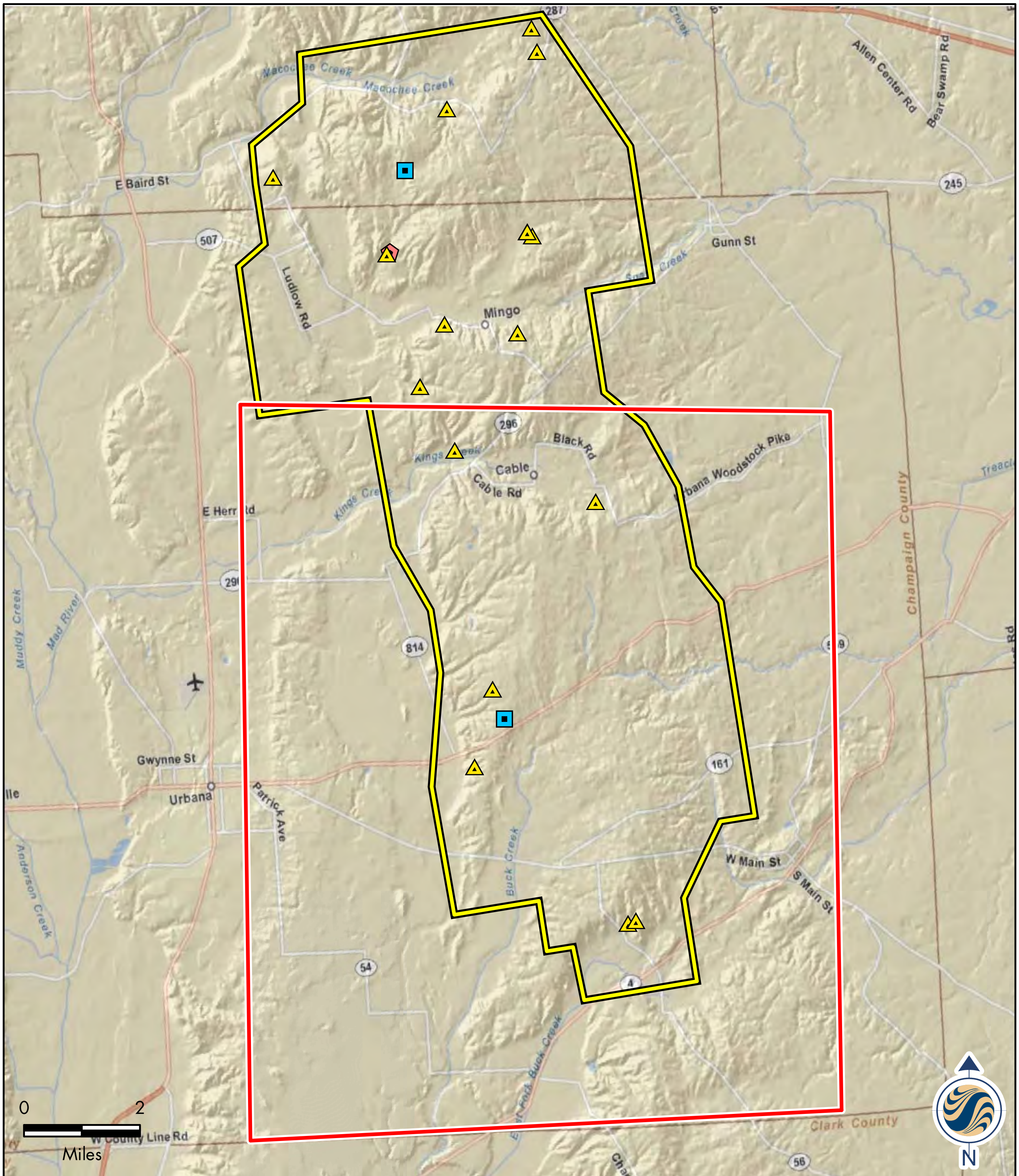
what additional studies or modeling were needed to assess those risks. The ABPP fully describes the results of these surveys.

Buckeye Wind has taken steps to proactively avoid or minimize impacts to migratory birds. These measures are described in more detail in Chapter 5.0 of the ABPP (Stantec 2011a). Further, the ABPP describes post-construction monitoring and adaptive management that will be conducted to document mortality levels of migratory birds and the triggers for implementation of measures to further reduce bird mortality.

### 3.3.3 Pre-Construction Bat Surveys Conducted

The following sections describe bat surveys that were conducted inside the initial study area, which included the Action Area (see Figure 3-2), and areas north of the Action Area (Stantec 2008a, Stantec 2008b, Stantec 2009a). The purpose of these surveys was to examine bat use within the initial study area and determine presence or probable absence of Indiana bats. As described in Section 1.1 – Overview and Purpose of the HCP, the initial study area was subsequently reduced due to documented presence of Indiana bats at the northern extent of the initial study area. The following bat surveys were conducted with all protocols developed cooperatively and in coordination with the ODNR DOW and the USFWS Ohio Ecological Services Field Office:

- Bat acoustic surveys using 6 acoustic detectors at 2 MET towers in fall 2007 and spring through fall 2008;
- Bat mist-netting surveys in summer 2008;
- Surveys to detect potential hibernacula at 14 known or suspected karst areas in 2008; and,
- Bat swarming surveys at 2 cave openings in fall 2008.

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Legend:

- Action Area
- Initial Study Area
- Bat Detector Location
- Mist Net Location
- Swarm Survey Location

Figure: 3-2

BUCKEYE WIND POWER PRE-CONSTRUCTION SURVEY LOCATIONS

#### *3.3.3.1 Acoustic Bat Surveys*

Acoustic bat call sequences were recorded using 6 Anabat SD1 detectors (Titley Electronics Pty Ltd.) at 2 MET towers from 28 August 2007 to 29 October 2007 (Stantec 2008a) and 29 March 2008 to 3 September 2008 (Stantec 2009a). One MET tower was located in the central portion of the Action Area, and another was located within the initial study area, but 6.2 km (3.8 mi) north of the Action Area. Three acoustic bat detectors were placed at each of the "North" and "South" MET towers (Table 3-2) at heights of 2 m (7 ft; "Tree"), 20 m (66 ft "Low"), and 40 m (131 ft "High") agl.

A total of 1,522 bat call sequences were recorded over 226 detector-nights during fall 2007, for a mean nightly detection rate of 6.7 call sequences per detector per night (s/d/n) (Stantec 2008*a*; Table 3-2). The majority of recorded bat call sequences (48%) were identified to the unknown (UNKN) guild, followed by those identified to the big brown bat (*Eptesicus fuscus*)/silver-haired bat (*Lasionycteris noctivagans*) /hoary bat (*Lasiurus cinereus*) (BBSHHB) guild (34%), the eastern red bat (*Lasiurus borealis*)/tri-colored bat (*Perimyotis subflavus*) (RBTB) guild (18%), and the *Myotis* (MYSP) guild (<1%). Twenty-six percent of call sequences across all guilds, and only 1 MYSP call sequence, were recorded at detectors at the 40 m (131 ft) height.

**Table 3-2.** Distribution of bat acoustic detections by guild at 2 60-m MET towers at the Buckeye Wind Power Project, Champaign County, OH, and initial study area, 28 August 2007 to 29 October 2007.

| | Guild | | | | |
|---|---|---|---|---|---|
| **Detector** | **Big brown silver-haired hoary bat (BBSHHB)** | **Red bat tri-colored bat (RBTB)** | **Myotis (MYSP)** | **Unknown (UNKN)** | **Total** |
| North High: 40 m (131 ft) | 101 | 5 | 1 | 69 | 176 |
| North Low: 20 m (66 ft) | 134 | 13 | 3 | 125 | 275 |
| North Tree: 2 m (6.5 ft) | 1 | 3 | 1 | 83 | 88 |
| South High: 40 m (131 ft) | 119 | 3 | 0 | 100 | 222 |
| South Low: 20 m (66 ft) | 45 | 2 | 1 | 32 | 80 |
| South Tree: 2 m (6.5 ft) | 110 | 253 | 0 | 318 | 681 |
| Total | 510 | 279 | 6 | 727 | 1,522 |
| Guild Composition | 34% | 18% | <1% | 48% | NA |

A total of 18,715 bat call sequences were recorded over 774 detector-nights during spring through fall 2008, for a mean nightly detection rate of 23.7 s/d/n (Stantec 2009a; Table 3-3). The majority of calls recorded across all detectors (60%) were identified to the big brown/silver-haired bat (BBSH) guild (separated from the BBSHHB guild in 2008), followed by the UNKN (32%), RBTB (4%), MYSP (3%), and hoary bat (HB; 1%) guilds. Four percent of call sequences across all guilds, and 1% of MYSP call sequences were recorded at detectors placed at 40 m (131 ft) agl. Mean nightly detection rate was variable across seasons, with the highest rates recorded during the fall sampling period.

**Table 3-3.** Distribution of bat acoustic detections by guild at 2 60-m MET towers at the Buckeye Wind Power Project, Champaign County, OH and surrounding vicinity, 29 March 2008 to 3 September 2008.

| | Guild | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Unknown | | | |
| Detector | Big brown silver-haired (BBSH) | Hoary (HB) | Red bat tri-colored bat (RBTB) | Myotis (MYSP) | High frequency (HFUN) | Low frequency (LFUN) | Unknown (UNKN) | Total |
| North High: 40 m (131 ft) | 91 | 9 | 20 | 4 | 35 | 112 | 1 | 272 |
| North Low: 20 m (66 ft) | 495 | 17 | 173 | 21 | 249 | 318 | 32 | 1,305 |
| North Tree: 2 m (6.5 ft) | 7,891 | 44 | 333 | 546 | 1,586 | 1,312 | 200 | 11,912 |
| South High: 40 m (131 ft) | 120 | 29 | 25 | 4 | 44 | 161 | 1 | 384 |
| South Low: 20 m (66 ft) | 343 | 24 | 70 | 4 | 102 | 304 | 3 | 850 |
| South Tree: 2 m (6.5 ft) | 2,298 | 25 | 96 | 24 | 423 | 1,046 | 80 | 3,992 |
| Total | 11,238 | 148 | 717 | 603 | 2,439 | 3,253 | 317 | 18,715 |
| Guild Composition | 60% | 1% | 4% | 3% | 13% | 17% | 2% | |

#### *3.3.3.2 Bat Mist-Netting Surveys*

A total of 298 bats were captured during mist-netting surveys that were conducted on 75 net-nights between 17 June 2008 and 25 July 2008 (Stantec 2008b). Mist-net sampling effort was conducted in portions of both the current Action Area and the initial study area to the north. While the initial study area to the north was originally assessed, it was later excluded from the Action Area when the presence of Indiana bats was detected in 2008 as described in Section 1.1 – Overview and Purpose of the HCP.

The average capture rate was 4.0 bats per net per night (b/n/n). A total of 7 bat species were captured, with big brown bats consisting of 66% of all captures, followed by northern long-eared bats (13%), eastern red bats (12%), little brown bats (6%), hoary bats (1%), tri-colored bats (1%), and Indiana bats (1%) (Table 3-4). Reproduction of all 7 species was documented through the capture of reproductive females. Two reproductive adult female Indiana bats and 1 non-reproductive adult male Indiana bat were captured and radio-tagged north of the Action Area, with the closest capture location approximately 7.8 km (4.8 mi) north, in Logan County.

**Table 3-4.** Bat species captured during summer 2008 mist-netting in the Buckeye Wind Power Project Action Area and initial study area, Champaign and Logan Counties, OH (values in parentheses represent juvenile bats; values not in parentheses represent adults).

| Species | Males | Females | Unknown | Total (% of total) |
|---|---|---|---|---|
| Big brown bat | 51 (39) | 87 (19) | 1 | 197 (66%) |
| Northern long-eared | 21 | 16 (1) | 0 | 38 (13%) |
| Eastern red bat | 8 (4) | 12 (8) | 4 | 36 (12%) |
| Little brown bat | 12 (2) | 4 | 0 | 18 (6%) |
| Hoary bat | 0 | 1 (2) | 0 | 3 (1%) |
| Tri-colored bat | 1 | 2 | 0 | 3 (1%) |
| Indiana bat | 1 | 2 | 0 | 3 (1%) |
| All Species | 94 (45) | 124 (30) | 5 | 298 |

#### *3.3.3.3 Bat Swarming Surveys*

Bat swarming surveys were conducted in fall 2008 at 2 cave openings (Sanborn's Cave and a nearby, unnamed cave) located approximately 6.3 km (3.9 mi) north of (outside) the Action Area and within the initial study area (Stantec 2009a). At total of 884 bats were captured during 5 capture events from 15 September 2008 to 27 October 2008 using harp traps placed at cave openings and a mist-net across a nearby stream during 1 capture event. Northern long-eared bats were the most common species captured during swarming surveys (74%), with males representing 58% of all northern long-eared bats captured. The second most frequently captured species was the little brown bat, representing 23% of all bats captured (Table 3-5). Males represented the majority (82%) of all little brown bats captured. The least frequently captured bats were tri-colored bats (2%) and big brown bats (1%). No Indiana bats were captured during the fall 2008 swarming surveys. A survey of 14 areas with known or suspected karst geologic features was also conducted in the vicinity of the Action Area during 2008; no features capable of hosting bats were documented at any of the areas surveyed.

**Table 3-5.** Bat species captured during fall 2008 swarming surveys at Sanborn's Cave and a nearby, unnamed cave located in Logan County, OH, approximately 6.3 km (3.9 mi) north of the Buckeye Wind Power Project Action Area.

| Species | Males | Females | Unknown | Total (% of total) |
|---|---|---|---|---|
| Northern long-eared | 380 | 250 | 23 | 653 (74%) |
| Little brown bat | 164 | 37 | 0 | 201 (23%) |
| Tri-colored bat | 9 | 9 | 0 | 18 (2%) |
| Big brown bat | 10 | 2 | 0 | 12 (1%) |
| All Species | 563 | 298 | 23 | 884 |

### *3.3.3.4 Other bat surveys within Action Area*

Fifty bats were captured during summer 2009 bat mist-net surveys conducted for an unrelated wind power project in an area that overlapped with the Action Area. Mist-netting was conducted at 17 net sites, 136 net nights, from 15 June 2009 to 6 July 2009 (Jackson Environmental Consulting Services, LLC, 2009) (Table 3-6).

**Table 3-6.** Bat species captured during summer 2009 for an unrelated wind power project that is completely within the Buckeye Wind Power Project Action Area.

| Species | Males | Females | Unknown | Total (% of total) |
|---|---|---|---|---|
| Northern long-eared | 7 | 9 | 1 | 17 (34%) |
| Big brown bat | 7 | 15 | 0 | 22 (44%) |
| Indiana bat | 0 | 4 | 1 | 5 (10%) |
| Eastern red bat | 2 | 2 | 0 | 4 (8%) |
| Little brown bat | 0 | 2 | 0 | 2 (4%) |
| All Species | 16 | 32 | 2 | 50 |

# 4.0 COVERED SPECIES: THE INDIANA BAT (*MYOTIS SODALIS*)

The Indiana bat is a small (7 g to 10 g), insectivorous bat. It was not described as a separate species until 1928 (Miller and Allen 1928) from a specimen collected in Wyandotte Cave, Crawford County, IN. The Indiana bat can be distinguished from other *Myotis* (particularly the little brown bat) by its short, inconspicuous toe hairs; smaller foot (8 millimeters [mm; 0.31 inch (in)] instead of 9 mm to 10 mm [0.35 in to 0.39 in] in the little brown bat); keeled calcar; more uniformly colored fur; and its pinkish colored pug-nose (Whitaker and Hamilton 1998). Albino and partially white bats have rarely been encountered during hibernacula surveys (Brack et al. 2005).

The range of the Indiana bat includes the eastern and mid-western United States, from IA, OK, and WI, northeast to VT, and south to northwestern FL and northern AK (Barbour and Davis 1969). Although the species has a large distribution, the majority of the wintering population occurs in the limestone cave regions of IN, KY, and MO. More recently, large colonies have been found in abandoned underground mines in IL and OH.

## 4.1 Species Status

Since its description as a separate species, Indiana bat populations have experienced marked population declines. The species was listed as being in danger of extinction in 1967 under the Endangered Species Preservation Act of 1966 (32 Fed. Reg. 4001, 11 March 1967) because of large decreases in population size and an apparent lack of winter habitat (USFWS 1983, 1999). It was later listed as federally endangered under the ESA in 1973.

The Indiana bat is also listed as endangered in the state of Ohio under Ohio Revised Code 1531.25. The first Indiana bat maternity colony was discovered in Ohio in 1974 (ODNR DOW n.d.). In 2007 and 2009, approximately 7,600 and 9,200 Indiana bats, respectively, were observed hibernating in Ohio (Table 4-1). These population estimates represent 1.6% and 2.4% of the 2007 and 2009 rangewide Indiana bat population, respectively.

A final ruling on critical habitat for the Indiana bat was established on 24 September 1976 (41 Fed. Reg. 41914) and included 11 caves and 2 mines. Designated critical habitat occurs in 6 states and includes: Blackball Mine (LaSalle County, IL), Big Wyandotte Cave (Crawford County, IN), Ray's Cave (Greene County, IN), Bat Cave (Carter County, KY), Coach Cave (Edmonson County, KY), Cave 021 (Crawford County, MO), Caves 009 and 017 (Franklin County, MO), Pilot Knob Mine (Iron County, MO), White Oak Blowhole Cave (Blount County, TN), and Hellhole Cave (Pendleton County, WV). No USFWS-designated Indiana bat critical habitat occurs in the Action Area or anywhere else in OH.

The first Indiana Bat Recovery Plan, published by the USFWS in 1983, outlined the Indiana bat's habitat requirements, critical habitat, potential causes for declines, and recovery objectives. In 1999, the USFWS published the *Agency Draft Indiana Bat (Myotis sodalis) Revised Recovery Plan* (USFWS 1999). In 2007, the USFWS completed an extensive literature search and provided updated information on the Indiana bat in the revised *Indiana Bat (Myotis sodalis) Draft Recovery Plan: First Revision* (hereafter 2007 Draft Recovery Plan; USFWS 2007). Like its predecessor, the 2007 Draft Recovery Plan focused on protection of hibernacula but also increased the focus on summer habitat and proposed use of 4RUs: Ozark-Central, Midwest, Appalachian Mountains, and Northeast (Figure 4-1). A combination of preliminary data on population discreteness and genetic differentiation (mostly associated with the Northeast RU), differences in population trends, and broad-level differences in macrohabitats and land use were used to delineate RU boundaries (USFWS 2007).

The Indiana bat population is not panmictic; i.e., movements of individuals and gene flow seem to be generally restricted to RU boundaries (USFWS 2007, see Section 4.4.3.2 – Migration Direction and Behavior). Since the Project is located in the Midwest RU, Project-related impacts are expected to occur in the Midwest RU population. However, due to paucity of data across the Indiana bat range, discussion of the Indiana bat and Project impacts will rely on Indiana bat information collected from all RUs as appropriate.

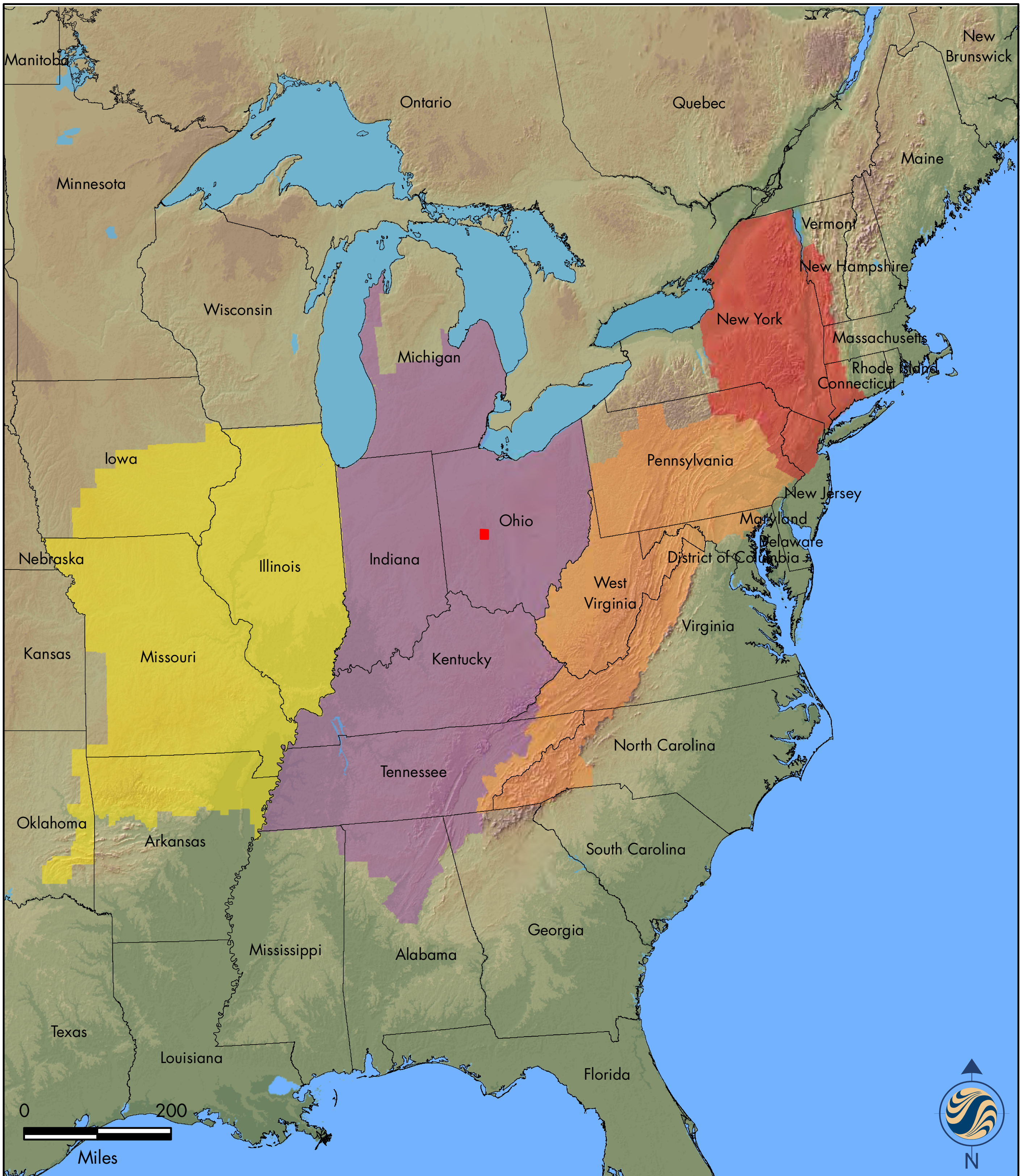
The 2007 Draft Recovery Plan revised Indiana bat priority criteria for hibernacula to be defined as follows:

- Priority 1 (P1): Essential to recovery and long-term conservation of Indiana bats. P1 hibernacula typically have (1) a current and/or historically observed winter population equal to or more than 10,000 Indiana bats and (2) currently have suitable and stable microclimates. P1 hibernacula are further divided into 1 of 2 subcategories, "A" or "B," depending on their recent population sizes.
    - Priority 1A (P1A) hibernacula are those that have held 5,000 or more Indiana bats during 1 or more winter surveys conducted during the past 10 years.
    - Priority 1B (P1B) hibernacula are those that have sheltered equal to or greater than 10,000 Indiana bats at some point in their past, but consistently have contained fewer than 5,000 Indiana bats over the past 10 years.
- Priority 2 (P2): Contributes to recovery and long-term conservation of Indiana bats. P2 hibernacula have a current or observed historic population of 1,000 or greater but fewer than 10,000, and an appropriate microclimate.
- Priority 3 (P3): Contribute less to recovery and long-term conservation of Indiana bats. Priority 3 hibernacula have current or observed historic populations of 50 to 1,000 Indiana bats.
- Priority 4 (P4): Least important to recovery and long-term conservation of Indiana bats. P4 hibernacula typically have current or observed historic populations of fewer than 50 Indiana bats.

In 2009, the first species-specific Five-Year Review was conducted for the Indiana bat since its listing (USFWS 2009a).

From 1965 to 2001, there was an overall decline in the rangewide population of the Indiana bat (USFWS 2007). Despite the discovery of many new, large hibernacula during this time, the rangewide population estimate dropped approximately 57% from 1965 to 2001. Since the advent of systematic survey efforts to estimate population numbers, some specific drivers have been clearly associated with positive and negative population trends at some of the largest hibernacula (e.g., changes in cave air flow and temperatures, and human disturbance levels), but the underlying causes of population change at other hibernacula remain unknown.

Contrary to the apparent long-term trend of decreasing population numbers of Indiana bats, the estimated rangewide population increased from 328,526 Indiana bats in 2001 to 468,181 Indiana bats in 2007 (USFWS 2010, Table 4-1). During the 3 biennial survey periods from 2001 to 2003, 2003 to 2005, and 2005 to 2007, the rangewide population increased by 10.8%, 16.9%, and 10.1%, respectively. Despite lack of standardization in measuring and reducing sources of variability in estimates, observer error, and lack of statistical accuracy, the USFWS regarded the apparent upward trend from 2003 to 2005 to be reliable due to a high level of surveyor consistency and obvious, large increases at some high-priority hibernacula in IL, IN, KY, and NY during that time (USFWS 2007).

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Legend:
Action Area
**Indiana Bat USFWS Recovery Units**
Appalachian Mountains
Midwest
Northeast
Ozark-Central

*Source: USFWS 2007

Figure: 4-1

INDIANA BAT
*(Myotis sodalis)*
USFWS RECOVERY UNITS

**Table 4-1.** Population estimates for the Indiana bat (*Myotis sodalis*) by USFWS region, state, and year with percent change in population from 2007 and percent of 2009 rangewide total (USFWS 2010).

| USFWS Region | State | 2001 | 2003 | 2005 | 2007 | 2009 | Change from 2007 | Percent of 2009 Total |
|---|---|---|---|---|---|---|---|---|
| Region 2 | Oklahoma | 0 | 5 | 2 | 0 | 0 | 0.00% | 0.00% |
| Region 3 | Indiana | 173,111 | 183,337 | 206,610 | 238,026 | 189,994 | -20.20% | 49.00% |
| | Missouri | 18,999 | 17,752 | 16,102 | 15,895 | 13,674 | -14.00% | 3.50% |
| | Illinois | 21,677 | 43,646 | 55,166 | 54,095 | 53,276 | -1.50% | 13.70% |
| | Ohio | 9,817 | 9,831 | 9,769 | 7,629 | 9,261 | 21.40% | 2.40% |
| | Michigan | 20 | 20 | 20 | 20 | 20 | 0.00% | 0.00% |
| | Total | 223,624 | 254,586 | 287,667 | 315,665 | 266,225 | -15.70% | 68.60% |
| Region 4 | Kentucky | 51,053 | 49,544 | 65,611 | 71,250 | 57,325 | -19.50% | 14.80% |
| | Tennessee | 9,564 | 9,802 | 12,074 | 8,906 | 12,721 | 42.80% | 3.30% |
| | Arkansas | 2,475 | 2,228 | 2,067 | 1,829 | 1,480 | -19.10% | 0.40% |
| | Alabama | 173 | 265 | 296 | 258 | 253 | -1.90% | 0.10% |
| | N. Carolina | 0 | 0 | 0 | 0 | 1 | 0.00% | 0.00% |
| | Total | 63,265 | 61,839 | 80,048 | 82,243 | 71,780 | -12.70% | 18.50% |
| Region 5 | New York | 29,671 | 32,981 | 41,702 | 52,783 | 32,734 | -38.00% | 8.40% |
| | Pennsylvania | 702 | 931 | 835 | 1,038 | 1,031 | -0.70% | 0.30% |
| | W. Virginia | 9,714 | 11,444 | 13,417 | 14,745 | 14,855 | 0.70% | 3.80% |
| | Virginia | 969 | 1,158 | 769 | 723 | 730 | 1.00% | 0.20% |
| | New Jersey | 335 | 644 | 652 | 659 | 416 | -36.90% | 0.10% |
| | Vermont | 246 | 472 | 313 | 325 | 64 | -80.30% | 0.00% |
| | Total | 41,637 | 47,630 | 57,688 | 70,273 | 49,830 | -29.10% | 12.80% |
| | Rangewide Total: | 328,526 | 364,060 | 425,405 | 468,181 | 387,835 | -17.20% | 100.00% |

The first observed Indiana bat rangewide decline since 2001 was documented from 2007 to 2009 when the overall Indiana bat population declined by approximately 17% (i.e., loss of approximately 80,346 Indiana bats) (USFWS 2010). In 2009, the Midwest RU contained two-thirds (66.7%) of the rangewide Indiana bat population followed by the Ozark-Central RU (17.6%), Northeast RU (8.6%) and Appalachian Mountains RU (7.1%). Between 2007 and 2009, the Indiana bat population in the Appalachian Mountains RU increased 23.2% (5,163 Indiana bats), whereas populations in the other 3 RUs declined (Midwest: 19.2%, 61,567 Indiana bats; Ozark-Central: 4.7%, 3,389 Indiana bats; and Northeast: 38.2%, 20,553 Indiana bats) (USFWS 2010). The observed decline (38.2%) from 2007 to 2009 in the Northeast RU was primarily the result of Indiana bat mortality associated with the onset and spread of WNS (A. King, USFWS, personal communication), described in detail in Section 4.1.1 – White-Nose Syndrome.

The overall population decline within the Midwest RU between 2007 and 2009 (a net loss of approximately 61,567 Indiana bats) was attributable to reductions reported for 1 hibernaculum in KY and 4 hibernacula in IN. WNS had not been detected at these sites. Following the 2009 winter surveys, the USFWS's Bloomington Field Office (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, personal communication). 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 IN (e.g., Ray's, Wyandotte, and Grotto Caves) in 2009 and subsequently exaggerated the decline in the Midwest RU to some degree (USFWS 2010; A. King, USFWS, personal communication). The BFO's analysis indicated that a significant proportion of the observed decline in the Midwest RU between 2007 and 2009 was directly attributable to error inherent with the traditional survey techniques employed at hibernacula in IN. The USFWS and its partners continue to investigate potential causes that may have contributed to any unexpected or unusual population declines and continue to research and develop new survey techniques in an ongoing effort to improve both the accuracy and consistency of their bat population estimates throughout the species' range.

The 2007 Draft Recovery Plan identified the Recovery Priority for the Indiana bat as an 8, meaning there is a moderate degree of threat and high recovery potential for the species. In order to achieve the intermediate recovery goal of reclassifying the Indiana bat as federally threatened instead of endangered, the 2007 Draft Recovery Plan identified the following draft Reclassification Criteria:

1. Permanent protection of 80% of P1 hibernacula in each RU;
2. A minimum overall population number equal to the 2005 estimate (457,000); and
3. Documentation of a positive population growth rate over 5 sequential survey periods.

The Indiana bat will be considered for complete delisting when the above draft Reclassification Criteria have been met and the following additional criteria have been achieved:

1. Permanent protection of 50% of P2 hibernacula in each RU;
2. A minimum overall population number equal to the 2005 estimate, and
3. Continued documentation of a positive population growth rate over an additional 5 sequential survey periods.

According to the 2007 Recovery Plan, if future research on summer habitat requirements indicates the quality and quantity of maternity habitat is threatening recovery of the species, the USFWS will amend the Reclassification Criteria as follows.

1. Reclassification to Threatened
    a. Permanent protection of a minimum of 80% of P1 hibernacula in each RU, with a minimum of 1 P1 hibernaculum protected in each unit.
    b. A minimum overall population estimate equal to the 2005 population estimate of 457,000.
    c. Documentation that shows important hibernacula within each RU have a positive annual population growth rate over the next 10-year period (i.e., 5 survey periods).

2. Complete Delisting
    a. Permanent protection of a minimum of 50% of P2 hibernacula in each RU.
    b. A minimum overall population estimate equal to the 2005 population estimate of 457,000.
    c. Documentation that shows a positive population growth rate within each RU over an additional 5 sequential survey periods (i.e., 10 years).

### 4.1.1 White-Nose Syndrome

The 2007 Draft Recovery Plan does not address Indiana bat population decreases that have occurred as a result of WNS, a disease that is responsible for the death of hundreds of thousands of hibernating bats in the eastern United States from 2006 to 2010 (USFWS 2009a). Recent studies have discovered that WNS is associated with a newly-described 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. The skin infection caused by *G. destructans* is thought to act as a chronic disturbance during hibernation (USGS 2010). Infected bats exhibit premature arousals, aberrant behavior, and premature loss of critical fat reserves which is thought to lead to starvation prior to spring emergence (Frick et al. 2010). Although it is not certain whether *G. destructans* is the primary cause of death or a secondary infection (Blehert et al. 2009), the fungus is directly associated with the deaths of bats (Puechmaille et al. 2010) and is widely considered to be the causal agent of WNS (USGS 2010). No other bacterial or viral agents have been detected through necropsies (CBD 2010).

WNS was first documented in bats in Schoharie County, NY, and mortality was confirmed at 4 sites in eastern NY in winter 2006-2007. WNS continued to spread and by the end of winter 2008-2009, all known WNS-affected hibernacula were in states located within USFWS Region 5 (R5; the Northeast Region). However, by March 2010 the presence of *G. destructans* had been confirmed or suspected in USFWS Regions R2 (Southwest), R3 (Midwest), R4 (Southeast), and R5 (Figure 4-2). Currently, WNS has been confirmed in 18 states and is suspect in an additional 2 states (Figure 4-2). The origin of WNS remains uncertain, although anthropogenic introduction of the disease, via commerce or travel from Europe, is a plausible hypothesis (Frick et al. 2010). In Ohio, WNS was confirmed in 2011 in a P4 hibernaculum in Lawrence County, Ohio, and in 2012 in Preble County, OH, home to a P2 Indiana bat hibernaculum. WNS has also been confirmed in Summit, Geauga, Cuyahoga, and Portage counties, OH (Jennifer Norris, ODNR, personal communication).

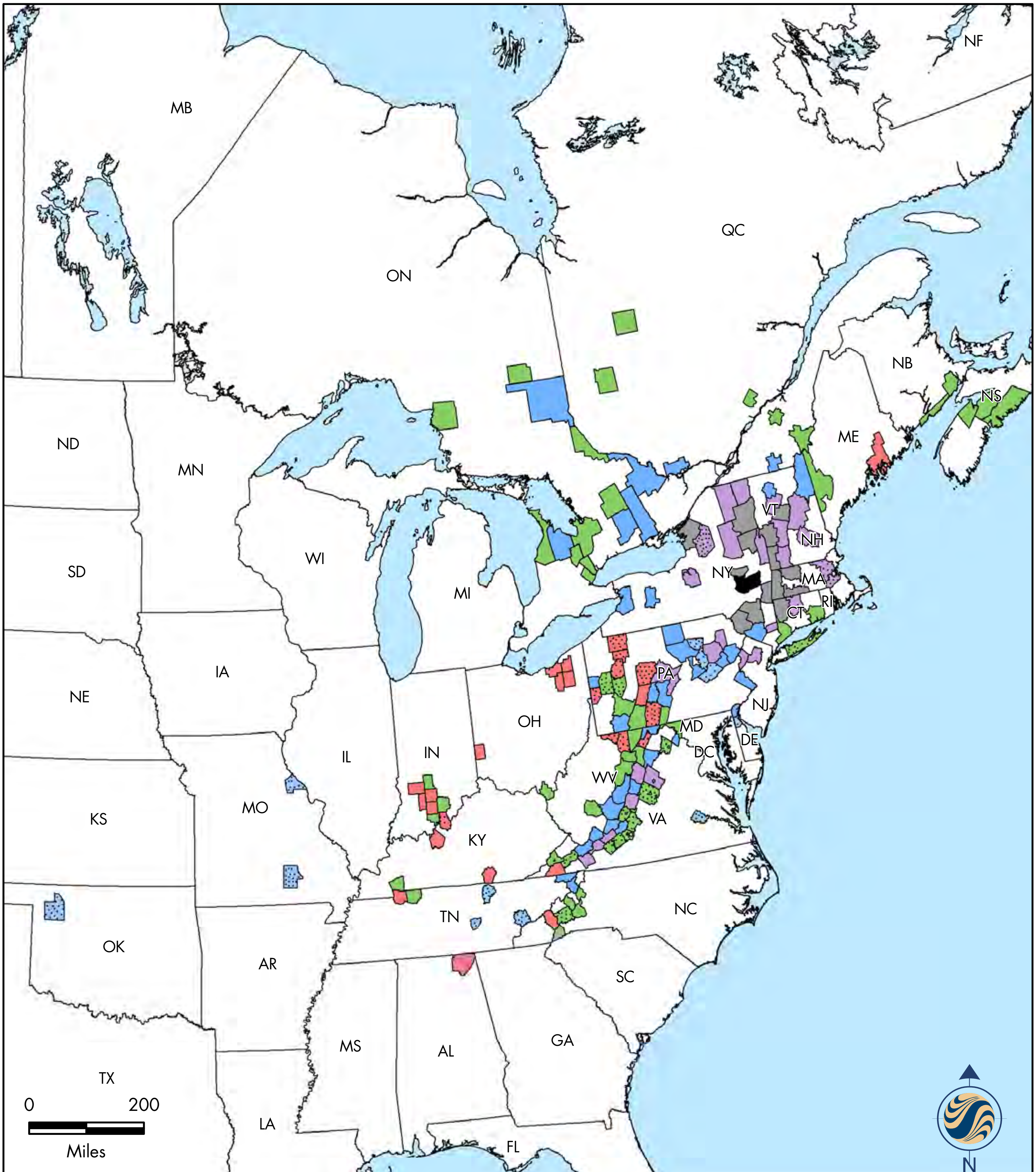
In Canada, WNS was documented in southern Ontario and Quebec in 2010 and New Brunswick and Nova Scotia in 2011 (Ontario Ministry of Natural Resources [OMNR] 2010, Figure 4-2). In Europe, WNS has been detected in southwestern France (Puechmaille et al. 2010), Switzerland, Hungary, and Germany (Wibbelt et al. 2010). However, no mass casualties have been detected among Europe's infected bats (Puechmaille et al. 2010, Wibbelt et al. 2010). Wibbelt et al. (2010) hypothesize that *G. destructans* is present throughout Europe and that bats in Europe may be more immunologically or behaviorally resistant to *G. destructans* than their North American congeners because they potentially coevolved with the fungus.

WNS is causing unprecedented mortality among at least 6 species of hibernating bats in North America (Frick et al. 2010): eastern small-footed bat, little brown bat, northern long-eared bat, tri-colored bat, big brown bat, and Indiana bat (USGS 2010). Other species affected include the cave myotis (*Myotis velifer*) and gray bat (*M. grisescens*). Until recently, Indiana bats were the only federally listed species known to be affected by WNS. However, in spring 2010 WNS was confirmed in 5 gray bats, also listed as federally endangered, in Shannon County, MO (Bat Conservation International [BCI] 2010a). All 25 species of bat in the United States that rely on hibernation may potentially be affected by WNS (USGS 2010). An estimated 5.7 to 6.7 million bat fatalities have occurred since WNS was first recorded in 2007 (USFWS 2012a); infected hibernacula are experiencing annual population decreases ranging from 30% to 99%, with a mean of 73% throughout eastern North America (Frick et al. 2010). Total mortality averaged 95% at closely monitored WNS hibernaculum that had multiple years of infection in NY, MA, and VT in 2009 (A. Hicks, New York State Department of Environmental Conservation, personal communication, as cited by Turner and Reeder 2009).

While it has been estimated that WNS is spreading at a rate of 24.1 km (15 mi) to 32.2 km (20 mi) per year (Turner and Reeder 2009), the recent documentation of WNS across large and disjunct geographic areas indicates that the spread is more rapid and far-reaching than originally thought. The mechanisms for persistence and transmission of the fungus during summer and fall months are currently unknown, but the spread of the fungus to new geographic regions and between species may result from social and spatial mixing of individuals across space and time, particularly at winter hibernacula (Frick et al. 2010). Laboratory experiments have observed bat-to-bat transmission of *G. destructans*. Additionally, the fungus has been collected from soils of affected hibernacula, indicating that environmental factors may play a role in WNS transmission (BCI 2010b). Further discussion of WNS and its potential future impact on Indiana bats and the ESA listing of other bat species with regard to this HCP is included in Section 5.1.2.6 – Biological Significance of Incidental Take and Section 7.2.1 Changed Circumstances.

The disease may also be impacting bat populations by lowering the reproductive rates of surviving colony members (Frick et al. 2009). Most of the affected bat species, including the Indiana bat, exhibit life history strategies which are dependent on relatively high survival rates and long-lived individuals. Because reproductive rates are naturally low among affected bat species, populations are not adapted to fluctuate significantly over time and consequently will not recover from WNS quickly (USGS 2010). Given the extremely rapid proliferation of WNS over a large geographic area in just 4 winter seasons, it is likely that similar declines will occur at hibernacula in other states in the coming years. WNS and other causes of population decline will also be discussed in Section 4.5 – Current Threats.

In 2007, before widespread WNS mortality of Indiana bats had been documented, hibernacula in R5 states (primarily NY) contained approximately 70,273 Indiana bats or 15% of the total 2007 rangewide population. Since 1965, the NY hibernating populations of Indiana bats steadily increased and in 2007 they represented 11% of the rangewide population (USFWS 2009a). By the end of winter 2008-2009, WNS had been documented in each NY major Indiana bat hibernacula. The 38% decline in the NY Indiana bat population observed from 2007 to 2009 is assumed to be a direct result of WNS-related mortality (A. King, USFWS, personal communication). The loss of 20,049 Indiana bats in NY from WNS during this period represented a loss of approximately 4% of the 2007 rangewide population (Table 4-1). As of winter 2010-2011, 74 hibernacula supporting 37.7% of the 2011 Indiana bat rangewide population were known or suspected of being infected by WNS (A. King, USFWS, personal communication).

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Legend:

- 2006-2007 - Confirmed
- 2007-2008 - Confirmed
- 2008-2009 - Confirmed
- 2008-2009 - Suspect
- 2009-2010 - Confirmed
- 2009-2010 - Suspect
- 2010-2011 - Confirmed
- 2010-2011 - Suspect
- 2011-2012 - Confirmed
- 2011-2012 - Suspect

Source: USFWS, ODWC, BCI. Updated 3/20/12

Figure: 4-2

COUNTIES WITH WHITE-NOSE SYNDROME RECORDS 2006 to 2012

## 4.2 Distribution

### 4.2.1 Winter Distribution

Indiana bat winter populations occur within cavernous limestone in the karst regions of the east-central United States (Figure 4-3), with the largest historical populations occurring in KY, IN, and MO. More recently, however, large colonies have been found in abandoned underground mines in IL and OH. Currently, the USFWS has designated critical winter habitat at 11 caves and 2 non-coal mines: 6 in MO, 2 each in KY and IN, and 1 each in IL, TN, and WV (USFWS 2007).

Over 86% of the estimated rangewide population in 2009 was known from hibernacula in just 4 states: IN (49.0%), KY (14.8%), IL (13.7%), and NY (8.4%). Most of the other Indiana bats hibernated in WV (4%), MO (4%), TN (3%), and OH (2%). Fifty percent of the 2009 rangewide population hibernated in 5 sites in 3 states: IN (Ray's, Wyandotte, and Jug Hole Caves), IL (Magazine Mine), and KY (Bat Cave, Carter County). Wyandotte Cave in southern IN had the largest hibernating population in 2009, with 45,516 Indiana bats (12% of the 2009 rangewide total; A. King, USFWS, personal communication). One hundred percent of the known population in 2009 hibernated in 211 sites in 16 states, with 85 sites containing fewer than 50 Indiana bats and 46 sites containing 10 or fewer Indiana bats (A. King, USFWS, personal communication).

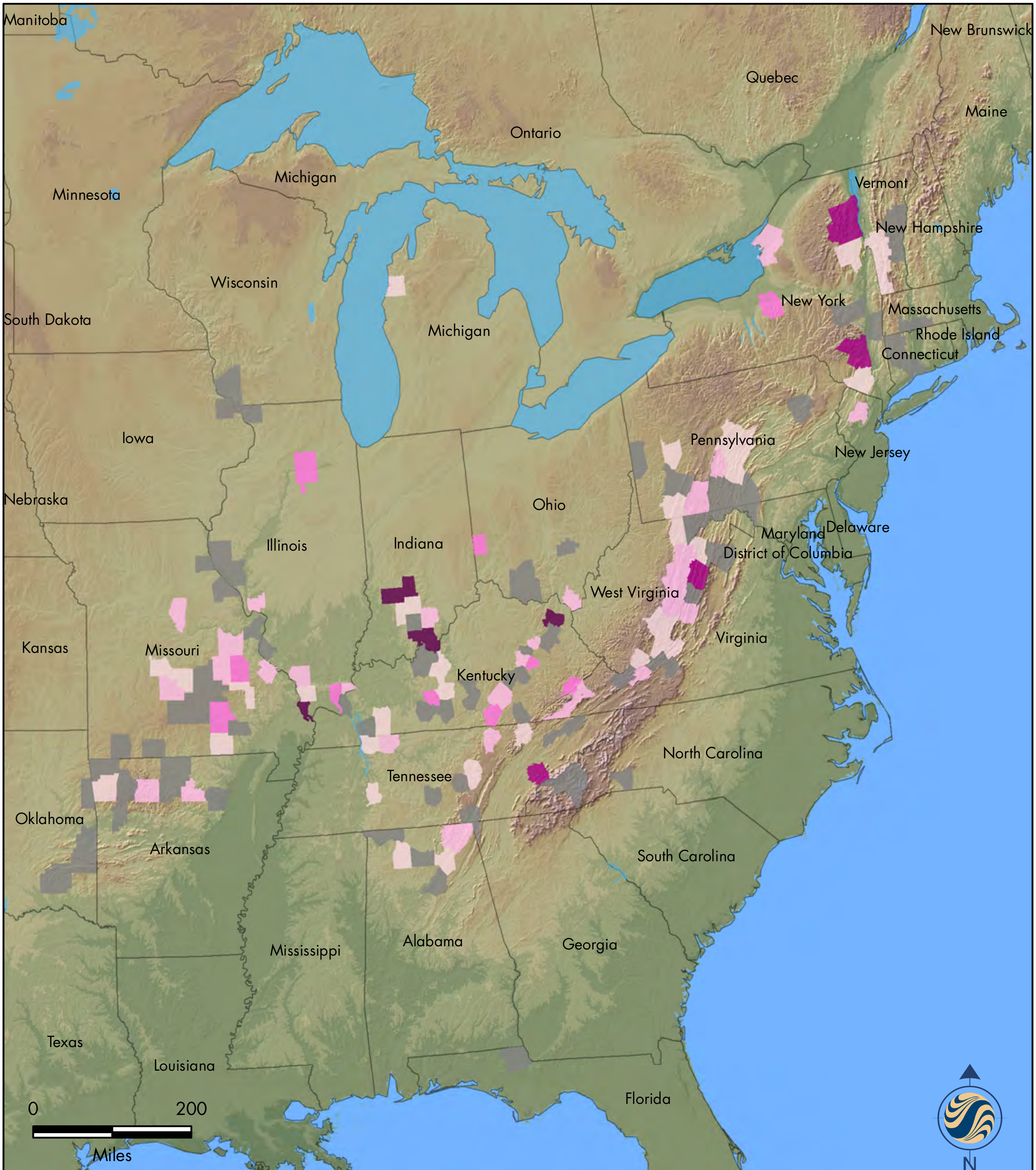
During the 1960s and 1970s, the vast majority (75%) of the known rangewide population of Indiana bats hibernated in the southern portion of the species' winter range (i.e., KY and MO; Clawson 2002). However, by 2001 60% of remaining Indiana bats occupied hibernacula in the northernmost portion of the winter range (Table 3 in USFWS 2007). Winter populations in KY and MO have experienced the most marked decreases in size since rangewide monitoring began. Although few specific drivers of this apparent population shift have been thoroughly investigated, unsuitable hibernacula temperatures (Elliott and Clawson 2001, Tuttle and Kennedy 2002, Elliott 2008) and regional climate change are either known or generally suspected as having played a role (USFWS 2007).

### 4.2.2 Summer Distribution

The first maternity colony was discovered in the summer of 1971 in east-central IN when a bulldozer pushed over a dead American elm (*Ulmus americana*) that sheltered approximately 50 Indiana bats, of which 8 were captured and identified as Indiana bats (Cope et al. 1974). Because maternity colonies are difficult to locate and are dispersed over large areas, the USFWS estimated that only a fraction of the maternity colonies presumed to exist have been documented (perhaps only 6% to 9%), based on the rangewide population estimates derived from hibernacula surveys (USFWS 2007). In 2006, the USFWS had records of 269 maternity colonies that were considered to be locally extant in 16 states. Of these, 54% (146 colonies) were discovered (mostly during mist-netting surveys) within the previous 10 years (USFWS 2007; Figure 4-4).

Summer colonies of Indiana bats occur as far north as MI, NY, and VT; as far south as AL, MO, NC, and TN; and as far west as IA. Although Indiana bat maternity colonies occur throughout much of the eastern United States (e.g., WV, VA, PA, NY), they appear to be relatively more abundant in the Midwest or more central portion of the range (i.e., IN, IL, southern IA, southern MI, and northern MO; USFWS 2004). Additionally, the more rugged, unglaciated portions of the Midwest (Ozarks/southern MO, parts of southern IL, and south-central IN) appear to have fewer maternity colonies per unit area of forest than the upper Midwest (USFWS 2007). Based on current records, the core Indiana bat summer range includes southern IA, northern MO, northern IL, northern IN, southern MI, and western OH.

Such regional differences in the relative abundance of maternity colonies may be attributed to the geographic distribution of important hibernacula and by regional differences in climate and elevation. During the summer, higher latitudes and elevations typically are cooler and wetter and temperatures are more variable, adding significantly to the cost of reproduction (Brack et al. 2002). Britzke et al. (2003) found that Indiana bat maternity colonies in western NC and TN were less frequently encountered in mountainous terrain and that the colonies encountered there were usually smaller in size.

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Legend:

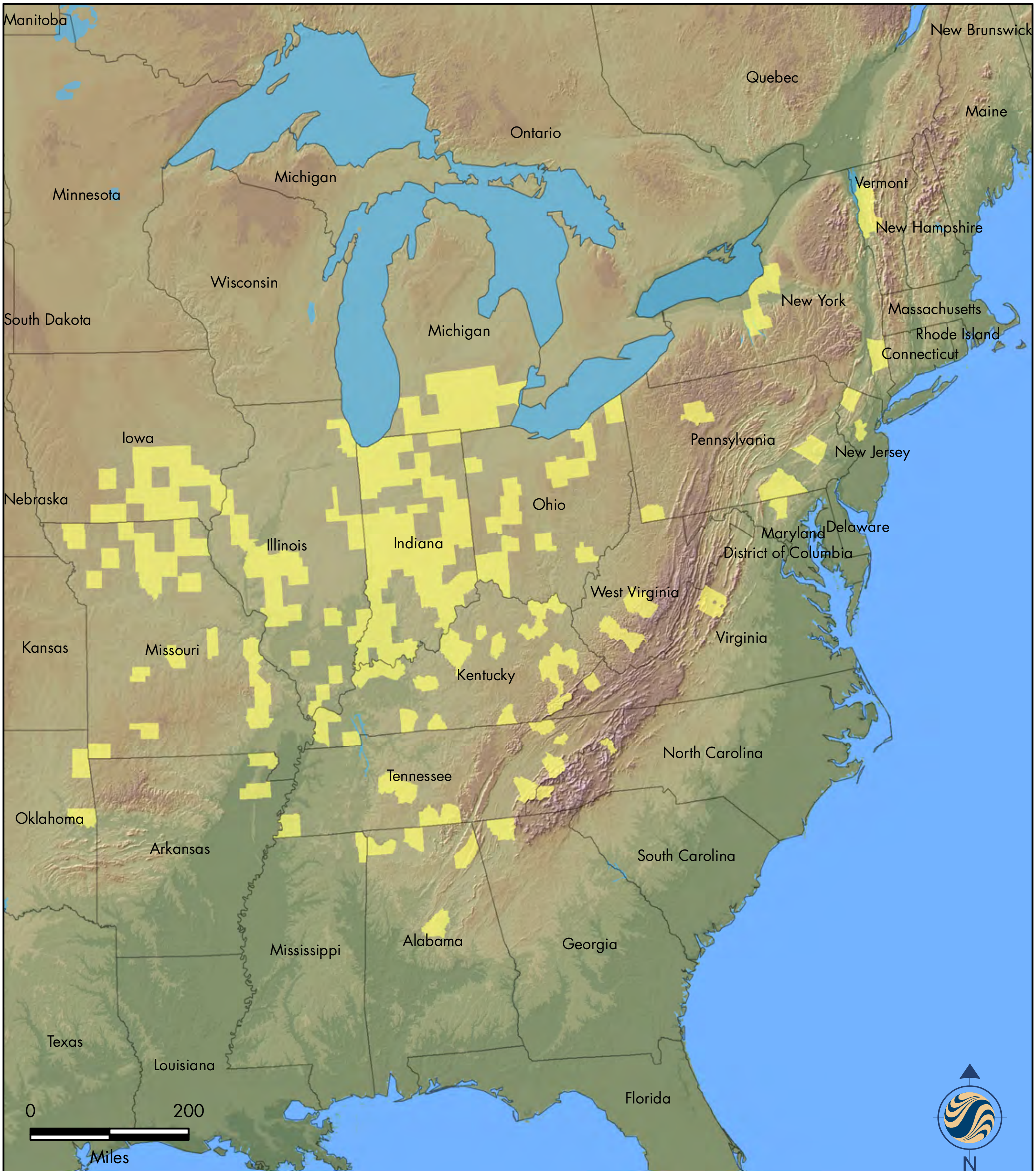
2009 Indiana Bat Population

- 1 - 100
- 101 - 2000
- 2001 - 10000
- 10001 - 20000
- 20001 - 57000
- 0

Source: A. King, USFWS, 2010

Figure: 4-3

INDIANA BAT
*(Myotis sodalis)*
WINTER 2009
COUNTY POPULATION

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Legend:

Indiana Bat Summer Records

Source: USFWS 2007, ODNR, and Butchkoski and Turner 2006, 2008

Figure: 4-4

INDIANA BAT
*(Myotis sodalis)*
SUMMER RECORDS

### 4.2.3 Distribution in Ohio

There is no Indiana bat critical habitat in OH. There are few known major hibernacula in the state for Indiana bats or other bats. The extant population of hibernating Indiana bats in OH is known from 2 underground mines: the Lewisburg Limestone Mine in Preble County (P2, the largest known Indiana bat hibernaculum in OH) and the Ironton Mine (P3) in Lawrence County. Four other hibernacula in 3 counties (Hocking, Brown, and Highland) have been designated as P4 (i.e., current or observed historic populations of fewer than 50 Indiana bats), but currently have no known hibernating Indiana bats[14] (USFWS 2007).

The closest known Indiana bat hibernaculum to the Action Area is the Lewisburg Limestone Mine, located approximately 100 km (62.5 mi) to the southwest. The 2007 Indiana bat winter population from the Lewisburg Limestone Mine and the Ironton Mine was estimated to be 7,629 individuals, a 21.9% decrease from the estimated 9,769 in 2005 (USFWS 2007). However, a February 2009 census of the Lewisburg Limestone Mine documented a winter population of 9,007 (Environmental Solutions and Innovations [ESI] 2009). The Lewisburg Limestone Mine is categorized as a P2 hibernaculum (i.e., population >1000 but <10,000) by the USFWS. The Lewisburg Limestone Mine also hosts hibernating populations of about 15,000 other non-federally listed bats; in addition to the Indiana bat, the 2009 census documented 13,799 little brown, 1,681 tri-colored, 356 northern long-eared, and 88 big brown bats, for a total census of 24,931 hibernating bats.

Data collected every 2 years since the Ironton Mine was discovered show annually fluctuating Indiana bat populations (e.g., winter counts were 276, 254, 224, 333, 208, and 150 Indiana bats recorded in 2011, 2009, 2007, 2005, 2003, and 1999, respectively) (A. King and M. Seymour, USFWS, personal communication).

Band return records indicate that Indiana bats that migrate through and/or summer in OH overwinter in hibernacula in southern states. Barbour and Davis (1969) reported that several Indiana bats banded at Bat Cave and Mammoth Cave in KY were recovered in west central OH. Indiana Bats migrating from KY and IN to southern MI may pass through OH on their northward migration, based on band recovery data summarized in Gardner and Cook (2002), Kurta and Murray (2002), and Winhold and Kurta (2006), as well as 3 unpublished band returns documented by A. Kurta (Eastern Michigan University, personal communication). These include records of 19 Indiana bats passing through OH (see further discussion and Figure 4-6 in Section 4.4.3 Migration).

More recently, 2 Indiana bats captured during summer mist-netting activities in Logan and Champaign Counties, OH, were recovered during hibernacula surveys in KY. One adult female banded in Logan County in 2008 was recaptured approximately 218 km (136 mi) southeast in Bat Cave in Carter Caves State Park, KY, during the following winter, and 1 adult female banded in Champaign County in summer 2009 was recaptured approximately 308 km (191 mi) southwest in Goochland Cave in the Daniel Boone National Forest, KY, during winter 2009-2010 (J. Kiser, Stantec, personal communication; K. Lott, ODNR, personal communication). A little brown bat that was captured during summer 2008 mist-netting surveys in Logan County was also found in a mixed-species cluster with Indiana bats during a winter 2009-2010 survey of Smoke Hole Cave, KY approximately 310 km (193 mi) southwest, also in the Daniel Boone National Forest, KY (J. Kiser, Stantec, personal communication; K. Lott, ODNR, personal communication).

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[14] It is noted that a comprehensive survey of all possible hibernacula in OH has not been conducted. Additional Indiana bat hibernacula may exist.

Although the summer distribution of Indiana bats has historically been poorly documented, summer mist-netting efforts in recent years in OH related to pre-permitting activities for proposed wind power projects have resulted in a number of newly documented Indiana bat maternity colonies in previously undocumented portions of their summer range OH (M. Seymour, USFWS, personal communication). Indiana bat summer records in western OH were known from Greene, Montgomery, Miami, and Preble counties prior to 2008. Additional summer reproductive records were documented in Champaign, Hardin, and Logan counties, OH (hereafter "tri-county area"), in 2008 and 2009.

Based on data provided by the ODNR, 26 Indiana bats (24 adult females and 2 adult males) were captured in 2008 and 2009 during pre-construction mist-netting surveys for various proposed wind power projects (including this Project) along the Bellefontaine Ridge (Stantec 2008b, K. Lott, ODNR, personal communication). Of these 26 Indiana bats, 19 (17 females and 2 males) were radio-tagged and 17 (15 females and 2 males) were successfully tracked to 36 day-roost trees. Seven additional day-roost locations were estimated using triangulation, for a total of 43 day-roost locations. Home ranges could only be calculated for 12 of the 19 Indiana bats (11 female and 1 male), due to lost radio transmitters or lack of access to properties where the Indiana bats traveled or roosted. Using the minimum convex polygon (MCP) method (Mohr 1947), the average home range size was 1,256 ha ± 900 ha (3,104 ac ± 2,223 ac). The average sample size of radio telemetry locations used to estimate home range size was 94 locations ± 57 locations (range from 34 locations to 208 locations).

Seventy emergence counts (i.e., visual counts of the number of bats exiting a single roost tree for the night) were conducted at 27 of the identified roost trees between 1 June and 24 July in 2008 and 2009. Emergence counts on nights when at least 1 bat was observed emerging from the roost (n=65) averaged 17 bats ± 17 bats (range from 1 bat to 83 bats). While some of the emergence counts were conducted on the same night at multiple roost trees used by the same maternity colony, the majority were counts conducted at a single tree on a single night (K. Lott, ODNR, personal communication).

### 4.2.4 Distribution in the Action Area

Mist-netting surveys conducted for the Project in 2008 resulted in no Indiana bats captured in the Action Area (refer to Figure 1-2 for the Action Area boundary). Two reproductive females and 1 non-reproductive male were captured approximately 7.8 km (4.8 mi) to the north of the Action Area within the initial study area (Figure 1-2). Based on the results of the 2008 survey, the Project boundary was adjusted to avoid impacts to these Indiana bats (see Figure 1-2). Specifically the northern Project boundary was moved to the south so that it was at least 8 km (5 mi) from the closest Indiana bat capture. No part of the current Action Area is located within Logan County.

During mist-netting conducted for an unrelated wind development project in 2009 (that studied an area that was entirely within the Buckeye Wind Action Area), a total of 5 Indiana bats were captured in the Action Area. Due to the sensitive nature of data on ESA endangered species locations, the ODNR or USFWS were not able to provide raw data on the 5 Indiana bat captures in the Action Area, and therefore their roost or telemetry locations will not be provided in this HCP. However, pertinent data from those telemetry surveys were provided and included in the analysis for this HCP. The following paragraphs provide information that describes the locations of these Indiana bats within the Action Area based on information provided by the ODNR and USFWS.

One adult lactating female Indiana bat was captured in June 2009 in the central portion of the Action Area and flew 10.1 km (6.3 mi) southeast following her capture. Her roost tree was located approximately 2.3 km (1.5 mi) east of the Action Area, where her transmitter signal was subsequently lost. Five emergence counts were conducted at her roost tree with an average emergence count size of 32.6 bats ± 12.8 bats. No home range was calculated for this female due to an insufficient sample size of radio locations.

Three additional adult lactating female Indiana bats were captured and radio-tagged in late June 2009 at a single mist net site in a riparian woodlot in the northernmost portion of the Action Area. An additional Indiana bat at this net site escaped as it was being removed from the net; therefore, no data were collected for this individual. Radio telemetry data from the 3 female Indiana bats were used to generate home ranges. The combined MCP home range for these 3 females was 1,099.3 ha (2,716.5 ac). Ninety-three percent of the combined MCP (1,024.5 ha [2,531.6 ac]) was situated inside the Action Area, and the remaining 7% was north of the Action Area. The portion of the combined MCP that overlapped the Action Area occupied 3% of the total Action Area.

Radio telemetry was also used to track these 3 females to roost trees where emergence counts were conducted to estimate their maternity colony sizes. For the 3 Indiana bats, 3 roost trees were identified in the Action Area (not including 1 temporary roost that was used by 1 of the females during night of capture). All 3 Indiana bats used the same roost tree on 6 nights, which had an average emergence count size of 21.0 bats ± 12.9 bats and a maximum of 38 bats. Average emergence count sizes at the other 2 roost trees were 7.3 ± 3.6 (n = 4) and 2.3 ± 0.6 (n = 3).

The potential summer population of Indiana bats in the Action Area was estimated using data from the 3 Indiana bats radio tracked in the Action Area in 2009, as well as 7 adult female Indiana bats captured and radio-tagged in 2008 and 2009 during summer mist-netting surveys in the tri-county area[15]. Summer population estimates in the Action Area were based on 76 emergence counts[16] at 23 roost trees in the tri-county area, the home range sizes (estimated from nighttime telemetry) of the female Indiana bats using those roost trees, and the number of maternity colonies the Action Area could support.

Data from Indiana bats captured in the tri-county area in 2008 and 2009 were also used to model Indiana bat habitat suitability in the Action Area. A partitioned Mahalanobis $D^2$ model (Watrous et al. 2006, Meinke et al. 2009) based on 1,124 nighttime radio-locations and 43 roost locations from 12 radio-tagged Indiana bats was used to create a predictive habitat suitability model (refer to Appendix B for a detailed description of methods and results). Spatial characteristics of forest patches, habitat heterogeneity, slope, elevation, and distance to stream, wetland, and forested stream were measured in a GIS within a 2-km buffer (representing the average foraging distance) of each pixel in the Action Area. The distances ($D^2$) between the vector of environmental conditions measured at each pixel and the mean vector of environmental conditions at known Indiana bat roosting and foraging locations were rescaled using a Chi-square distribution, converted to probability values, and divided into 4 quartiles. These 4 quartiles, named Category 1, Category 2, Category 3, and Category 4, represented most to least suitable habitat.

Indiana bat foraging habitat suitability was strongly associated with the configuration and spatial relationships of forested patches; the 3 most important variables were the degree of forest fragmentation,

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[15] Although a total of 24 adult female and 2 male Indiana bats were captured in the tri-county area in 2008 and 2009, only 17 females and 2 males were radio tagged, only 12 females and 2 males were tracked to roost trees, and only 10 females had home range information and emergence count numbers sufficient to generate a summer population estimate.

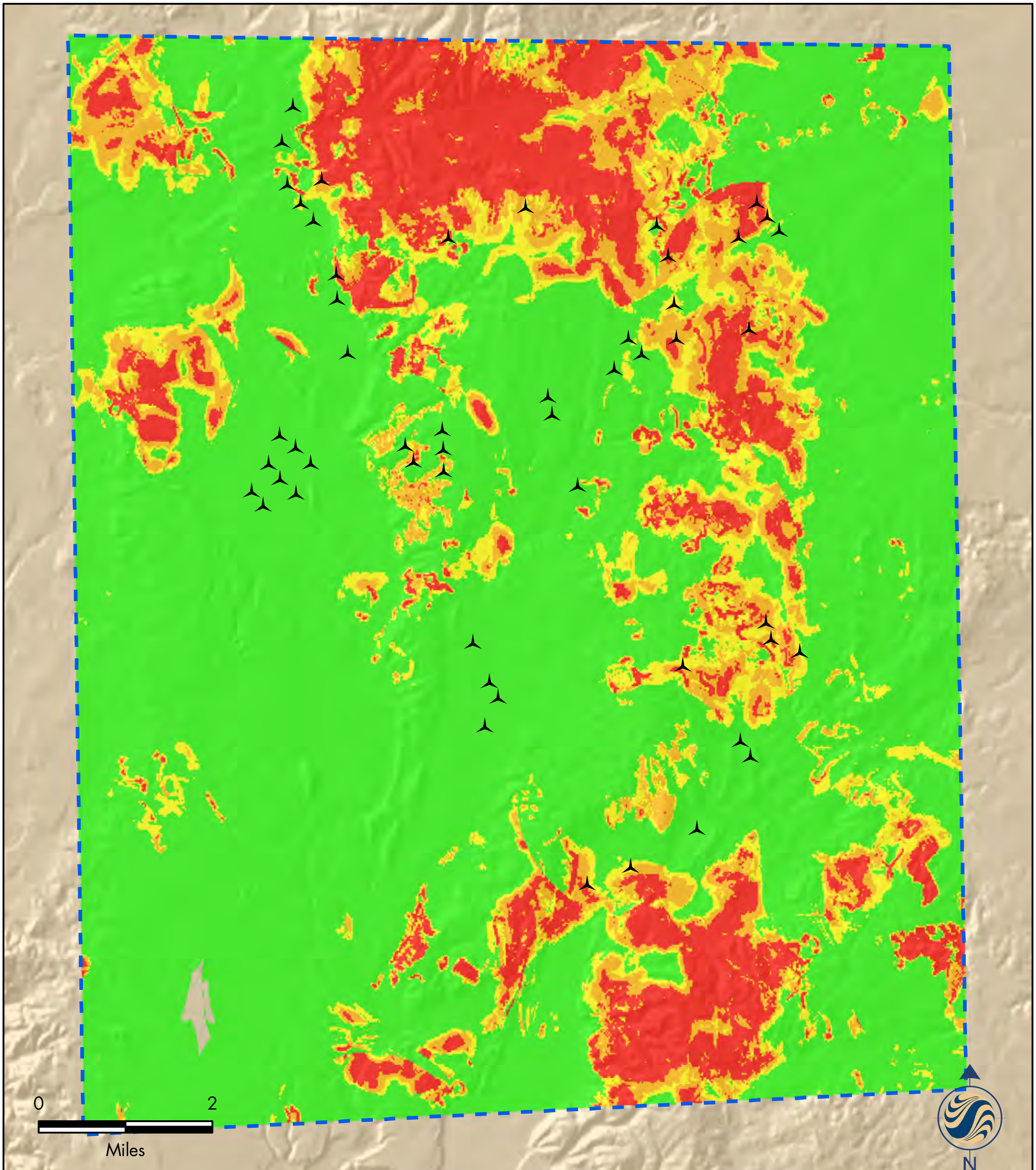
[16] This sample size was derived by treating observations of multiple radio-tagged females exiting the same roost tree as individual emergence counts.

the connectedness of forest patches, and the total core area of forested habitat. This differed from roosting habitat suitability, which was driven largely by distance to forested streams, distance to streams, and distance to the nearest forest edge. Twelve percent of the Action Area (4,016.1 ha [9,923.9 ac]) was categorized as having the highest suitability (i.e., Category 1) for Indiana bat roosting and foraging activities (Figure 4-5). When considering both foraging and roosting suitability, the spatial arrangement of forest patches, proximity to water sources, and amount of forested area were the most important habitat components. A full account of the assumptions, model inputs, analysis methods, and results contributing to the population size and habitat suitability estimates are presented in Appendix B.

The number of maternity colonies that the Action Area could support was estimated based on the amount of suitable habitat in the Action Area and the calculated home range sizes of Indiana bats in the tri-county area, following similar methods as those used in 2 recent USFWS BOs for Indiana bats (USFWS 2005a, 2005b). Even though active Indiana bat home ranges were only documented within the northernmost 3% of the Action Area, Indiana bats were assumed to have the potential to occur in suitable habitat throughout the Action Area to take the most conservative approach when estimating risk. Because portions of the Action Area are dominated by large expanses of agriculture or urban areas that are likely unsuitable for Indiana bat roosting and foraging activities, the amount of habitat considered suitable for Indiana bat roosting and foraging activities was reduced. Habitat in Categories 1, 2 and 3 were considered suitable for roosting, foraging, commuting and migrating (although Category 3 is 87% non-forested), and Category 4 was considered unsuitable for roosting and foraging (but suitable for migratory Indiana bat use). Categories 1, 2, and 3 habitats collectively comprised 9,847 ha (24,331 ac), which is equal to approximately 30% of the total Action Area size (see Appendix B for further detail).

Based on simultaneous emergence counts conducted at known Indiana bat roost trees within or near the Action Area, a minimum Indiana bat population size of 99 was documented in Summer 2009. Using a combination of these site-specific, empirical data, models predicting and quantifying suitable habitat within the Action Area and conservative assumptions based on relevant literature and professional judgment, and after increasing the estimated population by 8% to account for males (based on the proportion of males captured in mist-netting surveys in 2008 and 2009 in the tri-county area), the estimated mean summer Indiana bat population ranged from 10.1 to 2,271.4 Indiana bats. The range of estimated summer population size results from inherent uncertainty in estimating maternity colony size based on emergence counts and home range sizes. This inherent uncertainty was addressed using a probabilistic framework to represent uncertainty in model input (refer to Appendix A for a detailed description of methods and results). The results likely overestimate the actual number of Indiana bats using the Action Area during summer because the total home range area used by multiple Indiana bats from the same maternity colony was not available, and therefore individual home ranges were treated as approximations of total maternity colony home range size. Since the size of an area used by all members of a maternity colony is larger than that used by each individual colony member, this likely overestimated the number of maternity colonies the Action Area. However, this method allows for the highest numbers of maternity colonies to be present in the Action Area and provides some indication of the potential size of the local population of resident Indiana bats. This conservative approach was appropriate given the inherent uncertainty in estimating maternity colony size based on emergence counts and home range sizes.

Data from the 2008-2009 Indiana bat winter census (A. King, USFWS, personal communication) were used to estimate the number of Indiana bats likely to pass through the Action Area during spring and fall migration (i.e., the migratory population within the Action Area). Assumptions about the distances and directions of travel during migration were derived from literature, expert opinion, and band returns from Indiana bats captured in the Action Area (refer to Appendix A for a detailed description of methods). These data were used to estimate the numbers of Indiana bats likely to pass through the Action Area during migration, which ranged from approximately 2,900 Indiana bats to 5,800 Indiana bats.

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Legend:

Proposed Turbines

HCP Action Area

Foraging/Roosting Suitability

1 (Highest)

2

3

4 (Lowest)

Source: Stantec habitat suitability modeling based on data provided by ODNR

Figure: 4-5

INDIANA BAT
*(Myotis Sodalis)*
FINAL HABITAT
SUITABILITY MODEL

## 4.3 Demographics

Similar to most common bats of temperate regions, female Indiana bats give birth to 1 young each year (Mumford and Calvert 1960, Humphrey et al. 1977, Thomson 1982) and the birth rate of males to females appears to be essentially even (Hall 1962, Myers 1964, and LaVal and LaVal 1980). Many studies of common bats of temperate regions show that within a species, the proportion of breeding females may vary dramatically among populations and between years, and this variation is typically due to weather (e.g., amount of rainfall and temperature) (Racey and Entwistle 2000, Barclay et al. 2004). Based on captures of 63 adult female Indiana bats during mist-netting surveys in southern MI from 1978 to 2001, Kurta and Rice (2002) reported 89% of adult females were in reproductive condition (pregnant, lactating, or post-lactating). At a maternity colony in south-central IN, at least 93% and 82% of female Indiana bats during 2 consecutive years of study produced volant young (Humphrey et al. 1977).

Kurta and Rice (2002) reported that most births occurred in mid- to late-June, with lactation occurring throughout July and lasting 3 to 5 weeks, and pups becoming volant between early July and early August. The timing of reproductive events for Indiana bats in IN was essentially identical to that reported for females in southern MI (Humphrey et al. 1977), despite MI Indiana bats having longer migrations and cooler ambient temperatures (Kurta and Rice 2002). Age structure and survival rates among different life stages of Indiana bats are poorly understood due in part to the lack of accurate techniques for aging individuals (Anthony 1988, Batulevicius et al. 2001 as cited by USFWS 2007). Based on 1 season of observation of 1 maternity colony, Humphrey et al. (1977) estimated that neonatal mortality was 8%.

The only comprehensive estimates of Indiana bat demographic rates currently available were developed by Humphrey and Cope (1977) based on sampling of unknown-age Indiana bats over a 23-year period at hibernacula. These data suggested that although survival rates following weaning are unknown, the lowest survival occurred in the first year after banding. Humphrey and Cope (1977) also suggest a differential survival rate between the sexes as adults may occur. The authors hypothesized that there are 2 distinct survival phases of adult Indiana bats: 1) annual survival rates from 1 year to 6 years after banding were constant at approximately 75.9% and 69.9% for females and males, respectively; and 2) from 6 years to 10 years after banding, there was a lower, constant annual survival rate of 66.0% and 36.3% for females and males, respectively. Following 10 years, the survival rate for females dropped to only 4%; the authors suggested the lower rate may have been attributable to increased costs of migration and reproduction during old age, or due to sampling error, as a very small number of females remained alive after 10 years. However, Indiana bats have been known to live much longer, with the oldest known Indiana bat captured 20 years after it was first banded (LaVal and LaVal 1980).

More recently Boyles et al. (2007) reanalyzed a subset of the Humphrey and Cope (1977) data with a newer, more flexible, and less biased Cormack-Jolly-Seber model. The Boyles et al. (2007) estimate suggested that apparent survival is considerably higher than estimated by Humphrey and Cope (1977) the first year after banding and lower the second year after banding. Subsequent to the first 2 years after banding, survival estimates were similar, but slightly lower than those reported by Humphrey and Cope (1977). The authors caution, however, that their results, while useful, cannot be taken as true survival rates for Indiana bats because of limitations in the data.

## 4.4 Life History

In their 2007 Draft Recovery Plan, the USFWS (2007) provided an in-depth discussion of Indiana bat life history and a timeline for the annual chronology of significant life history events. The below sections will summarize this information and will include relevant additional or updated information on Indiana bat life history that has become available since the publication of the 2007 Draft Recovery Plan.

It should be noted that while the USFWS defines spring migration as occurring from 15 Mar to 15 May and fall migration from 15 Aug to 15 Oct in their 2007 Draft Recovery Plan, these dates are not static and can vary based on annual variability, weather conditions, location, or other factors. Given what is known about the geographic and annual variation in the exact timing of these activities, the USFWS has had recent internal discussions regarding the applicability of these dates across the range of the Indiana bat (M. Seymour, USFWS, personal communication). As such, in various places throughout this document descriptions of the annual chronology of Indiana bat life history may vary with respect to the exact timing of different events. Where appropriate, factors that influence this variability will be discussed.

### 4.4.1 Hibernation

As stated previously, Indiana bats overwinter in suitable underground habitats, known as hibernacula. The majority of hibernacula consist of limestone caves, especially in karst areas of east central United States, but abandoned underground mines, railroad tunnels, and even hydroelectric dams have been shown to provide winter habitat throughout the range of the species (USFWS 2007). Depending on local weather conditions, Indiana bats enter hibernation from late September to early November, this timing may vary based on the sex of Indiana bats (males may enter hibernation later than females) and latitude where the site is located. Although most Indiana bats enter hibernation by the end of November (mid-Oct in northern areas; Kurta et al. 1997), populations of hibernating Indiana bats may increase throughout fall and into early January at some southern hibernacula (Clawson et al. 1980).

Scientific understanding of appropriate microclimates within Indiana bat hibernacula have changed over time. Historically, it was thought that ambient cave temperatures below 10° Celsius (C; 50°F) with occasional drops below freezing were suitable for Indiana bats (Hall 1962, Henshaw 1965, Humphrey 1978). More recently, Tuttle and Kennedy (2002) found mid-winter temperatures between 3°C and 7.2°C (37.4°F and 45°F) at major hibernacula where Indiana bat populations were stable or increasing, while populations roosting outside this range were unstable or had declined. Mid-winter temperatures at hibernacula containing the highest concentrations of Indiana bats ranged between 6°C and 7°C (42.8°F and 44.6°F) according to Brack et al. (2005). Regardless of which temperature range is most accurate, stable, low temperatures allow Indiana bats to maintain reduced metabolic rates and conserve fat reserves until spring, when outside temperatures increase and insects (food) are more abundant (Humphrey 1978, Richter et al. 1993). As with cave temperatures, relative humidity also influences hibernation site suitability for Indiana bats. According to Hall (1962), Humphrey (1978), and LaVal et al. (1976 as cited by USFWS 2007), humidity at roost sites during hibernation is usually above 74% but below saturation.

Cave configuration determines internal microclimates, with larger, more complex cave systems with multiple entrances more likely to provide suitable habitat for the Indiana bat (Richter et al. 1993, LaVal and LaVal 1980, Tuttle and Stevenson 1978). Most Indiana bats hibernate in caves or mines that tend to have large volumes, large rooms, and extensive vertical relief and passages, often below the lowest entrance. Cave volume and complexity help buffer the cave environment against rapid and extreme shifts in outside temperature, and vertical relief provides a range of temperatures and roost sites (USFWS 2007).

Indiana bats usually hibernate in large, dense clusters ranging from 300 Indiana bats per square foot (LaVal and LaVal 1980) to 484 Indiana bats per square foot (Clawson et al. 1980, Hicks and Novak 2002), although cluster densities as high as 500 Indiana bats per square foot have been recorded (Stihler 2005 as cited in USFWS 2007). While the Indiana bat characteristically forms large clusters, small clusters and single Indiana bats also occur (Hall 1962, Hicks and Novak 2002). It is not uncommon for Indiana bats to hibernate in mixed-species groups and they have commonly been observed clustered with little brown bats and other species (Myers 1964, LaVal and LaVal 1980, Kurta and Teramino 1994). Species observed clustering with the Indiana bat in the southern United States include the little brown bat, northern long-eared bat, eastern small-footed bat, and gray bat (J. Kiser, Stantec, personal communication).

### 4.4.2 Spring Staging and Emergence

During the later stage of hibernation, bats arouse more often and may move towards the entrance of the cave (USFWS 2007). In Barton Hill mine in NY in early April, Indiana bat clusters shifted roost sites as the bats moved toward a "staging area" near the entrance (A. Hicks, NYSDEC, personal communication 2002, as cited in USFWS 2007). Staging is defined as the departure of bats from hibernacula in the spring, including processes and behaviors that lead up to departure (USFWS 2007).

The period during which bats exit their hibernaculum is referred to as spring emergence. Female Indiana bats begin to exit hibernacula in late March to early April, followed by the males (Hall 1962, Cope and Humphrey 1977, LaVal and LaVal 1980). Timing of spring emergence may vary across their range and depending on latitude, annual weather conditions, health of emerging bats, sex of bats, weather conditions, and location of hibernacula. Spring emergence of bats having less body mass and stored energy reserves may occur earlier than healthier bats because they are driven by the need to replenish their fat reserves. However, most Indiana bats have left their hibernacula by late April (Hall 1962). Exit counts from several hibernacula in southern PA and Big Springs Cave in Tucker County, WV, suggest that peak emergence from hibernation is mid-April for these 2 areas (Butchkoski and Hassinger 2002; Rodrigue 2004, as cited in USFWS 2007). Spring surveys of the interior of Barton Hill Mine in NY documented substantial numbers of Indiana bats through April and into mid-May; however, by the end of May only one-tenth of the population remained (A. Hicks, NYSDEC, personal communication, as cited in USFWS 2007).

Bats may remain in close proximity to the hibernaculum for a short period of time, which is referred to as spring staging. Few studies have documented roost tree requirements during this time. In KY, Gumbert (2001) tracked 10 males and 3 females to roost trees during April and May 1998 and 1999. Shortleaf pine (*Pinus echinata*) was used most often during spring (and in all seasons, in fact), followed by mockernut hickory (*Carya tomentosa*) and shagbark hickory (*C. ovata*). Indiana bats used hickories and oaks in greater proportions, and pines in lower proportions, during the spring season than in summer and fall. Spring roost trees were of a slightly larger diameter than those used in summer and fall. Live trees were used in similar proportions in the spring and fall, whereas no live trees were used as roosts in the summer. All identified spring roost trees were within 4.47 km (2.78 mi) of the hibernaculum (mean = 1.99 km [1.24 mi]), and distances between roost trees and the hibernaculum were similar for the summer (mean = 1.86 km [1.16 mi]) and fall (mean = 1.87 km [1.16 mi]) seasons.

Spring emergence roosting refers to roosting behavior that occurs when Indiana bats exit hibernacula and head towards their summer habitat. The distribution of Indiana bats expands during the spring and summer when Indiana bats migrate from their hibernacula and travel to their summer ranges. Roosting may occur at multiple locations while Indiana bats are traveling between hibernacula and summer habitat, or Indiana 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).

During the mid-spring period, female Indiana bats in the Lake Champlain Valley in VT and NY used live roost trees (primarily shagbark hickories) more commonly than previous research had shown, according to Britzke et al. (2006). Live trees may have been more heavily used because they provided more sheltered environments and thermal advantages over dead trees (Humphrey et al. 1977), which may have been particularly important during the unpredictable spring weather that characterizes the Lake Champlain

Valley (Britzke et al. 2006). Spring roost trees used in the Lake Champlain Valley were similar to those documented for summer roosting and include shagbark hickory, American elm, quaking aspen (*Populus tremuloides*), sugar maple (*Acer saccharum*), black locust (*Robinia pseudoacacia*), white ash (*Fraxinus americana*), American beech (*Fagus grandifolia*), yellow birch (*Betula alleghaniensis*), red maple (*Acer rubrum*), and eastern hemlock (*Tsuga canadensis*). Currently, spring emergence roosting behavior and the types of roost trees used during this life history stage are not known for the midwestern and southern populations of Indiana bats.

### 4.4.3 Migration

#### *4.4.3.1 Migration Distance and Duration*

The distribution of Indiana bats expands during the spring and summer when bats migrate from their hibernacula and travel to their summer ranges. Indiana bats are considered migratory (LaVal and LaVal 1980) because they make seasonal movements between hibernacula and maternity roosts. However, their migratory distances are not comparable to the long-distance and cross-continental migratory movements made by foliage- and tree-roosting Lasiurine species (Griffin 1970, Fleming and Eby 2003). Migration distances vary greatly across the species' range, with documented migration distances greatest in the Midwest RU and least in the Northeast RU (Figure 4-6, Table 4-2). Twelve female Indiana bats from maternity colonies in MI migrated an average of 477 km (296 mi) to their hibernacula in IN and KY, with a maximum migration of 575 km (357 mi) (Winhold and Kurta 2006). Gardner and Cook (2002) also reported long-distance migrations for Indiana bats traveling between summer ranges and hibernacula. Shorter migration distances are also known to occur in the Midwest RU. Twenty-seven Indiana bats banded during summer mist-netting at multiple locations in IN were subsequently relocated at 26 hibernacula in IN and 1 in KY[17], with distances between summer capture locations and hibernacula ranging from 8 km to 209 km (5 mi to 130 mi), with an average distance of 84 km (52 mi) (L. Pruitt, USFWS, personal communication). This is contrasted by relatively short migration distances documented in the Northeast RU; the maximum migration distances for 111 Indiana bats from NY and NJ caves or mines between 2001 and 2007 was 68 km (42 mi) (Figure 4-6, Table 4-2). Recent radio telemetry studies of 130 spring emerging Indiana bats (primarily females) from 6 NY hibernacula found that 75% of these bats were later detected and all migrated less than 68 km (42 mi) to their summer habitat (Butchkoski et al. 2008). Migration distances for Indiana bats in the Appalachian RU appear to be longer than those in the Northeast RU (maximum distance reported for an adult female to date is 173 km [107 mi; Butchkoski and Turner 2008]), but not as long as those in the Midwest RU (see migration distances reported for PA, MD, VA, and WV in Table 4-2). Few data are available to determine migration distances in the Ozark-Central RU.

Some male and non-reproductive female Indiana bats do not migrate as far as reproductive females and instead remain in the vicinity of their hibernaculum throughout the summer (Gardner and Cook 2002, Whitaker and Brack 2002). Mist-netting studies conducted from 1978 to 2002 in southern Michigan showed that only 11% of the adults captured were males (64 adult females, 8 adult males, and 15 juveniles; Kurta and Rice 2002).[18] Males captured in southern MI likely migrated over 400 km (249 mi) from hibernacula in southern IN and KY, based on several band return records for Indiana bats captured in this area (Kurta and Murray 2002).

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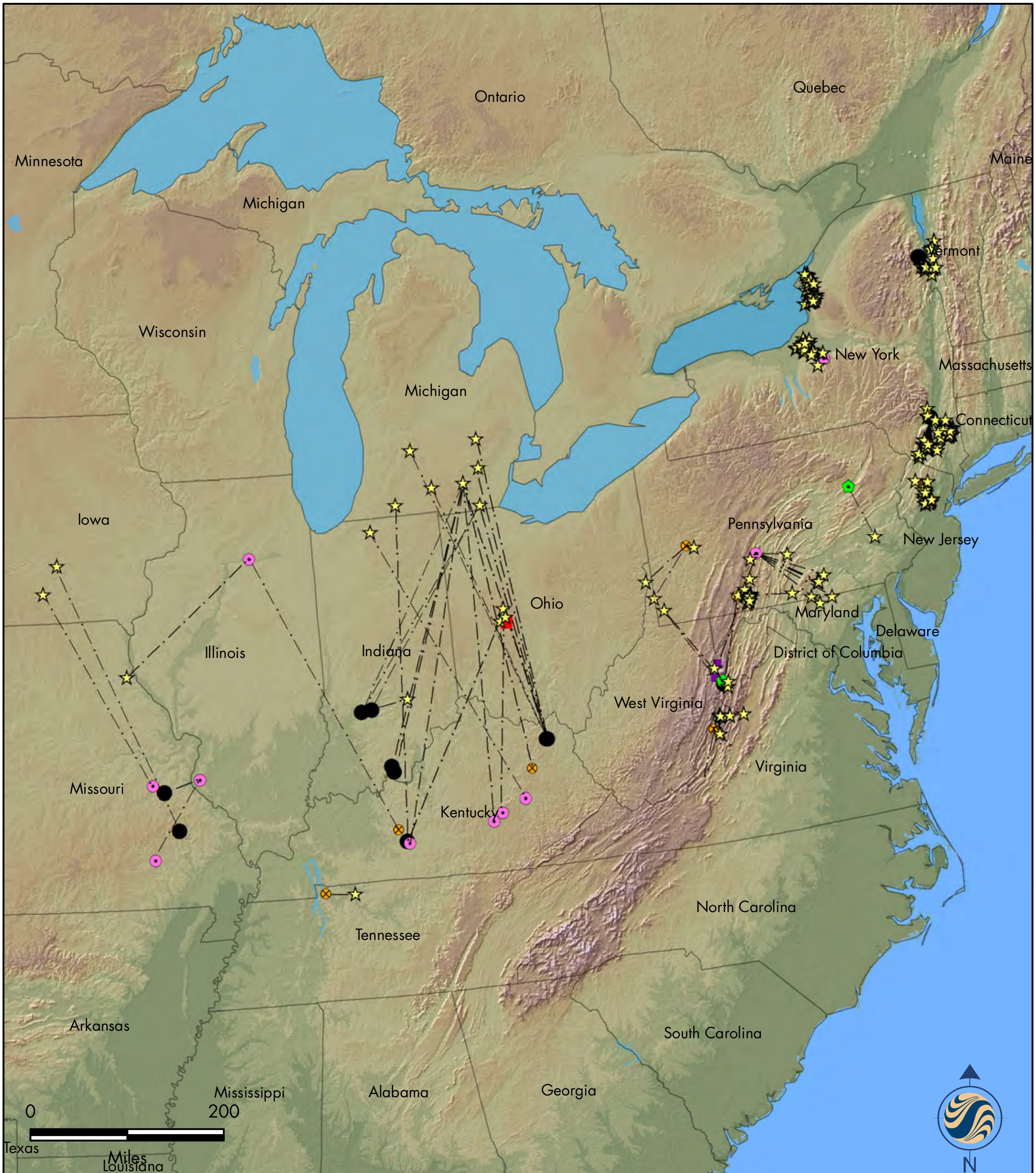
[17] These band returns are not displayed in Figure 4-6 due to lack of available information.

[18] However, the authors cautioned that 11% may have underestimated the proportion of adult males in the summer population because netting preferentially occurred near maternity roosts (Kurta et al. 1996, 2002) and male Indiana bats often do not roost with females during the maternity period (Gardner et al. 1991a).

Migration is an energetically expensive and risky undertaking (Fleming and Eby 2003), and bats may try to minimize the time spent in transit (Winhold and Kurta 2006). Spring radio telemetry studies have documented migrating Indiana bats traveling in relatively direct flight patterns towards their summer ranges shortly after they emerge from hibernacula (Butchkoski and Turner 2006, Britzke et al. 2006). According to Hicks et al. (2005), a comparison between the range of initial bearings and the final bearings for 82 reproductive female Indiana bats radio tracked to 65 maternity colonies in NY from 2000 to 2005 showed that Indiana bats followed more or less direct routes from the hibernacula to their summer ranges. Based on a combination of aerial and ground-based tracking, Indiana bats tracked from a hibernaculum in PA flew almost straight lines to their roost trees 135 km to 148 km (83 mi to 92 mi) away in MD (Butchkoski and Turner 2005).

The total time required for migration is a function of both flight speed and the amount of time spent migrating on a nightly basis, which is influenced by energetic constraints, among other factors. Winhold and Kurta (2006) estimated the time Indiana bats spent migrating between MI and the karst regions of IN and KY (average distance of 477 [296 mi]) and determined that the longest migrations documented for Indiana bats took approximately 3 days to 9 days. Thus, Indiana bats migrating the maximum recorded distance (i.e., 575 km) could complete the trip in only 7 days to 11 days, even when migrating for only 4 hours per night (Winhold and Kurta 2006).

Radio-tagged Indiana bats recently followed by aircraft during their spring migration in NY and PA usually maintained flight speeds between 13 kilometers per hour (km/hr) and 20 km/hr (8 mph and 12 mph), with 1 Indiana bat perhaps traveling at 24 km/h (15 mph; Butchkoski and Turner 2005; C. Herzog, in litt., as cited by Winhold and Kurta 2006). This is consistent with flight speeds measured for Indiana bats released in an open field (20 km/h [12.4 mph], Patterson and Hardin 1969) and close to the speed predicted for an 8 g bat using the allometric equation (Norberg and Rayner 1987 as cited by Winhold and Kurta 2006).

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Legend:

- Summer_Records
- HCP Action Area
- Approximate Migration Path
- Priority 1 Cave
- Priority 2 Cave
- Priority 3 Cave
- Priority 4 Cave
- Unknown Cave

Source: Multiple, refer to Table 4-2 in HCP

Figure: 4-6

INDIANA BAT

*(Myotis sodalis)*

MIGRATION RECORDS

1971 to 2010

**Table 4-2.** Records of migration distances (km) for Indiana bats (*Myotis sodalis*) by state and site from 1971 to 2010 (records are for adult females, unless otherwise noted).

| State(s) | Site(s) | Max distance (km) | Record type[a] | Date banded or tagged | Date retrieved | Number successfully recovered or tracked[b] | Source |
|---|---|---|---|---|---|---|---|
| OH – OH | Pickaway County, OH to Lawrence County, OH | 112 | BR | Summer 2009-2010 | Winter 2011 | 2 | K. Schultes, Wayne National Forest, personal communication to A. Boyer, USFWS |
| OH-KY | Pickaway County, OH to Bat Cave, KY | 153 | BR | Summer 2010 | Winter 2011 | 2 (1 juvenile male, 1 adult female) | K. Lott, USFWS, personal communication |
| OH- KY | Franklin County, OH to Bat Cave, KY | 177 | BR | Summer 2008 | Winter 2011 | 2 (1 juvenile male, 1 adult male) | K. Lott, USFWS, personal communication |
| OH- KY | Pickaway County, OH to Saltpeter Cave, KY | 153 | BR | Summer 2010 | Winter 2011 | 2 (1 adult male, 1 adult female) | K. Lott, USFWS, personal communication |
| OH-KY | Hamilton County, OH to Bat Cave, KY | 172 | BR | Summer 2008 | Winter 2011 | 1 | K. Lott, USFWS, personal communication |
| IN – IN, KY | Unknown | 209 | BR | Unknown | Unknown | 27 | L. Pruitt, USFWS, personal communication to M. Seymour, USFWS |
| KY-OH | Champaign County, OH to Bat Cave, KY | 218 | BR | Summer 2008 | Winter 2008-2009 | 1 | J. Kiser, Stantec, personal communication; K. Lott, ODNR, personal communication |
| KY-OH | Logan County, OH to Goochland Cave, KY | 308 | BR | Summer 2009 | Winter 2009-2010 | 1 | J. Kiser, Stantec personal communication; K. Lott, ODNR, personal communication |
| MI-KY, IN | Eaton County, MI to Jug Hole, Cave Branch, Colossall, Waterfall, Batwing, Ray's, Bat | 575 | BR | Spring 2004 | Winter 2004-2005 | 7 | Winhold and Kurta 2006 |

**Table 4-2.** Records of migration distances (km) for Indiana bats (*Myotis sodalis*) by state and site from 1971 to 2010 (records are for adult females, unless otherwise noted).

| State(s) | Site(s) | Max distance (km) | Record type[a] | Date banded or tagged | Date retrieved | Number successfully recovered or tracked[b] | Source |
|---|---|---|---|---|---|---|---|
| MI-IN | Lenawee County, MI to Grotto Cave, IN | 388 | BR | Summer 2004 | Winter 2006-2007 | 1 male (juvenile at summer site) | A. Kurta, Eastern Michigan University, personal communication |
| MI-IN | Lenawee County, MI to Ray's Cave, IN | 399 | BR | Summer 2006 | Winter 2006-2007 | 1 female (juvenile at summer site) | A. Kurta, Eastern Michigan University, personal communication |
| MI-KY | Lenawee Co. MI to Saltpeter Cave, Carter County, KY | 406 | BR | Summer 2007 | Fall 2009 | 1adult female | A. Kurta, Eastern Michigan University, personal communication |
| Multiple Midwest States | Multiple | 520 | BR | Multiple | Multiple | Unknown | Gardener and Cook 2002 (includes Bowles 1981, R.L. Clawson and J. E. Gardner unpubl. data, Kurta 1980, Kurta and Murray 2002, LaVal and LaVal 1980, Walley 1971) |
| NJ | Hibernia | 29 | RT | Spring 2006 | NA | 13 of 15 | Chenger 2006 |
| NY | Barton Hill | 39 | RT | Spring 2002 | NA | 19 of 24 | Britzke et al. 2006; C. Herzog, NYSDEC, personal communication, movebank.org |
| NY | Glen Park | 28 | RT | Spring 2005 | NA | 26 of 32 | C. Herzog, NYSDEC, personal communication, movebank.org |
| NY | Jamesville | 52 | RT | Spring 2006 | NA | 11 of 16 | C. Herzog, NYSDEC, personal communication, movebank.org |
| NY | Williams Complex | 56 | RT | Spring 2001 | NA | 0[b] of 4 | Sanders and Chenger 2001 |

**Table 4-2.** Records of migration distances (km) for Indiana bats (*Myotis sodalis*) by state and site from 1971 to 2010 (records are for adult females, unless otherwise noted).

| State(s) | Site(s) | Max distance (km) | Record type[a] | Date banded or tagged | Date retrieved | Number successfully recovered or tracked[b] | Source |
|---|---|---|---|---|---|---|---|
| NY | Williams Complex | 68 | RT | Spring 2004, 2005, 2007 | NA | 42 of 60 | C. Herzog, NYSDEC, personal, communication, movebank.org |
| PA | Glen Lyon Mine | 117 | RT | Spring 2006 | NA | 1 | Butchkoski and Turner 2006 |
| PA | Hartman Mine/Canoe Creek | 55 | RT | Spring 2003 | NA | 1[b] | Chenger 2003 |
| PA | Hartman Mine/Canoe Creek | 76 | RT | Spring 2008 | NA | 4 of 6 | Butchkoski and Turner 2008 |
| PA MD | Hartman Mine/Canoe Creek PA to MD | 148 | RT | Spring 2005 | NA | 5[b] of 6 | Butchkoski and Turner 2005 |
| PA | Long Run Mine | 96 | RT | Spring 2007 | NA | 4[b] of 6 | C. Butchkoski, PGC, personal communication |
| PA | Long Run Mine | 89 | RT | Spring 2010 | NA | 2[b] | C. Butchkoski, PGC, personal communication |
| PA | South Penn/Allegany Tunnel | 97 | RT | Spring 2000 | NA | 3[b] of 4 | Sanders and Chenger 2000 |
| PA | South Penn/Allegany Tunnel | 32 | RT | Spring 2007 | NA | 15 | J. Chenger, BCM, personal communication, Butchkoski and Turner 2008 |
| PA WV | Greene County, PA to Randolph County, WV Cave | 141 | BR | Summer 2007 | Winter 2007-2008 | 1 | Butchkoski and Turner 2008 |
| PA WV | Greene County, PA to Cliff Cave, WV | 173 | BR | Summer 2007, 2008 | Spring 2009 | 1 | Butchkoski 2009 |

**Table 4-2.** Records of migration distances (km) for Indiana bats (*Myotis sodalis*) by state and site from 1971 to 2010 (records are for adult females, unless otherwise noted).

| State(s) | Site(s) | Max distance (km) | Record type[a] | Date banded or tagged | Date retrieved | Number successfully recovered or tracked[b] | Source |
|---|---|---|---|---|---|---|---|
| PA WV | South Penn/Allegany Tunnel, PA to Hellhole Cave, WV | 138 | BR | Spring 2007 | Winter 2009-2010 | 1 male | J. Chenger, BCM, personal communication; C. Stihler, WVDNR, personal communication; C. Butchkoski, PGC, personal communication |
| PA WV | Hartman Mine/Canoe Creek, PA to Hellhole Cave, WV | 214 | BR | Fall 2007 | Winter 2009-2010 | 1 male | J. Chenger, BCM, personal communication; C. Stihler, WVDNR, personal communication; C. Butchkoski, PGC, personal communication |
| VA | Clarks and Star Chapel Caves | 80 | RT | Spring 2005 | NA | 12[b] of 13 | McShea and Lessig 2005 |
| WV | Pendleton and Tucker Counties WV to Hellhole | 32 | BR | Summer 2009 | Winter 2009-2010 | 7 | C. Stihler, WVDNR, personal communication |

[a] Record type: BR = band return and RT = radio telemetry study.

[b] Indicates that at least 1 bat was only partially tracked and lost before the presumed summer range could be confirmed.

#### *4.4.3.2 Migration Direction and Behavior*

There is some evidence that Indiana bats in the Appalachian RU and Northeast RU follow landscape features while migrating. Based on observations of 22 Indiana bats tracked during spring telemetry studies in PA from 2000 to 2006, bats appeared to go out of their way to follow tree lines, including riparian buffers along streams through otherwise developed areas, and avoided open areas (Turner 2006). Similarly, 12 Indiana bats tracked in western VA during spring migration generally followed ridges in the area, which run northeast-southwest, with only 1 bat flying east (i.e., into the Shenandoah Valley) and none flying west (i.e., over the higher mountain ridges into WV), suggesting that Indiana bats were using these corridors as migration flyways (McShea and Lessig 2005). J. Chenger (Bat Conservation and Management [BCM], personal communication) also reported that several Indiana bats tracked during spring migration from the South Penn Tunnel in south central PA appeared to be moving along U.S. Route 220, also known as the Appalachian Throughway, which follows a generally northeast-southwest direction in line with the Appalachian Mountains. Indiana bats radio tracked from the Jamesville Quarry Cave near the city of Syracuse, NY avoided the urban area and flew around the city rather than over it while migrating to their summer ranges (C. Herzog, NYSDEC, personal communication).

Indiana bats in the Midwest RU, where the Project is located, appear to primarily migrate from hibernacula in KY and IN to summer ranges to the north based on band recovery information (Gardner and Cook 2002, Whitaker and Brack 2002, Winhold and Kurta 2006; Figure 4-6). Band recovery data for Indiana bats captured in OH are consistent with this migration pattern (Barbour and Davis 1969; J. Kiser, Stantec, personal communication; K. Lott, ODNR, personal communication). However, the south to north spring migration trend is not evident in the Northeast or Appalachian RU, where Indiana bats in spring emergence telemetry studies have been documented fanning out in many directions to summer ranges that are in relatively close proximity to hibernacula (Table 4-2, Figure 4-6). Any assumptions about migration behavior for Indiana bats in the Ozark-Central RU would be difficult to make given the lack of migration data for that geographic region.

Despite the lack of consistency in migration data across Indiana bat RUs, limited genetics data seem fairly consistent with the patterns of movement that have been documented across geographic areas. Genetic samples (mtDNA) extracted from wing membrane punches collected from hibernating Indiana bats from 13 widely dispersed hibernacula were found to have genetic variance among samples. This was best explained by dividing sampled hibernacula into 4 separately defined population groups, as follows:

- Midwest included sampled populations in AR, MO, IN, KY, OH, Cumberland Gap, Saltpeter Cave in southwestern VA, and Jamesville Quarry Cave in Onondaga County, NY;
- Appalachia included White Oak Blowhole Cave in east TN, and Hellhole Cave in WV;
- Northeast 1 (NE1) included Barton Hill Mine and Glen Park Caves in northern NY (Essex and Jefferson Counties, respectively); and
- Northeast 2 (NE2) included Walter Williams Preserve Mine in Ulster County, NY (M. Vonhof, Western Michigan University, personal communication as cited by USFWS 2007).

While there was some level of male- and/or female-mediated gene flow occurring among 3 of the 4 defined groups (Midwest, Appalachia, and NE2), there was no apparent gene flow for either sex between the NE1 group and the other groups. These findings indicate that genetic bottlenecks in NE1 and NE2 may be the result of relatively recent colonization of the Northeast within historical times (estimated at 153 years before present for NE1) by a small number of individuals (USFWS 2007). This is also consistent with Hall's (1962) taxonomic studies of over 1,000 museum specimens collected from throughout the Indiana bat's range, which documented noticeable variation in morphometric and pelage characteristics in the northeast population. Hall concluded that "the establishment of populational ranges restricts gene flow within the species" and that "this apparently has not been in effect long enough to allow race differentiation to occur."

### 4.4.4 Summer Life History

#### *4.4.4.1 Maternity Roosts*

Female Indiana bats are pregnant when they arrive at their maternity roosts as early as April and as late as early May (Humphrey et al. 1977, Kurta and Rice 2002). Reproductive females occupy roost sites under the exfoliating bark of dead, dying, or live trees, and occasionally in narrow cracks of trees located in both upland and riparian forest (Gardner et al. 1991a, Callahan 1993, Kurta et al. 1993, Kurta et al. 2002, Carter 2003, Britzke et al. 2006). However, some reproductive females have been found in artificial roost sites. Ritzi et al. (2005) found adult females in a utility pole crevice and bird-house style bat boxes in IN. A rocket-style bat box was used by a group of females after the reproductive period in IL (Carter et al. 2001). Indiana bats in PA have been documented using a large artificial bat house (the "bat condo"), and various bat boxes and artificial roosts (Butchkoski and Turner 2006). Maternity colonies have also been found in buildings, including an abandoned church and nearby garage in PA (Butchkoski and Hassinger 2002), 2 houses in NY (USFWS 2007), and a barn in IA (Chenger 2003). In comparison, more than 400 roost trees have been documented for female Indiana bats (USFWS 2007).

Roost trees used by female Indiana bats have been described as either primary or alternate, depending on the number of bats that are consistently occupying the roost site (Kurta et al. 1996, Callahan et al. 1997, Kurta et al. 2002). In MO, Callahan (1993) defined primary roost trees as those with bat exit counts of more than 30 bats on more than 1 occasion; however, this number may not be applicable to small-to-moderate sized maternity colonies (Kurta et al. 1996).

Primary roosts usually receive direct solar radiation for more than half the day and are almost always located in either open canopy sites or above the canopy of adjacent trees (Kurta et al. 1996; Callahan et al. 1997; Kurta et al. 2002; J. Kiser, Stantec, personal communication). Primary roosts are usually not located in densely forested areas, but rather occur along forest edges or within gaps in forest stands (USFWS 2007).

Alternate roost trees can occur in either open or closed canopy habitats. Indiana bats from the same maternity colony may use between 10 trees and 20 trees throughout the summer, but usually only 1 to 3 of these are considered primary roosts where the majority of bats roost for part or all of the summer (Callahan 1993, Callahan et al. 1997). Alternate roost trees are typically used by individuals or small groups for only 1 day or a few days. Indiana bats typically switch roosts every 2 to 3 days, with the frequency of switching affected by reproductive condition of the female, roost type, weather conditions, and time of the year (Kurta et al. 2002, Kurta 2005). Indiana bats have shown site fidelity to summer roosting areas, individual roost trees (if they remain suitable), travel corridors, and foraging areas (Garner and Gardner 1992, Kurta et al. 2002, Winhold et al. 2005).

Maternity colonies typically contain 25 Indiana bats to 100 Indiana bats, but as many as 384 individuals have been documented emerging from a roost tree (Kiser et al. 2002). Recent studies at 1 of the large (>300 bats) colonies in IN found evidence that Indiana bats and little brown bats will share roost trees, so determining exact number of any species at a roost is nearly impossible (T. Carter, Ball State University, personal communication). Over 33 species of trees have been documented to be used as maternity roosts, but 87% of these are ash (*Fraxinus spp.*), elm (*Ulmus spp.*), hickory (*Carya spp.*), maple (*Acer spp.*), poplar (*Populus spp.*), and oak (*Quercus spp.*) (Murray and Kurta 2004). Most trees used by reproductive females are deciduous, but hemlock (*Tsuga* spp.) and pitch pine (*Pinus rigida*) have been used in western NC and eastern TN, and white pine has been used in VT (Britzke et al. 2003; Watrous et al. 2006; J. Kiser, Stantec, personal communication).

Although roost trees are ephemeral, they are reused from year to year as long as they continue to provide conditions necessary for females to raise their young. Roost trees are often damaged during severe weather events (e.g., by being blown over or by having bark blown off), but it appears Indiana bats can adapt to such situations by relocating to other suitable roost trees quickly. Some researchers believe that frequent roost switching behavior serves the purpose of keeping bats familiar with the locations of other suitable roost trees in the event that preferred roosts are damaged, parasite loads become heavy, and/or competition for roosting areas becomes prohibitive (Ritzi et al. 2005, Willis and Brigham 2004, Barclay and Kurta 2007).

Roost trees used by Indiana bats vary in size. The minimum tree size (diameter at breast height [dbh]) reported for a male roost is 6.4 cm (2.5 in; Gumbert 2001) and 11 cm (4.3 in) for a female roost (Britzke 2003). Primary maternity roosts are always found in larger diameter trees, usually more than 22 cm (8.7 in) dbh (Murray and Kurta 2004). Larger diameter trees provide thermal advantages to reproductive females and their pups by giving them more room to move around while locating appropriate temperatures.

#### *4.4.4.2 Foraging and Traveling Behavior*

Numerous foraging habitat studies have been completed for the Indiana bat throughout much of the species range. These studies have found Indiana bats forage in closed to semi-open forested habitats and forest edges located in floodplains, riparian areas, lowlands, and uplands (Humphrey et al. 1977, LaVal et al. 1977, Brack 1983, Gardner et al. 1991b, Garner and Gardner 1992, Butchkoski and Hassinger 2002, Romme´ et al. 2002, Murray and Kurta 2004, Sparks et al. 2005*a*). Indiana bats typically emerge from roosts between 19 minutes and 71 minutes after sunset to begin nightly foraging bouts (Brack 1983, Viele et al. 2002, Sparks et al. 2005*a*).

Indiana bats may fly linear distances between 0.5 km and 8.4 km (0.3 mi and 5.2 mi) while traveling from their roost trees to foraging areas, but most distances are about half the maximum, or approximately 4.0 km (2.5 mi) (Murray and Kurta 2004, Sparks et al. 2005*a*). For 21 radio-tagged Indiana bats captured in and around the Action Area in 2008 and 2009, the average distance between roost trees and telemetry points was 1.1 km ± 0.9 km (0.7 mi ± 0.5 mi), and the maximum distance was 5.6 km (3.5 mi) (K. Lott, ODNR, personal communication). This was similar to the average distance of 1.0 km (0.6 mi ) traveled between roost trees and the geometric centers of foraging areas for 5 adult female post-lactating Indiana bats tracked over 16 nights in IL (Garner and Gardner 1992). The average distance in the same IL study for 14 Indiana bats, including pregnant, lactating, and post-lactating females, males, and juveniles, was 2.3 km (1.4 mi).

Differences in commuting distances between summer foraging and roosting areas may be attributed to rangewide differences in habitat type, interspecific competition, and landscape terrain (USFWS 2007). Because Indiana bats typically do not cross large, open areas and instead follow tree lines or other habitat features that provide protective cover, Indiana bats may have to travel further distances in areas where connectivity of suitable habitat is limited. For example, Murray and Kurta (2004) found that Indiana bats increased their commuting distance by 55% to follow tree-lined paths rather than fly over large agricultural fields, some of which were at least 1 km (0.6 mi) wide. Further studies by Kurta (2005) and Winhold et al. (2005) found that for at least 9 years, this colony used the same wooded fenceline as a commuting corridor that connected forested areas situated in a largely agricultural area. Similarly, in a study area where over 60% of the landscape was either agricultural fields or urbanized areas, 12 of 13 foraging sites used by a colony were dominated by forest (Kurta et al. 2002).

Carter (2003) found that Indiana bat roost selection in southern IL in a large, open swamp was dependent on roost tree proximity to the forest edge near a dead tree zone created by the high water level. Indiana bats rarely used trees more than 50 m (164 ft) from the forest edge. Once Indiana bats emerged at dusk, they flew directly into the forest and were not seen flying in the more open portion of the swamp. Indiana bats have also been documented using protective cover along linear features not associated with tree cover, such as treeless channelized ditches (USFWS 2007).

Two radio telemetry studies in IL and IN assessed the types of habitats used by adult females while foraging compared to available habitat. Floodplain forest was the most preferred habitat in IL (Gardner et al. 1991b, Garner and Gardner 1992), and woodlots were used more often than other available habitats in IN (Sparks 2003; Sparks et al. 2005*a*, 2005*b*). Although it was difficult to document due to the errors inherent in conducting radio telemetry on a rapidly moving species, it appeared that Indiana bats likely were foraging most often along forest-field edges rather than over open fields when they used open habitats (Sparks et al. 2005*b*). While visual observations suggest that foraging over open fields or bodies of water more than 50 m (150 ft) from a forest edge did occur, it appeared to be less common than foraging within forested sites or along edges (Brack 1983, Menzel et al. 2001).

These findings are consistent with data collected within and in the vicinity of the Action Area. Stantec compiled data provided by the ODNR from 12 (11 females and 1 males) radio-tagged Indiana bats that were captured in 2008 and 2009 during mist-netting surveys in Champaign, Logan, and Hardin counties. Forty-three roost trees and 1,124 night time telemetry locations were documented for these 12 Indiana bats. Figure 4-7 shows the distance from each telemetry location to the edge of forested habitat (defined by all pixels classified as either deciduous, mixed, or conifer forest in the 2001 NLCD) (Homer et al. 2004). When the NLCD data layer was compared to a 2009 aerial photo (USDA National Agriculture Imagery 2010), the forest habitat classified by the NLCD included sizeable forested stands, fragmented small forested patches, as well as some streamside vegetation and hedgerows. The average distance from telemetry locations to a forested edge was 60 m ± 110 m (198 ft ± 361 ft), and 85% of telemetry locations were less than 170 m (559 ft; mean ± 1 SD) of a forest edge. All 1,124 telemetry locations were within 701 m (2,300 ft) of a forest edge.

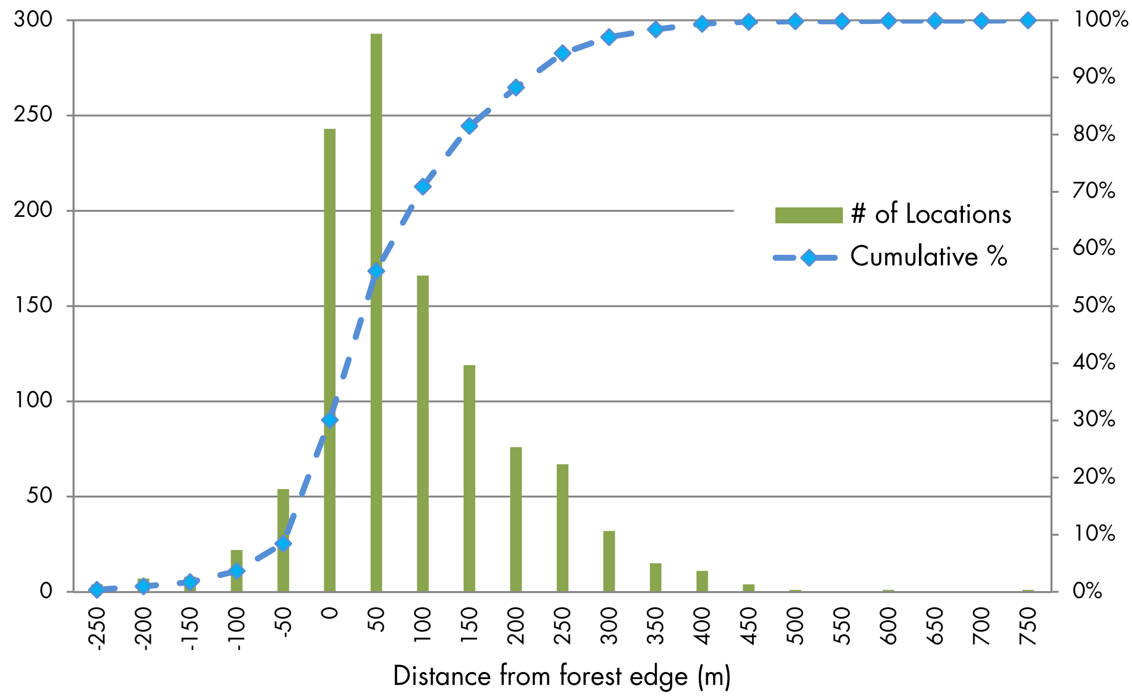


**Figure 4-7.** Distance from 1,124 nighttime telemetry locations from 11 female and 1 male Indiana bats captured in 2008 and 2009 during mist-netting surveys in Champaign, Logan, and Hardin counties, OH, to the edge of forested habitat (defined by all pixels classified as either deciduous, mixed, or conifer forest in the 2001 NLCD; Homer et al. 2004; 30 m resolution).

Previous studies have reported that Indiana bats typically fly between 2 m and 30 m (6 ft to 100 ft.) agl while foraging (Humphrey et al. 1977, Brack 1983, Gardner et al. 1989). Brack (1983) observed Indiana bats foraging around the crowns of scattered large trees in otherwise open habitats. Similarly, J. Kiser (Stantec, personal communication) also observed a female Indiana bat for approximately 20 min foraging along the edge of a dense forest and around the crowns of isolated trees with a maximum height of 15 m (49 ft) in and adjacent to a golf course in Jefferson County, NY.

This is also consistent with unpublished data collected by Stantec during acoustic bat surveys conducted for proposed wind power projects using Anabat detectors (Titley Electronics Pty Ltd.). Anabat detectors are frequency division detectors that divide the frequency of ultrasonic calls made by bats by a factor of 16 so that they are audible to humans, which are then recorded for subsequent analysis. The number of *Myotis* call sequences recorded during acoustic surveys at 19 proposed wind power projects using 96 detectors in 6 states (ME, NH, NY, OH [including the Action Area], VT, and WV) from 2005 to 2009 are presented in Figure 4-8. SAS procedure REG (SAS Institute Inc., Cary, North Carolina) was used to generate a least squares regression line based on 34,030 *Myotis* call sequences recorded at detectors deployed between 2 m to 50 m (7 ft to 164 ft) agl. Seasons were defined as spring 1 April to 31 May; summer 1 June to 31 July; and fall 1 August to 31 October.

Results indicated that, for every 1-m increase in detector height, activity rate (number of files recorded per detector per night) decreased by 0.44 (*Myotis* call per detector night). *Myotis* activity at 50 m (164 ft) was approximately 3% of activity at 2 m (7ft; Figure 4-8). There was no significant difference in vertical trends in activity between spring, summer, and fall, so data were pooled across seasons. Although *Myotis* calls were not identified to species, it may be reasonable to assume that the observed pattern is representative of

Indiana bat activity patterns. These data indicate that the vast majority of observed *Myotis* activity occurred below the lowest extent of the rotor-swept zone of Project turbines (i.e., 50 m); it should be noted that acoustic activity was not sampled above this height, so the activity patterns within the rotor-swept zone are not known.

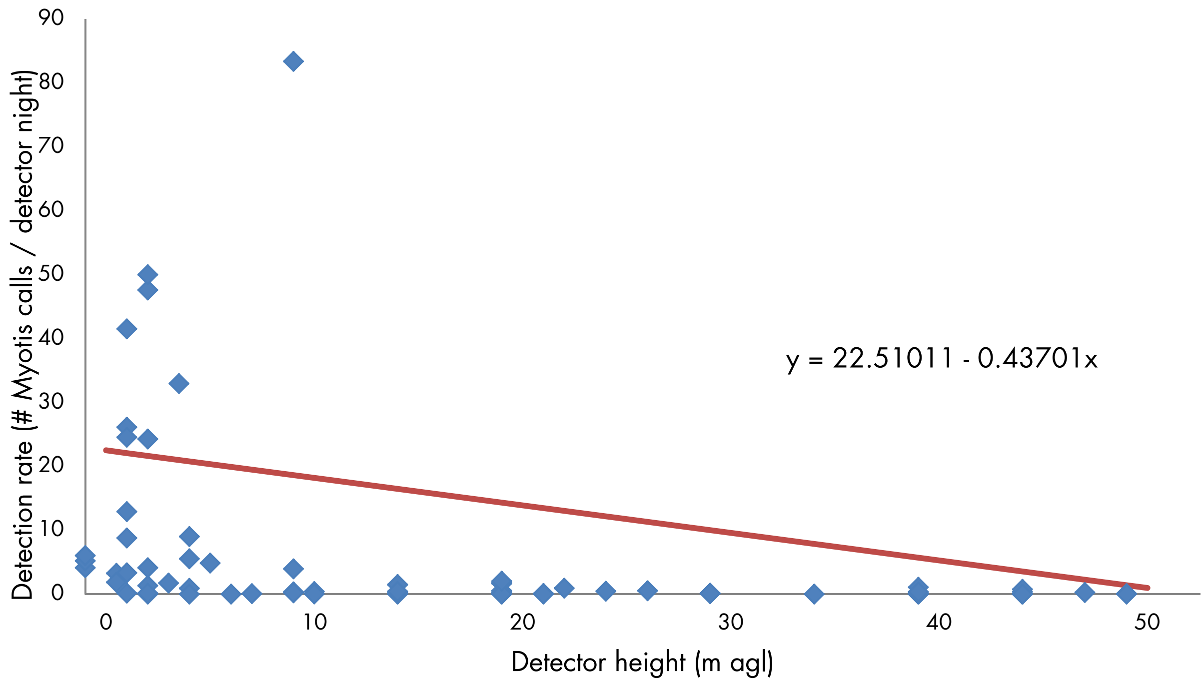


**Figure 4-8**. Detection rate (number of call sequences recorded per detector-night) for *Myotis* from acoustic data collected by Stantec at 19 proposed wind power projects (96 Anabat detectors) in 6 states (ME, NH, NY, OH [including the Action Area], VT, and WV) from 2005 to 2009.

Indiana bats are opportunistic foragers, feeding on a variety of small insects. The diet of Indiana bats varies depending upon habitat, geographic location, season, sex, and age of the foraging bat (Belwood 1979, Brack and LaVal 1985, Kurta and Whitaker 1998). Some geographic variations in diet have been noted, with Indiana bats from southern portions of the range consuming more terrestrial-based insects (Lepidoptera [moths] and Coleoptera [beetles]), while those from the northern localities prefer aquatic-based insects (Diptera [flies] and Trichoptera [caddisflies]) (USFWS 2007). Variations in diets of Indiana bats may occur from year to year within the same colony, and Indiana bats may take advantage or be "selectively opportunistic" when other types of insects are plentiful (Murray and Kurta 2002).

Nightly foraging activity is usually interrupted by periods of rest, referred to as night roosting. Most Indiana bats use trees as night roosts (Butchkoski and Hassinger 2002, Murray and Kurta 2004), although they occasionally utilize artificial roosts or "bat boxes" (Butchkoski and Hassinger 2002), concrete bridges (Kiser et al. 2002), or other structures. Night roosts are thought to provide Indiana bats a resting place between foraging bouts, promote digestion and energy conservation, provide retreats from predators and inclement weather, provide places to ingest food transported from nearby feeding areas, function as feeding perches for sit-and-wait predators, and serve as places to promote social interactions and information transfer (Ormsbee et al. 2007).

### 4.4.6 Home Range

Indiana bats are thought to occupy distinct home ranges (Garner and Gardner 1992), or areas in which they engage in several important behaviors such as foraging, commuting, night-roosting, and drinking. Relatively few studies have described home ranges for Indiana bats and have often based home range estimates on a small number of individuals. Given the challenges of tracking a rapidly moving animal over large geographic areas, it is difficult to estimate home range. Further limiting the value of home range estimates is the fact that different methods of home range estimation (i.e., MCP, adaptive or fixed kernel methods) can affect the size and shape of estimated home ranges, limiting comparability among studies (Lacki et al. 2007). Despite these limitations, home range estimates can provide meaningful information about how bats are using available habitat.

Home range size varies between the sexes and with varying reproductive status of females (Lacki et al. 2007). The average home range size for 1 adult male and 11 adult female Indiana bats captured in 2008 and 2009 in the tri-county area (1,256 ha ± 900 ha [3,104 ac ± 2,223 ac]) was substantially larger than other home range estimates that have been reported for Indiana bats at both hibernacula and summer roosting areas (Table 4-3). This difference is likely at least partially attributable to the use of differing methods to estimate home range, which can have a large impact on estimated size (Worton 1989, Burgman and Fox 2003, Lacki et al. 2007); therefore, variation in home range sizes reported among different studies should be interpreted with care. Differences may also be attributable to dissimilarity in habitat type, landscape configuration, and availability of resources among the various study areas; due to the differences among estimates in terms of including only males, females, or both sexes; or due to differences in seasonal timing of data collection (e.g., some described home ranges during fall swarming).

**Table 4-3**. Estimates of home range size (ha and ac) for Indiana bats (*Myotis sodalis*) by state and method of home range estimator.

| State | Home range size: Hectares Mean | Hectares SD or SE | Acres Mean | Acres SD or SE | Home range estimator | Number of bats | Source |
|---|---|---|---|---|---|---|---|
| Kentucky | 156 | 101[a] | 385 | 250[a] | MCP | 15 | Kiser and Elliot 1996 |
| Virginia | 361 | 78[b] | 892 | 193[b] | MCP | 11 | Brack 2006 |
| Illinois | 145 | 18[c] | 358 | 44[c] | Kernel | 11 | Menzel et al. 2005 |
| Missouri | 667 | 994[b] | 1,648 | 2,456[b] | MCP | 9 | Rommé et al. 2002 |
| Indiana | 335 | 66[c] | 828 | 163[c] | Kernel | 11 | Sparks et al. 2005a |
| Vermont | 83 | 82[b] | 205 | 203[b] | Kernel | 14 | Watrous et al. 2006 |

[a] unknown
[b] standard deviation
[c] standard error

### 4.4.7 Fall Swarming and Roosting

Indiana bats start arriving at hibernacula during late August and fly around the entrances in an attempt to find mates, a phenomenon referred to as "swarming," typically a multi-species event (Cope and Humphrey 1977). Male Indiana bats typically remain active longer during autumn than do females. Once arriving at hibernacula, females may only remain active for a few days, whereas males remain active, seeking mates into late October and early November (with exact timing varying with latitude and annual weather conditions).

Fall roosting occurs in conjunction with swarming activities of the Indiana bat and usually occurs outside of the hibernaculum during this period (i.e., bats will day roost in trees and fly to their hibernaculum at night). However, clusters of active Indiana bats have been observed in caves at night roosting during swarming events (Gumbert et al. 2002). The maximum distance between identified roost trees and associated hibernacula varies among telemetry studies conducted during the fall roosting and swarming season. At 2 small P3 hibernacula in KY, Indiana bats roosted primarily in dead trees on solar exposed upper slopes and ridgetops within 2.4 km and 4.1 km (1.5 mi and 2.5 mi) of the cave entrances (Kiser and Elliott 1996, Gumbert 2001). In MI, Kurta (2000) tracked 2 male Indiana bats to roost trees located 2.2 km and 3.4 km (1.4 mi and 2.1 mi) from a P4 hibernaculum. In VA, all roost trees identified from 8 male and 3 female Indiana bats were within 1.4 km (0.6 mi) of a P3 hibernaculum, though the author noted that bats traveling outside of the study area (defined as the north side of a 3.2 km circle, centered on the hibernaculum) were not able to be located (Brack 2006). In PA, a male Indiana bat twice traveled 14 km (9 mi) from the hibernaculum where it was captured (USFWS 2007). In MO, radiotagged individuals traveled maximum distances of 6.4 km (4.0 mi) away from the nearby hibernaculum (Rommé et al. 2002). During telemetry studies outside Wyandotte Cave in IN, 2 females were relocated 30.7 km (19.1 mi) away from the cave (Hawkins et al. 2005, USFWS 2007).

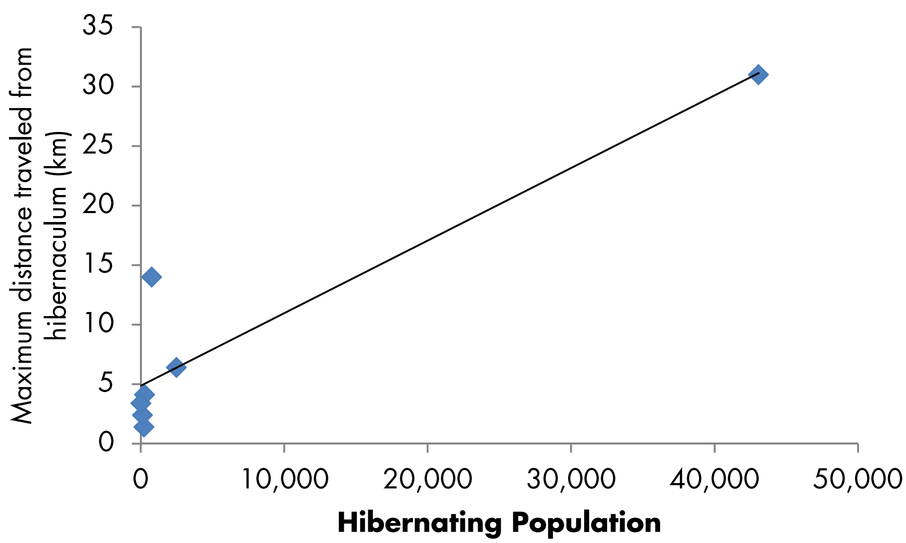


**Figure 4-9.** Population size of local hibernaculum and maximum distance traveled to roost trees from 7 fall swarming studies in VA, KY, IN, MI, MO, and PA (Brack 2006, Gumbert 2001, Hawkins et al. 2005, Kiser and Elliot 1996, Kurta 2000, Rommé et al. 2002, USFWS 2007).

Most telemetry studies conducted during fall swarming have occurred outside of hibernacula with small populations of Indiana bats. The long distances traveled by Indiana bats studied near Wyandotte Cave seem to suggest that use of habitat during fall swarming may change with hibernacula size (Hawkins et al. 2005). Thus, as the density of Indiana bats swarming outside of the hibernaculum increases, Indiana bats may need to move farther from the site to find available roost and prey resources. Despite the lack of data collected at moderately sized hibernacula (i.e., P2), a pattern of increased foraging distances with increased hibernating populations is apparent in the data collected for the aforementioned studies (Figure 4-9). This relationship is primarily being driven by the single study conducted outside of a P1 hibernaculum

(Hawkins et al. 2005, conducted near Wyandotte Cave, IN); additional swarming studies conducted at moderately sized hibernaculum would further elucidate this relationship. However, these data represent the best available information on foraging and travelling patterns of Indiana bats during fall swarming.

Kiser and Elliott (1996) found that during swarming, Indiana bats in KY used day roosts under the sloughing bark of trees near caves and traveled to the cave entrance each night. Few data are available on the roosts used by swarming Indiana bats, but roosts used by Indiana bats in KY tended to be smaller in size than roosts used in the summer reproductive period. Roost trees used during the fall in KY ranged from 11.9 cm to 67.1 cm (4.7 in to 26.4 in) dbh, primarily located on ridgetops and upper slopes (Kiser and Elliott 1996). Gumbert (2001) found a male Indiana bat roosting in a 6.4-cm (2.5-in) dbh flowering dogwood (*Cornus florida*), which is the smallest roost tree documented for the species. Species of roost trees used in KY were similar to those used for summer roosts, with the exception of the following species that were only documented in the fall: Virginia pine [*Pinus virginiana]*, shortleaf pine [*P. echinata]*, pitch pine [*P. rigida]*), flowering dogwood, and sourwood (*Oxydendrum arboreum*) (Kiser and Elliott 1996, Gumbert 2001).

Indiana bats tend to roost more often as individuals in fall than in summer (USFWS 2007). Roost switching occurs every 2 to 3 days and trees used by the same individual tend to be clustered in the environment. Similar to summer, fall roost trees most often are in sunny forest openings created by human or natural disturbance (USFWS 2007). Indiana bats show strong site fidelity (especially females) and typically return to the same hibernacula year after year (Hall 1962, LaVal and LaVal 1980, Gumbert et al. 2002), but switching between different hibernacula does occur. Hall (1962) reported Indiana bats apparently switching between hibernacula: 20 Indiana bats (n = 15 females, 5 males) banded in 1 hibernaculum were recovered in a different hibernaculum in subsequent winters, with distances between caves ranging from 2 mi to 320 mi. More recently, a female Indiana bat that was captured emerging from the South Penn Tunnel in Bedford County, PA, in the spring of 2007 was recaptured in winter 2009-2010 at Hellhole Cave in Pendleton County, WV, a distance of approximately 138 km (86 mi) (C. Butchkoski, PGC, personal communication and C. Stihler, WV Department of Natural Resources, personal communication). Similarly, an Indiana bat captured during swarming at the Hartman (or Canoe Creek) Mine in Blair County, PA, in fall 2007 was captured in a cave in Tucker County, WV, in winter 2009-2010, a distance of approximately 214 km (133 mi) (C. Butchkoski, PGC, and C. Stihler, WVDNR, personal communication).

## 4.5 Current Threats

As stated previously, the Indiana bat was listed as endangered in 1967 (32 Fed. Reg. 4001, 11 Mar 1967). Pursuant to Section 4 of the ESA a species may be listed as endangered or threatened because of any of the following 5 factors;

1) The present or threatened destruction, modification, or curtailment of its habitat or range;
2) Over utilization for commercial, recreational, scientific, or educational purposes;
3) Disease or predation;
4) Inadequacy of existing regulatory mechanisms; and
5) Other natural or man-made factors affecting its continued existence (16 U.S.C. § 1533 (a)(1).

Recovery of Indiana bats initially focused on minimizing disturbance at hibernacula, and efforts were made to protect all major hibernacula in the years following its listing. Despite this protection, the species continued to decline in number, suggesting that issues with its summer range or other factors were also contributing to its decline (USFWS 2007).

Current threats that influence recovery efforts for the Indiana bat include habitat destruction and degradation, disturbance at hibernacula, and disease. Threats to the Indiana bat vary during its annual life cycle. Factors that may influence the Indiana bat's vulnerability include energetic impacts caused by disturbance to roosting areas (both at hibernacula and maternity colonies), availability of hibernation and summer roosting habitat, and connectivity of suitable habitat. Life history characteristics such as obligate colonial roosting, early and rapid parturition of young, and necessary conservation of fat reserves during hibernation may intensify their susceptibility to these disturbances.

### 4.5.1 Loss or Degradation of Summer, Migration, and Swarming Habitat

Loss of forested habitats used by Indiana bats during the summer season for roosting, swarming, and feeding has been cited as a factor for endangerment (USFWS 1983). In some regions of the Indiana bat's summer range, up to 97% of forested habitat has been cleared (USFWS 2007). Historically, forest loss has been primarily due to land conversion to agriculture; but currently the greatest cause of forest loss is from urbanization and associated development (Wear and Greis 2002). Although Indiana bats will utilize forest-agricultural edges for foraging, they have been found to avoid high-density residential areas (Sparks et al. 2005b).

Forest harvest practices can impact the suitability of Indiana bat habitat. Removing or felling roost trees during the active period (1 Apr to 31 Oct) can cause direct injury or death to Indiana bats (Cope et al. 1974, Belwood 2002), and cutting (standing) dead trees for firewood is cited as threat to roost trees (USFWS 1983, Krusac and Mighton 2002). Impacts to forested habitats used for maternity colonies by Indiana bats can negatively impact reproduction. Because philopatry to maternity colonies is high (USFWS 2007), the loss of colonies due to forest destruction or degradation can have implications on reproductive success, as females must expend energy in search for new suitable colonies (Sparks et al. 2003, Barclay et al. 2004).

The alteration of riverine habitats can also negatively impact Indiana bat habitats (USFWS 2007). Specifically, channelization projects can destroy riparian vegetation, which, in turn impacts foraging and roosting habitat and insect food sources (Humphrey et al.1977, Humphrey 1992, Drobney and Clawson 1995). Migration pathways and swarming sites also may be affected by habitat loss and degradation.

Silvicultural practices such as selective harvesting and shelterwood cuts that result in the retention of dead and dying trees have been found to increase Indiana bat roosting potential (Gardner et al. 1991b, MacGregor et al. 1999, Ford et al. 2002). Managing forests to develop characteristics of old growth forests will help promote suitable roosting habitats for Indiana bats (Clawson 1986 as cited by USFWS 2007, Callahan 1993, Krusac and Mighton 2002).

### 4.5.2 Disturbance or Destruction of Hibernating Habitat

Indiana bat hibernacula have been degraded or destroyed for many reasons (USFWS 2007). Mining (saltpeter), cave recreation, and tourism have led to the alterations of caves that include barriers or modifications to cave entrances (e.g., doors, gates, buildings) and destruction of cave physical characteristics. These alterations can modify air flow patterns and temperatures, rendering caves unsuitable or marginal for hibernating Indiana bats. A specific example of this degradation is the construction of a building over the entrance of Coach Cave in KY, which resulted in cave temperatures increasing from 4°C to 6°C to 11°C (39°F to 43°F to 52°F) and a decline in the population of hibernating Indiana bats from approximately 100,000 Indiana bats to 4,500 Indiana bats (Currie 2002). Similar obstructions of airflow and subsequent increases in cave temperatures have been documented in Indiana bat hibernacula in KY (MacGregor 1993), IN (Johnson et al. 2002), and MO (Tuttle and Kennedy 2002).

In addition to altering cave microclimates through alteration of airflow, cave gates and doors have been reported to cause injury and mortality from collisions as bats exit and enter caves. Vandals have directly killed hibernating Indiana bats, and documented mortalities have numbered in the 10,000s (Carter County, Kentucky; Greenhall 1973, as cited by USFWS 2007). Campfires also have contributed to the direct killing of Indiana bats at hibernacula (MacGregor 1993 as cited by USFWS 2007).

Physical disturbance to hibernating bats from human activities such as mining (saltpeter), tourism and recreation, and research can negatively impact bats by causing them to arouse during hibernation. Because arousal is metabolically expensive, when bats are disturbed they use fat reserves that are critical for survival (Thomas et al. 1990, as cited by USFWS 2007). The impacts of disturbance can be manifested through lower survival and/or reproductive rates after bats leave their hibernacula. However, it is often difficult to document the impacts of disturbance because bats rarely experience immediate mortality from such events, and detection of a bat's response to disturbance is difficult to assess (Mohr 1972 and Humphrey 1978, as cited by USFWS 2007). Although disturbance at caves was a primary concern for Indiana bats when the species was first listed, through education and conservation activities human disturbance at caves largely has been addressed and is not affecting Indiana bats to the degree it once was (USFWS 2009a).

Other threats to Indiana bat hibernacula include flooding and ceiling collapse at caves, either due to mining or natural causes. Such catastrophes can have a significant effect on the Indiana bat population because of the concentration of individuals found in relatively few hibernacula.

### 4.5.3 Disease and Parasites

Disease and parasites in Indiana bats are poorly understood and had not been cited as major factors in population declines prior to the discovery of WNS in 2007 (USFWS 2007). Although rabies and parasites contribute to mortality, the 2007 Draft Recovery Plan did not associate these diseases with the decline of Indiana bats. WNS (discussed in Sections 4.1.1 – White-Nose Syndrome and 7.2.1 – Changed Circumstances) was not considered a threat to Indiana bats prior to its discovery in 2007, but is recognized in the 2009 Indiana Bat Five-Year Review (USFWS 2009a). The disease already has caused large scale mortality in the eastern United States and is anticipated to continue to spread to Indiana bat hibernacula in other eastern and midwestern states. It is possible that other previously undetected diseases could impact Indiana bats in the future, consistent with the emergence of diseases that have caused mass declines and extinctions in other species.

### 4.5.4 Climate Change

Although the manifestations of climate change are expected to be complex and widely varied, several potential negative impacts to Indiana bats may occur. Temperature increases associated with climate change may be influencing northward range shifts that have been documented for Indiana bats (Clawson 2002, USFWS 2007; although Meretsky noted that confounding factors are clearly involved [USFWS 2007]) and predicted for little brown bats (Humphries et al. 2002). A recent analysis of 866 studies on global warming's effects on wildlife found that nearly 60% of species considered 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, as cited in Gomberg 2008). Similarly, mismatched phenology of insect availability relative to times of peak energy demand for Indiana bats could negatively affect reproductive success and survival (V. Meretsky, Indiana University, personal communication as cited by USFWS 2009a). Refer to Section 7.2.1 – Changed Circumstances for a more in-depth discussion of the potential impacts of climate change on the Indiana bat.

### 4.5.6 Collision Mortality at Wind Facilities

To date, 3 Indiana bat fatalities have been documented in post-construction monitoring studies at wind energy facilities. Two of the fatalities occurred at the Fowler Ridge wind facility in Benton County, IN, during the fall migration period; the first occurred in September 2009 and the second occurred in September 2010 (Good et al. 2011). The third Indiana bat fatality occurred at the North Allegheny Wind facility in Cambria and Blair counties in Pennsylvania[19]. This fatality also occurred during the fall migration period in September 2011. While it is assumed that other Indiana bat mortality at wind facilities have occurred, these fatalities represent the only documented taking of a federally threatened or endangered bat species at a wind facility to date. Because very low Indiana bat mortality has been documented at wind facilities, there is a lack of direct data specific to the Indiana bat. Therefore, the following section will discuss impacts that have been documented for bats in general and will make inferences to Indiana bats where appropriate.

#### *4.5.6.1 Collision Rates*

Concern regarding impacts to wildlife from wind facilities focused primarily on birds prior to 2003 (Johnson et al. 2003a). Bat fatalities were discovered in relatively small numbers beginning in the late 1990s in conjunction with avian fatality monitoring. However, several high profile bat mortality surveys at wind facilities on forested ridges of the Appalachian Mountains in 2003 and 2004 raised concerns about the impacts to bats (Kunz et al. 2007a). An estimated 2,092 bats were killed at the Mountaineer Wind Energy Center in WV between 4 April 2003 and 11 November 2003 (Kerns and Kerlinger 2004), although Arnett et al. (2008) estimated that the total number of bats killed during 2003 could have been as high as 4,000.

Similarly high rates were estimated for 2 6-week studies conducted in 2004 at Mountaineer (1,364 to 1,980 fatalities) and Meyersdale, PA (400 to 920 fatalities) (Kerns et al. 2005; Table 4-4). In 2005, the estimated bat mortality rate at the Buffalo Mountain, TN, wind facility (18 turbines) was the highest documented annual rate reported in the United States to date (63.9 bats per turbine and 39.7 bats per MW; Fiedler et al. 2007). This was an order of magnitude greater than the 2004 national average of 3.4 bats per turbine per year (Johnson 2004). Post-construction monitoring at wind facilities in the latter part of the decade have continued to report higher than expected levels of bat mortality at wind energy sites, though mortality rates varied by region (Johnson 2005, Arnett et al. 2008, Gruver et al. 2009).

Bat deaths and injuries were initially thought to primarily result from the impact of physically colliding with turbines (Johnson et al. 2004, Horn et al. 2008). However, the recent discovery that bats can be killed as a result of decompression sickness, or barotrauma, caused by low-pressure vortices formed in the wake of rotating turbine blades demonstrates that bats do not have to physically collide with turbines to be at risk (Baerwald et al. 2008b). Tissue damage is caused by this rapid or excessive pressure change; pulmonary barotrauma is lung damage due to expansion of air in the lungs that is not accommodated by exhalation. Baerwald et al. (2008b) reported that internal hemorrhaging consistent with barotrauma was found in 90% of bat carcasses examined, and that direct contact with turbine blades only accounted for about half of the fatalities observed at the wind facility studied.

Bat mortalities rates are typically calculated by using the number of observed carcasses and correcting for searcher efficiency, carcass persistence, and searchable area. Variation in bat mortality estimates among studies may be partially attributable to differences in monitoring methodology and correction factors among other variables

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[19] See <http://www.fws.gov/northeast/pafo/>. Accessed October 2011.

#### *4.5.6.2 Geographic Variation*

In a review of 21 studies from 19 different wind energy facilities in 5 regions of the United States and 1 province in Canada, Arnett et al. (2008) found that estimates of bat fatalities were highest at wind energy facilities located on forested ridges in the eastern United States and lowest in the Rocky Mountain and Pacific Northwest regions. Bat fatalities were lower and more variable among sites in the upper Midwest, with estimates ranging from 0.2 bat per MW to 8.7 bats per MW or 0.1 to 7.8 bats per turbine (Table 4.4). However, a 2009 post-construction study at Blue Sky Green Field in WI documented an unprecedented, high mortality rate for the Midwest, with total estimated mortality of 40.5 bat fatalities per turbine (35.6 bats per turbine when incidental finds were removed) or 24.6 bat fatalities per MW (21.6 bats per MW when incidental finds were removed) for the 88-turbine facility (Gruver et al. 2009); the species composition of these fatalities will be discussed below in Section 4.5.5.2.1 – Species Distribution. Likewise, the Cedar Ridge wind facility in WI also documented high bat mortality rates, estimated at 50.5 bats per turbine per study period (BHE 2010).

Although trends among sites within the same geographic areas have been relatively consistent, in some cases facilities in the same geographic region have had highly variable rates. For example, in southwestern Alberta, 3 facilities in the same geographic region had significantly different estimates of bat fatalities. Bat mortality at Summerview (2005) was on average 14.1 times greater than Castle River and McBride Lake (E. Baerwald and R. M. R. Barclay, University of Calgary, unpublished data as cited by Arnett et al. 2008).

**Table 4-4.** Estimated bat mortality rates reported at wind-energy facilities in the United States and Canada.

| Project Location | Year | No. of turbines at site | Estimated no. bats per turbine/yr | 95% confidence interval (per no. b/t/yr) | Study period | Source |
|---|---|---|---|---|---|---|
| U.S. - Midwest | | | | | | |
| Blue Sky Green Field, WI | 2008 | 88 | 35.6 | 30.98-51.16[c,f] | 21 Jul-31Oct 2008, 15 Mar-31 May 2009 | Gruver et al. 2009 |
| Buffalo Ridge, MN (Phase I) | 1999 | 73 | 0.26 | 0.06-0.46[c] | 15 Mar-15 Nov 1999 | Johnston et al. 2003a |
| Buffalo Ridge, MN (Phase II) | 1998 | 143 | 1.62 | 1.21-2.03[c] | 15 Mar-15 Nov 1998 | Johnston et al. 2003a |
| Buffalo Ridge, MN (Phase II) | 1999 | 143 | 1.94 | 1.53-2.35[c] | 15 Mar-15 Nov 1999 | Johnston et al. 2003a |
| Buffalo Ridge, MN (Phase III) | 1999 | 138 | 2.04 | 1.46-2.62[c] | 15 Mar-15 Nov 1999 | Johnston et al. 2003a |
| Buffalo Ridge, MN (Phase II) | 2001 | 143 | 3.26 | 2.25-4.48[c] | 15 Jun-15 Sep 2001 | Johnston et al. 2004 |
| Buffalo Ridge, MN (Phase III) | 2001 | 138 | 2.78 | 1.96-3.71[c] | 15 Jun-15 Sep 2001 | Johnston et al. 2004 |
| Buffalo Ridge, MN (Phase II) | 2002 | 143 | 1.36 | 0.82-2.00[c] | 15 Jun-15 Sep 2002 | Johnston et al. 2004 |
| Buffalo Ridge, MN (Phase III) | 2002 | 138 | 1.3 | 0.89-1.77[c] | 15 Jun-15 Sep 2002 | Johnston et al. 2004 |
| Cedar Ridge, WI | 2009 | 41 | 50.5[d] | NR | Mar-May; July-Nov 2009 | BHE 2010 |
| Crescent Ridge, IL | 2005/2006 | 33 | 0.18-2.67 | 4.36-5.46 | Sep-Nov 2005;Mar-May 2006; Aug 2006 | Kerlinger et al. 2007 |
| Fowler Ridge, IN | 2010 | 355 | 22.2 | 19.32-29.17[c] | 13 Apr-5 May 2010; 1 Aug-15 Oct 15 2010; | Good et al. 2011 |
| Forward Energy Center, WI | 2008-2009 | 86 | NR | NR | 15 Jul 2008-15 Oct 2009 | Drake et al. 2010 |
| Kewaunee County, WI | 1999-2001 | 31 | 4.26 | NR | Jul 1999-Jul 2001 | Howe et al. 2002 |
| NPPD Ainsworth, NE | 2006 | 36 | 1.91[d] | 0.91-3.37[c] | 13 Mar-4 Nov, 2006 | Derby et al. 2007 |
| Top of Iowa, IA | 2003 | 89 | 3.74-8.08[d] | NR | 15 Apr-15 Dec 2003 | Jain 2005 |
| Top of Iowa, IA | 2004 | 89 | 7.19-13.14[d] | NR | 15 Apr-15 Dec 2004 | Jain 2005 |
| AVERAGE Midwest | | 112.2 | 9.7 | | | |

| Project Location | Year | No. of turbines at site | Estimated no. bats per turbine/yr | 95% confidence interval (per no. b/t/yr) | Study period | Source |
|---|---|---|---|---|---|---|
| U.S. - South-Central | | | | | | |
| Buffalo Gap, TX | 2007-2008 | 155 | 0.21 | NR | Jul 2007-Dec 2009 | Tierney 2009 |
| Oklahoma Wind Energy Center, OK | 2004-2005 | 68 | 1.19-1.71[i] | NR | May-Jul 2004/2005 | Piorkowski and O'Connell 2010 |
| AVERAGE South Central | | 111.5 | 0.83 | | | |
| Eastern United States | | | | | | |
| Buffalo Mountain, TN (Phase I) | 2000-2003 | 3 | 20.8 | 19.5-22[c] | 29 Sep 2000-30 Sep 2003 | Fiedler 2004 |
| Buffalo Mountain, TN (Phase II) | 2005 | 18 | 63.9 | | Apr-Dec 2005 | Fiedler et al. 2007 |
| Casselman, PA | 2008 | 23 | 32.2 | 20.8-51.4 | 26 Jul-10 Oct 2008 | Arnett et al. 2009 |
| Cohocton/Dutch Hill, NY | 2009 | 50 | 13.8-40 | 804.13-3062.02 | 15 Apr-15 Nov 2009 | Stantec 2010a |
| Cohocton/Dutch Hill, NY | 2010 | 50 | 5.04-25.62[d] | 65.63-963.89[d] | 26 Apr-22 Oct 2010 | Stantec 2011b |
| Lempster Ridge, NH | 2009 | 12 | 6.21[d] | 3.08-9.84[d] | 15 Apr-31 Oct 2009 | Tidhar et al. 2010 |
| Maple Ridge, NY | 2006 | 195 | 11.39-20.31 | 14.3-34.7 | 17 Jun-15 Nov 2006 | Jain et al. 2007 |
| Maple Ridge, NY | 2007 | 195 | 15.5 | 14.1-17.0 | 30 Apr-14 Nov 2007 | Jain et al. 2009a |
| Maple Ridge, NY | 2008 | 195 | 8.2 | 7.4-9.0 | 5 Apr-9 Nov 2008 | Jain et al. 2009b |
| Mars Hill, ME | 2007 | 28 | 4.37 | NR | 23 Apr-23 Sep 2007 | Stantec 2008c |
| Mars Hill, ME | 2008 | 28 | 0.17 | NR | 19 Apr-8 Oct 2008 | Stantec 2009b |
| Meyersdale, PA | 2004 | 20 | 25.1 | 20.1-32.7 [c] | 2 Aug-13 Sep 2004 | Arnett 2005 |
| Mount Storm, WV (Phase I) | 2008 | 82 | 24.2 | 17.1-33.1[cd] | 18 Jul-17 Oct 2008 | Young et al. 2009a |
| Mount Storm, WV (Phase I,II) | 2009 | 132 | 28.6 | 18.7-40.5 | 23 Mar-14 Jun & 16 Jul-8 Oct 2009 | Young et al. 2009b, 2010 |
| Mount Storm, WV (Phase I,II) | 2010 | 132 | 9.98[d] | 8.2-14.06[cd] | 16 Apr-14 Jul 2010 | Young et al. 2011 |
| Mountaineer, WV | 2004 | 44 | 37.7 | 31.2-45.1 [c] | 2 Aug-13 Sep 2004 | Arnett 2005 |
| Mountaineer, WV | 2003 | 44 | 47.5 | 31.8-91.6 [c] | 4 Apr-22 Nov 2003 | Kerns and Kerlinger 2004 |
| Munnsville, NY | 2008 | 23 | 3.6[fg] | 32.99-40.19[fg] | 15 Apr-15 Nov 2008 | Stantec 2009c |
| Noble Bliss, NY | 2008 | 67 | 7.58-14.66[h] | NR | 21 Apr-14 Nov 2008 | Jain et al. 2009c |

| Project Location | Year | No. of turbines at site | Estimated no. bats per turbine/yr | 95% confidence interval (per no. b/t/yr) | Study period | Source |
|---|---|---|---|---|---|---|
| Noble Clinton, NY | 2008 | 67 | 3.76-5.45[dh] | NR | 26 Apr-13 Oct 2008 | Jain et al. 2009e |
| Noble Ellensburg, NY | 2008 | 54 | 4.19-8.17[dh] | NR | 28 Apr-13 Oct 2008 | Jain et al. 2009d |
| Stetson Mountain I, ME (Year 1) | 2009 | 38 | 2.11 | NR | 20 Apr-21 Oct 2009 | Stantec 2010b |
| Stetson Mountain II, ME (Year 1) | 2010 | 17 | 2.48 | 2.19-2.77 | 19 Apr-31 Oct 2010 | Normandeau 2010 |
| AVERAGE East | | 66.0 | 17.9 | | | |
| U.S. - West | | | | | | |
| Foote Creek Rim, WY Year 1 | 1998-1999 | 69 | 2.38[f] | 0.68-4.71[f] | 3 Nov 1998-31 Oct 1999 | Young et al. 2003 |
| Foote Creek Rim, WY Year 2 | 2000 | 69 | 0.63[f] | 0.2-2.04[f] | 1 Nov 1999-31 Dec 2000 | Young et al. 2003 |
| Foote Creek Rim, WY Year 3 | 2001-2002 | 69 | 0.94[f] | 0.26-1.13[f] | 1 Jun 2001-5 Jun 2002 | Young et al. 2003 |
| Judith Gap, MT | 2006-2007 | 90 | 13.4 [d] | NR | Aug-Oct 2006, Feb-May, 2007 | TRC Environmental 2008 |
| AVERAGE West | | 74.3 | 4.3 | | | |
| U.S. - Pacific NW and Coast | | | | | | |
| Biglow Canyon, OR | 2008 | 76 | 3.29 | 2.27-4.85 [c] | Jan-Dec 2008 | Jeffrey et al. 2009 |
| Biglow Canyon, OR | 2009 | 76 | 0.96 | 0.57-1.49[c] | 26 Jan-11 Dec 2009 | Enk et al. 2010 |
| Combine Hills, OR (Phase I) | 2004-2005 | 41 | 1.88 | 1.15-2.8c | 9 Feb 2004-8 Feb 2005 | Young et al. 2006 |
| High Winds, CA Year 1 | 2003-2004 | 90 | 2.72 | NR | Aug 2004-Jul 2005 | Kerlinger et al. 2006 |
| High Winds, CA Year 2 | 2004-2005 | 90 | 3.63 | NR | Aug 2003-Jul 2005 | Kerlinger et al. 2006 |
| Hopkins Ridge, WA | 2006 | 83 | 1.13 | 0.69-1.71 [c] | Jan-Dec 2006 | Young et al. 2007 |
| Klondike, OR (Phase I) Year 1 | 2001-2002 | 16 | 1.16 | 0.41-2.12 [c] | 2001-2002 | Johnson et al. 2003b |
| Stateline, OR/WA | 2002 | 399 | 0.954 | 0.646-1.312[c] | Jul 2001-Dec 2002 | Erickson et al. 2003a |
| Stateline, OR/WA | 2003 | 454 | 1.51 | 1.08-1.94[c] | Jan 2003-Dec 2003 | Erickson et al. 2004 |
| Vansycle, OR | 1999 | 38 | 0.74 | 0.26-1.56 | 1999 | Erickson et al. 2000 |
| Wild Horse, WA | 2007 | 127 | 0.7 | NR | Jan-Dec 2007 | Erickson et al. 2008 |
| AVERAGE Pacific NW and Coast | | 135.5 | 1.7 | | | |

| Project Location | Year | No. of turbines at site | Estimated no. bats per turbine/yr | 95% confidence interval (per no. b/t/yr) | Study period | Source |
|---|---|---|---|---|---|---|
| Canada | | | | | | |
| Castle River, AB | 2001-2002 | 60 | 0.22-0.89[a] | NR | Apr 2001- Jan 2002 | Brown and Hamilton 2006a |
| McBride Lake, AB | 2003-2004 | 114 | 0.47[a] | NR | Jul 2003-Jun 2004 | Brown and Hamilton 2004 |
| Ripley, ON | 2008 | 38 | 0.17-12.38[j] | NR | Apr-May, Jul-Oct 2008 | Jacques Whitford Stantec Ltd. 2009 |
| Summerview, AB | 2005-2006 | 39 | 18.49 | NR | Jan 2005-Jan 2006 | Brown and Hamilton 2006b |
| Summerview, AB | 2006-2007 | 39 | 26.32 | NR | Jul-Sep, 2006 & 2007 | Baerwald 2008a |
| Wolfe Island, ON | 2009 | 86 | 14.77 | NR | 1 Jul-31 Dec 2009 | Stantec 2010c |
| AVERAGE Canada | | 62.7 | 11.1 | | | |
| AVERAGE U.S. and Canada | | 92.2 | 10.9 | | | |

[a] estimation unadjusted for searcher efficiency or scavenger rate

[b] where a range of estimated number of bats per turbine was given, the median was used to calculate average estimated number bats per turbine per year for each region

[c] reported as 90% confidence interval

[d] estimation based on study period, not per year

[e] reported as 99% confidence interval

[f] estimation includes incidental fatalities

[g] estimation is an average of standardized search estimate and dog search estimate

[h] range includes estimations of 1-day, 3-day, and 7-day standardized surveys

[i] author did not define if estimation is calculated for fatalities per turbine/year or per turbine/study period

[j] estimation is a range of spring and fall study periods

NR not reported by author

##### *4.5.6.2.1 Species Distribution*

At present, fatalities of 11 of the 45 bat species present in North America have been documented at wind energy facilities. These 11 species include: northern long-eared bat, little brown bat, Indiana bat, tri-colored bat, Seminole bat (*Lasiurus seminolus*), hoary bat, silver-haired bat, eastern red bat, western red bat (*Lasiurus blossevillii*), Brazilian free-tailed bat (*Tadarida brasiliensis*), and big brown bat (Arnett et al. 2008, USFWS 2010; Table 4-5).

Several consistent patterns have emerged with regard to the species distribution of bat fatalities at wind facilities in North America. Three species of long distance migratory bats have been killed in the largest proportions: the foliage-roosting hoary bat and eastern red bat and the cavity-roosting silver-haired bat (Kunz et al. 2007b, Arnett et al. 2008). Collectively, these species comprised approximately 75% of documented fatalities and hoary bats make up about half of all fatalities in 2008 (Arnett et al. 2008). Silver-haired bats have been recorded more frequently at sites in western Canada, IA, WI, and the Pacific

Northwest relative to the eastern United States (Arnett et al. 2008, Gruver et al. 2009). Eastern red bats have most commonly been found in eastern forested sites and in the Midwestern United States (Arnett et al. 2008). Eastern red bats comprised 61.3% and 60.9% of fatalities at Buffalo Mountain, TN from 2000 to 2003 and 2005, respectively (Fiedler 2004, Fiedler et al. 2007). The tri-colored bat also has experienced high mortality rates and has comprised up to 25% of North America fatalities (Arnett et al. 2008).

At the 19 facilities reviewed by Arnett et al. (2008), fatalities of summer resident species, including little brown, northern long-eared, and big brown bats, were relatively low (0% to 13.5%) with the exception of Castle River, Alberta, and Top of Iowa, IA, where little brown bats made up nearly 25% of 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 Blue Sky, WI, during fall 2008 and spring 2009. Similarly, post-construction mortality studies at 3 facilities in Clinton and Wyoming counties, NY, documented higher proportions of *Myotis* fatalities than those in the Arnett et al. (2008) review, ranging from 33.3% to 55.9% (Jain 2009c, 2009d, 2009e), as did studies at Cohocton/Dutch Hill and Munnsville wind facilities in central NY, 59.4% and 20.0%, respectively (Stantec 2009c, 2010a).

Looking at the species assemblages of bats reported in aircraft strike incidents may also be helpful in understanding use of airspace by different bat species and their relative risks of collision with objects in their flight path. Peurach et al. (2009) compiled data from 821 bat strikes that occurred between 1997 and 2007 in 40 states and from 20 countries as reported to the United States Air Force (USAF) Safety Center. A total of 402 bats were identified representing 25 species. Brazilian free-tailed bats comprised the majority of bat strikes (43%), followed by red bats (21%), hoary bats (8%), Seminole bats (6%), and silver-haired bats (4%). All of these species, with the exception of the Seminole bat (Wilkins 1987), are considered long-distance migrants (Villa and Cockrum 1962, Findley and Jones 1964, Timm 1989, Cryan 2003). Kuhl's pipistrelles (*Pipistrellus kuhlii)*; not native to North America) and tri-colored bats collectively comprised 8% of bat strikes. *Myotis* made up less than 0.5% of aircraft strikes. Although it has not been statistically demonstrated, aircraft strike data suggest a connection between long-distance migrants and risks at higher altitude.

**Table 4-5.** Observed species[a] composition of bat mortality reported at wind-energy facilities in the United States and Canada.

| Project Location | Year | Number of fatalities (Percentage of total fatalities) | | | | | | | | | | | Total no. bat fatalities | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EPFU | LABL | LABO | LACI | LANO | MYLU | MYSE | MYSO | PISU | TABR | Other | | |
| U.S. - Midwest | | | | | | | | | | | | | | |
| Blue Sky Green Field, WI | 2008 | 33 (17.0) | | 11 (5.7) | 29 (14.9) | 51 (26.3) | 60 (30.9) | | | | | 10 (5.2) | 194 | Gruver et al. 2009 |
| Buffalo Ridge, MN (Phase I,II,III) | 1998-1999 | 1 (0.5) | | 37 (20.1) | 108 (58.7) | 6 (3.3) | 5 (2.7) | | | 6 (3.3) | | 21 (11.4) | 184 | Johnson et al. 2003a |
| Buffalo Ridge, MN (Phase II & III) | 2001-2002 | 8 (5.3) | | 21 (13.9) | 115 (76.2) | 4 (2.6) | 3 (2.0) | | | | | | 151 | Johnson et al. 2004 |
| Cedar Ridge, WI | 2009 | 15 (17.9) | | 12 (14.3) | 29 (34.5) | 16 (19.0) | 12 (14.3) | | | | | | 84 | BHE 2010 |
| Crescent Ridge, IL | 2005-2006 | | | 6 (28.6) | 6 (28.6) | 8 (38.0) | | | | | | 1 (4.8) | 21 | Kerlinger et al. 2007 |
| Fowler Ridge, IN | 2010 | 17 (3.0) | | 368 (62.0) | 86 (15.0) | 116 (20.0) | 2 (0.3) | | 1 (0.2) | 2 (0.3) | | | 592[b] | Good et al. 2011 |
| Forward Energy Center, WI | 2008-2009 | 12 (9.9) | | 14 (11.6) | 34 (28.1) | 36 (29.5) | 12 (9.9) | | | | | 13 (10.7) | 121 | Drake et al. 2010 |
| Kewaunee County, WI | 1999-2001 | 1 (1.4) | | 27 (37.5) | 25 (34.7) | 13 (18.1) | | | | | | 6 (8.3) | 72 | Howe et al. 2002 |
| NPPD Ainswoth, NE | 2006 | 1 (8.3) | | 1 (8.3) | 12 (75.0) | | | | | | | 2 (16.7) | 16 | Derby et al. 2007 |
| Top of Iowa, IA | 2003 | 3 (10.0) | | 6 (20.0) | 11 (36.7) | 2 (6.7) | 9 (30.0) | | | | | | 31 | Jain 2005 |
| Top of Iowa, IA | 2004 | 9 (11.8) | | 18 (23.7) | 21 (27.6) | 9 (11.8) | 18 (23.7) | | | 1 (1.3) | | | 76 | Jain 2005 |
| AVERAGE Midwest | | 10.0 (9.8) | | 47.4 (22.3) | 43.3 (39.1) | 25.9 (17.5) | 15.4 (14.2) | | 1 (0.2) | 3.0 (1.6) | | 8.8 (9.5) | 140.2 | |
| U.S. - East | | | | | | | | | | | | | | |
| Buffalo Mountain, TN (Phase II) | 2005 | 1 (0.4) | | 145 (60.9) | 31 (13) | 18 (7.6) | | | | 41 (17.2) | | 2 (0.8) | 238 | Fiedler et al. 2007 |
| Buffalo Mountain, TN (Phase I) | 2000-2003 | 1 (0.9) | | 69 (60.5) | 11 (9.6) | 2 (1.8) | | | | 29 (25.4) | | 2 (1.8) | 114 | Fiedler 2004 |
| Casselman, PA | 2008 | 4 (2.7) | | 27 (18.2) | 46 (31.1) | 39 (26.4) | 14 (9.5) | | | 17 (11.5) | | 1 (0.01) | 148 | Arnett et al. 2009 |
| Cohocton/Dutch Hill, NY | 2009 | 2 (2.9) | | 2 (2.9) | 12 (17.4) | 11 (16.0) | 41 (59.4) | | | | | 1 (1.4) | 69 | Stantec 2010a |
| Cohocton/Dutch Hill, NY | 2010 | 4 (6.3) | | 13 (20.6) | 24 (38.1) | 9 (14.3) | 11 (17.5) | 1 (1.6) | | | | 1 (1.6) | 63 | Stantec 2011b |
| Lempster Ridge, NH | 2009 | 2 (2.0) | | | 3 (30.0) | 4 (40.0) | 1 (1.0) | | | | | | 10 | Tidhar et al. 2010 |
| Maple Ridge, NY | 2006 | 21 (5.4) | | 50 (13) | 176 (45.9) | 56 (14.6) | 52 (13.5) | | | | | 29 (7.6) | 384[b] | Jain et al. 2007 |
| Maple Ridge, NY | 2007 | 17 (8.4) | | 20 (9.9) | 100 (49.5) | 32 (15.8) | 31 (15.3) | | | | | 2 (1.0) | 202 | Jain et al. 2009a |
| Maple Ridge, NY | 2008 | 7 (5.0) | | 16 (11.4) | 61 (43.6) | 29 (20.7) | 24 (17.1) | | | | | 3 (2.1) | 140 | Jain et al. 2009b |
| Munnsville, NY | 2008 | 1 (10.0) | | 1 (10.0) | 6 (60.0) | | 2 (20.0) | | | | | | 10[b] | Stantec 2009c |
| Mars Hill, ME Year 1 | 2007 | | | 3 (13.0) | 5 (21.0) | 9 (38.0) | 4 (17.0) | | | | | | 21 | Stantec 2008c |
| Mars Hill, ME Year 2 | 2008 | | | 2 (40.0) | 2 (40.0) | 1 (20.0) | | | | | | | 5 | Stantec 2009b |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Meyersdale, PA | 2004 | 18 (6.9) | | 72 (27.5) | 119 (45.4) | 15 (5.7) | 7 (2.7) | 2 (0.7) | | 21 (8.0) | | 1 (0.5) | 262 | Kerns et al. 2005 |
| Mountaineer, WV | 2004 | 10 (2.5) | | 96 (24.1) | 134 (33.7) | 19 (4.8) | 39 (9.8) | | | 98 (24.6) | | 2 (0.5) | 398 | Arnett 2005 |
| Mountaineer, WV | 2003 | 2 (0.4) | | 200 (42.1) | 88 (18.5) | 28 (5.9) | 60 (12.6) | 6 (1.3) | | 87 (18.3) | | 4 (0.8) | 475 | Kerns and Kerlinger 2004 |
| Mount Storm, WV (Phase I) | 2008 | | | 35 (19.2) | 57 (31.3) | 30 (16.5) | 18 (9.9) | 1 (0.5) | | 29 (15.9) | | 3 (1.6) | 182 | Young et al. 2009a |
| Mount Storm, WV (Phase I & II) | 2010 | 3 (4.6) | | 16 (24.6) | 24 (36.9) | 9 (13.8) | 6 (9.2) | | | 7 (10.8) | | | 65 | Young et al. 2011 |
| Noble Bliss, NY | 2008 | 1 (1.4) | | 6 (8.1) | 24 (32.4) | 13 (17.6) | 29 (39.2) | | | 1 (1.4) | | | 74 | Jain et al. 2009c |
| Noble Bliss, NY | 2009 | | | 7 (19.4) | 14 (38.9) | 6 (16.7) | 6 (16.7) | | | | | 3 (8.3) | 36[b] | Jain et al. 2010a |
| Noble Clinton, NY | 2008 | | | 1 (2.6) | 9 (23.1) | 11 (28.2) | 13 (33.3) | | | 3 (7.7) | | 2 (5.1) | 39 | Jain et al. 2009e |
| Noble Clinton, NY | 2009 | | | 1 (2.4) | 19 (45.2) | 11 (26.2) | 11 (26.2) | | | | | | 42[b] | Jain et al. 2010b |
| Noble Ellensburg, NY | 2008 | | | 1 (2.9) | 6 (17.7) | 7 (20.6) | 19 (55.9) | | | 1 (2.9) | | | 34 | Jain et al. 2009d |
| Noble Ellensburg, NY | 2009 | 1 (3.6) | | 2 (7.1) | 11 (39.3) | 3 (10.7) | 10 (35.7) | | | 1 (3.6) | | | 28[b] | Jain et al. 2010c |
| Stetson Mountain I, ME (Year 1) | 2009 | | | | 2 (40) | 1 (20) | 1 (20.0) | | | | | | 5 | Stantec 2010b |
| Stetson Mountain II, ME (Year1) | 2010 | 2 (14.3) | | | 5 (35.7) | 6 (42.9) | 1 (7.1) | | | | | | 14 | Normandeau 2010 |
| AVERAGE East | | 5.7 (4.6) | | 35.7 (20.0) | 39.6 (33.5) | 15.4 (18.5) | 18.2 (20.4) | 2.5 (1.0) | | 27.9 (11.4) | | 4.0 (2.4) | 122.3 | |
| U.S. - South-Central | | | | | | | | | | | | | | |
| Buffalo Gap 2, TX | 2007-2008 | | | | 5 (41.7) | | | | | | 4 (33.3) | 3 (25.0) | 12 | Tierney 2009 |
| Oklahoma Wind Energy Center, OK | 2004-2005 | 1 (0.9) | | 3 (2.7) | 10 (9) | 1 (0.9) | | | | 1 (0.9) | 94 (84.7) | 1 (0.9) | 111 | Piorkowski and O'Connell 2010 |
| AVERAGE South Central | | 1 (0.9) | | 3 (2.7) | 7.5 (25.35) | 1 (0.9) | | | | 1 (0.9) | 49 (59) | 2 (13) | 61.5 | |
| U.S. - West | | | | | | | | | | | | | | |
| Foote Creek Rim, WY | 1999 | 1 (2.4) | | | 34 (82.9) | 1 (2.4) | 4 (9.8) | | | | | 1 (2.4) | 41 | Young et al. 2003 |
| Foote Creek Rim, WY | 2000 | | | | 10 (83.3) | 1 (8.3) | 1 (8.3) | | | | | | 12 | Young et al. 2003 |
| Foote Creek Rim, WY | 2001-2002 | | | | 12 (66.7) | 3 (16.7) | 1 (5.6) | | | | | 1 (5.6) | 18 | Young et al. 2003 |
| Judith Gap, MT | 2006-2007 | | | | 17 (49) | 4 (11) | | | | | | 14 (40) | 35 | TRC Environmental 2008 |
| AVERAGE West | | 1 (2.4) | | | 18.3 (70.5) | 2.3 (9.6) | 2 (7.9) | | | | | 5.3 (16) | 26.5 | |
| U.S. - Pacific NW and Coast | | | | | | | | | | | | | | |
| Biglow Canyon, OR | 2008 | | | | 25 (50.0) | 25 (50.0) | | | | | | | 50 | Jeffrey et al. 2009 |
| Biglow Canyon, OR | 2009 | | | | 4 (23.5) | 8 (47.1) | | | | | | 3 (17.6) | 17 | Enk et al. 2010 |
| Combine Hills, OR (Phase I) | 2004-2005 | | | | 13 (62.0) | 8 (38.0) | | | | | | | 21 | Young et al. 2006 |
| High Winds, CA Year 1 | 2003-2004 | | 3 (4.3) | | 45 (64.3) | | | | | | 22 (31.4) | | 70 | Kerlinger et al. 2006 |
| High Winds, CA Year 2 | 2004-2005 | | 1 (2.2) | | 17 (37.0) | 2 (4.3) | | | | | 26 (56.5) | | 46 | Kerlinger et al. 2006 |
| Hopkins Ridge, WA | 2006 | 1 (5.3) | | | 4 (21.0) | 12 (63.0) | 1 (5.3) | | | | | 1 (5.3) | 19 | Young et al. 2007 |
| Klondike, OR Phase I | 2001-2002 | | | | 3 (50.0) | 1 (16.7) | | | | | | 2 (33.3) | 6[b] | Johnson et al. 2003b |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stateline, OR/WA Year 1 | 2002 | 2 (3.7) | | | 25 (46.3) | 25 (46.3) | 1 (1.9) | | | | | 1 (1.9) | 54 | Erickson et al. 2003a |
| Stateline, OR/WA Year 2 | 2003 | | | | 34 (45.9) | 39 (52.7) | | | | | | 1 (1.4) | 74 | Erickson et al. 2004 |
| Vansycle, OR | 1999 | | | | 5 (50.0) | 3 (30.0) | 1 (10) | | | | | 1 (10) | 10 | Erickson et al. 2000 |
| Wild Horse, WA | 2007 | | | | 10 (58.8) | 3 (17.6) | 4 (23.5) | | | | | | 17 | Erickson et al. 2008 |
| AVERAGE Pacific NW and Coast | | 1.5 (4.5) | 2 (3.3) | | 16.8 (46.3) | 12.6 (36.6) | 1.8 (10.2) | | | | 24 (44) | 1.5 (11.6) | 34.9 | |
| Canada | | | | | | | | | | | | | | |
| Wolfe Island, ON | 2009 | 13 (7.2) | | 44 (24.4) | 54 (30.0) | 36 (20.0) | 13 (7.2) | | | | | 20 (11.0) | 180 | Stantec 2010c |
| Castle River, AB | 2001-2002 | | | | 30 (57.7) | 7 (13.4) | 12 (23.1) | | | | | 3 (5.8) | 52 | Brown and Hamilton 2006a |
| McBride Lake, AB | 2003-2004 | 1 (1.9) | | | 47 (87.0) | 1 (1.9) | 5 (9.2) | | | | | | 54 | Brown and Hamilton 2004 |
| Ripley, ON | 2008 | 5 (4.2) | | 7 (5.8) | 38 (31.7) | 17 (14.2) | 22 (18.3) | 2 (1.7) | | 10 (8.3) | | 19 (15.8) | 120 | Jacques Whitford Stantec Ltd. 2009 |
| Summerview, AB | 2005-2006 | 4 (0.8) | | 1 (0.2) | 244 (45.9) | 272 (51.1) | 6 (1.1) | | | | | 5 (0.9) | 532 | Brown and Hamilton 2006b |
| Summerview, AB Year 2, 3 | 2006-2007 | 18 (1.8) | | 6 (0.6) | 608 (61.2) | 337 (33.9) | 6 (0.6) | | | | | 18 (1.8) | 993 | Baerwald 2008a |
| AVERAGE Canada | | 8.2 (3.2) | | 14.5 (7.8) | 170.2 (52.3) | 111.7 (22.4) | 10.7 (9.9) | 2 (1.7) | | 10 (8.3) | | 13.0 (7.1) | 321.8 | |
| AVERAGE U.S. and Canada | | 6.8 (5.7) | 2.0 (3.3) | 36.0 (18.9) | 46.8 (35.2) | 26.1 (21.1) | 14.0 (16.0) | 2.4 (1.2) | 1.0 (0.2) | 20.9 (8.9) | 36.5 (51.5) | 5.6 (7.5) | 121.1 | |

[a] EPFU = big brown bat; LABL = western red bat; LABO = eastern red bat; LACI = hoary bat; LANO = silver-haired bat; MYLU = little brown bat; MYSE = northern long-eared bat; MYSO = Indiana bat; PISU = eastern pipistrelle (now tri-colored bat); TABR = Brazilian (Mexican) free-tailed bat.

[b] Number bats found includes incidental fatalities.

Similarly, long-distance migrants comprised the majority of fatalities at the 21 post-construction mortality studies reported by Arnett et al. (2008). While Brazilian free-tailed bats are not represented in significant numbers in post-construction monitoring results from wind facilities to date, this is likely due to paucity of post-construction studies within the range of this bat. Post-construction mortality studies have not been conducted at the majority of wind energy facilities in TX or NM where large colonies of Brazilian free-tailed bats are known to reside (Kunz et al. 2007b). High proportions of Brazilian free-tailed bat fatalities (41.3% and 85.6% in CA and OK, respectively) were documented at the only 2 post-construction mortality studies conducted at wind facilities within their range (Arnett et al. 2008).

In summary, it is clear that bats are being killed by wind turbines throughout the United States and Canada, with higher mortality occurring in the eastern United States along forested ridges and some agricultural facilities in the Midwest. Out of the 45 bat species in the United States, 11 have been documented as fatalities at wind farm sites and studies have found that migratory bat species have constituted 75% of all bat fatalities. Data indicated that risk for *Myotis* species, such as the Indiana bat, is significantly less than other migratory bat species, although risk may vary by site, and may be influenced by geographic variation, the habitat in which the wind turbines are sited or other factors. Indiana bats are at risk, as evidenced by 3 confirmed fatalities and the likely occurrence of undocumented fatalities due to a lack of post-construction monitoring or difficulty of detecting the species. However, these 3 fatalities represent the only Indiana bat fatalities documented to date, and therefore the degree to which Indiana bats are at risk is highly uncertain.

#### *4.5.6.2.2 Seasonal Timing*

While not all post-construction mortality studies have monitored bat mortality over the entire period in which bats are active (generally Apr through Nov), bat fatalities consistently have been found to be episodic and concentrated in the late summer dispersal and fall migration periods. This has been the case, with few exceptions, across all geographic areas within which post-construction mortality monitoring has been conducted (Young et al. 2003, Kerns and Kerlinger 2004, Johnson 2005, Nicholson et al. 2005, Kunz et al. 2007b, Fiedler et al. 2007, Arnett et al. 2008, Gruver et al. 2009, Drake et al. 2010, Stantec 2010c).

A long-term study at Buffalo Mountain, TN, from 2000 to 2003 and 2005 documented 75% of bat fatalities between early August and mid-September, although peaks in mortality varied slightly across years. From 2000 to 2003, 82.4% of fatalities occurred from 16 July to 30 September, with the majority (53.8%) occurring from 16 August to 15 September (no fatalities were documented after 31 Oct; Fiedler 2004). The seasonality of fatalities in 2005 was similar, with 84.9% of fatalities occurring between 16 July and 30 September. The peak, however, was more concentrated in 2005, with the majority (55.9%) of fatalities occurring between 16 August and 31 August (no fatalities were documented after 15 Oct; Fiedler et al. 2007). Bat fatality patterns at the recent Blue Sky Green Field study also documented a peak in mortality during August and September (Gruver et al. 2009). Studies from Germany also supported this pattern of seasonal fatality during the fall migration period (Durr and Bach 2004, Brinkmann 2006).

Bat mortality during the spring migration period has consistently been lower than mortality documented during the fall. One noted species-specific exception to this has been documented for silver-haired bats. At Buffalo Mountain, TN, 15 of 18 silver-haired bats (83%) were found between mid-April and early-June 2005 (Fiedler et al. 2007), although this pattern was not observed in studies conducted from 2000 to 2003 at the same site. Spring mortality of silver-haired bats was also documented, though in lesser numbers, at Summerview, Alberta; 16 of 272 (6%) silver-haired bat fatalities were found in May and June. These studies suggest that spring migration may be a period of risk particularly for silver-haired bats (and not the other species of long-distance migrants [i.e., hoary bats, eastern red bats, and western red bats]) at some wind facilities.

Data from post-construction studies compiled by the USFWS suggest that *Myotis* mortality patterns are consistent with that observed for long-distance migrants, with the majority occurring in the late summer/fall period (Jennifer Szymanski, USFWS, and Megan Seymour, USFWS, personal communication). Of the total 3,433 bat fatalities documented in 26 mortality monitoring studies conducted within the range of the Indiana bat, there were a total of 225 little brown bat fatalities (0.07%). Using 7 studies that conducted monitoring for the spring through fall period, 8%, 34%, and 58% of *Myotis* fatalities occurred in the spring, summer, and fall, respectively, with seasons defined as spring: 1 April to 30 May; summer: 1 June to 31 July; fall: 1 August to 30 November. This is similar to the proportions observed for all bat fatalities: 3%, 11%, and 86% (does not add to 100% because of rounding effects) in that most of the mortality occurred in the fall.

While a correlation between bat mortality and pre-construction acoustic studies has not been established, acoustic results are consistent with general bat mortality trends. Bat activity as measured by acoustic detectors during 2002 and 2003 in TN support some seasonal pattern of bat fatalities. Bat activity levels increased in mid-July to early August, quadrupled by mid-August, and then decreased to previous levels by early to mid-September (Fiedler 2004). At the Maple Ridge facility in NY, Jain et al. (2007) found that bat fatalities were low in mid-June, peaked from mid-July to mid-August, and then declined precipitously through mid-November. Acoustic calls identified to the genus *Myotis* during 2008 acoustic surveys conducted for the Project were consistent with these patterns. As shown in Figure 4-10, the majority of *Myotis* activity in the initial study area was recorded during the late summer and early fall period. Average *Myotis* bat activity across all detectors was 26%, 28%, and 47% in the spring, summer, and fall respectively[20]. However, 72% of summer calls occurred during the late summer dispersal period (15 July to 31 July), which is the period of overlap when both summer foraging and migration may be occurring. These acoustic activity patterns indicate that the majority of *Myotis* activity in the Action Area would occur in the late summer and early fall period consistent with bat mortality data from other projects. This pattern may have been more pronounced if acoustic surveys were continued beyond 3 September 2008, as other studies have shown fall bat activity to remain high throughout the month of September (see above discussion).

[20] Note that due to detector malfunction, some detectors had incomplete recordings for each season. Detectors with less than an 80% success rate were not included in the summary of activity per season.

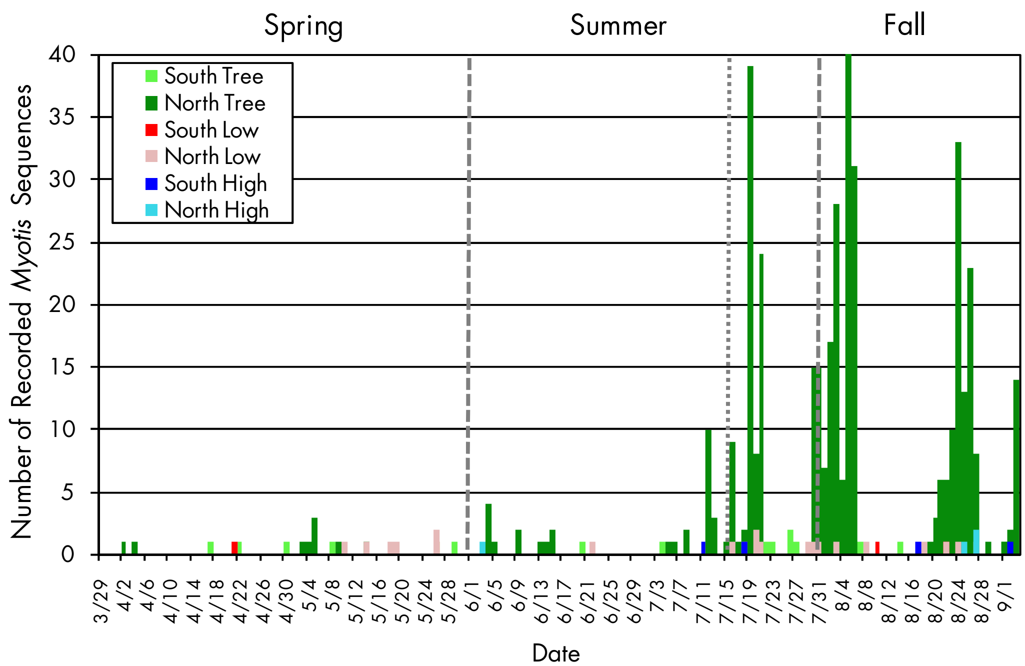


**Figure 4-10.** Number of *Myotis* call sequences per night recorded at 6 Anabat detectors deployed at 2 m (7 ft), 20 m (66 ft), and 40 m (131 ft) from 29 April to 3 September 2008 at 2 60-m (197-ft) MET towers in the Buckeye Wind initial study area (includes Action Area as well as area to the north), Champaign County, OH. (Note: data for the North tree detector is included in this figure; however, the detector success rate was less than 70% with detector malfunction from 5/27 to 6/1, 7/22 to 7/29 and 8/7 to 8/17. The proportion of late summer/fall detection rates therefore could be more pronounced.)

A further indication that the fall period represents the season with highest mortality risk is data from the USAF compiled by the National Museum of Natural History, Smithsonian Institution. These data lend support for the seasonal nature of bat mortality from collision with human structures. Of the 821 bat collisions reported to the USAF aircraft from 1997 through 2007, mortality peaked during the spring and fall, with more than 57% occurring from August through October (Peurach et al. 2009).

#### *4.5.6.2.3 Nightly Timing*

There may also be differences in the timing of mortality at finer temporal scales. It has been suggested that nightly foraging activity of all insectivorous bats studied to date can be characterized as bimodal (Erkert 1982), the result of 2 foraging periods interrupted by night roosting (Anthony et al. 1981). This bimodal pattern has been described as being especially apparent in lactating female bats because they must return to maternity roosts to feed young (Swift 1980, Maier 1992). Fluctuation in insect abundance also has been shown to follow bimodal patterns (Swift 1980), which may drive patterns of nightly activity observed for bats (Racey and Swift 1985, de Jong and Ahlén 1991).

Bat activity monitored in acoustic studies conducted at Buffalo Mountain, TN, documented a bimodal pattern of nightly activity during some years of study, but not in others (Fiedler 2004). Erkert (1982) postulated that insectivorous bats would be unlikely to follow the usual bimodal pattern under conditions of low prey density which would cause bats to forage more continuously throughout the night. Thus, Fiedler (2004) speculated the wet and cool weather conditions in 2003 may have explained why bimodal activity was not observed during this year of study, compared with the bimodal pattern observed in 2002.

Another possible explanation for deviations from Erkert's (1982) bimodal foraging activity theory could be related to species-specific patterns. Nightly activity of Myotis as determined from 34,030 Myotis call sequences recorded during acoustic surveys conducted by Stantec (described in detail in Section 4.4.4.2 – Foraging and Traveling Behavior) showed more of a unimodal pattern of activity. Hours after sunset were calculated as the difference between the timestamp on each acoustic file and the sunset time for that unique date and location with seasons defined as spring 1 April to 31 May; summer 1 June to 31 July; and fall 1 August to 31 October. Figure 4-11 (Stantec unpublished data 2010) showed Myotis activity peaking during the period from the first 1 hr to 6 hr after sunset and declining steadily thereafter. The observed pattern was apparent during all seasons but most pronounced during fall.

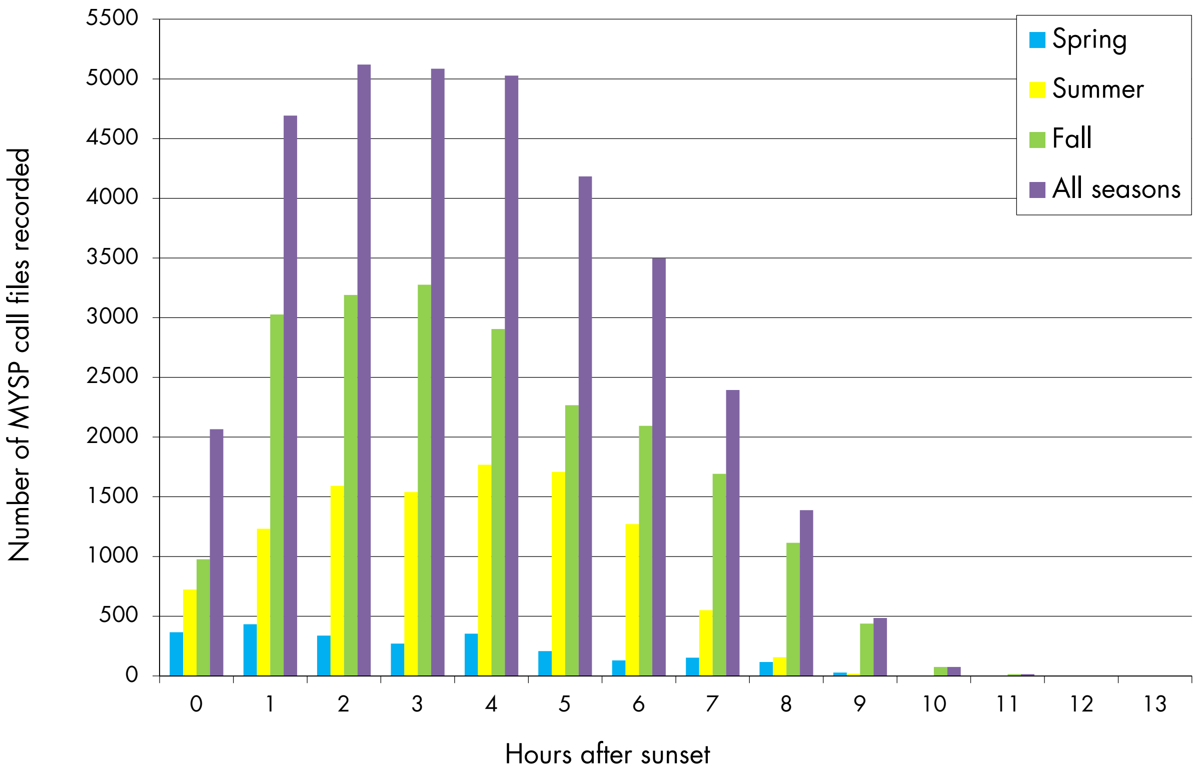


**Figure 4-11.** Number of Myotis call sequences recorded using 96 Anabat detectors during acoustic surveys from 2005 to 2009 at 19 proposed wind power facilities in ME, NH, NY, OH, VT, and WV.

Few studies have attempted to determine the timing of fatalities within a given night due to the difficulty of determining exact time of death. Fiedler et al. (2007) assessed hourly timing of fatalities for all species during searches on a few nights within a peak mortality window. There was no apparent hourly periodicity of bat mortality. However, small sample size and number of nights monitored may have obscured any existing hourly patterns.

Data from bat strikes with USAF aircraft may provide useful information in the absence of timing information associated with post-construction mortality monitoring. Of 174 bat strikes with USAF aircraft in the United States from 1997 to 2007 for which time and place of impact were known, more than 84% occurred between 1901 and 0200 (Peurach et al. 2009). As previously discussed, the majority of these bat strikes occurred during the spring and fall migratory periods and are, therefore, presumably related to patterns of activity during migration rather than during summer foraging.

#### *4.5.6.3 Behavioral Risk Factors*

It is not well understood why long distance migratory species appear to be most at risk from wind turbines (Howe et al. 2002, Cryan and Brown 2007, Kunz et al. 2007a) or why there are higher levels of mortality in the fall migration period compared to the spring. There are several hypotheses that suggest certain migratory and/or mating behaviors unique to migrant species make them more susceptible to collision with wind turbines, especially during the fall migration period (Cryan and Brown 2007). Long distance movements may result in greater exposure to wind facilities over a larger area. Hoary bats do not hibernate in caves but instead perform cross-continental migration movements to winter in warm climates (Cryan 2003, Cryan et al. 2004, Cryan and Brown 2007). Silver-haired bats have also shown movement at the continental scale, although migration patterns may differ between western and eastern groups (Cryan 2003).

Collision risk may also be elevated in migrating bats because they may travel without or with reduced use of echolocation (Van Gelder 1956, Griffin 1970, Crawford and Baker 1981, Timm 1989, as cited by Johnson and Strickland 2003, Johnson et al. 2003a, 2003c). There is evidence that bats use vision rather than echolocation to navigate during long-distance flights (Mueller 1968, Williams and Williams 1970, Fenton 2001 as cited by Johnson and Strickland 2003) which may make it more difficult to maneuver effectively around turbines. Cryan and Brown (2007) suggested mating behavior may play a role in elevated risk to hoary bats. Migrating hoary bats, and perhaps other species of Lasiurines, may orient toward and congregate around the tallest, most highly-visible landscape structures during the fall to locate potential mates.

Bats may follow different migration routes or patterns during the spring versus fall, similar to avian migration patterns (e.g., Cooke 1915; Lincoln 1950; Richardson 1974, 1976 as cited by Johnson and Strickland 2003). Hoary bats have been observed flying in clusters during the fall, compared to more scattered formations during the spring (Zinn and Baker 1979 as cited by Johnson and Strickland 2003). It also has been suggested that late-summer and early-fall peaks in mortality could be associated with increased numbers of volant juveniles who suffer higher mortality due to lack of experience, yet results of monitoring studies generally do not support this hypothesis (Arnett et al. 2008).

##### *4.5.6.3.1 Flight Behavior*

Morphological differences that affect flight characteristics, foraging habitat selection, and flight height (Aldridge and Rautenback 1987) have been suggested to influence collision risk. Bat species assemblages and activity levels have been found to vary by vertical strata and habitat types because wing morphology affects maneuverability within structural clutter (Norberg and Rayner 1987, Crome and Richards 1988, Bradshaw 1996, Lance et al. 1996, Kalcounis et al. 1999, Hayes and Gruver 2000, Menzel et al. 2000).

Species within the genus Myotis have average to low wing loading and a low aspect ratio, which allows for slow but agile flight (Norberg and Rayner 1987). This agility allows Myotis to forage in more cluttered environments. In a study conducted by LaVal et al. (1977) in MO, gray, little brown, northern long-eared, and Indiana bats all foraged in relatively cluttered environments to varying degrees. Gray bats foraged in riparian areas and over water, while little brown bats foraged along forest edges and within the forest. Both northern long-eared and Indiana bats were clutter foragers and foraged in forested areas, but Indiana bats foraged primarily in the canopy, while northern long-eared bats foraged below the canopy but above the understory shrub layer, suggesting vertical stratification of resource use.

In contrast, hoary and red bats have relatively high wing loading and aspect ratios and are thus adapted for fast, relatively unmaneuverable flight, which necessitates foraging in open areas with limited vegetative clutter (Farney and Fleharty1969, Barclay 1985, Norberg and Rayner 1987). Barclay (1985) described hoary bats as using long-range prey detection and pursuit foraging strategies, flying rapidly along straight line paths in open areas and using echolocation calls designed to detect insects at a distance. Similarly, LaVal et al. (1977) found that hoary and red bats tended to forage in open areas away from forest clutter, including high over the forest canopy and open fields.

While the lack of maneuverability may be an explanation for the disproportionate mortality rates for these species at wind facilities, it is unlikely that it is the only reason. These morphological differences primarily influence foraging behavior and their influence on migratory behavior is unknown. Species with similar morphological characteristics and flight behaviors as hoary and red bats, such as big brown bats (Barclay 1985, Menzel et al. 2005), have not experienced similar mortality rates at wind facilities (Arnett et al. 2008). Menzel et al. (2005) reported significantly greater big brown bat activity levels above the forest canopy than within or below it. Conversely, silver-haired bats have experienced relatively high rates of mortality at wind facilities, yet they fly slowly, are highly maneuverable, use echolocation calls that support a short-range foraging strategy, and are more commonly detected at ground level than hoary bats (Barclay 1985).

##### *4.5.6.3.2 Flight Height*

Although relatively little is known about the foraging behavior of bats during migration, flight altitude is likely an important factor contributing to collision risk for different species. Eastern red bats were visually observed flying during the day from 46 m to 140 m (151 ft to 459 ft) agl over Washington, D.C. (Allen 1939 as cited by Johnson and Strickland 2003). High altitude flights of Brazilian free-tailed bats have been documented in several publications (Williams and Williams 1967, Williams et al. 1973). Brazilian free-tailed bats have been recorded as high as 1,500 m (4,921 ft) while foraging on migrating insects (McCracken et al. 1996, 1997 as cited by Fiedler 2004).

Increased efforts to track bat collisions with aircraft have improved our knowledge of bat flight altitudes. Williams and Williams (1967) and Linnell et al. (1999) suggested most bat strikes with aircraft occurred at heights less than 300 m agl during take-off and landing. Records compiled from 1997 to 2007 for bat collisions with USAF aircraft documented bat strikes occurring as high as 2,500 m agl and showed that bat strikes often occur at altitudes higher than previously thought (Peurach et al. 2009). Of the 147 records of bat strikes that occurred in the United States in which the pilot recorded the altitude, 36% occurred between 300 m and 3,000 m (984 ft and 9843 ft) agl, with the average altitude reported as 345 m (Peurach et al. 2009). Peurach (2003) reported a hoary bat from a USAF strike at 2,500 m agl, which is the highest flight altitude known for this species. Given their high flight altitudes, it is not unexpected that Brazilian free-tailed bats comprised 43% of strikes with USAF aircraft (Peurach et al. 2009).

*Myotis* flight heights generally are thought to be low relative to long-distance migrant species. Bat strike data with USAF aircraft for *Myotis* support this assumption, as only 1% of USAF bat aircraft strikes were reported for *Myotis* from 1997 to 2007. Similarly, Williams and Williams (1967) did not report any *Myotis* in aircraft strikes at a study at Randolph Air Force Base, TX, despite observations of *Myotis* flying around buildings and light sources. Based on the 10-year USAF bat-strike database, Peurach et al. (2009) posited that it is likely that the bats struck by aircraft are flying in more open space and at greater heights while migrating or feeding, and locally common, resident bats infrequently encounter flying aircraft.

This is consistent with observations of *Myotis* flight altitudes in other studies. A PA study examined the influence of canopy height and structure on flight behavior (among other things) of a maternity colony that was largely composed of little brown bats, but also included Indiana bats (Russell et al. 2008). There were a total of 26,442 observations over 9.2 hr of bats crossing a heavily trafficked highway en route to foraging areas. Bats used canopy cover when approaching the highway from roosts, fewer bats crossed in areas lacking canopy cover, and bats crossed lower and closer to traffic where adjacent canopy was low (≤6 m; 20 ft). During the same study, more than 1,700 observations of bats crossing a mowed field (55 m [180 ft] wide) revealed that the vast majority of commuting individuals flew less than 2 m (7 ft) agl. Other studies have also documented Indiana bats flying relatively low to the ground while foraging (i.e., between 2 m and 30 m [6 ft to 100 ft.] agl, Humphrey et al. 1977, Brack 1983, Gardner et al. 1989).

Data regarding the height Indiana bats fly during migration are severely lacking, but there are 2 emerging viewpoints based on anecdotal and empirical data compiled by the USFWS (USFWS 2011a): Indiana bats fly at or below tree canopy height, and they fly considerably higher than tree canopy height. L. Robbins (Missouri State University, personal communication as cited in USFWS 2011a) argues that detection of Indiana bats above 10 m (33 ft) is rare during any part of their active season. Turner (2006) suggested that migrating Indiana bats may be flying low to the ground based on radio telemetry data from over 20 Indiana bats emerging from PA hibernacula, 1 of which was documented flying under Interstate 80 (I-80). Similarly, based on observations of over 100 Indiana bats tracked during spring and fall migrations, J. Chenger (BCM, personal communication) suspected migrating Indiana bats were flying low to the ground based on aircraft and ground telemetry data. This is also consistent with acoustic data collected by Stantec, presented in Section 4.4.4.2 – Foraging and Traveling Behavior, which found *Myotis* activity at 50 m (164 ft) was about 3% of activity at ground level.

However, the reliability of these data is uncertain because acoustic studies may not detect higher flying bats and while radio telemetry can detect higher flying bats, it cannot distinguish flight height. Additionally, radio telemetry studies to date have largely been conducted in the east and Indiana bat flight behaviors observed in these studies may not hold true for Indiana bats in other regions that likely migrate across large expanses of open terrain. Although it is not known if migrating Indiana bats follow certain landscape features, given the long migratory distances documented for Indiana bats in the Midwest RU, it is likely that Indiana bats have to fly over areas devoid of tree canopy during some portions of their journeys which may necessitate different flying behaviors. Further, Indiana bat researchers, V. Brack and D. Sparks (as per M. Seymour, USFWS, personal communication), have observed Indiana bats above tree canopy, approximately 60 m to 90 m (200 ft to 300 ft) agl.

Despite these uncertainties, several lines of evidence together point towards *Myotis* flying at relatively low heights, compared with species of long distance migrants. Observations from radio telemetry migration studies (J. Chenger, BCM, personal communication, Turner 2006), summer foraging observations (LaVal and LaVal 1980, Russell et al. 2008, others), aircraft bat strike data (Peurach et al. 2009), acoustic studies associated with pre- and post- construction studies at wind facilities (Stantec unpublished data, Reynolds 2006, Fiedler 2004), morphological characteristics (i.e., low aspect ratio and high wing loading), and echolocation call signatures adapted to cluttered environments (Saunders and Barclay 1992) all point towards *Myotis* flights predominately occurring below the rotor swept zone during migration and summer foraging and traveling activities. These low flight heights may help explain why *Myotis* are reported less frequently colliding with wind turbines (Arnett et al. 2008), aircraft (Williams and Williams 1967, Peurach et al. 2009), and other tall anthropogenic structures (discussed in detail in Section 4.5.5.6 – Bat Collision with Other Structures) than other groups of bats, particularly long-distance migrants.

**Bat Attraction to Wind Facilities**

Bats may be killed in higher than expected numbers at wind facilities because they are attracted to turbines or some other feature, or combination of features. Horn et al. (2008) observed the flight altitude, direction, and types of flight maneuvers of bats, birds, and insects at night during nightly 9-hr sessions of thermal infrared (TIR) video. Bats were observed actively foraging near operating turbines, approaching both rotating and non-rotating blades and monopoles, following or becoming trapped in blade-tip vortices, investigating various parts of the turbine with repeated fly-bys, and being struck directly by rotating blades. According to Horn et al. (2008), bats observed in the study may have been investigating the turbines as roosting, foraging or mating sites. Thus, risk of collision or barotrauma could disproportionately affect bats that may be flocking to turbines in association with mating behavior (Cryan and Brown 2007, Horn et al. 2008) or for foraging or roosting purposes (Horn et al. 2008).

Other theories as to why bats may be attracted to wind facilities exist; however, to date there are few empirical data to enable further understanding of these assumptions. Kunz et al. (2007b) proposed 11 hypotheses to explain where, when, how, and why insectivorous bats are killed at wind energy facilities. Several of these included ideas about possible attraction.

- Linear corridor hypothesis– wind energy facilities constructed along forested ridgetops create clearings with linear landscapes that are attractive to bats;
- Roost attraction hypothesis– wind turbines attract bats because they are perceived as potential roosts;
- Landscape attraction hypothesis– bats feed on insects that are attracted to the altered landscapes that commonly surround wind turbines;
- Heat attraction hypothesis– flying insects upon which bats feed are attracted to the heat produced by nacelles of wind turbines;
- Visual attraction hypothesis– nocturnal insects are visually attracted to wind turbines; and
- Thermal inversion hypothesis– thermal inversions create dense fog in cool valleys, concentrating both bats and insects on ridgetops.

Few data are currently available to either support or refute the hypotheses put forward by Kunz et al (2007b). However, in their study of ultrasound emissions from a variety of wind turbines as a potential attractant to bats, Szewczak and Arnett (2006) found evidence to suggest that the "acoustic attraction hypothesis" is not playing a significant role in attracting bats toward wind turbines with consequential fatalities from rotor strikes (see additional discussion of the effects of sound produced by turbines in Section 5.1.2.1 – Sound from Operating Turbines).

### *4.5.6.4 Influence of Weather*

Bats are known to suppress their activity during periods of rain, low temperatures, or strong winds (Erkert 1982, Adam et al. 1994, Erickson et al. 2002, Russo and Jones 2003). Weather variables such as wind speed, temperature, and barometric pressure have been found to influence bat activity and mortality rates at some wind facilities. Of the 21 post-construction monitoring studies reviewed by Arnett et al. (2008), studies that addressed relationships between bat fatalities and weather patterns found disproportionate number of bats were killed on nights with low wind speed (<6 m/s) and fatalities increased immediately before and after passage of storm fronts. Horn et al. (2008) also reported blade rotational speed was a significant negative predictor of observed collisions with turbine blades, suggesting that bats may be at higher risk of fatality on nights with low wind speeds. The association of bat activity with wind speed is expected because bat flight ability is limited by wind strength, as is the flight ability of their insect prey (Fiedler 2004). Pre- and post-construction acoustic monitoring has also documented a negative relationship with average nightly wind speed (Fiedler 2004, Reynolds 2006). Reynolds (2006) found bat activity to be highest on nights with wind speeds less than 5.4 m/s during the spring migratory period at the Maple Ridge, NY, wind facility. Bat activity levels at Buffalo Mountain, TN also showed a negative association with average nightly wind speeds (Fiedler 2004).

Positive correlations between bat activity and temperature have been documented, both on a nightly basis (Lacki 1984, Negraeff and Brigham 1995, Hayes 1997, Vaughan et al. 1997, Gaisler et al. 1998, Shiel and Fairley 1998) and annual basis (O'Farrell and Bradley 1970, Avery 1985, Rydell 1991). Associations between temperature and bat fatalities in post-construction monitoring studies have been less consistent than for wind speed. While a correlation between temperature and bat fatalities was not documented at Mountaineer, a positive association between temperature and fatalities was documented at Meyersdale (Kerns et al. 2005). Pre- and post-construction acoustic surveys at wind facilities have found bat activity to be negatively correlated with low nightly mean temperatures (Fiedler 2004, Reynolds 2006). For example, Reynolds (2006) found no detectable spring migratory activity on nights when daily mean temperature was below 10.5°C (50.9°F). Bat activity at Buffalo Mountain, TN, from 2000 to 2003 was most closely correlated with average nightly temperatures among the variables considered (Fiedler 2004). This is consistent with observations of J. Kiser (Stantec, personal communication) during 19 years of summer mist-netting surveys in the midwestern and eastern United States. According to Kiser, bat activity predictably declined once nighttime temperatures dropped below approximately 12°C (54.5°F). The data presented in the studies above, and other experiences, have led to the general conclusion among experts that,"…among all bat species…activity declines in heavy rain, high wind, and cold (some specifically mentioned temperatures below 50°F – 55°F) – conditions that impair flight or ability to thermoregulate, or reduce insect activity" (USFWS 2011a).

Unlike avian turbine collision, inclement weather (e.g., low fog or cloud ceilings or stormy conditions) does not appear to be strongly correlated with bat mortalities. At sites in MN, WY, and TN, bat collisions with wind turbines occurred during clear weather approximately one-third to one-half of the time (Johnson et al. 2000; Young et al. 2003; Nicholson 2001, 2003 as cited by Johnson and Strickland 2003; Fiedler et al. 2007). Consistent with this, Kerns et al. (2005) reported few bat fatalities were discovered during storms, contrasted by high bat fatalities before and after the passage of frontal systems, especially on low wind nights at Mountaineer and Meyersdale.

Barometric pressure, temperature, and relative humidity are all interrelated and are associated with passing storm fronts. There is some evidence that higher barometric pressure is associated with higher mortality. Good et al. (2011) found that mortality increased with increasing barometric pressure; and barometric pressure was higher than normal on the night when Indiana bat mortality occurred. However, barometric pressure was lower than normal on the night with the most overall mortality (Good et al. 2011). Barometric pressure was positively associated with mortality at Mountaineer and Meyersdale (Arnett et al. 2008).

Fiedler (2004) found that mortality was positively associated with average nightly wind direction. One explanation may be that mortalities increased as wind direction deviated from the predominant, southwestern, wind direction. Further, increased mortalities on nights with more northerly winds may be a result of more bats moving during weather conditions conducive to migration.

The correlations between wind speed and mortality are reinforced by operational curtailment and feathering experiments that demonstrated reductions in bat mortality by increasing the speed at which turbines become operational, or the cut-in speed. At the Casselman wind facility in PA over 2 years of experimental study during the peak fall migration period, total fatalities at turbines operating at the manufacturer's specified cut-in speeds were estimated to be 5.4 (2008) and 3.6 (2009) times greater on average than at turbines feathered at wind speeds of 5.0 and 6.5 m/s[21]. Overall, 83% (95% confidence interval [CI] = 52% to 93%) of fatalities in 2008 and 72% (95% CI = 44% to 86%) of fatalities in 2009 at experimental turbines likely occurred when the turbines were operating at the manufacturer's specified cut-in speeds. A similar feathering study in southwest Alberta, Canada (Baerwald et al. 2008a), documented a 60% reduction in fatality at turbines with cut in speeds of 5.5 m/s. A recent study in IN found that bat fatalities were reduced by a mean of 50% (90% CI = 38% - 60%) at 5.0 m/s and 79% (90% CI = 71% - 85%) at 6.5 m/s (Good et al. 2011)[22] when curtailment was employed. According to Arnett et al. (2010), similar reductions in mortality were reported in Germany by O. Behr (University of Erlangen), but no further information on this study is available. Thus, this study will not be discussed further in this HCP.

#### *4.5.6.5 Turbine Dimensions and Lighting*

Limited data suggest that turbine height may influence the risk of bat collision with wind turbines. Barclay et al. (2007) found that turbine height potentially influenced the number of bat fatalities in their review of post-construction mortality studies at 6 wind facilities in 7 states. While avian mortality remained constant with turbine height, the number of bat fatalities increased with increasing turbine height; turbines with more than 65 m (213 ft) nacelle height had the highest mortality rates among bats. The authors suggest the discrepancy between avian and bat mortality relative to turbine height could be related to differing migratory flights heights. Somewhat consistent with this, at Buffalo Mountain mortality rates were almost 2 times as numerous at larger turbines (78 m [256 ft] nacelle height; 69.6 bats per turbine per year) compared with that at smaller turbines (65 m [213 ft] nacelle height; 35.2 bats per turbine per year). However, sample sizes were highly unequal (i.e., 3 smaller [0.66 MW] turbines compared with 15 [1.8 MW] larger turbines) and on a per MW basis there were fewer fatalities at larger turbines (i.e., there were 53.3 bats per MW killed at 0.66 MW turbines compared with 38.7 bats per MW killed at 1.8 MW turbines, Fiedler et al. 2007). At the Buffalo Ridge facility, MN, taller turbines with greater rotor-swept areas caused higher numbers of bat fatalities per turbine and per MW compared with smaller turbines (Johnson et al. 2003a, 2004).

Limited data also suggest that rotor swept area may influence the risk of bat collision with wind turbines. Three turbine models are operating at the Fowler Ridge Wind Facility; all 3 have the same turbine height but each has a different rotor diameter (Good et al. 2011). Bat mortality increased with increasing rotor diameter, and the effect was significant even after adjusting for all other coefficients tested (Good et al. 2011).

Although bats are known to aggregate near lights (e.g., street lights) to forage on insects (Furlonger et al. 1987, Fenton 1997), studies conducted to date do not indicate increased collision risk for turbines lit with FAA-regulation red strobe lights on nacelles. While some birds were attracted to certain types of steady burning, non FAA-regulation lights at Mountaineer (i.e., sodium vapor lighting, Kerns and Kerlinger 2004 as cited by Kerns et al. 2005), data from post-construction mortality studies at Mountaineer and Meyersdale did not indicate a difference in bat fatalities at lit and unlit turbines (Kerns et al. 2005). This is supported by other post-construction mortality studies (Erickson et al. 2003a, as cited by Johnson and Strickland 2003, Johnson et al. 2003a, Fiedler et al. 2007), as well as the Horn et al. (2008) TIR camera study that found no significant difference in bat activity at lit and unlit turbines. While no studies to date indicate increased

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[21] There was no statistical difference in fatality reductions at the 2 cut-in speeds. However, Arnett noted that "we found little differentiation in the amount of time different cut-in speed treatments were in effect…which may explain in part why we found no difference in bat fatalities between the two treatments" (Arnett et al. 2011).

[22] There was a statistical difference in reductions between these 2 treatments (Good et al. 2011).

collision risk at lit turbines, controlled studies comparing fatalities at red and white FAA lights have not been conducted and response to white lights is unknown (Arnett et al. 2008).

#### 4.5.6.6 Bat Collision with Other Structures

Bat collisions with aircraft have been reported since 1967 (Williams and Williams 1967, Martin et al. 2005, Peurach et al. 2009) and bat collisions with tall anthropogenic structures including buildings, television and communication towers, lighthouses, fences, and power lines have been reported since 1930 (Saunders 1930, Van Gelder 1956, Zinn and Baker 1979, Avery and Clement 1972, Ganier 1962, Gollop 1965, Timm 1989, Terres 1956, Dedon et al. 1989 as cited by Johnson and Strickland 2003, Crawford and Baker 1981). Similar to mortality patterns at wind facilities and for bat-aircraft strikes (with the exception of Brazilian free-tailed and Seminole bats), the majority of recorded bat collisions with other structures has involved red, hoary, and silver-haired bats. The frequency and magnitude of fatalities resulting from collision with tall anthropogenic structures has been lower than those observed at wind turbines (Arnett 2005, Cryan and Veilleux 2007) and have been lower than reported bird fatalities (Anonymous 1961, Avery and Clement 1972, Elder and Hansen 1967, Ganier 1962, Overing 1936, Saunders 1930, Terres 1956, Timm 1989, Van Gelder 1956, Zinn and Baker 1979 as cited by Johnson and Strickland 2003, Crawford and Baker 1981).

Studies conducted to date suggest that bats are more at risk from rotating turbines than stationary structures. Of the 64 turbines studied at Mountaineer and Meyersdale in 2004, the only turbine with no observed fatalities was nonoperational throughout the study period (Kerns et al. 2005). The experts agree that there is no evidence that bats routinely collide with nonmoving blades or towers. Several cited data from specific wind facilities noted that while dead bats are routinely found at operational turbines, they are not found at non-operational turbines or MET towers (USFWS 2011a). MET towers searched at wind turbine sites in WY, TN, MN, and OR resulted in no bat collision mortalities (Nicholson 2003, Johnson et al. 2003b, Johnson et al. 2003c as cited by Johnson and Strickland 2003). Conversely, avian mortality at MET towers was 6 times higher than at wind turbines at a site in WY (Johnson et al. 2000).

# 5.0 IMPACT ASSESSMENT

According to the Section 7 implementing regulations (50 CFR Part 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. Direct effects are those that have an immediate effect on the species or its habitat. Indirect effects are those that are caused by the proposed action at a later time, but still are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Cumulative effects are those from future state or private activities (i.e., non-federal) that are reasonably certain to occur within an action area.

The following sections describe direct, indirect, and cumulative effects to Indiana bats that are expected to result from the 100-turbine Project, which are summarized in Table 5-1. Impacts to other bats and birds are addressed the EIS Section 5.6 and Chapter 4 of the ABPP (Stantec 2011a). Indiana bats are known to use the Action Area during the summer maternity period and are expected to travel through the Action Area during spring and fall migration (see Section 4.2.4 – Distribution in the Action Area). Based on genetic data and data from banding/telemetry studies (refer to Section 4.4.3 – Migration), it is highly likely that Indiana bats migrating through the Action Area are from the Midwest RU; therefore, all effects can be evaluated as they pertain to the Midwest RU or local populations.

A conditional CECPN has been issued for 52 turbines associated with the Project. A separate OPSB application for a CECPN (see Section 1.4.4 – Major Utility Facility Review) has been submitted for the Buckeye II Wind Project (see Section 2.1 – Applicant Background and Project History). This application has been submitted by Champaign Wind LLC, a seperate EverPower subsidiary. Construction of any of the additional turbines will not commence until the CECPN for Buckeye II Wind Project is issued. Due to the timelines for developing the OPSB application and HCP and uncertainty of the outcome of the CECPN process, the level of detail provided in the OPSB application and HCP are not identical. However, ample information has been included in this HCP to adequately assess the potential impacts to the Indiana bat (see Chapter 5.0 – Impact Assessment) from the full 100-turbine Project. The assessment in the HCP includes a reasonable worse case estimate of possible impacts for the 100-turbine Project and all 100 turbines will be constructed within the Action Area described in the HCP. The additional turbines, as described in the Buckeye II Wind Project OPSB application, will not result in a greater impact to the Indiana bat than what is described and analyzed in this HCP.

## 5.1 Direct Effects

### 5.1.1 Direct Effects – Construction and Decommissioning

#### *5.1.1.1 Noise, Vibration, and Disturbance*

Temporary increases in disturbance, such as noise, human activity, and vibrations from equipment are expected to result from construction and decommissioning activities. Noises associated with these activities will include sounds associated with diesel-powered earthmoving equipment such as irregular engine revs, back up alarms, gravel dumping, and the clanking of metal tracks (Hessler 2009). Construction activities are expected to occur during daylight hours throughout the year, although timing will favor non-inclement weather and activity is therefore likely to be heaviest during the spring, summer, and fall, with the tree clearing to be conducted between 1 Nov and 31 Mar. Construction activities will regularly move from place to place within the Action Area. The Project, including all 100 turbines, will be constructed within 1 to 2 construction phases; each phase is expected to continue for 12 to 18 months, with potential of overlap of the phases. The maximum potential construction disturbance at any particular location would occur over a few days to up to a few weeks. Similarly, decommissioning activities are estimated to take place over a limited time period, not to exceed approximately 1 year.

The distribution of construction/decommissioning activity is expected to result in limited disturbance to Indiana bats. While none of the 100 turbines will be closer than 2.9 km (1.8 mi) to any maternity roost tree identified in 2009, Indiana bats in the Action Area could be exposed to noise levels and vibrations that they may not have experienced in the past if unidentified maternity roosts are located in close proximity to construction or decommissioning activities. Some studies indicate that Indiana bats are sensitive to certain types of disturbance. Callahan 1993 and Sparks 2003 found that Indiana bats abandoned their primary roost trees near bulldozing activity, resulting in decreased Indiana bat abundance. Female bats in Illinois used roosts at least 500 m (1,640 ft) from paved roadways (Garner and Gardner 1992).

**Table 5-1.** Summary of direct and indirect effects to Indiana bats from the 100-turbine Buckeye Wind Power Project, Champaign County, OH.

| Impact Description | Effect Type | | Insignificant/ discountable | Likely to result in take |
|---|---|---|---|---|
| | Direct | Indirect | | |
| Construction | | | | |
| Noise, vibration, disturbance | X | | X | |
| Vehicular collision | X | | X | |
| Removal of wooded habitat | | | | |
| Loss of roosting habitat | | X | X | |
| Loss of foraging habitat | | X | X | |
| Habitat fragmentation | | X | X | |
| Increased energy expenditure | | X | X | |
| Impacts to aquatic habitat | | | | |
| Reduction of aquatic insect prey | | X | X | |
| Reduced water availability and/or quality | | X | X | |
| Increased energy expenditure | | X | X | |
| Operation/Maintenance | | | | |
| Sound from Operating Turbines | X | | X | |
| Lighting | X | | X | |
| Vegetative Control | X | X | X | |
| Collision with Vehicles | X | | X | |
| Collision/barotrauma Mortality | X | | | X |
| Decommissioning | | | | |
| Noise, vibration, disturbance | X | | X | |
| Collision with Vehicles | X | | X | |
| Impacts to aquatic habitat | | | | |
| Reduction of aquatic insect prey | | X | X | |
| Reduced water availability and/or quality | | X | X | |
| Increased energy expenditure | | X | X | |
| Mitigation | | | | |

| | | | |
|---|---|---|---|
| Tree Planting | X | | X |
| Noise, human activity, disturbance | X | | X |
| Collision with Vehicles | X | | |
| Invasive Species Control | | X | X |
| Tree Girdling | | X | X |

Construction-related activities may disturb Indiana bats that roost or forage in habitat ranked as Category 1, 2, or 3 located near turbines, roads, transmission lines, or lay-down areas. However, construction and decommissioning activities are not expected to be concentrated near high quality Indiana bat roosting and foraging habitat, as they will take place within a very small proportion of this habitat available to Indiana bats in the Action Area.

Some studies suggest that Indiana bats may be able to tolerate loud noises and seemingly disturbing activities; Indiana bats used roosts near Interstate 70 (I-70) and in close proximity to the Indianapolis Airport, including a primary maternity roost tree that was located 600 m (1,970 ft) south of I-70. The colony occupied this maternity roost tree despite constant high levels of noise from I-70 and airport runways. However, their use of this seemingly suboptimal area could have been due to lack of a more suitable roosting area away from noise and disturbance, as the surrounding area was highly fragmented with limited forested habitat remaining (USFWS 2007).

Additionally, some studies suggest that Indiana bats shift their centers of activity to avoid disturbance. As discussed in Section 5.2.1.1 – Wooded Habitat Removal, Indiana bats frequently shift roosts (Kurta et al. 2002, Kurta 2005) and have been known to shift their centers of activity in response to changing resources (Kurta and Murray 2002, Kurta et al. 2002, Carter 2003). Indiana bats have been documented shifting their centers of activity by up to 4.8 km (3.0 mi) (T. Carter, Ball State University, personal communication) and have been documented traveling up to 6.0 km (3.7 mi) between roosts (Carter 2003). These findings provide support that Indiana bats can shift their summer activity centers relatively large distances when needed.

Construction/decommissioning activities will occur largely in agricultural areas where the sounds of tractors, trucks, and other agricultural machinery are commonplace. While Project construction activities may be longer in duration and are not exactly the same as agricultural activities, Indiana bats in the Action Area may already be used to roosting in proximity to loud, temporary noises and human activity associated with agricultural activities.

If construction-related activities cause injury to individuals that significantly alters their behavior patterns, this constitutes "harassment" under Section 9 of the ESA. However, as previously described, noise, vibration, or disturbance associated with construction and decommissioning activities is expected to occur in a very small portion of the Indiana bat suitable habitat available in the Action Area (0.8% of areas designated as Categories 1 – 3). Any shifts in activity that may occur are expected to be temporary, since construction activity is not likely to exceed a few weeks at any one location, and Indiana bats should be able to resume normal activities in vacated areas after construction has subsided. Thus, negative physiological effects such as increased energy expenditure and lost reproductive fitness are expected to be insignificant or discountable (i.e., too small to be detectable or measurable).

#### *5.1.1.2 Collision with Vehicles*

Although bats are very agile flyers, there is evidence that bats (including Indiana bats) can be killed by collision with vehicles. A single Indiana bat fatality along with multiple little brown bat fatalities were documented over a 36-day study resulting from presumed collision with vehicles on U.S. Route 22 in PA (Russell et al. 2008). These mortalities were associated with a highway located along a narrow road corridor (20 m [66 ft]) surrounded by forested habitat, between an active little brown bat maternity colony and a core foraging area. However, the highway traffic that was the subject of the Russell et al. (2008) study is very different from the traffic that will result from construction activities for the Project.

Vehicle activity associated with the Project will include large, slow moving construction vehicles that will make trips in and out of the Action Area along local and state roads that already support significant traffic. Major Project components, including sections of the turbines and construction materials (such as concrete), would be delivered to active construction areas via truck. These components would arrive via I-70, and/or US Route 33 and deliveries to the Action Area would be via US Route 36 and State Route (SR) 56, with other state and local roads used to access specific turbine sites or other Project facilities. Similar roads would be used to take Project components out of the Action Area during decommissioning.

Unlike the Russell et al. (2008) study, construction vehicles will not make frequent trips within road corridors that are likely to function as Indiana bat foraging or traveling corridors. Rather, vehicular activity will be spread throughout the Action Area (see access road layout in Figure 1-1), with temporary concentrations of activity near turbines being constructed. Additionally, the small amount of increased vehicular traffic associated with Project construction of the 100-turbine Project will occur over a limited time period, estimated to be between a total of 1 to 3 years between 1 or 2 construction phases, which would only partially include the Indiana bat active period and would occur mostly during day-light hours when Indiana bats are not flying. Similarly, decommissioning activities are estimated to take place over a limited time period, not to exceed approximately 1 year.

As a result of the factors discussed above, mortality of Indiana bats caused by vehicle strikes with construction or decommissioning vehicles is not likely. Thus, it is anticipated that vehicular traffic associated with the Project will result in direct effects that are insignificant and discountable and not expected to rise to the level of take.

### 5.1.2 Direct Effects – Operation and Maintenance

#### *5.1.2.1 Sound from Operating Turbines*

There is a potential for increased ambient sound generated by wind turbines to impact wildlife that reside within or near wind facilities. Operating wind energy facilities raise background sound levels, although the sound footprint of a given facility will vary based on turbine design (i.e., size and operating specifications) and existing ambient sound levels. The influence of turbine-generated sound on wildlife also varies with the auditory perception of the species exposed to the increased sound and the extent to which their life history strategies depend on sound.

Several studies investigating the effects of activities associated with high levels of anthropogenic noise (e.g., roads, oil and gas infrastructure, aircraft overflights) have documented effects to animal behavior, population demographics, and community composition in the vicinity (Barber et al. 2010). However, these noise sources generally produce a much higher sound level than would be expected to be produced by wind turbines. Also, because few of these studies isolated noise from other possible causes (e.g., road mortality, visual disturbance, chemical pollution, habitat fragmentation, increased predation, and invasive species along edges), the independent contribution of anthropogenic noise is uncertain (Barber et al. 2010). Despite the difficulties of isolating the effects of noise from other causal factors, recent studies provide support that increased ambient noise levels from human activities can interfere with animal perception of sounds and can impede acoustical communication, predator-prey interactions, reproductive success, and time-energy allocation (Barber et al. 2010).

Little is known about the effects to Indiana bats, or bats in general, from increases in ambient sound generated by wind turbines. Studies have shown that gleaning bats, or those that rely on prey-generated sounds to capture prey on the ground or foliage surfaces (Neuweiler 1989), are susceptible to the masking effects of sound emissions. A radio-tag study showed that a gleaning bat, Bechstein's bat (*Myotis* *bechsteinii*), was less likely to cross a roadway than was a sympatric open-space foraging bat, Barbastrelle bat (*Barbastella barbastellus*) (Kerth and Melber 2009, as cited in Barber et al. 2010). A laboratory study demonstrated that gleaning bats avoided hunting in the presence of played back road noise that contained energy between 3 kHz and 8 kHz (Schaub et al. 2008, as cited in Barber et al. 2010). Noise may therefore act as a fragmenting agent, similar to other forms of habitat fragmentation such as forest removal or alteration, for gleaning bat species (Barber et al. 2010).

Indiana bats hunt their prey in the air while flying, also known as hawking, using echolocation (an auditory behavior that uses ultrasonic signals to detect prey and maneuver through the environment). Thus, similar impacts from road-generated noise as those seen in gleaning bats are not expected in Indiana bats. Although Gardner et al. (1991a) found that Indiana bat roosts were further from paved roads than non-paved roads, the potential contributing effects of noise were not isolated from other potential causal factors in this study, such as the configuration and quality of the surrounding habitat, and it is unknown what effect noise of paved roads may have contributed to this observed difference.

Kunz et al. (2007b) suggested that bats may become acoustically disoriented upon encountering turbines during migration or feeding. However, observations of bat flight activity using TIR cameras at wind energy facilities suggest that bats are able to normally fly and forage in close proximity to wind turbines (Ahlén 2003 as cited in Kunz et al. 2007b, Horn et al. 2008). There is some thought that turbine-generated sound could attract bats to turbines and increase collision risk, because some bat species are known to orient toward distant audible sounds (Buchler and Childs 1981, as cited in Kunz et al. 2007b). However, Szewczak and Arnett (2006) studied ultrasound emissions from a variety of wind turbines as a potential attractant to bats and concluded that ultrasound emissions, as measured from the ground-level, do not likely play a significant role in attracting bats toward wind turbines with consequential fatalities from rotor strikes[23]. While the studies referenced above indicate that bats may not be affected by sound from operating turbines, there are no data that specifically addresses the impacts of sound from wind turbine operation on migrating or foraging Indiana bats.

None of the 100 turbines will be closer than 2.9 km (1.8 mi) to maternity roost trees documented in 2009 (see Section 6.1 – Avoidance Measures and 6.1.1 – Project Planning and Siting). Of the known turbine locations, 33 (63%) will be sited in Category 4 habitat, the lowest quality habitat for Indiana bats, where Indiana bats are least likely to forage so that exposure to sound from operation of these turbines is unlikely. Of the 52 known turbine locations, 3 turbines (6%) are in Category 1 habitat (highest quality habitat), 10 (19%) will be sited in Category 2 habitat, and 6 (12%) will be sited in Category 3 habitat. While the locations of the additional 48 turbines are not yet known, the majority of the Action Area (about 70%) is comprised of Category 4 habitat and open areas are generally preferable for siting of turbines over wooded areas. The distribution of the remaining 48 turbines among habitat categories will be similar to the distribution for the known 52 turbine locations (see Table 6-2, Section 6.1 – Avoidance Measures, and Section 6.1.1 – Project Planning and Siting).

Operational turbines that occur within proximity to undocumented roost trees or foraging areas may create sound that is detectable to Indiana bats that occur in these areas. No literature exists that describes how Indiana bats respond to operating turbines. Contributions from turbine sound are likely to be negligible in the context of overall ambient sound levels. Sound from wind turbines is very low, estimated to be quieter

[23] The authors cautioned that ultrasound could be emitted from turbine models not tested during their investigation or from turbine nacelles.

than 50 db(A) (equivalent to a field with insects) approximately 200 feet from a turbine (Hessler 2009). Additionally, feathering of turbines at low wind speeds at night, which will be used as a tool to minimize impacts to Indiana bats, will also help reduce turbine-generated increases to ambient sound levels during times of increased bat foraging activity. During the summer months, when foraging success is critical for successful pup rearing, more restrictive nightly cut-in speeds would be applied to Project turbines located in the higher Habitat Categories roosting and foraging habitat. Thus, feathering would simultaneously reduce bat strike fatalities and keep ambient sound levels low during biologically critical periods and within ecologically important areas. Therefore, effects from sound at operating turbines are considered insignificant or discountable and take due to sound is not likely to occur.

#### *5.1.2.2 Lighting*

FAA lights that will be installed on some of the turbines are not expected to increase collision/barotrauma mortality or have any direct or indirect effects on Indiana bats. Arnett et al. (2008) synthesized available information on bat fatalities from 21 studies conducted at 19 wind energy facilities in 5 regions of the United States and 1 province in Canada. None of the studies reviewed demonstrated statistically significant differences in fatality between turbines equipped with FAA lights and those that were unlit. Further, Arnett (2005) studied bat activity and fatalities at the Mountaineer facility in WV and at the Meyersdale facility in PA and found that turbines with FAA lights did not appear to affect the incidence of foraging bats around turbines and there was no difference between numbers of bat passes recorded with acoustic detectors at lit and unlit turbines. Additionally, bat fatalities documented at the Mountaineer and Meyersdale facilities were not different between turbines equipped with FAA lights and those that were unlit. Finally, Horn et al. (2008) used TIR cameras to study behavioral responses of bats to operating wind turbines and concluded that aviation lighting did not appear to affect the incidence of foraging bats around turbines. However, controlled studies comparing fatalities at red and white FAA lights have not been conducted and response to white lights is unknown (Arnett 2008).

Regardless, Buckeye Wind will minimize turbine lighting per specifications of the FAA. Attached to the top of the some of the nacelles will be a single, medium intensity aviation warning light. The minimum amount of obstruction avoidance lighting specified by the FAA will be used (FAA 2007); approximately 1 in every 5 turbines will be lit, and all lights within the Project will illuminate synchronously. FAA lights are anticipated to be flashing red strobes (L-864) that operate only at night. Buckeye Wind will use the lowest intensity lighting as allowed by FAA. To the extent possible, USFWS-recommended lighting schemes will be used on the nacelles, including reduced intensity lighting and lights with short flash durations that emit no light during the "off phase". Further, MET towers will also utilize the minimum lighting as required by the FAA.

In addition to FAA lights, there may be a limited number of security lights that may be required at the substation and O&M facilities. However, operational lighting will be minimized to the maximum extent practicable and Project design will incorporate minimum intensity lighting on all Project structures, where feasible. Unnecessary lighting on the O&M building and substation will be eliminated to reduce attraction of bats at night (though no attraction of bats to building and substation lights has been documented, taking this step will reduce impacts to birds). No steady burning lights will be left on at Project buildings. Where lights are necessary for safety or security, motion detector lighting or infrared light sensors will be used to avoid continuous lighting. Any lights controlled by motion detector or infrared light sensors will be shielded downward to minimize skyward illumination, and high intensity, steady burning, bright lights such as sodium vapor or spotlights will not be used. Motion detector lights will be used above tower doors and at the substation for nighttime maintenance visits and for security. Thus, it is not anticipated that FAA or operations lighting will result in harm or mortality of Indiana bats; therefore, effects are insignificant or discountable and not likely to rise to the level of take.

See additional information on avoidance and minimization of impacts to bats and birds from lighting in the Buckeye Wind ABPP (Stantec 2011a) and in the EIS Section 5.6 and Section 5.1 of the ABPP.

#### *5.1.2.3 Vegetative Control*

To control the spread of invasive species, herbicides may be used around Project facilities, where needed. The vast majority of Project facilities will be located in areas that are currently used for agricultural purposes. Any areas of herbicide use will not extend outside of disturbed areas. Herbicides are commonly used in agricultural activities; therefore, the use of herbicides associated with the Project will not be significant as compared to current land use practices. As part of the monitoring outlined in Section 6.5.2.5 - Vegetation Management and Mapping, Buckeye Wind will mow the search areas of at least 25% of the turbines to increase searcher efficiency rates, unless other acceptable methods of searching become available (see Section 7.2.1.9 – Uses of New Methods, Information, or Technological Advances). Because the majority of turbines will be placed in agricultural areas and mowing will occur in areas that have been previously cleared of trees for agricultural purposes, mowing will not result in removal of Indiana bat habitat. No additional wooded areas beyond that which was removed during Project construction (see Section 5.2.1.1 – Wooded Habitat Removal) would be cleared in the Indiana bat active period during operation and maintenance. Human presence or noise from mowing equipment is expected to be similar to active agricultural operations that are ongoing in the Action Area and are not likely to result in disturbance to Indiana bats.

For the reasons stated above, ongoing vegetative controls associated with Project operation are insignificant and discountable and not likely to result in take of Indiana bats.

#### *5.1.2.4 Collision with Vehicle*

Although bats are very agile flyers, there is evidence that bats (including Indiana bats) can be killed by collision with vehicles (see Section 5.1.1.2 – Collision with Vehicles).

During Project operation and maintenance, vehicle activity associated with the Project will include maintenance vehicles traveling to various turbines daily. These vehicles will make trips in and out of the Action Area along local and state roads that already support significant traffic. Replacements for major Project components, including blades, generators and other components in the nacelle, would be delivered to active Project areas via truck. These components would arrive via I-70, and/or US Route 33 and deliveries to the Action Area would be via US Route 36 and SR 56, with other state and local roads used to access specific turbine sites or other Project facilities.

Vehicular activity will be spread throughout the Action Area (see access road layout in Figure 1-1), with temporary concentrations of activity near turbines during major maintenance activities. Additionally, the small amount of increased vehicular traffic associated with Project operation and maintenance of the 100-turbine Project will be insignificant compared to regular traffic in the Action Area and would occur mostly during day-light hours when Indiana bats are not active.

As a result of the factors discussed above, mortality of Indiana bats caused by vehicle strikes with operation and maintenance vehicles is not likely. Thus, it is anticipated that vehicular traffic associated with the Project will result in direct effects that are insignificant and discountable and not expected to rise to the level of take.

#### *5.1.2.6 Collision/Barotrauma Mortality*

As described in Section 4.5.5 – Collision Mortality at Wind Facilities, impacts to bats from wind facilities are well documented (Johnson et al. 2003a, Kunz et al. 2007a, Arnett et al. 2008), with long-distance migratory bats being the most affected, particularly during the late-summer through fall migratory period. Prior to fall 2009, no Indiana bats were known to have been killed at a wind facility. The 2 documented Indiana bat fatalities at the Fowler Ridge wind facility in Benton County, IN, and the 1 documented Indiana bat at the North Allegheny wind facility in Cambria and Blair Counties, PA, during the fall migratory periods of 2009, 2010, and 2011 confirm that Indiana bats are at risk of collision with wind facilities during the fall migratory period; risk during spring and summer remains unknown (Good et al. 2011). These Indiana bat fatalities were likely not the first Indiana bats to have been killed at a wind facility; other Indiana bat mortalities probably have not been detected due to lack of post-construction monitoring at many wind projects, inaccurate identifications, lack of detection due to small size, decomposition of carcasses, or removal by scavengers. So while it is assumed that additional mortality has occurred, these fatalities represent the only documented taking of Indiana bats at wind facilities to date. Therefore, Indiana bats compose an extremely low proportion of total documented bat mortality at wind facilities. Because very low Indiana bat mortality has been documented, there is a lack of data on collision and barotrauma risk specific to the Indiana bat.

##### *5.1.2.6.1 Collision Risk Model*

The risk of Indiana bat collision with wind turbines in the Action Area is unknown and relatively few empirical data exist to inform assumptions about risk. The following section summarizes the results of a collision risk model (presented in full in Appendix A) that was used to estimate mortality of Indiana bats as a result of Project operation. The collision risk model was based on best available scientific information and included site-specific empirical data, as well as expert opinion and historical and current literature on Indiana bats. The collision risk model incorporated information on Indiana bat use of the Action Area, site characteristics, and a 100-turbine Project layout[24].

Mortality of Indiana bats was estimated during 3 periods in which Indiana bats display distinct behavioral characteristics that could differentially affect their exposure to wind turbines: spring emergence and migration, or "spring" (1 Apr to 31 May); summer habitat use, or "summer" (1 Jun to 31 Jul); and fall migration, or "fall" (1 Aug to 31 Oct). Although these seasons are presented as being discrete, it is expected that there is overlap in seasonal behaviors (i.e., migration and summer habitat use) between these defined periods. Variation in weather conditions and other stochastic factors could also affect the exact timing of this annual chronology. However, these periods are expected to adequately encapsulate seasonal behaviors that could differentially affect collision risk.

Under conditions of high uncertainty, simple models with minimal inputs are generally preferred in the risk assessment literature to more complex models with large numbers of inputs (Warren-Hicks and Moore 1998). In cases where many key elements that affect risk are not well documented or understood, the use of simple models that incorporate uncertainty analysis focused on the model equations and inputs can provide

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[24] For the CRM (see Appendix A), the 100 turbine locations were derived using the known 52 turbine locations and a random placement of the additional 48 turbines within suitable areas (excluding wooded areas, accounting for OPSB regulated setbacks to residences, roads, property lines, etc., and other restrictions). If the CRM estimates a higher take estimate with the final placement of the additional 48 turbines, adaptive management will maintain actual take numbers at the level requested in this HCP. No amendment to the take limit will be sought as a result of the final location of the additional 48 turbines.

decision-makers with a framework for understanding the degree of confidence that can be assigned to model outputs (Warren-Hicks 1999, Canham et al. 2003, Warren-Hicks and Hart 2010). The Bolker et al. (2006) model is an example of this simplistic type of model that requires minimal inputs and employs simple geometry and basic probability theory. Given the uncertainty in modeling Indiana bat collision in the Action Area, the Bolker et al. (2006) model was used but expanded upon by incorporating empirical data and expert opinion on Indiana bat behaviors and conditions leading to risk into the published mathematical framework. Additionally, the Bolker et al. (2006) model framework was modified by formally incorporating a risk-based approach to decision-making based on the model outputs, including the use of a formal uncertainty analysis.

The uncertainty analysis used a probabilistic approach that relied on either a range of values, or a formal distribution for each model input, rather than a deterministic approach based on single-point estimates. A Beta distribution was used when input values varied between 2 limits, but there was reason to believe that a subset of values within those limits was more likely to occur, as with proportions or probabilities. A uniform distribution was used when there was limited information about whether 1 value was more likely to occur than another. In some cases, random samples were drawn from an actual distribution based on empirical data, rather than a theoretical distribution. For model inputs whose distributions were based only partially or not at all on empirical data, a sensitivity analysis was conducted to investigate the degree to which changes in the input distributions affected model results. Season-specific estimates of collision/barotrauma were influenced by 5 primary components: seasonal population size, flight height, weather conditions that influence the number of bats that are active on a nightly basis, movement bouts within the turbine array, and mortality probability.

*Seasonal Population*

To estimate the summer population of Indiana bats in the Action Area, a conservative approach was taken. Indiana bats were assumed to have the potential to occur in suitable habitat throughout the Action Area during the summer, even though mist-netting in 2008 did not document Indiana bats in the Action Area, and mist-netting in 2009 resulted in 3 Indiana bat captures whose home ranges collectively occupied 3% of the Action Area and 1 Indiana bat in the center of the Action Area who was only tracked for 1 night, and whose roost tree was located 2.3 km (1.5 mi) east (outside) of the Action Area. Using a combination of these site-specific, empirical data, models predicting and quantifying suitable habitat within the Action Area, and conservative assumptions based on relevant literature and professional judgment, the summer Indiana bat population was estimated to be between 10.1 and 2,271.4 Indiana bats (see Appendix A for details on methods). Based on simultaneous emergence counts conducted at known Indiana bat roost trees within or near the Action Area, a minimum Indiana bat population size of 99 was estimated in Summer 2009 (K. Lott, ODNR, personal communication).

The size of migratory populations of Indiana bats moving through the Action Area during the spring and fall migration periods was extrapolated from USFWS Indiana bat population estimates from winter 2008-2009 hibernacula surveys in the migratory range of the Action Area (A. King, USFWS, personal communication). Assumptions about the distances and directions of travel during migration were derived from literature, expert opinion, and band returns from Indiana bats captured in the Action Area. These data were used to estimate the numbers of Indiana bats likely to pass through the Action Area during migration which ranged from approximately 2,900 Indiana bats to 5,800 Indiana bats (see Section 4.2.4 – Distribution in the Action Area and Appendix A for more information).

*Flight Height*

Assumptions about flight height, an input variable that strongly influenced the potential for collision, were informed by the height distribution of *Myotis* call sequences recorded with acoustic detectors (previously described in Section 4.4.4.2 – Foraging and Traveling Behavior), as well as observations of Indiana bat and *Myotis* flight height reported in literature and expert opinion. To account for uncertainty of Indiana bat flight height relative to the rotor swept zone, probability distributions were created for high, moderate, and low flight height scenarios and run as separate models (Table 5-2).

**Table 5-2.** Proportion of Indiana bats assumed to be flying within the rotor swept zone under high, moderate, and low height scenarios of the collision risk model.

| **Flight height scenario** | **Season** | | |
|---|---|---|---|
| | **Spring** | **Summer** | **Fall** |
| Low | 5% | 1% | 10% |
| Moderate | 15% | 10% | 20% |
| High | 25% | 20% | 30% |

*Weather Conditions*
Probability distributions for wind speed and temperature were developed from approximately 3 years of data collected at 2 MET towers in the Action Area (see Appendix A). The probability distribution for the distances and frequency with which Indiana bats are likely to travel within the turbine array during the summer was based on professional judgment as well as empirical data from 11 radio-tagged female Indiana bats[25] and the distances traveled between 23 roost locations[26] and 1,124 telemetry locations. The probability distribution for Indiana bat movements within the turbine array during migration was based on literature and professional judgment. Given the uncertainty in migration flight paths through the turbine array, a uniform probability distribution was used to reflect the number of potential crossings between 0 and 1, with each possible distance traveled through the turbine area having an equal chance of occurrence.

*Movements within the Turbine Array*
The number of movements across the turbine area is a function of the total distance traveled within the turbine array, comprised of the number of times that a given distance will be traveled and the probability that a given distance will be traveled. Movements across the turbine array were estimated separately for summer and during migration. In summer, large-scale movement bouts between roost trees and foraging locations were derived from the available telemetry data. The maximum distance across the turbine array was divided into 10% distance bins, and each distance bin was given a probability of occurrence based on the distances recorded between Indiana bat roost and telemetry locations for 10 female radio tagged bats captured in the tri-county area in 2008 and 2009. It was assumed that summer activity could be summarized by 4 large-scale movement bouts during a night (leaving a roost tree at dusk; arriving at a night roost, or returning to a roost; leaving a roost for a second time; and returning to a roost at dawn), with the distance traveled during each bout based on the average distanced documented during Indiana

[25] Although 19 Indiana bats (17 females and 2 males) were radio tagged in the tri-county area in 2008 and 2009, only 11 female bats were successfully tracked during nightly foraging and traveling activities.
[26] Although 43 roost trees (38 female maternity roosts and 5 male roosts) were identified in the tri-county area in 2008 and 2009, only 23 maternity roosts had bats using them that had associated radio telemetry locations for distance calculation.

bat telemetry. Along with these large-scale movements, a bat could make an unspecified number of small-scale movements that did not affect its risk of collision, because these movements occurred at or below tree canopy height (see Appendix A for details on methods).

*Mortality Probability*
Mortality probability was estimated based on the average number of turbine encounters, adjusted by the probability that a bat would survive the encounter. In the Bolker et al. (2006) model framework, a turbine encounter will occur if a bat's flight height is within the rotor swept zone and its flight path intersects a turbine location; effectively, if it is within collision or barotrauma distance of a rotor blade. The factors affecting the number of predicted turbine encounters are turbine location, height of turbine center (i.e., nacelle height), rotor length, angle of approach, probability of safe passage (i.e., survival as a result of avoidance or other factors), and flight height.

The turbine blade was conservatively extended for the purposes of the model to account for the potential for Indiana bats to be trapped in low-pressure vortices at the tips of rotor blades (i.e., barotrauma). The distance from the blade tip within which barotrauma can occur is still unknown. Researcher E. Baerwald, University of Calgary, who first described barotrauma from wind turbines in bats, described the diameter of this "small zone of [dropping] pressure" as "a meter or so" (Handwerk 2008). To conservatively account for the uncertainty in defining the zone of barotrauma, and to ensure that barotrauma impacts to Indiana bats would not be underestimated in the model, the length of the turbine blade was extended by 3 m (9.8 ft). The estimated length of the barotrauma zone was increased from Baerwald's estimate to account for changes in the length of the zone of compression due to changes in the rotational speed of the turbines. This increase serves to effectively enlarge the size of the rotor swept zone, which results in a higher number of possible turbine encounters, which correspondingly increases mortality probability.

These factors were incorporated into a geometric model developed by Bolker et al. (2006) using a probabilistic approach. The actual chance of survival is unknown and may be affected by avoidance, attraction, random chance, or other unknown factors. To account for this uncertainty and to test the sensitivity of the model outcome to this parameter, Beta probability distributions were developed for 3 potential survival scenarios. Survival scenarios were based on professional judgment related to Indiana bat morphology, mortality patterns of *Myotis* bats at wind facilities, and survival rates used in available collision risk models.

To test the uncertainty of collision risk estimates to parameter assumptions, a Monte Carlo analysis (Manly 2007) was used that entailed repeated random sampling of model input distributions (or measured data) based on 100,000 iterations. This approach is most defensible, given the high degree of uncertainty in the underlying model inputs, and it lends itself well to the development of adaptive management strategies, described in Section 6.5 – Monitoring and Adaptive Management. The Monte Carlo analysis generated a distribution of model predictions that were used to inform the final estimations of mortality resulting from collision or barotrauma.

##### *5.1.2.6.2 Collision Risk Model Results*

As described in Appendix A, the predicted amount of incidental take is based on the mean values predicted by model simulations using various model inputs (i.e., population size, flight height, and survival probability). The requested amount of incidental take was then calculated by reducing the amount of modeled take due to reductions from implementation of a feathering program to minimize take (see Section 5.1.2.5.3 – Estimated Take with Feathering; Table 5-5). Given the conservative approach that was taken to develop highly influential model inputs (i.e., population size, flight height, and survival probability) and because many of the model input distributions were derived from empirical data on *Myotis* species or

Indiana bats specifically, the take estimate for this HCP is considered a conservative estimate of actual collision/barotrauma. Because survival probability is unknown for Indiana bats, the mean of the median values for 3 potential survival scenarios is used to represent expected mortality. Annual Indiana bat mortality for the low, moderate, and high flight height scenarios ranged from 6.9 Indiana bats per year to 25.4 Indiana bats per year, which includes adult female, adult male, and unborn and non-volant juveniles in the spring and summer (Table 5-3). Approximately 51% to 57% of the annual mortality is estimated to occur during the fall migration period.

**Table 5-3.** Collision risk model-predicted seasonal and annual Indiana bat fatalities (median values) under high, moderate, and low flight height scenarios within the rotor swept zone for 100-turbine Buckeye Wind Project.

| Flight height scenarios | Mean fatalities of 3 survival scenarios | | | |
|---|---|---|---|---|
| | Spring | Summer | Fall | Annual |
| Low | 2.4 | 0.1 | 4.4 | 6.9 |
| Moderate | 6.9 | 0.7 | 8.7 | 16.3 |
| High | 10.9 | 1.5 | 13.0 | 25.4 |

Collision risk model results indicate that predicted mortality of Indiana bats is highest during the migratory periods and lowest during summer residency in maternity colonies. This is a result of the assumptions made about Indiana bat exposure to the rotor swept zone during migration; assumptions that were made based on biology and not on observed post-construction mortality. Data on observed Indiana bat mortality at wind facilities do not provide sufficient information to accurately predict risks to Indiana bats since only 3 fatalities have been documented. While all 3 fatalities were observed in the fall, this does not preclude risk during the spring, since fewer post-construction mortality studies have been conducted in the spring. Buckeye Wind is situated in an area with documented summer habitat use and therefore it is a spring migration endpoint for some individuals. It is unknown if or how spring migration behavior may influence risk, and thus assumptions about spring and fall migratory behavior were kept similar.

#### *5.1.2.6.3 Estimated Take with Feathering*

The results of the collision risk model represent mortality probabilities under operating conditions that do not include feathering of turbines at low wind speeds. However, feathering will be applied to turbine operations with varying operational constraints as a condition of the HCP and associated ITP to minimize take of Indiana bats (see Table 5-4a and Section 6.2 – Minimization Measures for specifics of feathering plan). Three[27] operational effectiveness studies have documented substantial, but variable, rates of bat fatality reduction using cut-in speeds ranging from 5.0 m/s to 6.5 m/s (11.1 mph to 14.5 mph; Table 5-4b). The median minimum, maximum, and average reductions in bat fatalities in these 3 studies were 44.0%, 86.0%, and 68.3% respectively. It is important to note that different turbine models were used in each study, and as such, turbine blade rotation below the cut-in speed may be variable among studies.

[27] One study (Casselman) included 2 years of treatments.

**Table 5-4a.** Summary of nighttime operational feathering that will be applied to turbines during Evaluation Phase Year-1. Feathering will be applied to all turbines, using cut-in speeds that correspond to the habitat risk category assigned to each turbine location. Any turbines installed after the first year of operation will be feathered using the respective cut-in speeds of existing turbines in the same habitat risk category as adjusted through adaptive management, if those cut-in speeds differ from those in this table.

| Habitat risk category | Estimate for 52-Turbine Layout | Estimate for 100-Turbine Layout* | Cut-in speed - m/s | | |
|---|---|---|---|---|---|
| | | | Spring (1 Apr - 31 May) | Summer (1 Jun - 31 Jul) | Fall (1 Aug - 31 Oct) |
| **Category 1 - Highest Risk** | 4 | 10 | 5.0 | 6.0 | 6.0 |
| **Category 2 - Moderate Risk** | 9 | 15 | 5.0 | 5.75 | 5.75 |
| **Category 3 - Low Risk** | 6 | 15 | 5.0 | 5.5 | 5.75 |
| **Category 4 - Lowest Risk** | 33 | 85 | None** | 5.25 | 5.75 |
| **Totals** | 52 | 125 | | | |

* The breakdown for the known 52 turbine locations is given for reference. Siting for the additional 48 turbines will seek to avoid the higher risk category sites to the extent practicable. The table shows a reasonable estimate for maximum number of turbines in each category, resulting in a sum >100. No more than 100 turbines will be built.

** Turbines will be cut-in at the manufacturer's specified cut-in speed. The turbines will be feathered below the cut-in speed.

The 3 studies provide evidence that feathering is an effective way to reduce bat mortality and the general magnitude of that reduction. To estimate the take that would result from the Project, Buckeye Wind has applied the median reduction in fatality among all 3 studies (68.3%) to the median results from the collision risk model (refer to Appendix A), resulting in a take estimate for the Project of 5.2 Indiana bats per year. This provides a reasonable estimate of expected take of Indiana bats since the feathering plan for the Project employs cut-in speeds that are variable but within the parameters used for those 3 studies. However, assumptions made in the collision risk model, along with the use of distributions for model inputs (rather than static values), resulted in a range of possible mortality estimates. Under the most conservative assumptions (i.e., high flight height and with the median minimum reduction in fatality from the 3 operational effectiveness studies [44.0%]), the maximum annual mortality is estimated to be 14.2 Indiana bats per year. Likewise, under the least conservative assumptions (i.e., low flight height and with the median maximum reduction in fatality from the 3 operational effectiveness studies [86.0%]), the maximum annual mortality is estimated to be 1.0 Indiana bat per year (Table 5-5). Turbines at Buckeye Wind will not rotate (i.e., will be feathered) below the cut-in speed set during adaptive management (see Section 6.5.1 – Monitoring for Minimization). Increased reductions in mortality from feathering may be observed at Buckeye Wind compared to reductions observed at studies in Table 5-4b if turbines in those studies were curtailed (i.e., may still have rotated below the cut-in speed) instead of feathered.

**Table 5-4b.** Observed range in reductions in bat fatalities and median values for 4 operational effectiveness studies in the range of the Indiana bat. Turbines were feathered at Casselman and in Southwest Alberta, and curtailed at Fowler Ridge.

| Study | Observed fatality reduction[a] | | | Source |
|---|---|---|---|---|
| | Min | Max | Average | |
| Casselman 2008[b] | 52.0% | 93.0% | 82.0% | Arnett et al. 2010 |
| Casselman 2009[b] | 44.0% | 86.0% | 72.0% | Arnett et al. 2010 |
| Fowler Ridge 2010[c] | 38.0% | 85.0% | 64.5%[d] | Good et al. 2011 |
| Southwest Alberta[e] | NA | NA | 60.0% | Baerwald et al. 2009 |
| | | | | |
| Median fatality reduction | 44.0% | 86.0% | 68.3% | |

[a] All studies used a combination of cut-in speeds of 5.0 m/s to 6.5 m/s except Baerwald et al. 2009, which used 5.5 m/s

[b] Based on a 95% confidence interval

[c] Based on a 90% confidence interval

[d] Based on the median of the reported average reductions from each treatment (5.0 m/s = 50%; 6.5 m/s = 79%)

[e] Study did not provide confidence intervals for appropriate min and max comparison to other studies

Fluctuations in annual mortality can be expected as a result of natural stochasticity in variables that lead to mortality over time. To account for this uncertainty and natural variability, this HCP proposes that single and multi-year levels of take be authorized. Accordingly, the average annual mortality estimated by the collision risk model was used to develop 5-year and 25-year take limits (Table 5-6). Measures described in Section 6.5.3 – Adaptive Management for Minimization will allow Buckeye to manage any year-to-year fluctuations in the take number and maintain the 5-year and 25-year take limits. It is expected that any significant fluctuation from the expected annual take level of 5.2 Indiana bats per year will not occur after the first couple years of monitoring, as the operational parameters (e.g., cut-in speeds) will be adjusted to account for actual take levels, if necessary. Note that requested take will be reduced based on future population reductions from WNS in the Midwest RU as described in Section 5.1.2.6.4 – Take Reductions as a Result of WNS.

While the ITP Term is for 30 years, which includes construction, operation and decommissioning periods, no Indiana bat take is expected during construction, decommissioning, and mitigation activities (refer to previous and following subsections in Section 5.0 – Impact Assessment for more detail on expected effects from these activities). Although no take is expected during these phases, the ITP authorization would apply during these phases in the unlikely event that take did occur. Proposed take limits are for total mortality during the 25-year period during which turbines are operational and include both observed mortality (i.e., carcasses found during post-construction monitoring) and unobserved mortality that may occur but is not documented for various reasons, including ineffective searching or removal by scavengers. As detailed in Section 6.5 – Monitoring and Adaptive Management, monitoring throughout the life of the Project will be used to ensure compliance with the 5-year and 25-year take limits.

**Table 5-5.** Collision risk model-predicted annual Indiana bat mortality for the 100-turbine Buckeye Wind Project with expected reductions from feathering.

| Flight height scenario | Unadjusted average annual mortality | Estimated annual mortality with expected reductions from feathering | | |
|---|---|---|---|---|
| | | 86.0% | 68.3% | 44.0% |
| Low | 6.9 | 1.0 | 2.2 | 3.8 |
| Moderate | 16.3 | 2.3 | 5.2 | 9.1 |
| High | 25.4 | 3.6 | 8.1 | 14.2 |

**Table 5-6.** Requested Indiana bat take ITP limits for the 100-turbine Buckeye Wind Project in Champaign County, OH.

| ITP intervals | Take request[28] | Timing/calculation considerations |
|---|---|---|
| 5-Year | 26.0 | Calculation of the 5-year take period will begin in any year in which the estimated take exceeds 5.2 Indiana bats; estimated take over any consecutive 5-year period beginning with any year when take exceeds the expected average (5.2 Indiana bats) will not exceed 26.0 Indiana bats. |
| ITP Term | 130.0 | Calculated based on the cumulative expected annual take over the 25-year operational life of the Project (as defined in Section 2.4 – ITP Duration): Expected Average Mortality per year is 5.2 Indiana bats and will not exceed 130.0 Indiana bats for 25 years of operation. |

As stated above, the 5-year limit is based on the moderate flight scenario with the mean expected reductions in Indiana bat mortality (i.e., 5.2 Indiana bats x 5 years = 26.0 Indiana bats). Although it is not possible to have mortality of a partial bat, it is possible to estimate mortality of a partial bat; since annual Indiana bat mortality will be calculated using bias correction factors for searcher efficiency and carcass persistence, mortality estimates will be expressed in terms of partial bat fatalities (see Section 6.5.2 – Methods for Minimization Monitoring for details on these calculations). Based on these assumptions, a maximum take of 26.0 individuals over a 5–year period, for a total requested take authorization of 130.0 individuals over the ITP Term, is requested to be authorized under the ITP. While annual take levels provide a benchmark for monitoring take and will enable adaptive management actions to be tailored to respond to observable results from each monitoring year (see Section 6.2.2 –Project Operation and Maintenance), the 5-year limit is expected to more closely reflect the average expected annual mortalities that will result from the Project.

Because take could be higher in some years due to unusual weather event effects - -or other factors - -that are not currently understood, annual take estimates will indicate appropriate adaptive management. As more information is collected, it is expected those factors will become better understood and the adaptive

[28] Please see *Phase Considerations for Take Allowance* below for discussion on how these take numbers would change depending on the number of turbines erected and timing of the erection.

management measures will reduce the possibility that higher than average expected take will occur (see Section 6.5.3 – Adaptive Management for Minimization).

Since the collision risk model explicitly accounted for sex- and age-specific mortality (see Appendix A Section 3.3), take estimates include mortality of adult female, adult male, and unborn and non-volant juveniles. Adjustments to mortality documented during monitoring will also take into account mortality of unborn or non-volant juveniles. Since most adult female Indiana bats give birth to 1 pup per year, adult female Indiana bats found between 1 April and 15 July will be multiplied by 2. This multiplier is based on data from Kurta and Rice (2002) and Humphrey et al. (1977) which suggest that approximately 90% of captured females are in reproductive condition (i.e., pregnant, lactating, or post-lactating) during the summer reproductive period (see Section 4.3 – Demographics for further detail).

In addition to the 5-year and 25-year take limits proposed, this HCP defines annual mortality thresholds that will be used for the purposes of adaptive management and to facilitate responsiveness in management actions to ensure ITP compliance. At the conclusion of each monitoring year, annual Indiana bat mortality will be placed into 1 of the 3 categories described in Table 5-7.

Greater than Expected annual mortality measured over any 1-year term will be used as an early warning that adjustments to minimization efforts are necessary. Under these circumstances, Buckeye Wind will implement adaptive management strategies, as outlined in Section 6.5 – Monitoring and Adaptive Management.

**Table 5-7.** Annual Indiana bat mortality estimated from observed and unobserved mortality based on the 100-turbine Buckeye Wind Project collision risk model and expected reductions in mortality from feathering.

| Average Mortality category | Estimated annual mortality | Reasoning |
|---|---|---|
| Less than Expected | 5.2 or fewer Indiana bats per year | Mortality expected with greater than the median maximum reduction from feathering – 86.0% |
| Expected | 5.2 Indiana bats per year | Mortality expected with the median reduction from feathering – 68.3% |
| Greater than Expected | Greater than 5.2 Indiana bats per year (not expected to exceed 14.2) | Mortality expected with less than the median minimum reduction from feathering – 44.0% |

**Phasing Considerations for Take Allowance**

Since the collision risk model generated expected mortality for a 100-turbine Project, but construction could occur in a phased manner with only some of these turbines in operation in the beginning stages of the Project, the take allowances presented in Table 5-6 will be pro-rated according to the number of turbines that are in commercial operation in a given year. For example, if 52 turbines are built and put into commercial operation, the 5-year limit would be 52/100 = 52% of 26, or 13.5 Indiana bats. If additional turbines are commissioned within the 5-year period, the 5-year take limit would also be pro-rated. For example, if 52 turbines are commissioned in the first 2 years and the remaining 48 turbines are commissioned in Year-3, the 5-year take limit would include 2 years at 52% of the expected annual take limit (i.e., 2.7 Indiana bats), and 3 years at 100% of the expected annual take limit. Thus, the total 5-year take limit would be calculated as follows: (2.7 + 2.7) + (5.2 + 5.2 + 5.2) = 21.0 Indiana bats. As part of the reporting requirements for the HCP, Buckeye Wind will provide 30-day advance notice to the USFWS and ODNR DOW in writing for each turbine or group of turbines that is placed into commercial operation, providing the date and location of each turbine and a recalculation of the take limits.

If turbines are commissioned during the Indiana bat active period (1 Apr to 31 Oct), the take allowance would be similarly pro-rated. For example, if the first 52 turbines are commissioned on 1 June, 29% of the active period would have passed. The turbines would then be operating during 71% of the active period and the expected take for that year would be 52% x 71% x 5.2 = 1.9 Indiana bats. Using the above example (with the remaining 48 turbines being commissioned before the beginning of the Year 3 active period), the 5-year take limit then would be (1.9 + 2.7) + (5.2 + 5.2 + 5.2) = 15.6.

The 25-year operational life of the Project would commence upon commercial operation of the first turbine. Since this may include a partial year of operation, the expected take level for the 25-year period may be less than 130.0 Indiana bats. In the case that the full authorized take is not reached by the end of the ITP Term, Buckeye Wind may seek to extend the ITP Term through an amendment (see Section 7.3 – HCP Amendments).

#### *5.1.2.7 Biological Significance of Incidental Take (Collision Mortality)*

It is important to understand the long-term biological significance of sustained annual incidental take of Indiana bats from Project operation. Under the Proposed Action, total annual Indiana bat mortality, including adult females, adult males, and juveniles, is estimated to range from approximately 1.0 Indiana bat per year to 14.2 Indiana bats per year, assuming mortality is reduced by 44% to 86% as a result of feathering turbines (Tables 5-4b and 5-5). Based on the 5-year take limit, the total number of Indiana bats authorized to be taken over the ITP Term is 130.0 Indiana bats. Putting this level of mortality into context requires knowledge of Indiana bat life-history characteristics and baseline information on population trends.

When evaluating the biological significance of Indiana bat mortality from the Project, it is important to consider their unique life-history strategies (Barclay and Harder 2003). Life-history characteristics of a given population determine the degree to which its viability is affected by increased mortality. Organisms whose populations are characterized by low birth rate, long life span, naturally low mortality rates (i.e., K-selected species, Pianka 1970), high trophic level, and small geographic ranges are likely to be most susceptible to cumulative, long-term impacts on population size, genetic diversity, and ultimately, population viability (McKinney 1997, Purvis et al. 2000, as cited in National Research Council [NRC] 2007).

Bat species demonstrate considerable variation in traits such as fecundity, age of maturity, and longevity. As a group, bats have relatively long life spans and produce relatively few offspring compared with other small mammals, which may be due to low extrinsic mortality (e.g., low predation), reproductive constraints, or other characteristics (Barclay and Harder 2003 as cited in NRC 2007, Charnov 1993, Kozlowski and Wiegert 1986). Bats are atypical among mammals with respect to their life-histories because they have small body sizes but are long-lived (Barclay and Harder 2003 as cited in NRC 2007). The probability of extinction in bats has been linked to several of these characteristics (Jones et al. 2003 as cited in NRC 2007).

The Indiana bat population in the Midwest RU has experienced overall increases over the past 10 years (see Section 4.1—Species Status). Initial analysis of the biological significance of incidental take focuses on take in the context of this scenario. However, in winter 2010-2011, WNS was documented in the Midwest RU for the first time. While it is currently unknown what the impact of WNS is on the Midwest RU population, WNS in the Northeast RU has resulted in substantial Indiana bat population declines (e.g., 61.2% decline in NY's Indiana bat population based on hibernacula counts between 2007 and 2010 [A. King, USFWS, personal communication]) and may have similar results in the Midwest RU over time. Therefore, a second analysis of the biological significance of incidental take was completed using a WNS population effect scenario based on NY data. The biological significance of take based on both analyses is discussed in the following sections.

##### *5.1.2.7.1 Impacts to Local Maternity Colonies Pre-WNS*

Given the long lifespan of Indiana bats and their relatively low reproductive rates, loss of reproductive females can have significant impacts on the viability of the population. A proportion of spring, summer, and fall take may be to adult females who belong to a maternity colony located in the Action Area. To evaluate the impacts of the taking on the viability of a single local maternity colony within the Action Area, it was important to isolate expected adult female mortality from the total expected annual mortality. To do this, expected mortality during the spring, summer, and fall was calculated, and then the proportion of this mortality expected to be attributed to local adult females was estimated using a number of different assumptions as described in the following paragraphs. Impacts to the entire population of females, males, and juveniles from Project-related take are analyzed in Section 5.1.2.6.2 – Impacts to the Midwest RU Population Pre-WNS.

Because they are of the same guild, *Myotis,* as Indiana bats, observed mortality of little brown bats at wind facilities in the range of the Indiana bat was used as a surrogate to calculate the proportion of annual Indiana bat take expected to occur in the spring, summer, and fall seasons (little brown bat mortality patterns were not directly used to estimate Project-related take; see Appendix A). Of the total 3,433 bat fatalities documented in 26 post-construction mortality monitoring studies conducted within the range of the Indiana bat, there were a total of 225 little brown bat fatalities (0.07%; Jennifer Szymanski and Megan Seymour, USFWS, personal communication). Little brown bats comprised 8%, 34%[29], and 58% of fatalities in the spring, summer, and fall, respectively, with seasons defined as spring: 1 March to 31 May; summer: 1 June to 31 July; and fall: 1 August to 30 November. These proportions were used to estimate seasonal mortality expected to occur as a result of the Project, as shown in Table 5-8.

To estimate the amount of seasonal mortality expected to be attributed to adult females, the proportion of females expected to be in the population in each season was estimated. In the summer, females were estimated to comprise 92% of mortality based on the ratio of females to males observed during mist-netting studies in and near the Action Area (Table 5-9a, 5-9b; refer to Appendix A for more detail). During the spring and fall migratory period, females were estimated to comprise 73% of mortality, based on a 50:50 ratio of females to males at hibernacula and a ratio of 89 females to 11 males at the furthest migratory distances, resulting in an estimated average of 73% female Indiana bat composition within the Action Area (Table 5-9a, 5-9b; see Appendix A). Since the estimated number of females in the population was multiplied by 2 in the spring and summer prior to 15 July to account for loss of unborn juveniles in estimating mortality, and emergence counts conducted between 15 July and 15 August were assumed to include females and volant juveniles at a 1:1 ratio, to get the proportion of the population represented by adult females alone, the estimated spring and summer mortality estimates were divided by 2 (Table 5-9a, 5-9b; see Appendix A for derivation of these ratios and multipliers).

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[29] The majority of summer mortality occurred in late July during late-summer dispersal, with the highest daily mortality of the entire monitoring period on 29 July.

**Table 5-8.** Estimates of seasonal Indiana bat mortality for the 100-turbine Buckeye Wind Project based on 1-year take estimate and 5-year take limit.

| Season | Seasonal proportion of annual fatality[a] | Estimated seasonal mortality | |
|---|---|---|---|
| | | Maximum 1-year take estimate[b] | 5-year avg. annual take limit |
| Spring | 8% | 1.1 | 0.4 |
| Summer | 34% | 4.8 | 1.8 |
| Fall | 58% | 8.2 | 3.0 |
| Annual | – | 14.2 | 5.2 |

[a]Based on documented seasonal little brown bat mortality in 26 monitoring studies within the range of the Indiana bat.
[b]The CRM provides a range of potential annual take. Because it is expected that there will be year-to-year variation in incidental take, Buckeye Wind proposes a take limit based on the 5-year average, rather than a year-to-year limit. The maximum 1- year take estimate is based on the CRM's high flight scenario with minimum (44.2%) observed reductions from feathering.

**Table 5-9a.** Factors used to estimate the proportion of seasonal mortality that would be attributed to females from local maternity colonies under the 1-year take estimate for the 100-turbine Buckeye Wind Project.

| Season | Estimated seasonal mortality | Proportion of mortality that is local | Annual local mortality for 1-year take estimate | Percentage of females in local population | Divisor for unborn or non-volant juveniles lost[a] | Annual local female mortality for 1-year take estimate |
|---|---|---|---|---|---|---|
| Spring | 1.1 | 14% | 0.2 | 73% | 2 | 0.1 |
| Summer | 4.8 | 100% | 4.8 | 92% | 2 | 2.2 |
| Fall | 8.2 | 14% | 1.1 | 73% | – | 0.8 |
| Annual | 14.2 | – | 6.1 | – | – | 3.1 |

[a]The estimated number of females in the population was multiplied by 2 in the spring and summer to account for loss of unborn juveniles in estimating mortality. Thus, to get the proportion of the population represented by just adult females, estimated spring and summer mortality was divided by 2.

**Table 5-9b.** Factors used to estimate the proportion of seasonal mortality that would be attributed to females from local maternity colonies under the 5-year take estimate for the 100-turbine Buckeye Wind Project.

| Season | Estimated seasonal mortality | Proportion of mortality that is local | Annual local mortality for 5-year take estimate | Percentage of females in local population | Divisor for unborn or non-volant juveniles lost[a] | Annual local female mortality for 5-year take estimate |
|---|---|---|---|---|---|---|
| Spring | 0.40 | 14% | 0.1 | 73% | 2 | 0 |
| Summer | 1.80 | 100% | 1.8 | 92% | 2 | 0.8 |
| Fall | 3.00 | 14% | 0.4 | 73% | – | 0.3 |
| Annual | 5.20 | – | 2.3 | – | – | 1.1 |

[a]The estimated number of females in the population was multiplied by 2 in the spring and summer to account for loss of unborn juveniles in estimating mortality. Thus, to get the proportion of the population represented by just adult females, estimated spring and summer mortality was divided by 2.

The final step in estimating impacts to local populations was to estimate the proportion of the spring and fall migratory populations that was expected to be adult females belonging to maternity colonies in the Action Area. Given that up to 5,800 Indiana bats are estimated to travel through the Action Area during migration from up to 575 km (357 mi) away, there is a high probability that female Indiana bats killed during migration would be from multiple maternity colonies in different geographic areas. However, it's possible that some summer resident Indiana bats migrating between the Action Area and their hibernacula would be killed en route. Estimated population sizes in the Action Area in the spring/fall migratory periods and summer periods (Appendix A) were used to estimate the proportion of the migratory population that is likely to belong to the local population.

The mean local population size in the Action Area was between 10.1 and 2,271.4 Indiana bats (see Appendix A Section 2.1.1 – Summer Population). The estimated population size expected to migrate over the Action Area during spring and fall migration was approximately 5,800 Indiana bats assuming a 180-degree migration pattern from hibernacula, or 2,900 Indiana bats assuming a 360-degree migration pattern (see Appendix A Section 2.1.2 – Migratory Population).

The USFWS provided the following Leslie matrix model (Leslie 1945), a type of geometric population model, for use in assessing the viability of local maternity colonies with expected Project-related mortality over the ITP Term (USFWS comments on Buckeye Wind Draft HCP, March 10, 2011). This model provides a simplistic way of comparing population size with and without Project-associated take. This model represents a "best case" population scenario, as it does not address stochasticity or other perturbations that may be occurring in the environment that may impact the population. However, the model does provide insights on how Project-related take may influence population dynamics:

$$\text{Population size}_{(\text{year } t+1)} = (\text{Population size}_{[\text{year } t]} * \lambda) - \text{additive mortality} - \text{nonrecruitment}$$

Under recent conditions in the Midwest RU, and prior to WNS being discovered in the Midwest RU the USFWS recommended a population growth rate (λ, or "lambda") for local maternity colonies equal to 1.03, and a 100% recruitment (i.e., 0% non-recruitment) rate. Population growth rate of Indiana bats within the Action Area is unknown and likely varies from year to year depending on weather and other stochastic factors. Survival rates for adult females have been documented to range from 75.9% to 66.0% during a 10-

year period after banding (Humphrey and Cope, 1977, Boyles et al. 2007; see Section 4.3 – Demographics). However, results are generated from banding studies using unknown-aged individuals, and the authors caution that their results, while useful, cannot be taken as true survival rates for Indiana bats because of limitations in the data. Studies within the Midwest RU have indicated that reproductive rate of adult females can range from 82% to 93% (Kurta and Rice 2002, Humphrey et al. 1977; see Section 4.3 – Demographics). Juvenile Indiana bat survival rates are also uncertain, though a study of 1 maternity colony for 1 season estimated neonatal mortality to be 8% (i.e., 92% survival; Humphrey et al. 1977; see Section 4.3 – Demographics). Juvenile sex ratios are assumed to be generally equal (50:50), based on work by Hall (1962), Myers (1964), LaVal and LaVal (1980) and Humphrey et al. (1977).

The assumption of 100% recruitment (i.e., a closed population with no immigration or emigration and all juvenile females that survive return to the population in the following year as adults) is supported by evidence demonstrating strong philopatry (i.e., returning to the same place each year) in Indiana bats at maternity colonies, roost trees, foraging locations, and hibernacula (Garner and Gardner 1992, Kurta et al. 2002, Winhold et al. 2005).

The Leslie matrix model was run using a starting population of 70 Indiana bats, based on the average of 2 cumulative emergence counts in the tri-county area in 2008 and 2009 (43 Indiana bats and 99 Indiana bats, respectively).

Using the above information, we assumed a starting maternity colony size of 70 adult female Indiana bats, an annual adult survival rate of 66%, a reproductive rate of 82%, a juvenile sex ratio of 50 males to 50 females, a juvenile survival rate of 92%, and 100% recruitment of surviving juvenile females and adult females the following year. The annual population the following year would be calculated as follows:

Population in Year 2 = number of adult females in Year 1 that survive and return + their female offspring that survive and return; or

Population in Year 2 = (70*0.66) + (70*0.82*0.5*0.92) = 72.6

The population growth rate (λ, or "lambda") in this instance would be calculated by dividing the change in population size between Year 1 and Year 2 by the starting population size:

$$\lambda = 2.6/70 = 0.03 \text{ or } 3\%$$

A growth rate of 3% is equal to a lambda value of 1.03.

A Leslie matrix growth model was used because simple models are generally preferred to more complex models when there is little information on which to base model assumptions. This model was chosen to demonstrate how the Indiana bat population within the Action Area would be impacted by Project-related take, compared to the population without Project-related take. The Action Area is dominated by agriculture and landcover has remained largely unchanged (see Section 3.1.6 – Landcover); therefore, it is likely that within the Action Area, Indiana bat habitat suitability, quantity, and quality are likely stable. As a result, it is reasonable to assume high survivorship, reproductive, and recruitment rates for maternity colonies in the Action Area.

Impacts to local maternity colonies assuming losses to the population under the 1-year take estimate and 5-year take limits projected over the operational life of the Project (i.e., 25 years) were modeled using expected and worst-case scenarios (Table 5-10). Under the expected scenario, the survival of the local population was evaluated under the assumption that the average annual mortality of 5.2 individuals would occur each year. In the second, worst-case scenario, it was assumed that reproductive and energetic losses to local maternity colonies would be greater as larger numbers of Indiana bats are lost in a single, or successive, reproductive seasons. Thus, the maximum estimated 1-year take (i.e., 14.2) was assumed to occur in the first year of Project operation. Since take of no more than 26 Indiana bats would be authorized over any 5-year period, the cumulative mortality over the next 4 years would have to equal 26 – 14.2, or 11.8 Indiana bats. It was then assumed that the maximum take also occurred in Year-2 (i.e., 11.8 Indiana bats), and 0 mortality occurred in Year-3, Year-4, and Year-5. After applying the assumptions described in Tables 5-8, 5-9a, and 5-9b, the proportion of annual mortality that would be attributed to adult females was calculated (Table 5-10). This 5-year pattern was then repeated for 25 years for the purpose of running the Leslie matrix model.

To run the model, it was necessary to estimate the size of the population from which reproductive females would be lost. Individuals from 2 separate maternity colonies were documented in the Action Area during summer mist netting (see Section 4.2.4 – Distribution in the Action Area); therefore, Project-related impacts have the potential to affect at least 2 maternity colonies. Additional maternity colonies may be affected if suitable habitat exists adjacent to the Action Area and colony foraging activity overlaps with the Action Area.

**Table 5-10.** Expected and worst-case scenarios of total and adult female local Indiana bat mortality modeled over a 5-year period for the 100-turbine Buckeye Wind Power Project.

| | Expected Scenario | | Worst-case Scenario | |
|---|---|---|---|---|
| **Year** | **Total Local Mortality** | **Local Female Mortality** | **Total Local Mortality** | **Local Female Mortality** |
| 1 | 2.3 | 1.1 | 6.2 | 3.1 |
| 2 | 2.3 | 1.1 | 5.3 | 2.4 |
| 3 | 2.3 | 1.1 | 0 | 0 |
| 4 | 2.3 | 1.1 | 0 | 0 |
| 5 | 2.3 | 1.1 | 0 | 0 |
| Total | 11.5 | 5.5 | 11.5 | 5.5 |

Since maternity colonies are the reproductive unit, loss of a single maternity colony would mean loss of the individuals in that colony, as well as their reproductive potential in future years. To assess the impacts in the theoretical worst case scenario, Buckeye Wind has considered the unlikely scenario in which all Project-related mortality affects 1 maternity colony. The projected population change of a single maternity colony resulting from Project-related take over the 25-year operational life of the Project was plotted against projected population change for this colony without take from the Project.

Given previously described assumptions about the starting population size, proportion of annual take attributed to local adult females each season, and the Leslie matrix model and parameters provided by the USFWS, estimated Project-related mortality of local adult females did not reduce the long-term viability of a single local maternity colony (Figure 5-1). Under both the expected and worst-case scenarios, the local population increased during the operational life of the Project by 36 Indiana bats and 33 Indiana bats, respectively. In the absence of Project-related take, the population is estimated to increase by 77 Indiana bats over the same term, which is a difference of 41 Indiana bats and 44 Indiana bats for the expected and worst-case scenarios, respectively. Based on collision risk modeling and expected reductions from feathering, it was estimated that up to 27.5 adult female Indiana bats from the local population would be taken over the 25-year operational life of the Project (see Table 5-10, 1.1 local female Indiana bats per year over 25 years).

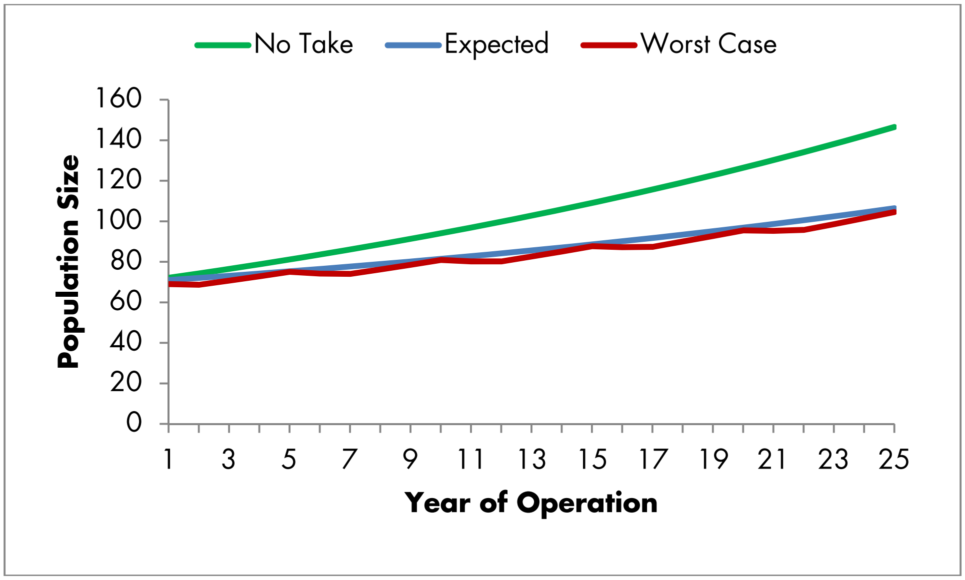


**Figure 5-1.** Impacts to a local maternity colony population due to the 100-turbine Buckeye Wind Project, pre-WNS. Leslie matrix model results given starting population size of 70 Indiana bats in a single, local maternity colony; λ = 1.03, and 0% nonrecruitment for expected scenario of annual adult female mortality = 1.1 Indiana bats each year in a 5-year cycle, and worst-case scenario of annual adult female mortality = 3.1 Indiana bats in Year-1, 2.4 Indiana bats in Year-2, and 0 Indiana bats in Year-3, Year-4 and Year-5.

Note that this modeling scenario is conservative because the level of mortality estimated by the collision risk model was strongly influenced by population size. Because the collision risk model was based on a population range of 10.1 to 2,271.4 Indiana bats, if the model were instead run assuming a local population of 70 Indiana bats, the expected mortality would be a small percentage of the mortality assumed in the Leslie matrix model analysis. Based on the results of the Leslie matrix model analysis and the assumptions used in that analysis, it is highly unlikely that the impacts of Project-related mortality would reduce the long-term viability of the local population.

##### *5.1.2.7.2 Impacts to the Midwest RU Population Pre-WNS*

Due to the location of the Action Area, Indiana bats that migrate through it are assumed to come from the Midwest RU (USFWS 2007) (refer to Section 4.4.3 – Migration for more detail). Therefore, this HCP is also evaluating the impact of Project-related take on the viability of the Midwest RU. Because of their long-standing endangered status and the ability to monitor Indiana bat populations via hibernacula counts, there are fairly robust data on current and historical population trends for Indiana bats. The 2009 rangewide population of Indiana bats was estimated to be 387,835 (Table 4-1), and the 2009 population estimate for the Midwest RU was 269,574 (Table 5-11, USFWS 2010).

**Table 5-11.** U.S. Fish and Wildlife Service Indiana bat (*Myotis sodalis*) population estimates from 2001, 2003, 2005, 2007, and 2009 by state within the Midwest Indiana bat RU.

| State | 2001 | 2003 | 2005 | 2007 | 2009 |
|---|---|---|---|---|---|
| Alabama | 173 | 265 | 296 | 258 | 253 |
| Indiana | 173,111 | 183,337 | 206,610 | 238,026 | 189,994 |
| Kentucky | 51,053 | 49,544 | 65,611 | 71,250 | 57,325 |
| Michigan | 20 | 20 | 20 | 20 | 20 |
| Ohio | 9,817 | 9,831 | 9,769 | 7,629 | 9,261 |
| Tennessee | 9,564 | 9,802 | 12,074 | 8,906 | 12,721 |
| Midwest RU | 243,738 | 252,799 | 294,380 | 326,089 | 269,574 |

The loss of up to 130 Indiana bats over the ITP Term represents 0.04% or 0.05% of the Midwest RU population in 2007 and 2009, respectively. Affects to the long-term viability of the Midwest RU were analyzed using the Leslie matrix model and parameters provided by the USFWS (USFWS comments on Buckeye Wind Draft HCP, March 10, 2011). The USFWS recommended using a growth rate (λ) equal to 1.00 and 100% recruitment for the Midwest RU population pre-WNS. While the Midwest RU population size has fluctuated over the past 10 years, it has been on a stable or increasing trajectory (prior to WNS), with small population size fluctuations likely due to a lack of standardization in measuring and observer error (see Section 4.1 – Species Status). Further, OH hibernacula data show the same trend, with fluctuating but generally stable population sizes. Therefore, an estimate of λ = 1.00 (indicating a stable population) seems conservative and supported for a pre-WNS population. Similar to the maternity colony analysis, assuming 100% recruitment is supported by evidence of philopatry toward hibernacula (see Section 5.1.2.6.1 – Impacts to Local Maternity Colonies Pre-WNS) and because there is genetic evidence that the Midwest RU is a distinct reproductive unit (USFWS 2007; see Section 4.1 – Species Status).

The same expected and worst-case mortality scenarios were used for the Midwest RU analysis as were used to analyze impacts to a single maternity colony. However, impacts to the entire Midwest RU were calculated based on total annual mortality. Therefore, an annual mortality of 5.2 individuals (females, males, and juveniles) every year for 5 years was assumed under the expected scenario. For the worst-case scenario, annual mortality of Indiana bats was assumed to be 14.2 in Year 1, 11.8 in Year 2, and 0 in Year 3, Year 4 and Year 5 of a 5-year cycle. A starting population size of 269,574 Indiana bats (Time 0) was used in the Leslie matrix model, which is the 2009 estimated population size.

With a λ of 1.0 and no non-recruitment (i.e., 100% recruitment), the effect of estimated annual Project-related mortality on the Midwest RU is to reduce the Midwest RU population by 26 Indiana bats every 5 years in either the expected-case or the worst-case scenario (Figure 5-2). Over the ITP Term, this would equate to 130 Indiana bats, or 0.05% of the total RU population. Unlike the effects of Project-related mortality on a single maternity colony, there would not be additional loss of individuals due to lost reproductive capacity at the Midwest RU level. Unlike maternity colonies, the Midwest RU is not the reproductive unit. Because the Project will result in loss of a proportionately small number of individuals including males, females, and juveniles, with females most likely belonging to multiple maternity colonies among hundreds of colonies that will be unaffected by the Project, the Project is expected to have an insignificant effect on the reproductive capacity of the Midwest RU as a whole. Therefore, at current population levels, it is highly unlikely that the impacts of the Project-related taking would reduce the long-term viability of Indiana bats within the Midwest RU.

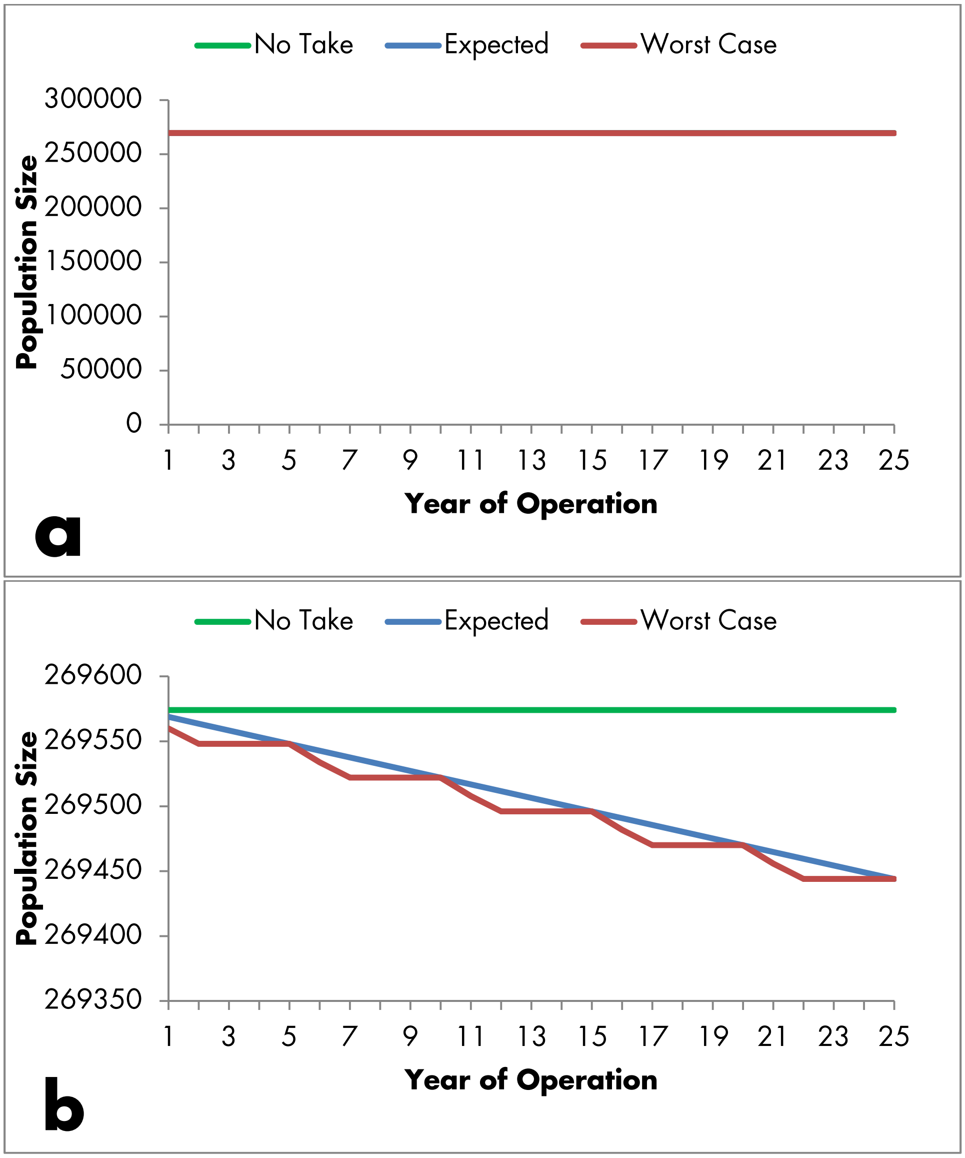


**Figure 5-2.** Impacts to the Midwest RU population due to the 100-turbine Buckeye Wind Project, pre-WNS. (a) Leslie matrix model results given starting Midwest RU population size of 269,574 Indiana bats, $\lambda$ = 1.00, and 0% nonrecruitment for expected scenario of annual adult female mortality = 5.2 Indiana bats each year in a 5-year cycle, and worst-case scenario of annual adult female mortality = 14.2 Indiana bats in Year-1, 11.31 Indiana bats in Year-2, and 0 Indiana bats in Year-3, Year-4 and Year-5. Total impact of take is equal to 0.05% of the total RU population. (b) The same analysis, with the Y-axis scale bar truncated to show slight differences between the no take, expected, and worst-case scenarios.

##### *5.1.2.7.4 Population Declines from White-Nose Syndrome*

Although impact of the taking likely to result from the Project is highly unlikely to reduce the viability of a single local maternity colony or the Midwest RU at their current population levels, the impact of Project-related taking must be considered in light of anticipated population declines from WNS, which was first documented in the Midwest RU including OH in winter 2010-2011. As summarized in Section 4.1 – Species Status, the most significant threat to both local and migratory Indiana bats in the Action Area is WNS. As previously discussed, WNS has the potential to undermine the basic survival strategy of more than half the bat species in the United States and almost all species of bats that occur at higher latitudes in North America by "causing premature arousals, aberrant behavior, and premature loss of critical fat reserves" in hibernating bats (Frick et al. 2010).

This HCP assesses the impact of Project-related take assuming WNS causes declines in the Midwest RU population and in local populations in the Action Area, as has been seen in the Northeast RU. Frick et al. (2010) reported that populations of all bats at hibernacula in eastern North America infected by WNS have decreased 73% on average from 2006 to 2010 (range from 30% to 99%). Winter Indiana bat census data from 2009-2010 in CT, MA, NY, and VT indicate that Indiana bat populations have experienced less severe declines as a result of WNS (i.e., 42% reduction), compared with declines in little brown bat and tri-colored bat populations (both estimated at 93% reduction), and northern long-eared bat populations (i.e., 99% reduction) (Langwig et al. 2010). The reductions reported by Frick et al (2010) and Langwig et al (2010) look at the impacts of WNS at the hibernacula level, whereas impacts across the entire RU could be different if individual hibernaculum are affected differently. The USFWS has estimated a 36.5% reduction in Indiana bat populations due to WNS across the Northeast RU from 2007 to 2009 (A. King, USFWS, personal communication).

Recently summarized data from NY, the state where WNS was first documented at a hibernaculum in 2007, provide the best available information on long-term population declines from WNS that might occur in the Midwest RU. In NY, Indiana bat survival rates were 65%, 98%, 61%, and 78% year-to-year during the first 4 winters WNS affected hibernating Indiana bats (A. King, USFWS, personal communication). Figure 5-3 and 5-4 represent population change at the individual maternity colony level and in the Midwest RU, with and without Project-related take, assuming Indiana bat populations were to experience similar declines as Indiana bats did in NY in the first 4 years of Project operation, and survival rates of 78% in each subsequent year over the 25-year operational life of the Project. A survival rate of 78% is maintained for Year 5 through Year 25 because it is the last known survival rate from the 4-year NY data set, it is similar to the 4-year average survival rate of 76% observed in NY, and there is no other information on the long-term results of WNS on Indiana bat populations. The scenario presented in Figure 5-3 assumes that declines of a single maternity colony in the Action Area track the same declines assumed for hibernacula in the Midwest RU; assumptions that are based on NY data.

Assuming similar annual population reductions at the single maternity colony level as those observed at the hibernacula level in NY, the single maternity colony was reduced to a population of 0 in Year 8 without the impacts of the Project-related take, while the single maternity colony was reduced to a population of 0 in Year 7 under both expected and worst case scenarios (Figure 5-3). Since only annual data were available from NY from which to base potential population reductions in the Midwest RU, it is not possible to know the exact time scale within which the population could be eliminated. In other words, it is possible that the difference in time between the population reaching 0 with and without impacts of Project-related take may be less than a full year and could be a difference of only several months or weeks, but it is not possible to determine based on best available information.

A similar modeling exercise was performed at the Midwest RU population level. Assuming similar annual population reductions in the Midwest RU as those in NY, the Midwest RU population affected with WNS at the end of 25 years is estimated to be 568 with no impacts from Project-related take, compared with a population of 544 or 552 under expected and worst-case take scenarios of impacts from the Project at the end of a 25-year operational life of the Project, which is a difference of 24 and 16 Indiana bats, respectively (Figure 5-4).

ITP issuance criteria state that, "the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild" [16 USC Section 10(a)(2)(B)(ii))]. Based on the Leslie matrix model, the single maternity colony would not be reduced to a non-viable population level appreciably sooner as a result of the Project than it would as a result of WNS in the absence of Project-related take. Similarly, the Midwest RU would not be reduced to low or non-viable population levels appreciably sooner as a result of the Project than it would as a result of WNS in the absence of impacts from Project-related take. Given what experts know about research on and management of WNS (i.e., there has been about 4 years of research on WNS to date, with no effective actions or solutions to slow or halt population declines), it is not reasonable to anticipate that impacts from Project-related take would preclude actions to reverse the effects of WNS on the species from taking effect. Therefore, impacts from the Project take are highly unlikely to appreciably reduce the likelihood of survival and recovery of the species.

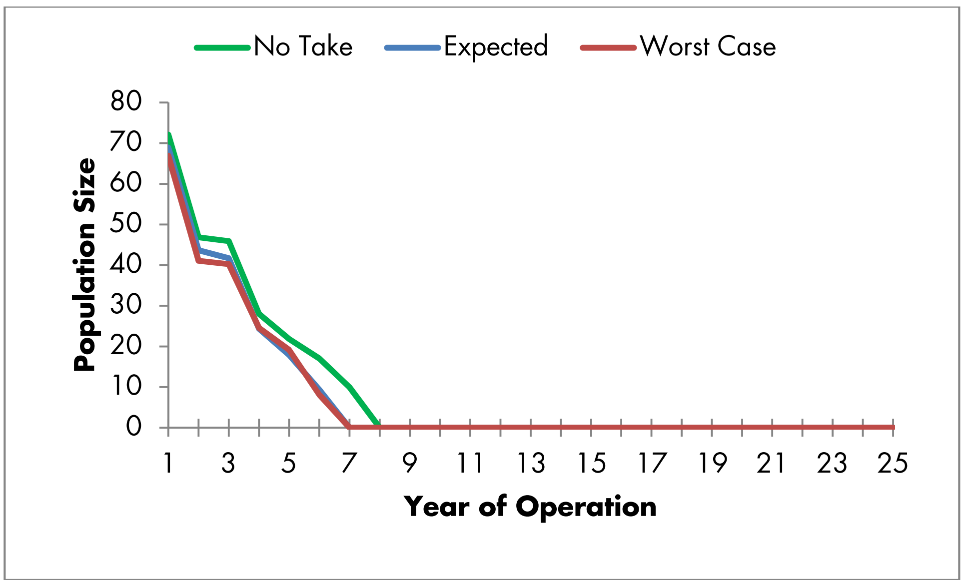


**Figure 5-3.** Impacts to a local maternity colony due to the 100-turbine Buckeye Wind Project, with WNS effects. Leslie matrix model results given starting population size of 70 adult female Indiana bats in the local maternity colony, expected and worst-case scenarios of Project-related mortality, and estimated population reductions from WNS based on NY data from 2007 to 2011.

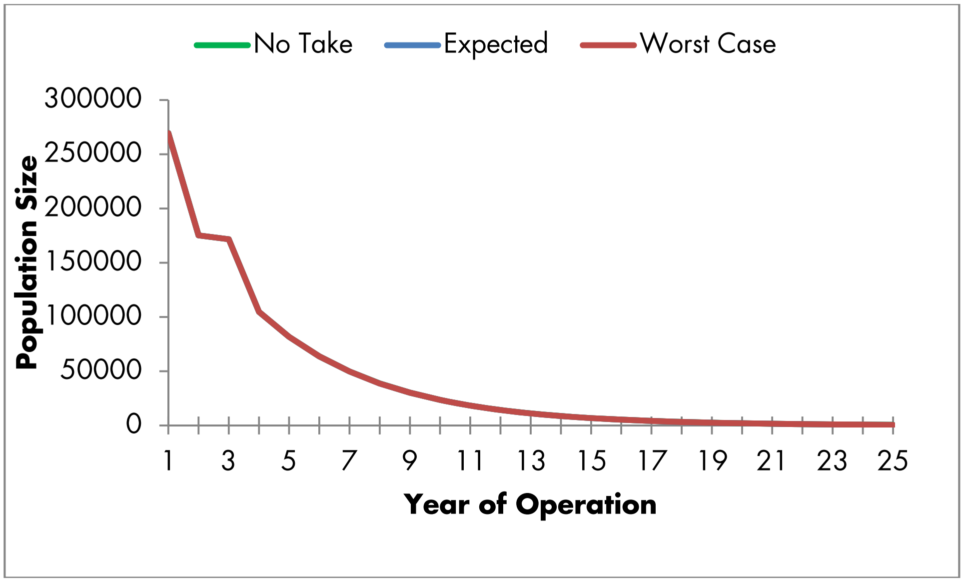


**Figure 5-4.** Impacts to the Midwest RU population due to the 100-turbine Buckeye Wind Project, with WNS effects. Leslie matrix model results given starting Midwest RU population size of 269,574 Indiana bats, expected and worst-case scenarios of Project-related mortality, and estimated population reductions from WNS based on NY data from 2007 to 2011. Note that although there are slight differences between no take, expected, and worst-case scenarios, they appear identical at this scale.

##### *5.1.2.7.5 Take Reductions as a Result of WNS*

As a result of past and anticipated future declines due to WNS, the recovery of the Indiana bat is dependent upon reversing the current rate of decline. Therefore, Buckeye Wind, in coordination with the USFWS, will review the biennial winter census results compiled by the USFWS Indiana Bat Recovery Team and if the population of Indiana bats in the Midwest RU is reduced by 50% or more from 2009 pre-WNS levels, Buckeye Wind will commit to reducing requested 5-year take limits by 50%. In this event, the 5-year take limit would be 13.0 Indiana bats (or average of 2.6 Indiana bats per year). These reductions in take will result from fewer Indiana bats exposed because of overall population declines, having an effective adaptive management plan in place, and voluntary reductions in take because as the population declines, each individual becomes more valuable to the population as a whole. While impacts to Indiana bat populations would not be significant at full take limits, even with WNS-induced population declines (see Section 5.1.2.6 – Biological Significance of Incidental Take [Collision Mortality]), Buckeye Wind will implement these reduced take limits as an added conservation program.

To estimate the effect of take limits reduced by 50% on the long-term viability of Midwest RU and maternity colony populations that have been reduced from current levels by WNS assuming similar reductions as those documented in NY data from 2007 to 2011, the Leslie matrix model was used to develop expected and worst-case scenarios (refer to Section 5.1.2.6 – Biological Significance of Incidental Take [Collision Mortality]). Figures 5-5 and 5-6 represent population change at the individual maternity colony and Midwest RU levels based on estimated population reductions from WNS and with Project-related mortality reduced by 50% after the Midwest RU population is reduced by 50% from estimated 2009 pre-WNS levels (i.e., 70 adult female Indiana bats in the local maternity colony and 269,574 in the Midwest RU).

When Project-related mortality is reduced by 50%, the single maternity colony was reduced to a population of 0 in Year 8 with no Project-related mortality, and under the expected scenario. The single maternity colony was reduced to a population of 0 in Year 7 under the worst-case scenario. In Section 5.1.2.6.3 – Population Declines from WNS, the single maternity colony was reduced to a population of 0 in Year 7 under both the expected and worst-case scenarios; therefore, reducing take by 50% resulted in 1 extra year before the population was eliminated under the expected scenario, and no extra time under the worst-case scenario. However, since only annual data were available from NY from which to base potential population reductions, it is not possible to know the exact time scale within which the population could be eliminated. In other words, it is possible that the difference in time between the population reaching 0 with and without a 50% reduction in take may be less than a full year and could be a difference of only several months or weeks, but it is not possible to determine based on best available information.

In terms of the Midwest RU, the difference in population declines with and without Project-related take were less than the scenario in which take was not reduced by 50%. Specifically, the Midwest RU population affected with WNS at year 25 is estimated to be 568 with no Project-related take, compared with a population of 556 or 560 under expected or worst-case take scenarios at the end of the ITP Term, which is a difference of 12 and 8 Indiana bats respectively (Figure 5-6). In Section 5.1.2.6.3 – Population Declines from WNS, the Midwest RU population was reduced by 24 and 16 Indiana bats, respectively, under the expected and worst-case scenarios, when Project-related take was not reduced by 50%.

ITP issuance criteria state that, "the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild" [16 USC Section 10(a)(2)(B)(iv)]. Based on these modeling results, Indiana bat populations at both the maternity colony and Midwest RU levels will not be reduced to low or non-viable levels appreciably sooner with impacts from Project-related take than without it, either with or without reducing impacts of Project-related take by 50%. Therefore, Project take is highly unlikely to appreciably reduce the likelihood of survival and recovery of the species. However, to minimize take to the maximum extent practicable, Buckeye Wind will commit to reducing authorized take by 50% when biennial winter census results compiled by the USFWS Indiana Bat Recovery Team indicate that the Indiana bat population in Midwest RU has been reduced by 50% of pre-WNS levels, defined as the 2009 population levels of 269,574, used in the effects analysis in Section 5.1.2.6.2 – Impacts to the Midwest RU Population Pre-WNS and in this Section 5.1.2.6.3 – Population Declines from WNS. These reductions are appropriate because fewer Indiana bats will be exposed to potential collision/barotrauma and because each individual Indiana bat becomes more valuable as the population declines.

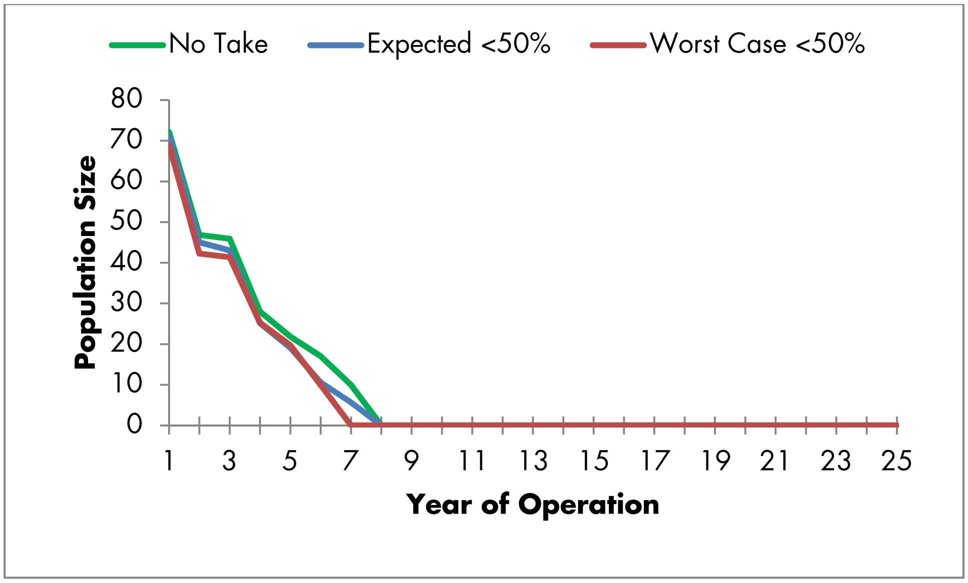


**Figure 5-5.** Impacts to a local maternity colony due to the 100-turbine Buckeye Wind Project, with WNS effects and 50% reduction in take. Leslie matrix model results given starting population size of 70 adult female Indiana bats in the local maternity colony, expected and worst case scenarios of Project-related mortality reduced by 50% after the Midwest RU population is reduced by 50%, and estimated population reductions from WNS based on NY data from 2007 to 2011.

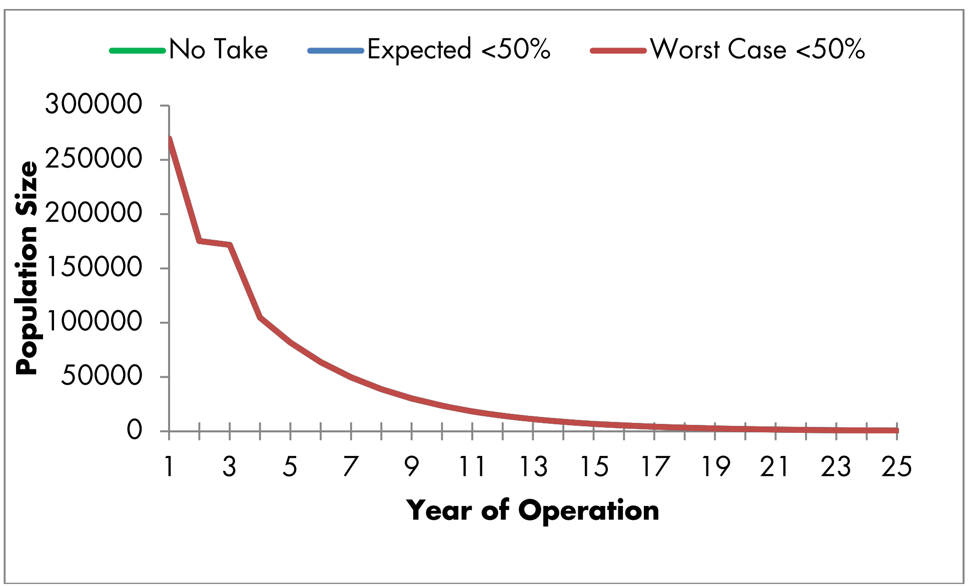


**Figure 5-6.** Impacts to the Midwest RU population due to the 100-turbine Buckeye Wind Project, with WNS effects and 50% reduction in take. Leslie matrix model results given the 2009 starting Midwest RU population size of 269,574 Indiana bats, expected and worst-case scenarios of Project-related mortality reduced by 50% after the Midwest RU population is reduced by 50%, and estimated population reductions from WNS based on NY data from 2007 to 2011. Note that although there are slight differences between no take, expected, and worst-case scenarios, they appear identical at this scale.

##### *5.1.2.7.6 Summary of Leslie Matrix Model Results*

The Leslie matrix model was applied to the population of a single maternity colony in the Action Area and to the entire Midwest RU Indiana bat population under 3 take scenarios: (1) no Project-related take, (2) expected impacts from Project-related take, and (3) worst-case impacts from Project-related take. For each of the 3 scenarios, the population trajectory was analyzed with 3 options: (1) no effect of WNS, (2) effect of WNS on population decline, and (3) effect of WNS on population decline with an associated 50% reduction in Project-related take once WNS reduced the Midwest RU Indiana bat population by 50%. Therefore, a total of 9 models were analyzed for a single maternity colony and a total of 9 models were analyzed for the Midwest RU (Table 5-12, Table 5-13). It is highly unlikely that the impacts of Project-related take would reduce the long-term viability of the maternity colony or Midwest RU population when no effect of WNS is included in the analysis. Further, impacts of Project-related take are highly unlikely to appreciably reduce the likelihood of survival and recovery of the maternity colony or Midwest RU population under predicted WNS scenarios.

**Table 5-12.** Results of 9 Leslie matrix growth models on a single maternity colony in the Action Area with a starting population size of 70 Indiana bats. Models compare population sizes with and without impacts of Project-related take from the 100-turbine Buckeye Wind Power Project over 25 years.

| **Scenario** | **Estimated year in which population is reduced to 0** | | | **Population size at year 25 (starting population = 70)** | | |
|---|---|---|---|---|---|---|
| | **No Project-related Take** | **Expected Project-related Take** | **Worst-case Project-related Take** | **No Project-related Take** | **Expected Project-related Take** | **Worst-case Project-related Take** |
| No effect of WNS (Figure 5-1) | n/a | n/a | n/a | 147 | 106 | 103 |
| Effect of WNS (Figure 5-3) | 8 | 7 | 7 | 0 | 0 | 0 |
| Effect of WNS with 50% take reduction (Figure 5-5) | 8 | 8 | 7 | 0 | 0 | 0 |

**Table 5-13.** Results of 9 Leslie matrix growth models on the 2009 Midwest RU with a starting population size of 269,574 Indiana bats. Models compare population sizes with and without impacts of Project-related take for the 100-turbine Buckeye Wind Power Project over 25 years.

| Scenario | Population size at year 25 (starting population = 269,574) | | |
|---|---|---|---|
| | **No Project-related Take** | **Expected Project-related Take** | **Worst-case Project-related Take** |
| No effect of WNS (Figure 5-1) | 269,574 | 269,444 | 269,444 |
| Effect of WNS (Figure 5-3) | 568 | 544 | 552 |
| Effect of WNS with 50% take reduction (Figure 5-5) | 568 | 556 | 560 |

### 5.1.3 Direct Effects – Mitigation

Mitigation activities will be composed of permanent preservation and enhancement in areas that support Indiana bat swarming habitat. Section 6.3 – Mitigation Measures includes a detailed description of mitigation actions, which include permanent preservation and enhancement of 87.8 ha (217.0 ac) of land within 11.2 km (7 mi) of a P2 hibernaculum in OH. Over the ITP Term, mitigation actions are expected to have a net beneficial effect on Indiana bats that will fully offset the impact of the taking. The beneficial effects of mitigation are fully discussed in Section 6.3 – Mitigation Measures. Other potential direct effects to Indiana bats from mitigation activities include disturbance from noise, human activity, tree planting and vehicular traffic associated with habitat restoration and enhancement activities.

#### *5.1.3.1 Tree Planting*

Some amount of mitigation land may require enhancement due to inadequate tree density. Tree planting on mitigation lands will help to achieve a density of 300 stems per acre, on average, per Planting Area (stems/ac/PA), and will use at least 6 different tree species found in Appendix L of the PEP Guidelines (USFWS 2009b; see Section 6.3.4 – Restoration and Enhancement). A Planting Area is defined as any contiguous area where Buckeye Wind has protected lands in accordance with the Mitigation Measures (see Section 6.3 – Mitigation Measures) and is conducting restoration and enhancement activities (see Section 6.3.4 – Restoration and Enhancement). Travel corridors linking roosting and foraging habitats are an important feature of Indiana bat habitat; therefore, Buckeye Wind may choose to plant trees to establish a minimum travel corridor of 4 rows of trees covering an area of at least 15 m (50 ft) wide (USFWS 2009b) to connect woodlots or along unforested stream corridors.

Tree planting will necessitate minor soil and vegetation disturbance due to digging holes for tree planting and vehicular traffic for site preparation and maintenance. Because the rate of survival of planted trees can increase if completed during the growing season and because tree planting is expected to take place largely in currently non- or thinly-forested areas that are less likely to be occupied by Indiana bats, tree planting may be done in the Indiana bat active period, including the swarming period (15 Mar to 15

Nov[30]). Soil disturbance from planting activity (e.g., digging holes for tree planting) is expected to be minor and erosion and sediment control measures would not be necessary. It is not anticipated that tree planting associated with mitigation will result in take of Indiana bats and effects are anticipated to be insignificant or discountable.

#### *5.1.3.2 Collision with Vehicles*

Although bats are very agile flyers, there is evidence that bats (including Indiana bats) can be killed by collision with vehicles (see Section 5.1.1.2 – Collision with Vehicles).

During Project mitigation, vehicle activity associated with the Project will include contractor vehicles traveling to various portions of the mitigation area. These vehicles will make trips in and out of the mitigation area along local and state roads that already support significant traffic. Direct impacts may occur during tree planting activities when trucks delivering trees (for planting) will be traveling to and from the site. Understory thinning and other mitigation activities will occur during the non-active periods and will not have potential for direct or indirect effects.

Vehicular activity will be spread throughout the mitigation area, with temporary concentrations of activity in areas that require tree planting activities. Additionally, the small amount of increased vehicular traffic associated with Project mitigation will be insignificant compared to regular traffic in and around the mitigation area and would occur mostly during day-light hours when Indiana bats are not active.

As a result of the factors discussed above, mortality of Indiana bats caused by vehicle strikes with mitigation vehicles is not likely. Thus, it is anticipated that vehicular traffic associated with the Project will result in direct effects that are insignificant and discountable and not expected to result in take of the species.

#### *5.1.3.3 Noise, Human Activity, and Disturbance*

Temporary increases in noise, human activity, and disturbance may result from mitigation activities and monitoring for mitigation (see Section 6.5.4 – Monitoring for Mitigation):

- Temporary increase in noise associated with activities for ground preparation and vehicular traffic used to transport materials; and,
- Temporary increase in human activity for monitoring or tree planting.

Mitigation activities are expected to require a small team of workers. A small team of about 5 surveyors is expected to be required to conduct habitat assessments over a duration that is not likely to exceed 2 weeks during each survey year.

See Section 5.1.1.1 – Noise, Vibration, and Disturbance for a discussion of the potential impacts of anthropogenic disturbance on Indiana bats. Mitigation activities will be temporary in nature, require minimal noise-producing equipment (such as small power tools) and vehicular use, and involve day-time human activity (when Indiana bats are generally not active). Some activities (monitoring, tree planting) may occur in areas potentially used by Indiana bats for roosting. While this has the potential to result in arousal of roosting Indiana bats, disturbance will temporary and minor. Tree planting, which may result in minor

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[30] The active period for the Action Area has been defined as 1 Apr to 31 Oct. Because mitigation activities will occur in areas where swarming will occur, the applicable period is extended.

disturbance due to activities associated with ground preparation and vehicular traffic to transport materials, is expected to occur most often at restoration parcels, which will be located largely in areas less likely to be occupied by Indiana bats. It is not anticipated that noise, human activity, or disturbance associated with mitigation activities will result in take of Indiana bats. Therefore, potential direct effects from mitigation activities are expected to be insignificant and discountable.

## 5.2 Indirect Effects

### 5.2.1 Indirect Effects – Construction and Decommissioning

#### *5.2.1.1 Wooded Habitat Removal*

Removal of wooded habitat that includes potential Indiana bat maternity roosting and foraging habitat during the non-active period for Indiana bats has the potential to negatively impact adult female and juvenile Indiana bats during the summer reproductive period. Because Indiana bats show site fidelity and return to the same foraging and roosting areas every year, adult females could suffer energetic losses if they had to find new roosting and/or foraging areas upon their return to their summer maternity colonies in early summer. Because adult female Indiana bats are already energetically stressed from hibernation and due to the energetic demands of pregnancy, having to expend additional energy to locate new roosts could result in lost reproductive fitness.

Impacts to local Indiana bats communities can vary based on the quality and quantity of habitat removed (including proximity to streams and wetlands) and connectivity and proximity to other alternate habitat of comparable quality and character. Removal of dead and dying trees or live shagbark hickories that typically provide higher quality roosting habitat would presumably have greater impact to Indiana bats than removal of young saplings or healthy older trees without exfoliating bark. Kurta (2005) suggested that the magnitude of impact from roost tree removal will vary greatly depending on the scale of roost loss (i.e., how many roosts are lost and how much alternative habitat is left for the Indiana bats in the immediate vicinity of the traditional roost sites).

Although Indiana bats are known to exhibit site fidelity to both individual roost trees and foraging areas (Cope et al. 1974, Humphrey et al. 1977, Gardner et al. 1991a, 1991b, Gardner et al. 1996, Callahan et al. 1997, Whitaker and Sparks 2003, Murray and Kurta 2004, Whitaker et al. 2004, Sparks et al. 2005b as cited in USFWS 2007), they are also known to frequently shift from one roost tree to another. Indiana bats are known to have a fission-fusion society, whereby members of a colony regularly come together to form a group (fusion), but individuals frequently depart to be solitary or to form smaller groups (fission) for some time before returning to the main unit. At any given time, many members of a colony may reside in a single tree (often known as the primary roost), while other members of the colony roost solitarily or in smaller subgroups in other trees (often known as secondary roosts) (USFWS 2007). On average, Indiana bats switch roosts every 2 days to 3 days, although female reproductive condition, roost type, and time of year affect switching (Kurta et al. 2002, Kurta 2005).

In studying 2 Indiana bat colonies located in IN for over a decade, T. Carter (Ball State University, personal communication) observed the centers of activity of both colonies shift between 1.6 km and 4.8 km (1.0 mi and 3.0 mi). Carter (2003) also observed Indiana bats traveling as far as 6.0 km (3.7 mi) between roosts. Similarly, Kurta and Murray (2002) and Kurta et al. (2002) documented shifts in the focal point of Indiana bat roosting activity by 2 km (1.2 mi) over a 3-year period.

In terms of the amount of wooded habitat that will be removed for the Project, the majority of the Project will be built in or adjacent to agricultural land that will be restored to former agricultural use after construction; cultivated crop and hay/pasture land cover types collectively comprise approximately 95% of the area that will be disturbed for the 100-turbine Project (Table 5-14, also 95% in the Redesign Option, Table 5-15). To estimate the total amount of tree clearing that is expected to occur during Project construction, the 2001 NLCD (Homer et al. 2004) together with the 2010 National Agriculture Imagery Program (NAIP)[31] ortho-aerial imagery were used to estimate areas of tree clearing for the 100-turbine layout, which was estimated as the worst-case scenario.

Based on the NAIP, no more than 6.5 ha (16.1 ac; or 6.8 ha [16.8 ac] for the Redesign Option) of wooded areas will be removed for the 100-turbine Project. NAIP tree clearing was estimated by digitizing all wooded areas into a polygon layer and then intersecting all Project facilities with the digitized forest layer. Because the NAIP provides more detailed land cover data and suggests a greater amount of tree clearing, the NAIP data were used to calculate maximum tree clearing. However, much of this area is at the edges of woodlots or along tree lines. Once final Project construction engineering is completed, it is expected that much of this area will not be subject to clearing as simple micro-siting and tree trimming will reduce the amount of tree clearing. To provide a general assessment of the quality and quantity of Indiana bat roosting and foraging habitat that may be impacted by tree removal, a ground-based habitat assessment was conducted jointly by the USFWS and Buckeye Wind in November 2010. Based on this assessment, it was found that potential roost trees occur within areas where tree clearing may occur. Therefore, the following paragraph describes micro-siting to avoid and minimize clearing of potential Indiana bat roost trees during construction activities (USFWS 2010).

Buckeye Wind will take the following steps to minimize any potential indirect effects to Indiana bats resulting from the removal of trees (also see Section 6.1.2– Project Construction):

- Buckeye Wind will not remove trees that are known to have been used as a roost site for Indiana bats.
- Buckeye Wind will avoid removal of potential roost trees identified during the November 2010 habitat assessment to the maximum extent practicable.
- Buckeye Wind will conduct habitat assessments jointly with the USFWS for the areas of planned tree clearing once Project plans are finalized and before any clearing is conducted, during which all potential roost trees will be identified and flagged.
- Buckeye Wind will use micro-siting of Project components to minimize tree clearing to the maximum extent practical.
- Prior to finalizing the detailed design of Project components, Buckeye Wind will make all reasonable attempts to offset the clearing radii around turbines or adjust roads/interconnects to preserve flagged potential roosts to avoid and minimize impacts of potential roost removal to the maximum extent practicable.
- At the time of tree clearing, a Natural Resource Specialist who is familiar with Indiana bat habitat requirements will be present and any potential roost trees not identified previously (including maternity roosts) within the clearing zone will be flagged.
- To the extent removal cannot be avoided, potential roost trees or potential maternity roost trees or other forested habitat will only be cut between 1 November and 30 March when Indiana bats would not be present.

[31] The minimum mapping extent of the NLCD is 0.09 ha (0.2 ac; based on 30m x 30m [98 ft x 98 ft] pixels), which is likely to overestimate the actual amount of forested habitat that will be removed. By comparison, the NAIP has a minimum mapping extent of 1m x 1m [3.2 ft x 3.2 ft].

In terms of the amount of suitable alternate roosting habitat, the 6.5 ha (16.1 ac) (6.8 ha [16.8 ac] for the Redesign Option) of tree clearing planned for the 100-turbine Project represents approximately 0.2% (0.2% in the Redesign Option) of the 2,744 ha (6,779.4 ac) of wooded habitat available in the Action Area[32]. The maximum amount of clearing is based on the known 52-turbine layout plus a reasonable estimate for the additional 48 turbines (see Table 5-14 and Table 5-15). Given the small portion of the total wooded area that would be cleared for the Project, it is expected that Project-related clearing will not significantly decrease the availability of suitable habitat. Additionally, tree clearing is expected to be spread throughout the Action Area and is not expected to be extensive in any single area. Therefore, in the unlikely event that a previously unknown maternity roost was removed, female Indiana bats would not have to expend substantial amounts of energy locating alternate maternity roost trees as other suitable habitat would be expected to be present in the Action Area.

[32] Note that much of this area is located along the edges of woodlots or along thin/sparse tree lines separating parcels, resulting in a conservative estimate. Avoidance and minimization measures described in Section 5.2.1.1 – Wooded Habitat Removal will reduce the area of tree removal based on construction needs, landowner preference, and quality of habitat.

**Table 5-14**. Worst-case scenario impacts[a] to NLCD 2001 land cover types[b] for the 100-turbine Buckeye Wind Project, Champaign County, OH.

| | Area of disturbance | | | | | | |
|---|---|---|---|---|---|---|---|
| | Total | | | Temporary | | Permanent | |
| Land cover type | Hectares | Acres | Percent of total | Hectares | Acres | Hectares | Acres |
| Cultivated crops | 199.1 | 492.0 | 90.1% | 157.1 | 388.2 | 42.0 | 103.8 |
| Hay/pasture and herbaceous grassland | 0.6 | 1.5 | 0.3% | 0.2 | 0.5 | 0.4 | 1.0 |
| Hay/pasture and herbaceous grassland – CRP | 11.3 | 27.9 | 5.1% | 9.0 | 22.2 | 2.3 | 5.7 |
| Developed, open space | 3.2 | 7.9 | 1.4% | 2.3 | 5.7 | 0.9 | 2.2 |
| Deciduous forest[c] | 6.4 | 15.8 | 2.9% | 0 | 0 | 6.4 | 15.8 |
| Emergent herbaceous wetlands | 0 | 0 | 0% | 0 | 0 | 0 | 0 |
| Developed, low intensity | 0.2 | 0.4 | 0.1% | 0.1 | 0.2 | 0.1 | 0.2 |
| Evergreen forest | 0.1 | 0.3 | 0.1% | 0 | 0.1 | 0.1 | 0.2 |
| Open water | 0 | 0 | 0% | 0 | 0 | 0 | 0 |
| Barren land | 0 | 0 | 0% | 0 | 0 | 0 | 0 |
| Developed, medium intensity | 0 | 0 | 0% | 0 | 0 | 0 | 0 |
| Mixed forest | 0 | 0 | 0% | 0 | 0 | 0 | 0 |
| Developed, high intensity | 0 | 0 | 0% | 0 | 0 | 0 | 0 |
| Total | 220.9 | 545.8 | 100% | 168.8 | 416.9 | 52.2 | 128.9 |

Source: Homer et al. 2004

[a] Impacts are estimated from actual impacts calculations of the known 52 turbines and associated facilities and a reasonable estimate of impacts from the additional 48 turbines based on characteristics of the Action Area and the avoidance and minimization measures described in Sections 6.1 – Avoidance Measures and 6.2 – Minimization Measures.

[b] Numbers based on the NLCD and adjusted for impacts to wooded areas as determined with the 2010 NAIP and specific avoidance measures such as avoidance of wetlands.

[c] Included in the mitigation acres calculation as an offset for cleared wooded areas.

**Table 5-15**. The Redesign Option worst-case scenario impacts[a] to NLCD 2001 land cover types[b] for the 100-turbine Buckeye Wind Project, Champaign County, OH based on the collection system redesign.

| | Area of disturbance | | | | | | |
|---|---|---|---|---|---|---|---|
| | Total | | | Temporary | | Permanent | |
| Land cover type | Hectares | Acres | Percent of total | Hectares | Acres | Hectares | Acres |
| Cultivated crops | 196.8 | 486.4 | 89.5% | 154.8 | 382.6 | 42.0 | 103.8 |
| Hay/pasture and herbaceous grassland | 0.7 | 1.8 | 0.3% | 0.3 | 0.8 | 0.4 | 1.0 |
| Hay/pasture and herbaceous grassland - CRP | 12.4 | 30.7 | 5.6% | 10.1 | 25.0 | 2.3 | 5.7 |
| Developed, open space | 3.0 | 7.5 | 1.4% | 2.1 | 5.2 | 0.9 | 2.3 |
| Deciduous forest[c] | 6.7 | 16.5 | 3.0% | 0 | 0 | 6.7 | 16.5 |
| Emergent herbaceous wetlands | 0 | 0 | 0% | 0 | 0 | 0 | 0 |
| Developed, low intensity | 0.2 | 0.4 | 0.1% | 0.1 | 0.2 | 0.1 | 0.2 |
| Evergreen forest | 0.1 | 0.3 | 0.1% | 0 | 0.1 | 0.1 | 0.2 |
| Open water | 0 | 0 | 0% | 0 | 0 | 0 | 0 |
| Barren land | 0 | 0 | 0% | 0 | 0 | 0 | 0 |
| Developed, medium intensity | 0 | 0 | 0% | 0 | 0 | 0 | 0 |
| Mixed forest | 0 | 0 | 0% | 0 | 0 | 0 | 0 |
| Developed, high intensity | 0 | 0 | 0% | 0 | 0 | 0 | 0 |
| Total | 219.9 | 543.6 | 100% | 167.4 | 413.9 | 52.5 | 129.8 |

Source: Homer et al. 2004

[a] Impacts are estimated from actual impacts calculations of the known 52 turbines and associated facilities and a reasonable estimate of impacts from the additional 48 turbines based on characteristics of the Action Area and the avoidance and minimization measures described in Sections 6.1 – Avoidance Measures and 6.2 – Minimization Measures.

[b] Numbers based on the NLCD and adjusted for impacts to wooded areas as determined with the NAIP and specific avoidance measures such as avoidance of wetlands.

[c] Included in the mitigation acres calculation as an offset for cleared wooded areas.

Additionally, the area planned for tree clearing represents an extremely small proportion of the home range areas documented for Indiana bats in the Action Area and tri-county area. The average home range size for 1 adult male and 11 adult female Indiana bats captured in 2008 and 2009 in the tri-county area was 1,256 ha ± 900 ha [3,104 ac ± 2,223 ac]. Therefore, the maximum 6.5 ha (16.1 ac) (6.8 ha [16.8 ac] for the Redesign Option) of tree clearing represents 0.5% (0.5% for Redesign Option) of the average home range of Indiana bats in the area and will have minimal impact on the availability of foraging habitat. Habitat composition of home range areas was not available from the ODNR. However, given that 85% of the 1,124 telemetry locations from which home ranges were derived were not more than 170 m (559 ft) from a forest edge, it is likely that the majority of these areas were comprised of wooded habitat. Thus, it is unlikely that maternity colonies would have to find additional or alternate rooting or foraging areas outside their traditional areas of use. Because adult females are not likely to suffer energetic losses, it is unlikely that juvenile Indiana bats will be negatively affected. Therefore, it is unlikely that the small amount of tree clearing will result in lost reproductive fitness that would constitute take of Indiana bats.

In summary, given the very small amount of tree clearing planned for construction of the 100-turbine Project, Indiana bats are not expected to be displaced from currently occupied foraging or roosting habitat. Further, Buckeye Wind and USFWS will conduct site visits to identify and mark suitable roost trees as detailed Project planning progresses, and Buckeye Wind will use micro-siting and on-site Natural Resource Specialists during construction to avoid and minimize clearing of potential roost trees to the maximum extent practicable. In the unlikely event that a previously unidentified maternity roost tree is cut during the winter and adult female Indiana bats are subsequently displaced from previously occupied roosts the next spring, adult female Indiana bats are not expected to have to expend substantial amounts of additional energy locating suitable alternate habitat due to the amount of similar wooded habitat available in the surrounding area and because roost trees are not expected to be limited. Indiana bats regularly shift roosts and their centers of activity, and members of a maternity colony are known to have multiple roost sites. Therefore, it is likely that removal of 6.5 ha (16.1 ac) (6.8 ha [16.8 ac] for the Redesign Option) of the 2,744 ha (6,779.4 ac) of wooded habitat available in the Action Area - including a small number of potential roost trees - will not result in indirect take of Indiana bat resulting from increased energy expenditure or lost reproductive fitness due to lost foraging or roosting habitat. For these reasons, indirect effects from tree clearing are not likely to result in take of Indiana bats due to removal of trees during the non-active period and are therefore expected to be insignificant and discountable. Indirect effects to other wildlife will be discussed in detail in the EIS Section 5.6.

#### *5.2.1.2 Impacts to Aquatic Habitats*

Water quality degradation has the potential to impact Indiana bats. Reduced water quality could decrease the prey base, reduce water available for drinking, and cause need for greater expenditures of energy devoted to foraging farther distances and/or for longer periods of time. Therefore, large built components of the Project, including wind turbines, staging areas, the O&M building, access roads and collection lines, and the substation, will be sited to completely avoid any impacts to wetlands. All wetlands within the Action Area with the potential to be impacted will be delineated by a qualified wetland delineator. The field delineations in 2008 for the 52 known turbine locations were conducted in accordance with the 1987 USACE wetland manual, while the 2009 and 2011 field delineations were conducted according to both the 1987 USACE wetland manual and the 2008 Midwest Supplement. The wetland delineation is planned to be jurisdictionally confirmed by the USACE once pre-construction notifications (PCN) are submitted to the USACE for anticipated stream crossings for construction of the Project. Wetland delineations for the additional 48 turbines will also be completed to the same standards. USACE will require a site visit prior to approving the PCNs, so the wetland delineation and PCNs will be approved during the same site visit by the USACE. No wetlands will be impacted during the construction, operation, maintenance or decommissioning phases of the Project. See the EIS Section 5.4 for further description of the stream and wetland impacts.

Access roads, collection lines, and crane paths will be required to cross streams at various points within the Action Area. Buckeye Wind will submit a PCN to the USACE for Clean Water Act (CWA) Section 404 Nationwide Permit authorization for all impacts associated with the stream crossings. Nationwide Permit 12 appears to be the most applicable, authorizing both interconnection and access roads "for the construction and maintenance of utility lines…including substations" (USACE 2007). The Nationwide Permits covering crossings that are intended for use in maintenance and access throughout the ITP Term will remain in place. The OEPA-issued Water Quality Certification (WQC) for Nationwide Permits in 2007 added state-specific conditions and exclusions. The WQC excludes certification of impacts to Ohio Exceptional Warmwater Habitat and Cold Water Habitat streams. The Project will not require an Individual WQC for impacts to

Exceptional Warmwater Habitat and Cold Water Habitat streams from Ohio EPA because there will be no in-water work at any proposed crossing location and therefore there will be no impacts to these types of streams[33] (see 5.2.2.1 – Stream Crossings).

The Huntington District of the USACE has indicated that they would treat each stream crossing as a separate Nationwide Permit 12. Access roads, collections lines, and crane paths for the 100-turbine Project are expected to cross no more than 32 streams (46 streams in the Redesign Option; see Table 5-16). Many of these crossings are of drainage ditches and other ephemeral waterways of low habitat quality (see Table 5-16). USGS topographic maps were used to identify streams as these streams are typically USACE jurisdictional. In addition, streams were field delineated using characteristics such as a defined bed and bank, an ordinary high water mark, and other stream morphological features. Streams that are suspected to have channels and be jurisdictional are further investigated to determine their upstream source and their downstream channel fate. The stream delineation is planned to be jurisdictionally confirmed once PCNs are submitted to the USACE for stream crossings. USACE will require a site visit prior to approving the PCNs, so both the wetland delineation and PCNs will be approved during the same site visit from USACE.

**Table 5-16**. Worst-case estimated stream crossings for the 100-turbine Buckeye Wind Project based on field delineation and desktop analysis of Project designs for the known 52 turbines and associated collection lines, with maximum impacts for the additional 48 turbines.

| Crossing Number | Crossing Identifier | Facility Crossing Type | Estimate Stream Width (linear feet) | Maximum Impact Length (linear feet)[a] | Crossing Type[b] | Stream Type |
|---|---|---|---|---|---|---|
| 1 | Between T9 and T-13; Stream B | Access Road, Buried Interconnect & Crane Path | 10.0 | 58 | Existing, Culvert and Trenched or Directionally Bored | Unnamed: Modified Class II PHWH, intermittent |
| 2 | Between T-11 and T-16; Stream D | Temp Const Road & Buried Interconnect | 7.5 | 58 | Existing, Culvert and Trenched or Directionally Bored | Unnamed: Modified Class I PHWH, ephemeral |
| 3 | Near T-17; Stream E | Crane Path & Buried Interconnect | 13.0 | 60 | Temporary Crossing and Trenched or Directionally Bored | Dugan Run; Modified Class II PHWH, intermittent |
| 4 | Near ST HWY 814 and access road for T-27; Stream K | Crane Path | 4.0 | 0 | Temporary Crossing | Unnamed: Modified Class I PHWH, ephemeral |
| 5 | Near T-28; Stream BB | Interconnect | 11.9 | 0 | Directionally Bored | Treacle Creek; Exceptional Warmwater Habitat; intermittent |

[33] Crossings will entail techniques and structures that do not disturb ground that is within the delineated edge of the stream.

**Table 5-16**. Worst-case estimated stream crossings for the 100-turbine Buckeye Wind Project based on field delineation and desktop analysis of Project designs for the known 52 turbines and associated collection lines, with maximum impacts for the additional 48 turbines.

| Crossing Number | Crossing Identifier | Facility Crossing Type | Estimate Stream Width (linear feet) | Maximum Impact Length (linear feet)[a] | Crossing Type[b] | Stream Type |
|---|---|---|---|---|---|---|
| 6 | Access road for T-27; Stream J | Access Road, Crane Path & Buried Interconnect | 12.5 | 60 | Existing and Trenched or Directionally Bored | Unnamed; Modified Class II PHWH, intermittent |
| 7 | Near T-43; Stream W | Access Road & Buried Interconnect | 16.0 | 48 | Existing, Culvert and Trenched or Directionally Bored | Unnamed; Modified Class II PHWH, Intermittent |
| 8 | Near T-37 and T-41; Stream R | Access Road, Crane Path & Buried Interconnect | 13.0 | 90 | Culvert | Unnamed; Class II PHWH, intermittent |
| 9 | Near T-28 and T-33; Stream AA | Access Road, Crane Path and Buried Interconnect | 12.0 | 0 | Elliptical culvert and/or Directionally Bored | Buck Creek; Cold Water Habitat; intermittent |
| 10 | Between US HWY 36 and T-43; Stream I | Access Road | 16.3 | 34 | Culvert | Unnamed; Modified Class II PWHW, perennial |
| 11 | Near T-52; Stream Y | Crane Path & Buried Interconnect | 12.9 | 0 | Temporary Crossing and Directionally Bored | Buck Creek; Cold Water Habitat, intermittent |
| 12 | Near T-55 and ST HWY 29; Stream CC | Access Road & Buried Interconnect | 2.5 | 60 | Culvert and Trenched or Directionally Bored | Unnamed; Modified Class I PHWH; ephemeral |
| 13 | Near T-53; Stream DD | Access Road & Buried Interconnect | 20.0 | 60 | Culvert and Trenched or Directionally Bored | Unnamed; Modified Class I PHWH; ephemeral |
| 14 | Near T-18; Stream S | Access Road & Buried Interconnect | 8.5 | 60 | Existing; Culvert and Trenched or Directionally Bored | Unnamed; Modified Class I PHWH; ephemeral |
| 15 | Near T-42 and T-45;mj Stream V | Access Road & Buried Interconnect | 16.0 | 60 | Culvert and Trenched or Directionally Bored | Unnamed; Modified Class II PHWH; intermittent |
| 16-32 | 16 Phase II Crossings estimated for additional 48 turbines | Crane Paths, Access Roads and Collection | 8-10 | 600 | As needed | Various |
| 33-49 (for Redesign | Buried Interconnect | Buried Interconnect | 8-10 | 350 | Trenched or Directionally | Various |

**Table 5-16**. Worst-case estimated stream crossings for the 100-turbine Buckeye Wind Project based on field delineation and desktop analysis of Project designs for the known 52 turbines and associated collection lines, with maximum impacts for the additional 48 turbines.

| Crossing Number | Crossing Identifier | Facility Crossing Type | Estimate Stream Width (linear feet) | Maximum Impact Length (linear feet)[a] | Crossing Type[b] | Stream Type |
|---|---|---|---|---|---|---|
| Option Only) | Crossings | | | | Bored | |
| Total (Without Redesign Option | Approx. 32 Crossings | | - | 1,248 | | |
| Total (for Redesign Option) | Approx. 49 Crossings | | | 1,598 | As needed | Various |

[a] Where existing crossing are present, the *new* impact will be reduced by the impact that already exists. Advanced engineering studies will determine what (if any) additional in-water work is needed to support Project construction and operation. Temporary crossings consist of steel plates or other rigid structures that can be placed over and above a stream so no in-water work is necessary.
[b] Values do not include subtraction for existing crossings.
Source: Hull 2009 and updates, preliminary construction engineering

***5.2.1.2.1 Stream Crossings***

Buckeye Wind will implement all appropriate low impact stream crossing techniques for road crossings and crane path crossings. All streams to be crossed by Project facilities will undergo field screening for federally endangered and threatened species. Surface water delineations will be performed and Project facilities will be sited to avoid or minimize impacts to surface water resources. This field delineation will be done for all of the crossings associated with the 100-turbine Project. Almost all of the crossings for the additional 48 turbines will accommodate access roads and crane paths, as well as collection lines. Since the final plan layout for the additional 48 turbines has not been completed, the estimates given in Table 5-16 for the 100-turbine Project are a reasonable worst-case scenario and final impacts will almost certainly be less than what is presented, but will not be more.

Where road crossings will require in-water work, a culverted crossing will be utilized (see Figure 5-7). Culverted crossings will be permitted through the USACE Nationwide Permit program under Section 404 of the CWA. Further measures to minimize impact will be utilized, such as installation of crossings "in the dry" when there is no flowing water and with no excavation equipment located in flowing waters (for ephemeral or intermittent streams).

For road crossings over high quality streams, specifically Ohio Exceptional Warmwater Habitat and Cold Water Habitat[34], open bottomed culverts, elliptical culverts, or arched bridges will be utilized to minimize

[34] According to Ohio Revised Code, Exceptional Warmwater Habitat streams are capable of maintaining an exceptional or unusual community of warmwater aquatic organisms with the general characteristics of being highly intolerant of adverse water quality conditions and/or being rare, threatened, endangered or species of special status. This is the most protective use designation assigned to warmwater rivers and streams in Ohio. A Coldwater Habitat stream is capable of supporting populations of coldwater aquatic organisms on an annual basis and/or put-and-take

loss of aquatic habitat and restriction of fish passage (see Figure 5-8). These crossings will utilize techniques and structures that do not disturb ground that is within the delineated edge of the stream. Similar methods will be used for road crossings over any streams thought to have the characteristics necessary to support federally listed threatened or endangered aquatic species (see Section 3.2.1 – Federal Threatened, Endangered, and Candidate Species). No permits will be required for these crossings.

**Figure 5-7.** Example of a culverted crossing that would be permitted through the USACE Nationwide Permit program under Section 404 of the CWA.

Some crossings (primarily those associated with crane paths that do not follow a planned access road) will only require a temporary crossing. Temporary crossings consist of steel plates or other rigid structures that can be placed over and above the stream. These crossing techniques can be installed without disturbance to areas below the high water mark of the stream and will not impact the aquatic resource (see Figure 5-9). No permits will be required for these crossings and the crossing will be removed after construction. Depending on the stream width and the grade of the areas around the stream, this technique may not be available. In cases where temporary crossings cannot be utilized, culverted crossings will be used or, if the stream is an Ohio Exceptional Warmwater Habitat or Cold Water Habitat, open bottomed culverts, elliptical culverts, or arched bridges would be utilized.

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salmonid fishing. These water bodies are not necessarily capable of supporting the successful reproduction of salmonids and may be periodically stocked with these species. Both are afforded special protections under Ohio's CWA provisions.

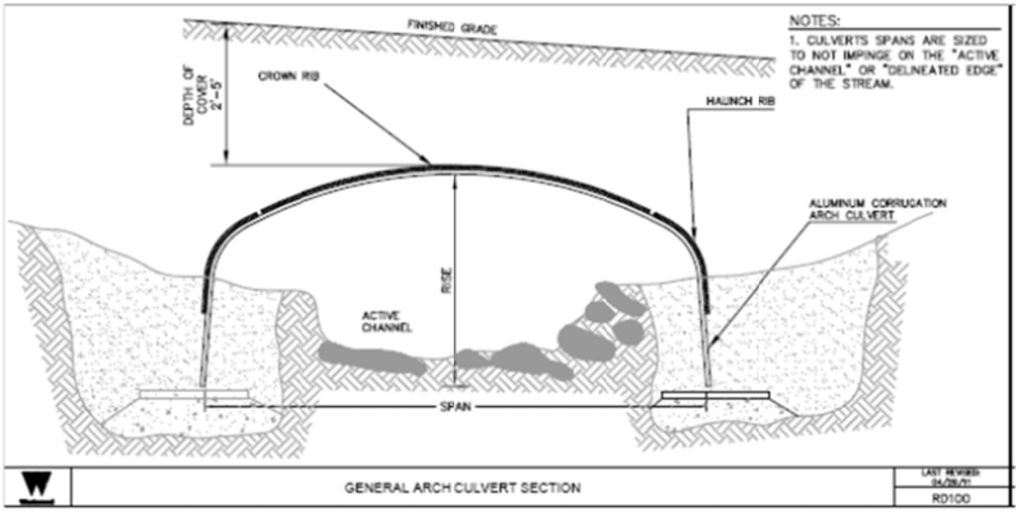


**Figure 5-8.** Example of an open-bottomed culvert or arched bridge that would be built above the delineate edge of the stream.

Where only collection lines cross streams, the impacts would be significantly less than the impacts for access road or crane path crossings. Most collection line crossings of intermittent and ephemeral streams will trench through the stream and will be done when the stream is dry. In those cases when only buried electrical interconnects cross a perennial stream, Buckeye Wind will horizontally directionally drill underneath the stream regardless of its beneficial use classification.

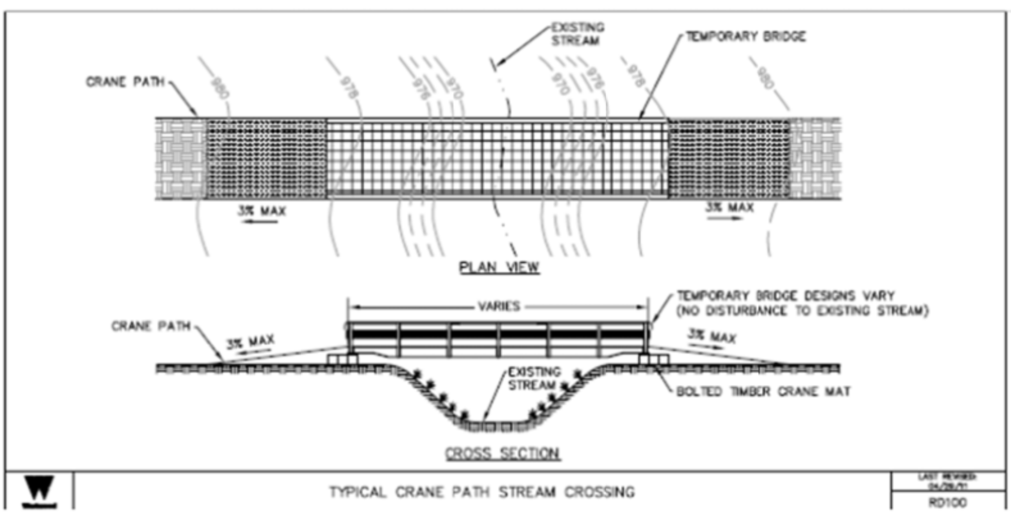


**Figure 5-9.** Example of a temporary construction crossing that would be placed above the delineated edge of a stream.

Some stream crossings may require clearing of trees and disturbance to the riparian zone. However, any tree clearing has already been accounted for in the total wooded habitat removal in Section 5.2.1.1 – Wooded Habitat Removal. However, removal of wooded areas in these riparian areas may cause fragmentation that could alter the behavior of Indiana bats. While Indiana bats have been known to traverse 1000 ft or more of non-wooded areas during the course of foraging activities, they have also been known to travel longer distances in order to go around open areas and stay within wooded areas. It is therefore possible that removal of trees in areas providing a wooded corridor between foraging habitats could result in increased energy expenditures and alteration of foraging behavior. However, the width of the disturbances for the Project will be less than 100 ft along any stream crossing (see Table 5-16), which is not expected to preclude Indiana bats from using that corridor.

Temporary crossings and areas of temporary construction impact will be restored and re-vegetated per the erosion and sediment control plan (consisting of planting native plant species to provide ground stabilization). Erosion and sediment control measures will limit the amount of sediment from exposed soil entering the stream, so impacts to aquatic foraging habitat will be minimized. For example, silt fences, hay bales and/or filter socks will be used to catch any sedimentation from active construction areas. Catch basins may be installed to allow sedimentation to fall out before the run-off enters the streams. Swales and ditches may be installed to divert sedimented water away from streams and into areas that have the proper sediment control measures (silt fences, catch basins, etc.) These measures will ensure that the stream quality is not degraded and that the ability of the water features in the Action Area to support prey species and hydration for the Indiana bat will not be degraded.

The Redesign Option may logically necessitate additional stream crossings and impacts because the electrical interconnect will not aerially span the streams. In many cases buried electrical interconnects will be co-located with planned access roads and crane paths, so the number of new stream crossings will be minimized. In some cases buried electrical interconnects will be the only Project component crossing a stream. In those cases when only buried electrical interconnects cross a perennial stream, Buckeye Wind will horizontally directionally drill underneath the stream regardless of its beneficial use classification. In cases where only buried electrical interconnects cross an intermittent or ephemeral stream, Buckeye Wind will open trench through the stream and conduct the trenching during periods of no water flow. Additionally, in order to continue to avoid any impacts to high quality potential Indiana bat foraging habitat, Buckeye Wind will use horizontal directional boring for electrical interconnect crossings of any stream Ohio designated as Exceptional Warmwater Habitat or Cold Water Habitat as well as any streams thought to have the characteristics necessary to support federally threatened or endangered species of freshwater mussels (see Section 3.2.1 – Federal, Threatened and Candidate Species). For each stream crossing in the Redesign Option, that is not an OH designated Exceptional Warmwater or Cold Water Habitat and that will be temporarily impacted by open trenching to install buried interconnect, Buckeye Wind will also secure a Nationwide Permit for these impacts from the USACE. Streams that are open trenched will be restored to their pre-existing grade and re-vegetated with appropriate native riparian species. Thus, there will be no permanent impacts to any streams that are crossed with buried interconnects only. Potential impacts to wetlands due to changes to a buried interconnect system will be avoided. Buckeye Wind may remove or add measures to the planned erosion and soil control measures section in order to avoid and minimize impacts to streams due to the different construction methods necessary to cross streams with buried interconnects from those proposed.

##### *5.2.1.2.2 Soil and Erosion Control*

Without proper erosion control measures in place, earth-moving activities associated with Project construction and decommissioning have the potential to cause siltation and sedimentation impacts down slope of the area of disturbance and, in turn, affect aquatic habitats and food resources (i.e., aquatic insects).

Buckeye Wind has undertaken several steps to prevent adverse effects to water quality and aquatic habitat during construction, such as siting Project components away from wetlands and streams to the extent practicable and using horizontal directional boring to avoid in-water work at high quality stream crossings. Runoff will be managed under a National Pollutant Discharge Elimination System (NPDES) construction storm water permit and associated SWPPP. The NPDES permit program is implemented through the CWA. The NPDES permit program is authorized at the state government level by the EPA and the Ohio EPA issued construction storm water NPDES permits. The NPDES permit program is designed to reduce pollutants, sediment and erosion from impacting surface waters and aquatic habitats. Through a NPDES permit, Buckeye Wind will be required to control pollutant, sediment and erosion discharges. This protection of aquatic habitats will be implemented through erosion and sediment control measures. These measures will prevent degradation of Indiana bat foraging habitat by ensuring that stream quality does not diminish and therefore, their prey base is not negatively affected by construction activities. Pollutants and sediment can reduce the diversity and quantity of insects. Erosion and sediment control measures will protect against this and also ensure that the existing drinking water quality of the streams in the Project is not degraded. Additionally, these erosion and sediment control measures will also prevent negative impacts to any mussel or other aquatic species inhabiting streams within and downstream of the Project. Most mussel species require good water quality and erosion and sediment control measures implemented through the NPDES permit will preserve the existing water quality level.

As part of the NPDES requirements and prior to construction, an erosion and sediment control plan will be developed and will use appropriate runoff diversion and collection devices. This plan is developed and implemented by the general contractor and has not been developed, so it is not possible to know exactly where certain erosion and sediment control practices will be utilized. However, based on previous wind farm construction experience, typical erosion and sediment control best management practices may include: silt fences, filter socks, swales, temporary and permanent mulching and seeding, infiltration berms, inlet and outlet protection, construction entrances, and orange construction fencing to protect wetlands located near disturbance areas. The ODNR Division of Soil and Water Resources' Rainwater and Land Development Manual will be used as a to guide to determine the appropriate erosion and sediment control measures and the post-construction storm water practices to be used at the Project.

The NPDES permit will also include restoration measures that will ensure that disturbed ground is stabilized, preventing ongoing erosion and sedimentation of storm water run-off. These restoration measures consist of revegetation (typically using native species; and depending upon the land use), regrading and permanent swales or catch basins as needed.

In summary, as a result of the erosion and sediment control measures that will be implemented by Buckeye Wind and enforced by its NPDES permit during construction and decommissioning to avoid and minimize impacts to wetlands and streams, impacts to aquatic habitat will be minimal. Consequently, potential indirect effects on Indiana bats such as a decreased prey base, reduced water available for drinking, and the need for greater expenditures of energy devoted to foraging farther distances and/or for longer periods of time is expected to be insignificant and discountable. Refer to Section 6.2 – Minimization Measures and the EIS Section 5.4 for a detailed description of anticipated impacts to streams and wetlands in the Action Area and how they will be avoided and minimized.

### 5.2.2 Indirect Effects – Operation and Maintenance

#### *5.2.2.1 Vegetative Control*

During Project operations, vegetative control will be implemented for general Project operation and as part of the HCP. Periodic tree trimming will occur for safety and accessibility of the Project facilities. For example, overhead collection lines will be cleared of all overhanging limbs and trees around access roads may have to be trimmed to maintain open access. No additional clearing of wooded areas will be required during Project operation and areas that were temporarily disturbed during construction will be allowed to grow back, while cleared areas required for permanent access will be maintained. Further tree trimming performed by Buckeye Wind and associated with Project maintenance will be completed during the non-active period (1 Nov – 31 Mar) for Indiana bats to avoid potential direct impacts (disruption to roosting bats) that would result if potential roost trees were disturbed during the active period. Trimming of live or downed trees that are not suitable for roosting Indiana bats may occur during the active period. Therefore, it is not anticipated that tree trimming will result in harm to Indiana bats and indirect effects will be insignificant and discountable and will not likely rise to the level of take.

### 5.2.3 Indirect Effects – Mitigation

#### *5.2.3.1 Invasive Species Control*

The majority of mitigation activities are expected to be composed of preservation and enhancement in areas likely to currently support Indiana bat foraging or roosting activities (see Section 6.3 – Mitigation Measures). In order to preserve and enhance the suitable habitat, woody invasive species removal will be employed as necessary to remove species that impede flight and make snags more accessible (IN DNR 2008). Invasive species could also impede development of wooded habitats in areas where restoration activities will be implemented (corridors to connect existing wooded habitat areas).

Control of invasive species will include clearing of woody invasives such as bush honeysuckle (*Diervilla lonicera*) and tree of heaven (*Ailanthus altissima)*. Methods for clearing invasive species will include brush cutting (using bushhogs, mowers, or other similar equipment), hand cutting, and the use of herbicides if necessary. Herbicides may be used to paint cut stems and/or large shrubs too big to remove. Woody invasive species coverage will be maintained at no more than 5% of the understory cover (see Section 6.3 – Mitigation Methods). Areas around the P2 hibernacula in OH are primarily agricultural lands, where herbicides are commonly used; therefore, the use of herbicides associated with the Project will not be significant as compared to current land use practices. Clearing activities could necessitate soil and vegetation disturbance and potential vehicular traffic for site preparation and maintenance. Soil disturbance, if any, from movement of clearing equipment and the clearing activity is expected to be minor and erosion and sediment control measures would not be necessary. Invasive species control will not degrade or remove suitable habitat or potential roost trees and will be an overall enhancement of Indiana bat use areas. Please see Section 6.3 – Mitigation Measures for a more detailed discussion of restoration and enhancement measures.

In order to avoid direct impacts to the Indiana bat, including disturbance from noise, vibration, human activity, and vehicular collision, invasive species management will occur during the non-active period for Indiana bats (15 Nov to 15 Mar, also excluding swarming periods). Indirect adverse effects are expected to be insignificant and discountable and will not result in take of Indiana bats.

#### *5.2.3.2 Tree Girdling*

Reproductive females occupy roost sites under the exfoliating bark of dead, dying, or live trees, and occasionally in narrow cracks of trees located in both upland and riparian forest (Gardner et al. 1991a, Callahan 1993, Kurta et al. 1993, Kurta et al. 2002, Carter 2003, Britzke et al. 2006). Roost trees used by Indiana bats vary in size. The minimum tree size (diameter at breast height [dbh]) reported for a male roost is 6.4 cm (2.5 in; Gumbert 2001) and 11 cm (4.3 in) for a female roost (Britzke 2003). Primary maternity roosts are always found in larger diameter trees, usually more than 22 cm (8.7 in) dbh (Murray and Kurta 2004). Larger diameter trees provide thermal advantages to reproductive females and their pups by giving them more room to move around while locating appropriate temperatures. See Section 4.4.4.1 – Maternity Roosts for more information on Indiana bat use of maternity roost trees. If there is a deficiency in the number of suitable roost trees, girdling (i.e., cutting of the bark and a portion of the underlying cambium layer to create a ring-like groove encircling the base of the trunk) can create suitable Indiana bat roost trees over a period of several years. Girdling will be deemed necessary in a preservation or enhancement area if there are less than 2 natural snags or girdled trees of at least 25 cm (10 in) dbh per ac, less than 5 trees between 25 cm (10 in) and 48 cm (19 in) dbh per ac, and less than 2 trees greater than 48 cm (19 in) dbh per ac (see Section 6.3.4 – Restoration and Enhancement).

Girdling will be accomplished by using a chainsaw or handsaw to cut a 1-inch to 2-inch deep cut around the circumference of the tree. The saw cut should not exceed 5% of the diameter of the trunk at 2 feet above the ground surface.

In order to avoid impacts to the Indiana bat, tree girdling will occur during the non-active period for Indiana bats (15 Nov to 15 Mar, also excluding swarming periods). Tree girdling will enhance Indiana bat habitat by creating potential roost trees and, therefore, indirect adverse effects from tree girdling would be insignificant and discountable and will not result in take of Indiana bats.

## 5.3 Cumulative Effects

As described previously, the Action Area is composed of active agricultural areas, low density residential areas, and fragmented woodlots. Other than ongoing agricultural and small-scale and periodic timber harvesting activities, which are occurring or may occur in the Action Area over the ITP Term, Buckeye Wind is not aware of future state or private activities in the Action Area. According to the Logan-Union-Champaign Regional Planning Commission and Champaign County Building Regulations office, no known residential subdivisions or retail/commercial developments have been approved or are currently proposed in the general vicinity of the Action Area. However, several new private homes, pole barns, and an equipment storage yard have been approved (received building permits) and lot splits are common.

Given that agriculture has been the predominant land use in the Action Area for the past several decades and wooded habitat is already substantially fragmented, it is not likely that small-scale timber harvesting activities and the sporadic building of individual homes will result in significant reductions in available suitable habitat for Indiana bats. To the contrary, wooded habitat in the Action Area is likely to increase in the future, based on patterns of changing land use that have occurred over the past half century and are expected to continue, such as the conversion of agricultural areas back to wooded areas. As described in Section 3.1.6 – Landcover, prior to European settlement, OH was approximately 95% wooded. However, rapid conversion of woodlots to agricultural lands resulted in a steady decline of tree cover to a low of 12% in 1940 (ODNR DOW 2011). Wooded land has been increasing in OH since 1940 and in 2001 it comprised approximately 33% of the state's land area. Thus, other future state or private actions in the Action Area are not expected to result in cumulative effects to Indiana bats (See Section 5.6 of EIS for cumulative effects to other wildlife species).

## 5.4 Potential Beneficial Effects of Wind Energy on Indiana Bats

The expansion of wind energy may have beneficial effects on biological resources, including Indiana bats. Increases in wind power production and consumption will help to reduce reliance on fossil-fuels and will reduce carbon dioxide emissions. Coal provides 86% of electricity generated in OH and it has the highest carbon dioxide emission per unit of electricity produced in the United States (DOE EIA 2007). The state was the fourth largest contributor of carbon dioxide pollution in the country in 2007 and it was among the highest contributors internationally; only 23 countries emitted more carbon dioxide pollution into the atmosphere than the state of OH in 2007 (Gomberg 2008, EPA 2009b). Increased carbon dioxide and other greenhouse gases emissions are resulting in global climate change that includes rising temperatures and changes in temperature regimes, precipitation patterns, fire cycles, storm severity, and sea level rise, among other things (EPA 2009b). As described in Section 4.5.4 – Climate Change, Indiana bats may be negatively affected by a number of manifestations of climate change, including changes to temperature and moisture regimes within hibernacula and maternity roosts, reduced availability of insect prey, range shifts, increased forest fires and associated removal of roosting and foraging habitat, flooding, and changes in species composition within forests.

Other by-products of non-renewable energy extraction can negatively affect Indiana bats, including habitat destruction and degradation and water and air pollution. Combustion of fossil fuels produces air pollutants such as nitrogen oxides, sulphur dioxide, volatile organic compounds, and heavy metals that could negatively affect Indiana bat health and viability. Habitat destruction from surface mining of coal affects Indiana bats, both through removal of large, contiguous areas of intact forest, and through destruction and degradation of streams that provide food resources. Coal slurry, a fluid byproduct of the preparation process created when coal is washed with water and chemicals, has been known to be accidentally spilled into OH streams, resulting in mass mortality of aquatic insects and fish. According to a recent study, surface mining of coal is now the dominant driver of land-use change in the central Appalachian eco-region of the United States (Palmer et al. 2010), which includes a portion of the Midwest RU in eastern KY. Surface mining for coal is the dominant energy extraction practice in the region (i.e.., OH, WV, KY, VA, TN, and PA).

One major form of such mining, mountaintop mining with valley fills (MTM/VF), authorized under Section 515(c)(1) of the Surface Mining Control and Reclamation Act of 1977 (SMCRA) and widespread throughout eastern KY, WV, and southwestern VA, involves the removal of extensive tracts of deciduous forests that are cleared and stripped of topsoil. Although the USACE and the EPA have issued a moratorium on new permits for MTM/VF, they are allowing existing projects to continue the practice for the duration of current permits. With regard to MTM/VF, Palmer et al. (2010) revealed that there is a "preponderance of scientific evidence that impacts are pervasive and irreversible and that mitigation cannot compensate for losses." Indiana bats are impacted by MTM/VF by the removal of roosting and foraging habitat and valley fill activities that degrade and destroy streams and Indiana bat prey species (EPA 2003).

While MTM/VF mining is not practiced in OH, states commonly sell coal amongst each other. Increased demand for energy in OH could be met by MTM/VF mining activities in adjoining states, or by surface coal mining, which causes similar landscape scale effects on forest and other natural habitats[35]. Demand for coal-generated electricity, the dominant fuel source in OH, will likely increase unless alternate energy sources are available. Increased coal mining and coal burning will continue to contribute towards the loss of forested habitat at a large scale and to pollution of air and water sources, all of which can negatively impact Indiana bats.

While the Project alone is not expected to individually slow, halt, or offset the negative effects of climate change or other by-products of non-renewable energy extraction, the Project is part of a larger state and national strategy to reduce reliance on carbon-emitting fuel sources, that together with other renewable energy projects have the potential to minimize the associated negative effects to Indiana bats.

In addition, information provided by the Project in the form of post-construction mortality monitoring results will help advance the understanding of wind-bat interactions. This information will help this Project and other wind projects implement construction, operation, and decommissioning approaches that will reduce

[35] Impacts to wetlands and streams are more heavily regulated for surface coal mining than for MTM/VF mining; the USACE and EPA now require pre-project topographic and vegetation restoration following mining activities as a permit condition.

impacts to Indiana bats, as well as non-federally listed bats and birds. Mitigation measures implemented as part of this HCP will also benefit Indiana bats and other non-federally listed bat species.

# 6.0 CONSERVATION PROGRAM

According to the HCP Handbook (USFWS and NOAA 1996), mitigation actions under HCPs usually take 1 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.

The Handbook further states that several strategies can be used to address project effects, including:

1) Avoiding by relocating project facilities within the project area;
2) Minimizing through timing restrictions and buffer zones;
3) Rectifying by restoration and revegetation of disturbed project areas;
4) Reducing or eliminating over time by proper management, monitoring, and adaptive management; and,
5) Compensating by habitat restoration or protection at an on-site or off-site location.

In accordance with the HCP Handbook, the conservation program described in the following sections uses a combination of these strategies to achieve avoidance, minimization, and mitigation of potential direct and indirect effects to Indiana bats caused by the Project. These measures will be implemented by Buckeye Wind to meet the biological goals and objectives of this HCP, described in Section 1.2 – Biological Goals and Objectives of the HCP.

The avoidance and minimization measures and adaptive management that will be implemented as part of this HCP will minimize the incidental take to the maximum extent practicable, and mitigation measures will offset the impact of the take caused by the Project and aid in achieving goals identified in the Indiana bat 2007 Draft Recovery Plan. As described in Section 5.1.2.6 – Biological Significance of Incidental Take (Collision Mortality), the estimated level of Indiana bat mortality over the ITP Term (130.0 Indiana bats over 30 years) is not likely to measurably reduce the size of local, migratory, or Midwest RU populations of Indiana bats at current population levels. Conservation measures that will be implemented by providing funding for research on Indiana bat-wind interactions will provide valuable information that can be used to increase the effectiveness of future minimization and avoidance measures at the Project and other wind energy developments within the range of the Indiana bat. Avoidance, minimization, mitigation, adaptive management, and conservation measures for the Indiana bat will be described in the following sections.

## 6.1 Avoidance Measures

### 6.1.1 Project Planning and Siting

An iterative screening process was initiated in 2006 in Champaign and Logan counties, OH, that was very similar to the tiered process recommended by the Wind Turbine Guidelines Federal Advisory Committee Guidelines (FAC Guidelines; FAC 2010). Buckeye Wind relied on input and guidance from the USFWS and ODNR to inform their site selection process, along with standard practices utilized by the wind industry in siting of projects throughout the United States, initially settling on the initial study area that extended north from the current Action Area into Logan County (Figure 1-2). The FAC Guidelines provide a formalization of the basic approach that many wind power developers have used for many years while working with state and federal natural resources agencies.

Beginning in the summer of 2006, the Tier 1 site selection process included a broad-level review of publicly available information to evaluate potential development sites within the initial study area. The evaluation included screening for known and potential occurrence of ESA or state listed species, presence of designated critical habitat, and general ecological context of the potential locations, including the degree of fragmentation, land ownership, and land use. Landscape-level screening also identified several areas as having potentially suitable wind resources and land lease potential. This Tier 1 evaluation identified the initial study area as having among the best wind resource in OH, transmission available within a reasonable distance, and where publicly available information–such as screening federal and state species lists, migratory pathways, important bird areas, and protected areas–indicated that risks to bird and bat breeding or migratory areas, important habitat areas, and federally and state listed species would be low.

Later in 2006, for the Tier 2 site selection process, available site-specific information was gathered from public sources to further characterize sites identified as potentially suitable in terms of their potential to support state and federal listed species and other protected wildlife species. Areas with potential to support "wildlife species of concern" as described in the FAC Guidelines and that could present risk to particular species or species groups were identified, such as known or suspected hibernacula, areas of known raptor or eagle migratory corridors or nesting sites, or records of special status bird or bat species. Based on these evaluations, the initial study area was not found to have any known critical areas where wildlife congregate, was determined to be highly fragmented from previous and ongoing agricultural activities, and did not have any records of federally listed species. The site was also found to be sufficiently distant from any known Indiana bat hibernacula (the closest known hibernacula is the Lewisburg Limestone Mine in Preble County, OH, approximately 100 km [62.5 mi] southwest of the Action Area) and did not have any known Indiana bat summer records (Indiana bat summer records in western OH were only known from Greene, Montgomery, and Miami counties in OH prior to 2008). Thus, the Project site was considered suitable for further evaluation and in-depth studies to fully characterize the natural resources potentially at risk from development of the Project.

In the Tier 3 phase of site evaluation, quantitative and scientifically rigorous studies were conducted in the initial study area to assess the potential risk of the Project to species and/or habitats of concern. Beginning in 2008, a series of studies to characterize the distribution, relative abundance, behavior, and site use by birds and bats were designed based on protocols developed in consultation with the USFWS and ODNR DOW. Study work plans were discussed and shared with the USFWS and ODNR DOW beginning in fall 2007. Several meetings were held in 2007 and 2008 to discuss agency comments and several field trips were conducted with agency representatives. Agency recommendations were subsequently incorporated into final study protocols. In addition, representatives of both the ODNR DOW and the USFWS participated in several of the field studies.

In the summer of 2008, during Tier 3 studies, a new summer colony of Indiana bats was discovered in the initial study area in Logan County. Based on this finding, in consultation with the USFWS, Buckeye Wind reduced the area of proposed turbine development to avoid potential impacts to Indiana bats (see Section 1.1 – Overview and Purpose of the HCP and Figure 1-2), resulting in the current Action Area. Because the Action Area was more than 8 km (5 mi) away from the nearest capture site for Indiana bats, it appeared that impacts to Indiana bats were sufficiently avoided and Buckeye Wind, in consultation with the USFWS and ODNR, made a decision to proceed with the Project within the current Action Area. Buckeye Wind then proceeded to develop an application for a CECPN for approval through the OPSB in 2008-2009.

Despite thorough pre-planning, prior bat surveys within the Action Area that did not detect Indiana bats, due diligence, and ongoing consultation with the USFWS and the ODNR DOW, Indiana bats were unexpectedly discovered in the Action Area in summer 2009. The discoveries were made in the northern part of the Action Area during mist-netting surveys conducted by another entity as part of site evaluations for an unrelated wind project. Due to these discoveries, Buckeye Wind determined that it was appropriate to enter into discussions with the USFWS to seek an ITP under Section 10 of the ESA. Furthermore, research (Arnett et al. 2010, Baerwald et al. 2009 and Good et al. 2011; see Table 6-1) indicates that specific avoidance and minimization methodologies are effective in reducing direct and indirect impacts to bats from wind projects, making it likely that an HCP could be developed that would allow the Project to be built while avoiding and minimizing impacts to Indiana bat populations. The following sections describe additional measures that will be taken by Buckeye Wind to avoid impacts to Indiana bats and where those impacts cannot be avoided, how they will be minimized and mitigated, to the maximum extent practicable.

The following avoidance actions were taken during Project siting and planning:

1) The initial study area was reduced to remain 8 km (5 mi) away from discovery of Indiana bats in 2008.
2) Initial turbine siting avoided large blocks of contiguous forested habitat and protected areas. Instead, areas in which prior agricultural practices had created a highly fragmented landscape where wind development would pose substantially less risk to species of concern were prioritized for further consideration. For the additional 48 turbine locations, similar efforts will be taken to avoid such wooded areas, resulting in the worst-case scenario of habitat impacts for the 100-turbine Project presented in Table 5-14 (Table 5-15 for the Redesign Option);
3) None of the 100 turbines will be closer than 2.9 km (1.8 mi) to known maternity roost trees documented in 2009.
4) Up to 10 turbines (8%) will be located in Category 1 habitat. Table 6-2 provides the maximum number of the turbines that may be sited in each of the remaining Categories 2-4.

### 6.1.2 Project Construction

In addition to siting the Project away from forested areas and largely in agricultural areas, the following actions will be taken to avoid adverse effects to Indiana bats from construction activities of the 100-turbine Project. Many of these measures also assist in avoidance of impacts to other bats such as the little brown and northern long-eared bat. These cave bats also roost in trees and forage in forested habitat, so avoidance and minimization of tree clearing will benefit these species as well as the Indiana bat (see EIS Section 5.6 and Chapter 5 of the ABPP).

1) Buckeye Wind will not remove the 3 known Indiana bat roost trees in the Action Area for the 100-turbine Project.

2) Buckeye Wind will avoid potential direct effects from habitat loss to roosting Indiana bats in unidentified maternity roost trees:
    a. All tree clearing activities will be conducted outside the period when Indiana bats are expected to be roosting in the Action Area. Any tree clearing will be conducted between 1 Nov and 31 Mar.

3) Prior to any tree removal, the limits of proposed clearing will be clearly demarcated on-site with orange construction fencing (or similar) to prevent inadvertent over-clearing of the site.

4) A Natural Resource Specialist knowledgeable on Indiana bats and their habitat requirements will be present at the time of tree clearing:

a. Buckeye Wind will conduct habitat assessments jointly with the USFWS for the areas of planned tree clearing once Project plans are finalized and before any clearing is conducted, during which all potential roost trees will be identified and flagged.
b. Prior to the finalization of the detailed design of Project components, Buckeye Wind will make all reasonable attempts to offset the clearing radii around turbines or adjust roads/interconnects to preserve any potential roosts and avoid any unnecessary clearing.

5) Measures will be taken to avoid impacts to high quality potential Indiana bat foraging riparian habitat and the prey that it supports:
   a. Horizontal directional boring will be used to avoid impacts to any Ohio designated Exceptional Warmwater Habitat or Coldwater Habitat stream.
   b. Wetlands will not be impacted by construction activities for the 100-turbine Project (includes Redesign Option).
   c. The Project was designed to avoid stream crossings whenever possible. Due to the nature of this type of project, there is some flexibility in selecting turbine locations and, more so, access road and electric collection line locations. As such, great care was taken to design Project facilities to avoid tree clearing and in-water work associated with stream crossings to the maximum extent practicable. See Section 5.2.1.2 – Impacts to Aquatic Habitats for a discussion of stream impacts.
   d. Horizontal directional boring for collection lines will be used to avoid impacts to all perennial streams.

## 6.2 Minimization Measures

### 6.2.1 Project Construction

In addition to avoidance measures listed above, the following actions will be taken to minimize adverse effects to Indiana bats from construction activities for the 100-turbine Project:

1) Buckeye Wind will limit the amount of tree removal:
   a. Only 6.5 ha (16.1 ac), or 6.8 ha (16.8 ac) for the Redesign Option, of forest habitat will be cleared for the 100-turbine Project; or 0.2% (0.2% for the Redesign Option) of the 2,744 ha (6,779.4 ac) of forested habitat available in the Action Area (see Section 5.2.1.1 – Wooded Habitat Removal).
   b. Areas where tree removal is planned will be spread throughout the Action Area and tree removal will not be concentrated in in any single area.
   c. Forest patches cleared will be small, with an average size for the known 52 turbine locations of 0.2 ha ± 0.4 ha (0.4 ac ± 0.9 ac) and a maximum size of approximately 1.1 ha (2.7 ac). The other areas of tree clearing are less than 0.2 ha (0.4 ac). For the additional 48 turbines, a maximum forest patch size of approximately 1.1 ha (2.7 ac) may be cleared.
   d. Only 3.2 ha (8.0 ac, or 3.3 ha [8.2 ac] for the Redesign Option) of wooded areas within habitat Categories 1, 2 or 3 (see Appendix B) will be removed for the 100-turbine Project: 1.0 ha (2.5 ac) of Category 1, 1.3 ha (3.3 ac) of Category 2, and 0.9 ha (2.2 ac) of Category 3. In the Redesign Option, removed wooded areas would include 1.1 ha (2.6 ac), 1.3 ha (3.3 ac), and 0.9 ha (2.3 ac) in each Category, respectively.

2) Measures will be taken to minimize impacts to high quality potential Indiana bat foraging riparian habitat and the prey that it supports:

a. Only streams that are not designated Coldwater Habitat or Exceptional Warmwater Habitat will be impacted. A Nationwide Permit will be secured for each stream crossing involving in-water work (see Section 5.2.1.2 – Impacts to Aquatic Habitats).
b. Crossing widths and clearing of wooded riparian areas for crossings will be limited to the minimum required for the crossing methods (see Table 5-16).
c. A plan note will be incorporated into the construction contract requiring that contractors adhere to all provisions of the SWPPP and NPDES permits, which will specify Best Management Practices for construction activities to minimize stormwater runoff and sedimentation from construction areas into adjacent water bodies and provide adequate restoration measures (see Section 5.2.1.2 – Impacts to Aquatic Habitats).
d. Horizontal directional boring for collection lines will be used to avoid impacts to all perennial streams.

### 6.2.2 Project Operation and Maintenance

As described in Section 5.0 – Impact Assessment, direct and indirect effects to Indiana bats from forested habitat removal, disturbance from construction activities, noise from operating turbines, displacement from operating turbines, and lighting are expected to result in insignificant and discountable effects that do not rise to the level of take of Indiana bat. The following actions will be taken to minimize adverse effects to Indiana bats from operations and maintenance activities for the 100-turbine Project:

a. Minimal FAA lighting will be utilized (see Section 5.1.2.2 – Lighting). Any ground-based lighting at the turbines or substation necessary for safety or security will be controlled by motion detectors or infrared sensors.
b. Regularly scheduled tree trimming for maintenance purposes will not be conducted in the active period for Indiana bats. Some minor clearing of fallen trees or safety trimming may be conducted during the active period. No potential Indiana bat roost trees will be trimmed or cleared during the active period.
c. Access roads built for the Project will be posted with a 25 mile per hour speed limit to minimize risk of collision with Indiana bats and other wildlife.

Due to measures taken by Buckeye Wind to avoid and minimize impacts to Indiana bats during construction and operation and maintenance described in this and in preceding sections, it is anticipated that operation of the Project is the only activity covered by this HCP that will result in unavoidable incidental take of Indiana bats. As such, the primary method to minimize impacts to Indiana bats will be operational restrictions.

Operational restrictions (see Section 6.2.3 – Feathering Plan Phases) will dictate that turbines are feathered (i.e., not spinning) until a designated cut-in speed is reached. This cut-in speed is generally higher than the wind speed at which the turbine is technically able to begin spinning and producing power. A number of studies have now shown that increased cut-in speed can be expected to reduce mortality of bats (Arnett et al. 2010, Baerwald et al. 2009 and Good et al. 2011; see Table 6-1; see Section 5.1.2.5.3 – Estimated Take with Feathering), although a statistically significant correlation between increased cut-in speeds and Indiana bat mortalities cannot be made with existing data. It is, however, expected that the overall reduction in mortalities from feathering that has been observed in other bat species will also be observed for Indiana bats.

As described in Section 4.5.5.4 – Influence of Weather, 4 studies that evaluated the effects of increasing turbine cut-in speed on bat fatalities during the fall migration period (PA [Arnett et al. 2010], Alberta [Baerwald et al. 2009] and IN [Good et al. 2011]) found that reductions between 38% and 93% (median of 68.3% across all studies) were achieved by curtailing or feathering turbine operations at wind speeds of 5.0 m/s and 6.5 m/s (Table 6-1). Although site-specific factors such as turbine model, local weather patterns, and bat populations may affect the relative effectiveness of operational adjustments at different wind facilities, the finding that similar reductions in bat mortality were achieved in areas as geographically diverse as PA, Alberta and IN holds promising support for broad application of curtailing or feathering as a take minimization technique.

**Table 6-1.** Observed range in reductions in bat fatalities and median values for 4 operational effectiveness studies. Turbines were feathered at Casselman and in Southwest Alberta, and curtailed at Fowler Ridge.

| Study | Observed fatality reduction[a] | | | Source |
|---|---|---|---|---|
| | Min | Max | Average | |
| Casselman 2008[b] | 52.0% | 93.0% | 82.0% | Arnett et al. 2010 |
| Casselman 2009[b] | 44.0% | 86.0% | 72.0% | Arnett et al. 2010 |
| Fowler Ridge 2010[c] | 38.0% | 85.0% | 64.5%[d] | Good et al. 2011 |
| Southwest Alberta[e] | NA | NA | 60.0% | Baerwald et al. 2009 |
| Median fatality reduction | 44.0% | 86.0% | 68.3% | |

[a] All studies used a combination of cut-in speeds of 5.0 m/s to 6.5 m/s except Baerwald et al. 2009, which used 5.5 m/s
[b] Based on a 95% confidence interval
[c] Based on a 90% confidence interval
[d] Based on the median of the reported average reductions from each treatment (5.0 m/s = 50%; 6.5 m/s = 79%)
[e] Study did not provide confidence intervals for appropriate min and max comparison to other studies

Results from post-construction mortality monitoring suggest non-operating turbines pose little to no risk to bats; of 44 wind turbines studied at the Mountaineer facility, the only turbine with no reported fatalities was non-operational during the study period (Kerns et al. 2005). Although the cut-in wind speed may be the most significant factor determining the effectiveness of feathering, other variables to consider include seasonal and nightly timing of feathering, number of turbines feathered, habitat type surrounding turbines, and other weather factors, as described in the following sections.

## Seasonal Considerations

Seasonal patterns of bat mortality documented in post-construction monitoring studies at wind facilities across North America have consistently documented the highest mortality in the late summer/early fall period (see Section 4.5.5.2 – Geographic Variation for further details). Lower levels of mortality have consistently been documented during the spring and after 31 October in monitoring studies that included surveys during the early spring and after 31 October, with a few noted exceptions for silver-haired bat mortality in the spring (refer to Section 4.5.5.2 – Geographic Variation). Specifically, from 2007 – 2009, 0% of all bat mortality in Pennsylvania was observed in March, while just 2% of all bat mortality was observed in April. This includes results from 8 different sites and 11 seasons of monitoring (Capouillez 2011). Also, 7 studies that conducted monitoring for the spring through fall period documented *Myotis* fatality rates of 8%, 34%, and 58% in the spring, summer, and fall, respectively (Jennifer Szymanski and Megan Seymour, USFWS, personal communication). As such, the feathering plan will vary seasonally, based on 3 periods in which Indiana bats display distinct behavioral characteristics that could differentially affect their exposure to wind turbines:

- Spring emergence and migration, or "spring" (1 Apr to 31 May);
- Early summer habitat use, or "summer" (1 Jun to 31 Jul); and

- Late summer and fall migration, or "fall" (1 Aug to 31 Oct).

**Weather Considerations**

Bats are known to suppress their activity during periods of rain, low temperatures, or strong winds (Erkert 1982, Adam et al. 1994, Erickson et al. 2002, Russo and Jones 2003). Weather variables such as wind speed, temperature, and barometric pressure have been found to influence bat activity and mortality rates at some wind facilities. Of the 21 post-construction monitoring studies reviewed by Arnett et al. (2008), studies that addressed relationships between bat fatalities and weather patterns found disproportionate numbers of bats were killed on nights with low wind speed (<6 m/s) and fatalities increased immediately before and after passage of storm fronts. Horn et al. (2008) also reported blade rotational speed was a significant negative predictor of observed collisions and/or barotrauma with turbine blades, suggesting that bats may be at higher risk of fatality on nights with low wind speeds.

Positive correlations between bat activity and temperature have been documented, both on a nightly basis (Lacki 1984, Negraeff and Brigham 1995, Hayes 1997, Vaughan et al. 1997, Gaisler et al. 1998, Shiel and Fairley 1998) and annual basis (O'Farrell and Bradley 1970, Avery 1985, Rydell 1991). Associations between temperature and bat fatalities in post-construction monitoring studies have been less consistent than for wind speed. While a correlation between temperature and bat fatalities was not documented at Mountaineer, a positive association between temperature and fatalities was documented at Meyersdale (Kerns et al. 2005). Pre- and post-construction acoustic surveys at wind facilities have found bat activity to be negatively correlated with low nightly mean temperatures (Fiedler 2004, Reynolds 2006). For example, Reynolds (2006) found no detectable spring migratory activity on nights when daily mean temperature was below 10.5°C (50.9°F).

Turbines will be allowed to operate at full capacity at temperatures below 10 °C (50°F), based on USFWS summer survey protocol (USFWS 2007) and a multitude of studies that have documented low levels or no bat activity at low temperatures; refer to Section 4.5.5.4 – Influence of Weather for details). Turbines will be allowed to operate at manufacturer specified cut-in speeds if nighttime temperatures fall below 10 °C (50°F) for a period of 15 consecutive minutes. Likewise, the cut-in speeds as specified by the feathering plan and any subsequent adaptive management actions will be implemented if the nighttime temperature has risen above 10 °C (50°F) for a period of 15 consecutive minutes.

Barometric pressure, temperature, and relative humidity are all interrelated and are associated with passing storm fronts. There seems to be some evidence that higher barometric pressure is associated with higher mortality. Good et al. (2011) found that mortality increased with increasing barometric pressure; and barometric pressure was higher than normal on the night when an Indiana bat mortality occurred. However, barometric pressure was lower than normal on the night with the most overall mortality, which included mainly migratory tree bats (Good et al. 2011). Barometric pressure was positively associated with mortality at Mountaineer and Meyersdale (Arnett et al. 2008).

Fiedler (2004) found that mortality was positively associated with average nightly wind direction. One explanation may be that mortalities increased as wind direction deviated from the predominant, southwestern, wind direction. Further, increased mortalities on nights with more northerly winds may be a result of more bats moving during weather conditions conducive to migration.

**Habitat Considerations**

As is evident in the results of the habitat suitability model detailed in Appendix B, habitat in the Action Area is not uniform with respect to its suitability for Indiana bat roosting and foraging activities. The suitability of habitat in which turbines are placed is expected to influence risk to Indiana bats during the summer maternity period, as risk of encounters is expected to be greatest at turbines placed in areas where Indiana bats are most likely to be actively foraging and traveling to and from their roosts. The habitat suitability model resulted in 4 risk categories within the Action Area, with Category 1 being the most suitable for Indiana bat foraging and roosting activities and presenting the highest risk of exposure to operating turbines and Category 4 being the least suitable and presenting the least risk. For purposes of the risk analysis, Categories 1, 2 and 3 were considered suitable roosting and foraging habitat (although Category 3 is 87% non-forested) and Category 4 was excluded on the basis of being entirely agricultural land (See Table 6-2 for habitat categories).

Although these habitat categories were developed based on telemetry data from summer foraging and roosting Indiana bats, they may also present varying levels of risk during migration. While some migration studies suggest that Indiana bats follow vegetative or other landscape features, other studies suggest that Indiana bats fly direct routes without respect to landscape structure or habitat (see Section 4.4.3 –Migration for more detail). The 2 documented Indiana bat fatalities at an IN wind facility were both found during the fall migration period in a largely agricultural area (Good et al., 2011), while the documented Indiana bat fatality in PA was also during the fall migration period, but in a forested ridge line.

However, there is likely overlap in seasonal behaviors (i.e., migration and summer habitat use) and weather conditions and other stochastic factors can affect the exact timing of annual chronology from year to year. Additionally, Indiana bats that migrate to and from the Action Area during spring and fall may be at higher risk than Indiana bats merely passing through the Action Area, because migratory activity may coincide with foraging activity that is associated with their return or departure from their local roosts. Therefore, it is appropriate to consider these habitat categories when evaluating potential risk to Indiana bats from operating turbines during active periods.

### 6.2.3 Feathering Plan Phases

While some type of feathering will likely be in place over the ITP Term, the Project will have 3 distinct phases: 1) Evaluation Phase, 2) Implementation Phase, and 3) Re-evaluation Phase. An adaptive management framework will be used to apply the results of the Evaluation Phase, Implementation Phase, and each Re-evaluation Phase, as well as new information from research or increases in scientific understanding, to guide the ongoing implementation of this HCP. The following section focuses on the specific details of the Evaluation Phase, as the details of the other 2 phases will be informed by results of the Evaluation Phase and consultation with the USFWS and ODNR DOW. Buckeye Wind will work cooperatively with the USFWS and the ODNR DOW throughout the Evaluation Phase to implement the appropriate Adaptive Management measures. The feathering plan during each of the 3 phases will be described in the following sections. Monitoring methods during each of the phases will be summarized in Section 6.5 – Monitoring and Adaptive Management. All turbines in all habitat categories will be feathered at night until the specified cut-in speed is reached (See Table 6-2).

#### *6.2.3.1 Evaluation Phase*

The Evaluation Phase will begin once a turbine becomes operational and will encompass spring, summer, and fall (1 April through 31 October) for at least the first 2 years of operation of that turbine. If a turbine becomes operational prior to 1 April, that year will constitute a full Evaluation year. If operation begins after 1 April, monitoring will proceed for the remainder of the active period and the turbine(s) will be subject to trigger point adaptive management as described in Section 6.5.3.4 – Trigger Point for Immediate Adaptive Management, but the following year will constitute Year 1 Evaluation Phase monitoring. Each year of the Evaluation Phase will be subdivided into the 3 seasonal periods described previously, each with a slightly different feathering strategy suited to the expected behavior of Indiana bats and corresponding risk during that period. In addition to reducing Indiana bat mortality to the maximum extent practicable, the feathering strategy, detailed in Table 6-2, is intended to meet the biological goals of the HCP and Biological Objectives 1, 3 and 4. The basis for the feathering strategy in each season will be described in the following sections.

**Spring Feathering Plan**

The spring feathering plan will be applied over a period of approximately 8.5 weeks from 1 April to 31 May during the nighttime period, ½ hour before sunset to ½ hour after sunrise. Because post-construction mortality studies at wind facilities across the country have consistently documented lower levels of bat mortality during the spring migration period (refer to Section 4.5.5.2 – Geographic Variation), feathering levels during this period will be the least restrictive of all seasons in the Indiana bat active period. Feathering will be applied to turbines in the 3 highest habitat risk categories at wind speeds of 5.0 m/s (Table 6-2). Feathering of turbines in Category 4 will occur up until the manufacturer-set cut-in speed is reached. The basis for selecting this cut-in speed, as discussed previously, was operational adjustment studies that documented cut-in speeds of 5.0 m/s and above substantially reduced bat mortality in fall (see Table 6-1). Two years of study at the Casselman wind facility (Arnett et al. 2010) in PA and 1 year of study at the Fowler Ridge facility (Good et al. 2011) in IN found evidence to suggest that a cut-in speed of 5.0 m/s significantly reduces bat mortality[36] in fall. The Fowler Ridge study report indicates that increasing cut-in speeds from 5.0 m/s to 6.5 m/s significantly reduced all bat fall mortality by an additional 29% (Good et al. 2011); however, the costs to implement higher cut-in speeds increase exponentially with wind speed (see Section 6.6.2 – Practical Implementation by Buckeye Wind). Given that in 7 studies that conducted monitoring for the spring through fall period, only 8% of *Myotis* fatalities occurred in the spring (Jennifer Szymanski and Megan Seymour, USFWS, personal communication), the application of the 5.0 m/s cut-in speed as an effective minimization approach during the spring represents a conservative approach and a higher cut-in speed is not practicable, given the substantially higher costs (refer to Section 6.6 – Issuance Criteria – Maximum Extent Practicable).

[36] Note that the studies did not document reductions in impacts to Indiana bats specifically (because of lack of data) nor did they occur over the spring and summer time frames. However, it is assumed that the beneficial effects will be similar to fall feathering.

**Table 6-2.** Summary of nighttime (½ hour before sunset to ½ hour after sunrise) operational feathering that will be applied to turbines during Evaluation Phase Year-1*.

| Habitat risk category | Estimate for 52-Turbine Layout | Maximum for 100-Turbine Layout** | Cut-in speed - m/s | | |
|---|---|---|---|---|---|
| | | | Spring (1 Apr - 31 May) | Summer (1 Jun - 31 Jul) | Fall (1 Aug - 31 Oct) |
| **Category 1 - Highest Risk** | 4 | 10 | 5.0 | 6.0 | 6.0 |
| **Category 2 - Moderate Risk** | 9 | 15 | 5.0 | 5.75 | 5.75 |
| **Category 3 - Low Risk** | 6 | 15 | 5.0 | 5.5 | 5.75 |
| **Category 4 - Lowest Risk** | 33 | 85 | None*** | 5.25 | 5.75 |
| **Totals** | 52 | 125 | | | |

* Any turbines installed after the first year of operation will be feathered using the cut-in speeds for the respective risk Category as adjusted through adaptive management, if those cut-in speeds differ from those in this table.
** The breakdown for the known 52 turbine locations is given for reference. The table shows the maximum number of turbines in each category, resulting in a sum >100. No more than 100 turbines will be built.
*** Turbines will be cut-in at the manufacturer's specified cut-in speed. The turbine will be feathered below the cut-in speed.

Feathering will not be applied to all turbines equally because risk is expected to be lower overall during the spring. Instead, feathering will be focused on turbines located in habitat Category 1, 2 and 3, which represent the most suitable roosting and foraging habitat in the Action Area, because some Indiana bats that spend the summer reproductive period in the Action Area may arrive prior to 31 May to establish summer maternity colonies. It is likely that these Indiana bats would engage in foraging and commuting behavior, and turbines located in the most suitable roosting and foraging areas could present greater risk to these Indiana bats. Category 4 habitat has been established in the habitat suitability model as being unsuitable for roosting and foraging. Furthermore, post-construction mortality studies at wind facilities across the country have consistently documented lower levels of bat mortality during the spring migration period (refer to Section 4.5.5.2 – Geographic Variation). Therefore, turbines will only be feathered until manufacturer-set cut-in speed is reached in the spring in Category 4 habitat, which should represent the lowest risk time period for Indiana bats.

**Summer Feathering Plan**

The summer feathering plan will be applied over a period of approximately 8.5 weeks from 1 June to 31 July during the nighttime period, ½ hour before sunset to ½ hour after sunrise. Although mortality monitoring at wind facilities during the early summer reproductive period has consistently documented less bat mortality than the fall period (refer to Section 4.5.5.2 – Geographic), feathering will be applied to all turbines during this period because risk to Indiana bats in the Action Area during this time is uncertain and higher mortality during late summer has been demonstrated. The summer feathering plan was based on the results of the habitat suitability model (Appendix B). Using a tiered approach, the highest cut-in speeds (6.0 m/s) will be applied to turbines located within habitat category 1, which was predicted to have the highest suitability for Indiana bat roosting and foraging activities (refer to Table 6-2 and Figure 4-5 for the distribution of the 52 known turbine locations relative to the predicted habitat suitability). This is based on 3 studies that have consistently documented that fall bat mortality is substantially reduced at wind speeds of 5.0 m/s and higher (Baerwald et al. 2009, Arnett et al. 2010, and Good et al. 2011; (see Table 6-1). The cut-in speed in this Category is the most conservative of any cut-in speed throughout the active period because there is a higher level of uncertainty as to the impacts to Indiana bats and bats in general. Assuming there is a reduced risk in increasingly lower suitability habitats, cut-in speeds will be stepped down evenly in 0.25 m/s increments in habitat Category 2 through Category 4 (see table 6-2).

**Fall Feathering Plan**

The fall feathering plan will be applied over a period of approximately 13 weeks from 1 August to 31 October[37] during the nighttime period, ½ hour before sunset to ½ hour after sunrise. Mortality monitoring at wind facilities during the fall period has consistently documented the greatest numbers of bat fatalities relative to other seasons. Therefore, equal or more restrictive cut-in speeds will be applied to all turbines during this period to minimize impacts to Indiana bats. The late summer/early fall cut-in speeds were selected based on acoustic and post-construction mortality monitoring studies that consistently documented substantially reduced bat activity and mortality at cut-in speeds of 5.0 m/s and 6.5 m/s (refer to HCP Section 4.5.5.4 – Influence of Weather for detailed information). These cut-in speeds were also informed by 3 operational adjustment studies (Baerwald et al. 2009, Arnett et al. 2010, Good et al. 2011) that documented substantial reductions in bat fatalities (between 38% and 93%, median of 68.3% across all studies) at curtailed and feathered turbines during the fall period using cut-in speeds of 5.0 m/s and above (Table 6-1). As noted previously, the seasonal definitions do not define a hard switch from foraging to migration behaviors, and there will inevitably be cross-over of behaviors between the defined seasonal periods. In order to ensure that pre-migratory Indiana bats are afforded the same protection as is provided in the summer feathering plan, cut-in speeds for turbines located in Category 1 habitat areas will be 6.0 m/s.

#### *6.2.3.2 Implementation and Re-evaluation Feathering Plan Phases*

The results of post-construction monitoring during the Evaluation Phase will be used to adjust the feathering plan to effectively maintain Indiana bat mortality within levels authorized in the ITP, while maximizing production of renewable energy. The Implementation Phase will begin once the feathering plan has been demonstrated to be effective at keeping mortality within expected levels for a minimum of 2 years. The Implementation Phase will continue throughout the ITP Term, as long as take levels allowed under the ITP are not being exceeded or until Buckeye Wind initiates, at its discretion or through Implementation Phase mortality results, a Re-evaluation Phase. The purpose of the Re-evaluation Phase will be to evaluate the effectiveness of a new operational feathering plan or test other emerging methods or technologies available to reduce mortality of Indiana bats, if approved by the USFWS and per the adaptive management section of this HCP. Each Re-evaluation Phase will allow Buckeye Wind to modify the feathering plan or test new avoidance or minimization techniques, in consultation with the USFWS, as new information or technology becomes available in order to effectively meet the biological goals and objectives of this HCP. The adaptive management criteria defined in Section 6.5.3 – Adaptive Management for Minimization will be used to guide any adjustments to the feathering plan.

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[37] While the Fall Feathering Plan ends on 31 October, Evaluation Phase monitoring will extend to 15 November in order to comply with the ODNR Protocol (see Section 6.5.2.2 – Survey Period).

### 6.2.5 Project Decommissioning

Decommissioning of the 100-turbine Project entails many of the same activities as Project construction, although no new impacts are expected as existing access and facilities can be used for decommissioning. The following measures will be undertaken to minimize any impacts to Indiana bats and their habitat:

1) Limited tree clearing may be needed to expand existing access. Buckeye Wind will avoid potential direct effects to roosting Indiana bats in unidentified maternity roost trees:
    a. Tree clearing activities will be conducted outside the period when Indiana bats are expected to be roosting in the Action Area. Any tree clearing will be conducted between 1 Nov and 31 Mar.

2) Measures will be taken to avoid impacts to high quality potential Indiana bat foraging riparian habitat and the prey that it supports:
    a. No new stream crossings resulting in in-water work will be utilized and clear span methods, such as open bottomed culverts, elliptical culverts, arched bridges, or temporary crossings (see Section 5.2.1.2 – Impacts to Aquatic Habitats) will be employed.
    b. Wetlands will not be impacted by decommissioning.

3) To the extent that soil disturbance will be needed and a NPDES permit is necessary (for removal for access roads or bridges), all appropriate best management practices for soil and erosion control and restoration will be implemented and Nationwide Permits, or other compliance under Section 404 of the CWA, will be secured.

4) Temporary crossings and areas of temporary construction impact will be restored and re-vegetated per the erosion and sediment control plan (consisting of planting native plant species to provide ground stabilization). Erosion and sediment control measures will limit the amount of sediment from exposed soil entering the stream, so impacts to aquatic foraging habitat will be minimized. For example, silt fences, hay bales and/or filter socks will be used to catch any sedimentation from active construction areas. Catch basins may be installed to allow sedimentation to fall out before the run-off enters the streams. Swales and ditches may be installed to divert sedimented water away from streams and into areas that have the proper sediment control measures (silt fences, catch basins, etc.) These measures will ensure that the stream quality is not degraded and that the ability of the water features in the Action Area to support prey species and hydration for the Indiana bat will not be degraded

## 6.3 Mitigation Measures

As described in Section 5.1.2.6 – Biological Significance of Incidental Take, total annual Indiana bat mortality, including adult females, adult males, and juveniles, is estimated to range from approximately 1.0 Indiana bat per year to 14.2 Indiana bats per year, but is expected to be approximately 5.2 Indiana bats per year, with no more than 26.0 individual Indiana bat mortalities over a 5-year period. Based on the 5-year take limit, a total take of 130.0 Indiana bats would be requested over the ITP Term. The impact of this taking is the loss of an estimated 130.0 Indiana bats, or 5.2 Indiana bats per year, across the Midwest RU. Of those mortalities, approximately 57.5, or 2.3 per year, are estimated to come from local populations (see Section 5.1.2.6.1 – Impacts to Local Maternity Colonies Pre-WNS). Of those local Indiana bats, 27.5, or 1.1 per year, are estimated to be local females (see Section 5.1.2.6.1 – Impacts to Local Maternity Colonies Pre-WNS). Objective 2 specifically relates to mitigation:

Objective 2: Mitigate for the impacts of the incidental taking of 130.0 Indiana bats over the 30-year ITP Term through the purchase or easement acquisition and subsequent restoration and/or enhancement (if necessary), with permanent preservation of 87.8 ha (217.0 ac) of suitable Indiana bat habitat within 11.2 km (7 mi) of a P2 Indiana bat hibernaculum in OH (see Section 6.3 – Mitigation Measures for more details);

Meeting Objective 2 will offset the impact of the incidental take caused by the Project by helping enhance the reproductive success and survival probability of local and migratory Indiana bat populations. Mitigation will consist of permanent preservation of 87.8 ha (217.0 ac) of habitat within 11.2 km (7 mi) of a P2 Indiana bat hibernaculum in OH (see Section 6.3.1 – Acres of Mitigation Calculation). Mitigation habitat will be restored or enhanced if it does not meet the criteria addressed in Section 6.3.4. – Restoration and Enhancement. Protection of hibernacula remains a focus of the 2007 Indiana bat Recovery Plan, with conservation and management of swarming habitat identified as a key recovery strategy (USFWS 2007). The recovery plan states:

> The habitat surrounding hibernacula may be one of the most important habitats in the annual cycle of the Indiana bat. This habitat must support the foraging and roosting needs of large numbers of bats during the fall swarming period. After arriving at a given hibernaculum, many bats build up fat reserves (Hall 1962), making local foraging conditions a primary concern. Migratory bats may pass through areas surrounding hibernacula, apparently to facilitate breeding and other social functions (i.e., bats that utilize the area for swarming may not hibernate at the site) (Barbour and Davis 1969; Cope and Humphrey 1977). Modifications of the surface habitat around the hibernacula can impact the integrity, and in turn the microclimate, of the hibernacula. Areas surrounding hibernacula also provide important summer habitat for those male Indiana bats that do not migrate, which is thought to be a large proportion of the male population. Loss or degradation of habitat within this area has the potential to impact a large proportion of the total population.

Delisting of the species will be attained by meeting Delisting Criteria; Delisting Criterion 1 requires protection of at least 50% of P2 hibernacula in each RU (USFWS 2007). Protection of hibernacula includes conserving a buffer zone around a hibernaculum to ensure that land clearing or development does not result in hibernaculum disturbance. Per the Indiana bat Recovery Plan (USFWS 2007):

> Further, forested buffer areas surrounding known hibernacula should be established. Current understanding of the species' biology may warrant buffers as large as 0.4 km (0.25 mi) in diameter. However, boundaries of forested buffer zones ideally should be custom designed to conform to the unique topography and natural features surrounding each hibernaculum rather than drawn as a generic circle. The goal of these buffer areas is to conserve the integrity of the entrance and hibernacula.

There are several options that can be utilized for mitigation:

a) Acquiring or otherwise providing protection to of 87.8 ha (217.0 ac) of suitable Indiana bat swarming habitat within 11.2 km (7 mi) of a P2 Indiana bat hibernaculum in OH through acquisition of a conservation easement into perpetuity or purchase of the property and then assigning a conservation easement in perpetuity.
    i. Within the easement areas, restore travel corridors between woodlots and/or along stream corridors to increase availability of suitable Indiana bat habitat through enhanced connectivity.

ii. Within easement areas, enhance suitable habitat through ensuring an adequate number of suitable roost trees and through managing woody invasive species.

b) Buying credits from an USFWS approved Indiana bat mitigation bank whose geographical range service area includes the Project (USFWS 2009b; see Section 7.3.4 – Change in Mitigation Acres).

Preservation and enhancement of land within 11.2 km (7 mi) of a P2 Indiana bat hibernaculum in OH will protect valuable fall roosting, foraging, and swarming habitat. During the fall swarming period, female, juvenile, and male Indiana bats arrive at hibernacula after migrating potentially long distances from summer habitat (distances up to 575 km [357 mi] have been documented; Winhold and Kurta 2006). Migration is an energetically expensive undertaking (Fleming and Eby 2003), and bats therefore require roosting and foraging opportunities outside hibernacula in order to increase fat stores prior to hibernation. Hall (1962) found that bats returning to Coach Cave, KY, in the fall had no stored fat reserves, and that weight was the lowest measured at any point during the annual cycle. Weight peaks in September or October as a result of foraging outside hibernacula (Hall 1962, LaVal and LaVal 1980). Entering hibernation with ample energy reserves is key to surviving winter hibernation for all bats, and for adult females it is critical for ovulation (Humphries et al. 2003, Jonasson and Willis 2011, Kunz et al. 1998). Increasing opportunities for juveniles to build up energy stores prior to their first winter hibernation has the potential to increase survivorship (Jonasson and Willis 2011). In sum, protection and enhancement of foraging and roosting habitat outside a P2 hibernaculum will provide roosting and foraging resources for swarming adult female, adult male, and juvenile Indiana bats in the fall, which will reduce competition for limited resources at a time when building energy reserves for the winter hibernation period is critical.

Similarly, Indiana bats may remain in close proximity to a hibernaculum for a short period of time after emerging from hibernation in spring. At this time, individuals have used much of their fat stores during hibernation and food resources are low, which may contribute to increased risk of mortality immediately following emergence (Tuttle and Stevenson 1978 as cited in USFWS 2007). Habitat around hibernacula has been identified as being critically important for the health of Indiana bat populations. The Indiana bat Recovery Plan (USFWS 2007) includes extensive discussions on the importance of this habitat:

> Biologically intrinsic needs of this species include limiting use of fat during hibernation, obligate colonial roosting, high energy demands of pregnant and nursing females, and timely parturition and rapid development and weaning of young. Factors that may exacerbate the bats vulnerability because of these constraints include energetic impacts of significant disruptions to roosting areas (both in hibernacula and maternity colonies), availability of hibernation habitat, and connectivity and conservation of roosting-foraging and migration corridors.

And

> Threats to the Indiana bat vary during its annual cycle. At the hibernacula, threats include modifications to caves, mines, and surrounding areas that change airflow and alter microclimate in the hibernacula… During summer months, possible threats relate to the loss and degradation of forested habitat. Migration pathways and swarming sites may also be affected by habitat loss and degradation.

As a result of the recognized importance of habitat around hibernacula, 1 of the 4 broad components of the recovery plan (USFWS 2007) is the "conservation and management of habitat (hibernacula, swarming and, to a degree, summer)."

Therefore, preservation or enhancement of land surrounding a hibernaculum will provide individuals with permanent roosting and foraging resources and reduce competition for those resources during swarming periods when replenishing energy reserves is critical.

Resources directly outside a hibernaculum are becoming even more important as WNS spreads throughout the range of the Indiana bat. Infected bats exhibit premature loss of critical fat reserves which is thought to lead to starvation prior to spring emergence (Frick et al. 2010). Indiana bats that survive winter hibernation in affected caves/mines will benefit from ample roosting and foraging habitat immediately outside cave/mine entrances, which they can utilize in order to quickly build up fat stores. Similarly, Indiana bats returning to hibernacula in the fall are in need of readily available foraging resources directly outside hibernacula to encourage accumulation of fat stores for hibernation, particularly if WNS causes premature loss of fat. In both cases, presence of permanent available fall and spring suitable habitat near hibernacula has the potential to increase survivorship.

Further benefit is realized when proposing to preserve land that is at risk of development. Development would remove roosting and foraging resources that Indiana bats rely upon prior to hibernation in the fall and after hibernation in the spring. Permanent protection of this land will ensure that development does not occur, leaving habitat available for roosting and foraging activities.

Finally, this habitat would also be suitable for use during the summer for Indiana bats that remain near the hibernaculum and for Indiana bats that potentially migrate to the area from other hibernacula. Males and non-reproductive females typically do not form large colonies and can remain close to hibernacula during the active period, roosting in nearby trees (Brack 1983, Gardner and Cook 2002, USFWS 2007, Whitaker and Brack 2002). In counties containing hibernacula, "most" summer records are for males and nonreproductive females (Gardner and Cook 2002). However, Gardner and Cook (2002) do not claim that "all" summer records near hibernacula are of males and non-reproductive females, implying that some maternity colonies are located within counties containing hibernacula. Indeed, fall swarming habitat can be similar in composition to summer roosting habitat (Kiser and Elliot 1996, Gumbert et al. 2002, as cited in USFWS 2007). Therefore, suitable summer habitat near a hibernaculum also has the potential to support maternity colonies and will be improved by the same beneficial characteristics as described in Section 6.3.4 – Restoration and Enhancement.

Also, preserved habitat has the potential to benefit Indiana bats utilizing different hibernacula, as Indiana bats (particularly males) may stop at several hibernacula during fall migration and swarming period (Cope and Humphrey 1977, LaVal and LaVal 1980). Increased foraging and roosting opportunities relative to existing conditions, and protection of existing suitable habitat from future development, will allow swarming adults and juveniles in the fall, and staging adults in the spring, to rebuild their energy stores more readily by reducing competition and ensuring that limited resources are protected into the future.

Potential methods, expected outcomes, and measurable variables for protection and restoration of Indiana bat fall swarming habitat are summarized in Table 6-3 and detailed below; also see Section 6.5.4.1 – Adaptive Management for Mitigation.

**Table 6-3**. Summary of mitigation measures that will be implemented to offset the impact of the take of Indiana bats from the 100-turbine Buckeye Wind Project (selection of most effective measures will be finalized in consultation with the USFWS).

| Mitigation measures | Expected outcomes/benefits | Measurable variables | Population Segment Benefit |
|---|---|---|---|
| **Protect and enhance P2 habitat around hibernacula** | | | |
| Establish conservation easement in perpetuity, for 87.8 ha (217.0 ac) within 11.2 km (7 mi) of a P2 hibernaculum in OH | Permanently protect existing fall swarming, foraging, and roosting areas, sustain overwinter survival of male and female Indiana bats, sustain breeding success, increase spring fitness of males and reproductive females, provide summer habitat for males, nonreproductive females, and maternity colonies. | 87.8 ha (217.0 ac) protected | Adult female, adult male and juvenile |
| Within permanently protected area, enhance or restore roosting/foraging areas by girdling, planting trees, invasives species management, creating travel corridors or other USFWS approved measures. | Shorten distance Indiana bats travel to forage before entering and when emerging from hibernation, improve roosting opportunities near hibernacula, increase overwinter survival of males and females, increase breeding success, increase spring fitness of males and reproductive females. | Enhance quality of habitat within purchased/protected land by effecting: number of roost trees, survival of planted trees invasive species composition | Adult female, adult male and juvenile |

After suitable land is acquired and/or placed in conservation easement in perpetuity, subsequent enhancement and/or restoration of land will be undertaken to improve habitat for Indiana bats. Methods used to restore or enhance degraded or suboptimal habitats will be informed by the Range-wide Indiana Bat Protection and Enhancement Plan Guidelines (PEP Guidelines; USFWS 2009b), as well as other relevant literature and input from appropriate technical experts and agencies including USFWS and ODNR DOW.

To ensure that the habitat is adequately protected with the conservation easement, any conservation easement will be provided to the USFWS and the ODNR DOW for comment, be held by a third-party conservation group approved by USFWS and ODNR DOW, and will include, at a minimum, the restriction as included in the conservation easement template (see Appendix C – USFWS Template Language to be Included in Easement and Fee Simple Conveyances):

- No Industrial Use
- No New Residential Use
- No Commercial Use
- No Agricultural Use
- No Vegetative Clearing
- Development Rights Extinguished

Because there are multiple wind projects currently being proposed within the Indiana bat range, Buckeye Wind is aware of various efforts to establish an Indiana bat mitigation bank. A mitigation bank would generally consist of blocks of suitable habitat that have been identified by the bank manager as being beneficial to Indiana bats and suitable for offsetting the effects of take. A mitigation bank could help provide a more effective mitigation strategy since resources from multiple sources could be combined. A mitigation bank would only be considered if all of the following conditions are true:

1) Use of the mitigation bank has been approved by USFWS.
2) The mitigation bank includes lands within OH.
3) If the mitigation bank has established a ratio of Indiana bat habitat acres to offset the impact of Indiana bat take, and such ratio is approved by the USFWS, then that ratio will be used to calculate the habitat mitigation required at the bank for the Buckeye Wind project. If the mitigation bank has not established such a relationship, Buckeye Wind, ODNR DOW and the USFWS may agree upon a number of acres within the mitigation bank that could be used to fulfill the remainder of the mitigation obligation to offset the impacts of take by the project.

### 6.3.1 Acres of Mitigation Calculation

Using best available information from fall swarming studies at known Indiana bat hibernacula, the density of Indiana bats per unit area surrounding hibernaculum was estimated to determine the land area size that would need to be protected and enhanced to mitigate for the impact of the take of 130.0 Indiana bats over the ITP Term. The distance traveled from hibernacula to roost trees or foraging areas was summarized from 7 telemetry studies conducted outside hibernacula during the fall swarming season (Brack 2006, Gumbert 2001, Hawkins et al. 2005, Kiser and Elliot 1996, Kurta 2000, Rommé et al. 2002, USFWS 2007; see Section 4.4.6 – Fall Swarming and Roosting). Distances traveled were associated with the population size of Indiana bats roosting in the local hibernaculum (see Figure 4-8). A linear regression line was used to summarize the pattern of increasing distances traveled from hibernacula with increasing population size at hibernacula; this formula (maximum distance traveled = 0.0006 * hibernating population + 4.8681) was then used to estimate the expected distance traveled for a P2 hibernaculum with a population size of 10,000 individuals (representing the maximum population size in a P2 Hibernaculum; Section 4.4.6 – Fall Swarming and Roosting).

Using this method, individuals using P2 hibernacula could be expected to travel a distance of 10.87 km (6.75 mi) from the hibernacula for roosting or foraging activities when they emerge from hibernation in the spring or immediately prior to winter hibernation. However, not all areas within 10.87 km (6.7 mi) of a hibernaculum would be expected to support Indiana bats. Forested areas or areas near forest edges or streams would be most likely to support Indiana bat activities. Thus, Buckeye Wind estimated the amount of forested area, plus a 60 m buffer representing the average distance between telemetry locations and the forest edge (see Figure 4-7), within an 11.2 km (7 mi) buffer around a known P2 hibernaculum in OH. This resulted in 6,370 ha (15,741 ac) of suitable habitat within an 11.2 km (7 mi) circle centered on the hibernaculum. For a P2 hibernaculum with population size of 10,000 individuals, the density of Indiana bats per area of suitable habitat is therefore 1.6 Indiana bats/ha (0.63 bat/ac). Given that density, a total of 81.3 ha (200.9 ac) would need to be conserved or restored in order to mitigate for the impact of take of 130.0 Indiana bats.

This method results in a conservative estimate of acres necessary to offset the impacts of the taking. It is known that Indiana bats may visit several hibernacula during the swarming season. Thus, densities outside hibernacula could be larger than those calculated, which would in turn decrease the amount of acres necessary to preserve for 130.0 individuals. Furthermore, Buckeye Wind used maximum distance traveled during swarming instead of average distance traveled to account for studies in which some bats with transmitters were never found (which may indicate that they traveled beyond the maximum distance observed). Still, the majority of individuals likely require an area around the hibernaculum that is smaller than that indicated by the maximum distance traveled. By using the maximum distance traveled, Buckeye

Wind calculated a larger area of use around the hibernaculum, resulting again in smaller densities and thus requiring a larger amount of acres to protect and enhance for 130.0 Indiana bats.

While it is not expected that tree clearing during Project construction will result in take of Indiana bats, Buckeye Wind proposes to mitigate for the forested areas that will be cleared during Project construction. No more than 6.5 ha (16.1 ac), or 6.8 ha (16.8 ac) for Re-design Option, of forested habitat will be cleared for the 100-turbine Project (see Section 5.2.1.1 – Wooded Habitat Removal). Buckeye Wind proposes to add an additional 6.5 ha (16.1 ac), of proposed mitigation land to the 81.3 ha (200.9 ac) to compensate for habitat lost during construction. Therefore, a total of 87.8 ha (217.0 ac) of suitable habitat within 7 miles of a Priority 2 hibernaculum in OH will be permanently protected and restored or enhanced to mitigate for the impact of the taking of 130.0 Indiana bats and to replace Indiana bat habitat that will be removed during Project construction. Because the Redesign Option will only result in impacts to an additional 0.7 acres of wooded habitat, the number of acres conserved for mitigation will not be adjusted if the Redesign Option is implemented.

### 6.3.2 Selection of Mitigation Areas

Mitigation will occur at a P2 hibernaculum in OH to maximize chances for offsetting incidental take attributable to the Project and to meet the biological goal and objective 2 of the HCP. Final selection of suitable areas for mitigation and appropriate restoration actions will be identified in cooperation with the USFWS and ODNR. The amount of funding dedicated to mitigation and the mechanism that will be used to provide funding will be detailed in Section 6.7 – Funding for the HCP.

### 6.3.3 Timing of Mitigation

Buckeye Wind proposes a 2-stage process for implementation of the mitigation plan. A staged process will help maximize efficiency of the plan and to allow for practical limitations of full plan implementation. In stage 1, Buckeye Wind will have in place all funds required to purchase and manage habitat sufficient to mitigate the first 10 years of expected Indiana bat take. At an expected average of 5.2 Indiana bats per year, the first 10 years of operation would result in the loss of 52 Indiana bats (40% of total estimated take). To offset the impacts of take for 52 Indiana bats, 35.1 ha (86.8 ac), would need to be protected (taken as a simple percentage of the total 87.8 ha (217.0 ac) as calculated in Section 6.3.1). Before beginning of commercial operation, Buckeye Wind will acquire and/or place in conservation easement the initial 35.1 ha (86.8 ac). For any amount that Buckeye Wind has not yet purchased and/or protected at the time operation begins, sufficient funds would be placed in a form of surety acceptable to the USFWS (Surety; for example, an escrow account, cash, or bond). The Surety will be sufficient to purchase and/or protect the remaining mitigation acres. While Buckeye Wind will aim to purchase and/or protect the entire 35.1 ha (86.8 ac) before the beginning of operation, all of the lands will be purchased and/or protected no later than 1 year after the beginning of operation.

Before the beginning of the eleventh year of operation (stage 2), Buckeye Wind will acquire and/or place in conservation easement the additional 52.7 ha (130.2 ac). For any portion of the 52.74 ha (130.2 ac) not actually purchased or protected by the beginning of the eleventh year of operation, sufficient funding will be provided in a Surety to purchase and/or protect the remaining mitigation acres. While Buckeye Wind will aim to purchase and/or protect the entire 52.7 ha (130.2 ac) before the beginning of the eleventh year of commercial operation, all of the lands will be purchased and/or protected no later than 1 year after the beginning of the eleventh year of commercial operation.

Alternatively, the mitigation plan could utilize any mitigation bank that has been set up and approved by the USFWS for mitigation of Indiana bats in the Midwest RU. Any mitigation bank utilized must have a geographical service area range that includes the Project and include lands within OH. Buckeye Wind will have the option to contribute to the mitigation bank at a level sufficient to offset the impacts of take for any remaining take that has not yet been mitigated (for example, if Stage 1 mitigation is complete, the mitigation bank may be used to offset the effects of take for the remaining 78 Indiana bats). The sufficient level of contribution will be determined in coordination with the USFWS and ODNR DOW (see Section 7.3.4 – Change in Mitigation Acres).

If Buckeye Wind does not ultimately erect and operate all 100 turbines, all obligations to reach the appropriate acreage in both stage 1 and stage 2 will be reduced by a proportion equal to the number of turbines erected. For example, if only 52 turbines are erected out of a planned 100 turbines, then only 52% of Incidental Take is expected: 52% of 130.0 Indiana bats, or 67.6 Indiana bats, will be the estimated total take for a 52-turbine Project. Based on the calculations described in Section 6.3.1 – Acres of Mitigation, the density of Indiana bats per acre outside a P2 hibernaculum supporting 10,000 bats would remain at 0.63 bat/ac. Given that density, a total of 43.3 ha (107 ac), plus the amount of forest cleared for a 52-turbine Project, would need to be conserved or restored in order to mitigate for the mortality of 67.6 Indiana bats.

### 6.3.4 Restoration and Enhancement

Some amount of mitigation land may require restoration and/or enhancement of wooded travel corridors and wooded riparian habitat. In general, Indiana bats have been shown to be reluctant to cross open areas. Travel corridors linking roosting and foraging habitats are an important feature of Indiana bat habitat. Therefore, a minimum travel corridor of 4 rows of trees may be planted to establish a suitable travel corridor at least 15 m (50 ft) wide (USFWS 2009b). Indiana bats may also use such corridors for foraging and roosting during swarming activities. Priority should be given to restoring riparian habitat along existing stream corridors, particularly unchannelized streams, as these would provide both travel corridors and foraging habitats. Further, existing forest stands that have been preserved as part of the mitigation plan will be assessed and enhanced if necessary girdling to create roost trees, conducting invasive species management, or creating and/or connecting travel corridors.

Methods used to restore degraded or suboptimal habitats will be informed by the Range-wide PEP Guidelines and existing forest management plans. Currently there are 3 states that have forest management plans specific to Indiana bat habitat: IN (Indiana Department of Natural Resources 2001), MO (Missouri Department of Conservation 2009), and VT (Vermont Fish and Wildlife Department 2008). In addition, 2 USFWS Field Offices have developed forest management plans: IN (USFWS – BFO 2008a) and NJ (USFWS – New Jersey Field Office 2008b). Each characterize Indiana bat habitat in the state and recommend a minimum number of snags and/or potential roost trees per acre within 3 size classes (Table 6-4).

Following these existing recommendations, tree planting and girdling will be used to create suitable Indiana bat roosting habitat in restoration areas such that, on average, there are:

- 2 small roost trees/ac less than 25 cm (10 in) dbh;
- 5 medium roost trees/ac between 25 cm (10 in) and 48 cm (19 in) dbh; and
- 2 large roost trees/ac greater than 48 cm (19 in) dbh.

**Table 6-4.** Summary of recommended number of potential roost trees per acre in existing Indiana bat forest management plans (DBH range for each size class).

| Entity | Small | Medium | Large | Tree Condition |
|---|---|---|---|---|
| IN Department of Natural Resources | | 6 (11 – 19") | 3 (> 20") | snag |
| MO Department of Conservation | | | | |
| Heavily Forested | 2 (< 10") | 4 (10 - 19") | 0.5 (> 19") | snag |
| Open/Semi-Open | 2 (< 10") | 4 (10 - 19") | 1 (> 19") | snag |
| Riparian Corridor | 4 (< 10") | 7 (10 - 19") | 1 (> 19") | snag |
| Bottomland Hardwood | 2 (< 10") | 4 (10 - 19") | 1 (> 19") | snag |
| VT Fish and Wildlife Department | 2 (< 10") | 4 (10 - 18") | 1 (> 18") | live and snag |
| USFWS Bloomington, IN Field Office | | 6 (11 - 20") | 3 (> 20") | live |
| USFWS NJ Field Office | | 6 (11 - 20") | 3 (> 20") | live |
| USFWS PEP Guidelines | | 6 (> 9") | | snag |

In unwooded corridors, or where tree density is deficient, tree planting will be used to restore Indiana bat swarming, foraging and roosting habitat. Assuming a 70% survival rate (Davis et al. 2010), approximately 430 stems/ac (less existing tree densities, if any) will be planted to achieve no less than 300 stems per acre, on average, per Planting Area (stems/ac/PA). Following planting (in Year 1), Year 2 habitat assessments will determine whether an average of 300 stems/ac/PA have survived. If not, the ratio of surviving stems to total stems planted will be calculated to determine the stem survival rate. The actual survival rate will be used to determine the number of trees necessary to plant in Year 2 in order to achieve an average of 300 stems/ac/PA in Year 3. For example, if an average of 430 stems/ac/PA are planted in Year 1, and an average of 258 stems/ac/PA survive to Year 2, the result is a success rate of 60%. In order to achieve an average of 300 stems/ac/PA, 42 (300 minus 258) additional stems/ac/PA need to survive. Since a 60% survival rate of trees planted in Year 1 was observed in Year 2, an additional 70 stems/ac/PA, on average (42 divided by 0.6) will be planted in Year 2.

Annual habitat assessments will occur in Years 1 to 5, or beyond Year 5 until an average of 300 stems/ac/PA have survived. After Year 5, or after at least an average of 300 stems/ac/PA, have been established (whichever is greatest), habitat assessments will be conducted every 5 years to ensure continued survival of planted trees and to enumerate the number of trees within each size class described above. Restoration or enhancement activities will be initiated within 1 year of the land being purchased or placed in conservation easement.

**Tree Girdling**

Girdling trees (i.e., cutting of the bark and a portion of the underlying cambium layer to create a ring-like groove encircling the base of the trunk) can create suitable Indiana bat roost trees over a period of several years. Girdling is deemed necessary in a restoration area if there are less than 2 natural snags or girdled trees of at least 25 cm (10 in) dbh per ac, less than 5 trees between 25 cm (10 in) and 48 cm (19 in) dbh per ac, and less than 2 trees greater than 48 cm (19 in) dbh per ac. Trees selected for girdling will be based on the following characteristics identified by previous research to be suitable for Indiana bat roosting: a species known to be used by Indiana bats, the tree's solar exposure and location in relation to other trees, the tree's spatial relationship to water sources and foraging areas, and tree size (USFWS 1999, 2007, Kurta et al. 2002, Kurta 2005). Trees on north-facing slopes are not recommended for girdling. Trees would be selected and marked for girdling by a person with expertise in Indiana bat biology and habitat requirements. Tree girdling will occur during the period of time when Indiana bats would not be swarming, staging, roosting, or foraging near the hibernacula (16 November – 14 March).

**Tree Planting**

A minimum of 6 different tree species from the list found in Appendix L of the PEP Guidelines (USFWS 2009b) will be targeted for planting in riparian and travel corridor restoration. The 6 species of tree will be native to OH and will consider the species composition of nearby mature forest stands with similar soil composition and landscape position. Species selection will be determined based on site-specific characteristics (soil moisture, sun exposure, etc.) and seedling availability. In order to maximize Indiana bat habitat benefits, a stocking success rate of "not less than 300 stems per acre" will be achieved (USFWS 2009b). A minimum of 4 species identified as "Exfoliating Bark Species" on the Appendix L species list will be planted, such that they comprise at least 40% of planted trees. Ash and elm tree species will be avoided due to Dutch elm disease and emerald ash borers. Low compaction grading techniques, such as the Forestry Reclamation Approach, will be used where possible to increase the survival rate of planted trees (Burger et al. 2005 as cited in USFWS 2009b). To promote survival of planted trees, tree planting may occur during the timeframe of 1 April-31 October, during the period of time when Indiana bats are active.

**Invasive Species Control**

Non-native woody and shrubby invasive species will be reduced by periodically thinning the understory to remove invasive species that would out-compete native species (USFWS 2009b). Invasive species control will occur during the period of time when Indiana bats would not be swarming, staging, roosting, or foraging near the hibernacula (16 November – 14 March). In no instance will woody invasive species be allowed to represent more than 5% of the understory. A particular focus will be given to bush honeysuckle (*Diervilla lonicera*) and tree of heaven (*Ailanthus altissima*). Bush honeysuckle, tree of heaven and other non-native, woody, invasive shrubs will be controlled through brush cutting (using bushhogs, mowers, or other similar equipment), hand cutting, and the use of herbicides if necessary (see Section 5.2.3.1 – Invasive Species Control). Herbicides may be used to paint cut stems and/or on large shrubs too big to dig or pull.

## 6.4 Conservation Measures

To help further the conservation of Indiana bats and increase knowledge related to Indiana bat-wind energy interactions, Buckeye Wind will allocate $200,000 from operating revenues for research. Funding for conservation measures will be made available from Project revenues to a qualified research program(s) after 1 year of Project operation has been completed. The funding will be assigned within 5 years of the beginning of Project operation and will be provided to appropriate private or academic institutions to conduct research on Indiana bat behavior relative to wind energy development.. . Research efforts will focus on the known population of Indiana bats in the Action Area, or on other summer or hibernating populations of Indiana bats in OH that would provide valuable information. Results of the research will be incorporated into the adaptive management of the Project, where appropriate. The assignment of funds and all research and sampling protocols will be developed in consultation with the USFWS, ODNR DOW, and appropriate scientific experts. The amount of funding dedicated to research and the mechanism that will be used to provide funding will be detailed in Section 6.7 – Funding for the HCP. Possible research topics are described below and potential methods, expected outcomes, and measurable variables are summarized in Table 6-8.

**Indiana Bat Wind Turbine Interaction Studies**

To better understand Indiana bat behavior in the vicinity of operating wind turbines, mist-netting and radio-telemetry could be used to capture and track Indiana bats in the Action Area. The 3 known roost trees in the northern portion of the Action Area or nearby suitable habitat could be targeted for mist-netting. Certain techniques could be used to investigate Indiana bat behavior, such as radio-telemetry, light-tagging or TIR camera recordings at turbines. Important behavioral characteristics or other variables that could be measured include:

- Flight height relative to the rotor swept-zone;
- Spatial use patterns relative to turbines;
- Potential attraction or avoidance of turbines;
- Activity during different weather (wind speeds, temperature, barometric pressure, and humidity);
- Nightly timing of activity; and
- Accuracy of habitat suitability model and collision risk model.

**Indiana Bat Migration Studies**

There is a paucity of information about how Indiana bats migrate, particularly during the fall, when bats, in general, are most susceptible to collision or barotrauma at wind facilities. Such information could help to validate the assumptions of the collision risk model and help to understand the extent to which Indiana bats are at risk of collision or barotrauma with wind turbines during migration at the Buckeye Wind Project or other wind facilities. Funding provided by Buckeye Wind could be used to conduct telemetry studies to better understand aspects of fall migration that may result in greater risk from wind power projects.

For fall migration studies, Indiana bats would be captured in mist nets in late August/early September, radio-tagged and followed using aircraft and/or vehicles as they depart for fall migration. Important behavioral characteristics or other variables that could be measured include:

- Whether Indiana bats follow landscape or habitat features;
- Migration speed, flight height, and duration; and
- Avoidance behavior of potential barriers to migration, such as wind power projects, urban areas, or major transportation thoroughfares.

**Table 6-5.** Summary of conservation measures to be implemented by Buckeye Wind to increase scientific knowledge of Indiana bat behavior as it relates to wind power (selection of an appropriate conservation measure will be finalized in consultation with the USFWS and ODNR DOW).

| Conservation measures | Expected outcomes | Measurable variables |
|---|---|---|
| **Fund Indiana bat wind interaction research** | | |
| Conduct radio-telemetry, light-tagging, mist netting, and/or TIR camera studies on Indiana bats during summer in Action Area | Increased understanding of Indiana bat/wind power interactions that will increase effectiveness of future minimization and avoidance measures at wind power facilities | Data on:<br>a. Flight height relative to the rotor swept-zone,<br>b. Spatial use patterns relative to turbines,<br>c. Potential attraction or avoidance of turbines,<br>d. Activity during different weather conditions including wind speed, temperatures, barometric pressure, and humidity,<br>e. Nightly timing of activity,<br>f. Accuracy of habitat suitability model and collision risk model |
| **Fund Indiana bat migration research** | | |
| Conduct fall migration telemetry studies of Indiana bats | Increased understanding of Indiana bat migration patterns that will increase effectiveness of future minimization and avoidance measures at wind power facilities | Data on:<br>a. Whether or not Indiana bats follow landscape or habitat features,<br>b. Migration flight height, speed, and duration,<br>c. Avoidance behavior of potential barriers to migration, such as wind power projects, urban areas, or major transportation thoroughfares. |

## 6.5 Monitoring and Adaptive Management

Monitoring will be used to ensure that the goals and objectives set forth in Section 1.2 – Biological Goals and Objectives are being met. In addition, monitoring studies are designed to provide information pertaining to 3 key factors:

1) Post-Construction Monitoring (PCM): PCM will be conducted at every turbine location from 1 April to 15 November during the first 1 to 2 years of monitoring, to comply with ODNR DOW's "On-Shore Bird and Bat Pre- and Post-Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio" (ODNR Protocol; ODNR 2009). Each subsequent monitoring year, monitoring will occur from 1 April to 31 October unless otherwise amended through adaptive management as

described in this chapter. The purpose of the PCM is to provide assurance that the Project is in compliance with the authorized take limits as specified in Biological Objective 1. In addition, PCM will inform changes to the feathering plan through adaptive management, which may result in increased environmental benefits from wind energy generation, thus providing a means by which to achieve Biological Objective 4.

2) Monitoring of mitigation actions will allow Buckeye Wind to measure the success of Biological Objective 2. In the case of restoration/enhancement of habitat, Buckeye Wind will monitor the habitat features within the mitigation areas subject to enhancement, including number and diameter of potential roost trees, survival of planted trees, and status of invasive species management.
3) Monitoring of potential factors influencing Indiana bat mortality: in order to enhance our understanding of the factors that contribute to increased risk of Indiana bats (Biological Objective 3), and potentially refine the feathering plan and maximize operational output of the Project (Biological Objective 4), Buckeye Wind will monitor the following factors:
    - Seasonal variation of mortality;
    - Variation in mortality with respect to turbine location and habitat; and,
    - Variation in mortality with respect to weather characteristics, including wind speed, barometric pressure, temperature, and humidity.

While this section and this HCP are focused on the Indiana bat, the post-construction monitoring methods were developed in cooperation with ODNR and will be used to also monitor for mortality of non-federally listed species. The Buckeye Wind ABPP (Stantec 2011a) provides a more specific discussion of how these approaches will be applied to monitoring for non-federally listed species.

### 6.5.1 Monitoring for Minimization

The first biological goal described in Section 1.2 – Biological Goals and Objectives pertains to minimizing take of Indiana bats to the maximum extent practicable. There are 3 biological objectives that describe measureable targets needed to achieve the goal of minimizing take:

Objective 1: Implement an operational feathering strategy that will limit mortality of Indiana bats due to collision with the turbines or barotrauma resulting from near collisions with moving blades to no more than 26 Indiana bats over any 5-year period beginning in any year in which more than the expected average morality of 5.2 Indiana bats is estimated, and not more than 130.0 Indiana bats over the 30-year ITP Term;

Objective 3: Enhance understanding of the factors that contribute to increased risk of Indiana bat collisions and barotrauma resulting from near collisions with moving blades and tailor the conservation program to meet the biological goals. Specific factors that will be considered include:

- Seasonal variation in mortality;
- Variation in mortality with respect to turbine location and habitat; and
- Variation in mortality with respect to weather characteristics (wind speed, temperature, barometric pressure, and humidity).

Objective 4: Maximize operational output of the Project, such that the environmental benefits of wind energy are maximized, thereby reducing potentially harmful effects of other energy products. In particular, increased generation from wind energy facilities will offset carbon emissions from other electric generation technologies. Carbon emissions contribute to global climate change, which has been identified as a potential risk to Indiana bats

(USFWS 2007). Other environmental benefits are also associated with wind energy (see Section 1.3.1 – Fossil Fuel Offsets and Reductions, and Section 5.4 – Beneficial Effects of Wind Energy on Indiana Bats).

Monitoring the Indiana bat mortality levels at the Project will help to ensure that the Biological Goals and Objectives 1, 3 and 4 are being achieved. Post-construction mortality monitoring will be used to ensure compliance with the terms of the ITP, and will be used to inform adaptive management actions. The specific goals of the post-construction monitoring protocol are to:

- Ensure that USFWS-authorized take of Indiana bats is not exceeded;
- Identify the circumstances and conditions under which Indiana bat fatalities are likely to occur;
- Use adaptive management to identify the operational strategies that maintain Indiana bat mortality rates within those authorized by the ITP and allow for maximal production of renewable energy;
- Provide a mechanism to evaluate the use of new technology that can be used to reduce uncertainty about Project impacts to Indiana bats over time; and
- Provide information that will increase knowledge of Indiana bat-wind energy interactions and contribute to reducing the negative impacts of current and future wind energy development on Indiana bats.

Mortality monitoring will be conducted throughout the ITP Term with a frequency and intensity that is sufficient to document that Indiana bat take is not exceeding the level authorized by the ITP. Feathering will be applied to turbines during 3 phases: 1) Evaluation Phase, 2) Implementation Phase, and 3) Re-evaluation Phase. The objective of the Evaluation Phase is to monitor Indiana bat mortality to ensure that it is at or below the authorized threshold. During the Implementation Phase, the results of the Evaluation Phase will be used to implement the most appropriate operational feathering plan as informed by adaptive management. Monitoring will be conducted during the Implementation Phase to ensure that incidental take of Indiana bats remains at or below Expected Average Mortality levels. Each Re-evaluation Phase will allow Buckeye Wind to incorporate a modified feathering plan according to the adaptive management approach described below. The Re-evaluation Phase will also allow Buckeye Wind to test new avoidance or minimization techniques that may become available, as described in Section 6.5.3.6 – Special Cases, in order to effectively minimize Indiana bat mortality while operating the Project in the most cost-effective manner. In addition, Re-evaluation Phase monitoring will be used if estimated mortality in any Implementation Phase monitoring year meets certain adaptive management criteria as described in Section 6.5.3.5 – Implementation Phase Adaptive Management.

Consistent with adaptive management, it is expected that changes may be made to monitoring methods as appropriate and in consultation with the USFWS. Changes are addressed in Section 6.5.2.9 – Adaptive Management for Minimization Monitoring.

### 6.5.2 Methods for Minimization Monitoring

Mortality monitoring will be conducted to document mortality of Indiana bats throughout the ITP Term, in accordance with the HCP and ITP. Monitoring will also document annual estimated bird and non-federally listed bat mortality caused by the Project (Stantec 2011a). The ODNR Protocol was used to guide the development of this monitoring plan, in consultation with the ODNR DOW and the Ohio Ecological Services Field Office of the USFWS. Over the ITP Term, modifications to this monitoring plan may be appropriate and will be made as part of the ongoing adaptive management of the Project and in compliance with the terms of the HCP.

Buckeye Wind will enlist the services of an independent consultant to conduct mortality monitoring. Buckeye Wind will select the consultant based on qualifications, experience, and costs and will receive a scope of work proposal from the selected consultant that provides detailed information on the consultant's qualifications. The scope will include detail on adequate implementation of the monitoring methods described in this Section 6.5.2 – Methods for Minimization Monitoring. A qualified project manager (PCM Manager) and field technicians will be assigned to oversee the day-to-day monitoring efforts. Before awarding a contract, Buckeye Wind will provide the proposal to the USFWS and ODNR DOW for approval.

If Buckeye Wind decides to change the consultant at any point during the ITP Term, the same process for selection and USFWS and ODNR DOW approval will be followed.

#### *6.5.2.1 Monitoring Phases*

Post-construction mortality monitoring will be conducted within 3 phases: the Evaluation Phase, Implementation Phase, and Re-evaluation Phase. Monitoring will be most intensive during the first years of Project operation, during the Evaluation Phase. It is expected that the Evaluation Phase will provide sufficient information to identify the level of risk to Indiana bats and to monitor compliance with the ITP. The Evaluation Phase will last for a minimum of 2 years, and will result in a feathering plan that maintains Indiana bat take at Less than Expected or Expected levels (Table 5-7).

Once a feathering plan has been identified to maintain mortality at these levels during the Evaluation Phase, the Implementation Phase will begin. Post-construction mortality will be monitored biennially during the Implementation Phase (beginning with a year of no monitoring). The level of mortality during a year when no monitoring occurs will be assumed to be the same as that from the previous year when monitoring occurred. On years when monitoring occurs, monitoring effort (i.e., search frequency, search area, vegetation management, weather monitoring, data collection, data analysis, and reporting) will be the same as during the final year of Evaluation Phase monitoring. The only difference between Evaluation and Implementation monitoring methods may be Survey Period (see Section 6.5.2.2), Search Frequency (see Section 6.5.2.3), and Search Area (see Section 6.5.2.4), all of which may change after the initial 2 years of Evaluation Phase monitoring (see Section 6.5.2.9 – Adaptive Management for Minimization Monitoring). After 4 calendar years of Implementation Phase monitoring (at which time a minimum of 2 Evaluation Phase monitoring years have been conducted as well as 2 biennial search years under the Implementation Phase), if take remains at Less than Expected or Expected levels, mortality monitoring may move to once every 3 years following the adaptive management strategy outlined in Section 6.5.3 – Adaptive Management for Minimization.

Provided that annual Indiana bat take levels are Less than Expected or Expected, the Implementation Phase will be in effect until Buckeye Wind, at their discretion, implements a Re-evaluation Phase or until/if results from Implementation Phase monitoring dictate the need to alter operations in a way that would necessitate Re-evaluation Phase monitoring. The purpose of the Re-evaluation Phase will be to monitor compliance with the ITP once new minimization measures are implemented, such as changes to operational feathering or other emerging methods or technologies to reduce mortality of Indiana bats, per Section 6.5.3 – Adaptive Management for Minimization. Because testing of new minimization techniques will introduce additional uncertainty with regard to risk to Indiana bats, methods and sampling intensity will be the same as those used during the Evaluation Phase; therefore, a minimum of 2 consecutive years of mortality searches will be conducted. Implementation Phase monitoring will again be implemented at the conclusion of each Re-evaluation Phase. The following sections will describe the details of the monitoring methods under each monitoring Phase in more detail.

#### *6.5.2.3 Survey Period*

During the initial Evaluation Phase, mortality searches will be conducted for approximately 32 consecutive weeks within 3 seasonal periods that correspond to unique seasonal behaviors of Indiana bats: spring (1 Apr to 31 May), summer (1 Jun to 31 Jul), and fall (1 Aug to 15 Nov). This will be referred to as the survey period or monitoring period. The fall monitoring period here is longer than the fall season discussed in Section 1.1 – Overview and Purpose of the HCP and elsewhere to be consistent with ODNR Protocol. After 2 years of study during the complete monitoring period, if no Indiana bat carcass is documented at the site after 31 October, and if less than 5% of all documented bat carcasses occur after 31 October, the monitoring period will be shortened to end on 31 October. The monitoring period will not be shortened such that it would end earlier than the latest discovery of an Indiana bat. If the monitoring season is shortened to end on 31 October in the Evaluation Phase, any Re-evaluation Phase monitoring will also end on 31 October (see Section 6.5.2.9 – Adaptive Management for Minimization Monitoring).

The Evaluation Phase will begin once a turbine begins to produce electricity and is operational and will encompass the spring, summer, and fall (1 April through 15 November) for at least the first 2 years of operation of that turbine. If a turbine becomes operational prior to 1 April, that year will constitute a full Evaluation year. If operation begins after 1 April, monitoring will proceed for the remainder of the active period and the turbine(s) will be subject to trigger point adaptive management as described in Section 6.5.3.4 – Trigger Point for Immediate Adaptive Management, but the following year will constitute Year 1 Evaluation Phase monitoring.

#### *6.5.2.4 Search Frequency*

Monitoring will be conducted with a sampling scheme and intensity that will ensure that the authorized level of Indiana bat mortality is not exceeded and that will provide data necessary to evaluate the feathering regime. In order to address these objectives, all operating turbines will be searched during annual Evaluation Phase monitoring, biennial or greater Implementation Phase monitoring, and Re-evaluation Phase monitoring.

Searches will be conducted using a 3-day search interval for every turbine. Under a 3-day search interval, mortality searches will occur every day of the week throughout the survey period, with approximately one third of the turbines searched every day (i.e., turbines searched on Monday would have 3 nights of potential mortality and would then be searched again on Thursday). By using a 3-day search frequency and searching every turbine, there is a positive probability of detecting an Indiana bat fatality if it occurs; whereas, if only a subset of turbines is searched, the probability of detecting an Indiana bat at the non-searched turbines is necessarily 0. The former method is therefore preferable when the goal of monitoring is to detect a rare event, such as an Indiana bat fatality (M. Huso, Oregon State University, personal communication).

In order to balance the objective of assessing Indiana bat mortality at all turbines while also providing the ODNR DOW with annual data that is more closely compatible with current ODNR Protocol (ODNR 2009), during the first 1 to 2 years of monitoring, additional searches may be conducted at a portion of turbines using a shorter search interval.

During the first 1 to 2 years of monitoring, some turbines may be searched using a shorter search interval, but in no circumstance will any turbine be searched using less than a 3-day search interval. The resulting combination of search intervals will be designed to meet the data needs of the ODNR DOW while always meeting the objectives of the HCP. Buckeye Wind and ODNR DOW will re-evaluate the combined search intervals after the first year of monitoring and determine what percent of the turbines, if any, would still need to be searched using a shorter search interval.

The goals and objective of the ODNR Protocol are different than they are for this HCP. The goals and objectives of this HCP will be met using a 3-day search interval, which will be the minimum implemented during all monitoring phases through the ITP Term, regardless of what is also implemented to meet ODNR recommendations. Mortality searches may also be conducted at all MET towers in the Action Area during the first year of Project operation, as recommended in the ODNR Protocol. Depending on the results of the first year of monitoring, Buckeye Wind and ODNR DOW will determine if monitoring at MET towers during the optional second year of post-construction monitoring may be waived, reduced, or continued. Since MET towers are not expected to pose risks to Indiana bats (See Section 4.5.5.6 – Bat Collision with Other Structure), monitoring will not continue past the first or second year after erection.

Searches will be initiated at sunrise and end by 1:00 PM in an effort to recover carcasses before removal by diurnal scavengers, as well as to increase the chances of recovering live Indiana bats (coincidentally, chances of recovering live birds and non-federally listed bats will also be increased).

#### *6.5.2.5 Search Area*

Plot size will include an area that extends 2.0 times the blade length from the base of the turbine (i.e., radius of 100 m (328 ft) for a 50 m [164 ft] blade). Results from mortality monitoring studies indicate that the majority of bird and bat carcasses fall within 50% of the maximum height of turbines (Kerns and Kerlinger 2004, Arnett 2005, Fiedler et al. 2007, Young et al. 2009a, Jain et al. 2007, 2009ab, Piorkowski and O'Connell 2010), with most bat fatalities falling within 30 m to 40 m (98 ft to 130 ft) of turbines (Kerns and Kerlinger 2004, Johnson et al. 2003a[38]). In PA, 95% of detected bat fatalities fell within 50 m (164 ft) of the turbine and 85% of bat fatalities fell within 40 m (130 ft) of the turbine at 9 sites studied between 2007 and 2009 (PGC 2011).

After 2 years of study, the search area will be adjusted to the distance within which 90% of the total bat carcasses and 100% of Indiana bat carcasses were found, not to exceed the size of the original search area. In this way, any reduction in search area will include the maximum distance that any Indiana bat carcass was found from a turbine. If the search area is reduced during Evaluation Phase monitoring, the reduced area will be utilized for any Re-evaluation Phase monitoring that may occur. See Section 6.5.2.7.3 – Searchable Area and Section 6.5.2.8.2 – Data Analysis for information on how variable search area is used as a correction factor for estimating unobserved mortality.

Search transects will be positioned north-to-south and will be spaced 5 m (16 ft) apart across search plots. In an attempt to standardize time spent searching each turbine, carcasses will be marked in the field when they are found, and will be processed after the turbine search is complete.

The entire plot size will be searched, subject to a measurable probability of finding carcasses and worker safety. In many cases, the full plot size at each turbine cannot be completely searched because of factors that make areas within the plot too difficult or too dangerous to search (Strickland et al. 2011, USFWS 2011c). Areas will be considered too difficult to search if there is little to no bare ground cover and more than 25% of the ground cover is over 12 inches in height. The PCM Manager will determine what areas and conditions present conditions that deem it too dangerous to search.

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[38] During avian and bat mortality monitoring at the Buffalo Ridge wind facility in MN in which all areas within 50 m (164 ft) of turbines were searched, only 1 of 184 bats was found greater than 30 m (98 ft) from a turbine.

Wind facilities located largely in agricultural settings, such as the Project, can present difficult searching conditions (e.g., 3 m [10 ft] tall corn). Pesticide use in agricultural settings can make conditions unsafe for workers for short periods of time after pesticide application. ODNR Protocol (2009) states that transects should not venture into hazardous areas such as steep slopes or water. Further, vegetative conditions such as tall corn can make searching difficult. In conditions of tall corn, the probability of finding a carcass along the transect line itself will be similar to the probability found in other vegetative cover; however, the probability of finding a carcass off the transect line will be close to 0. Searcher efficiency trials (see Section 6.5.2.7.1 – Searcher Efficiency Trials) are designed to adjust observed mortality by the probability that a searcher will find a carcass, given it is present. However, these trials are conducted under the assumption that a searcher is walking a transect line and searching several meters off each side of the line, which cannot be done in extremely low visibility, such as tall corn. If the probability of detecting a carcass is un-measureable given current searcher efficiency methods, or extremely low, searching these areas will likely bias mortality estimates.

ODNR Protocol (2009) requires that an estimate of searchable area be provided for each searched turbine. Most post-construction mortality monitoring uses an area correction factor to adjust mortality estimates by the amount of area searched beneath turbines (for example, see Kerns et al. 2005, Arnett et al. 2009, and Strickland et al. 2011). A simple adjustment by the proportion of areas searched below turbines cannot be used, as density of carcasses is known to decrease as distance from turbine increases (Kerns et al. 2005) – unsearched areas tend to be farthest from turbines in areas of low carcass density, so a simple adjustment based on proportion of area searched would over-estimate mortality (Arnett et al. 2009). Therefore, a function is used to relate density of observed carcasses with distance from the turbine. Within each standardized search plot, searches will therefore be focused within areas where probability of detection is measurable and search areas will be delineated by the area around each turbine that is clear of dense crops, shrubs, forested habitat, open water, large rock or rubble, or conditions that otherwise prohibit effective or safe searching conditions. For these reasons, searchable area may vary by turbine and month.

#### *6.5.2.6 Vegetation Management and Mapping*

Because vegetation influences carcass detectability, 25% of turbine search plots (i.e., 13 for the 52-turbine Project, and 25 for the 100-turbine Project) will be regularly mowed or chemically treated to remove vegetation. For those turbines where mowing will be utilized, vegetation will be maintained at a height of 4 inches or less, with less than 2% of interspersed vegetation no higher than 12 inches. Should mowing be used, Buckeye Wind will ensure scheduled mowing occurs during the day in which the turbine was searched, and after the search is completed (within 12 hours after last mortality search), to avoid carcasses being destroyed by mowing. Should other acceptable means to maintain searcher efficiency become available during the ITP Term, Buckeye Wind may change its methods (See Section 7.2.1.9 – Use of New Methods, Information, or Technological Advances).

Vegetation in all search plots will be monitored on a weekly basis by a Buckeye Wind employee or contractor hired by Buckeye Wind; the aerial extent of each ground cover type and respective vegetation heights will be recorded. Any significant changes in ground cover type will be noted (e.g., plowing, mowing, harvesting). Once during each of the seasonal periods in which searches are conducted, the aerial extent of each cover type within search plots will be mapped using a global positioning system (GPS) unit. Vegetation height and percent cover will be recorded at 10 m (33 ft) distances along each transect of the search plot. Additional GPS points will be taken at points of abrupt ground cover transition and to document conditions that cause the searchable area to be reduced (e.g., forest edge). All records and documentation will be kept on file and/or in electronic format and may be provided to USFWS on request. See Section 6.5.2.7.1 – Searcher Efficiency Trials and Section 6.5.2.7.2 – Carcass Persistence Trials for information on how ground cover will be used as a factor to estimate unobserved mortality.

#### *6.5.2.7 Weather Monitoring*

On nights preceding mortality searches, general weather conditions in the vicinity of the Project (i.e., precipitation, cloud type, cloud height, percent cloud cover, and moon phase) and notable weather events (e.g., storm or passage of a front) will be recorded on standardized datasheets. Additional weather data (i.e., wind speed, wind direction, temperature, and barometric pressure) will be downloaded by meteorological professionals associated with Buckeye Wind from an on-site permanent MET tower and a turbine nacelle for the entire survey period. At the beginning of each turbine search effort, the surveyor will record weather conditions including sky conditions, precipitation, and visibility. In addition, the surveyor will record his/her name, date, estimated wind speed, wind direction, temperature, and time searches are initiated and completed.

#### *6.5.2.8 Estimating Unobserved Mortality*

Not all fatalities will be found by surveyors during turbine searches, and the need to adjust observed carcasses by some factor in order to estimate total mortality has long been recognized (Huso 2010, Strickland et al. 2011, USFWS 2011c). Carcasses within the search area may be missed by searchers, carcasses may be removed by scavengers prior to the next scheduled search, or carcasses may land outside the searched area. If there was a direct relationship between observed carcasses and the number of individuals actually killed, then observed carcasses could be used as an index of fatalities (Huso 2010). Unfortunately, there is no direct relationship, as factors leading to imperfect detection of carcasses (i.e., searcher efficiency, scavenger removal rate, searchable area) can be site-specific and variable (Huso 2010, Strickland et al. 2011).

Many approaches have been developed to estimate fatality from observed carcasses (e.g., Erickson et al. 2004, Johnson et al. 2003b, Kerns and Kerlinger 2004, Shoenfeld 2004, Fiedler et al. 2007, Jain et al. 2009a, Arnett et al. 2010, Huso 2010, Tidhar 2010,). These approaches continue to be developed and refined as more information becomes available. In their draft Land Based Wind Energy guidance document (USFWS 2011c), the USFWS strongly recommends "that only the most contemporary equations for estimating fatality be used, as some original versions are now known to be extremely biased under many commonly encountered field conditions." Section 6.5.2.7 – Estimating Unobserved Mortality contains information on methods for calculating bias-correction factors, which will then be applied to observed mortality in order to estimate total fatality. However, in the time between creation of this HCP and commencement of post-construction mortality monitoring, and at times throughout the term of the ITP, it is highly likely that new formulas for estimating mortality based on observed carcasses will be developed.

At this time, several formulas exist that are considered to be appropriate to use under certain conditions. For example, the Huso estimator (Huso 2010) appears to be most accurate when there are low detection rates and high carcass persistence rates; the Shoenfeld estimator (Shoenfeld 2004) or the Huso estimator may be employed when carcass persistence time is shorter than the search interval; when carcass persistence time is greater than the search interval, both the Shoenfeld and Huso estimators may underestimate or overestimate (respectively) fatalities (Strickland et al. 2011). While currently appropriate formulas are described in Section 6.5.2 – Methods for Minimization Monitoring, it is expected that, as recommended by the USFWS draft guidance document (2011c), the most contemporary and most accurate equations for estimating fatality available at the time of analysis will be used. In the case that other formulas will be more appropriate, Buckeye Wind would propose to utilize those formulas for estimating unobserved mortality. The utilization of any new formulas will be made in coordination with and with the approval of the USFWS and ODNR and will be based on site-specific information.

The following sections contain information on methods for calculating bias-correction factors, which will then be applied to observed Indiana bat mortality in order to estimate total fatality. Example formulas are provided to demonstrate the basic inputs of each correction factor, though as stated above, the most appropriate formula for use will be determined based on the results of annual monitoring.

##### *6.5.2.8.1 Searcher Efficiency Trials*

Searcher efficiency rates are variable among studies at wind facilities in the United States and are largely dependent on ground cover conditions. Searcher recovery rates have ranged from 25% to 56% for small carcasses, and as high as 100% for large carcasses (Arnett 2005, Erickson et al. 2003a, Jain et al. 2007). Therefore, trials will be conducted by the PCM Manager in each year that mortality monitoring is performed to estimate searcher efficiency and carcass removal rates. Both searcher efficiency and carcass removal trial methods will remain the same during the Evaluation, Implementation, and Re-evaluation phases.

Trials will involve the placement of a minimum of 200 carcasses over the course of the monitoring year (where 1 carcass equals 1 trial) per ODNR Protocol. The same individual trial carcasses will be re-used in multiple trials over the course of the study period, and up to 20 trial carcasses may be used on a single trial day. Given that it is rare to find multiple carcasses at a single turbine (NRC 2007), "over-seeding" may occur if too many trial carcasses are placed in a small area (which may increase scavenger activity). Therefore, no more than 2 trial carcasses will be placed at any time at a single turbine (Strickland et al. 2011, USFWS 2011c). On trial days, carcasses will be placed at multiple turbines scheduled to be searched that day and will be placed at random distances from turbine towers and in a variety of cover types.

Multiple trials (at least 200) will be conducted throughout the survey period to account for changes in ground cover conditions. Recommended placement procedures range from distributing carcasses equally across ground cover types (USFWS 2011c) to having higher sample sizes in low visibility ground cover in order to obtain more precise estimates of searcher efficiency in areas contributing to higher uncertainty in overall fatality estimates (Strickland et al. 2011). No studies to date have suggested a preferred method for stratifying trial carcass placement (Strickland et al. 2011). As ground cover conditions will be highly variable throughout the survey period and from year to year, and trial schedule will be dependent upon carcass availability, the PCM Manager will attempt to distribute trials evenly across ground cover types to his or her best ability.

Bat trial carcasses in varying stages of decomposition will be marked by the PCM Manager so that trial carcasses may be distinguished from actual fatalities without the surveyor's knowledge. Non-bat surrogates (for example, mice or birds) will not be used to estimate searcher efficiency for bats. If a sufficient number of trial carcasses cannot be obtained from on-site mortality, then Buckeye Wind will attempt to obtain carcasses from outside sources. Buckeye Wind will first consult with the USFWS and ODNR DOW to identify whether either agency has a source of additional carcasses. If not, then Buckeye Wind will attempt to find a source of additional carcasses from other sources, such as academia, the Ohio Department of Health, or other wind facilities, as long as precautions can be followed to avoid spreading WNS. These precautions will follow USFWS and ODNR Protocol. To the extent that it is feasible (i.e., carcasses are in good condition and do not show signs of WNS), carcasses from Project fatalities or carcasses from elsewhere that are of species expected to be encountered during the searches will be used in trials. If nothing else is available, non-bat surrogates may be used if necessary in coordination with USFWS and ODNR DOW (see Section 6.5.2.9 – Adaptive Management for Minimization Monitoring).

A *Myotis* carcass will not be used in a trial unless its identification has been verified. Negative identification of the carcass will be verified by the USFWS and ODNR DOW through agreed upon means, which may include, but not be limited to, DNA testing by an appropriate lab (as determined in coordination with the USFWS), examination by a recognized expert or some other mutually agreeable method.

Surveyors being tested will be unaware of trial dates and locations. The PCM Manager will leave carcasses out before sunrise at search turbines and will make every effort to leave no evidence of trial set-up (e.g., vehicle or foot prints in wet grass or mud). The PCM Manager will record the following information for each carcass placed and will use the Searcher Efficiency Form as provided in the ODNR Protocol:

- Date, time of set-up, PCM Manager, and surveyor being tested;
- Turbine number;
- Carcass identification;
- Carcass distance and direction from tower;
- Ground cover type and vegetation height where carcass was placed; and
- GPS location.

After searches are completed on trial days, the PCM Manager will determine how many trial carcasses were recovered. Trial carcasses that were not found the first day will be left in place for possible detection on subsequent days. The presence of the trail carcass (i.e., availability for detection) will be determined and recorded by the PCM Manager each day immediately after the completion of each searcher efficiency trial day.

Searcher efficiency rate will be expressed as the proportion of trial carcasses found by searchers (the number of trial carcasses found by searchers divided by the total number of trial carcasses placed during searcher efficiency trials, i.e., searcher efficiency = number found/total number placed). Searcher efficiency will be calculated separately by season and by vegetation cover type (such as cleared versus uncleared plots) as trial carcasses are available and as sample sizes allow. Each trial carcass collected during mortality surveys will be associated with a searcher efficiency value specific to the season, trial carcass type, and cover type in which it was found. If alternative formulas are developed over time, the formula determined to be most applicable to the Project and most accurate at the time of analysis will be chosen in coordination with the USFWS and ODNR DOW (see Section 6.5.2.7 – Estimating Unobserved Mortality). Separate searcher efficiency rates will be developed for all bats and *Myotis* bats, as trial carcasses are available and as sample sizes allow.

##### *6.5.2.8.2 Carcass Persistence Trials*

Trials will be conducted to estimate the carcass persistence rate, or the average length of time carcasses remain in the area prior to removal by scavengers. Per ODNR Protocol (2009), a minimum of 50 trial carcasses will be placed at random distances and directions from turbines over the course of each monitoring year (subject to carcass availability). Several trial carcasses will be placed per month during the course of the survey year in order to account for seasonal changes of scavenger activity, per ODNR protocol (2009). Carcasses in fresh condition will be used in trials and will be marked discreetly to differentiate them from actual fatalities. Non-bat surrogates (for example, mice or birds) will not be used to estimate carcass persistence rates for bats, unless nothing else is available. If nothing else is available, non-bat surrogates may be used if necessary in coordination with USFWS and ODNR DOW (see Section 6.5.2.9 – Adaptive Management for Minimization Monitoring). Preferably, carcasses used for trials will be those collected from the site (ODNR 2009).

Trial carcasses will be randomly placed and stratified across various habitat types in proportion to their occurrence (for example, if 90% of the area under turbines is agricultural, then 90% of trial carcasses will be randomly placed in agricultural settings). Carcasses will be placed at cleared and uncleared search plots. Trial carcasses will be randomly placed at multiple turbines throughout the monitoring area and will be checked daily for the first 7 days, then every 2 days until the trial carcass is removed or completely decomposed, per ODNR (2009) protocol. On each day the trial carcass is checked, surveyors will indicate whether the trial carcass is present (intact, or partially scavenged but readily detectable) or absent (completely removed, or with so few feathers or tissue that they are not readily detectable). The following additional information will be recorded on standardized datasheets for each trial carcass:

- Date, time of set-up, PCM Manager;
- Turbine number;
- Carcass identification;
- Carcass distance and direction from tower;
- Ground cover type and vegetation height where carcass was placed;
- Detailed notes describing any scavenging and evidence of scavenger identification; and
- GPS location.

There are several formulas currently available to estimate carcass persistence rate, and new methods are continuously being developed (see Section 6.5.2.7 – Estimating Unobserved Mortality). In coordination with the USFWS, the formula determined to be most applicable to the Project and most accurate at the time of analysis will be used. Using an example estimator employed by Erickson et al. (2004) and Tidhar (2009), the average number of days a carcass remained at a site before it was removed by scavengers ($\bar{t}$) was expressed as:

$$\bar{t} = \frac{\sum_{i=1}^{s} t_i}{s - s_c}$$

- Where *s* is the number of test carcasses used in the search trials,
- $s_c$ is the number of test carcasses remaining in the study area at the end of the trial, and
- $t_i$ is the number of days carcass *i* remained in the study area.

If all trial carcasses are removed before the end of the 14-day trial, then $s_c$ is equal to 0 and *t* is equal to the arithmetic average number of days each carcass remained in the study area.

Other methods currently in use calculate the number of trial carcasses remaining after the average time between impact and discovery (Jain et al 2009a) or calculate the probability that a trial carcass was not removed in the interval between searches (Arnett et al. 2010). The formula determined to be the most applicable to the Project and the most accurate at the time of analysis will be used, pending USFWS approval (USFWS 2011c). Separate carcass persistence rates will be developed for all bats and *Myotis* bats, as trial carcasses are available and as sample sizes allow. Carcass persistence will also be calculated separately by season and by vegetation cover type (such as cleared versus uncleared plots) as trial carcasses are available and as sample sizes allow. Each carcass collected during mortality surveys will be associated with a carcass persistence value specific to the season, carcass size, and cover type in which it was found.

It is expected that, as recommended by the USFWS draft guidance document (2011c), the most contemporary and most accurate equations for estimating fatality available at the time of analysis will be used. In the case that other formulas will be more appropriate, Buckeye Wind would propose to utilize those formulas for estimating unobserved mortality. The utilization of any new formulas will be made in coordination with and with the approval of the USFWS and will be based on site-specific information (see Section 6.5.2.7 – Estimating Unobserved Mortality).

#### 6.5.2.8.3 Searchable Area

Searchable area around each turbine may vary by turbine and month; therefore, vegetation mapping will be conducted on a weekly basis to record the aerial extent of each ground cover type and respective vegetation heights. There are several methods currently available to adjust estimated mortality by searchable area, and new methods are continuously being developed (see Section 6.5.2.7 – Estimating Unobserved Mortality). In coordination with the USFWS, the method and formula determined to be most applicable to the Project and most accurate at the time of analysis will be used.

One method is to adjust mortality estimates to account for area searched and distribution of carcasses around turbines following Young et al. (2009a). Density of carcasses decreases as distance from turbines increases (Kerns et al. 2005). Therefore, an area adjustment calculates the density of carcasses within distance bands, centered on the turbine. The adjustment relates the density of carcasses within each distance band with the proportion of area searched in the same band, resulting in a factor by which estimated mortality is adjusted to account for unsearched areas.

With this example method, a multiplier, *A*, is calculated based on the percentage of area searched within circular bands of fixed radius surrounding each turbine, searcher efficiency, and numbers of carcasses found within each band. An estimate of *A* is then calculated according to the following formula:

$$A = \frac{\sum_{k'=1}^{7} \frac{c_{k'}}{p_{k'} s_{k'}}}{\sum_{k'=1}^{7} \frac{c_{k'}}{p_{k'}}}$$

- Where $c_k$ = the number of carcasses within the kth distance band,
- $p_k$ = searcher efficiency, and
- $s_k$ = the proportion of area searched within the kth distance band across turbines.

Estimates of *A* are calculated separately for season and carcass type. Estimated mortality is derived by multiplying total observed mortality *"m"* (see Section 6.5.2.8.2 – Data Analysis) by *A*.

### 6.5.2.9 Data Collection and Analysis

#### 6.5.2.9.1 Data Collection

The staff from the independent consultant, under the supervision of the PCM Manager, will collect and analyze mortality data. During searches, a trained surveyor will walk slowly looking for carcasses on either side of the search transect. All intact bat (and bird) carcasses or remnants of scavenged carcasses (e.g., a cluster of feathers representing more than a molt, or a patch of skin and bone) will be documented at fatalities. Surveyors will be trained by the PCM Manager to follow the appropriate protocol when performing the transect searches:

- Surveyors will be trained to walk proper transects in the appropriate time intervals within search plots (see Section 6.5.2 – Methods for Minimization Monitoring).
- For each individual carcass found, the site will be flagged and returned to after the turbine search has been completed.
- Once relocated, a photograph and GPS point will be taken of the carcass before it is moved.

- The carcass will be collected in individual re-sealable plastic bags, and the carcass identification number will be written in pencil on a piece of write-in-the-rain paper and enclosed with the carcass.
- To the extent possible, the PCM Manager will distinguish turbine-related fatalities from those that occurred as a result of collisions with MET towers, electrical collection lines, vehicles, or other sources of mortality.
- For the first 2 years, all carcass data will be recorded on the ODNR DOW's standard Fatality Reporting Form as provided in the ODNR Protocol. After the first 2 years, Buckeye Wind will use a form suitable to record all relevant data, with a preference for the Fatality Reporting Form, or some derivative thereof, to allow for consistency. Whatever form is used, the information detailed below will be recorded for each carcass or injured bat (and bird) found.
- If an injured bat is encountered, a qualified and licensed rehabilitator will be contacted by the PCM Manager as soon as possible and at least within 24 hours. All data collected for fatalities will be collected for injured bats.

Carcasses or injured animals found incidentally (i.e., in non-search areas or outside the study period) within the Action Area, either by surveyors or other site personnel, will also be documented and/or collected, but will be reported separately from those found during planned searches and will not be included in calculations of fatality estimates. If a carcass is found incidentally within a standard search area, the carcass will be left undisturbed. Operations and maintenance personnel will be instructed to notify the PCM Manager and to document incidental findings but instructed not to pick up carcasses, unless the carcass is found in a search area, in which case no action will be taken and the carcass will be left for formal searchers. The following information will be recorded for each carcass found, whether during a search or incidentally using the Fatality Reporting Form, or some derivative thereof:

- If the individual is alive, the PCM Manager should be immediately notified.
- For each deceased individual, the site should be flagged and returned to after the turbine search has been completed. Once relocated, the following data will be collected:
    - A photograph should be taken of the carcass before it is moved;
    - Date, time, and surveyor identification;
    - Location (turbine, MET tower, etc.) at which the carcass was found;
    - Search type during which the carcass was found (i.e., turbine search, MET tower search, or incidentally);
    - Distance (determined with a laser range finder) and compass direction of carcass from turbine tower, etc.;
    - GPS location of carcass;
    - Ground cover type, height, and condition (i.e., wet, dry) where carcass was found, as well as proximity to habitat features (stream, forest, wetland);
    - All other information on the "Fatality Reporting Form" should be recorded.
- The carcass should be collected in individual re-sealable plastic bags and the carcass identification number written in pencil on a piece of write-in-the-rain paper and enclosed with the carcass.
- Carcass species identification, age (juvenile or adult), sex, and reproductive condition (to the extent possible); the PCM Manager will be available to identify species as needed.
- Carcass condition (estimate of number of days decomposed, if they are live/injured, intact or scavenged and/or level of scavenging activity).
- If applicable, notes will be recorded to indicate why a carcass was not believed to be a turbine-related fatality.
- Evidence of scavenger activity (e.g., tracks or scat) in the vicinity of the carcass.

Prior to initiation of mortality searches, Buckeye Wind and its contractors will obtain the appropriate state and federal permits necessary for the collection and possession of Indiana bats (and other bats and birds), including permits for euthanizing bats if necessary. Surveyors will be trained by the PCM Manager on the proper handling of live birds and bats in the event that they are found. Any individual that handles live bats will maintain an up-to-date rabies vaccination.

During Implementation Phase monitoring years in which no formal post-construction monitoring is performed, carcasses found incidentally will be reported in a similar way. Because a PCM Manager will not be on site during non-monitoring years, incidentally found carcasses will not be collected and will not be included in calculation of fatality estimates.

If allowed under the conditions of state and federal collection permits, efforts will be made to bring live but injured animals to the closest licensed wildlife rehabilitator able to take that species. A list of local, licensed wildlife rehabilitators that are capable of accepting regional bird and bat species will be developed and provided to searchers and the PCM Manager. A qualified and licensed rehabilitator will be contacted by the PCM Manager as soon as possible and at least within 24 hours to ensure that the animal has the best chance of survival. If rehabilitator determines that successful rehabilitation is not likely, then the individual will be humanely euthanized through cervical dislocation. If the individual is a state or federal protected species, the appropriate agency will be contacted immediately upon detection of the live individual and before it is euthanized (if necessary), per the ODNR Protocol. If rehabilitation efforts are not successful, the fatality will be recorded as an incidental fatality and included in annual reports as such. It will be recorded as incidental because it will likely not be possible to confirm that the mortality was caused solely by turbine-related collision or barotraumas or if other factors contributed to the mortality.

The ODNR DOW and USFWS OH field office supervisor and project biologists will be notified within 24 hours via email if a suspected or confirmed Indiana bat carcass or other federally listed species carcass is found. All *Myotis* bats that are not suspected or confirmed to be an Indiana bat will be collected and provided to ODNR DOW and/or USFWS for inspection and identification verification. These carcasses should be frozen and given to the ODNR DOW at a prearranged date (at least annually). Bats within the *Myotis* genus are difficult to differentiate and should not be used for scavenging rate or searcher efficiency trials unless negative identification is achieved and approved by ODNR DOW and USFWS. Identification of *Myotis* carcasses will be verified by the USFWS and ODNR DOW through agreed upon means, which may include, but not be limited to, DNA testing by an appropriate lab (as determined in coordination with the USFWS), examination by a recognized expert or some other mutually agreeable method. Genetic testing may be performed if the species of a bat is unclear and it is necessary to confirm the carcass identification. Buckeye Wind may elect to conduct a DNA analysis to accurately identify a *Myotis* carcass. If any other OH endangered or threatened species is found, it will be reported to the ODNR DOW within 48 hours and arrangements will be made to deliver the carcass to the ODNR DOW.

##### *6.5.2.9.2 Data Analysis*

To estimate total annual bat and Indiana bat fatalities on a total Project, per turbine, per MW, and per rotor-swept area basis, the following data from mortality monitoring will be used:

- Number of carcasses found;
- Searcher efficiency rate, expressed as the percentage of carcasses recovered during searcher efficiency trials;
- Carcass persistence rate, expressed as the length of time a carcass is estimated to remain at a turbine and be available for detection by the searchers;
- Proportion of searchable area below each turbine; and

- Estimate of the number of carcasses that fell in unsearchable areas.

If searcher efficiency and carcass persistence rates specifically for *Myotis* bats are available, these will be used to estimate annual Indiana bat mortality.

There are a variety of estimators that have been developed to establish annual mortality at wind facilities and new methods are constantly evolving (see Section 6.5.2.7 – Estimating Unobserved Mortality). In coordination with the USFWS, the formula determined to be most applicable to the Project and most accurate at the time of analysis will be used. One example method currently in use is to estimate the probability that a carcass remains in the study area (i.e., is not scavenged) and is detected by a searcher (Erickson et al. 2004, Tidhar 2009):

$$\hat{\pi} = \frac{\bar{t} \cdot p}{I} \cdot \left[ \frac{e^{\frac{I}{t}} - 1}{e^{\frac{I}{t}} - 1 + p} \right]$$

- Where *I* is the search interval (equals 1 for daily searches or 7 for weekly searches);
- *p* is the searcher efficiency rate; and
- *t* is the carcass persistence rate.

In this example, the mortality adjustment ($\pi$) represents the likelihood that a carcass would be found by searchers after multiple survey days, combining search interval, searcher efficiency, and carcass persistence rates. Total mortality (*m*), or the number of mortalities estimated per turbine during a survey period, can be calculated as:

$$m_i = A \cdot \frac{\overline{c_i}}{\hat{\pi}}$$

- Where *A* = the adjustment for unsearchable areas under turbines;
- *c* = the average number of fatalities documented per searched turbine; and
- $\pi$ adjusts for searcher efficiency and scavenger removal rates.

Since there is no way to directly estimate variances for any of the available formulas, bootstrapping methods will be used to estimate 95% confidence intervals surrounding each estimate. Confidence intervals for searcher efficiency are calculated by choosing 5,000 random samples (with replacement) from the trial data set and calculating a searcher efficiency rate for each sample. Confidence intervals for carcass persistence rates are calculated by choosing 5,000 random samples (with replacement) from the trial data set and calculating a carcass persistence rate for each sample. An additional 5,000 samples of observed mortality are derived by choosing random turbines 5,000 times and summing the total number of carcasses found at each turbine in the sample. The mortality adjustment ($\pi$) and total mortality (*m*) are calculated for each bootstrapped sample (Erickson et al 2004).

Model results, calculated as the mortality rate per-turbine, will be used to estimate annual mortality of Indiana bats and other bat species (as well as birds, concurrently) on a total Project, per turbine, per MW, and per rotor-swept area basis. It should be noted that the mortality estimators developed for wind facilities to date have been designed to determine overall estimated mortality rates for bats for a project, rather than to determine estimates of mortality for certain species or species groups. The precision of mortality estimates increases with the number of carcasses found (Sonnenberg and Erickson 2010). Therefore, extrapolating estimated mortality from rare events can increase the uncertainty in resulting mortality estimates.

However, mortality estimate precision is improved with increased effort, increased carcass persistence, and increased searcher efficiency (Sonnenberg and Erickson 2010). The reliability of mortality estimates can also be improved by having accurate searcher efficiency and carcass persistence rates. Indiana bat mortality should be calculated based on searcher efficiency and carcass persistence rates derived specifically from Indiana bat carcasses; however, Indiana bats cannot be used for carcass trials. Therefore, searcher efficiency and carcass persistence rates for little brown, northern long-eared and big brown bats, or other appropriate non-federally and non-state listed bat species will be used as a surrogate for Indiana bats (in consultation with USFWS), if sufficient numbers of carcasses from these species are available. If insufficient numbers of appropriate surrogate bat species are available, searcher efficiency and carcass persistence rates derived from trials using all bats will be used to estimate take of Indiana bats.

Because these efforts are expected to result in reliable detection probabilities, mean estimates of annual Indiana bat mortality will be used to determine compliance with the authorized level of Indiana bat take. Further, if no Indiana bats are found during mortality searches, then estimates of Indiana bat mortality cannot be reasonably made (M. Huso, Oregon State University, personal communication) and mortality will be presumed to be zero for purposes of evaluating ITP compliance.

A report will be prepared annually containing a presentation of the information as described in the HCP Section 6.5.5 – Reporting.

#### *6.5.2.10 Adaptive Management for Minimization Monitoring*

Buckeye Wind will adjust monitoring protocol according to the results of the first 2 years of Evaluation Phase monitoring. Specifically, adjustments to Survey Period, survey frequency and Search Area will be made.

During the initial Evaluation Phase, mortality searches will be conducted for approximately 32 consecutive weeks within 3 seasonal periods that correspond to unique seasonal behaviors of Indiana bats: spring (1 Apr to 31 May), summer (1 Jun to 31 Jul), and fall (1 Aug to 15 Nov). The fall monitoring period here is longer than the fall season discussed in Section 1.1 and elsewhere to be consistent with ODNR protocol. After 2 years of study, if no Indiana bat carcasses are documented at the site after 31 October, and if less than 5% of all documented bat carcasses occur after 31 October, the monitoring period will be shortened to end on 31 October. The monitoring period will not be shortened such that it would end earlier than the latest discovery of an Indiana bat. If the monitoring season is shortened to end on 31 October in the Evaluation Phase, any Re-evaluation Phase monitoring will also end on 31 October.

At each searched turbine, north-south oriented transects will be established every 5 m (16 ft). The length of transects and the perpendicular distance that transects will extend from the turbine base will be equal to twice the blade length of the turbine being searched, resulting in a search area with radius of 100 m (328 ft). After 2 calendar years of monitoring during the complete monitoring period, the search area will be adjusted to the distance within which 90% of all bat carcasses, or 100% of Indiana bat carcasses are found, whichever is greater.

A minimum of 200 searcher efficiency trials and 50 carcass persistence trials will be conducted during monitoring, subject to carcass availability. However, the more successful the Project is at minimizing mortality, the more difficult it will be to obtain sufficient carcasses for trials. Further, sensitive species cannot be used for trials, so if additional bat species become federally or state listed during the course of Project operation, then these carcasses will be unavailable for trials. Finally, given the yearly spread of WNS it may not be advisable to import carcasses from other sources.

If a sufficient number of trial carcasses cannot be obtained from on-site mortality, then Buckeye Wind will attempt to obtain carcasses from outside sources. Buckeye Wind will first consult with the USFWS and ODNR DOW to identify whether either agency has a source of additional carcasses. If not, Buckeye Wind will attempt to find a source of additional carcasses from other sources, such as academia, the Ohio Department of Health, or other wind facilities, as long as precautions can be followed to avoid potential spreading of WNS. These precautions will follow USFWS and ODNR Protocol. If nothing else is available, non-bat surrogates may be used if necessary in coordination with USFWS and ODNR DOW.

### 6.5.3 Adaptive Management for Minimization

Based on the best scientific information available, Buckeye Wind expects this HCP to achieve the goals and objectives set forth in Section 1.2 – Biological Goals and Objectives. However, since there have been only 3 documented cases of Indiana bat mortality due to wind turbines, uncertainty exists regarding Project impacts to Indiana bats. Therefore, implementation of this HCP will adopt an adaptive management approach. A key aspect of adaptive management will be the "systematic acquisition of reliable information" (Wilhere 2002), which will be used to refine the management of the Project over time. In accordance with the Five-Point Policy (65 Fed. Reg., 35241-35257), information collected through the monitoring program will be used to examine the effectiveness of minimization measures and to develop alternative strategies to refine management actions over time. By integrating new information as it becomes available, adaptive management will be used to help reduce uncertainty in the effectiveness of avoidance and minimization measures and maximize protection of Indiana bats.

Currently, key uncertainties exist regarding wind power and Indiana bats in the following areas: which cut-in speed(s) reduces mortality to the maximum extent practicable; the weather conditions that influence mortality; the exact dates and the extent to which key seasonal periods influence risk to Indiana bats; and, the extent to which locating turbines in various habitat categories influences risk. Buckeye Wind proposes to monitor the factors relating to each of these uncertainties, as described in the previous section, in conjunction with post-construction mortality monitoring. The results of post-construction monitoring will be analyzed to document relationships between mortality and any of the above uncertainties. Based on the findings of post-construction monitoring and monitoring of these additional factors, the feathering regime will be adjusted as prescribed below.

Mortality monitoring will be the primary method used to acquire new information about Project effects, and adaptive management decisions will be made within the context of the take thresholds defined in Section 5.1.2.5.3 – Estimated Take with Feathering. Broadly speaking, results of the Evaluation Phase could range from Less than Expected Average Mortality of Indiana bats (i.e., 5.2 or less per year) to Greater than Expected Average Mortality of Indiana bat mortality (i.e., greater than 5.2 per). If Greater than Expected Average mortality is observed in any single year, adaptive management will be implemented to bring mortality to Expected or Less than Expected Average (i.e., 5.2 or fewer Indiana bats) in order to maintain mortality to within authorized 5-year and 30-year annual take levels. Because mortality rates can vary seasonally as well as spatially, and a complex matrix of possible mortality patterns could be observed, a range of possible adaptive management actions may be employed based on an evaluation of impacts to the Indiana bat:

- Adjusting cut-in speeds based on Indiana bat mortality rates;
- Adjusting cut-in speeds based on mortality rates as they correlate to weather conditions (wind speeds, temperature, barometric pressure and humidity;
- Adjusting cut-in speeds based on mortality rates as they correlate to habitat categories;
- Based on the temporal distribution of mortality rates, modifying the seasonal timing of feathering (i.e., the dates that define each season) and/or the cut-in speeds in particular seasons;
- Changing specific turbines subject to feathering; and
- Changing specific turbines included in Implementation or Re-evaluation Phase monitoring.

#### *6.5.3.1 Adaptive Management Criteria*

At the end of Year-1 of the Evaluation Phase, annual mortality of Indiana bats will be calculated. To calculate the estimated Indiana bat take number from the results of monitoring, a correction factor using searcher efficiency and carcass removal rates and searchable area will be used (see Section 6.5.2.7 – Estimating Unobserved Mortality). Confidence intervals will indicate the degree of precision associated with estimates of annual mortality; however, adaptive management decisions will be based on the average annual mortality estimate and not on the confidence intervals surrounding it. Adjustments to the feathering plan may be implemented during subsequent years of the Evaluation Phase based on the results of the monitoring efforts and as appropriate to meet the Biological Goal and Objectives 1, 3 and 4, as described in the following sections. Trigger points for adaptive management will be used to indicate the need for action before end of the year estimates can be made. If trigger point adaptive management is implemented in any year (see Section 6.5.3.4 – Trigger Point for Immediate Adaptive Management), the following year will proceed as if Greater than Expected Average mortality was observed in Year 1 (increase cut-in speeds and proceed with at least 2 more years Evaluation Phase monitoring [see Section 6.5.3.3 – Greater than Expected Average Mortality of Indiana Bats in Year 1]).

Since it is not expected that significant numbers of Indiana bat carcasses will be documented, some adaptive management will be informed by observations of other *Myotis* species. While the correlation between Indiana bat mortality and overall *Myotis* mortality has not been definitively established, it is expected that there are substantial similarities within the species group and the use of *Myotis* mortality data will provide additional confidence for adaptive management decisions in the absence of significant numbers of Indiana bat carcasses.

#### *6.5.3.2 Expected or Less than Expected Average Mortality of Indiana Bats in Year-1*

If Expected or Less than Expected Average Take is estimated to have occurred during Year-1 based on post-construction mortality monitoring data (i.e., 5.2 Indiana bats or less estimated), cut-in speeds can be reduced by 0.5 m/s for Year-2 at all turbines. Buckeye Wind may also choose maintain the same cut-in speeds for Year-2 (Figure 6-1).

If Expected or Less than Expected Average mortality is again estimated at the conclusion of Year-2, the Project could enter the Implementation Phase of monitoring using the Year-2 cut-in speeds, or cut-in speeds can again be adjusted an additional 0.5 m/s downward during Year-3 at all turbines, followed by an additional year (Year-3) of Evaluation phase monitoring. This annual reduction of cut-in speeds can be continued as long as Expected or Less than Expected Average mortality levels are calculated. However, a minimum of 1 additional year of Evaluation Phase-level monitoring will be conducted for any adjusted feathering level to verify its effectiveness prior to the initiation of the Implementation Phase.

If, after 2 years of Evaluation phase monitoring, or after any additional year of Evaluation phase monitoring, mortality patterns suggest certain factors pose significantly less risk to Indiana bats, additional adaptive management actions could be implemented:

- **Seasonal Considerations:** If it is observed that between 0% and 5% of the cumulative number of all documented Indiana bat fatalities occurs in any season(s) and less than 10% of the cumulative number of all *Myotis* fatalities is also documented in the same season (not limited to just 1 season), cut-in speeds can be reduced by 0.5 m/s within that season(s).

- **Habitat Considerations:** If it is observed that between 0% and 5% of the cumulative number of all documented Indiana bat fatalities occurs in 1 habitat category, and less than 10% of the cumulative number of all *Myotis* fatalities is also documented in the same habitat category, cut-in speeds can be reduced by 0.5 m/s within that habitat category.
    - For example, if 65% of all turbines are located in habitat Category 4, cut-in speeds could be reduced if 3.25% (65% x 5%) or less of all observed Indiana bat mortality and 6.5% (65% x 10%) or less of all observed *Myotis* mortality is observed for all Category 4 turbines.

- **Weather Considerations:** If it is observed that 0% of all documented Indiana bat fatalities occurs above or below any particular extreme in any one weather condition, and less than 5% of the cumulative number of all *Myotis* fatalities is also documented beyond the same weather extreme, cut-ins speeds can be reduced by 0.5 m/s beyond that weather extreme. The evaluation and any adaptive management actions that would adjust cut-in speeds will be implemented on a season specific basis. Specific weather conditions that will be monitored include:
    - Wind speed
    - Barometric pressure
    - Temperature
    - Humidity

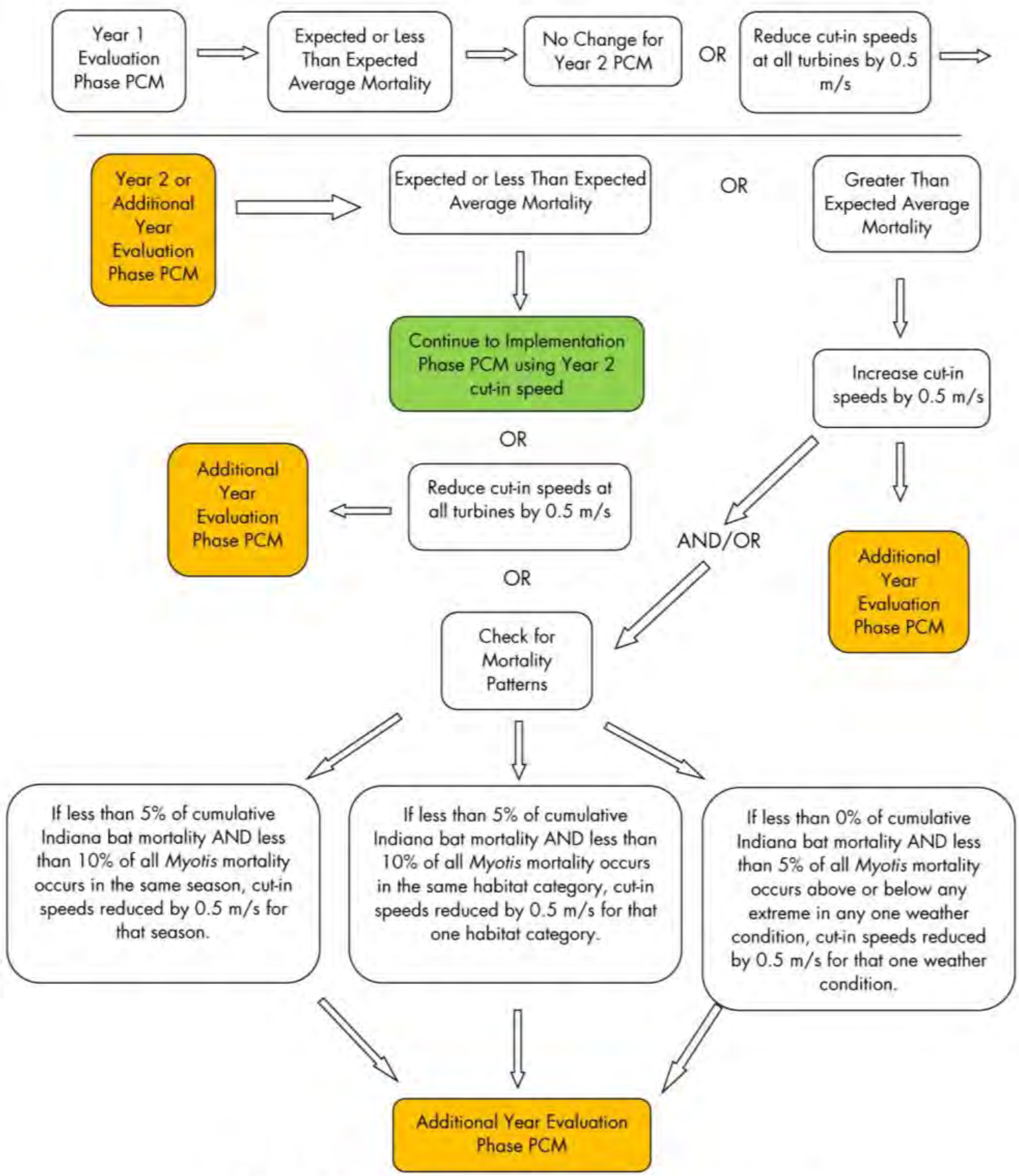


**Figure 6-1.** Adaptive management decisions for Expected or Less Than Expected average mortality of Indiana bats in Year 1.

Any adjustments will be followed by an additional year of Evaluation phase monitoring. If subsequent Evaluation phase monitoring indicates that Expected or Less than Expected Average mortality occurs with implementation of adaptive management, the adjusted cut in speeds will be utilized throughout the Implementation phase. If Greater than Expected Average mortality occurs, the feathering plan will revert to the previous levels and an additional year of Evaluation phase monitoring will occur to confirm that the mortality levels have returned to Expected Average or Less Than Expected Average levels. Implementation Phase monitoring will not begin until at least 1 year (and 2 years total) of Expected or Less Than Expected Average has been recorded. In no instance will the cut-in speeds of any particular turbine be decreased by more than 0.5 m/s in any one year.

#### *6.5.3.3 Greater than Expected Average Mortality of Indiana Bats in Year-1*

If Greater than Expected Average annual Indiana bat mortality (i.e., more than 5.2 Indiana bats) is estimated to occur during Year-1 based on the post-construction mortality monitoring data, or at any point during the monitoring year, but the triggers for immediate adaptive management as specified in Section 6.5.3.5 are not reached, then cut-in speeds at all turbines will be immediately raised by 0.5 m/s. The increased cut-in speeds will apply to all turbines during Year-2 unless mortality patterns suggest certain factors pose significantly less risk to Indiana bats (Figure 6-2):

- **Seasonal Considerations:** If it is observed that between 0% and 5% of the cumulative number of all documented Indiana bat fatalities occurs in any one season and less than 10% of the cumulative number of all *Myotis* fatalities is also documented in the same season (not limited to just 1 season), cut-in speeds can remain unchanged within that season for Year 2 Evaluation phase monitoring.

- **Habitat Considerations:** If it is observed that between 0% and 5% of the cumulative number of all documented Indiana bat fatalities occurs in 1 habitat category, and less than 10% of the cumulative number of all *Myotis* fatalities is also documented in the same habitat category, cut-in speeds can remain unchanged within that habitat category for Year 2 Evaluation phase monitoring.
    - For example, if 65% of all turbines are located in habitat category 4, cut-in speeds could remain unchanged if 3.25% (65% x 5%) or less of all observed Indiana bat mortality and 6.5% (65% x 10%) or less of all observed *Myotis* mortality is observed for all category 4 turbines.

- **Weather Considerations:** If it is observed that 0% of all documented Indiana bat fatalities occurs above or below any particular extreme in any one weather condition, and less than 5% of the cumulative number of all *Myotis* fatalities is also documented beyond the same weather extreme, cut-ins speeds can be reduced by 0.5 m/s or remain unchanged beyond that weather extreme. The evaluation and any adaptive management actions that would adjust cut-in speeds will be implemented on a season specific basis. Specific weather conditions that will be monitored include:
    - Wind speed
    - Barometric pressure
    - Temperature
    - Humidity

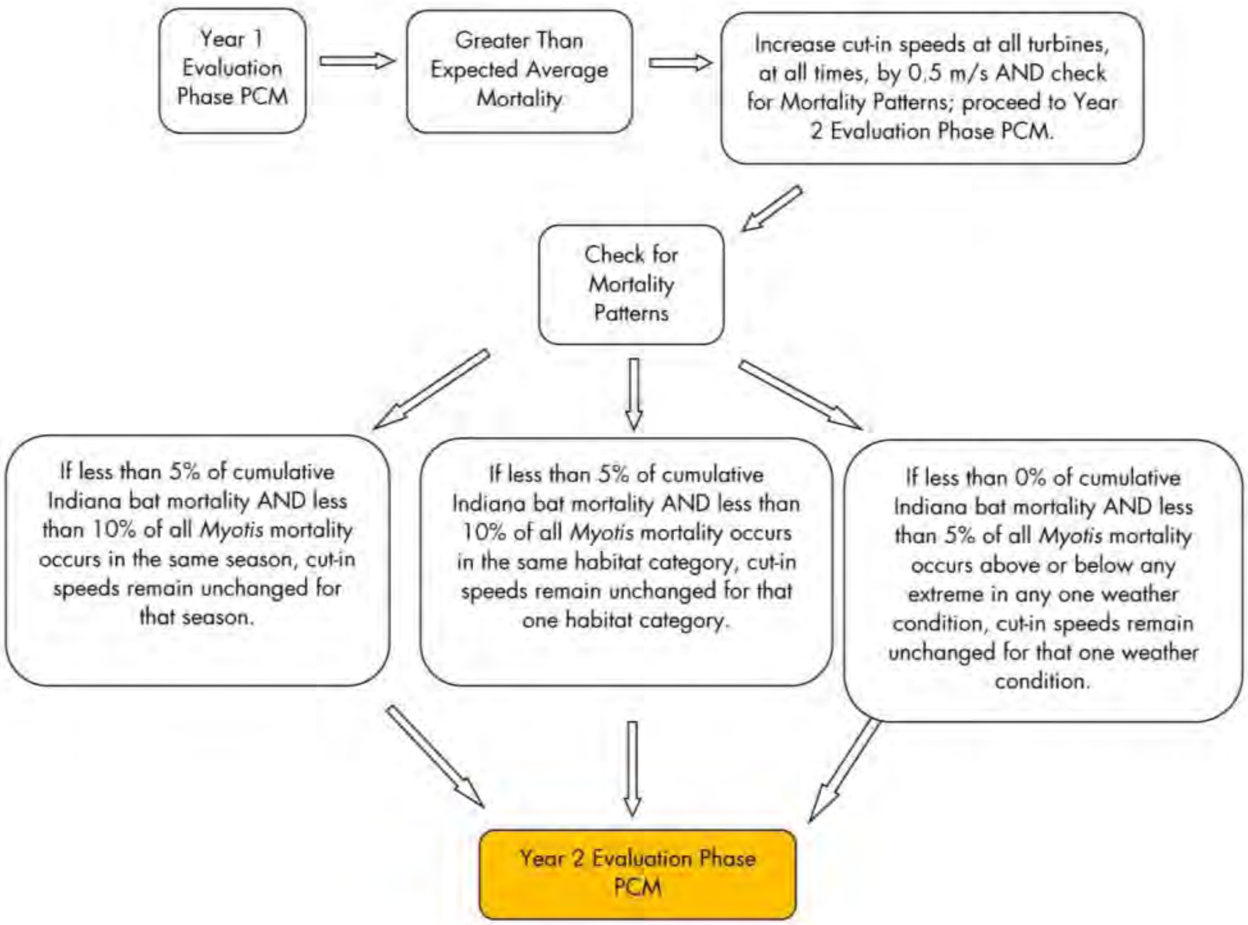


**Figure 6-2.** Adaptive management decisions for Greater Than Expected average mortality of Indiana bats in Year 1.

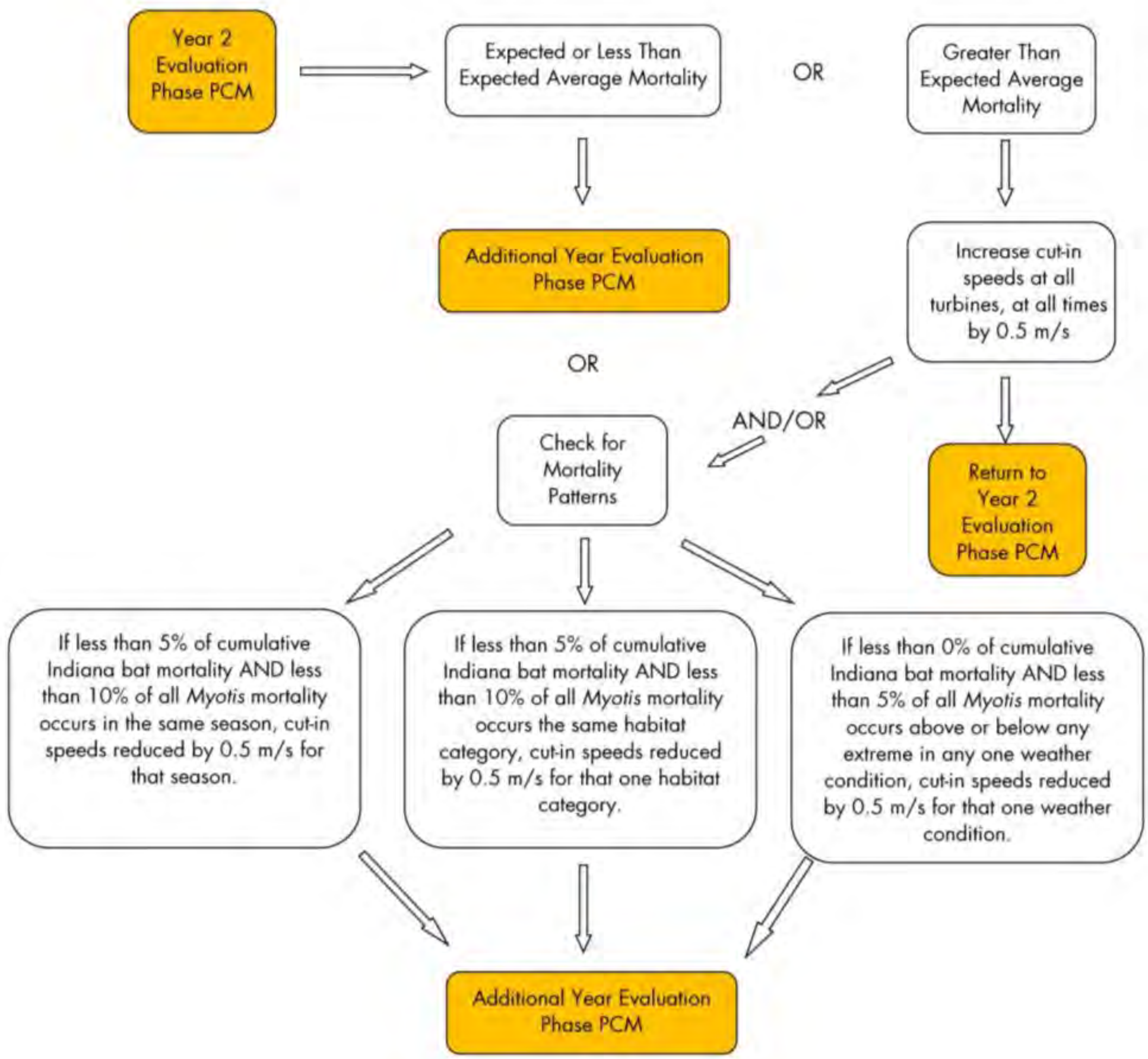


**Figure 6-3.** Adaptive management decisions for Greater Than Expected average mortality of Indiana bats in Year 2.

If Greater than Expected Average annual mortality is again estimated to have occurred at the conclusion of Year-2, or at any point during the monitoring year, cut-in speeds will again be increased by 0.5 m/s at all turbines and during all seasons, again unless mortality patterns suggest certain factors pose significantly less risk to Indiana bats as described above (Figure 6-3). This upward adjustment to the feathering plan and subsequent Evaluation phase monitoring will continue every year that Greater than Average Expected mortality is observed and until Expected or Less Than Expected mortality is achieved. In no instance will the cut-in speeds of any particular turbine be increased by more than 0.5 m/s in any one year, unless trigger point adaptive management requires additional adjustment (see Section 6.5.3.4 – Trigger Point for Immediate Adaptive Management).

Once Expected or Less than Expected Average mortality is achieved and the most effective feathering plan is decided upon at the conclusion of a given Evaluation Phase year, a minimum of 1 additional year of Evaluation Phase-level monitoring will be implemented to verify the effectiveness of the new feathering plan, prior to the initiation of the Implementation Phase (Figure 6-4), unless mortality patterns suggest certain factors pose significantly less risk to Indiana bats and Buckeye Wind chooses to implement further adjustments to cut-in speeds (see Figure 6-3).

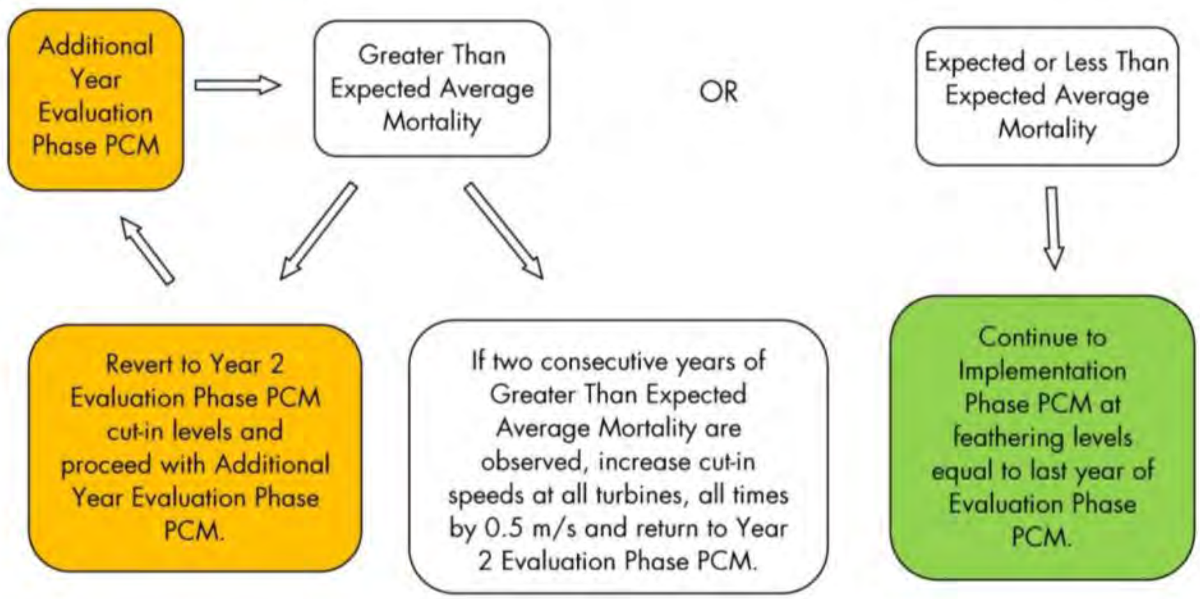


**Figure 6-4.** Adaptive management decisions for Greater Than Expected average mortality of Indiana bats, Additional Evaluation Phase.

#### *6.5.3.4 Trigger Point for Immediate Adaptive Management*

During any year of post-construction monitoring, observed Indiana bat mortality rates may trigger the need for immediate adaptive management. If 2 Indiana bat mortalities are documented at the site before the fall season, cut-in speeds will be increased by 1.0 m/s at all turbines for the remainder of the active period (Figure 6-5). Any additional documented Indiana bat mortality before the fall season or 2 additional fatalities during the fall season will result in all turbines being operated with a cut-in speed of 7.0 m/s. After the cut-in speeds are increased to 7.0 m/s, if additional Indiana bat mortality is documented all turbines will be turned off from 1 hour before sunset to 1 hour after sunrise for the remainder of the active period.

If less than 2 Indiana bat mortalities are documented before the fall season, 2 Indiana bat mortalities in the fall season will trigger immediate adaptive management. If no Indiana bat mortalities are documented before the fall season and 3 Indiana bat mortalities are documented at the site during the fall season, immediate adaptive management will be triggered. In either scenario cut-in speeds will be increased by 1.0 m/s for the remainder of the active period. Any additional documented Indiana bat mortality will result in all turbines being operated with a cut-in speed of 7.0 m/s. If additional Indiana bat mortality is documented, all turbines will be turned off from 1 hour before sunset to 1 hour after sunrise for the remainder of the active period.

Without knowing the scavenger rate and searcher efficiency correction factors at this time, it is not possible to predict how many "estimated" Indiana bats would be calculated from a particular number of "observed" Indiana bats. However, once a "trigger point" is reached, adaptive management is designed to identify when "observed" Indiana bats would indicate exceptionally high number of "estimated" Indiana bats and to ensure that the elevated take does not occur in any one year. If a trigger event occurs in any year, adaptive management will be applied the following year according to the procedure following Greater than Expected Average mortality as described in section 6.5.3.4 – Greater Than Expected Average Mortality of Indiana Bats in Year-1.

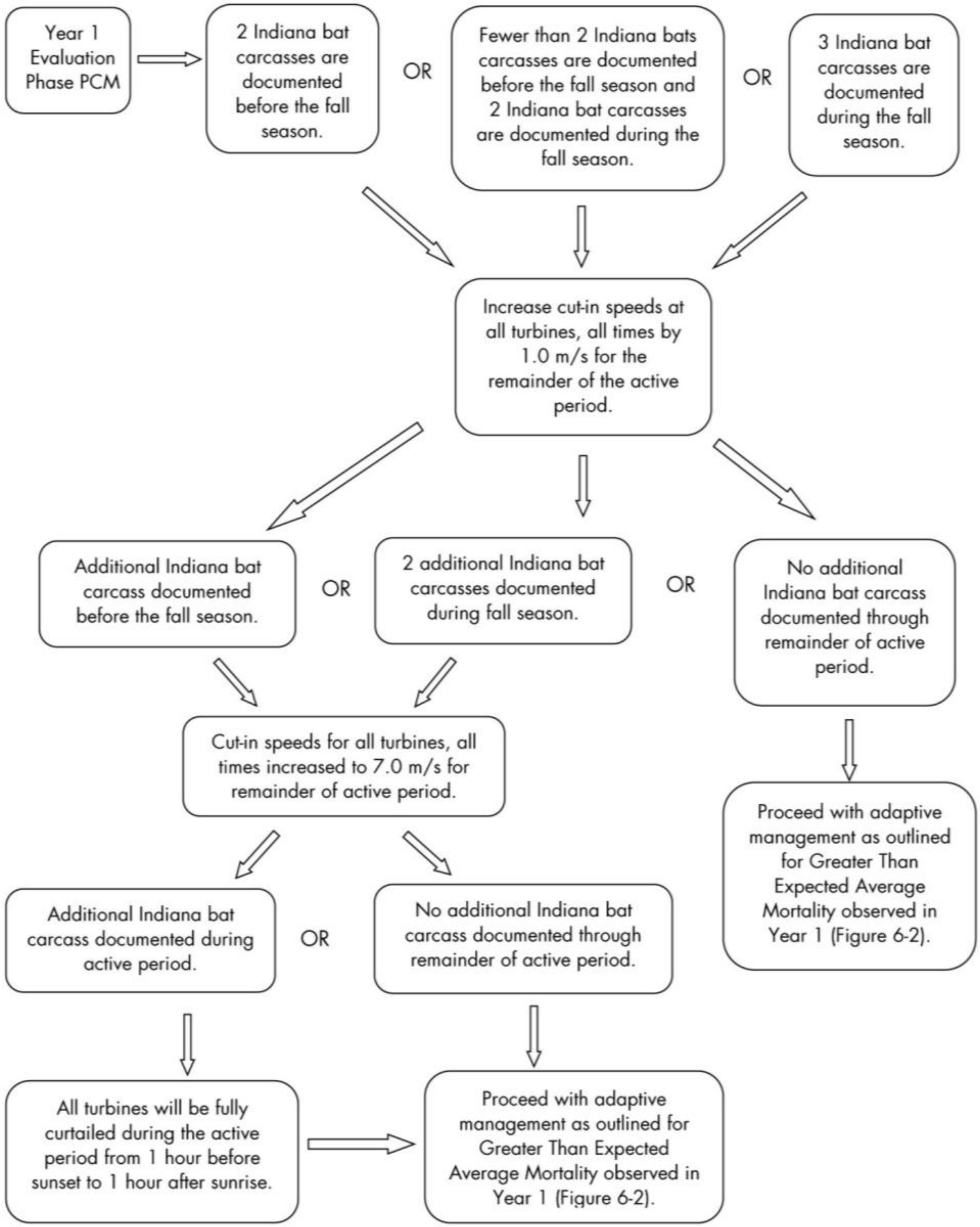


**Figure 6-5.** Within-season Trigger Points for adaptive management.

#### *6.5.3.5 Implementation Phase Adaptive Management*

After the Evaluation Phase monitoring, efforts will be made to continue meeting the Biological Goals and Objectives 1, 3 and 4. Results of Implementation phase monitoring, as well as other factors, may be used to incorporate adaptive management actions, resulting in the need for a Re-evaluation Phase. There are 3 circumstances that could result in adaptive management and re-evaluation:

1) If Greater than Expected Average Mortality is estimated for any monitoring year without reaching trigger points for immediate adaptive management (see Section 6.5.3.4 – Trigger Point for Immediate Action), post-construction monitoring will be conducted in the subsequent year.
    a. If the Greater than Expected Average Mortality is again estimated, Re-evaluation would be warranted. Re-evaluation will enter a Year 2 Evaluation phase process as if Greater than Expected mortality was observed in Year 1 (see Section 6.5.3.3 – Greater than Expected Average Mortality of Indiana Bats in Year-1), including an increase in cut-in speeds of 0.5 m/s at all turbines, unless mortality patterns suggest otherwise (see Figure 6-2).
    b. If in that subsequent monitoring year, Expected or Less than Expected Average Mortality is estimated, the Implementation Phase will continue without Re-evaluation Phase, beginning with a year that does not include post-construction monitoring.

2) If in any year trigger points for immediate action are reached (see Section 6.5.3.4 – Trigger Point for Immediate Action), adaptive management will proceed as described in Section 6.5.3.5, and enter a Year 2 Evaluation phase process as if Greater than Expected mortality was observed in Year 1 (see Section 6.5.3.3 – Greater Than Expected Average Mortality of Indiana Bats in Year-1).

3) Results of Implementation Phase monitoring indicates that certain factors contribute more or less risk to Indiana bats: Continued monitoring of the potential mortality factors could provide more confidence in the observations and criteria for adjustments to cut-in speeds due to seasonal, habitat and weather considerations may become apparent. In this case, Buckeye Wind could elect to apply adaptive management, which would require Re-evaluation phase monitoring to verify that Biological Goals and Objectives are still met. Re-evaluation phase monitoring in this case would occur for 2 years. If Expected or Less Than Expected Average Mortality of Indiana bats is estimated for both years, the Project would re-enter Implementation phase monitoring. If Greater Than Expected Average Mortality of Indiana bats is estimated in either year, Buckeye Wind could elect to either revert to previous cut-in speeds and re-enter Implementation phase monitoring, or proceed as stipulated in Section 5.5.3.3 - Greater Than Expected Mortality of Indiana bats in Year-1.

4) New techniques or new information are developed that can help reduce Indiana bat mortality (see Section 7.2.1.9 – Use of New Methods, Information, or Technical Advances): The wind industry is committing substantial resources toward identifying risk factors and possible minimization approaches to reduce impacts to Indiana bats along with all bat species. If new techniques are proven through the work of non-Project specific studies, Buckeye Wind and the USFWS will work together to determine if those new techniques can be incorporated while also ensuring that the Biological Goal and Objectives 1, 3, and 4 are still met. Re-evaluation in this

case would follow the same path as the Evaluation phase monitoring prescribed, beginning with Year 1 Evaluation phase PCM.

#### *6.5.3.6 Special Cases*

This feathering plan will be maintained as long as Expected or Less Than Expected mortality is documented, or until advancements in avoidance and minimization methods are developed that warrant Re-evaluation. New avoidance and minimization methods will be implemented within a Re-evaluation Phase with approval from the USFWS (see Section 7.2.1.9 – Use of New Methods, Information, or Technological Advances).

Based on documented mortality and estimated take levels, Buckeye Wind may, at its discretion, opt to increase cut-in speeds above those described above in order to ensure compliance with permitted take limits. Particular adaptive management measures may include:

- Increased cut-in speeds at turbines or turbine groups that appear to have particularly high mortality levels.
- Increased cut-in speeds above the increments indicated above, up to and including selective nightly shut downs.

No reduction in cut-in speeds will be initiated without meeting the conditions of the adaptive management plan outlined above and without coordination with the USFWS.

### 6.5.4 Monitoring for Mitigation

The second biological goal described in Section 1.2 – Biological Goals and Objectives pertains to promoting the health and viability of Indiana bat populations both locally and in the Midwest RU. There is 1 biological objective which describes measureable targets needed to achieve this goal:

Objective 2: Mitigate for the impacts of the incidental taking of 130.0 Indiana bats over the 30-year ITP Term through the purchase or easement acquisition and subsequent restoration and/or enhancement (if necessary), with permanent preservation of 87.8 ha (217.0 ac) of suitable Indiana bat habitat within 11.2 km (7 mi) of a P2 Indiana bat hibernaculum in OH (see Section 6.3 – Mitigation Measures for more details).

Monitoring will document the location, quantity, and landcover of each mitigation site, and any restoration or enhancement actions that have occurred at the mitigation site to date. After acquisition of mitigation land or establishment of conservation easements on mitigation land, and enhancement or restoration of mitigation sites to meet the criteria described in Section 6.3.4 – Restoration and Enhancement has occurred, habitat assessment monitoring will be used to help determine if these biological goals and objectives are continually being met by assessing the condition of potential roost trees within the mitigation site, monitoring invasive species cover, monitoring survival of planted trees, ensuring compliance with the terms of the ITP, and evaluating the effectiveness of mitigation. Mitigation is planned to be completed in 2 phases (see section 6.3.3). Consequently, mitigation monitoring for each phase will be performed in Years 1 through 5 after the mitigation has occurred and every 5$^{th}$ year thereafter until the end of the ITP Term. If funding to an approved mitigation bank is used for any portion of the mitigation, and that mitigation bank has established a USFWS approved monitoring program, mitigation monitoring for that portion of mitigation may be deferred to the mitigation bank with USFWS and ODNR DOW approval (see Section 7.3.4 – Change in Mitigation Acres).

Monitoring will be completed by a third party contractor with knowledge of Indiana bat habitat requirements. Buckeye Wind will issue a Request for Proposals to select an appropriate contractor to perform the work. Upon selecting a preferred contractor based on costs and qualification, Buckeye Wind will provide the winning bid to the FWS and to ODNR DOW for approval.

Monitoring will generate a variety of data on existing and planted trees within the mitigation area. These data will be used to assess the density of potential roost trees per acre and the success of tree planting and girdling activities in order to inform the adaptive management plan discussed in the following section. Mitigation areas will be monitored by photographing the area, assessing the quality of roosting and foraging habitat by enumerating the number of suitable roost trees, documenting the state of understory vegetation (e.g., cluttered or open) and percent invasive non-native woody cover, and measuring survival and growth of planted riparian vegetation or trees. Potential roost trees, planted trees, and trees selected for girdling will be photographed and the following characteristics will be measured:

- dbh,
- Tree species;
- Tree height;
- Canopy class (e.g., emergent, dominant, midstory, suppressed);
- Decay stage (e.g., alive, declining, dead, loose bark, no bark, broken top);
- Percent exfoliating bark available for roosting;
- Type of roosts available (e.g., cavities, exfoliating bark, or splits); and
- Canopy closure at 4 cardinal directions as measured by a densiometer.

#### *6.5.4.1 Adaptive Management for Mitigation*

Based on the best scientific information available, Buckeye Wind expects this HCP to achieve the goals and objectives set forth in Section 1.2 – Biological Goals and Objectives. Further, mitigation actions will be based on the outcome of actions during previous years. Therefore, implementation of mitigation actions will adopt an adaptive management approach that will begin 1 year after implementation of mitigation actions at each mitigation site. Adaptive management actions will be implemented if during any monitoring year, any mitigation site fails to meet 1 or more of the restoration and enhancement criteria described in Section 6.3.4 – Restoration and Enhancement.

Within areas to be preserved, it is expected that there will be existing forest which may contain snags. During any habitat assessment year, if there are less than 2 small snags, 5 medium snags, and 2 large snags per acre on average, then assessment results will be used to decide whether to plant additional trees or to girdle existing trees. If there are the appropriate numbers of living trees in each size class, and they are species found in Appendix L of the PEP Guidelines (USFWS 2009b), then these trees will be girdled to create snags. Success of tree girdling will be assessed in the following survey year. If there are the appropriate numbers of potential roost trees, but there are insufficient numbers of medium and large dbh trees, then potential roost trees will be identified and will be revisited for girdling once they are of sufficient dbh.

In unwooded corridors or where tree density is deficient, tree planting will be used to restore Indiana bat swarming, foraging, and roosting habitat. Assuming a 70% survival rate (Davis et al. 2010), approximately 430 stems/ac will be planted to achieve no less than an average of 300 stems/ac/PA. Following planting, Year 2 habitat assessments will determine whether an average of 300 stems/ac/PA have survived. If not, the ratio of surviving stems to total stems planted will be calculated to determine the stem survival rate. The actual survival rate will be used to determine the number of trees necessary to plant in Year 2 in order to achieve an average of 300 stems/ac/PA in Year 3. For example, if an average of 430 stems/ac/PA are planted in Year 1, and an average of 258 stems/ac/PA, survive to Year 2, the result is a success rate of 60%. In order to achieve an average of 300 stems/ac/PA, 42 (300 minus 258) additional stems/ac/PA need to survive. Since a 60% survival rate of trees planted in Year 1 was observed in Year 2, an additional 70 stems/ac/PA, on average (42 divided by 0.6), will be planted in Year 2 (see Section 6.3.4 – Restoration and Enhancement for more information).

Yearly habitat assessments will occur in Years 1 to 5, or until an average of 300 stems/ac/PA have survived. After Year 5, or after at least an average of 300 stems/ac/PA, have been established (whichever is greatest), habitat assessments will be conducted every 5 years to ensure continued survival of planted trees, and to enumerate the number of trees within each size class described above. If non-native woody invasive are preventing adequate survival of trees, the understory will be cleared, outside the active period, in order to allow adequate survival. .

Results of each habitat assessment will be analyzed to determine if woody invasive species cover remains below 5% at each mitigation site. If woody invasive species cover exceeds 5% at any mitigation site in any monitoring year, control methods including manual pulling and digging and herbicides will be used to reduce cover to below 5%.

### 6.5.5 Reporting

Buckeye Wind will implement this monitoring program in consultation with USFWS and ODNR DOW. An annual report describing methods and results of mortality and mitigation monitoring will be submitted to the ODNR DOW and USFWS by 31 December of each calendar year that monitoring is actively conducted. Buckeye Wind will also provide summaries of spring and summer Indiana bat mortality to the USFWS at the end of each of these seasons to inform potential adaptive management according to Section 6.5.3 – Adaptive Management for Minimization. Intermittent construction reports will also be submitted as new turbines are erected.

Intermittent Construction Reports will include:

- A written notification of the turbine number, location, and date placed in commercial operation for each turbine(s). This notification will be submitted at least 30 days prior to the turbine(s) being placed in commercial operation.
- A calculation of the extrapolated annual, 5-year, and total take allowance, as well as any annual trigger points, for the total Project including all turbines in commercial operation at that time (see Section 5.1.2.5.3 – Estimated Take with Feathering, under *Phasing Considerations for Take Allowance*). This report will be submitted within 30 days of the turbine(s) being placed in commercial operation.

Seasonal Reports will include:

- Quantity and species composition of observed bat mortality, including Indiana bat mortality during reporting period (bird mortality will also be reported);
- Review of adaptive management measures implemented, if any, in response to observed mortality.

Annual Reports will include:

- Quantity and species composition of observed bat mortality, including Indiana bat mortality during reporting period (bird mortality will also be reported);
- Estimates of total mortality of all bats, *Myotis* species, and Indiana bats using searcher efficiency trials, carcass persistence trials, and searchable area adjustments (estimated bird mortality will also be reported). All estimates will include 95% confidence intervals;

- Cumulative estimated Indiana bat mortality for entire ITP Term to date.
- Specific conditions, dates, locations, and circumstances of each observed Indiana bat mortality;
- Report on weather conditions monitored during nights preceding mortality searches and weather conditions during searches;
- Review of adaptive management measures implemented in response to observed and/or estimated mortality;
- Annual operating parameters (cut-in speeds at each turbine during each season) and compilation of mortality data as it relates to those parameters;
- Results of habitat assessment surveys at mitigation parcels, including vegetation management and mapping reports;
- Adaptive management measures implemented in response to results of habitat assessment surveys;
- Changed/unforeseen circumstances that have arisen;
- Raw carcass data of bat fatalities in Excel spreadsheet format (raw date for bird fatalities will also be provided);
- Fatality Reporting Forms;
- A calendar reflecting dates, times, and locations of searches;
- Injured bat reporting forms and rehabilitator reports (also provided for birds);
- A description of the subsequent year's monitoring efforts based on the monitoring phase and any adaptive management measures that will be implemented;
- A cost estimate of the subsequent year's monitoring, which will be reserved in a Surety to provide additional funding assurance (see Section 6.7 – Funding for the HCP). A Surety, sufficient to cover the subsequent year's monitoring costs will be established by 1 Mar of each year. Evidence of the Surety will be provided to the USFWS by 1 Mar. of each year.
- Conservation measures implemented during the report year and findings, and/or conservation measures to be implemented the following year.

Annual meetings will be held with the USFWS and ODNR DOW in January of each calendar year to review the results of the previous year's monitoring. Additional meetings may be called by either the USFWS or Buckeye Wind to discuss new information or research that may be relevant to the ongoing implementation of the monitoring plan. The primary objectives of annual meetings will be to:

- Review the results of the previous year's monitoring;
- Evaluate the effectiveness of the monitoring plan;
- Evaluate the efficacy of the feathering strategy;
- Determine whether changes to the feathering plan need to be made in the following year based on the adaptive management criteria laid out in the HCP; and
- Develop recommendations for additional avoidance, minimization, and monitoring techniques.

Annual meetings will also provide the opportunity to review:

- The population status of Indiana bats in the Midwest RU and the implications that any changes may have on the ongoing implementation of the monitoring plan;
- The listing status of other species that might be impacted by the Project;
- The status of mitigation including habitat protection, restoration/enhancement, and monitoring implemented by Buckeye Wind to offset permitted Indiana bat mortality; and
- The status of and results from research implemented as conservation measures under the HCP.

## 6.6 Issuance Criteria – Maximum Extent Practicable

Section 10 (a)(2)(B) and 50 CFR 17.22(b)(2) and 50 CFR 17.32 (b)(2) list 6 criteria that must be met in order for the USFWS to approve the HCP and issue an ITP (see Section 1.4.1 – Federal Endangered Species Act). In particular, 1 of the criteria is that minimization and mitigation measures must be to the maximum extent practicable.

The finding that an HCP has minimized and mitigated impacts of take to the maximum extent practicable requires consideration of 2 factors: adequacy of the minimization and mitigation program and whether it is the maximum that can be practically implemented by the Applicant. According to the Services' HCP Handbook (USFWS and NOAA 1996), "to the extent maximum that the minimization and mitigation program can be demonstrated to provide substantial benefits to the species, less emphasis can be placed on the second factor."

### 6.6.1 Adequacy of Minimization and Mitigation Program

To the extent that the biological goals and objectives help translate the statutory and regulatory criteria or standards into meaningful biological measures, specific to this particular HCP situation and in a manner that will facilitate monitoring (Section 1.2 – Biological Goals and Objectives), the minimization and mitigation plan offers an adequate minimization program. The minimization plan proposed here is adequate for the following reasons:

- Operational feathering has been proven to reduce bat mortality in multiple different studies (Arnett et al. 2010, Baerwald et al. 2009, Good et al. 2011; see Section 5.1.2.5.3 – Estimated Take with Feathering).
- Buckeye Wind is proposing to implement operational feathering at turbines during the Indiana bat active period. The feathering plan will avoid and minimize Indiana bat mortality specifically from turbine operation, resulting in no more than 26 Indiana bats over any 5 consecutive year period (see Section 5.1.2.5.3 – Estimated Take with Feathering).
- Despite multiple post-construction surveys for wind power in the eastern and midwestern United States, Indiana bat mortality has been rarely documented.
- Because some uncertainties exist, mortality monitoring will document Indiana bat take levels during the ITP Term. The results of the monitoring will inform rigorous and detailed adaptive management actions that will ensure that the authorized take is not exceeded.
- Through implementation of the feathering plan, monitoring, and adaptive management, Buckeye Wind will strive to ensure the estimated average level of Indiana bat mortality will not be exceeded on an annual basis. As discussed in the Section 5.1.2.6 – Biological Significance of Incidental Take (Collision Mortality), the requested take for the Project will not preclude the Indiana bat population from expanding, both locally and within the Midwest RU.

Mitigation measures are designed to offset the impacts of the incidental take that does occur due to the Project operation. By protecting and enhancing important Indiana bat habitat, the mitigation plan will promote the health and viability of the species within the Midwest RU, as described in Objective 2. Permanent protection of areas around a P2 hibernaculum will ensure habitat for foraging and swarming and staging and therefore promote the overwinter survival and reproductive success of the species. The proposed mitigation program is therefore adequate to offset the proposed incidental take of Indiana bats.

By using the Biological goals and objectives to translate the statutory criteria into meaningful biological measures, the HCP presents an adequate minimization and mitigation plan. Benefit to the species is also demonstrated:

- Indiana bat mortality will be kept to a very low level that will not preclude the species from expanding or persisting on the Midwest RU level or within the Action Area as a result of the Project operations (Section 5.1.2.6 – Biological Significance of Incidental Take [Collision Mortality]).
- Mitigation will enhance and permanently protect suitable Indiana bat habitat in the Midwest RU during the ITP Term and beyond. Enhanced and protected habitat will improve the health and viability of the species, offsetting the impacts of the taking.
- Adaptive management will inform minimization measures that will further enhance understanding of the interaction between Indiana bats and wind turbines.
- Conservation Measures including research on Indiana bat and wind turbine interactions and/or research on fall migration behavior will enhance understanding of Indiana bat and wind turbine exposure potential during key seasonal periods during which risk is high or uncertain, which can be applied at wind facilities across the range of the Indiana bat.

### 6.6.2 Practical Implementation by Buckeye Wind

As the wind industry grows, projects must become more competitive in all aspects of design and operation. A wind project is not viable unless it can find an entity that will buy the electric power and the environmental attributes (renewable energy credits or RECs) for a price that allows the project investors to make an adequate return on their investments. Determination of the adequate return on investment depends on the investor's own internal targets as well as the returns that can be realized by other projects in the industry. Costs associated with operation of a project are a key factor in evaluating the return on investment.

**Costs of Minimization and Mitigation**

The costs of implementing the minimization plan will negatively affect the viability of the Project. These costs result in a less competitive Project when compared to wind projects that do not have a feathering plan (cut-in speeds are equal to the manufacture's cut-in speeds at all times during all seasons). Wind projects generate revenue based on how much energy is generated and the price of energy and RECs:

Revenue = Energy Generated * Price of Energy * Price of RECs

More restrictive operational cut-in speeds have an exponentially higher cost to the Project and can quickly begin to erode Project viability. The power in the wind that hits a wind turbine and turns the blades is given by the equation:

$$\text{Power} = \tfrac{1}{2} * \text{Rotor Swept Area} * \text{Air Density} * \text{Wind Speed}^3$$

In other words, the power hitting the turbine, and thus the power available to be converted into energy, increases by the wind speed cubed. This means that each increment of power lost at higher wind speed is exponentially larger than what is lost at lower wind speeds. Subsequently, since the Project produces revenue based on the amount of energy that is produced, the amount of lost revenue increases exponentially as the cut-in speed is increased.

Therefore, the estimated costs associated with implementation of minimization and mitigation measures proposed in this HCP can be calculated based on assumptions about Project operation (lost production due to feathering plan), price of energy and price of RECs (submitted as Confidential Business Information; CBI Report). The following estimated costs would be associated with implementation of the minimization and mitigation measures proposed in this HCP:

1) 2.50% less clean energy generated (lost production due to feathering);
2) $980,000 in lost annual revenues;
   - Lost production due to feathering * price of energy * price of RECs.
3) $24.5 million in lost revenues over the ITP Term.
   - Lost annual revenues multiplied by 25 years of operational life.
4) $1.6 million to implement the mitigation strategy presented in this HCP (see Section 6.7.2 – Mitigation).

Overall, minimization and mitigation for incidental take for Indiana bats will cost the Project approximately $26.1 million over the ITP Term as a result of the feathering plan and the mitigation plan.

If the maximally restrictive operations alternative was selected as the preferred method to reduce take of Indiana bats, the cost of minimization would be significantly greater. In the maximally restrictive operations alternative all 100 turbines would be non-operational from sunset to sunrise during the entire period over which Indiana bats are active (1 Apr to 31 Oct; Section 2.6.2.3 – Maximally Restrictive Operations Alternative). Again using base assumptions about Project operation (lost production due to maximally restrictive operating plan) and price of energy and price of RECs, this alternative would result in the following additional estimated costs to the Project:

1) 22.7% less clean energy generated as compared to the proposed feathering plan (total of 24.6% less energy generated compared to no feathering).
2) $8.65 million in lost annual revenues as compared to the proposed feathering plan (total of $9.63 million in lost annual revenue compared to no feathering).
3) $216.5 million in lost revenues over the ITP Term as compared to the proposed feathering plan ($241 million in lost revenues over the ITP Term compared to no feathering).

Buckeye Wind has proposed a minimization and mitigation plan that will provide adequate minimization and mitigation of impacts to the Indiana bat and will provide benefits to the species. Using the biological goals and objectives as a translation of the issuance criteria into meaningful biological measures, it is clear that the HCP does minimize and mitigate to the maximum extent practicable.

A minimization plan that incorporates more restrictive operational constraints would result in costs of up to $241 million over the ITP Term (a substantial increase in costs from the proposed minimization plan costs of $24.5 million). While a more restrictive operational cut-in speed may be more protective of the Indiana bat, that proposition is not certain and would place substantial additional financial burden on the Project. It is therefore not practicable to commit up to $8.65 million per year and $216.5 million over the ITP Term in additional costs, as compared to the proposed plan, for uncertain additional benefits to the species. Monitoring and adaptive management afford the opportunity for Buckeye Wind to alter the minimization plan if it proves to be inadequate. The minimization and mitigation plans proposed in Section 6.2 and Section 6.3, respectively, along with the monitoring and adaptive management approaches described in Section 6.5 represent minimization and mitigation to the maximum extent practicable.

## 6.7 Funding for the HCP

Under Section 10(a)(2)(A)(ii) and 10(a)(2)(B)(iii) of the ESA, an HCP submitted in support of an ITP must establish "the funding that will be available to implement such steps the applicant will take to monitor, minimize, and mitigate the impacts from the proposed taking" (50 C.F.R. § 17.22(b)(1)). The ITP approval could be denied and is subject to full or partial suspension, or revocation, should Buckeye Wind fail to ensure funding for mitigation and conservation measures outlined in this HCP.

Buckeye Wind will provide funding to implement the Conservation Program outlined in Chapter 6.0. Funding or implementation of specific portions of the Conservation Program will be provided prior to beginning Project operation, unless otherwise indicated, as provided in Table 6-6, and additional portions of funding will be provided as the Project progresses. Funding assurance will be provided in the form of a Surety acceptable to the USFWS (for example, an escrow account, cash, or bond). The Surety will be used to provide funding assurances for those portions of the Conservation Program that are not yet actually implemented. Buckeye Wind will provide funds required to implement mortality and mitigation monitoring to comply with its obligations under the HCP, ITP, and the Implementing Agreement. Buckeye Wind will be responsible for the continued implementation of the HCP through the ITP Term.

Buckeye Wind's history of funding costly wind power project development, including pre- and post-construction studies to minimize impacts to avian and bat resources, demonstrates Buckeye Wind's ability and commitment to continue such funding. By entering into an Implementing Agreement with the USFWS, Buckeye Wind provides assurances that funding will be available to implement actions that mitigate the impact of the proposed taking of Indiana bats. Unless otherwise noted, all amounts described in this section are based on 2012 dollars and will therefore need to be adjusted for inflation in the future.

### 6.7.1 Mortality Monitoring

Funding for mortality monitoring will be earmarked in the capital and annual operating budgets of the Project. Estimated amounts will be included in the financial projections used to close debt financing for the Project, and the Project loan documents will clearly state that actual ongoing HCP monitoring and mitigation costs will be included in operating costs that are to be paid out of wind generation revenues prior to debt service payments to the lenders. It is important to note that if the Project has insufficient funds for operations, the Project will not be operational and therefore would not pose risk to Indiana bats. Since mitigation measures will be funded prior to take occurring (see Table 6-6 and Section 6.3 – Mitigation Measures), all take associated with the Project would be mitigated if the Project suffered from insufficient funds. As a further assurance that funds will be in place to conduct monitoring, Buckeye Wind will establish a Surety sufficient to cover the costs of PCM required for the upcoming monitoring year. Any independent surety company providing bonding under this HCP shall have a Best's credit rating of not less than A minus. The Surety will be made payable to the independent consultant selected to conduct the PCM (see Section 6.5.2 – Methods for Minimization Monitoring). At the end of each survey year, the annual report will include a description of the PCM needed for the subsequent year, based on the results of the prior year's monitoring phase and any adaptive management. Buckeye Wind will also provide as part of its annual report a proposal from an independent consultant (see Section 6.5.2 – Methods for Minimization Monitoring) for the monitoring work described for the upcoming year. The Surety will be updated as necessary to reflect the amount set forth in the independent consultant's proposal, and evidence of the Surety will be provided to the USFWS by 1 March of each year during the ITP Term.

EverPower and its subsidiaries have conducted post-construction monitoring at other sites across the eastern US. Estimates for mortality monitoring are based on costs associated with those other projects, extrapolated for the level of effort associated with the monitoring plan described in this HCP. For example, 2 of EverPower's subsidiaries will conduct post-construction monitoring in 2012 (see Section 6.5.2 – Methods for Minimization Monitoring for a description of the monitoring methods):

- Project X in New York State: Six turbines will be searched each day for 2 years, from 15 April to 15 November, for a proposed cost of $121,500 per year.
  - By extrapolation, 33.3 turbines each day, as would be required to meet the objectives of this HCP, would cost $674,300 per year[39].

- Project Y in Pennsylvania: Ten Turbines will be searched each day for two years, from 15 April to 15 November, for a proposed cost of $230,000 per year
  - By extrapolation, 33.3 turbines each day, as would be required to meet the objectives of this HCP, would cost $765,000 per year[40].

While the level of effort for monitoring in this HCP is greater than in NY or PA (e.g., a search area of 2.0 times the blade length is significantly greater than other states), Buckeye Wind expects economies of scale to offset the resulting cost increases. The estimated annual costs are $700,000 per monitoring year. Combined with every other year or greater monitoring, average annual costs may be reduced to about $350,000 after the Evaluation Phase and include the following scope:

- Monitoring an average of 33.3 turbines each day according to the specification of this HCP[41].
- Performing searcher efficiency trial and carcass removal trials according to the specification of this HCP.
- Calculating the estimated mortality based on statistical analysis and the observed mortality.
- Producing a written report summarizing findings.

Note that while the amounts presented here are reasonable estimates based on actual proposals for similar monitoring efforts, the amount of the Surety each year (including year 1) will be based on a proposal from an independent consultant. The PCM plan outlined in the independent consultant's proposal must be adequate to meet the requirements of this HCP. The appropriate Surety will be established by 1 March of each year (see Section 6.5.5 – Reporting).

### 6.7.2 Mitigation

Mitigation funding will be provided based on the estimated cost of securing 87.8 ha (217.0 ac) of land within 11.2 km (7 mi) of a P2 hibernaculum in OH.

#### *6.7.2.1 Costs Associated with Identification of Mitigation Property(ies)*

Initial estimates for identifying mitigation property(ies) are based on a proposal provided by a nationally recognized organization capable of implementing and managing mitigation efforts. The cost proposal was approximately $250,000 (referred to herein as "Identification Costs"). Identification Costs are subject to adjustment for inflation in the future. Identification of mitigation property(ies) includes the following tasks:

- Identify and Prioritize Potential Mitigation Site. This task will be based on the criteria provided in the HCP;
- Research Mitigation Properties. This task will include contacting landowners, conducting field work (including title) and developing a long term management and monitoring strategy;

[39] Additional costs may be incurred to meet ODNR recommendations (see Section 6.5.2.3 – Search Frequency).
[40] Additional costs may be incurred to meet ODNR recommendations (see Section 6.5.2.3 – Search Frequency).
[41] In order to meet ODNR post-construction monitoring recommendations, monitoring for the first year or two may include more than 33.3 turbines per day (See Section Section 6.5.2.3 – Search Frequency).

- Select and Approve Sites for Mitigation. This will occur with input and final approval of Buckeye Wind, USFWS, and ODNR DOW;
- Acquire land and/or purchase conservation easement. This will include all contract for sale or easement and all due diligence (including real estate engagement, ground verification, estimate of initial restoration or enhancement needs, preliminary title work, etc.);.

These tasks do not include the cost of purchasing the property or purchasing a conservation easement over the property.

A 3rd party conservation organization approved by FWS and ODNR DOW will be identified to hold the land or conservation easement in perpetuity. Memoranda of Agreement between Buckeye Wind and any agency or 3rd party restoration and enhancement partners will be executed.

Implementation of mitigation is proposed to occur in 2 stages. Stage 1 will include the first 10 years of operation. The first 10 years equate to 40% of the 25-year operational life of the Project. Thus, Buckeye Wind will obtain a Surety equal to 40% of the $250,000 Identification Costs, or $100,000 (subject to adjustment for inflation). The Surety will be obtained, and evidence of the Surety will be provided to USFWS, prior to the beginning of Project operation. The Surety will be made payable to a qualified firm experienced in acquiring mitigation and natural habitat for conservation and approved by the USFWS.

Stage 2 will include the remaining years of operation, beginning with operational Year 11. The remaining years equate to 60% of the 25-year operational life of the Project. Thus, Buckeye Wind will obtain a Surety equal to 60% of the $250,000 Identification Costs, or $150,000 (subject to adjustment for inflation). The Surety will be obtained, and evidence of the Surety will be provided to USFWS, prior to the 11th year of Project operation. The Surety will be made payable to a qualified firm experienced in acquiring mitigation and natural habitat for conservation and approved by the USFWS.

At any time during the ITP Term, Buckeye Wind may provide an estimate of Identification Costs actually remaining and adjust the Surety to contain an amount sufficient to cover those remaining Identification Costs. Such estimate will be provided by the firm selected to complete identification of mitigation properties.

#### *6.7.2.2 Acquisition Costs*

Initial research suggests that forested property in OH does not typically exceed $5,000 per ac. Therefore, Buckeye Wind estimates that it would cost about $1.1 million ("Acquisition Cost") to secure 87.8 ha (217.0 ac) of land for mitigation to offset the impacts of take of Indiana bats from the project. Buckeye Wind expects the cost of securing a permanent easement on a property to be no more than the full value of the land and therefore equal to purchasing the land. Acquisition Costs are subject to adjustment for inflation in the future.

Before the beginning of Project operation, Buckeye Wind will obtain a Surety in an amount adequate to cover mitigation acquisition costs associated with take during the first 10 years of Project operation (Stage 1). The first 10 years equate to 40% of the 25-year operational life of the Project. Thus, Buckeye Wind will obtain a Surety equal to 40% of the estimated $1.1 million of Acquisition Costs ($440,000 subject to adjustment for inflation), for purchase and/or protection of 35.1 ha (86.8 ac) of mitigation land that would be adequate to offset the impacts of take of 52 Indiana bats. The Surety will be made payable to a qualified firm experienced in acquiring mitigation and natural habitat for conservation and approved by the USFWS. Evidence of the Surety will be provided to the USFWS prior to Project operation.

If all or a portion of Stage 1 mitigation land is purchased prior to the beginning of project operation, the Surety will then be equal to the cost of the remaining acreage needed to achieve 35.1 ha (86.8 ac). For example, if 8.0 ha (20 ac) of mitigation land are purchased prior to the beginning of project operation, the Surety would be valued at $334,000 (86.8 ac – 20 ac = 66.8 ac x $5,000/ac = $334,000).

Stage 2 includes the remaining years of operation, beginning with operational Year 11. The remaining years equate to 60% of the 25-year operational life of the Project. Thus, Buckeye Wind will obtain a Surety equal to 60% of the estimated $1.1 million of Acquisition Costs ($660,000 subject to adjustment for inflation), for purchase and/or protection of 52.68 ha (130.2 ac) of mitigation land that would be adequate to offset the impacts of take of 78 Indiana bats. The Surety will be made payable to a qualified firm experienced in acquiring mitigation and natural habitat for conservation and approved by the USFWS. The Surety will be obtained and evidence of the Surety provided to the USFWS prior to the beginning of the 11th year of Project operation.

If all or a portion of Stage 2 mitigation land is purchased prior to the beginning of the 11th year of project operation, the Surety will then be equal to the cost of the remaining acreage needed to achieve 52.68 ha (130.2 ac). For example, if 8.0 ha (20 ac) of mitigation land are purchased prior to the beginning of the 11th year of project operation, the Surety would be valued at $551,000 (130.2 ac – 20 ac = 110.2 ac x $5,000/ac = $551,000).

All land acquisition and conservation easements will aim to be in place before the beginning of the respective stage, but in no case after the 1st year of the respective stage (by the end of the 1st and 11th year, respectively).

At any time during the ITP Term, Buckeye Wind may provide an estimate of Acquisition Costs actually remaining and adjust the Surety to contain an amount sufficient to cover those remaining Acquisition Costs. Such estimate will be provided by the firm selected to complete identification of mitigation properties.

#### *6.7.2.3 Restoration/Enhancement, Maintenance, and Monitoring Costs*

Buckeye Wind has received an estimate for restoration/enhancement, maintenance, and monitoring of the mitigation effort (referred to herein as "Management Costs"). That estimate includes an upfront cost of $66,500 for restoration/enhancement, which includes site preparation and any necessary tree planting, invasive species control, and tree girdling[42]. Annual maintenance would be approximately $135,000 total for the Years 1 through 5 and $7,500 for every year thereafter. Annual monitoring would be $8,500 per year. Therefore, Buckeye Wind will obtain a Surety, for the following amounts for Stage 1 Management Costs:

- $26,600 for up front restoration/enhancement ($66,500 x 40%);
- $66,000 for annual maintenance, based on a total of $165,000 (annual maintenance for Years 1 to 5, then in each of Years 10, 15, 20 and 25) multiplied by 40%[43]. Year 1 is the year after a conservation easement is placed on the land (whether purchased or not).

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[42] This amount was estimated using the assumption that 16.2 ha (40 ac) would need to be restored forest plots. Since mitigation for this HCP will be focused on enhancement and preservation of existing wooded areas, with limited restoration, the estimate is considered conservative.

[43] If more than 40% of the 87.8 ha (217 ac) is purchased before Stage 2 mitigation, the Surety will be adjusted on a pro-rated basis.

- $30,600 for annual monitoring, based on a total of $76,500 (annual monitoring for Years 1 to 5, then in each of Years 10, 15, 20 and 25) multiplied by 40%. Year 1 is the year after a conservation easement is placed on the land (whether purchased or not).

A Surety totaling $123,200 (subject to adjustment for inflation) will be obtained by Buckeye Wind prior to the beginning of Project operation in order to provide assurance that funds will be in place for Stage 1 Management Costs. The Surety will be made payable to the independent contractor or consultant selected to conduct the restoration/enhancement, maintenance, and monitoring.

Buckeye Wind will obtain a Surety in the following amounts for Stage 2 Management Costs:

- $39,900 for restoration/enhancement ($66,500 x 60%);
- $90,000 for maintenance based on a total of $150,000 (annual maintenance for Years 10 to 15, then in each of Years 20 and 25) multiplied by 60%.
- $35,700 for monitoring based on a total of $59,500 (annual monitoring for Years 10-15, then in each of Years 20 and 25) multiplied by 60%.

A Surety totaling $165,600, subject to adjustment for inflation, will be obtained by Buckeye Wind prior to the beginning of the 11th year of Project operation in order to provide assurance that funds will be in place for Stage 2 Management Costs. The Surety will be made payable to the independent contractor or consultant selected to conduct the restoration/enhancement, maintenance, and monitoring.

All mitigation funding amounts will be pro-rated according to the number of turbines actually erected. For example, if 52 turbines are placed in commercial operation before the additional 48, funding for at least $344,900 (or, 52% x [$100,000 + $440,000 + $123,200], covering Stage 1 Identification Costs, Acquisition Costs and Management Costs, respectively), subject to adjustment for inflation, will be assured by a Surety obtained by Buckeye Wind prior to the beginning of operation of those 52 turbines. When the remaining 48 turbines are placed into commercial operation, the remaining Stage 1 funding, $318,500 (or 48% x [$100,000 + $440,000 + $123,200], covering Stage 1 Identification Costs, Acquisition Costs, and Management Costs, respectively), subject to adjustment for inflation, will be assured by a Surety obtained by Buckeye Wind prior to the beginning of commercial operation of those 48 turbines. Funding for the Stage 2 Surety will be pro-rated in the same manner if the remaining 48 turbines are not operational at the beginning of the 11th year of Project operation.

At any time during the ITP Term, Buckeye Wind may provide an estimate of Management Costs actually remaining and adjust the Surety to contain an amount sufficient to cover those remaining Management Costs. Such estimate will be provided by the firm selected to conduct the restoration/enhancement, maintenance, and monitoring.

### 6.7.3 Conservation Measures

Funding for conservation measures will be made available from Project revenues to a qualified research program(s) after 1 year of Project operation has been completed. The funding will be assigned within 5 years of the beginning of Project operation and will be provided to appropriate private or academic institutions to conduct research on Indiana bat behavior relative to wind energy development (See Section 6.4 – Conservation Measures). Disbursement of funds will be decided in coordination with the FWS and ODNR DOW.

### 6.7.4 Other Expenses

#### *6.7.4.1 Changed Circumstances Fund*

Reasonably foreseeable circumstances described in Section 7.2.1 – Changed Circumstances could trigger the need to restore or enhance the mitigation lands. Due to the uncertainty surrounding future impacts from changed circumstances and effective measures to minimize or mitigate them, Buckeye Wind will obtain a Surety in order to provide assurance 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 Section 7.2.1 – Changed Circumstances will be implemented to restore and enhance the effected mitigation lands.

Potential responses to changed circumstance include: girdling to create snags if there are less than 2 small diameter snags, 5 medium diameter snags, and 2 large diameter snags per acre on average; planting trees if there are less that 300 stems per acre on average; or controlling for woody invasive species if they occupy more than 5% cover in the understory. The most expensive of these potential responses per acre is replanting of trees. Therefore the restoration costs are based on the costs of replanting trees within the area of changed circumstances. Buckeye Wind considers it unlikely that a single changed circumstance event will deforest all 87.8 ha (217 ac) of mitigation land, as these events are rare in Ohio, and because mitigation land will likely be made up of disjunct parcels. Therefore, the changed circumstance Surety will contain funds sufficient for restoration, monitoring, and management for 44 ha (109 ac), to account for deforestation of half the mitigation lands by a single changed circumstance event. However, should a single event deforest the entire mitigation area (i.e., 87.8 ha [217 ac] of mitigation lands), Buckeye Wind will commit the appropriate funds necessary to restore, monitor, and manage the entire 87.8 ha (217 ac). The annual operating budget will be the funding source for these additional funds.

Buckeye Wind received an estimate for Management Costs from an environmental consulting firm with experience in habitat restoration for restoration of 16.2 ha (40 ac) of mitigation land. That estimate includes an upfront cost of $66,500 for restoration/enhancement, $11,300 per year for maintenance of that 16.2 ha (40 ac) plot, and approximately $8,500 per year for annual monitoring. These estimates were extrapolated to calculate Management Costs for restoration of 44 ha (109 ac) in response to a changed circumstance.

Monitoring after a changed circumstance will occur annually for the first 5 years. However, subsequent monitoring in 5-year intervals will be dependent upon the timing of the changed circumstance event in light of the 30-year ITP Term. For example, an event in Year 7 of operation will require annual monitoring during Years 8 to 12 of operation, then again in Year 17, and finally in Year 22. However, an event in Year 18 of operation will require annual monitoring during Years 19 to 23 of operation, in which case no further monitoring would occur. Therefore, estimated costs in response to a changed circumstance event assume monitoring will occur over 7 monitoring years (annually in Years 1 to 5 following the event, then in each of Years 10 and 15 following the event). This is likely a conservative estimate, as events occurring after Year 15 of operation will require less monitoring effort.

For Stage 1 ($1^{st}$ 10 years of operation), a Surety in the amount of $170,700 will be obtained by Buckeye Wind to cover Management Costs to restore, enhance, maintain, and monitor 44 ha (109 ac) of mitigation lands that have been affected by a changed circumstance event:

- $72,500 for up front restoration/enhancement ($66,500 x 109 ac/40 ac x 40%);
- $86,200 for annual maintenance ($11,300 x 109 ac/40 ac x 7 years [Years 1 to 5, then in each of Years 10 and 15], multiplied by 40%[44]). Here, Year 1 is the year after a changed circumstance event.
- $12,000 for annual monitoring ($8,500 x 109 ac/217 ac x 7 years [Years 1 to 5, then in each of Years 10 and 15], multiplied by 40%). Here, Year 1 is the year after a changed circumstance event.

Evidence of the Surety will be provided to the USFWS prior to the start of Project operation. For Stage 2 (remaining years of 25-year operational life of the Project), a Surety in the amount of an additional $255,900 ($427,500 total; subject to adjustment for inflation) will be obtained by Buckeye Wind to restore and enhance mitigation lands that have been affected by changed circumstances:

- $108,700 for up front restoration/enhancement ($66,500/ac x 109 ac/40 ac x 60%);
- $129,300 for annual maintenance ($11,300 x 109 ac/40 ac x 7 years [Years 1 to 5, then in each of Years 10 and 15] multiplied by 60%). Here, Year 1 is the year after a changed circumstance event.
- $17,900 for annual monitoring ($8,500 x 109 ac/217 ac x 7 years [Years 1 to 5, then in each of Years 10 and 15], multiplied by 60%). Here, Year 1 is the year after a changed circumstance event.

Evidence of the Surety will be provided to the USFWS prior to the beginning of the 11th year of Project operation. The Surety obtained by Buckeye Wind will provide assurance that the funds are in place to conduct any necessary restoration or enhancement on the mitigation lands that have been affected by changed circumstance as described in Section 7.2.1 – Changed Circumstances. 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 circumstances trigger, identified in Section 7.2.1 – Changed Circumstances, has been met. Because it is difficult to know exactly what the cost of covering changed circumstances could be, Buckeye Wind will obtain a contingency Surety in an amount equaling 10% of the total amount bonded for changed circumstances. This Surety will assure that there is a contingency fund available to cover any unexpected costs resulting from changed circumstances. Corrective measures that could be funded (in whole or in part) by the contingency fund are identified for each changed circumstance addressed in Section 7.2.1 – Changed Circumstances. Every 5 years, the changed circumstance Surety and the resulting changed circumstances contingency Surety will be re-evaluated to account for current land values and inflation. If a changed circumstance triggers a response and the Surety is depleted to fund the response, the Surety will be maintained or replenished to the appropriate value within 6 months of the Surety being depleted to fully fund any future changed circumstances events that may occur during the ITP Term. This amount is subject to adjustment for inflation.

[44] If more than 40% of the 217 ac is purchased and requires restoration before Stage 2 mitigation, the Surety will be adjusted on a pro-rated basis.

### *6.7.4.2 ITP Administration Costs*

Aside from the costs identified in Section 6.7 – Funding for the HCP, there will be costs associated with the administration of the ITP. It is expected that a portion of the time for senior operations staff and environmental and permit compliance staff at Buckeye Wind will be dedicated to ITP administration. This will include maintaining lines of communication with the USFWS and ODNR DOW, managing consultants' work (monitoring, reports, etc.), attending annual meetings with USFWS and ODNR DOW, and other tasks necessary to ensure successful implementation of the ITP. It is expected that these costs will be absorbed within the annual salary of such managers and will consist of less than 5% of the total responsibilities for 2-3 appropriate managers.

### *6.7.4.3 Contingency Fund*

The purpose of this contingency amount is to provide a reasonable "buffer" if costs estimated in this section are higher than anticipated. This total will change year to year as the assured funding is revised based on year-ahead monitoring estimates and mitigation lands actually purchased and conserved (thereby eliminating the need for funding assurance).

The Contingency Fund takes 5% of the base costs that will be placed in a Surety to provide funding assurance, including Year 1 monitoring ($700,000), Stage 1 Acquisition Costs ($440,000), Stage 1 Identification Costs ($100,000), Stage 1 Management Costs ($123,200) and Reporting Costs, for a total contingency base of $1.36 million. Five percent of $1.36 million equals $68,200. 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. The purpose of this contingency amount is to provide a reasonable "buffer" if costs estimated for specific actions (i.e., monitoring, mitigation, changed circumstances and reporting) are higher than anticipated.

**Table 6-6.** Funding estimates and assurances for 100 turbines (based on 2012 dollars).

| Conservation Strategy | Annual costs | Total over ITP Term | Funding Source | Timing of Strategy | Timing of Funding |
|---|---|---|---|---|---|
| | | | **Monitoring** | | |
| Evaluation Phase PCM[1] | $700,000 | First 2 years, $1.4 M | Annual operating budget, with 1 year ahead Surety | Annual, during active period | 1 Mar of every year during ITP Term |
| Implementation Phase PCM [1] | $350,000[2] | Dependent on results, estimate 23 years, $8.1 M | Annual operating budget, with 1 year ahead Surety | Every 2 years or every 3 years | 1 Mar of every year during ITP Term |
| Mitigation Monitoring | Included in Management Costs below | Included in Management Costs below | | Years 1-5, then every 5th year thereafter | Included in Management Costs below |
| *Subtotal* | | *$9.5 M* | | | |
| | | | **Mitigation** | | |
| Acquisition Costs[3] | Stage 1, $440,000 Stage 2, $660,000[3] | $1.1 million | Demonstration of land actually purchased or protected, with the balance deposited to a Surety. | Stage 1 to be completed by the end of year 1 and Stage 2 completed by end of year 11. | Stage 1: prior to the beginning of Project operation. Stage 2: prior to the beginning of year 11. |

**Table 6-6.** Funding estimates and assurances for 100 turbines (based on 2012 dollars).

| Conservation Strategy | Annual costs | Total over ITP Term | Funding Source | Timing of Strategy | Timing of Funding |
|---|---|---|---|---|---|
| Identification Costs[4] | Stage 1, $100,000 Stage 2, $150,000 | $250,000[4] | Demonstration of expenses paid or services rendered, with balance deposited in a Surety. | Stage 1 to be completed by the end of year 1 and Stage 2 completed by end of year 11. | Stage 1: prior to the beginning of Project operation. Stage 2: prior to the beginning of year 11. |
| Management Costs[5] | Stage 1, $123,200. Stage 2, $165,600 | $288,800 | Demonstration of expenses paid or services rendered, with balance deposited in a Surety. | Stage 1 to be completed by the end of year 1 and Stage 2 completed by end of year 11. | Stage 1: prior to the beginning of Project operation. Stage 2: prior to the beginning of year 11. |
| *Subtotal* | *Stage I, $663,200 Stage 2, $975,600* | *$1.6 M* | | | |
| **Conservation Measures** | | | | | |
| Research on Indiana bat behavior relative to wind energy projects | | $200,000 | Provided from operation revenue. | | Available after 1 year of Project operation, assigned within 5 years of beginning of Project operation |
| *Subtotal* | | *$200,000* | | | |
| **Reporting** | | | | | |
| Report Preparations | | | Included in mortality monitoring budget | By 1 Jan of each year during the ITP Term | |
| Agency Consultation and Meetings | $4,000 | $120,000 | Annual operating budget | By 1 Jan of each year during the ITP Term | |
| *Subtotal* | | *$120,000* | | | |
| **Other Expenses** | | | | | |
| Changed Circumstances[6] | Stage 1, $170,700 Stage 2, $255,900 | $426,600 | Deposited in a Surety | Conditional on occurrence of Changed Circumstance | Stage 1: prior to the beginning of Project operation. Stage 2: prior to the beginning of year 11. |
| Adaptive Management[7] | | Minimal | | Ongoing | |

**Table 6-6.** Funding estimates and assurances for 100 turbines (based on 2012 dollars).

| Conservation Strategy | Annual costs | Total over ITP Term | Funding Source | Timing of Strategy | Timing of Funding |
|---|---|---|---|---|---|
| ITP Administration | 5% of total annual time for 2-3 appropriate managers | | Absorbed within annual salaries | Ongoing | |
| *Subtotal* | | *$426,600* | | | |
| | | **Total Non-Contingency** | | | |
| **Total** | | **$11.6 M** | | | |
| | | **Contingency** | | | |
| 10% Contingency for Changed Circumstances | Stage 1, $17,100. Stage 2, $25,600. | $42,700 | Deposited in a Surety | N/A | Stage 1: prior to the beginning of Project operation. Stage 2: prior to the beginning of year 11. |
| 5% Contingency for non-Changed Circumstances[8] | | $68,200 | Deposited in a Surety | N/A | Stage 1 by beginning of operation. Stage 2 beginning of year 11. |
| *Subtotal* | | *$110,900* | | | |
| | | **Grand Total** | | | |
| **GRAND TOTAL** | | **$11.7 M** | | | |

[1]Assumes 100-turbine layout searched.
[2]Average annual cost based on $700,000 for each year of monitoring, conducted every other year.
[3]Based on maximum funding needed to reach 87.8 ha (217 ac). In Stage 1, 35.1 ha (86.8 ac), or $440,000 less mitigation land already purchased. In Stage 2, 52.7 ha (130.2 ac), or $660,000 (to be adjusted for then current values), less mitigation land already purchased.
[4]These costs include initial land identification and real estate transaction costs.
[5]Value based on estimate for land management of 87.8 ha (217 ac), with 16.2 ha (40 ac) reforested, from a firm experienced in restoration/enhancement, maintenance, and monitoring.
[6]Value is funding for half of mitigation land. Buckeye Wind considers it unlikely that a single changed circumstance event will deforest all 87.8 ha (217 ac) of mitigation land. Should such an event occur, Buckeye Wind will provide funds as needed to restore, monitor, and manage up to 87.8 ha (217 ac). The source of this funding will be the annual operating budget.
[7]Most of the adaptive management measures are related to altering the operations of the wind farm. While this could have substantial costs related to lost revenue, there are no "out of pocket" expenses.
[8]Based on Year 1 monitoring ($700,000), Stage 1 Acquisition Costs ($440,000), Stage 1 Identification Costs ($100,000), and Stage 1 Management Costs ($123,200) for a total contingency base of $1.36 M. Five percent of $1.36 M equals $68,200. This total will change year to year as the assured funding is revised based on year-ahead monitoring estimates and mitigation lands actually purchased and conserved (thereby eliminating the need for funding assurance), adjustments for inflation and other factors. The purpose of this contingency amount is to provide a reasonable "buffer" if costs estimated for specific actions (i.e., monitoring, mitigation, changed circumstances and reporting) are higher than anticipated.

# 7.0 PLAN IMPLEMENTATION

## 7.1 HCP Administration

Buckeye Wind will implement the HCP upon approval of the HCP and issuance of the ITP. Buckeye Wind is actively developing plans for the Project's additional 48 proposed turbines and securing all state and local permits for construction and operation of the additional turbines. While the timing of construction of the additional 48 turbines relative to the original 52 turbines is uncertain, this HCP includes an assessment of impacts from the entire 100-turbine Project, with specific Conservation Measures and monitoring being applied as described in Chapter 6.0 – Conservation Measures.

Buckeye Wind will be solely responsible for meeting the terms and conditions of the ITP and will allocate sufficient personnel and resources to ensure effective implementation of the HCP. Buckeye Wind will implement this HCP in coordination with the USFWS and ODNR DOW. An HCP Coordinator, who will likely be a representative of Buckeye Wind, will be identified by Buckeye Wind in coordination with the USFWS. The HCP Coordinator will be responsible for overseeing the HCP implementation, planning, and coordination of all meetings and agenda items and delivery of all monitoring and other reports to the USFWS and ODNR DOW as specified in this HCP and as required in the ITP. Should the HCP Coordinator leave his or her position for any reason, the most appropriate replacement will be determined in coordination with the USFWS. Buckeye Wind expects that management of mitigation lands will be carried out by a conservation trust or other appropriate conservation organization. Monitoring is expected to be carried out by third party contractors with expertise in conducting avian and bat fatality studies at wind facilities (for post-construction mortality monitoring) and with knowledge of Indiana bat habitat requirements (for mitigation monitoring). Funding that Buckeye Wind will provide for research (i.e., conservation measures) will also be carried out by third party contractors, academic institutions, or non-governmental organizations with expertise in Indiana bat behavior as it relates to wind energy development.

Buckeye Wind will meet at least annually with USFWS and ODNR DOW throughout the ITP Term. The objective of annual meetings will be to review annual mortality and mitigation monitoring reports to determine the need for adjustments to minimization, monitoring, and mitigation in accordance with the adaptive management criteria identified in Section 6.5 – Monitoring and Adaptive Management. Additional objectives of annual meetings will be to evaluate the potential application of new scientific findings to the adaptive management of this HCP and to evaluate potential occurrence of changed or unforeseen circumstances. Additional meetings or conferences may be initiated by Buckeye Wind and/or USFWS to address other concerns, as necessary, including implementation and results of conservation measures.

## 7.2 Changed and Unforeseen Circumstances

Implementing regulations for Section 10 of the ESA recognized that revisions to the original HCP may be required as circumstances and information may change. 50 CFR 17.22(b)(1)(iii)(C) requires that "…any plan approved for a long term permit will contain a procedure by which the parties will deal with unforeseen circumstances." Circumstances that can be reasonably anticipated and planned for are considered "changed circumstances" and may include new ESA listing of a species or a natural catastrophe in areas prone to such an event (USFWS and NOAA 1996). "Unforeseen circumstances" are defined as changing circumstances that were not or could not be anticipated by HCP participants and the USFWS and that result in a substantial and adverse change in the status of the Covered Species (USFWS and NOAA 1996). During the 30-year ITP Term of the HCP, Buckeye Wind and USFWS recognize that both anticipated or "changed circumstances" and unanticipated or "unforeseen circumstances" may occur.

### 7.2.1 Changed Circumstances

#### *7.2.1.1 Listing of New Species under ESA*

As cited previously, winter bat census data from 2009-2010 in CT, MA, NY, and VT indicate that the species experiencing the most significant declines from WNS include the little brown bat and tri-colored bat populations (both estimated at 93% reduction) and northern long-eared bat populations (estimated at a 99% reduction) (Langwig et al. 2010). Similar to reductions reported by Langwig et al. (2010), little brown bat populations in NY declined 93% from 2006 to 2009 (BCI 2010b). Initial modeling of the dynamics of WNS-infected populations indicates that little brown bats are at risk of regional extinction as a result of WNS within the next 16 years (Frick et al. 2010). The little brown bat occurs in the Action Area and was captured during pre-construction mist-netting surveys (197 little brown bats, or 66% of all individuals captured in a 2008 survey [Stantec 2008a] and 2 little brown bats or 4% of all individuals captured in a 2009 survey [Jackson Environmental Consulting Services LLC, 2009]) and during swarming surveys (201 little brown bats, or 23% of all individuals captured [Stantec 2008a]).

Other bat species are experiencing similar mortality from WNS and may also be at risk of population collapse, most notably northern long-eared bats, eastern small-footed bats, and Indiana bats (USGS 2010). The CBD recently petitioned the Secretary of the Interior to list the eastern small-footed bat and northern long-eared bat as a federally threatened or endangered species under the ESA and to designate critical habitat for these species concurrent with listing (CBD 2010; filed 21 January 2010). On 29 June 2011, the USFWS announced that the eastern small-footed and northern long-eared bats may warrant Federal protection as threatened or endangered under the ESA pursuant to 16 U.S.C. § 1533(b)(3)(B) (76 Fed. Reg. 38095-38106). The USFWS has thus initiated a more thorough status review of these species. The USFWS is also collecting information on additional species susceptible to WNS (USFWS 2011b).

The CBD petition states that the eastern small-footed bat and the northern long-eared bat are threatened by 4 of the 5 factors identified by the ESA to warrant listing: the loss and curtailment of their habitat or range; disease (i.e., WNS); numerous natural and anthropogenic factors (e.g., environmental contaminants, climate change, wind energy development); and inadequacy of existing regulatory mechanisms. Although many bat species in the eastern U.S. are experiencing the threats discussed above, the CBD petition (2010) argues that the life histories, habitat associations, and current population statuses of the eastern small-footed bat and northern long-eared bat make these species especially vulnerable to severe population declines and local extinctions. These 2 species were added to the USFWS Region 3 federal list of Species of Concern, an informal term indicating species which Region 3 feels might be in need of conservation activities and are listed as Species of Concern by ODNR DOW.

The eastern small-footed bat was not detected during bat surveys in the Action Area or initial study area, and no suitable habitat for the species exists within the Action Area. It is not anticipated that this Project would have an effect on this species. The northern long-eared bat does occur in the Action Area and individuals were captured during pre-construction mist-netting surveys (38 northern long-eared bats, or 13% of all individuals captured in a 2008 survey [Stantec 2008a] and 17 northern long-eared bats or 34% of all individuals captured in a 2009 survey [Jackson Environmental Consulting Services LLC, 2009]) and during swarming surveys (653 northern long-eared bats, or 74% of all individuals captured [Stantec 2008a]). While northern long-eared bats comprised a large proportion of the species documented in the Action Area, data from post-construction monitoring studies indicate that they are one of the species least susceptible to collision/barotrauma mortality at wind facilities. A total of 12 northern long-eared bat fatalities have been recorded in 59 monitoring studies conducted from 1998 to 2010 at wind energy facilities in the United States and Canada (refer to Table 4-10), which represents only 0.2% of the 7,144 total bat fatalities documented at these facilities.

In the event that the USFWS determines that the listing of the northern long-eared bat, little brown bat and/or other bat or bird species is warranted under 16 U.S.C § 1533(b)(3)(B)(ii) or (5)(A)(i), Buckeye Wind, in coordination with the USFWS, will evaluate the potential for the Project to result in incidental take of those species. The same coordination will occur for any other species for which the Service determines listing is warranted under 16 U.S.C § 1533(b)(3)(B)(ii) or (5)(A)(i), either through a petition action or through a status assessment absent a petition action, that is expected to occur within the Action Area. The evaluation will consider the known occurrence of the species and habitat within the Action Area and results of post-construction mortality monitoring in the Action Area and at other wind facilities. As previously stated, the avoidance, minimization, mitigation, and conservation measures that will be implemented for the Indiana bat as part of this HCP will result in similar minimization of impacts and benefits to the other bats that share similar life history characteristics, roosting and foraging behavior, and habitat with the Indiana bat. If incidental take is deemed to be likely, the ITP will be amended or other avenues for take coverage will be explored. In the case that the northern long-eared bat or little brown bat is listed before an amendment is obtained, Buckeye Wind will take the appropriate actions pursuant to the ESA to avoid take.

#### *7.2.1.2 White Nose Syndrome*

In addition to potentially causing new species to be federally listed, WNS is a changed circumstance in itself because the ultimate effects on the Indiana bat range wide population are yet unknown (see Section 4.1.1 – White Nose Syndrome and Section 4.5.3 – Disease and Parasites). The 2007 Draft Recovery Plan does not address Indiana bat population decreases that have occurred as a result of WNS. However, it is a condition already present throughout much of the Indiana bat's range, including OH, and therefore WNS was included in the analysis of the biological significance of incidental take (see Section 5.1.2.6.3 – Population Declines from White Nose Syndrome).

Buckeye Wind is required to minimize and mitigate the impacts of the taking to the maximum extent practicable. Therefore, Buckeye Wind, in coordination with the USFWS, will review the biennial winter census results compiled by the USFWS Indiana Bat Recovery Team and if the population of Indiana bats in the Midwest RU is reduced by 50% or more from 2009 pre-WNS levels (269,574 Indiana bats), Buckeye Wind will commit to reducing requested 5-year take limits by 50% (see Section 5.1.2.6.4 – Take Reductions as a Result of WNS). In this event, the 5-year take limit would be 13.0 Indiana bats (or average of 2.6 Indiana bats per year). For the purposes of Adaptive Management for minimization, Less than Expected take would be defined as less than 2.6 Indiana bats per year. Expected take would be 2.6 Indiana bats per year, and Greater than Expected take would be greater than 2.6 Indiana bats per year. These reductions in take would be expected as a result of fewer Indiana bats exposed because of overall population declines. Project operations under reduced take would continue to be subject to adaptive management decisions as outlined in Section 6.5 – Monitoring and Adaptive Management.

If the 5-year take limits are reduced, the mitigation acres will be recalculated to adjust for the reduced mortality expected for the project. For example, if the reduction in take limits occurs in the 10$^{th}$ year, take limits for the remaining 15 years will consider an average of 2.6 Indiana bats per year. The take limit for the ITP Term would then be 5.2 x 10 years + 2.6 x 15 years, or 91 Indiana bats. Therefore, the mitigation acres needed to offset the effects of take would necessarily be reduced. As offsetting the effects of take of 130 Indiana bats would require 81.3 ha (206.3 ac; see Section 6.3.1 – Acres of Mitigation Calculation), offsetting the take of 91 bats would require 56.9 ha (144.4 ac). Since mitigation for 91.2 ac will have already been dedicated, Stage 2 mitigation would cover the additional 53.2 ac, plus 16.1 ac for tree clearing during construction, or a total of 69.3 ac for the remaining 15 years of the ITP Term.

In addition, the trigger point for immediate adaptive management would also change. In this case, if 2 Indiana bat mortalities are documented at the site before the fall season, cut-in speeds will be increased by 1.0 m/s at all turbines for the remainder of the active period (Figure 7-1). Any additional documented Indiana bat mortality will result in all turbines being operated with a cut-in speed of 7.0 m/s. After the cut-in speeds are increased to 7.0 m/s, if additional Indiana bat mortality is documented all turbines will be turned off from 1 hour before sunset to 1 hour after sunrise for the remainder of the active period.

In addition, if 1 Indiana bat mortality is documented before the fall season, 1 Indiana bat mortality in the fall season will trigger immediate adaptive management. If no Indiana bat mortalities are documented before the fall season and 2 Indiana bat mortalities are documented at the site during the fall season, immediate adaptive management will be triggered. In either scenario cut-in speeds will be increased by 1.0 m/s for the remainder of the active period. Any additional documented Indiana bat mortality will result in all turbines being operated with a cut-in speed of 7.0 m/s. If additional Indiana bat mortality is documented, all turbines will be turned off from 1 hour before sunset to 1 hour after sunrise for the remainder of the active period.

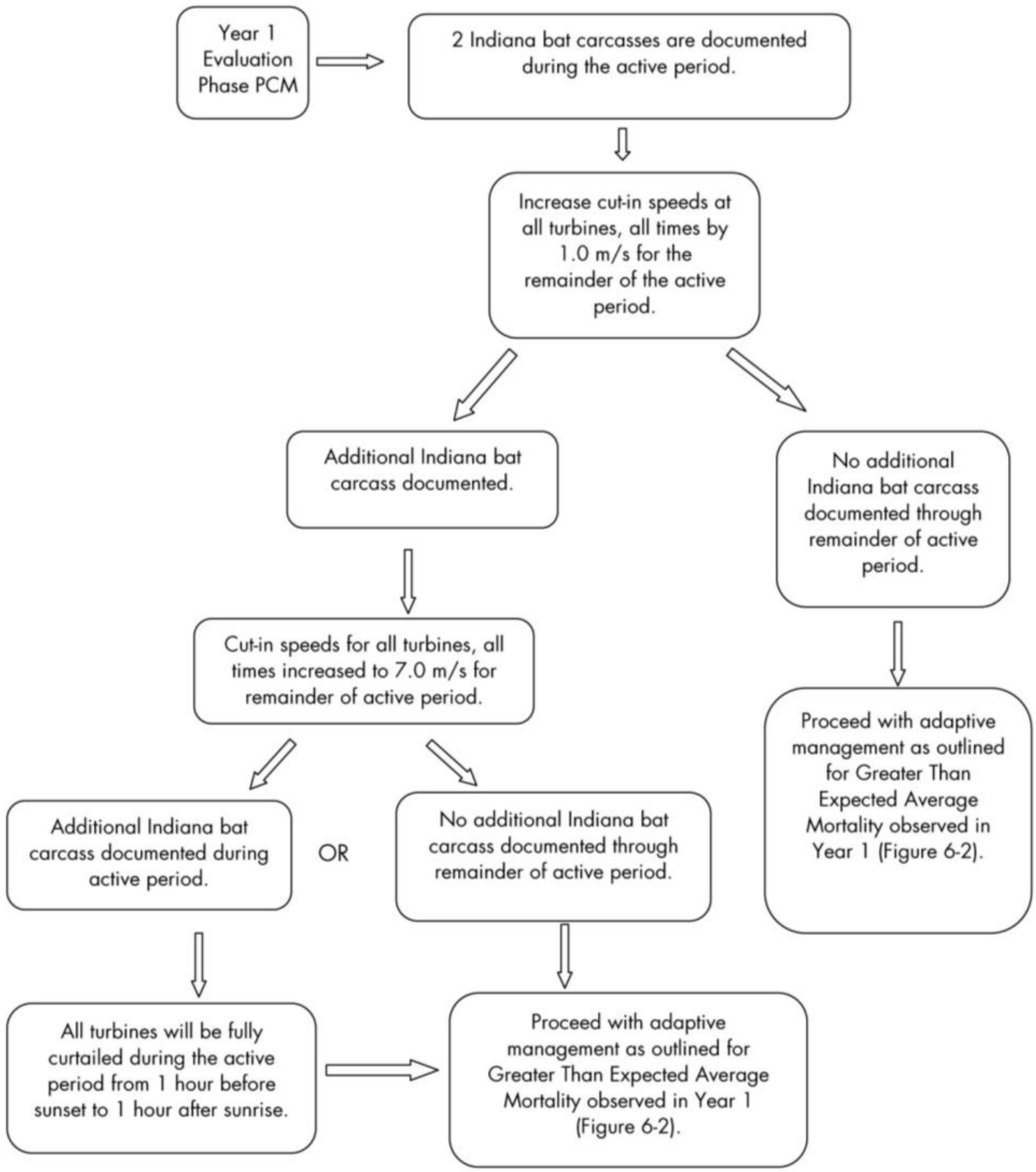


**Figure 7-1.** Within-season Trigger Points for adaptive management with Indiana bat populations decreased by 50% due to WNS.

#### *7.2.1.3 Drought*

Drought is defined as a period of time (generally months or years) when actual moisture supply is below the "climatically expected or climatically appropriate moisture supply" (Palmer 1965). Average annual precipitation in Ohio ranges from 32 in to 42 in across the state from north to south; minimum annual precipitation occurred in the drought year of 1930 (26.59 in; National Climatic Data Center [NCDC] no date). In OH, drought is most common in the spring and summer months and occurs an average of 2 times per decade, and periods of drought tend to cluster together in time (NCDC n.d., Rogers 1993). Periods of drought in OH commonly persist for 2 to 5 years and are linked to unusually high summer temperatures through increased evapotranspiration (Rogers 1993).

Climate change may increase the frequency and intensity of drought conditions in the summer months. Warmer temperatures are expected to leave OH's soils drier for more of the year. Despite an increase in overall precipitation, average summer rain in OH could decrease by 20% or more, increasing the risk of drought (Kling et al. 2003, as cited in Gomberg 2008). Warmer temperatures will lead to an increase in evaporation, and combined with a decrease in summer precipitation will cause increased soil moisture deficit, lower lake and river levels, and more drought-like conditions (IPCC 2007). Increased drought also has the potential to increase the frequency and magnitude of forest fires, which have the potential to eliminate areas of Indiana bat roosting and foraging habitat, depending on fire intensity (see Section 7.2.1.5 – Fire).

OH is characterized by short-term and long-term variation in water supply (Rogers 1993). The NCDC (n.d.) suggests that an average of 2 droughts per decade can be expected. Historic data in OH indicate that between 1895 and 1992 (i.e., over 97 years) there were approximately 13 periods in which drought occurred (Rogers 1993). However, there were 17 12-month periods during the same span of years (where 12-month periods were not tied to calendar years) that had the lowest precipitation. Drought severity is also variable. The Palmer Hydrological Drought Index (PHDI) is a measure of drought intensity. Historic OH data collected during the same time frame (i.e., between 1895 and 1992, or over 97 years) indicate that there were 17 years in which the PHDI reached a minimum during the growing season (i.e., April to September; Rogers 1993): 2 years were considered to have had mild drought conditions (PHDI values from -1.00 to -1.99); 11 years had moderate drought conditions (PHDI values from -2.00 to -2.99); 2 years had severe drought conditions (PHDI values from -3.00 to -3.99); and 2 years had extreme drought conditions (PHDI values below -4.00; Rogers 1993).

Drought has the potential to negatively affect Indiana bats because water is important as a drinking source and is important to the insect populations found in and near water sources, both necessary elements in meeting the energetic demands of pregnant and nursing females with dependent young (Kurta 2001). Insectivorous bats typically obtain 20% to 26% of their daily water from drinking (Kurta et al. 1989, 1990, 2001). Summer precipitation has also been shown to be related to adult female and juvenile survival in the closely related little brown bat. Based on 16 years (1993-2008) of mark-recapture data to estimate age-specific survival and breeding probabilities of the little brown bat in southern New Hampshire, Frick et al. (2009) found that adult female survival was highest in wet years with high cumulative summer precipitation. Given that this species exhibits low fecundity and high longevity, a substantial decline in the survival rate of reproductive females is expected to reduce population growth of little brown bats (Frick et al. 2009), as well as other bat species that share their life history characteristics, such as the Indiana bat.

As part of this HCP, mitigation will consist of permanent preservation, enhancement, and restoration of land surrounding a P2 hibernaculum in OH in conjunction with a third party conservation organization. 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. Mitigation actions are intended to offset the impacts of Project-related take, and therefore measureable thresholds set out in Section 6.3 – Mitigation Measures will be used to ensure that effective mitigation is maintained. On preserved land with existing forest stands, annual monitoring in Year 1 through Year 5, followed by subsequent monitoring every 5 years, will occur.

Drought will constitute a changed circumstance if monitoring determines that there are less than 2 small diameter snags, 5 medium diameter snags, and 2 large diameter snags per acre on average; if there are less that 300 stems per acre on average; or if woody invasive species occupy more than 5% cover in the understory. It is anticipated that, at a minimum, the response to changed circumstances due to drought would include 1 or more of the following activities, as described more fully in Section 6.3.4 – Restoration and Enhancement:

- Tree planting where tree mortality has reduced tree density to below an average of 300 stems/ac/PA;
- Tree girdling to return snag densities to the stated target; and
- Non-native woody invasive species control such that woody invasive species do not exceed 5%. Methods for clearing invasive species will include brush cutting (using bushhogs, mowers, or other similar equipment), hand cutting, and the use of herbicides if necessary.

However, drought is also one of a suite of natural disturbance events that can result in increased tree mortality and therefore increases in snag density (Wisdom and Bate 2008). While this effect is beneficial in that it would result in increased roosting opportunities, severe or extreme drought lasting over a long period of time has the potential to result in extreme tree mortality.

Once drought triggers a changed circumstance, and within 1 year of the drought ending, Buckeye Wind will begin restoration activities in accordance with the approach described in Section 6.3.4 – Restoration and Enhancement. Tree planting in response to severe tree mortality resulting from extended drought cannot be effectively implemented until after the drought is over. Prolonged drought lasting beyond the 30-year ITP Term will constitute an unforeseen circumstance. Actions will be implemented as described in Section 6.3, will be consistent with ITP obligations, and will be funded (in whole or in part) by the Changed Circumstances fund (see Section 6.7 – Funding for the HCP).

#### *7.2.1.4 Flooding*

Floods in OH generally occur in the winter and early spring as a result of high precipitation during times of saturated ground (NCDC n.d.). Flooding can become severe in spring when these factors combine with melting snow. In summer, localized flooding in hilly terrain can result from repeated thunderstorms in the same area. Average annual precipitation in OH ranges from 32 in to 42 in across the state from north to south, with a state-wide average of 38 in (NCDC n.d.). The NCDC Storm Events database (http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms) lists 42 flood events that occurred in Preble County between 1993 and 30 April 2011; damages ranged from no property damage to half a million dollars' worth, but most flood events caused very little damage. None caused injuries, deaths, or crop damage. Similarly, Montgomery County has 6 reported flood events, with property damages ranging from $1,000 to $5,000 and no injuries, deaths, or crop damage; Darke County has 10 reported flood events with property damages ranging from $1,000 to $5,000 and no injuries, deaths, or crop damage. While summers may become drier as a result of global climate change, winters and springs in OH are expected to be wetter, making flooding events more likely. Winters could become 20% to 30% wetter when compared with the 1960-1990 average (Kling et al. 2003, as cited in Gomberg 2008). OH has already seen a 43% increase in the state's extreme precipitation events since 1948 (Madsen and Figdor 2007, as cited in Gomberg 2008). Storms with as much rain and snow as those that occur only once every 20 years now, are predicted to occur every 4 years to every 6 years by 2100 (Madsen and Figdor 2007, as cited in Gomberg 2008).

It is difficult to predict flood events since flooding depends on stream capacity, runoff potential, and rainfall patterns across a wide area. A 100-year flood, as defined by the Federal Emergency Management Agency (FEMA), has a 1% chance of occurring in any given year. Over long periods of time, this type of flood would occur on average once every 100 years, but in the short term its frequency could be more than once in a single year or once in more than 100 years. Similarly, a 1-year flood has a 100% chance of occurring each year, on average. However, 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. USGS 1:24,000 topographic maps indicate a number of intermittent and perennial streams within the mitigation area; FEMA flood maps show that the 100-year flood hazard areas are limited to the immediate proximity of the streams. Because of issues with predicting flood intensity and frequency, a specific number of flood events expected over the 30-year ITP has not been developed for this HCP.

Flooding events could threaten the stability of Indiana bat hibernacula that are vulnerable to flooding; the result could be direct mortality of Indiana bats or unfavorable hibernating conditions due to changes in cave microclimate. However, flooding could also have a positive effect on Indiana bats if frequent water inundation resulted in senescence of deciduous trees, which would create conditions favorable to roosting, such as sloughing bark.

As part of this HCP, mitigation will consist of preservation, enhancement, and restoration of land surrounding a P2 hibernaculum in OH. Mitigation actions are intended to offset the impacts of Project-related take, and therefore measureable thresholds set out in Section 6.3 – Mitigation Measures will be used to ensure that mitigation is effective. On preserved land with existing forest stands, annual monitoring in Year 1 through Year 5, followed by subsequent monitoring every 5 years, will determine whether there are at least 2 small diameter snags, 5 medium diameter snags, and 2 large diameter snags per acre on average. Tree planting or girdling will occur if the number of snags on average is below this ratio. If no trees are present on preserved land, then restoration in the form of tree planting will occur. Monitoring will ensure a 70% survival rate for seedlings during the first 5 years, and subsequent monitoring years will determine when trees are large enough to be girdled in order to create potential roosts.

Flooding will constitute a changed circumstance if a severe flood (i.e., a 50-year flood as defined by FEMA) occurs during the Project term and monitoring determines that there are less than 2 small diameter snags, 5 medium diameter snags, and 2 large diameter snags per acre on average, if there are less than 300 stems per acre on average, or if woody invasive species occupy more than 5% cover in the understory. It is anticipated that, at a minimum, the response to changed circumstances due to flooding would include 1 or more of the following activities, as described more fully in Section 6.3.4 – Restoration and Enhancement:

- Tree planting where tree mortality has reduced tree density to below an average of 300 stems/ac/PA;
- Tree girdling to return snag densities to the stated target; and
- Non-native woody invasive species control such that woody invasive species do not exceed 5%. Methods for clearing invasive species will include brush cutting (using bushhogs, mowers, or other similar equipment), hand cutting, and the use of herbicides if necessary.

Although FEMA maps show areas bordering creeks in the mitigation area and adjacent low-lying areas, which are more likely to experience flooding under high-water conditions, the extent of flooding and damages will depend on water levels, the rate at which water levels rise, soil conditions, specific topography, and many other factors. Once flood triggers a changed circumstance, and within 1 year of the flooding ending, Buckeye Wind will begin restoration activities in accordance with the approach described in Section 6.3.4 – Restoration and Enhancement. Tree planting in response to severe tree mortality resulting from extensive flooding cannot be effectively implemented until after the inundated soil has drained. Actions will be implemented as described in Section 6.3, will be consistent with ITP obligations, and will be funded (in whole or in part) by the Changed Circumstances fund (see Section 6.7 – Funding for the HCP).

#### *7.2.1.5 Fire*

Fire is a natural part of many ecosystems. In OH, small, frequent fires occurred naturally in pre-settlement times, but widespread fire suppression through the 1980s degraded ecosystems, reduced biodiversity, reduced the occurrence of open natural communities such as prairies, and allowed fuel to build up in forested areas (Snyder 2004). Currently, prescribed burns are conducted on federal, state, and private lands to manage forests, and small frequent fires elsewhere in the state occur. Prescribed burns are not contemplated to be used for conservation programs as part of this HCP.

Land cover types that have low fuel loads or high moisture content, including cropland, wetland, and developed cover types, are not prone to fire. In contrast, fire could propagate through forest, pasture, and grassland cover types. 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. Of those land cover types that could support fire in the mitigation area, the majority are classified as Class II: these areas have natural fire regimes that include predominantly high-severity fires occurring once every 35 years, on average (Fire Regime Condition Class [FRCC] 2010). The remaining fire-prone land cover types have been identified as Class III areas having natural fire regimes which include predominantly mixed-severity fires occurring once every 35 to 200 years (FRCC 2010). No forest fire events for Preble, Montgomery, or Darke counties have been reported to the NCDC Storm Events database (http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms). Climate change may cause an increase in the frequency and severity of wildfires in Ohio, as warmer temperatures and decreased summer rainfall are expected to leave soils drier for more of the year and increase the frequency and intensity of drought conditions in the summer months (Kling et al. 2003, as cited in Gomberg 2008) (See Section 7.2.1.3 – Drought).

Forest fire has the ability to affect Indiana bat habitat in the mitigation land located outside a P2 hibernaculum in OH. Fire may be beneficial to Indiana bats: it can remove understory clutter, producing semi-open forest stands preferred by Indiana bats (see Section 4.4.4.2 – Foraging and Traveling Behavior). It can create potential roost trees by creating standing snags (see Section 4.4.4.1 – Maternity Roosts). And it can create canopy gaps, which in turn can result in increased insect diversity and increased solar exposure to any nearby roost trees (see Section 4.4.4.2 – Foraging and Traveling Behavior). However, large, intense, or frequent fires could have a negative impact on Indiana bat or fall swarming/spring emergence and roosting habitat in mitigation lands surrounding a hibernaculum. Destruction of large swaths of forest could reduce roost tree availability or sufficient canopy closure or it could allow woody invasives an opportunity to infiltrate the area.

As part of this HCP, mitigation will consist of preservation, enhancement, and restoration of land surrounding a P2 hibernaculum in OH. Mitigation actions are intended to offset the impacts of Project-related take, and therefore measureable thresholds set out in Section 6.3 – Mitigation Measures will be used to ensure that mitigation is effective.

Fire will constitute a changed circumstance if a single mixed-severity fire, defined as a fire replacing 25% to 75% of the dominant overstory vegetation, or if a single high-severity fire, defined as a fire replacing greater than 75% of the dominant overstory vegetation (FRCC 2010), occurs during the Project term and monitoring determines that there are less than 2 small diameter snags, 5 medium diameter snags, and 2 large diameter snags per acre on average, if there are less that 300 stems per acre on average, or if woody invasive species occupy more than 5% cover in the understory. It is anticipated that, at a minimum, the response to changed circumstances due to fire would include 1 or more of the following activities, as described more fully in Section 6.3.4 – Restoration and Enhancement:

- Tree planting where tree mortality has reduced tree density to below an average of 300 stems/ac/PA;
- Tree girdling to return snag densities to the stated target; and
- Non-native woody invasive species control such that woody invasive species do not exceed 5%. Methods for clearing invasive species will include brush cutting (using bushhogs, mowers, or other similar equipment), hand cutting, and the use of herbicides if necessary.

Fire is 1 of a suite of natural disturbance events that can result in increased tree mortality and therefore increases in snag density (Wisdom and Bate 2008). While this effect is beneficial in that it would result in increasing roosting opportunities within preserved areas, severe crown fires have the potential to result in extreme tree mortality. Indiana bat roost trees have been documented in stands with canopy closure ranging from less than 20% to 80% for females and from 49% to 80% for males (Kurta 2005). Although roost trees can therefore be located in areas of open canopy, it is likely that large areas of high snag density, resulting in an open canopy, would be unsuitable for roosting.

Once fire triggers a changed circumstance, and within 1 year of the fire event, Buckeye Wind will begin restoration activities in accordance with the approach described in Section 6.3.4 – Restoration and Enhancement. Tree planting in response to extreme tree mortality resulting from severe fire cannot be effectively implemented until after soils have cooled and adequate water content has been reestablished. Actions will be implemented as described in Section 6.3, will be consistent with ITP obligations, and will be funded (in whole or in part) by the Changed Circumstances fund (see Section 6.7 – Funding for the HCP).

#### *7.2.1.6 Tornadoes*

A tornado is defined as violently rotating column of air extending from a cumuliform cloud, such as a thunderstorm, to the ground. The United States experiences more tornadoes than any other country (NOAA 2010). Tornadoes may occur at any time during the year, but are most frequent in the late spring and summer months. Based on Disaster Center data, OH experienced a total of 656 recorded individual tornadoes from 1950 to 1995 and averages approximately 14 individual tornadoes per year[45]. FEMA tornado maps indicate that most areas in OH experience F3 (136-165 mph), F4 (166-200 mph), and F5 (>200 mph) tornadoes with moderate to high frequency compared to other states in the United States[46]. Eleven tornado events in Preble County were reported to the NCDC Storm Events database[47] between 1950 and 30 April 2011; most were of magnitudes F0 (65-85 mph) or F1 (86-110 mph), but there was 1 tornado each of magnitudes F3 and F4. One tornado event was reported to the NCDC Storm Events

[45] http://www.disastercenter.com/ohio/tornado.html
[46] http://www.fema.gov/plan/prevent/saferoom/tsfs02_torn_activity.shtm
[47] http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms

database for Montgomery County (FO) and 3 were reported for Darke County (2 were FO, 1 was F1). Property damages ranged from a couple thousand to 25 million dollars. Tornadoes may increase in frequency and magnitude in OH and elsewhere as climate change results in more frequent and more severe thunderstorms, hurricanes, and extreme weather patterns (Dutzik and Willcox 2010).

A tornado has the potential to destroy Indiana bat roosting habitat through the destruction and removal of both live trees and snags. Tornadoes occurring during the active season for Indiana bats have the potential to cause direct mortality of both adults and juveniles. The scale of damage from a tornado will depend on the magnitude of the tornado and the duration and linear speed of the tornado, which may range from a localized area of touch-down to a wide path extending tens or hundreds of miles. Tornadoes are not expected to create or enhance habitat for Indiana bats, as most trees killed by a tornado are unlikely to remain standing.

As part of this HCP, mitigation will consist of preservation, enhancement, and restoration of land surrounding a P2 hibernaculum in OH. Mitigation actions are intended to offset the impacts of Project-related take, and therefore measureable thresholds set out in Section 6.3 – Mitigation Measures will be used to ensure that mitigation is effective.

A tornado that moves through forested habitat is likely to cause tree damage and destruction, especially to standing snags. A tornado will constitute a changed circumstance if a tornado of magnitude F4 or less is documented to occur within the mitigation area by the National Weather Service during the Project term and monitoring determines that there are less than 2 small diameter snags, 5 medium diameter snags, and 2 large diameter snags per acre on average, if there are less that 300 stems per acre on average, or if woody invasive species occupy more than 5% cover in the understory. It is anticipated that, at a minimum, the response to changed circumstances due to tornado would include 1 or more of the following activities, as described more fully in Section 6.3.4 – Restoration and Enhancement:

- Tree planting where tree mortality has reduced tree density to below an average of 300 stems/ac/PA;
- Tree girdling to return snag densities to the stated target; and
- Non-native woody invasive species control such that woody invasive species do not exceed 5%. Methods for clearing invasive species will include brush cutting (using bushhogs, mowers, or other similar equipment), hand cutting, and the use of herbicides if necessary.

Tornadoes occurring within forested parts of the mitigation area have the potential to result in extreme tree mortality, depending on tornado magnitude and path size. Although a tornado may cause only patchy destruction, leaving areas of standing trees, it is likely that habitat with large areas of open canopy would be unsuitable for roosting.

Once a tornado triggers a changed circumstance, and within 1 year of the tornado event, Buckeye Wind will begin restoration activities in accordance with the approach described in Section 6.3.4 – Restoration and Enhancement. Actions will be implemented as described in Section 6.3 – Mitigation Measures, will be consistent with ITP obligations, and will be funded (in whole or in part) by the Changed Circumstances fund (see Section 6.7 – Funding for the HCP).

#### *7.2.1.7 Invasive Species and Vegetation Disease*

Both invasive species and vegetation disease can threaten the health and productivity of forest ecosystems. Outbreaks of these 2 conditions may occur separately or vegetation disease may result from an invasive species. Trees within the mitigation area may be subject to a variety of diseases caused by parasitic fungi, bacteria, viruses, nematodes, and other non-invasive or invasive organisms (Asselin 2010). In addition to disease-causing invasive species, herbivorous or parasitic invasive species may destroy deciduous trees through over-consumption of leaves or bark or disruption of metabolic processes within the tree, and vegetative invasive species may out-compete deciduous trees for resources such as sunlight or water.

Diseases currently threatening OH's deciduous trees include Bacterial leaf scorch, caused by the bacterium *Xylella fastidiosa;* oak wilt, caused by the fungus *Ceratocystis fagacearum;* Sudden Oak Death, caused by the fungus *Phytophthora ramorum;* and Thousand Cankers Disease, caused by the walnut twig beetle (*Pityophthorus juglandis*); and the fungus *Geosmithis morbida* (ODNR Division of Forestry [DOF] 2011). Gypsy moth (*Lymantria dispar*), emerald ash borer (*Agrilus planipennis*), and jumping oak gall (caused by the *Neuroterus saltatorius* wasp) have affected many forests across OH in recent decades. The Asian longhorned beetle (*Anoplophora glabripennis*) was recently documented in Clermont County, OH, and ODNR is concerned that it and the hemlock woolly adelgid (*Adelges tsugae*) may soon spread to Ohio's forests. Tree-of-heaven (*Ailanthus altissima*), bush honeysuckle (*Diervilla* spp.), multiflora rose (*Rosa multiflora*), autumn olive (*Elaeagnus umbellata)*, Japanese honeysuckle (*Lonicera japonica*), glossy buckthorn (*Frangula alnus)*, and *Paulownia* spp. are harmful woody invasive plants common in OH.

It is not possible to predict with any certainty the frequency, extent, or severity of disease outbreaks or invasive species. However, climate change may influence the effects of disease and invasive species on tree species. In general, diseases tend to be more prevalent in warmer climates, and vegetation stressed by increased temperatures or more drastic weather patterns may be more susceptible to disease or may be out-competed by invasive species. Climate change may allow certain invasive species or pathogens to expand their range, impacting forests that are not adapted to sustain the impacts from these organisms (Battles et al. 2006). Drought-stressed forests within the mitigation area may experience an increase in the occurrence of diseases and invasive species, and new diseases and invasive species may arrive with increased temperatures.

Invasive species and vegetation disease may improve habitat for Indiana bats by increasing tree mortality, thereby creating standing snags and, potentially, openings in the forest canopy. However, invasive insect species may replace suitable prey species for Indiana bats or destroy herbaceous vegetation that supports prey species. Invasive woody species may replace the deciduous tree species that provide suitable roosting habitat. Additionally, disease and invasive species both have the potential to cause extensive tree mortality, which may result in unsuitable Indiana bat habitat.

As part of this HCP, mitigation will consist of preservation, enhancement, and restoration of land surrounding a P2 hibernaculum in OH. Mitigation actions are intended to offset the impacts of Project-related take, and therefore measureable thresholds set out in Section 6.3 – Mitigation Measures will be used to ensure that mitigation is effective. Although the mechanisms by which invasive plants, disease, and invasive animals affect the forest stand, the triggers for each are the same.

An invasive species or a vegetation disease will constitute a changed circumstance if documented evidence from recognized experts confirms the presence of an invasive species or a disease and monitoring determines that the invasion or disease has resulted in less than 2 small diameter snags, 5 medium diameter snags, and 2 large diameter snags per acre on average, less that 300 stems per acre on average, or woody invasive species that occupy more than 5% cover in the understory. It is anticipated that, at a minimum, the response to changed circumstances due to invasive species or vegetative disease would include 1 or more of the following activities, as described more fully in Section 6.3.4 – Restoration and Enhancement:

- Tree planting where tree mortality has reduced tree density to below an average of 300 stems/ac/PA;
- Tree girdling to return snag densities to the stated target; and
- Non-native woody invasive species control such that woody invasive species do not exceed 5%. Methods for clearing invasive species will include brush cutting (using bushhogs, mowers, or other similar equipment), hand cutting, and the use of herbicides if necessary.

Outbreaks of disease and invasive species are likely to result in increased tree mortality and therefore increased snag density. While this effect is beneficial in that it would result in increasing roosting opportunities within preserved areas, severe epidemics have the potential to result in extreme tree mortality, loss of forest canopy, and degradation of quality of Indiana bat habitat. Indiana bat roost trees have been documented in stands with canopy closure ranging from less than 20% to 80% for females and from 49% to 80% for males (Kurta 2005). Although roost trees can therefore be located in areas of open canopy, it is likely that large areas of high snag density, resulting in an open canopy, would be unsuitable for roosting.

Because it is not possible to predict at this time the outbreak, extent, or location of land that may be negatively affected by disease or invasive species, implementation of the restoration will occur within 1 year of the outbreak or invasion being controlled and will be tailored to specific impact(s) of the outbreak or invasion on individual mitigation parcels. For example, if the invasive species is the emerald ash borer, then ash trees will not be used to replant the mitigation parcel. Actions will be implemented as described in Section 6.3 – Mitigation Measures, will be consistent with ITP obligations, and will be funded (in whole or in part) by the Changed Circumstances fund (see Section 6.7 – Funding for the HCP).

#### *7.2.1.8 Climate Change*

Climate change is defined as an increase in global average temperature, due to observed increase in greenhouse gas concentrations as a result of human activity (IPCC 2007). Global average temperatures have increased by approximately 1.3°F (0.74°C) between 1900 and 2000 and are predicted to increase by as much as 11.5°F (11.4°C) by 2100 (IPCC 2007). In the Midwest, average summer temperatures are predicted to be 3°F to 4°F (1.5°C to 2°C) above current averages by 2025 – 2035 (Kling et al. 2003). By the end of the century, models predict that winter temperatures could increase up to 14°F (8°C) above current averages and summer temperatures could increase up to 16°F (9°C) above current averages, under high-emission (worst-case) scenarios (Kling et al. 2003).

As described in the preceding sections, climate change may affect the effectiveness of mitigation by increasing the frequency and magnitude of natural disasters and epidemics above historic patterns. Climate change is expected to increase the frequency and intensity of drought conditions in the summer months, thereby potentially increasing the frequency and severity of forest fires (Kling et al. 2003 as cited in Gomberg 2008). Winters and springs in OH are expected to be wetter, making flooding events more likely (Kling et al. 2003 as cited in Gomberg 2008). Tornadoes may increase in frequency and magnitude in OH and elsewhere as climate change results in more frequent and more severe thunderstorms, hurricanes, and extreme weather patterns (Dutzik and Willcox 2010). Due to increasing drought stress in forests, occurrence of diseases and invasive species may increase, and new diseases and invasive species may arrive with increased temperatures (Battles et al. 2006).

Climate change represents a reasonably foreseeable circumstance that may negatively impact Indiana bat populations. However, impacts are expected to be complex and widely varied, which makes it extremely difficult to plan for measures that can effectively minimize or mitigate such effects (Hall 2008, Myers 2008). For example, increased drought, forest fires, flooding, and intense storm events are predicted for OH in the coming decades (see previous sections). The extent to which the increased frequency and intensity of these events could impact Indiana bats within the 30-year ITP Term is not possible to know. The impacts of natural disaster and epidemic events on Indiana bats, discussed in detail in each of the circumstance-specific sections above, may be magnified as climate change increases the frequency or magnitude at which such impacts occur.. The triggers for taking responsive action due to changed circumstances for each of the sections above are primarily based on the effects of the changed circumstance (in terms of tree and snag density) rather than frequency or severity, and will therefore allow for more frequent events resulting from climate change effects. The threshold that would define these events as unforeseen circumstances are conservative and exceed historic record of occurrence (see Section 7.2.2 – Unforeseen Circumstances and "No Surprise." As a result, reasonable effects of climate change are adequately covered in this HCP.

Additionally, by generating clean energy that will help offset or replace carbon-emitting energy sources, such as coal and oil, the Project is helping to mitigate the effects of climate change. Refer to Section 1.3 – Purpose and Need for the Project and Section 5.4 – Beneficial Effects of Wind Energy on Indiana Bats for additional information on the Project's contribution to minimizing climate change and the associated beneficial impacts on Indiana bats.

#### *7.2.1.9 Use of New Methods, Information, or Technological Advances*

Over the course of the ITP Term, new information on Indiana bats and wind power interactions may become available, new methods for monitoring mortality may be developed, or technological advances may be developed to minimize bat mortality at wind turbines. Buckeye Wind may wish to apply 1 or more of these new developments into the operations and/or monitoring plan outlined in the HCP. For example, the use of dogs to assist searchers has been studied and may become a viable method of monitoring. Dogs have been shown to increase searcher efficiency (Arnett 2005), although dogs will not be used for the first 2 years of monitoring per ODNR Protocol.

Use of chemicals to control vegetation around turbines is another monitoring method that may be employed. Chemical control may become the preferred method to improve searcher efficiency through vegetation removal. For example, it may not be feasible to mow all the required areas as outlined in this HCP. In this case, a chemical regime may be started in order to achieve the monitoring vegetative control requirements in this HCP.

Finally, there may be new information, methods, or procedures for monitoring or operation that may become available during the course of the ITP Term (see Section 6.5.3.7 – Special Cases). It is expected that over time, results of post-construction mortality monitoring, findings from research conducted as part of the conservation measures implemented under this HCP, and results from research and evaluation related to the wind industry made elsewhere will be used to inform changes to the operation and monitoring plans. The following results of post-construction monitoring and research comparing Indiana bat activity and interaction with wind turbines may help inform management actions, including adjusting the feathering regime when higher or lower feathering cut-in speeds are appropriate to avoid or minimize Indiana bat mortality:

- Results with respect to monitored weather conditions could identify factors that result in more or less risk to Indiana bats.
- Studies that look at nightly timing of foraging activity could inform the best times to feather turbines to limit Indiana bat mortality.
- Attraction studies could influence additional minimization and avoidance measures that could be taken to make turbines less attractive to Indiana bats.

- Studies that examine spatial use patterns with respect to turbines may provide evidence that establish trends in Indiana bats movement around turbines, which could be used to inform the feathering plans for the Project.
- If Indiana bats exhibited patterns of use that indicated avoidance of certain turbines, then these turbines could be feathered at the lower cut-in speed due to predicted lower risk and vice versa.
- Migration studies could help demonstrate if and what habitat features Indiana bats follow while migrating, and if they avoid landscape features such as wind farms.
- Enhanced understanding of migration characteristics such as flight height, speed, and distance could inform how effective and necessary feathering would be during migration periods depending on the flight height, turbine avoidance, and migratory pattern data.
- If studies are done to better understand habitat use and features preferred by Indiana bats, the mitigation measures may change to create a more attractive habitat enhancement as part of the mitigation measures for the HCP.
- Acoustic deterrent techniques or other deterrents may be developed and shown to significantly reduce Indiana bat interactions at turbines.
- New methods for estimating total fatality may be developed, including new methods for conducting trials to estimate bias, or new formulas to make more precise or accurate estimates.

Ideally, the results of these studies can be compared and merged to add strength to changes to the feathering and monitoring plans. Other, non-Project-related advancements in scientific understanding of Indiana bat biology and behavior may be used to inform changes to the avoidance, minimization, mitigation, and conservation measures. Any changes to the minimization measures would result in 2 years of Evaluation Phase monitoring to confirm the results.

Buckeye Wind may choose to utilize any alternative monitoring methods should they be demonstrated, based on the best available science, to be as or more effective than the methods described in this HCP, as approved by USFWS and ODNR DOW. Similarly, other technological advances or new techniques and information may become available during the course of the ITP Term that Buckeye Wind may want to use to more effectively implement other areas of the HCP such as adaptive management. Potential new techniques and/or information are described further in Section 6.5.3.7 – Special Cases. Buckeye Wind will work with USFWS to ensure that any new information or techniques that are planned to be used are compatible with the biological goals and objectives of the HCP.

Any new method, information or technology will only be considered if it has been demonstrated in an acceptable scientific study, has been approved by the USFWS as the best available science and will not require an increase in the take authorization for the Project.

### 7.2.2 Unforeseen Circumstances and "No Surprises"

Unforeseen circumstances include changes in circumstances that could not reasonably have been anticipated, and that result in a substantial and adverse change in the status of the Indiana bat. In addition to WNS, it is possible that other previously undetected diseases could impact Indiana bats in the future. Emergent infectious diseases represent circumstances that could impact Indiana bats in the future, but are unforeseen. There has been an increase in mass population declines and species extinction caused indirectly or directly by emerging infectious diseases in the past 20 years (Daszak et al. 2000, Daszak and Cunningham 2003) and emerging infectious diseases in wildlife populations are currently recognized as a major threat to global biodiversity (Cunningham 1996, Scott 1988, Daszak et al. 2000, Dobson and Foufopoulos 2001, Daszak and Cunningham 2003). The effects of emerging diseases can be exacerbated in populations that are stressed due to habitat loss, overexploitation, climate change, and pollution (Daszak et al. 2000, Harvell et al. 2002). This puts already threatened and endangered wildlife most at risk (Dobson and Foufopoulos 2001).

The increase in emergent diseases has been linked to a multitude of factors including antibiotic resistant microbes, centralization of the food processing industry, human encroachment into wildlife habitat, and globalization of human movement and trade (Aguirre and Tabor 2008, Daszak and Cunningham 2003, Cunningham et al. 2003, Karesh et al. 2005). Because the specific diseases or the mechanism by which they could affect Indiana bats is currently unknown and there is not sufficient information to currently predict this, impacts to Indiana bats from future emergent infectious diseases represent an unforeseen circumstance, excepting WNS, which is discussed in detail in Section 7.2.1.2 – White Nose Syndrome and assessed as part of this HCP.

Natural disasters or epidemics of unusual severity or frequency will be considered unforeseen circumstances and will not be considered for restoration or additional mitigation funding or actions. Unforeseen circumstances include, but by their unforeseen nature are not limited to, the following criteria:

- During the 30-year ITP Term, more than 6 periods of moderate drought, more than 1 period of severe drought, or 1 period of extreme drought [PHDI index value less than -4.00] will be considered an unforeseen circumstance and will not be considered for funding.
- During the 30-year ITP Term, more than 1 50-year flood or the occurrence of a 100-year flood will be considered an unforeseen circumstance and will not be considered for funding.
- During the 30-year ITP Term, more than 1 fire event (either mixed-severity or high-severity) will be considered an unforeseen circumstance and will not be considered for funding.
- During the 30-year ITP Term, unforeseen circumstances specific to tornadoes will include: more than 5 category F1 or F2 tornados; more than 1 F3 or F4 tornado; or any F5 tornado.
- During the 30-year ITP Term, more than 2 confirmed detrimental outbreak of vegetation disease or invasive species will be considered unforeseen. (A detrimental outbreak will reduce snag densities or stem densities, or increase woody invasive cover, beyond the thresholds described in Section 6.3.4 – Restoration and Enhancement.)

Should Buckeye Wind become aware of an unforeseen circumstance that has the potential to impact Indiana bats in the Action Area, Buckeye Wind shall notify USFWS within 30 days. Demonstrating that unforeseen circumstances exist is the burden of the USFWS and will be based on the best scientific and commercial data available. Consistent with the "No Surprises" policy [50 CFR 17.22 (b)(5)], established by the Department of the Interior and the Department of Commerce, if additional mitigation measures are deemed necessary to provide for the conservation of the Indiana bat that was otherwise adequately covered under the terms of the properly functioning HCP, the obligation for such measures shall not rest with Buckeye Wind. The "No Surprises" policy states, in part (50 CFR 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 the 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 the maximum extent possible. Additional conservation and mitigation measures will not involve the commitment of additional land, water or financial compensation or additional restrictions on the use of land, water, or other natural resources otherwise available for development or use under the original terms of the conservation plan without the consent of the permittee.

## 7.3 HCP Amendments

### 7.3.1 Minor Amendments

The USFWS or Buckeye Wind may propose minor modifications to the HCP by providing notice to the other party. Such notice shall include a statement of the reason for the proposed modification and an analysis of its environmental effects, including its effects on operations under the HCP and on Covered Species. The USFWS and Buckeye Wind will use reasonable efforts to respond to proposed modifications within sixty (60) days of receipt of such notice. Proposed modifications will become effective upon written approval of the USFWS and Buckeye Wind. If for any reason the USFWS or Buckeye Wind objects to a proposed modification, the modification must be processed as an amendment of the ITP in accordance with Section 7.3.2 – Amendment of the ITP. The USFWS will not propose or approve minor modifications to the HCP if the USFWS determines that such modifications would result in operations under the HCP that are significantly different from those analyzed in connection with this HCP, adverse effects on the environment that are new or significantly different from those analyzed in this HCP, or additional take not analyzed in this HCP.

Minor modifications to the HCP processed pursuant to this subsection may include but are not limited to the following:

- corrections of typographic, grammatical, and similar editing errors that do not change the intended meaning;
- corrections of any maps or exhibits to correct minor errors in mapping or to reflect previously approved changes in the ITP or HCP; and
- minor changes to survey, monitoring or reporting protocols.

Any other modifications to the HCP will be processed as amendments of the ITP in accordance with Section 7.3.2 – Amendment of the ITP below.

### 7.3.2 Amendment of the ITP

The ITP may be amended in accordance with all applicable legal requirements, including but not limited to the ESA, NEPA, and USFWS' regulations. The USFWS or Buckeye Wind may propose an amendment and will provide a statement of the reasons for the amendment and an analysis of its environmental effects, including its effects on operations under the HCP and on Covered Species.

### 7.3.3 Renewal of the ITP

Upon agreement of the USFWS and Buckeye Wind and compliance with all applicable laws and regulations, including but not limited to 50 C.F.R. § 13.22, the ITP Term may be extended beyond its initial term in accordance with USFWS regulations in force on the date of the renewal. If Buckeye Wind desires to renew the ITP Term, it will notify USFWS at least one hundred eighty (180) 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 renewal.

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# Appendix A

## Indiana Bat Collision Risk Model

# Indiana Bat Collision Risk Model for the Buckeye Wind Power Project

## Champaign County, Ohio

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# 1.0 INTRODUCTION

This collision risk model was developed to evaluate the probability of Indiana bat (*Myotis sodalis*) collision with wind turbines at the proposed Buckeye Wind Power Project (the Project) in Champaign County, OH. Buckeye Wind LLC, a wholly owned subsidiary of EverPower Wind Holdings, Inc., (EverPower; hereafter referred to as "Buckeye Wind" or the "Applicant") proposes to construct and operate a wind-powered electric generation facility that would include installation of up to 100 wind turbine generators (turbines), each with a generating capacity of 1.8-megawatts to 2.5-megawatts (MW), resulting in a maximum capacity of 250 MW. The facility will be situated within an area that encompasses approximately 32,395 hectares (ha; 80,051 acres [ac]; hereafter "Action Area") (refer to Figure 1-1 in the HCP). The results of this model will be used to estimate mortality (i.e., "take") that would be permitted under an Incidental Take Permit (ITP) issued by the U.S. Fish and Wildlife Service (USFWS) in accordance with the Buckeye Wind Project Habitat Conservation Plan (HCP).

Operation of the Project has the potential to result in mortality of Indiana bats, listed as federally endangered under the Endangered Species Act (ESA) of 1973 (7 U.S.C. § 136, 16 U.S.C. § 1531 et seq.), as amended. Indiana bats are known to fly within and near the Action Area during summer based on summer mist netting captures. Indiana bats are also likely to pass through the Project area during spring and fall migration. Bats using the Action Area could be injured or killed if individuals collide with turbines or come in close proximity to spinning blades, which can result in rapid pulmonary pressure changes leading to death as a result of barotrauma (Baerwald et al. 2008).

Impacts to bats from wind facilities are well documented in the continental United States (Johnson et al. 2003, Kunz et al. 2007, Arnett et al. 2008, Horn et al. 2008), with long-distance migratory bats being the most affected, particularly during the late-summer through fall migratory period. Prior to fall 2009, no Indiana bats were known to have been killed at a wind facility. However, the 2 documented fatalities of Indiana bats at the Fowler Ridge wind facility in Benton County, Indiana during the fall migratory periods in 2009 and 2010 confirm that Indiana bats are at risk of collision with wind facilities during the fall (Good et al. 2011). Indiana bats are also suspected to be at risk during the spring and summer periods, but mortality during these periods has not been documented.

Indiana bat use of the Action Area and their associated collision risk was estimated during 3 periods in which Indiana bats display distinct behavioral characteristics that could differentially affect their exposure to wind turbines: spring emergence and migration, or "spring" (1 Apr to 31 May), summer habitat use, or "summer" (1 Jun to 31 Jul), and fall migration and swarming, or "fall" (1 Aug to 31 Oct). The modeling technique presented here estimates mortality on a seasonal basis.

## 1.1 Model Approach

This collision risk model seeks to estimate Indiana bat mortality resulting from the rotating blades of operating wind turbines in the Action Area. Choosing the appropriate modeling approach for Indiana bat mortality estimation is a difficult process, because relatively few collision risk models are available for use in assessing collision based mortality at wind facilities, and none have previously been used to estimate bat mortality. Madders and Whitfield (2006) reviewed existing models that have been used for inland wind facilities and found that in general, existing mathematical models can be categorized into (1) simple correlations between the rate of mortality and turbine characteristics (Erickson et al. 2001; Barclay et al. 2007), and (2) highly detailed models requiring a large amount of information on the physical characteristics of the turbine geometry and bird size and speed (Tucker 1996a, 1996b; Podolsky 2003, 2005; Band 2000; Band et al. 2005). A third type of model exists that uses simple geometry with a minimum of information on the physical characteristics of a turbine (Hatch and Brault 2007; Bolker et al. 2006). The usefulness of a particular model is dependent upon the situation to which it is applied.

Under conditions of high uncertainty, simple models with minimal inputs are generally preferred in the risk assessment literature to more complex models with a large number of inputs (Warren-Hicks and Moore 1998). In cases where many key elements that influence risk are not well documented or understood, over-complication of mathematical models can lead to correspondingly high uncertainty in the model predictions, potentially giving decision makers a false sense of accuracy in the model findings. In these situations, the use of simple models that incorporate uncertainty analysis focused on the model equations and inputs can provide decision makers with a framework for understanding the degree of confidence that can be assigned to model outputs (Warren-Hicks 1999, Canham et al. 2003, Warren-Hicks and Hart 2010).

An example of this type of model was developed by Bolker et al. (2006) to estimate avian mortality at the proposed Cape Wind offshore wind facility in MA. The Bolker et al. (2006) model requires minimal inputs and employs simple geometry and basic probability theory. Given the uncertainty in modeling Indiana bat collision in the Action Area, the Bolker et al. (2006) model was used but expanded upon by incorporating empirical data and expert opinion on Indiana bat behaviors and conditions leading to risk into the published mathematical framework. Additionally, the Bolker et al. (2006) framework was modified by formally incorporating a risk-based approach to decision-making based on the model outputs, including the use of a formal uncertainty analysis.

A probabilistic approach was used in this collision risk model that relied on either a range of values, or on a formal distribution for each model input, rather than a deterministic approach based on single-point estimates. A large variety of assumed or theoretical distributions can be fit to the data used for each model input (Hogg and Craig 1978). A Beta distribution was used when input values varied between 2 limits, but there was reason to believe that a subset of values within those limits was more likely to occur, as with proportions or probabilities. A uniform distribution was used when there was limited information about whether 1 value was more likely to occur than another. In some cases, random samples were drawn from an actual distribution based on empirical data, rather than a theoretical distribution. The distributions used for each model input will be described in the following sections.

Most model input distributions were based either directly on empirical data (e.g., weather conditions), or indirectly by extrapolating empirical data (e.g., summer population size extrapolated from field data). However, some inputs either had missing empirical data from some important portion of the distribution (e.g., activity rate within the rotor swept zone), or no empirical data at all (e.g., survival probability). For model inputs whose distributions were based only partially or not at all on empirical data, a sensitivity analysis was conducted to investigate the degree to which changes in the input distributions affected model results.

To test the uncertainty of collision risk estimates to parameter assumptions, a Monte Carlo analysis was used (Manly 2007). Monte Carlo analysis propagates uncertainty in model inputs, through the model equation, into uncertainty in the model predictions. Random sampling of model input distributions (or measured data) generates a distribution of model predictions. Monte Carlo analysis is useful for modeling phenomena with uncertainty in the model inputs, such as the calculation of collision risk for Indiana bats. Repeated sampling based on 100,000 iterations was used (10,000 or more iterations are recommended for biological studies by Jackson and Somer 1989, as cited by Manly 2007).

This probabilistic framework was used to represent uncertainty in model inputs, as well as the final estimation of mortality. Thus, the model output is presented in terms of what is most likely to occur, but also in terms of the range of Indiana bat mortality that is estimated to occur under best case and worst case scenarios. This approach is most defensible, given the uncertainty in the underlying model inputs, and it is lends itself well to the development of adaptive management strategies presented in the HCP.

### *1.1.1* Model Limitations

In the case of bats, little empirical information is available on the number of bats that have the potential to encounter wind facilities, avoidance or attraction behavior of the wind facilities completely or turbines individually, flight height, angle of flight, the influence of weather conditions and wind direction, and other variables that may be highly correlated to the probability of mortality. As a result of these data limitations, in addition to available empirical data, this model used professional scientific opinion informed by published literature, expert opinion, and consultation with the USFWS.

Because a collision risk model has not previously been developed for bats, this model was modified from an existing model developed for birds and wind facilities. A potential limitation of using a model developed for birds is the assumption of straight-line flight, an assumption which has been made by all collision risk models developed for wind facilities to date (Tucker 1996a, 1996b, Band 2000, Podolsky 2003, 2005, Band et al. 2005, Bolker et al. 2006, Nations and Erickson 2009). Bats display erratic flight behavior both vertically and horizontally relative to the ground, while existing models assume straight-line flight across the turbine array. However, only flight behavior at the height of spinning turbine blades affects mortality risk. For the purposes of this model, it is assumed that non-linear and erratic flight characteristic of foraging bats occurs primarily at or below tree canopy height (Humphrey et al. 1977, Brack 1983, Gardner et al.

1989) and that any flight behavior within the rotor swept zone that could lead to an encounter with a spinning turbine blade would primarily consist of straight-line travel.

It is possible that this assumption could be violated if Indiana bats do not exhibit primarily straight-line flight when flying at turbine height. For example, if Indiana bats are attracted to turbines they could exhibit non-linear flight in the rotor swept zone as they fly in and around spinning turbine blades to investigate. However, there is currently no indication that Indiana bats are attracted to wind turbines. The only 2 documented Indiana bat fatalities at wind facilities occurred during the fall migratory period when bats must travel long distances from summer reproductive areas to hibernacula over short periods of time. While little empirical data exist on Indiana bat flight behavior during migration, it is reasonable to expect that such long traveling bouts at a time when energy stores are critically important likely necessitates direct, energy efficient, linear flight. Therefore, the timing of documented Indiana bat mortality at wind facilities provides further support for the appropriateness of assuming linear flight within the rotor swept zone and use of the Bolker et al. (2006) model. Further discussion about flight behavior is included in Section 2.3 – Movement within the Turbine Array.

Another potential limitation of this model includes assumptions about survival probability when an Indiana bat is within the rotor swept zone, since no empirical data on Indiana bats exist from which to base model inputs. A critically important parameter in collision risk modeling is behavioral avoidance of turbines (Fox et al. 2006). Both avoidance and attraction (the latter has not been addressed for birds, but is assumed to be a potential factor in bat collision risk [Kunz et al. 2007]) have direct implications for a bat's ability to survive if it flies at rotor swept height within a turbine array. Behavioral avoidance and attraction are difficult to measure empirically, and have not been incorporated into collision models that have been published to date.

However, a Horn et al. (2008) study using thermal infrared cameras at the Mountaineer, WV wind facility showed that bats have the ability to avoid spinning turbine blades. From 998 total bat passes observed in the rotor swept area, direct contact with moving blades was observed only 5 times (0.5%) and avoidance behavior was observed 41 times (4.1%). Avoidance involved sharp, evasive flight maneuvers, with many instances involving multiple passes in which bats appeared to repeatedly investigate turbine blades after multiple near misses, rather than flying off quickly. In these cases, bats often appeared to be buffeted by turbulence close to the blade surface (Horn et al. 2008). Given that the majority of documented fatalities at this facility were long-distance migratory tree bats, it is likely that it was also these species of bats that displayed avoidance behavior. However, given that Indiana bats are more maneuverable than migratory tree bats as a result of their lower wing aspect ratio (see Section 4.5.5.3 of the HCP for more information), it is likely that Indiana bats also have the ability to avoid spinning turbine blades and have the potential to survive an encounter with a spinning blade. Based on this assumption, survival probabilities between 48% and 97% were included in this model, meaning that bats that fly within the rotor swept zone survive approximately half of the time or more. Given that only 0.5% of observed bat passes within the rotor swept zone resulted in direct contact with blades in the Horn et al. (2008) study and Indiana bats are even more maneuverable than migratory tree bats, these survival probabilities are considered reasonable and conservative.

Similarly, there are no empirical data on flight activity of Indiana bats under different temperature and wind speed conditions. Based on data from acoustic monitoring, post-construction fatality, mist-netting, and operational curtailment studies, assumptions were made about the reductions in bat activity under different temperature and wind speed conditions. Specifically, the estimated population size exposed to risk was reduced by 90% for a proportion of time that corresponds to conditions in the Action Area when documented wind speeds were above 6 meters per second (m/s). Similarly, the estimated population size exposed to risk was reduced by 80% for a proportion of time that corresponds to conditions in the Action Area when documented temperatures were below 10°C (50°F).

If these assumptions are inaccurate, the mortality risk predicted by this model could be higher or lower. However, given that conditions in which assumed bat activity was reduced occurred during a relatively small proportion of the time (i.e., temperatures < 10°C occurred 32%, 0%, and 18% of the time in the spring, summer, and fall respectively; wind speeds > 6 m/s 53%, 20%, and 38% of the time in the spring, summer, and fall respectively), adjustments to risk based on these weather conditions had a relatively small affect on overall mortality estimates. Also, since multiple lines of evidence from different types of studies point to similar thresholds in reductions in activity based on these temperature and wind conditions (see additional information in Section 2.2 – Effect of Weather Conditions on Activity), even if the exact thresholds that have been assumed in this model are not completely accurate, temperature and wind conditions under which activity is substantially reduced are likely not substantially different than what has been assumed in this model.

## 2.0 DESCRIPTION OF MODEL INPUTS



The total number of bats at risk on any random night is a function of the seasonal population size (see Section 2-1) and the weather conditions (see Section 2-2) thought to affect whether bats in that population are actively flying. Summer population sizes were estimated from emergence counts at roost trees within and in the vicinity of the Action Area; spring and fall population sizes were estimated from the 2009 winter census of Indiana bats at hibernacula in the Midwest Recovery Unit within migrating distance of the Action Area. A frequency histogram of wind speed and temperature were individually generated for summer, fall, and spring periods based on more than 3 years of data collected at meteorological towers in the Action Area. The relative frequency of specific wind speeds and temperature conditions were used to randomly select representative weather conditions on any given night during each season. Based on this distribution of weather conditions, the total number of bats at risk of collision on any given night was reduced under weather conditions known to be associated with low bat activity: low temperature and high wind speed. The number of bats at risk was further adjusted based on the number of times these bats are estimated to move within the Action Area (see Section 2-3). The number of large-scale movement bouts was calculated as a function of distance traveled across the turbine array and the probability of a bat traveling that distance. Probability of mortality was calculated as a function of flight height (see Section 2-4), flight direction (see Section 2-5), probability of survival (see Section 2-6), and turbine design and location (see Section 2-7). Each of these factors was used to estimate the total number of turbine encounters expected, and ultimately, estimates of mortality (see Section 3.0). The following narrative describes each of the above model input parameters and provides details on the generation of uncertainty estimates and distributions for each model input.

## 2.1 Seasonal Population Size

The number of Indiana bats likely to be present in the Action Area was estimated separately for the summer maternity period and for the spring and fall migratory periods; referred to as the "summer population" and the "migratory population". These seasons are presented as being discrete; however, it is expected that there is overlap in seasonal behaviors (i.e., migration and summer habitat use) and that weather conditions and other stochastic factors could affect the exact timing of this annual chronology. As such, these cut-off dates (presented in Section 1.0) have been selected to adequately encapsulate seasonal behaviors that could differentially affect collision risk, but it is recognized that the exact timing of these events may differ based on a number of varying factors that cannot be known. It should also be noted that the term "population" is used to define the number of individuals in the Action Area, but does not include any assumptions about death, birth, immigration, and emigration rates that are associated with the term in the field of ecology.

### *2.1.1 Summer Population*

The potential summer population of Indiana bats in the Action Area was estimated using emergence count and home range data from 3 adult female Indiana bats captured and radio tracked in the Action Area in 2009 (in Champaign County), as well as 7 adult female Indiana bats captured and radio tagged in 2008 and 2009 during summer mist netting surveys in Logan and Hardin Counties, OH[1] (hereafter, Champaign, Logan, and Hardin Counties will be referred to as the tri-county area). Summer population estimates were based on 76 emergence counts[2] at 23 roost trees, the home range sizes (estimated from nighttime telemetry) of the female bats using those roost trees, and the number of maternity colonies the landscape could support. These methods followed 2 USFWS Biological Opinions for Indiana bats (2005*a*, 2005*b*) which used average Indiana bat emergence counts and home range sizes reported in the literature to estimate summer population sizes. Data on Indiana bats in the tri-county area used in this analysis were supplied by the Ohio Department of Natural Resources (ODNR).

The average emergence count on nights when at least 1 bat was observed emerging from a maternity roost ranged was 18 bats ± 17 bats (mean ± standard deviation; range from 1 bat to 83 bats). Emergence counts in the tri-county area were similar to those reported by Kurta et al. (1996) for a maternity colony in south central MI, where 89% of 150 observed emergence counts

[1] Although a total of 24 adult female and 2 male Indiana bats were captured in the tri-county area in 2008 and 2009, only 17 females and 2 males were radio tagged, only 12 females and 2 males were tracked to roost trees, and only 10 females had home range information and emergence count numbers sufficient to generate a summer population estimate.

[2] This sample size was derived by treating observations of multiple radio tagged females exiting the same roost tree as individual emergence counts, and associating home ranges for an individual with all roost trees used by that individual.

documented between 2 and 21 bats. However, a study by Whitaker and Brack (2002) documented as many as 384 bats emerging from 1 maternity roost tree in IN, and found that the average maternity colony size was approximately 80 adult female bats. Similarly, the mean maximum emergence count after young began to fly (measured in 12 studies) was approximately 119 bats (Kurta 2005), suggesting that 60 adult females to 70 adult females were present. Harvey (2002) reported that most documented Indiana bat maternity colonies contained 100 or fewer adult females.

Although summer use estimates relied on emergence count data, there are limitations to using these data to determine the size of a maternity colony, because colony members are dispersed among various roosts at any given time (Kurta 2005). Also, estimating colony size relies on the following assumptions, which may not be applicable in all cases:

1. Emerging bats are adult female Indiana bats if counts occur prior to dates when young typically become volant, or they include young of the year if counts occur after juveniles become volant. Kurta and Rice (2002) and Humphrey et al. (1977) reported that most pups become volant between early July through early August in southern MI and southern IN. Although adult male bats have been documented in maternity roosts, it is considered unlikely that large numbers of male bats occupy maternity roosts (USFWS 2007).
2. All bats emerging from the roost are Indiana bats, although there are documented cases of more than 1 species of bats using the same maternity roost (T. Carter, Ball State University, personal communication).
3. Assumptions must be made regarding what proportion of the colony may have been counted during the count. Counts conducted on multiple nights at multiple known roost sites over the course of the maternity season provide better estimates than a single count at a single tree.



While some of the emergence counts in the tri-county area were conducted on the same night at multiple roost trees used by the same maternity colony, the majority (87%) were counts conducted at a single tree on a single night. Therefore, by necessity each emergence count was considered a single estimate of the maternity colony size. To adjust the population to include juveniles that were not yet volant at the time emergence counts were conducted, the number of emerging bats was multiplied by 2 for counts conducted before 15 July, similar to methods used by the USFWS (2005*a*, 2005*b*). This multiplier is based on data from Kurta and Rice (2002) and Humphrey et al. (1977) which suggest that approximately 90% of captured females are in reproductive condition (i.e., pregnant, lactating, or post-lactating) during the summer reproductive period (see Section 4.3 of the HCP – Demographics for further detail).

Summer use estimates relied on home range sizes of radio tagged females to approximate the total area used by all members of their associated maternity colonies, because the area used by multiple bats from the same maternity colony was not available. In other words, individual home ranges from radio tagged Indiana bats were treated as approximations of the total area used by the entire maternity colony. The average minimum convex polygon (MCP) estimate of home range size was 1,021 ha ± 732 ha (2,523 ac ± 1,809 ac); with a range from 217 ha to 2,704 ha

(536 ac to 6,682 ac). Sample sizes ranged from 34 to 208 radio telemetry locations per home range estimate (93.7 ± 56.4).

Because portions of the Action Area are dominated by large expanses of agriculture or urban areas that are likely unsuitable for Indiana bat roosting and foraging activities, the amount of habitat considered suitable for Indiana bat roosting and foraging activities was reduced. Only habitat that was ranked in the top 3 suitability categories in the habitat suitability model (i.e. Categories 1, 2, and 3; see Appendix B for further detail) was included. This resulted in a 9,847 ha (24,331 ac) area which comprised approximately 30% of the total Action Area.

The amount of suitable habitat in the Action Area was divided by each home range size to estimate the number of maternity colonies the Action Area could support. For each home range size estimate, the number of home ranges the Action Area could support was then multiplied by emergence count results for the associated bat to determine the potential summer population of bats in the Action Area (Table 2-1). For example, an emergence count conducted on July 9, 2008 documented 36 bats emerging from a roost tree. This count occurred prior to 15 July, so the number of emerging bats was doubled to account for non-volant juveniles. The radio tagged female that was tracked to this roost tree had a home range size of 862.7 ha (2,131.8 ac). Based on this home range size, a total of 11 maternity colonies could be present within the Action Area (9,847 ha of suitable area), or a total of 822 bats (11 maternity colonies x 72 bats per maternity colony).



**Table 2-1.** Estimates of Indiana bats using the Buckeye Wind Power Action Area during summer based on emergence counts conducted at 23 roost trees occupied by 10 radio-tagged female Indiana bats and their associated home range sizes. When multiple bats used a single roost tree, multiple population size estimates were created; therefore, 76 separate estimates of summer population size were created from 57 emergence counts.

| Count Date | # Emerging bats | # Adjusted for non-volant juveniles | Home range size (ha) | # of maternity colonies in Action Area | Estimate of # bats in Action Area[3] |
|---|---|---|---|---|---|
| 07/09/08 | 36 | 72 | 862.7 | 11 | 893 |
| 07/11/08 | 44 | 88 | 862.7 | 11 | 1092 |
| 07/14/08 | 22 | 44 | 862.7 | 11 | 546 |
| 07/15/08 | 19 | 19 | 862.7 | 11 | 236 |
| 07/16/08 | 40 | 40 | 862.7 | 11 | 496 |
| 07/17/08 | 35 | 35 | 862.7 | 11 | 434 |
| 07/18/08 | 26 | 26 | 862.7 | 11 | 323 |
| 07/09/08 | 36 | 72 | 601.3 | 16 | 1281 |
| 07/11/08 | 44 | 88 | 601.3 | 16 | 1566 |
| 07/14/08 | 22 | 44 | 601.3 | 16 | 783 |
| 07/15/08 | 19 | 19 | 601.3 | 16 | 338 |

[3] Equal to the number of maternity colonies in the Action Area, multiplied by the emergence count adjusted for non-volant juveniles, increased by 8% to incorporate males into the estimate.

**Table 2-1.** Estimates of Indiana bats using the Buckeye Wind Power Action Area during summer based on emergence counts conducted at 23 roost trees occupied by 10 radio-tagged female Indiana bats and their associated home range sizes. When multiple bats used a single roost tree, multiple population size estimates were created; therefore, 76 separate estimates of summer population size were created from 57 emergence counts.

| Count Date | # Emerging bats | # Adjusted for non-volant juveniles | Home range size (ha) | # of maternity colonies in Action Area | Estimate of # bats in Action Area[3] |
|---|---|---|---|---|---|
| 07/16/08 | 40 | 40 | 601.3 | 16 | 712 |
| 07/17/08 | 35 | 35 | 601.3 | 16 | 623 |
| 07/18/08 | 26 | 26 | 601.3 | 16 | 463 |
| 07/16/08 | 1 | 1 | 862.7 | 11 | 12 |
| 07/17/08 | 1 | 1 | 862.7 | 11 | 12 |
| 07/17/08 | 1 | 1 | 216.7 | 45 | 49 |
| 07/18/08 | 1 | 1 | 216.7 | 45 | 49 |
| 07/19/08 | 1 | 1 | 216.7 | 45 | 49 |
| 07/20/08 | 1 | 1 | 216.7 | 45 | 49 |
| 07/21/08 | 46 | 46 | 216.7 | 45 | 2271 |
| 07/10/09 | 9 | 18 | 1000.1 | 10 | 193 |
| 07/11/09 | 14 | 28 | 1000.1 | 10 | 300 |
| 07/12/09 | 15 | 30 | 1000.1 | 10 | 321 |
| 07/20/09 | 3 | 3 | 1000.1 | 10 | 32 |
| 07/10/09 | 2 | 4 | 1000.1 | 10 | 43 |
| 07/10/09 | 17 | 34 | 1000.1 | 10 | 364 |
| 07/12/09 | 4 | 8 | 1000.1 | 10 | 86 |
| 07/13/09 | 8 | 16 | 1000.1 | 10 | 171 |
| 07/20/09 | 22 | 22 | 1000.1 | 10 | 235 |
| 07/15/09 | 35 | 35 | 1000.1 | 10 | 375 |
| 07/18/09 | 83 | 83 | 1000.1 | 10 | 888 |
| 07/20/09 | 70 | 70 | 1000.1 | 10 | 749 |
| 07/16/09 | 23 | 23 | 1000.1 | 10 | 246 |
| 07/17/09 | 18 | 18 | 1000.1 | 10 | 193 |
| 07/20/09 | 2 | 2 | 1000.1 | 10 | 21 |
| 07/16/09 | 23 | 23 | 1000.1 | 10 | 246 |
| 07/17/09 | 18 | 18 | 1000.1 | 10 | 193 |
| 07/20/09 | 2 | 2 | 1000.1 | 10 | 21 |
| 07/15/09 | 21 | 21 | 1837.1 | 5 | 122 |
| 07/16/09 | 23 | 23 | 1837.1 | 5 | 134 |
| 07/18/09 | 4 | 4 | 1059.8 | 9 | 40 |
| 07/19/09 | 1 | 1 | 1059.8 | 9 | 10 |
| 07/19/09 | 5 | 5 | 1059.8 | 9 | 50 |
| 07/23/09 | 2 | 2 | 1059.8 | 9 | 20 |

**Table 2-1.** Estimates of Indiana bats using the Buckeye Wind Power Action Area during summer based on emergence counts conducted at 23 roost trees occupied by 10 radio-tagged female Indiana bats and their associated home range sizes. When multiple bats used a single roost tree, multiple population size estimates were created; therefore, 76 separate estimates of summer population size were created from 57 emergence counts.

| Count Date | # Emerging bats | # Adjusted for non-volant juveniles | Home range size (ha) | # of maternity colonies in Action Area | Estimate of # bats in Action Area[3] |
|---|---|---|---|---|---|
| 07/02/09 | 12 | 24 | 803.4 | 12 | 320 |
| 07/03/09 | 8 | 16 | 803.4 | 12 | 213 |
| 07/04/09 | 5 | 10 | 803.4 | 12 | 133 |
| 07/05/09 | 4 | 8 | 803.4 | 12 | 107 |
| 07/02/09 | 2 | 4 | 598.2 | 16 | 72 |
| 07/03/09 | 3 | 6 | 598.2 | 16 | 107 |
| 07/05/09 | 2 | 4 | 598.2 | 16 | 72 |
| 06/29/09 | 38 | 76 | 803.4 | 12 | 1012 |
| 06/30/09 | 20 | 40 | 803.4 | 12 | 533 |
| 06/01/09 | 34 | 68 | 803.4 | 12 | 906 |
| 06/02/09 | 15 | 30 | 803.4 | 12 | 400 |
| 06/03/09 | 3 | 6 | 803.4 | 12 | 80 |
| 06/04/09 | 16 | 32 | 803.4 | 12 | 426 |
| 06/29/09 | 38 | 76 | 598.2 | 16 | 1360 |
| 06/30/09 | 20 | 40 | 598.2 | 16 | 716 |
| 06/01/09 | 34 | 68 | 598.2 | 16 | 1217 |
| 06/02/09 | 15 | 30 | 598.2 | 16 | 537 |
| 06/03/09 | 3 | 6 | 598.2 | 16 | 107 |
| 06/04/09 | 16 | 32 | 598.2 | 16 | 573 |
| 06/29/09 | 38 | 76 | 526.9 | 19 | 1544 |
| 06/30/09 | 20 | 40 | 526.9 | 19 | 813 |
| 06/01/09 | 34 | 68 | 526.9 | 19 | 1381 |
| 06/02/09 | 15 | 30 | 526.9 | 19 | 609 |
| 06/03/09 | 3 | 6 | 526.9 | 19 | 122 |
| 06/04/09 | 16 | 32 | 526.9 | 19 | 650 |
| 07/17/08 | 11 | 11 | 2703.8 | 4 | 44 |
| 07/24/08 | 28 | 28 | 2703.8 | 4 | 111 |
| 07/18/08 | 7 | 7 | 2703.8 | 4 | 28 |
| 07/19/08 | 3 | 3 | 2703.8 | 4 | 12 |
| 07/24/08 | 10 | 10 | 2703.8 | 4 | 40 |
| 07/24/08 | 5 | 5 | 2703.8 | 4 | 20 |



To estimate the number of males in the summer population, the population sizes estimated using the above methods were adjusted based on the proportion of males to females observed in the Action Area during mist-netting surveys. A total of 24 females and 2 males were captured in

2008 and 2009, indicating that females made up approximately 92% and males made up 8% of the summer population. This is similar to the proportion of males captured during summer mist-netting in southern MI from 1977 to 2002 (11% of the 87 Indiana bats captured were male; Kurta and Rice 2002). In other words, population sizes estimated from maternity colony data (emergence counts and associated home ranges) were assumed to represent only 92% of the total population size (comprised of females and juveniles), which was increased by 8% to account for males in the summer population. After increasing the estimated population by 8% to account for males, the estimated mean summer Indiana bat population was 415.7 bats ± 461.2 bats (range from 10.1 bats to 2,271.4 bats).

Since the size of an area used by all members of a maternity colony may be larger than that used by each individual colony member, using individual home ranges as estimates of maternity colony home range area likely overestimated the number of maternity colonies the Action Area. Furthermore, this method assumes that maternity colonies are non-overlapping and all are occupied. Recognizing these limitations and the assumptions discussed above, instead of using a static number to represent the likely size of the summer population, a range of potential summer population sizes was generated from the emergence count and home range data (Table 2-1). Although this method of calculating summer population size likely overestimates the actual number of Indiana bats using the Action Area during summer, it provides a conservative estimate of population size, and empirical random sampling from the 76 population observations provides a basis for incorporating population uncertainty into the model.

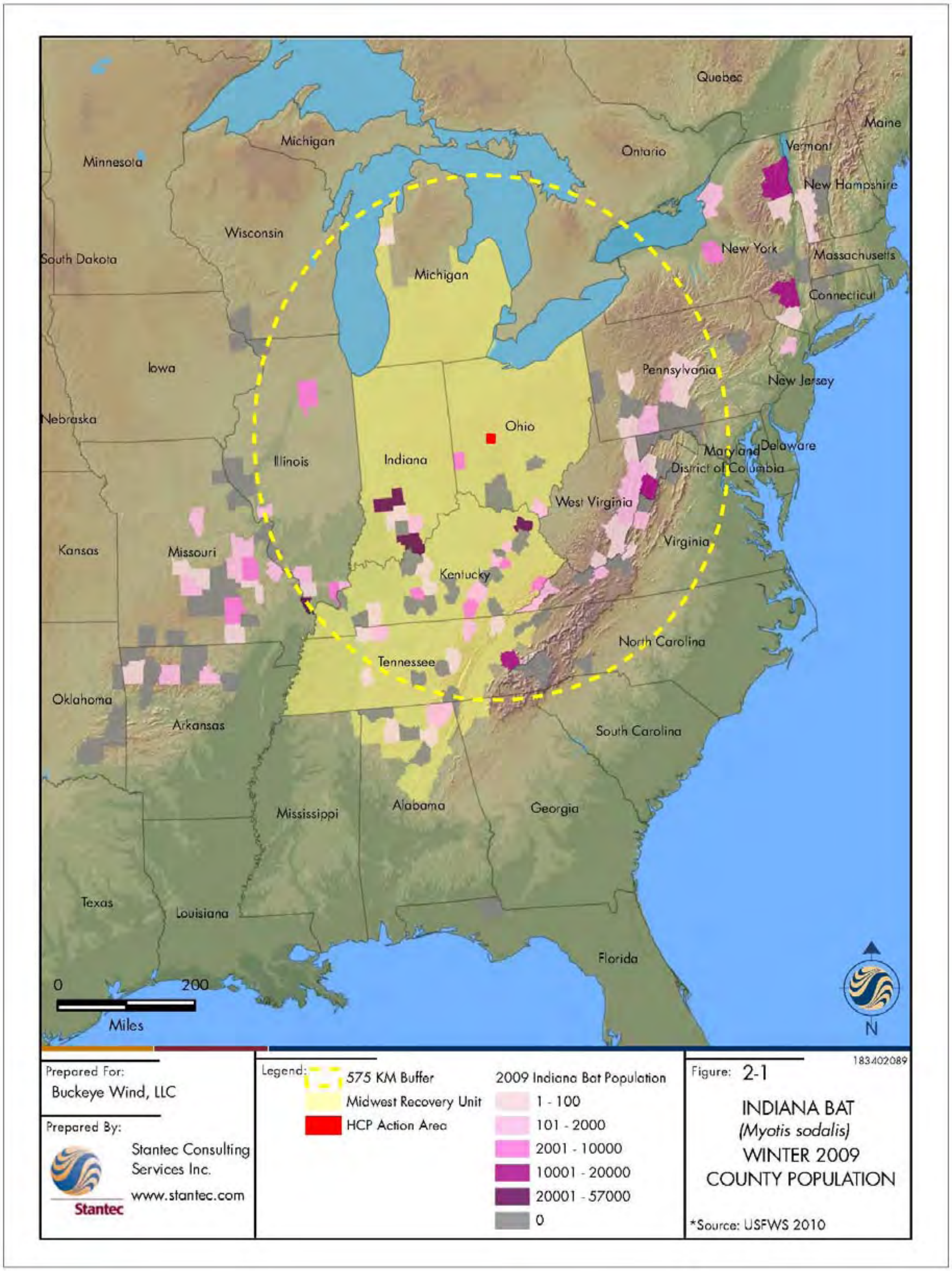
### 2.1.2 Migratory Population



To calculate the number of Indiana bats likely to pass through the Action Area during spring and fall migration (hereafter referred to as the spring and fall population), the number of bats within a 12-km (7.5-mi) radius of the geometric center of the Action Area was estimated. This buffer size encompassed the area in which all 100 turbines could possibly be sited in the Action Area. The Indiana bat migratory range from the Action Area was defined by a buffer around the Action Area with a 575-km (357-mi) radius, equal to the maximum recorded Indiana bat migratory distance (Winhold and Kurta 2006) (Figure 2-1). The total number of Indiana bats within the migratory range of the Action Area was estimated from the most current winter census data provided by the USFWS (A. King, personal communication). This included 56 counties in IL, IN, KY, MI, MO, OH, PA, WV, TN, and VA, with a total winter 2008-2009 population of 333,079.

The migratory population was further restricted to include only hibernacula within the Midwest Recovery Unit (RU, refer to Figure 4-1 in the HCP) based on genetic (USFWS 2007), morphometric (Hall 1962 as cited by USFWS 2007), and migratory records (Barbour and Davis 1969, Kurta 1980, Gardner and Cook 2002, Kurta and Murray 2002, A. Kurta, Eastern Michigan University, personal communication, and K. Lott, ODNR, personal communication) that indicate bats hibernating within the Midwest RU migrate to summer habitat also within the Midwest RU (refer to Figure 4-1 in the HCP). The total number of Indiana bats hibernating within the migratory range of the Action Area in the Midwest RU during winter of 2008-2009 included hibernacula in 51 counties in IN, KY, MO, OH, TN, and VA, totaling 252,350 bats.

Based on migration records from the late 1970s to the present, Indiana bats appear to migrate in a south-north pattern in the Midwest RU (refer to Figure 4-1 in the HCP). Band returns reported by Barbour and Davis (1969), Kurta (1980), Gardner and Cook (2002), Kurta and Murray (2004), A. Kurta (personal communication), and K. Lott (personal communication) showed bats fanning out from hibernacula in KY and southern IN primarily in a northward direction to summer breeding areas in MI and OH. Based on these observed patterns, most bats in the Midwest RU appear to migrate within in a 180-degree arc from hibernacula to summer breeding areas. However, bats in the Northeast and Appalachian Mountains RUs appear to disperse from hibernacula in multiple directions, with no consistent migration direction pattern (refer to Figure 4-1 in the HCP).


Quebec
Maine
Vermont
New Hampshire
Ontario
Michigan
Minnesota
Wisconsin
South Dakota
Michigan
New York
Massachusetts
Connecticut
Iowa
Pennsylvania
New Jersey
Nebraska
Ohio
Illinois
Indiana
Maryland
Delaware
District of Columbia
West Virginia
Kansas
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Kentucky
North Carolina
Tennessee
Oklahoma
Arkansas
South Carolina
Mississippi
Alabama
Georgia
Texas
Louisiana
Florida
0
200
Miles
N
Prepared For:
Buckeye Wind, LLC
Prepared By:
Stantec Consulting Services Inc.
www.stantec.com
Stantec
Legend:
575 KM Buffer
Midwest Recovery Unit
HCP Action Area
2009 Indiana Bat Population
1 - 100
101 - 2000
2001 - 10000
10001 - 20000
20001 - 57000
0
183402089
Figure: 2-1
INDIANA BAT
(Myotis sodalis)
WINTER 2009
COUNTY POPULATION
*Source: USFWS 2010

To account for the uncertainty in migration direction, migratory population sizes were calculated under both assumptions (i.e., assuming that bats migrate within a possible 180 degrees and 360 degrees surrounding hibernacula) and represent the estimated migratory population under both assumptions. The migratory population of bats in the Action Area was estimated by calculating the distance from the geometric center of each county containing a hibernaculum (since exact hibernacula locations were not available) to the center of the Action Area. Trigonometric principle were then applied to calculate the proportion of a 180-degree or 360-degree arc that intersected the 12-km Action Area buffer using the following formula:

$$\textit{Degrees} = \textit{Tangent}^{-1}\ (\textit{Opposite/Adjacent})$$

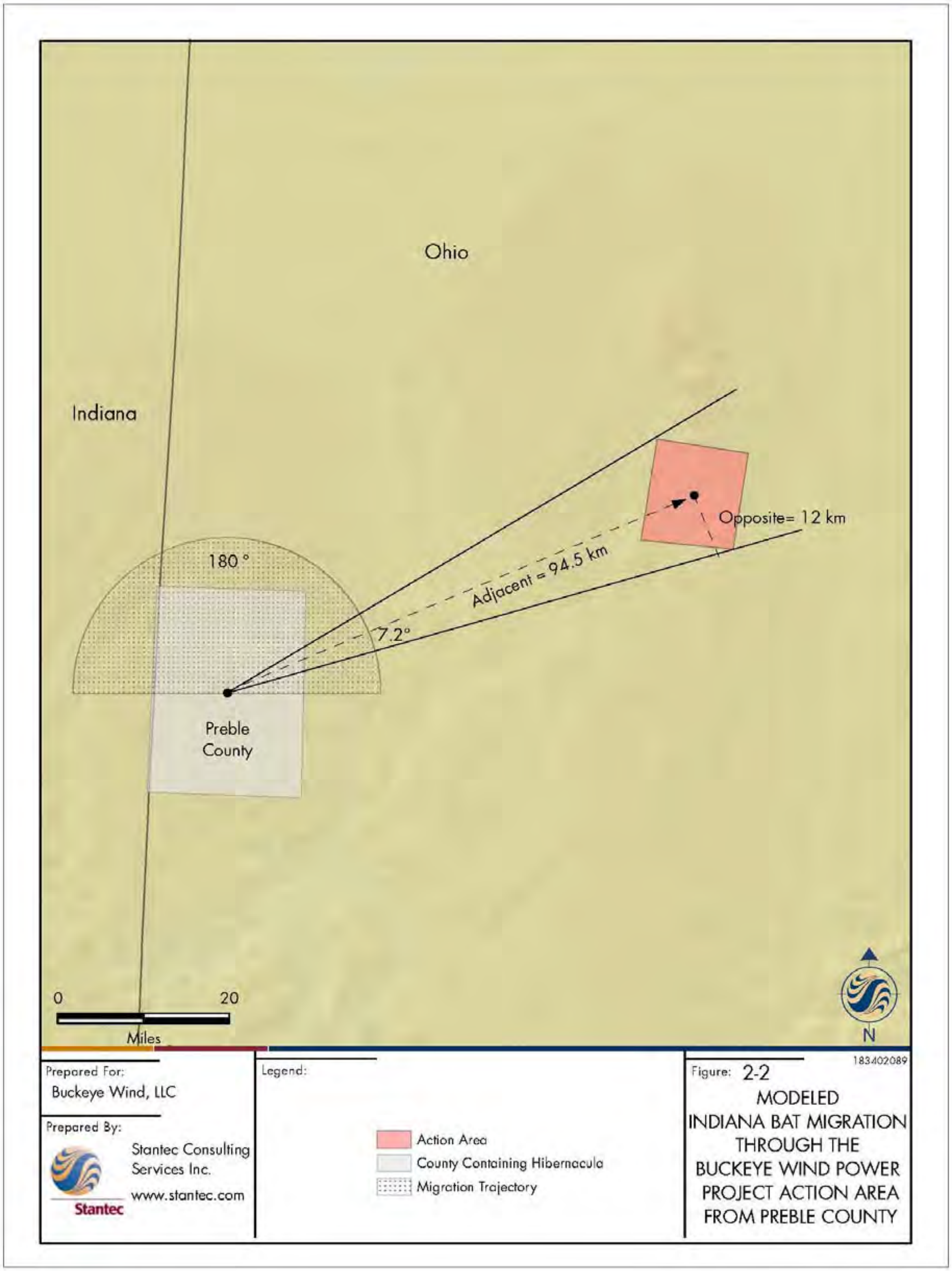
Because this only solved for half of the arc of intersection, this value was multiplied by 2 to get the full arc of intersection, which becomes narrower as distance between the hibernaculum of origin and the Action Area increases. Using Preble County, OH (which contains the Priority 2 Lewisburg Limestone Mine) as an example, the geometric center of the County is 94.5 km (58.7 mi) miles southwest of the Action Area center (Figure 2-2), resulting in 14.5 degree arc that intersected the 12-km Action Area buffer, based on the below equation:

$$\textit{Arc of Intersection} = 2 * (7.2° = \textit{Tangent}^{1}(12\ km\ 94.5\ km))$$

The estimate of the migratory population of bats in the Action Area was then refined by multiplying the hibernacula population within each county by the proportion of the 180-degree or 360-degree arc that each calculated arc of intersection represented. For the Preble County example, the 14.5-degree arc represented 8% of a 180 degree arc (i.e., 14.5/180 = 0.08). Therefore, it is estimated that of the 9,007 Indiana bats emerging from Preble County hibernacula in 2009, 8% or 721 bats were likely to travel through the Action Area during migration under the 180-degree assumption; half that number, or 360 bats, were likely under the 360-degree assumption. Assuming the 180-degree migration pattern for the Midwest RU, the estimated migratory population was reduced from a total possible 252,350 bats to 7,242 bats that could potentially migrate through the Action Area. When 360-degree dispersal was assumed from hibernacula, the population was reduced to 3,621.



The migratory population was further refined by assuming that the male population was lower than the female population at the furthest migration distances. Gardner and Cook (2002) and Whitaker and Brack (2002) reported that male Indiana bats typically remain in the vicinity of their hibernaculum throughout the summer. Mist-netting studies conducted from 1978 to 2002 in southern Lower MI showed only 11% of the adults captured were males (Kurta and Rice 2002). Band returns from this population revealed that males likely migrated over 400 km (249 mi) from hibernacula in southern IN and KY (Kurta and Murray 2002, Kurta and Rice 2002). Kurta and Rice (2002) cautioned that 11% probably underestimated the proportion of adult males in the summer population, because netting preferentially occurred near maternity roosts (Kurta et al. 1996, 2002), and male Indiana bats often do not roost with females during the maternity period (Gardner et al. 1991). Therefore, the male populations were assumed to be reduced to 11% only at the furthest migration distances (i.e., 575 km), resulting in an average population estimate composed of 73% females and 27% males over the Action Area.


Ohio
Indiana
180 °
7.2°
Adjacent = 94.5 km
Opposite= 12 km
Preble County
0
20
Miles
N
183402089
Prepared For:
Buckeye Wind, LLC
Prepared By:
Stantec Consulting Services Inc.
www.stantec.com
Stantec
Legend:
Action Area
County Containing Hibernacula
Migration Trajectory
Figure: 2-2
MODELED INDIANA BAT MIGRATION THROUGH THE BUCKEYE WIND POWER PROJECT ACTION AREA FROM PREBLE COUNTY

To estimate the male migratory population, a 50:50 sex ratio was assumed at each hibernaculum (Hall 1962, Myers 1964, LaVal and LaVal 1980) and the male population was then adjusted based on a presumed negative linear relationship with increasing distance away from the hibernaculum of origin. In other words, the male population was assumed to be 100% at a distance of 0 km from the hibernaculum of origin and 11% at a distance of 575 km. Using the 2 known data points: ($x_1$ = 0, $y_1$=1; or 0 km from Action Area, 100% male population) and ($x_2$ = 575, $y_2$ = 0.11; 575 km from project site, 11% population) the slope of the linear relationship was:

$$Slope = (y_2\ y_1)\ (x_2\ x_1) \rightarrow (0.11\ \ 1)\ (575\ \ 0) = 0.00155$$

The slope-intercept equation was used to estimate the male migratory population in the Action Area, given the known distances from each hibernaculum, as follows:

*Slope-intercept equation: y = mx+b*, where:

*m* is the slope of the line
*x* is the independent variable of the function *y*, or the distance from the hibernacula to the Action Area; and
*b* is the y-intercept of the line.

*Estimated percentage of population = 0.00155 (distance from* Action Area*) + 1*

Using Preble County as an example, the estimated male population of bats in the Action Area was reduced to 85% of the population at the hibernaculum (from 362 bats to 309 bats, or from 50% of the population to 43% of the population), based on the following equation:

*0.8535 = 0.00155 (94.5) + 1 (or 85% of population at the hibernacula).*

Using this method, the percent of males in the migratory population ranged from 8% to 46%, with an average of 27% ± 9%. Based on the aforementioned assumptions, the estimated Indiana bat migratory population in the Action Area is 5,756 (n = 3,621 females; n = 2,136 males) under the 180-degree migratory assumption, and 2,878 Indiana bats (n = 1,810 females; n = 1,068 males) under the 360-degree migratory assumption. These migratory populations represent approximately 2% and 1%, respectively, of the total number of Indiana bats hibernating in the Midwest RU within the 575 km migratory range of the Action Area. Because these estimates are based on a series of assumptions, a Beta distribution (Figure 2-3) was selected to describe the possible migratory population size. The maximum population estimate was derived using the 180-degree migratory assumption (approximately 5,800 Indiana bats), and the distribution was weighted toward the results of the 360-degree migratory assumption (2,900 Indiana bats). In this way, all possible population sizes between 0 and 5,800 were included. The migratory population was assumed to be the same during both spring and fall migration. The number of bats at risk on any given night was further adjusted based on temperature and wind speed, as explained in the next section.

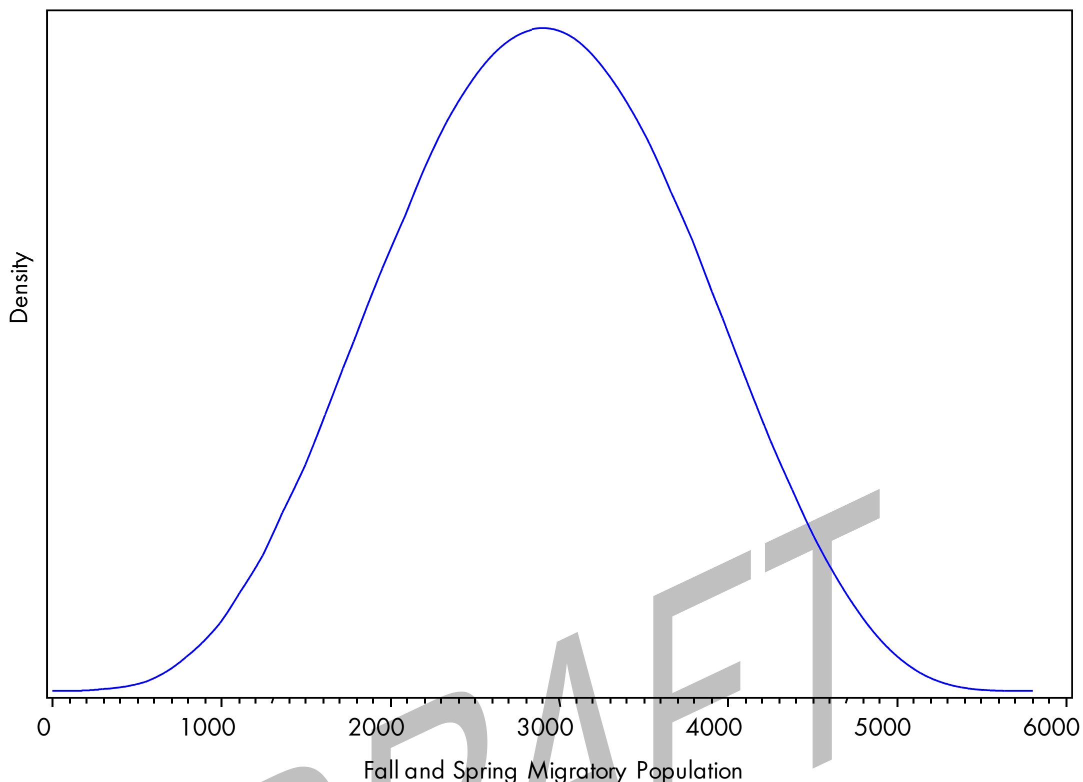



**Figure 2-3.** Distribution of bat populations during the fall and spring seasons; minimum=0, maximum=5800, shape=5, scale=5



## 2.2 Effect of Weather Conditions on Activity

Weather variables such as wind speed and temperature have been shown to affect activity patterns of bats; bats are known to suppress their activity during periods of rain, low temperatures, and strong winds (Erkert 1982, Adam et al. 1994, Erickson et al. 2002, Russo and Jones 2003). Accordingly, weather variables such as wind speed, temperature, and barometric pressure have been found to influence bat activity and mortality rates at some wind facilities. Of the 19 wind facilities across the United States reviewed by Arnett et al. (2008), all studies that addressed relationships between bat fatalities and weather patterns found that most bats were killed on nights with low wind speed (<6 m/s) and that fatalities increased immediately before and after passage of storm fronts.

For example, at studies conducted at the Mountaineer, WV and Meyersdale, PA wind facilities in 2004, the proportion of the night when wind speed was < 4 m/s was positively related to bat fatalities, whereas the reverse was true for proportion of the night when winds were > 6 m/s (Kerns et al. 2005). At Mountaineer and Meyersdale, during 81% of nights when no bats were found the next day, median nightly wind speed was on average > 6 m/s. Conversely, on nights before days when the highest numbers of bats were found, median nightly wind speed was 4.1 m/s at Mountaineer and 4.2 m/s at Meyersdale, and only 6.5 to 18.2% of these nights had wind speeds > 6 m/sec, respectively. Consistent with this, average nightly turbine blade speed (RPM) was negatively related to bat fatalities at both facilities (Kerns et al. 2005). Horn's (2008) thermal infrared camera study at Mountaineer also showed that blade rotational speed was a significant negative predictor of observed collisions with turbine blades, suggesting that bats may be at higher risk of fatality on nights with low wind speeds. The association of bat activity with wind speed is not unexpected, given that their flight ability is limited by wind strength, as is the ability of their airborne, insect prey (Fiedler 2004).

This pattern has also been supported by pre- and post-construction acoustic monitoring of bat activity, which has documented a negative relationship with average nightly wind speed (Fiedler 2004, Reynolds 2006). Reynolds (2006) found activity of bats to be highest on nights with wind speeds of < 5.4 m/s during the spring migratory period at the Maple Ridge, NY, wind facility. Bat activity levels at Buffalo Mountain, TN also showed a negative association with average nightly wind speeds (Fiedler 2004).

The relationship between low wind speed and high activity is reinforced by operational curtailment experiments which have documented reductions in bat mortality by reducing the speed at which turbines become operational, or the "cut-in speed". During 2 years of study during the peak fall fatality period at the Cassleman, PA, wind facility, 12 turbines were randomly assigned each night to 1 of 3 experimental groups: fully operational, cut-in speed of 5.0 m/s, or cut-in speed of 6.5 m/s. Total fatalities at fully operational turbines were estimated to be 5.4 times greater on average than at curtailed turbines in 2008, and 3.6 times greater in 2009[4]. In other words, 82% (95% confidence interval [CI] = 52% to 93%) of all fatalities at experimental turbines in 2008 and 72% (CI = 44% to 86%) in 2009 likely occurred when the turbines were fully operational (Arnett et al. 2010).



A similar study was conducted at the Fowler Ridge, IN wind facility in 2010, after the first documented Indiana bat fatality was discovered there in 2009 (Good et al. 2011). From 1 August 2010 to 15 October 2010, 27 turbines were randomly assigned on a weekly basis to 1 of 3 experimental groups: fully operational, cut-in speed of 5.0 m/s, or cut-in speed of 6.5 m/s. An additional 9 turbines were fully operational for the entire survey period. Curtailment at 5.0 m/s was found to reduce mortality by 50% (90% CI = 37% to 61%), and curtailment at 6.5 m/s was found to reduce mortality by 79% (90% CI = 71% to 85%).

At a similar study in southwestern Alberta, Canada, Baerwald et al. (2008) examined the difference in fatality rates under 2 experimental treatments: 1) turbines were curtailed below wind speeds of 5.5 m/s, and 2) a low-speed idle strategy was used whereby operations of turbines were manipulated to change the pitch angle of the blades and lower the generator speed required to start energy production, which caused turbines to be motionless in low wind speeds.

[4] There was no statistical difference between the numbers of fatalities at the 2 different cut-in speeds (Arnett et al. 2010). A difference in mortality can only be measureable when the wind speed is between the 2 operational treatments. Wind speeds at Casselman were not within this range for a long enough period of time to show a statistical difference, if one existed (M. Huso, Oregon State University, personal communication).

Fatalities were significantly reduced by 60.0% and 57.5%, respectively, under the 2 different treatments.

Similar to low wind speed, positive correlations between bat activity and temperature are common in bat literature, both on a nightly basis (Lacki 1984, Negraeff and Brigham 1995, Hayes 1997, Vaughan et al. 1996, Gaisler et al. 1998, Shiel and Fairley 1998) and annual basis (O'Farrell and Bradley 1970, Avery 1985, Rydell 1991). Some pre- and post-construction acoustic surveys at wind facilities have documented bat activity to be negatively correlated with low nightly mean temperatures (Fiedler 2004, Reynolds 2006). Reynolds (2006) found that no detectable spring migratory activity occurred on nights when the daily mean temperature was below 10.5°C (50.9°F). Bat activity at Buffalo Mountain, WV, from 2000 to 2003 was most closely correlated with average nightly temperature (Fiedler 2004).

This is consistent with the observations of J. Kiser (personal communication), developed over 19 years of summer mist-netting surveys in the Midwest and eastern U.S. According to Kiser, bat activity declined dramatically once nighttime temperatures dropped below approximately 12°C (54.5°F). Associations between temperature and bat fatalities in post-construction monitoring studies have been less consistent than for wind speed, but still have been documented. Although a correlation between temperature and bat fatality was not documented at Mountaineer, WV, there was a positive association between temperature and fatality at Meyersdale, PA (Kerns et al. 2005). At the Fowler Ridge, IN wind facility, 91.1% of fatalities during the fall migratory period occurred on nights with mean nightly temperature above 20.1°C (68.1°F) (Good et al. 2011).

High barometric pressure at both Mountaineer and Meyersdale and low relative humidity at Meyersdale, conditions associated with the passage of storm fronts, were also associated with higher bat fatality rates (Kerns et al. 2005). However, because relative humidity is confounded by temperature, it is not a reliable predictor of ecological variables, including mortality (Thornthwaite 1940, A. Kurta, personal communication). Storm activity was associated with bat mortality at both Mountaineer and Meyersdale: few bat fatalities were discovered during storms at Mountaineer and Meyersdale, contrasted by the days with the highest number of fatalities which occurred in the few days after the storm, especially on low wind nights (Kerns et al. 2005). At the Fowler Ridge facility, the night with the most bat casualties appeared to be associated with the passage of one or more weather fronts (Good et al. 2011).

Based on the aforementioned studies and observations, assumptions were made about bat activity and the proportion of the seasonal populations likely to be active as a function of wind speed and temperature on any given night. Although some studies also indicated that the passage of storm fronts was an index to bat activity, storm events were not able to be modeled given their stochastic nature. Temperature and wind speed data collected from a 60-m (197-ft) meteorological tower from June 2007 to July, 2010 in the Action Area (Tables 2-2 and 2-3) were used to estimate the proportion of time during each season that wind speeds were > 6 m/s and temperatures were < 10 °C (50 °F), conditions that have been shown to strongly influence bat activity and collision risk.

**Table 2-2.** Average nightly temperatures measured at 60-m meteorological towers in the proposed Buckeye Wind Power Project area from June 2007 to January 2010 during spring (1 Apr to 31 May), summer (1 Jun to 31 Jul), and fall (1 Aug to 31 Oct).

| Temperature (°C) | Proportion of nights in spring (n=362) | Proportion of nights in summer (n=427) | Proportion of nights in fall (n=552) |
|---|---|---|---|
| <2 | 2.2% | 0.0% | 1.1% |
| 2-4 | 3.9% | 0.0% | 2.4% |
| 4-6 | 7.5% | 0.0% | 2.9% |
| 6-8 | 6.6% | 0.0% | 4.5% |
| 8-10 | 12.2% | 0.0% | 7.2% |
| 10-12 | 12.4% | 0.5% | 6.2% |
| 12-14 | 17.1% | 1.6% | 6.9% |
| 14-16 | 12.2% | 8.4% | 12.5% |
| 16-18 | 11.0% | 14.5% | 17.4% |
| 18-20 | 8.3% | 23.9% | 13.6% |
| 20-22 | 6.6% | 30.4% | 13.0% |
| 22-24 | 0.0% | 16.6% | 9.2% |
| 24-26 | 0.0% | 3.5% | 2.5% |
| 26-28 | 0.0% | 0.5% | 0.5% |

**Table 2-3.** Average nightly wind speeds measured at 60-m meteorological towers in the proposed Buckeye Wind Power Project area from June 2007 to January 2010 during spring (1 Apr to 31 May), summer (1 Jun to 31 Jul), and fall (1 Aug to 31 Oct).

| Wind speed (m/s) | Proportion of nights in spring (n=358) | Proportion of nights in summer (n=427) | Proportion of nights in fall (n=548) |
|---|---|---|---|
| <2 | 0.0% | 0.0% | 0.0% |
| 2-2.5 | 0.0% | 1.4% | 0.7% |
| 2.5-3 | 1.1% | 2.6% | 1.8% |
| 3-3.5 | 3.4% | 2.8% | 3.1% |
| 3.5-4 | 5.0% | 7.5% | 5.1% |
| 4-4.5 | 5.0% | 14.8% | 8.8% |
| 4.5-5 | 7.5% | 20.4% | 13.9% |
| 5-5.5 | 8.9% | 16.9% | 14.1% |
| 5.5-6 | 15.9% | 13.8% | 15.0% |
| 6-6.5 | 12.3% | 7.5% | 10.0% |
| 6.5-7 | 9.2% | 7.7% | 10.6% |
| 7-7.5 | 9.2% | 3.3% | 6.6% |
| 7.5-8 | 6.1% | 0.5% | 3.5% |
| 8-8.5 | 7.3% | 0.2% | 3.6% |
| 8.5-9 | 4.2% | 0.7% | 1.1% |
| 9-9.5 | 2.8% | 0.0% | 1.8% |
| 9.5-10 | 1.7% | 0.0% | 0.0% |
| 10-10.5 | 0.0% | 0.0% | 0.4% |
| 10.5-11 | 0.3% | 0.0% | 0.0% |

For each seasonal simulation in the Monte Carlo analysis, a random population size was drawn from the seasonal population distribution. In addition, a random wind speed and temperature were drawn based on the weighted distributions shown in Tables 2-2 and 2-3. Based on the random wind speed and temperature drawn, the random population size was adjusted according to the information in Table 2-4. The reduction scenarios given in Table 2-4 were inferred from the aforementioned studies. To reflect reduced bat activity and correspondingly low rates of observed mortality at wind facilities at high wind speeds, the estimated population size exposed to risk was reduced by 90% for wind speeds above 6 m/s. Similarly, the estimated population size exposed to risk was reduced by 80% for temperatures below 10°C (50°F) based on numerous studies and observations showing that only low levels of bat activity are observed at low temperatures.

**Table 2-4.** Reductions in Indiana bat activity and the numbers of bats exposed to collision risk as a function of wind speed and temperature.

| | | **Temperature** | |
|---|---|---|---|
| | | <10° C | >10° C |
| **Wind Speed** | >6 m/s | reduce activity by 90% | reduce activity by 90% |
| | <6 m/s | reduce activity by 80% | no reductions in activity |



## 2.3 Movement within the Turbine Array

Previous sections have described how the seasonal population size of Indiana bats was estimated and adjusted based on the expected activity patterns of bats under differing weather conditions. The outcome is populations of bats that may pass partially or completely through the turbine array in any given night, and may do so once or multiple times. The total number of individual bats that encounter turbines and the resulting probability of mortality are a function of distance traveled into the wind facility and the number of times this distance is travelled during a movement event. The Bolker et al. (2006) model calculates the total number of turbine encounters expected when a single bat makes a complete pass through the wind facility (discussed in full in Section 3.1). In order to use the Bolker et al. (2006) model to calculate mortality probability, the results must be adjusted by the expected number of full or partial crossings of the turbine array.

This section discusses the large-scale movements Indiana bats are estimated to make during the course of a given night. While bats can display erratic flight behavior both vertically and horizontally relative to the ground as a result of foraging, most collision risk models, including the Bolker et al. (2006) model used here, assume a straight-line flight path across the entire turbine array. However, it is important to note that only flight behavior at the height of spinning turbine blades affects the amount of estimated mortality, because mortality occurs by colliding with (or flying near the edges of) spinning turbine blades. For the purposes of this model, it is assumed that non-linear flight occurs primarily during foraging, foraging occurs primarily at or below tree canopy height (Humphrey et al. 1977, Brack 1983, Gardner et al. 1989), and therefore non-linear flight patterns do not contribute to risk of collision with turbine blades that are located well above tree-canopy height. Conversely, it has been assumed that any flight behavior within rotor swept zone height that could lead to an encounter with a spinning turbine blade would primarily consist of straight-line travel, and therefore the Bolker et al. (2006) model can be adapted for use here. Supporting information on flight height is presented in Section 2.4 (Flight Height).

Because of the aforementioned assumptions, the model has been applied to presumed straight-line movements. It is important to note that no assumptions are made with regard to the number of small-scale foraging movements that may contribute to a single large-scale movement bout. For example, during the summer, a bat may leave a roost and move between several foraging areas before returning to its roost tree. However, this model is concerned only with the large-scale movement away from the roost and back, since it has been assumed that foraging behavior occurs at or below tree canopy height and therefore does not result in collision risk. It is possible that these assumptions could be violated if Indiana bats are attracted to turbines and exhibit non-linear flight patterns in the rotor swept zone as a result of their attraction. However, there is currently no indication that Indiana bats are attracted to wind turbines due to the very low rates of observed Indiana bat mortality at wind facilities.

### 2.3.1 Movement during Summer

Bats using the Buckeye Action area during summer are presumed to travel in many directions with no dominant movement patterns, such as primarily northward or primarily between a certain number of foraging areas for a certain number of times per night (which is different from collision risk models developed for migrating birds such as seaducks [Desholm and Kalhert 2006], or marbled murrelets [Nations and Erickson 2009]). Although empirical data on Indiana bats in the tri-county area was provided by the ODNR, the available telemetry data did not provide information on local foraging behavior, as flight behavior is difficult to assess during nighttime telemetry and therefore is not typically collected. Therefore, the number of foraging areas that bats visited during the course of their nightly movements could not be estimated, nor could the distances traveled between multiple foraging areas. Instead, large-scale movement bouts between roost trees and foraging locations were used in the model, which could be derived from the available telemetry data.

The area in which 100 turbines are proposed to be installed is approximately 16.3 kilometers (km) by 19.0 km (10.1 by 11.8 miles [mi]) at its widest points. Indiana bats may fly linear distances between 0.5 km and 8.4 km (0.3 mi and 5.2 mi) while traveling from their roost trees to foraging areas, but most distances are about half the maximum, or approximately 4.0 km (2.5 mi) (Murray and Kurta 2004, Sparks et al. 2005). For the 10 female radio tagged bats captured in the tri-county area in 2008 and 2009, the average distance between roost trees and telemetry points was 1.1 km ± 0.9 km (0.7 mi ± 0.5 mi), and the maximum distance was 5.6 km (3.5 mi) (K. Lott, personal communication). This was similar to the average distance of 1.0 km (0.6mi ) traveled between roost trees and the geometric centers of foraging areas for 5 adult female post-lactating Indiana bats tracked over 16 nights in Illinois (Garner and Gardner 1992). The average distance in the same Illinois study for 14 bats including pregnant, lactating, and post-lactating females, males, and juveniles was 2.3 km (1.4 mi).

Differences in commuting distances between summer foraging and roosting areas may be attributed to rangewide differences in habitat type, interspecific competition, and landscape terrain (USFWS 2007). Typically, Indiana bats do not cross large, open areas and instead follow tree lines or other habitat features that provide protective cover, when available. However, Indiana bats may have to travel larger distances or across open areas in areas where connectivity of suitable habitat is limited. For example, Murray and Kurta (2004) found that bats increased their commuting distance by 55% to follow tree-lined paths rather than flying over large agricultural fields, some of which were at least 1 km (0.6 mi) wide. Further studies by Kurta (2005) and Winhold et al. (2005) found that this colony used the same wooded fenceline as a commuting corridor that connected forested areas situated in a largely agricultural area for at least 9 years. Similarly, in a study area where over 60% of the landscape was either agricultural fields or urbanized areas, 12 of 13 foraging sites used by this colony were dominated by forest (Kurta et al. 2002).

Given the disparity in foraging distances traveled in different geographic areas, it was most appropriate to use site-specific, empirical data to inform assumptions about distances traveled by bats during summer foraging and commuting behaviors. Thus, based on Indiana bat foraging distances estimated from 1,124 telemetry locations that were collected from 10 adult female radio tagged bats in the tri-county area, it is known that Indiana bats in the Action Area rarely travel distances large enough to completely cross an area the size of the proposed turbine array (i.e., 19 km [11.8 mi]). Bats traveled an average distance of 1.1 km between roost trees and foraging areas, which equates to traveling across 6% of the proposed turbine array. All recorded distances were < 5.6 km (3.5 mi), or approximately 30% of the maximum width of the turbine array (Figure 2-4).

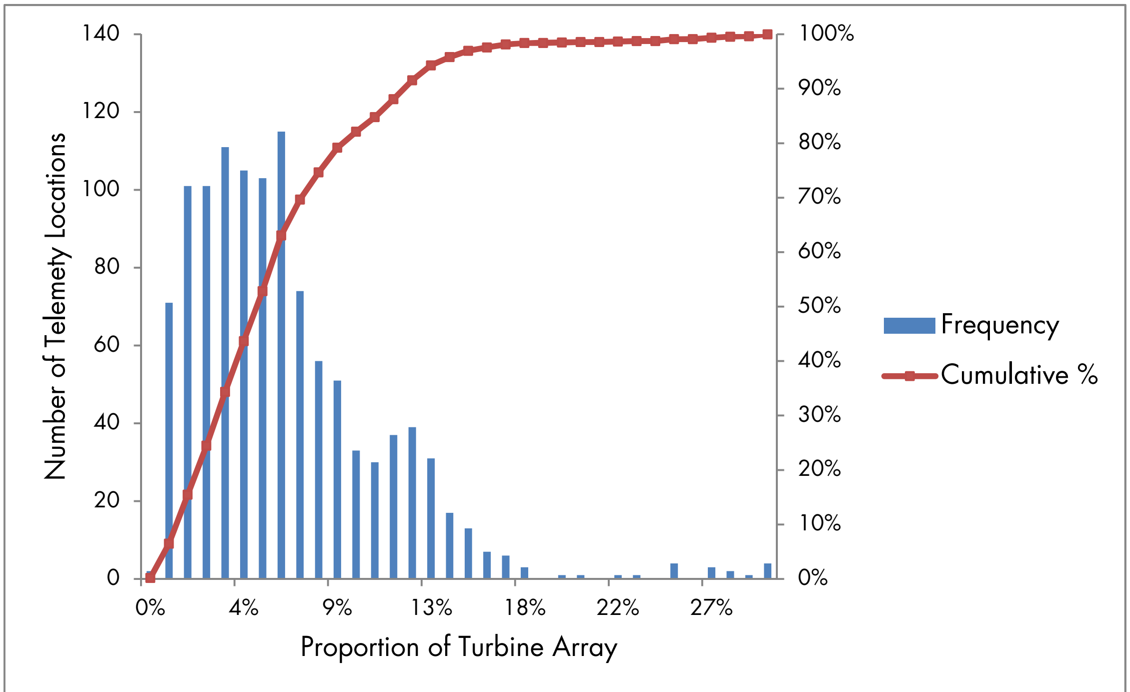



**Figure 2-4.** Estimated proportions of the turbine array represented by distances between roost locations and 1,124 telemetry locations collected for 11 adult female Indiana bats radio tagged in Champaign, Logan, and Hardin counties, OH during the summer in 2008 and 2009.



In order to incorporate known traveling distances into the model, the maximum distance across the turbine array was divided into 10% bins (Table 2-5). Each distance bin was then given a probability of occurrence based on the distances recorded between Indiana bat roost and telemetry locations. For example, since 82% of the distances between telemetry and roost locations were equal to 10% of the proposed turbine array, it was assumed that there was an 82% probability of a bat traveling a distance equal to 10% of the array. Similarly, 14% of telemetry locations occurred at distances between 10% and 20% of the way across the turbine array. Although no Indiana bats were recorded at distances greater than 5.6 km (3.5 mi; or 30% of the maximum width of the turbine array), a very small proportion in each 10% distance bin greater than this was included to take the most conservative approach.

For the purposes of this model, it was assumed that summer activity could be summarized by 4 large-scale movement bouts during a night:

1. Leaving a roost tree at dusk;
2. Arriving at a night roost, or returning to a roost;
3. Leaving a roost for a second time; and
4. Returning to a roost at dawn.

The distance traveled during each of these large-scale movement bouts was based on the average distances documented between roost trees and foraging locations for Indiana bats in the tri-county area (Table 2-5). The 4 large-scale movement bouts are assumed to represent the maximum number of large-scale movements a bat may make within the turbine array on a given night. However, consistent with the assumptions stated above in Section 2.3, a bat may make an unspecified number small-scale foraging bouts within each large-scale movement bout, that presumably do not affect their risk of collision because they occur at or below tree canopy height.

**Table 2-5.** Estimated Indiana bat distances traveled within the turbine array during summer.

| Distance traveled (proportion of turbine array area) | No. large-scale movements | Total distance traveled (distance traveled x no. movements) | Probability (based on Fig 2-5) |
|---|---|---|---|
| 0 0.1 | 4 | 0.4 | 0.82 |
| 0.1 0.2 | 4 | 0.8 | 0.14 |
| 0.2 0.3 | 4 | 1.2 | 0.03 |
| 0.3 0.4 | 4 | 1.6 | 0.009 |
| 0.4 0.5 | 4 | 2 | 0.00017 |
| 0.5 0.6 | 4 | 2.4 | 0.00017 |
| 0.6 0.7 | 4 | 2.8 | 0.00017 |
| 0.7 0.8 | 4 | 3.2 | 0.00017 |
| 0.8 0.9 | 4 | 3.6 | 0.00017 |
| 0.9 1.0 | 4 | 4 | 0.00017 |



### 2.3.2 Movement during Migration

It is likely that Indiana bats follow relatively straight-line paths during migration. Migration is an energetically expensive and risky undertaking (Fleming and Eby, 2003) and bats may try to minimize the time spent in transit (Winhold and Kurta 2006). Spring radio telemetry studies have documented migrating Indiana bats traveling in relatively direct flight patterns towards their summer ranges shortly after they emerge from hibernacula (Butchkoski and Turner 2006, Britzke et al. 2006, Gumbert et al. 2011). According to Hicks et al. (2005), a comparison between the range of initial bearings and the final bearings for 82 reproductive female bats radio tracked to 65 maternity colonies in NY from 2000 to 2005 showed that bats followed more or less direct routes from the hibernacula to their summer ranges. Based on a combination of aerial and ground tracking, Indiana bats tracked from a hibernaculum in PA flew almost straight lines to their roost trees 135 km to 148 km (83 mi to 92 mi) away in MD (Butchkoski and Turner 2005). Migrating Indiana bats in eastern Tennessee only changed course in response to mountain gaps or ranges, or to follow rivers, suggesting primarily straight-line travel (Gumbert et al. 2011).

The assumption of straight-line migration paths is supported by these telemetry studies, as well as the lack of hibernacula within 20 miles of the Action Area (where swarming activities would result in non-linear flight behavior). Migration paths may take a bat directly through the center of the wind facility, which would result in 1 complete pass through the turbine array, or alternatively may result in only a partial traverse of a section of the turbine array. Additionally, bats likely forage and roost during the course of their migration, and these activities may result in partial or complete passages through the turbine array. Given the uncertainty in migration flight paths through the turbine array, a uniform probability distribution was used to reflect the number of potential crossings between 0 and 1, with each possible distance traveled through the turbine area having an equal chance of occurrence (Table 2-6).

**Table 2-6.** Estimated Indiana bat distances traveled within the turbine array during spring and fall migration.

| Distance traveled (proportion of turbine array area) | No. large-scale movements | Total distance traveled (distance traveled x no. crossings) | Probability |
|---|---|---|---|
| 0 0.1 | 1 | 0.1 | 0.1 |
| 0.1 0.2 | 1 | 0.2 | 0.1 |
| 0.2 0.3 | 1 | 0.3 | 0.1 |
| 0.3 0.4 | 1 | 0.4 | 0.1 |
| 0.4 0.5 | 1 | 0.5 | 0.1 |
| 0.5 0.6 | 1 | 0.6 | 0.1 |
| 0.6 0.7 | 1 | 0.7 | 0.1 |
| 0.7 0.8 | 1 | 0.8 | 0.1 |
| 0.8 0.9 | 1 | 0.9 | 0.1 |
| 0.9 1.0 | 1 | 1 | 0.1 |

The number of crossings, therefore, is a function of the total distance traveled within the turbine array, the number of times that a given distance will be traveled during a single large-scale movement bout, and the probability that a given distance will be traveled. For each season, a Monte Carlo analysis was used to randomly sample the estimated number of partial or complete crossings, weighted by the probability that the distance traveled would be observed (Tables 2-5 and 2-6). This value was then used to adjust the outcome of the Bolker et al. (2006) model, as discussed in Section 3.1.



## 2.4 Flight Height

Flight height is thought to play a large role in bat collision risk with turbines. Only flight behavior at the height of spinning turbine blades affects the amount of estimated mortality, because mortality occurs by colliding with (or flying near the edges of) spinning turbine blades. The low incidence of *Myotis* species in post-construction mortality monitoring studies across the country (Arnett et al. 2008, Kunz et al. 2007) compared to species of long-distance migrants which typically fly at higher altitudes provides support for the assumptions that *Myotis* bats fly at relatively low heights, which places them at lower risk of collision with wind turbines.

Relatively few empirical data exist from which to base assumptions about Indiana bat flight height. Acoustic data collected by Stantec at 19 proposed wind power projects (96 Anabat detectors) in 6 states (ME, NH, NY, OH [including the Action Area], VT, and WV) from 2005 to 2009 indicate that bats belonging to the genus *Myotis* fly at low heights relative to the rotor swept zone. Data collected during spring, summer, and fall were not statistically different and were therefore pooled. Ninety-five percent of *Myotis* activity was recorded at detectors placed at or below a height of 10 meters (m; 33 feet [ft]) and *Myotis* activity recorded at 50 m (164 ft) was approximately 3% of that recorded at 2 m (7ft; Figure 2-5). While acoustic call files were not identified to species, the vertical distribution of calls identified to the genus *Myotis* may adequately represent activity patterns of the Indiana bat.

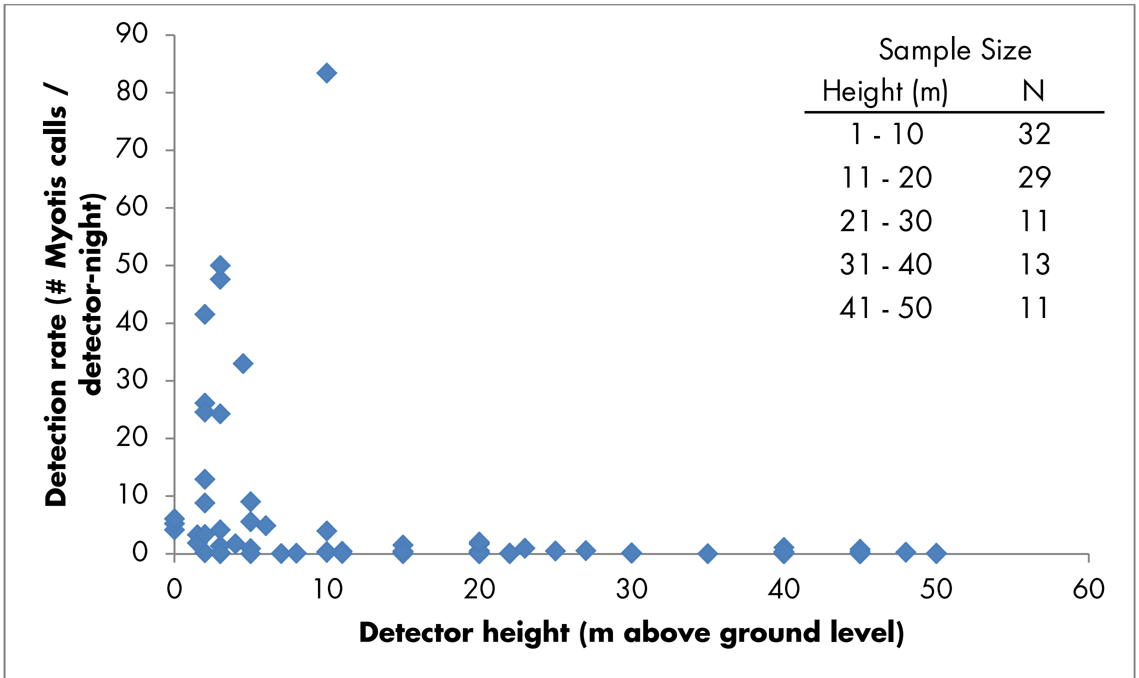



**Figure 2-5**. Detection rate (number of call sequences recorded per detector-night) for *Myotis* species from acoustic data collected by Stantec at 19 proposed wind power projects (96 Anabat detectors) in 6 states (ME, NH, NY, OH [including the Action Area], VT, and WV) from 2005 to 2009.



The low flying height of *Myotis* during summer foraging and traveling activities, and during migration, is supported by information from spring radio telemetry studies (Turner 2006, Gumbert et al 2011, J. Chenger, personal communication), summer foraging observations (LaVal and LaVal 1980, Russell et al. 2008, others), aircraft bat strike data (Peurach et al. 2009), acoustic studies associated with pre- and post- construction studies at wind facilities (Stantec unpublished data, Reynolds 2006, Fiedler 2004), morphological characteristics (i.e., low aspect ratio and high wing loading), and echolocation call signatures adapted to cluttered environments (Saunders and Barclay 1992).

Although these data collectively present fairly strong support for the assumption that *Myotis* bats fly at low heights relative to the rotor swept zone, their reliability is uncertain because acoustic studies may not detect higher flying bats (e.g., the maximum detector height used in the Stantec acoustic dataset presented in Figure 2-5 was 50 m [164 ft], which is at the lowest extent of the rotor swept zone) and while radio telemetry can detect higher flying bats, it cannot distinguish flight height. Additionally, radio telemetry studies to date have largely been conducted in the East and Indiana bat flight behaviors observed in these studies may not hold true for Indiana bats in other regions that likely migrate across large expanses of open terrain. . Further, Indiana bat researchers, V. Brack and D. Sparks (as per M. Seymour, personal communication), have observed Indiana bats above tree canopy, approximately 60 m to 90 m (200 ft to 300 ft) above ground level.

A further complicating factor to estimating Indiana bat flight height relative to the rotor swept zone is the issue of potential attraction to turbines or wind facilities. Kunz et al. (2007) summarized 11 hypotheses that have been postulated by leading bat researchers to explain where, when, how, and why insectivorous bats are killed at wind energy facilities, of which 7 included ideas about possible attraction:

- Linear corridor hypothesis wind energy facilities constructed along forested ridgetops create clearings with linear landscapes that are attractive to bats;
- Roost attraction hypothesis wind turbines attract bats because they are perceived as potential roosts;
- Landscape attraction hypothesis bats feed on insects that are attracted to the altered landscapes that commonly surround wind turbines;
- Heat attraction hypothesis flying insects upon which bats feed are attracted to the heat produced by nacelles of wind turbines;
- Acoustic attraction hypothesis bats are attracted to audible and/or ultrasonic sound produced by wind turbines;
- Visual attraction hypothesis nocturnal insects are visually attracted to wind turbines; and
- Thermal inversion hypothesis thermal inversions create dense fog in cool valleys, concentrating both bats and insects on ridgetops.

If Indiana bats are attracted to wind turbines, acoustic and radio telemetry studies conducted in areas with no wind facilities would not accurately reflect flight height distributions that could be expected post-construction. However, attraction to turbines is speculative at best for Indiana bats, as most of these hypotheses have been put forth for long-distance migratory bat species due to their high rates of mortality at wind facilities. For the purposes of this model, it is assumed that Indiana bats are not attracted to operating turbines.

Given that available acoustic data did not survey the entire airspace relative to the rotor-swept zone, 3 flight height scenarios were developed to model the existing uncertainty regarding Indiana bat flight height above 50 m. Acoustic studies indicated that 99.9% of *Myotis* activity was recorded below 47 m, regardless of season (Figure 2-5). This information was used to develop a baseline flight distribution of the proportion of activity expected below the rotor-swept zone (< 47 m), within the rotor-swept zone (> 47 m and < 153 m, in 10 m bins), and above the rotor-swept zone (> 153 m; cut-off altitudes of 47 and 153 m reflect the 3 m addition to rotor blade length to account for barotrauma, as discussed in Section 2-7). This baseline flight distribution was used for the "low flight height" scenario in summer (see Table 2-7). Moderate flight height and high flight height scenarios were derived by adjusting the proportion of the bats assumed to be flying within the rotor-swept zone upwards of the low flight height distribution indicated by acoustic studies conducted by Stantec. The moderate flight height scenario has 10% more activity within the rotor-swept zone than the low flight height scenario; the high flight height scenario has 20% more activity within the rotor-swept zone than the low flight height scenario. Note that for every scenario, most activity still occurs below the rotor-swept zone.

The flight distribution for the summer season was derived from literature and acoustic survey results. Observations of Indiana bats (Humphrey et al. 1977, Brack 1983, Gardner et al. 1989), and little brown bats (*Myotis lucifugus*) (Russell et al. 2008) during the summer indicate that they fly relatively low to the ground while foraging (i.e., between 2 m and 30 m [6 ft to 100 ft.] above ground level). Consistent with this and with acoustic studies, it was assumed that 99% of summer activity would occur below 47 m, and the remaining 1% of summer activity was divided among the remaining flight heights, decreasing the percentage within each flight height bin as flight height increased, so as to not eliminate the possibility that activity could occur within the rotor swept zone during the summer (Table 2-7).

As stated previously, the flight height of migrating Indiana bats is not known. However, it seems likely that migrating Indiana bats would have to fly at higher altitudes than summer foraging Indiana bats in order to efficiently travel to their winter hibernacula, documented to occur as far as 575 km (357mi) away (Winhold and Kurta 2006). Because migration is an energetically expensive undertaking (Fleming and Eby 2003), bats may try to minimize the time spent in transit (Winhold and Kurta 2006). For example, a male Indiana bat that was banded at a cave in KY traveled approximately 530 km (329 mi) to southern MI in 9 days (Davis 1964, Kurta 1980). Spring radio telemetry studies in PA have documented migrating Indiana bats traveling in relatively direct flight patterns towards their summer ranges shortly after they emerge from hibernacula (Butchkoski and Turner 2006, Britzke et al. 2006). Radio-tagged Indiana bats recently followed by aircraft during their spring migration in NY and PA usually maintained flight speeds between 13 kilometers per hour (km/hr) and 20 km/hr (8 miles per hour [mph] and 12 mph), with 1 bat perhaps traveling at 24 km/h (15 mph; Butchkoski and Turner 2005; C. Herzog, in litt., as cited by Winhold and Kurta 2006). Given the assumed efficiency with which Indiana bats must migrate, it seems likely that they would have to fly higher than summer foraging Indiana bats to avoid obstructions such as vegetation and anthropogenic structures that might impede direct and efficient travel. Therefore, the flight distribution of Indiana bats was assumed to be higher during spring and fall migration compared with assumed flight behavior during summer. This assumption was also made because since the only documented Indiana bats at a wind facility occurred during the fall migratory period, we know that some Indiana bats must fly within the rotor swept zone during this period.



Finally, because documented bat mortality has been highest in the fall, irrespective of geographic location, habitat in which a wind facility is located, or species of bat (see Section 4.5.5 of the HCP for more details), flight height was assumed to be highest during the fall. Further, the only 2 documented Indiana bat mortalities occurred in the fall (Good et al. 2011). This assumption is based on the notion that in order for a disproportionate number of bats to be killed during the fall, there must be a greater proportion of bats flying within the rotor swept zone compared with the spring and summer. However, the model makes no assumptions about the causal factors for this increased flight height in the fall.

Based on the previously stated assumptions, a range of flight distributions was generated that reflect uncertainty about Indiana flight height during each season. The proportion of activity below the rotor-swept zone was decreased in the summer (99%) in 5% increments, starting with spring (95%) and then fall (90%). Similar to summer, the remaining proportion of activity among the remaining flight height categories was divided, decreasing the percentage within each flight height bin as flight height increased. This resulted in an increasing proportion of activity at higher altitudes for the spring and fall, respectively, which in turn would result in an increase in turbine encounters, and thus mortality, for the migratory seasons (Table 2-7). Similarly, the proportion of activity below the rotor swept zone was decreased in 10% increments to generate moderate and high flight height scenarios for each season (Table 2-7).

**Table 2-7.** Proportion of bats flying at low, moderate, and high flight heights relative to the rotor swept zone during spring, summer, and fall.

| **Low Flight Height Model** | | | |
|---|---|---|---|
| **Flight Height (m)** | **Spring** | **Summer** | **Fall** |
| < 47 | 95.0% | 99.0% | 90.0% |
| 47-60 | 1.0% | 0.3% | 2.0% |
| 61 70 | 1.0% | 0.3% | 2.0% |
| 71 80 | 0.5% | 0.1% | 1.0% |
| 81 90 | 0.5% | 0.1% | 1.0% |
| 91 100 | 0.5% | 0.1% | 1.0% |
| 101 110 | 0.3% | 0.1% | 0.5% |
| 111 120 | 0.3% | 0.1% | 0.5% |
| 121 130 | 0.3% | 0.1% | 0.5% |
| 131 140 | 0.3% | 0.1% | 0.5% |
| 141 153 | 0.3% | 0.0% | 0.5% |
| > 153 | 0.3% | 0.0% | 0.5% |
| **Moderate Flight Height Model** | | | |
| **Flight Height (m)** | **Spring** | **Summer** | **Fall** |
| < 47 | 85.0% | 90.0% | 80.0% |
| 47-60 | 5.0% | 2.0% | 5.0% |
| 61 70 | 2.0% | 2.0% | 5.0% |
| 71 80 | 2.0% | 1.0% | 2.0% |
| 81 90 | 1.0% | 1.0% | 2.0% |
| 91 100 | 1.0% | 1.0% | 1.0% |
| 101 110 | 1.0% | 0.5% | 1.0% |
| 111 120 | 1.0% | 0.5% | 1.0% |
| 121 130 | 0.5% | 0.5% | 1.0% |
| 131 140 | 0.5% | 0.5% | 1.0% |
| 141 153 | 0.5% | 0.5% | 0.5% |
| > 153 | 0.5% | 0.5% | 0.5% |
| **High Flight Height Model** | | | |
| **Flight Height (m)** | **Spring** | **Summer** | **Fall** |
| < 47 | 75.0% | 80.0% | 70.0% |
| 47-60 | 10.0% | 5.0% | 10.0% |
| 61 70 | 5.0% | 5.0% | 5.0% |
| 71 80 | 2.0% | 2.0% | 5.0% |
| 81 90 | 2.0% | 2.0% | 2.0% |
| 91 100 | 2.0% | 1.0% | 2.0% |
| 101 110 | 1.0% | 1.0% | 2.0% |
| 111 120 | 1.0% | 1.0% | 1.0% |
| 121 130 | 0.5% | 1.0% | 1.0% |
| 131 140 | 0.5% | 1.0% | 1.0% |
| 141 153 | 0.5% | 0.5% | 0.5% |
| > 153 | 0.5% | 0.5% | 0.5% |

The available information on Indiana bat foraging and traveling flight heights, and the low incidence of Indiana bat mortality at operating wind facilities, both seem to support the assumption that that the majority of Indiana bat activity occurs below typical rotor swept zone heights. Further, *Myotis* species as a whole contribute only a small proportion of total bat mortality, despite their abundance on the landscape (see HCP Section 4.4.5.2 – Geographic Variation [Species Distribution]). Still, a conservative approach was taken in order to address flight height uncertainty by allowing for up to 30% of activity to occur in the rotor swept zone during the fall under the high flight height scenario.

## 2.5 Flight Direction

There is little information on which to infer a prevailing flight direction across the turbine array, and there is no reason to suspect that any direction would prevail during the summer months. Therefore, a distribution of expected turbine encounters was created for all possible flight directions. For any given flight height (see above), the number of encounters was generated using the Bolker et al. (2006) model for 1 degree increments of flight angle (perpendicular to the rotor swept area) ranging from 0 to 180 degrees (the number of encounters for flight angles of 180 to 360 were equal to those for angles 0 to 180). Combining the probability of flight height with a randomly selected angle of flight provides an estimate of the total collisions for any event (see Section 3.0).

## 2.6 Survival Probability

Survival probability is the probability that a bat survives an imminent collision with a turbine rotor (i.e., a turbine encounter) that would occur if its flight height was within the rotor swept zone and its flight path intersected a turbine location; effectively if it is within striking distance of a rotor blade. Survival probability in this case represents any number of reasons an individual bat might survive an encounter including avoidance, body size, flight speed, and random chance. Also, this model assumes that turbines are spinning at all times, so survival probability can also be thought of as accounting for the chance that a blade is not spinning when it is encountered.

In many collision risk studies, survival probabilities (sometimes referred to as avoidance rates) are set at >0.90% (Cooper and Day 2004, Podolsky 2005, Chamberlain et al. 2006, Hatch and Brault 2007, Sanzenbacher and Cooper 2009), indicating a high chance of survival. For example, in the Cape Wind report (Hatch and Brault 2007), biological arguments were used to establish 2 possible survival probabilities for roseate terns (95.3% and 98.3%), with 2 additional probabilities (91% and 99%) used in a sensitivity analysis. The lowest survival probability to date, 75% (for rotating turbine blades), was used in a collision risk model estimating marbled murrelet mortality at a wind facility (Nations and Erickson 2009).

The actual chance of survival if an Indiana bat flies into the rotor swept zone of a turbine is unknown. Therefore, in the probability-based model presented here, the chance of survival is presented as a Beta probability distribution to reflect uncertainty. Three potential survival scenarios were created to both reflect uncertainty and to test the sensitivity of the model outcome to this parameter, based on the model framework, Indiana bat morphology, mortality patterns of *Myotis* bats at wind facilities, and survival rates used in available collision risk models. A graphic illustrating the 3 Beta distributions used is shown in Figure 2-6, where 1 represents the outcome that 100% of bats encountering a turbine would successfully avoid a collision and survive, and 0 represents the outcome that every bat encountering a turbine would be struck and killed. The full collision risk model was run 3 separate times, each time using a different survival scenario. In survival scenario 1 (blue), 90% of 100,000 Monte Carlo simulations had survival probabilities between 48% and 84% (representing the 10th and 90th percentiles of the Beta distribution). In survival scenario 2 (green), 90% of simulations had survival probabilities between 55% and 90%. In survival scenario 3 (red), 90% of simulations had survival probabilities between 68% and 97%.

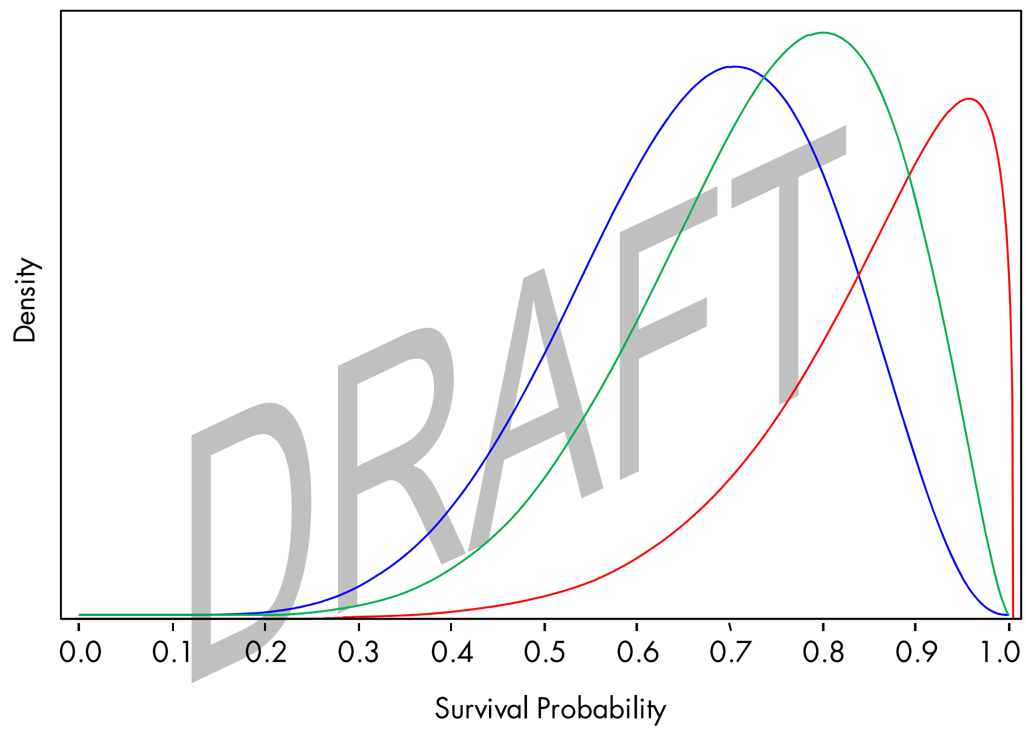




**Figure 2-6**. Survival probability distributions for Indiana bats, weighted toward 70% survival (blue), 80% survival (green) and 95% survival (red).

Most of the area below each survival scenario curve falls above 50%; therefore these distributions reflect a chance of surviving an encounter with a wind turbine blade that is most often above 50% for any Monte Carlo simulation; but each scenario also includes the possibility of choosing any survival probability from 0 to 1 during any simulation. It is important to reemphasize that factors leading to an Indiana bat surviving an encounter with a turbine (e.g., avoidance) are very poorly understood and are confounded even more by evidence that suggests that other bat species may be attracted to turbines (Cryan 2008, Cryan and Barclay 2009). By incorporating a distribution of survival probabilities over 3 different scenarios, it is expected that this method provides a reasonable and conservative estimation of the survival probability.

In addition to modeling a range of possible survival potentials, the approach taken is considered conservative because the Bolker et al. (2006) model assumes that turbine blades are spinning at all times. However, according to nightly wind speed data recorded from June 2007 through July 2010, 5.5% of nights in the spring, summer, and fall seasons have average nightly wind speeds below 3 m/s (Table 2-3); given these are averages across an entire night, there is likely a much higher amount of time during these seasons when turbines are not moving. Additionally, wind turbines will be curtailed (i.e., rotor blades will be feathered into the wind so that they cannot rotate) at varying wind speeds during the Indiana bat active period as a condition of the ITP. On these occasions, survival probabilities would likely be equal to 1 (or 100%).

Since the model assumes that turbine blades are spinning all the time, it underestimates Indiana bat survival probability during times when turbines will be curtailed and when wind speeds are too low for turbines to spin. Again, this conservative approach is appropriate given the uncertainty in conditions that could lead to an Indiana bat successfully surviving a turbine encounter. Furthermore, Indiana bat morphology (low aspect ratio and high wind loading) make this species agile and highly maneuverable flyers, which may indicate an ability to avoid turbines. Finally, relatively high rates of avoidance may be evidenced by the relatively low number of *Myotis* bats found in post-construction mortality facilities (Arnett et al. 2008, Kunz et al. 2007, Johnson et al. 2003) and the fact that only 2 Indiana bats have been confirmed to have been killed at a wind facility.

## 2.7 Turbine Design and Location

The model assumed the use of Nordex N100 turbines, although the final turbine model has not yet been selected. This turbine model was used because it represents the worst case scenario in terms of potential mortality of Indiana bats, given that it has the largest rotor swept zone of all turbine models considered and the lowest cut-in speed (or wind speed at which blades are pitched into the wind and blades begin rotating). Details on the characteristics of Nordex N100 2.5 MW turbines are provided in Table 2-8.

**Table 2-8.** Characteristics of Nordex N100 2.5 MW wind turbine generators.

| | |
|---|---|
| Turbine Manufacturer and Type | Nordex N100 |
| Power Generation | 2.5 MW per turbine |
| Hub Height | 100 m (328 ft) |
| Rotor Diameter | 100 m (328 ft) |
| Total Tower Height (Hub + ½ Rotor) | 150 m (492 ft) |
| Height of Lowest Rotor Blade Reach | 50 m (164 ft) |
| Rotor Swept Area | 7,823 $m^2$ (84,206 $ft^2$) |
| Rotor Speed (*range possible*) | 9.6-14.9 rotations per minute (rpm) |
| Rotor Tilt Angle Blade Cone Angle | 5° 3.5° |
| Wind Speed of Generator Initiation (Cut-in) | 3 meters/second (m/s; 7 mile/hour [mph]) |
| Wind Speed of Generator Cessation (Cut-out) | 20 m/s (45 mph) |
| Maximum Tip Speed | 77 m/s (172 mph) |
| Rated Wind Speed (Unit Reaches Maximum Output) | 12.5 m/s (28 mph) |

Each wind turbine will consist of 3 major components: the tower, the nacelle, and the rotor. The height of the tower, or "hub height" (height from foundation to top of tower) will be 100 m (328 feet [ft]). The nacelle sits atop the tower and the rotor hub is mounted to the front of the nacelle. The rotor diameter will be 100 m (328 ft). Thus, the total turbine height at the highest blade tip position (i.e., rotor apex) will be approximately 150 m (492 ft).

At the time of model development, 52 of 100 turbine locations were known. Random coordinates within the Action Area were generated for the remaining 48 turbines using a random number generator in order to account for the total number of proposed turbines at the facility (Figure 2-7). To ensure that random turbines were located in areas where turbines could potentially be placed, constraint parameters developed for compliance with Ohio Power Siting Board (OPSB) standards, as well as economic and feasibility factors, were used to delineate areas in which random turbine locations were generated (refer to Buckeye Wind Project Draft Environmental Impact Statement for more information on the constraints analysis process).

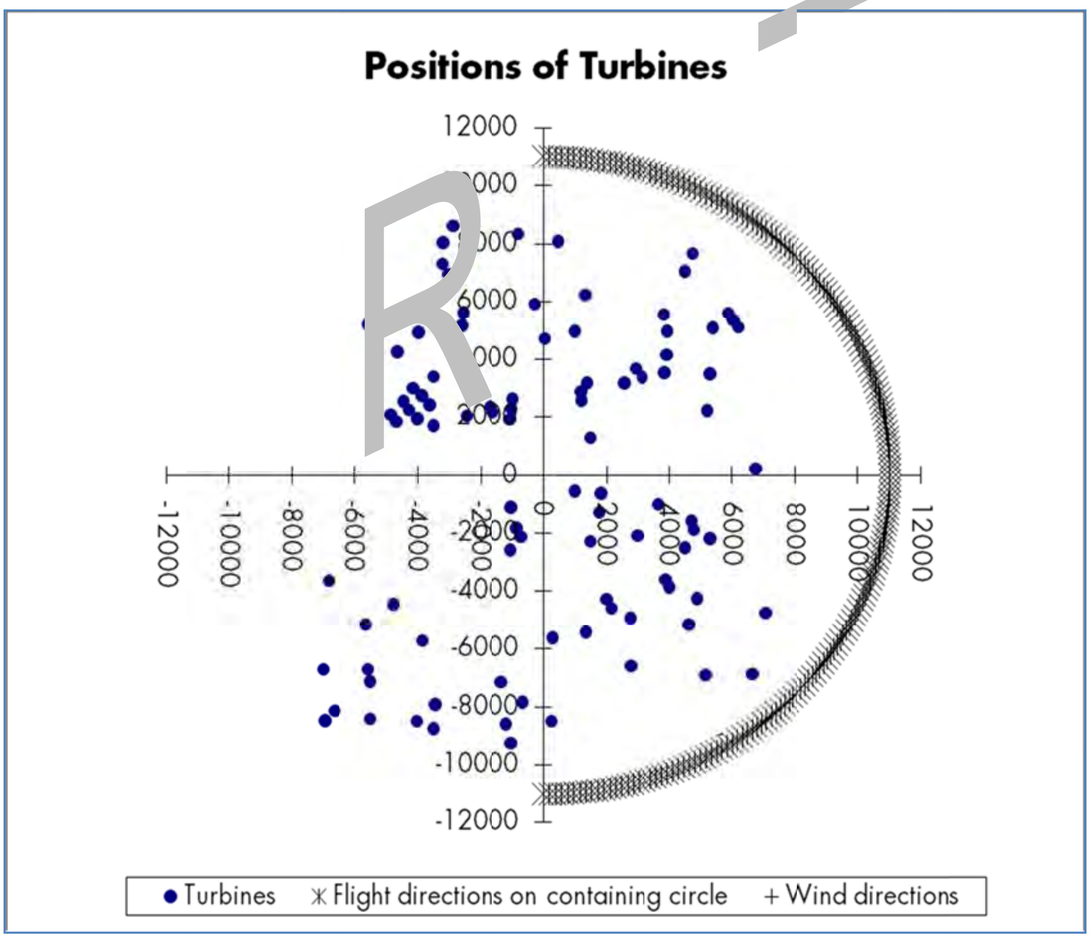



**Figure 2-7.** Graphic representation of the Buckeye Wind Power Project showing 52 known and 48 randomly generated turbine locations.

Nacelle height and rotor length were derived from the characteristics of Nordex N100 2.5 MW turbines (see Table 2-8). Bats flying at the nacelle height are assumed to have the highest chance of collision in the Bolker et al. (2006) model, while bats flying above or below the blade length are assumed to have no chance of collision. Until recently it was thought that bats were killed or injured by the impact from physically colliding with turbines (Johnson et al. 2004, Horn et al. 2008, as cited in by Kunz et al. 2007). However, the recent discovery that bats can be killed by passing through the rotor zone, but not striking turbines, demonstrated that bats do not have to experience physical impact to be at risk (Baerwald et al. 2008). Such mortality is the result of tissue damage to lungs caused by rapid or excessive pressure changes formed in the wake of rotating turbine blades, also known as barotrauma. Bats that experience barotrauma can die from internal bleeding as their blood vessels burst on exposure to the low pressure.

The Bolker et al. (2006) model was adjusted to account for mortality from both direct collisions and barotrauma by extending the length of the turbine blade by 3 m (9.8 ft). This distance was based on an article in which researcher E. Baerwald, University of Calgary, (Handwerk 2008) described the diameter of this "small zone of [dropping] pressure" as "a meter or so." Subsequent correspondence with R. Barclay (University of Calgary, personal communication, April 17 and April 23, 2010; E. Baerwald was unavailable for comment) and B. Thresher (National Renewable Energy Lab, personal communication) to provide further support for this distance was inconclusive, with neither researcher able to provide a specific estimate, and both stating that the length of the zone of decompression varies with respect to the rotational speed of turbines.

Because it was not possible to confirm the "meter or so" estimate, and because the size of the "zone of decompression" will vary based on several dynamic factors such as wind speed, the rotational speed of the turbine rotors, and the length, width, and shape of the turbine blades, among other things, 3 m was selected as a conservative estimate. Although the decompression zone extends along the entire length of the rotor blade edge, the rotor swept zone in this model was modeled as a solid disc with a radius equal to the rotor blade length. Thus, increasing the rotor blade length by 3 m effectively increased the size of the rotor swept zone, which in turn increased the number of turbine encounters possible during a given traverse of the turbine array. Since mortality probability is based on the average number of turbine encounters, increasing the rotor blade size resulted in an increase in the number of turbine encounters, and thus an increase in mortality probability. The model was run assuming the wind turbines rotated into the wind and the bats were flying parallel with the wind direction, which is the most conservative approach because it results in the highest number of possible collisions.

# 3.0 ESTIMATING MORTALITY

The collision risk model inputs are considered uncertain random parameters, whose sampling distributions were selected using a combination of expert judgment, empirical measurements, and literature references, as described in the above sections. Crystal Ball software (a Microsoft Excel add-on) was used to implement a Monte Carlo analysis in which the uncertainty in the model inputs was propagated through the model equation to describe the uncertainty in seasonal mortality. The mortality model can be succinctly written as follows:

$$M_s = Pop_s * W * C_s * M_c$$

*where:*

- $M_s$ = seasonal mortality
- $Pop_s$ = seasonal population size (Section 2.1)
- W = weather factor influencing the number of bats at risk of exposure (Section 2.2)
- $C_s$ = number of complete or partial crossings as a function of total distance traveled within risk area of the wind facility (Section 2.3)
- $M_c$ = probability of mortality as defined in Bolker et al. (2006) as $M_c = 1\text{-}p^E$ where p is the probability of surviving an encounter and E is the total number of encounters with the bat passing completely through the wind facility risk area (Section 3.1).

As described in preceding sections, the total number of bats at risk on any random day is a function of the seasonal population size ($Pop_s$; see Section 2-1) and weather conditions (W; see Section 2-2) thought to affect whether bats are actively flying. An empirical distribution derived from emergence counts at local Indiana bat roost trees was used to randomly select summer population size; a Beta distribution based on the population size of hibernating Indiana bats within migrating distance of the Action Area was used to randomly select spring and fall population sizes; an empirical distribution derived from frequency histograms of wind speed and temperature conditions in the Action Area was used to randomly select representative nightly weather conditions. The total number of bats at risk on any given night was further adjusted based on the number of times and the distance these bats were estimated to move within the turbine array (Cs; see Section 2-3). An empirical distribution derived from foraging telemetry data from local Indiana bats was used to randomly select a random distance an individual bat would travel across the turbine array. Note that the probability of survival is the only term in the model that does not effectively reduce the total mortality by reducing the number of individual bats that may be at risk (see above discussions on weather conditions, movements within the turbine array, and flight height).

The following sections describe how the number of turbines encountered (E), the probability of mortality (Mc), and estimated mortality were calculated. The model was run for 100,000 iterations independently for each season (with the seasonal runs reflecting the seasonal differences in population, weather, and flight height). The resulting distribution of mortality for a specific season represents the uncertainty in bat mortality, given the uncertainties in the variables influencing the mortality calculations.

## 3.1 Number of Turbine Encounters

A turbine encounter occurs if a bat's flight height is within the rotor swept zone and its flight path intersects a turbine location; effectively if it is within striking distance of a rotor blade. The Bolker et al. (2006) model calculates the average and maximum number of turbines encountered by an individual animal flying through the wind facility, conditional on the angle (θ) of movement relative to the radius of the turbine blade. Therefore, any path (T) given θ may or may not intersect with a turbine's rotor swept area. The chance of a collision is calculated as the average (or expected) number of turbine encounters over all possible flight paths with angle θ and the probability of surviving a turbine encounter (E. Bolker, University of Massachusetts, personal communication). To estimate the number of turbine encounters, the Bolker et al. (2006) model treats the rotor swept area as a vertically-mounted disc, without thickness, that may be oriented in any direction in response to the wind, and estimates the average number of collisions as a function of the following 6 factors:

1) Turbine location;
2) Height of turbine center (i.e., nacelle height);
3) Rotor length;
4) Angle of approach;
5) Probability of safe passage (i.e., survival); and
6) Flight height.

As discussed in previous sections, probable flight heights, flight directions, and survival probabilities are all uncertain for Indiana bats, while the remaining inputs into the Bolker et al. (2006) model (turbine location, nacelle height, rotor length) are known or can be estimated with confidence. Therefore, the Bolker et al. (2006) model was adjusted such that for every Monte Carlo simulation (n = 100,000), all possible flight heights and all possible flight directions were incorporated into a single estimate of the number of expected encounters. An open-source spreadsheet designed by Bolker et al (2006; http://www.cs.umb.edu/~eb/windfarm) was used to create a matrix of the average number of turbine encounters for each flight angle (0 to 180 degrees) within each flight height bin (< 47 m, 47 m to 153 m in 10 m bins, > 153 m). No turbines are encountered at flight heights below 47 m or above 153 m. Because each output of the Bolker et al. (2006) model is an average value, based on all possible flight paths through the turbine array for a given flight direction (where some will result in 0 turbine encounters), all estimated average number of encounters were less than 1.

A weighted estimate of the average number of turbine encounters for an individual bat, should it fly completely through the wind facility, was calculated using the following equation:

$$E = \sum_{i=1}^{k} C_{\theta_{i,j}} * PH_i ; j = 1,180 \text{ randomly selected angles equation } 1$$

In the above equation, the weighted number of collisions (E) is a function of the possible flight heights (i =1 to k height bins, Table 2-7; with the chance of any flight height dependent upon the probability associated with each height bin), and the angle of flight ($\theta$, j = angles 1 to 180 degrees). For each Monte Carlo simulation, the model selected a random angle for each possible flight height bin (Table 2-7). Based on the angle randomly chosen, the average number of turbine encounters for each flight height bin was selected from the matrix of all possible turbine encounters generated from the Bolker et al. (2006) model. To generate an adjusted number of encounters for each flight height bin, the average number of turbine encounters was then weighted by the probability that each flight height would be expected to occur. Finally, the adjusted number of turbine encounters was summed across all flight height bins to calculate the total number of expected encounters for the simulation. This resulting weighted number of encounters represents the possible number of collisions for a bat traveling through the wind facility.

## 3.2 Estimated Mortality

The final step in estimating total mortality was to combine the number of bats expected to encounter turbines with the probability of mortality. Mortality will occur when a bat encounters a turbine blade and does not survive. The probability of mortality is $M_c = 1\text{-}p^E$; where p is the probability of surviving an encounter and E is the total number of encounters, calculated as described above. For each Monte Carlo simulation, a random value for p was selected from one of the Beta distributions shown in Figure 2-6.

The probability of mortality was calculated using output from the Bolker et al. (2006) model, which assumes complete passage through the turbine array. Therefore, the probability was adjusted for partial movements through the turbine array by multiplying mortality probability by a random distance traveled (the chance of selecting each distance traveled dependent upon the probability associated with each distance bin; Table 2-5 and 2-6). A random population size, wind speed, and temperature were then chosen (the chance of selecting dependent upon the probability associated with each input, with the exception of summer population size, Table 2-1, 2-2, and 2-3, Figure 2-3). The process of selecting random values for each input was repeated 100,000 times.

## 3.3 Sex- and Age-Specific Adjustments to Mortality Estimates

As described in Section 2.1.1, summer population size was derived from emergence counts and home ranges associated with radio tagged female Indiana bats. As described in Section 2.1.1, emergence counts conducted before 15 July were multiplied by 1.9 to account for unborn or non-volant young and emergence counts conducted after this date were presumed to include approximately 1 volant juvenile per adult female. This is a conservative estimate because it assumes no pre-weaning mortality and that all females successfully give birth. Thus, summer mortality estimates can be assumed to include approximately 50% adult females and 50% juveniles. To account for adult males that could be killed by wind turbines, the summer population estimates for females and juveniles was increased by 8% (based on the male:female ratio observed during mist netting surveys in the tri-county area).

In terms of the migratory population, the methods used to estimate the size of the migratory population took into account differences in male and female migratory behavior. As described in Section 2.1.2, sex-specific population sizes from any given hibernaculum were explicitly defined (on average females comprised 73%, and males comprised 27% of the migratory population). However, estimates of the spring migratory population did not take into account the loss of juveniles that will occur if pregnant females are killed during this time. To adjust collision risk estimates to account for this additional mortality, the proportion of females in the spring migratory population (i.e., 73%; Section 2.1.2) was multiplied by 1.9. Using these methods, females, males, and juveniles were accounted for in the estimates of spring, summer, and fall mortality.

# 4.0 RESULTS

The following section presents the estimated mortality of female, male, and unborn or non-volant juveniles (prior to 15 Jul) Indiana bats under the high, moderate, and low flight height scenarios presented in Section 2.0, and for each of 3 survival scenarios (presented in Section 2.6). For each scenario, the median fatality estimate is presented, which indicates that 50% of the 100,000 resampled values were below this value and 50% were above. In other words, the 50th percentile represents the average estimated mortality of Indiana bats for the given scenario. The 30th and 70th percentile values are also presented to represent the lower and higher estimated values of mortality and to show the range of uncertainty in the model. The 30th and 70th percentile values should not be interpreted in terms of the usual confidence intervals in hypothesis testing. Given the degree of uncertainty in the model input parameters, the upper 70th percentile results are considered the extreme upper bound of the model output distribution and represent higher than expected values.

## 4.1 Sensitivity of Survival Probability

The 3 survival probability scenarios had variable impacts on estimated collision mortality, as expected. In summer, when little activity was expected within the rotor swept zone, changing the Beta distribution for survival had little effect on estimated mortality (Figure 3-1, Summer). The effect of survival probability was higher in the spring, as the amount of activity expected in the rotor swept zone increased (Figure 3-1, Spring). The effect of survival probability was most pronounced in the Fall, when the largest amount of activity (30% under the high flight height scenario) was estimated to be in the rotor swept zone (Figure 3-1, Fall).



## 4.2 Low Flight Height

The median (i.e., 50th percentile) fatality estimates (averaged over the 3 survival scenarios) for the low flight height scenario were 2.35, 0.07, and 4.43 bats for the spring, summer, and fall seasons respectively. The 30th percentile for the number of bats potentially killed was lowest in the summer at 0.03 bats; while the 70th percentile was highest in the fall at 11.24 bats. Thus, the range of uncertainty (i.e., range between the 30th and 70th percentiles) under the low flight height scenario in all seasons combined (i.e., annual mortality) ranged from 3.14 to 16.33, with the most likely estimated annual mortality of 6.86 Indiana bats, based on the cumulative seasonal mean values (Table 3-1).

## 4.3 Moderate Flight Height

As expected, the median fatality estimates under the moderate flight height scenario were higher than those estimated under the low flight height scenario, given the higher proportions of bats flying within the rotor swept zone, with estimated mortality of 6.79, 0.72, and 8.74 bats for the spring, summer, and fall seasons respectively. The 30th percentile value for the number of bats potentially killed was lowest in the summer, at 0.24 bats; while the 70th percentile value was highest in the fall at 22.10 bats. Thus, the range of uncertainty under the moderate flight height scenario in all seasons combined ranged from 7.51 to 38.12, with the most likely annual estimated mortality of 16.26 Indiana bats, based on the cumulative seasonal median values (Table 3-1).

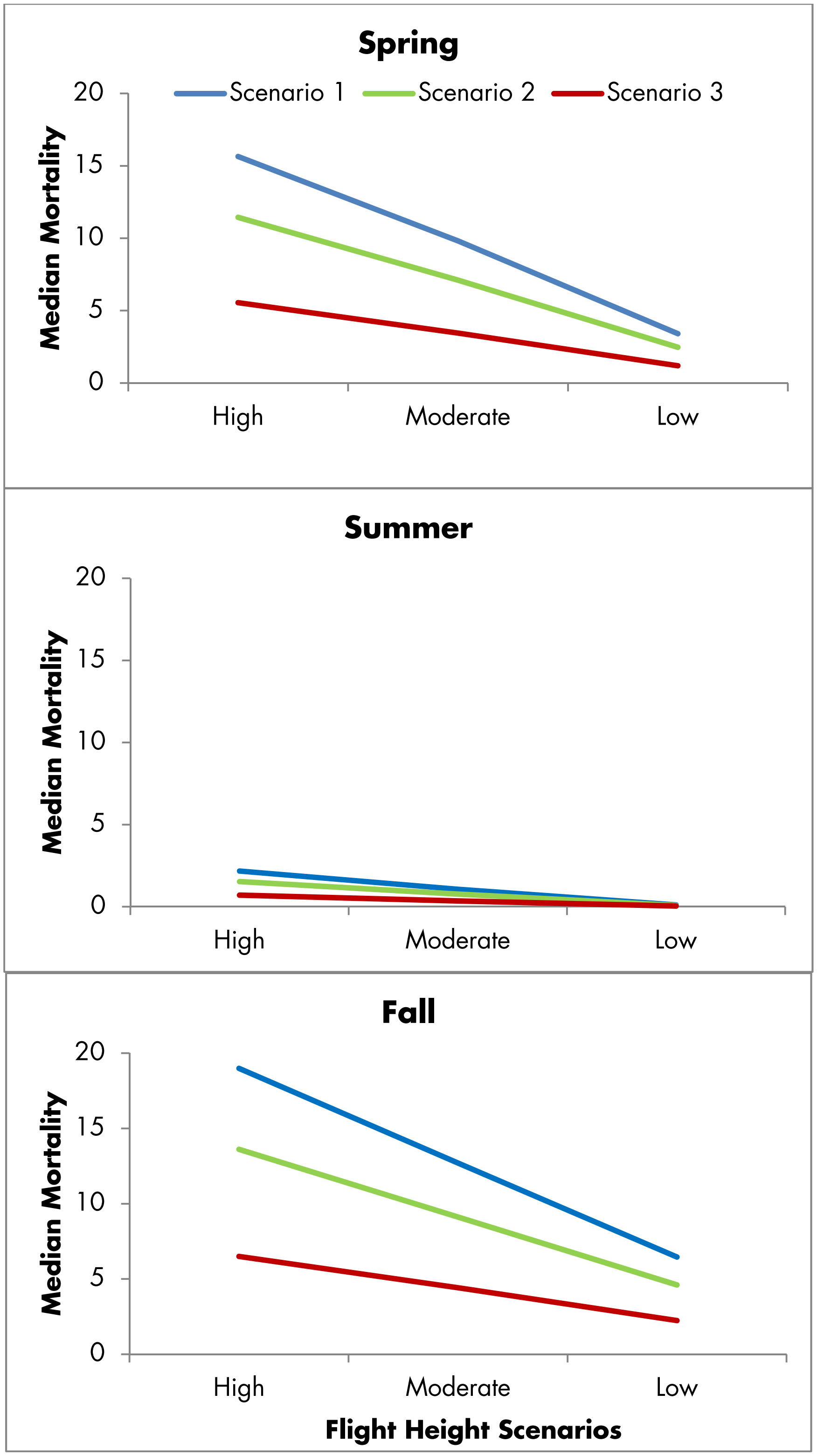


**Figure 4-1.** Median mortality estimates for 3 flight height scenarios (high, moderate, and low) under 3 survival scenarios (Beta distributions weighted toward 70% [blue], 80% [green], and 95% [red]), during the spring (April 1 to May 31), summer (June 1 to July 31), and fall (August 1 to October 31).

## 4.4 High Flight Height

As expected, the median fatality estimates were greatest under the high flight height scenario, at 10.88, 1.47, and 13.03 bats for the spring, summer, and fall seasons respectively. The 30th percentile value for the number of bats potentially killed was lowest in the summer, at 0.49 bats; while the 70th percentile value was highest in the fall at 33.07 bats. Thus, the range of uncertainty under the high flight height scenario in all seasons combined ranged from 11.69 to 59.66, with the most likely annual estimated mortality of 25.38 Indiana bats, based on the cumulative seasonal median values (Table 3-1).

**Table 3-1.** Estimated Indiana bat fatalities (median values) under 3 survival scenarios during the spring (1 Apr to 31 May), summer (1 Jun to 31 Jul), and fall (1 Aug to 31 Oct) periods, and annually, under high, moderate, and low flight height scenarios relative to the rotor swept zone.

| Flight height scenario | Median estimated fatalities | | | |
|---|---|---|---|---|
| | Survival Scenario 1 (48 - 84% survival) | | | |
| | Spring | Summer | Fall | Annual |
| Low | 3.40 | 0.11 | 6.46 | 9.97 |
| Moderate | 9.82 | 1.07 | 12.70 | 23.59 |
| High | 15.65 | 2.17 | 19.00 | 36.82 |
| | Survival Scenario 2 (55 - 90% survival) | | | |
| | Spring | Summer | Fall | Annual |
| Low | 2.47 | 0.08 | 4.60 | 7.15 |
| Moderate | 7.10 | 0.76 | 9.12 | 16.98 |
| High | 11.45 | 1.53 | 13.61 | 26.58 |
| | Survival Scenario 3 (68 - 97% survival) | | | |
| | Spring | Summer | Fall | Annual |
| Low | 1.19 | 0.04 | 2.23 | 3.46 |
| Moderate | 3.45 | 0.34 | 4.41 | 8.21 |
| High | 5.55 | 0.70 | 6.50 | 12.75 |
| | Mean of 3 Survival Scenarios | | | |
| | Spring | Summer | Fall | Annual |
| Low | 2.35 | 0.07 | 4.43 | 6.86 |
| Moderate | 6.79 | 0.72 | 8.74 | 16.26 |
| High | 10.88 | 1.47 | 13.03 | 25.38 |

# 5.0 DISCUSSION

The range of estimated mortality of Indiana bats reflects uncertainty around each of the model inputs: population size; flight height; the effect of temperature and wind speed on nightly activity; movements within the turbine array; and factors that lead to survival or mortality (e.g., avoidance or attraction). This uncertainty is evident in the disparity of values at the upper and lower edges of estimated mortality distributions (i.e., the 30$^{th}$ and 70$^{th}$ percentiles). A probabilistic approach was chosen for this model, using distributions for each model input derived from empirical data, derived data, or professional opinion to account for this uncertainty. This was preferred over using single-point estimates for each of the input parameters, which would have resulted in less variability, but also less confidence, in the model results.

Estimates of mortality relied heavily on the total population size and the proportion of the population exposed to risk as a function of flight height. Population size is essentially unknown for populations of migratory and summer resident bats in the Action Area. Although a relatively large site-specific dataset from was available which to base assumptions about the summer resident population, the data were not without limitations. Due to the sensitive nature of location data on endangered species, access to raw telemetry data was not provided and therefore, associated location error could not be estimated. Similarly, because data were collected by multiple consultants as part of pre-construction studies for multiple proposed wind power developments, multiple observers collected telemetry data and likely used varying methods with differing levels of experience. These factors could have affected the accuracy of home range estimates which influenced summer population estimates. However, sample sizes of radio telemetry locations used to derive home ranges were relatively large (93.7 locations ± 56.4 locations), which increases the reliability of these estimates.



Due to these limitations, each emergence count had to be treated as a separate estimate of maternity colony population size. Further, because home range estimates for multiple bats from the same maternity colony were not available in most cases, individual home ranges had to be treated as approximations of total maternity colony home range size. This likely overestimated the number of maternity colonies the Action Area to a large degree, since the size of an area used by all members of a maternity colony will likely be larger than that used by each individual colony member. Further, this method assumes that maternity colonies do not overlap and that all are occupied. These methods allowed for the highest numbers of maternity colonies to be present in the Action Area, which was appropriate given the limitations of the data and the inherent uncertainty in estimating maternity colony size based on emergence counts. However, there is likely higher variability in the estimated summer population sizes than actually occurs in the Action Area.

The annual mortality estimates were especially sensitive to the greater proportion of Indiana bats flying within the rotor swept zone during the fall migratory period, which affected the impact that survival probability had on model outcomes. Assumptions about the proportion of activity at different height bins were based in part on acoustic data; other sources included published and unpublished telemetry studies, visual observation, and published aircraft-bat collision information.

It is important to note that acoustic data indicated that a much lower percentage of *Myotis* bats would be expected to fly within the rotor swept zone than what was presented in all flight height scenarios (*Myotis* activity recorded at 50 m [164 ft] was approximately 3% of that recorded at 2 m [7ft]); this was particularly true for the moderate and high flight scenarios. However, relying solely on acoustic data to inform assumptions about Indiana bat flight height is questionable because data were not recorded throughout the rotor swept zone; the highest detectors were placed at the lower limit of the rotor swept zone, at 50 m (164 ft). Finally, acoustic detectors cannot be used to determine the number of individuals recorded, but rather to establish an index of relative activity. Due to these limitations, a conservative approach was taken, such that the proportions of bats flying within the rotor swept zone were assumed to be much higher than the 1% indicated by acoustic data alone (the maximum proportion of activity within the rotor swept zone was 30% under the high flight height scenario in the fall).

Another potential limitation of this model is that it was not able to directly incorporate the erratic, non-linear flight behavior of bats because a model was used that was created for birds, which presumably exhibit more direct and linear flight behavior. Furthermore, methods have not currently been developed for modeling non-linear flight. However, for Indiana bats, it is expected non-linear flight behavior would be exhibited primarily during active foraging that occurs most often at or below canopy height, which would not lead to risk of collision with spinning turbine blades that are placed well above canopy level. Instead, it was assumed that when Indiana bats were flying within the rotor-swept zone, they would exhibit direct and linear flight behavior that would be expected during traveling or commuting activity. Thus, the assumption of straight-line flight at heights within the rotor swept zone is appropriate and is not expected to violate the assumptions of the model framework.



The probabilistic approach used in this collision risk model represented a unique way of adapting the existing Bolker et al. (2006) model to fit the needs of a species whose behavior did not match that of migratory or nesting bird species. For each individual simulation (out of 100,000), the calculation of collision risk combined the average number turbine encounters for all possible flight directions and all possible flight heights (weighted by probability), along with a randomly-selected survival probability between 0 and 1 that varied among survival scenarios. By using distributions whose shapes were derived from available data on bats, *Myotis* species, or Indiana bats specifically, a reasonable range of uncertainty was encapsulated during each simulation, which likely captured the expected amount of mortality that would result from the proposed Project.

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# Appendix B

## Summer Habitat Suitability Model

# Summer Habitat Suitability Model for Indiana Bats at the Buckeye Wind Power Project in Champaign County, Ohio

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June 2011

## EXECUTIVE SUMMARY

Section 10 of the ESA of 1973 (7 U.S.C. § 136, 16 U.S.C. § 1531 et seq.) allows for the incidental take of listed species via an Incidental Take Permit (ITP), as long as an associated Habitat Conservation Plan (HCP) demonstrates that incidental take has been avoided, minimized, and mitigated to the maximum extent practicable. To avoid and minimize take of Indiana bats at the Buckeye Wind Power Project (the Project) during the summer maternity season, a turbine curtailment strategy was developed in which operational adjustments will be based on the suitability of habitat in which turbines are placed. The proposed Project includes up to 100 turbines that will generate up to 250 megawatts of energy. Turbines will be situated within a 32,395-ha (80,051 ac) area in Champaign County, Ohio. The Project area is dominated by agricultural lands and is comprised of approximately 9% forested habitat.

Indiana bat habitat suitability was based on data supplied by the Ohio Department of Natural Resources (ODNR) for 17 adult Indiana bats (n=15 females, n= 2 males) captured in 2008 and 2009 during pre-construction mist netting surveys for various proposed wind power projects (including the proposed Project) in Champaign, Logan, and Hardin Counties. Sampled locations for the 17 Indiana bats included 1,124 telemetry points that were collected during nighttime foraging and traveling activities, and 43 roost trees.

A partitioned Mahalanobis $D^2$ technique was used to predict suitable Indiana bat habitat across the Project area. This multivariate technique measures the spatial distance ($D^2$) between a collection (or vector) of environmental variables measured at locations where the target species was identified, and a vector of those same environmental variables measured at unsampled locations. Environmental variables which are consistent across locations where the species was identified are considered more important and are given more weight in the model than variables which vary widely across known locations. A high probability of occurrence is assigned to sites at which conditions are most similar to the conditions where the species was detected.

We used a Geographic Information System (GIS) to consider 13 environmental variables thought to influence Indiana bat habitat selection (see Table 3-1), based on literature review and professional judgment. The program FRAGSTATS manipulated the 2001 National Land Cover Database (30-m resolution) to generate spatial metrics for 7 of the 13 environmental variables. The additional 6 variables were obtained from existing data sources.

Separate predictive maps were created for Indiana bat roosting suitability (using the 43 roost tree locations) and foraging suitability (using the 1,124 telemetry locations) because sample size and location error was significantly larger for the telemetry dataset, and with unequal sample sizes, a model containing both data types would not properly identify potential roosting habitat. Using the 1,124 telemetry locations, a predictive map for foraging suitability was created based on all 13 environmental variables. A separate predictive map based on only 7 of the environmental variables was created for Indiana bat roosting suitability so that roost suitability was properly mapped, and so that the smaller roost tree data set did not result in an overfitted model. We determined the distance ($D^2$) between the vector of environmental conditions measured at each pixel and the mean vector of environmental conditions derived from known Indiana bat roosting or foraging locations. These $D^2$ values were then rescaled using a chi-squared ($\chi^2$) distribution and converted to p-values to determine probability of occurrence in each 30-m pixel in the Project area. P-values were divided into four quantiles, representing most to least suitable for Indiana bat roosting and foraging activities. Roosting and foraging suitability maps were then combined into a single predictive map by retaining the highest suitability category assigned to each pixel in either predictive map when a discrepancy occurred. A turbine curtailment strategy will be derived in which turbine operation will vary during the summer maternity season based on turbine location in relation to predicted suitable summer Indiana bat habitat.

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# 1.0 INTRODUCTION

Since its description as a separate species, Indiana bat (*Myotis sodalis*) populations have experienced marked population declines. The species was listed as being in danger of extinction in 1967 under the Endangered Species Preservation Act of 1966 (32 FR 4001, March 11, 1967) because of large decreases in population size and an apparent lack of winter habitat (Clawson 2002; USFWS 1983, 1999). It was later listed as federally endangered under the Endangered Species Act (ESA) when it was enacted in 1973.

Section 10 of the ESA of 1973 (7 U.S.C. § 136, 16 U.S.C. § 1531 et seq.) allows for the incidental take of listed species via an Incidental Take Permit (ITP), as long as an associated Habitat Conservation Plan (HCP) demonstrates that incidental take has been avoided, minimized, and mitigated to the maximum extent practicable (among other issuance criteria described in detail in the HCP). To avoid and minimize take of Indiana bats at the Buckeye Wind Power Project (the Project), a turbine curtailment strategy will be derived in which turbine operation will vary during the summer maternity season based on turbine location in relation to predicted suitable Indiana bat foraging and roosting habitat.

Suitable habitat is thought to be more restrictive for female Indiana bats, which congregate in maternity colonies during the summer months, than for males or nonreproductive females (Rommé et al. 1995, Farmer et al. 2002, Carter 2005). Maternity colonies can use between 10 and 20 different roost trees per year, although usually only 1 to 3 of these are considered primary roosts which are used more consistently by a larger number of individuals in the colony (Callahan 1993, Callahan et al. 1997). Indiana bats roost underneath bark or in cracks or crevices of trees, so roosts are most often found in trees which are dead or dying; although live trees with exfoliating bark are also used (Kurta 2005). In an analysis of 393 roost trees from 11 states, Kurta (2005) found that 87% were ash (*Fraxinus*), elm (*Ulmus*), hickory (*Carya*), maple (*Acer*), poplar (*Populus*) and oak (*Quercus*). Although most trees used by reproductive females are deciduous, hemlock (*Tsuga* spp.) and pitch pine (*Pinus rigida*) have been used in western NC and eastern TN, and eastern white pine (*Pinus strobes*) has been used in VT (Britzke et al. 2003, Watrous et al. 2006). The large number of tree species identified as roosts (> 30 species; Kurta 2005) may indicate that tree location and structure are more important than the species of tree itself.

Numerous foraging habitat studies have been completed for the Indiana bat throughout much of the species range. Indiana bats forage in closed to semi-open forested habitats and forest edges located in floodplains, riparian areas, lowlands, and uplands (Humphrey et al. 1977, LaVal et al. 1977, Brack 1983, Garner and Garner 1992, Carter 2003). Forest edges are often used as protective travel corridors. In fragmented habitat, bats typically use hedge rows and other features of the landscape that provide cover and serve as travel corridors between foraging areas and roosts (Murray and Kurta 2004). While visual observations suggest that foraging over open fields or bodies of water more than 50 m (150 ft) from a forest edge do occur, it appears to be less common than foraging within forested sites or along edges (Brack 1983, Menzel et al. 2001).

## 1.1 Review of Existing Habitat Suitability Index Models

Three habitat suitability index (HSI) models have been developed to evaluate the suitability of Indiana bat maternity sites in the Midwest (Rommé et al. 1995, Farmer et al. 2002, Rittenhouse et al. 2007). An Indiana bat HSI was developed for the Indiana Department of Natural Resources (Rommé et al. 1995) that used known roosting and foraging characteristics determined by studies in the Indiana bat's "core area" of

Indiana, Illinois, Missouri, southern Michigan, and western Ohio. Five roost tree variables were used to assess suitability of roosting habitat including: 1) percent overstory canopy cover, 2) diameter of overstory trees, 3) density of potential live roost trees by class > 22 cm (8.7 in) diameter at breast height (dbh), 4) density of snags by class > 22 cm (8.7 in) dbh, and 5) percent cover of understory from 2.0 m (6.6 ft) to the base of overstory canopy. Two variables were identified to evaluate the suitability of foraging habitat: 1) percent overstory canopy cover, and 2) percent of trees 5 to 12 cm (2 to 4.7 in) dbh. Each variable had an associated suitability index curve so that the average values collected in the field could be transformed into an index value between 0 and 1, with higher values representing more suitable habitat. The minimum of the roosting or foraging index value was then multiplied by the mean index values for 2 landscape variables (distance to water and the amount of forested area) to determine the overall HSI for the site (Rommé et al. 1995).

The Farmer et al. (2002) model condensed the Romme et al. (1995) model down to only three variables: number of land cover types covering > 10% of the study area, density of suitable roost trees, and the percent of landscape in forest. Similar to the Rommé et al. (1995) HSI model, implementation of the Farmer et al. (2002) model requires that input values be measured at the site and transformed into an index value using curves developed from known roosting and foraging characteristics. Performance of the model, using various combinations of index values, was assessed by comparing HSI values calculated for locations where Indiana bats had been previously detected in mist netting studies in Missouri to values calculated for locations where Indiana bats were deemed absent. Higher index values were found at locations where Indiana bats were found; however, results were driven solely by the density of suitable roost trees. Farmer et al. (2002) were careful to point out that sound empirical support was lacking for various components of their model.

Rittenhouse et al. (2007) developed an HSI model based on reported ecological relationships for Indiana bats in the Central Hardwoods region of Indiana. The Rittenhouse et al. (2007) HSI model differed from the previous two models in that it used information derived in a Geographic Information System (GIS) to evaluate Indiana bat roosting and foraging habitat suitability. The Rittenhouse et al. (2007) model was most similar to the Farmer et al (2002) model, but differed in that it used Forest Inventory Analysis data and estimates of snag density by tree age class to identify potential roost trees, and it accounted for solar radiation of roost trees. Four variables measured summer habitat suitability: 1) roost tree dbh and snag density as functions of tree age, 2) suitability of open habitat and early successional forest (thought to indicate suitable foraging habitat) based on tree age, 3) distance to water, and 4) solar exposure. The final habitat suitability value was the maximum of the composite roost site suitability or the foraging suitability. While this model allows for predictions of suitable habitat to be made over larger areas, it relies on arbitrary suitability index curves to assess the suitability of roost tree and landscape information, similar to the Rommé et al. (1995) and Farmer et al. (2002) HSI models.

### *1.1.1 Model Limitations*

While these models attempt to quantitatively predict suitable habitat, there are several drawbacks to their methods. These studies relied on limited (Rommé et al 2005, Farmer et al. 2002) or no empirical data (Rittenhouse et al. 2007) to develop suitability index curves. Because these models have rarely been tested with empirical data to validate their underlying assumptions, the scope of inference is restricted to areas in which the studies were conducted. Carter (2005) used data collected in Illinois in a post-hoc test of both the Rommé et al. (1995) and Farmer et al. (2002) HSI models and found contradicting results. Although Carter believed an appropriate HSI for his study area should have been well above average (0.8 to 0.9), the Rommé et al. (1995) model resulted in an HSI value of only 0.42, while the Farmer et al. (2002) model predicted an HSI of up to 0.8, suggesting that it might be more useful. However, until these various models are validated through field studies that are designed and implemented specifically to test the predictions of the models at multiple sites, these HSI models will be of questionable value.

Another limitation to the aforementioned HSI models is that they assume that all variables are equally important in assessing habitat suitability and that no unimportant variables have been included. Additionally, implementation of the Rommé et al. (1995) and Farmer et al. (2002) HSI models require extensive field work to derive values for each roost tree variable in the model, but the optimal number of samples required and the proper scale at which each model operates are not known. As a result, these models cannot be applied to a large landscape. Similarly, none of these models addressed landscape-scale spatial patterns of habitat configuration such as fragmentation and connectedness of forested habitat. Yet, Indiana bat foraging studies have consistently shown that bats use linear features such as forest edges, hedge rows, road corridors, streams, and other features on the landscape that provide cover as travel corridors between foraging areas and roosts (Gardner et al. 1991b, Kurta et al. 2002, Carter 2003, Murray and Kurta 2004, Kurta 2005, Winhold et al. 2005), indicating that the spatial configuration of forested habitat may be as important as other features such as the density of suitable roost trees.

## 1.2 Selected Model Framework

In order to predict suitable Indiana bat habitat across the Project area, a model was needed that would allow for predictions over a large landscape based on site-specific, empirical data on Indiana bat habitat features. Two examples of such models were developed by Carter et al. (2002) and Miller et al. (2002). Carter et al. (2002) used a GIS model to compare habitat characteristics measured at roosting areas with the same characteristics measured at random points in Illinois. Roosting habitats had less urban development, larger patches of closed-canopy deciduous forest, more patches of water, and less agricultural area (although more individual patches), than random locations. In comparison, Miller et al. (2002) did not find any difference in 5 of 7 landscape characteristics measured at locations where Indiana bats had been captured in mist nets and locations where mist netting had not resulted in capture (and the authors believe the 2 significant characteristics would not strongly influence Indiana bat occurrence).

Common statistical techniques (e.g., logistic regression, discriminant function analysis, canonical correlation analysis) often used to identify suitable habitat are based on comparison of sampled locations where the target species was determined to be present, with random or surveyed locations where the species was presumed to be absent. However, assigning "absence" can be difficult for rare and elusive species such as the Indiana bat, since the species could be present but not detected. For example, if the random locations used in the Carter et al. (2002) model, or the mist net locations where Indiana bats were not captured in the Miller et al. (2002) model did not truly represent unoccupied habitat, the outcome of these models would not accurately predict Indiana bat habitat suitability.

Models based solely on presence data, such as Mahalanobis $D^2$, avoid misclassification of absence. This multivariate technique measures the spatial distance ($D^2$) between a collection (or vector) of environmental variables measured at locations where the target species was identified, and a vector of those same environmental variables measured at unsampled locations. A high probability of occurrence is assigned to sites that have small distance ($D^2$) values; i.e., sites at which conditions are most similar to conditions where the species was detected. Low probabilities of occurrence are assigned to sites that are distant (i.e., large $D^2$ values) from the vector derived from occupied sites. An additional benefit to the Mahalanobis $D^2$ technique is that it is appropriate for use within a GIS, which allows for analysis of environmental conditions across large landscapes, such as areas used for foraging and roosting activities by Indiana bats. Furthermore, multivariate statistical models account for interactions between variables while making no assumptions on variable distributions; therefore, environmental variables need not be normally distributed across sites in order to be included.

This technique has been used to predict suitable summer habitat for Indiana bats in the Lake Champlain Valley, Vermont (Watrous et al. 2006), where predicted suitable habitat was located in areas that had diverse land cover types, predominantly characterized by agriculture, isolated forest patches, and water sources. Within a 0.5 km (0.3 mi) buffer, forest patch area (mean ± SD = 36 ha ± 12.79 ha [89.0 ac ± 31.6 ac]), elevation (110 m ± 44 m [361.0 ft ± 144.4 ft]), aspect (90.6° ± 2.3°), and Shannon's diversity index (0.6 ± 0.1) were strong predictors of suitable habitat. Traditional and modified Mahalanobis $D^2$ techniques have also been used to predict suitable habitat for black bear (*Ursus americanus*; Clark et al. 1993*a,b*), black-tailed jackrabbit (*Lepus californicus*; Knick and Dyer 1997), gray wolf (*Canis lupus*; Corsi et al. 1999), sage sparrows (*Amphispiza belli*; Knick and Rotenberry 1998, Rotenberry et al. 2002), Acadian flycatcher (*Empidonax virescens*; Dunn and Duncan 2000, Duncan and Dunn 2001), timber rattlesnake (*Crotalus horridus*; Duncan and Dunn 2001, Browning et al. 2005), California gnatcatcher (*Polioptila californica*; Rotenberry et al. 2006), and sagebrush ecosystems (*Artemisia* spp., Meinke et al. 2009).

### *1.2.1 Model Limitations*

While GIS-based models can be used to predict suitable habitat over large landscapes, they require model inputs that are measureable on a landscape scale. Several roost tree factors, such as tree species, dbh, the amount of solar exposure, or the amount of peeling bark are of known importance to Indiana bats, but cannot be mapped on a landscape scale. The density of suitable roost trees was the most important component of previous habitat suitability index models developed by Rommé et al. (1995), Farmer et al. (2002), and Rittenhouse et al. (2004). Roost tree suitability was determined either in the field (Rommé et al. 1995, Farmer et al. 2002), or using surrogate measures, such as the combination of tree age and size class (Rittenhouse et al. 2007). Indeed, Rittenhouse et al. (2007) was able to create a landscape-scale predictive map using those surrogate tree-scale characteristics. However, the variables in the model estimated the number of suitable roosts based on snag density, and not all snags will be suitable roost trees due to differences in species, size, and bark characteristics (Menzel et al. 2001), and not all roost trees will be snags (Kurta 2005). Further, the relationship between the density of potential roost trees and the suitability of an area has not been well established (Menzel et al. 2001). Miller et al. (2002) found that stands where Indiana bats had been captured in mist nets had a higher number of medium and large diameter trees than stands where no Indiana bats had been captured; however, it is not stated whether the trees measured were considered suitable roost trees.

Because Indiana bats are rare, it is difficult to collect a sufficiently large data set of independent samples. Due to the sensitive nature of information for this endangered species, and the sensitive nature of investigations at proposed wind facilities, precise locations for roost trees or telemetry points were not available for this analysis. Instead, environmental characteristics at sampled locations were provided by the ODNR. These data were collected by multiple observers and did not include estimates of telemetry error. Thus, issues related to sampling independence or spatial autocorrelation were not able to be addressed. However, the effects of spatial autocorrelation were likely minimized as a function of tracking fast-moving bats.

Tracking bats typically involves multiple observers taking simultaneous bearings at a specified time interval (often every 5 minutes) and then triangulating those bearings to derive a location or "fix". Because bats move rapidly while flying (Indiana bats have been documented flying between approximately 13 km/hr and 20 km/hr [8 mph and 12mph]; Patterson and Hardin 1969, Butchkoski and Turner 2005), and due to other issues inherent in tracking animals across varied landscapes (e.g., signal bounce, blocked signals), bearings are often collected that do not cross other bearings (i.e., cannot be triangulated). Thus, usable triangulations are often separated in time, increasing the independence of successive radio locations.

Another limitation of this model is that the number of unique maternity colonies in the dataset was not able to be identified because all roost trees used by each tracked individual were not identified. Mist netting surveys from which data were derived were designed to establish presence or likely absence of Indiana bats; more rigorous study would have been required to determine primary and secondary roost trees and colony membership of tracked individuals. However, because the 17 radio tagged individuals were each tracked to at least 1 roost tree (the average number of roost trees identified per individual was 2; range = 1 to 5 roost trees identified per individual), the sample of roost trees was representative of roosting activity by the entire group. In other words, a small percentage of radio tagged individuals did not account for an unusually high percentage of identified roost trees.

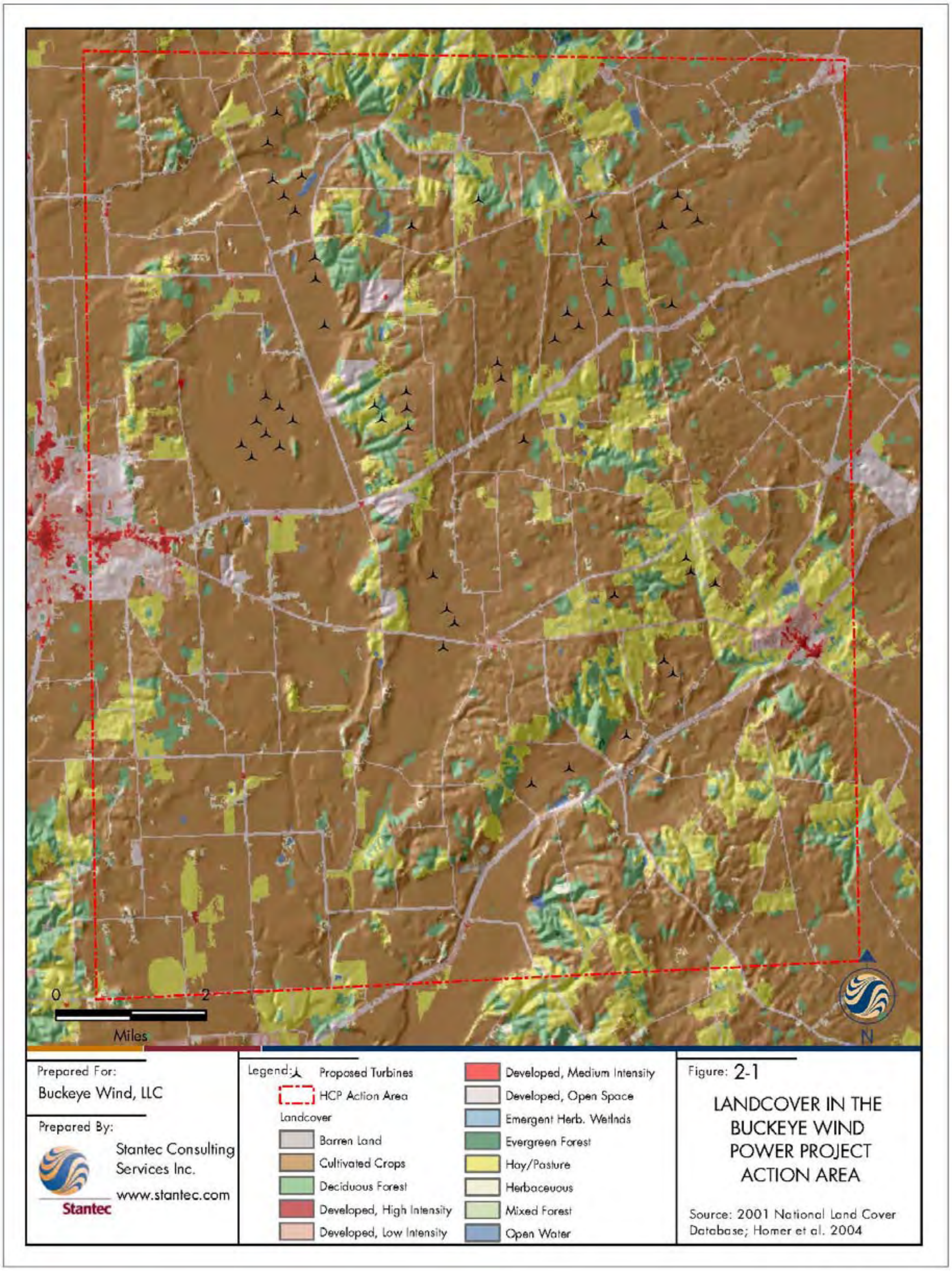
Finally, the accuracy of the model is dependent on the accuracy of the spatial layers used to derive model inputs. Although the most current GIS data was used to develop spatial layers, the resolution and accuracy of some spatial data may have resulted in inaccuracy of model predictions. Because the NLCD (Homer et al. 2001) land cover data that were used had a minimum mapping unit of 30-m (98-ft), habitat features that occupied a smaller area may not have been accurately mapped. For example, tree-lined hedgerows may not have been accurately identified as forested habitat even though they contained deciduous trees. If a radio location were recorded for an Indiana bat that was using such a hedgerow, the GIS analysis would not have accurately identified this individual as occurring at a forest edge; rather, it would be identified as occurring some distance from the nearest forest patch. Because we did not have access to the original data and a ground-based accuracy assessment of the NLCD data was outside of the scope of this assessment, we were not able to identify how often this may have occurred. However, based on a desktop assessment comparing the forested habitat identified in the NLCD dataset to a current (2009) aerial image, the spatial accuracy of mapped forested habitat, even in the case of narrow stream corridors and hedgerows, appeared accurate except in cases where trees became very sparse.

# 2.0 PROJECT AREA DESCRIPTION

The proposed Project will be situated within an area that encompasses approximately 32,395 ha (80,051 ac) within portions of Union, Wayne, Urbana, Salem, Rush, and Goshen Townships in Champaign County, Ohio, hereafter referred to as the "Action Area". The Action Area is characterized by flat and rolling terrain with elevations ranging from 396 to 548 m (1,300 to 1,800 ft) above mean sea level.

## 2.1 Land Cover

The Action Area is comprised largely of active agricultural lands (producing mostly corn and soybean crops), interspersed with scattered stands of deciduous forest (Figure 2-1). Based on the 2001 National Land Cover Database ([NLCD; Homer et al. 2004), the majority (69%) of vegetation in the Action Area is comprised of the *Cultivated Crop* landcover type, 13% is comprised of *Pasture/Hay*, 9% is comprised of *Deciduous Forest*, and 6% is comprised of *Developed Open Spac*e (Homer et al. 2004). Remaining native land cover types, such as *Grassland/Herbaceous* (i.e., old fields, Conservation Reserve Program [CRP] lands) and *Developed, Low Intensity* each makes up approximately 1% of the Action Area, while *Evergreen Forest*, *Mixed Forest*, and *Emergent Herbaceous Wetlands*, each make up 0.1% or less of the Action Area (Table 2-1, Figure 2-1).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HCP Action Area
Landcover
Barren Land
Cultivated Crops
Deciduous Forest
Developed, High Intensity
Developed, Low Intensity
Developed, Medium Intensity
Developed, Open Space
Emergent Herb. Wetlnds
Evergreen Forest
Hay/Pasture
Herbaceuous
Mixed Forest
Open Water
Figure: 2-1
LANDCOVER IN THE BUCKEYE WIND POWER PROJECT ACTION AREA
Source: 2001 National Land Cover Database; Homer et al. 2004

**Table 2-1.** 2001 National Land Cover Database landcover types and size (ha and ac) identified in the Buckeye Project Action Area, Champagne County, OH.

| Landcover type | Hectares | Acres | Percent of action area |
|---|---|---|---|
| Cultivated crops | 22,408 | 55,372 | 69.2% |
| Hay/pasture | 4,163 | 10,287 | 12.9% |
| Deciduous forest | 2,744 | 6,779 | 8.5% |
| Developed, open space | 1,962 | 4,849 | 6.1% |
| Grassland/herbaceous | 445 | 1,099 | 1.4% |
| Developed, low intensity | 422 | 1,042 | 1.3% |
| Open water | 84 | 208 | 0.3% |
| Developed, medium intensity | 55 | 135 | 0.2% |
| Emergent herbaceous wetlands | 40 | 100 | 0.1% |
| Evergreen forest | 31 | 76 | 0.1% |
| Developed, high intensity | 26 | 65 | 0.1% |
| Barren land (rock/sand/clay) | 13 | 33 | <0.1% |
| Mixed forest | 2 | 6 | <0.1% |
| Totals | 32,395 | 80,051 | 100% |

Source: Homer et al. 2004

Based on the 2001 NLCD, there are approximately 766 distinct forest patches in the Action Area[1] that average 3.6 ha ± 10.0 ha (9.0 ac ± 24.7 ac) in size and vary from 0.1 ha to 106.47 ha (0.2 ac to 263.09 ac). Eighty-two percent of the forest patches were 4 ha (10 ac) or smaller and only 2% (n=13) were 40 ha (100 ac) or more. The deciduous forest habitat in the Action Area includes mature stands and early-successional scrub-shrub, primarily bordered by agricultural fields, generally even-aged, and dominated by oaks (*Quercus* spp.), maples (*Acer* spp.), hickories (*Carya* spp.), and ash (*Fraxinus* spp.) as determined during the course of 2008 bat mist-netting surveys in the Action Area (Stantec 2008) and during ground-based habitat assessments conducted by Buckeye Wind in conjunction with the USFWS in November 2010.

## 2.2 Hydrology

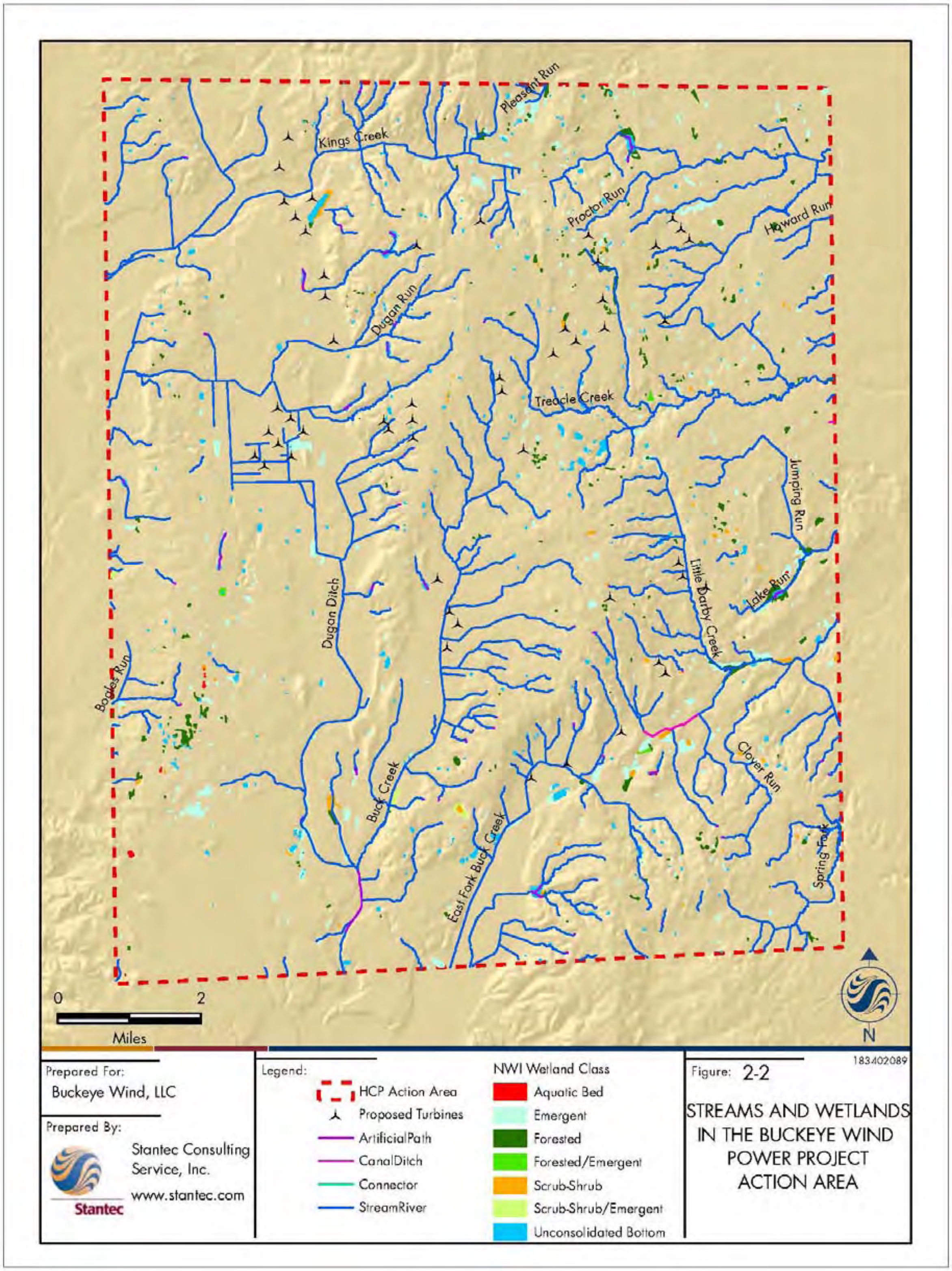
The Action Area lies within the Upper Scioto River and Upper Great Miami River drainages, both of which drain to the Ohio River (USGS 2003). These drainage basins are divided into smaller watersheds and sub-watersheds in the USGS hydrologic classification system in which hydrologic units are divided and sub-divided into successively smaller hydrologic units. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of 2 to 12 (or more) digits based on tiered levels of classification in the hydrologic unit system. Table 2-2 presents the hydrologic units in the Action Area at the watershed and sub-watershed levels. Named perennial streams or ditches within these watersheds include Bogles Run, Buck Creek, Clover Run, Dugan Ditch, Dugan Run, East Fork Buck Creek, Howard Run, Jumping Run, Kings Creek, Lake Run, Little Darby Creek, Pleasant Run, Proctor Run, Spring Fork, and Treacle Creek (Figure 2-2).

[1] Excluding portions of 6 forest patches that only partially overlap the Action Area, totaling 0.4 ha (0.9 ac).

**Table 2-2.** Watersheds and subwatersheds within the Buckeye Wind Project, Champaign County, Ohio[a].

| 12-Digit HUC Number | Watershed (10-digit HUC) | Subwatershed (12-digit HUC) | Streams |
|---|---|---|---|
| 50800011702 | Buck Creek | Headwaters Buck Creek | |
| 50800011705 | Buck Creek | Clarence J Brown Lake-Buck Creek | |
| 50800011701 | Buck Creek | East Fork Buck Creek | |
| 50800011801 | Donnels Creek-Mad River | Moore Run | |
| 50600011902 | Headwaters Big Darby Creek | Spain Creek-Big Darby Creek | |
| 50800011503 | Headwaters Mad River | Kings Creek | |
| 50600012003 | Little Darby Creek | Headwaters Little Darby Creek | Little Darby Creek to Big Darby Creek to Scioto River |
| 50600012001 | Little Darby Creek | Headwaters Treacle Creek | Little Darby Creek to Big Darby Creek to Scioto River |
| 50600012002 | Little Darby Creek | Proctor Run-Treacle Creek | Little Darby Creek to Big Darby Creek to Scioto River |
| 50600012004 | Little Darby Creek | Spring Fork | Little Darby Creek to Big Darby Creek to Scioto River |
| 50800011602 | Nettle Creek-Mad River | Dugan Run | Big Darby Creek to Scioto River |
| 50800011607 | Nettle Creek-Mad River | Bogles Run | Buck Creek to Mad River to Great Miami River |

[a]All watersheds drain into the Ohio River.


Pleasant Run
Kings Creek
Proctor Run
Howard Run
Dugan Run
Treacle Creek
Jumping Run
Dugan Ditch
Little Darby Creek
Lake Run
Bogles Run
Clover Run
Buck Creek
East Fork Buck Creek
Spring Fork
0
2
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Prepared For:
Buckeye Wind, LLC
Prepared By:
Stantec Consulting Service, Inc.
www.stantec.com
Stantec
Legend:
HCP Action Area
Proposed Turbines
ArtificialPath
CanalDitch
Connector
StreamRiver
NWI Wetland Class
Aquatic Bed
Emergent
Forested
Forested/Emergent
Scrub-Shrub
Scrub-Shrub/Emergent
Unconsolidated Bottom
183402089
Figure: 2-2
STREAMS AND WETLANDS IN THE BUCKEYE WIND POWER PROJECT ACTION AREA

The Action Area also contains a number of wetlands identified in the National Wetlands Inventory (NWI) database that was updated based on current (2005 to 2007) aerial photos by Ducks Unlimited (DU) in 2009 in draft format (DU 2009; Table 2-3). The DU update to the NWI database was recommended for use by the ODNR as the most accurate source for wetlands information in Ohio at the desktop level (Keith Lott, ODNR, personal communication). The largest wetland in the Action Area is a 10.0 ha (24.7 ac) palustrine (i.e., non-tidal, inland wetland which lacks flowing water), emergent, seasonally flooded wetland located in the west central portion of the Action Area (Figure 2-2). The largest open water wetland is a 9.2 ha (22.7 ac) lacustrine/limnetic (i.e., freshwater lake or pond), unconsolidated bottom, permanently flooded, excavated pond in the northwest portion of the Action Area.

**Table 2-3.** Description and total area (ac and ha) of NWI wetland categories identified in the Buckeye Wind Project Action Area by the Ducks Unlimited 2009 update to the National Wetlands Inventory database.

| NWI System/Class Code | Wetland description | Acres | Hectares |
|---|---|---|---|
| PAB | Palustrine Aquatic Bed | 11.4 | 4.6 |
| PEM | Palustrine Emergent | 718.3 | 290.7 |
| PFO | Palustrine Forested | 377.2 | 152.6 |
| PFO/PEM | Palustrine Forested/Emergent | 12.0 | 4.9 |
| PSS | Palustrine Scrub-Shrub | 106.3 | 43.0 |
| PSS/PEM | Palustrine Scrub-Shrub/Emergent | 21.1 | 8.6 |
| PUB | Palustrine Unconsolidated Bottom | 383.1 | 155.0 |
| L1UB | Lacustrine/Limnetic Unconsolidated Bottom | 22.7 | 9.2 |
| Total | | 1652.2 | 668.6 |

## 2.3 Indiana Bat Distribution In and Near the Action Area

Although the summer distribution of Indiana bats has historically been poorly documented, recent summer mist netting efforts in OH related to pre-permitting activities for proposed wind power projects have resulted in a number of newly documented Indiana bat maternity colonies in previously undocumented portions of their summer range (M. Seymour, USFWS, personal communication). Indiana bat summer records in western OH were known from Greene, Montgomery, Miami, and Preble Counties prior to 2008. Additional summer reproductive records were documented in Champaign, Hardin, and Logan Counties, OH (hereafter "tri-county area") in 2008 and 2009.

Based on data provided by the ODNR, 26 Indiana bats (24 adult females and 2 adult males) were captured during pre-construction mist netting surveys for various proposed wind power projects (including the proposed Project) in the tri-county area (Stantec 2008, K. Lott, ODNR, personal communication). Of these 26 Indiana bats, 19 (17 females and 2 males) were radio-tagged and 17 (15 females and 2 males) were successfully tracked to 36 day-roost trees. Seven additional day-roost locations were estimated using triangulation, for a total of 43 day-roost locations. A total of 1,124 radio telemetry locations were collected for the 19 radio-tagged bats. Refer to Section 4.2.2 of the HCP for additional information on Indiana bats in the Action Area and tri-county area.

## 3.0 METHODS

### 3.1 Environmental Variables

Research has shown that the spatial relationships of forest habitat, water resources, and topography are important predictors of Indiana bat habitat (Menzel et al. 2001, Carter 2002). Using the 2001 National Land Cover Database (NLCD; Homer et al. 2004), we assessed forest class and landscape variables produced by FRAGSTATS (McGarigal et al. 2002) for their ability to discriminate areas of expected Indiana bat presence in the Action Area. Environmental variables were measured within a 2-km (1.2-mi) buffer of each 30-m pixel in the Action area, based on the average distance (mean ± standard deviation [SD]; 1.1 km ± 0.9 km [0.7 mi ± 0.5 mi]) between roost trees and foraging locations identified for 17 radio-tagged Indiana bats (n=15 females, n= 2 males) captured in the tri-county area in 2008 and 2009. Forty-three roost tree and 1,124 telemetry locations were collected for the 17 bats during pre-construction mist netting surveys for various proposed wind power projects (including the proposed Project).

We used a Geographic Information System (GIS) to consider 13 environmental variables thought to influence Indiana bat habitat selection (see Table 3-1), based on literature review and professional judgment. These environmental variables include forest patch attributes related to size, connectivity to other wooded areas, amount of forest edge, percentage of the landscape, and dispersion across the landscape. Each pixel in the Action Area was also evaluated for its distance to the nearest forest edge or water resource (stream, wetland, or forested stream). Although there is overlap within distance to streams, forested streams, wetlands, and forest, all were included in the analysis because we did not know which of these measures would be most discriminating, and because they were developed from different data sources. The Mahalanobis $D^2$ approach scales deviations by the variance-covariance matrix, thereby standardizing variables and incorporating their correlations (Rotenberry et al. 2002). We used Shannon's diversity index to measure the overall heterogeneity in the landscape; elevation and slope were used to assess vertical relief (Table 3-1).

**Table 3-1**. Environmental variables used in Habitat Suitability Model for Indiana bats at the Buckeye Wind Power Project in Champaign County, Ohio.

| Variable (abbreviation) | Unit | Description (data source) |
|---|---|---|
| Forest patch area (AREA_MN)[a] | ha | Mean patch area of forest (codes 41, 42, and 43 in 2001 National Land Cover Database [NLCD; Homer et al. 2004]; 30-m resolution) within 2-km buffer |
| Patch cohesion index (COHSN)[a] | – | Cohesion of forest patches (codes 41, 42, and 43 in 2001 NLCD) within 2-km buffer |
| Elevation (ELEV) | m | Elevation (30-m digital elevation model - DEM; National Elevation Dataset [Gesch et al. 2009]) |
| Euclidean nearest neighbor (ENN_AM)[a] | m | Area-weighted mean distance to the nearest neighboring forest patch (codes 41, 42, and 43 in 2001 NLCD) |
| Distance to forest (FOR_D) | m | Distance to nearest forest pixel (codes 41, 42, and 43 in 2001 NLCD) |
| Distance to forested stream (FORSTRM_D) | m | Distance to nearest stream (high resolution linear water features; National Hydrography Dataset [Simley and Carswell 2009]) intersecting forest pixels (codes 41, 42, and 43 in 2001 NLCD) |
| Perimeter-area ratio (PARA_AM)[a] | – | Perimeter to area ratio (area-weighted) of forest patches (codes 41, 42, and 43 in 2001 NLCD) within 2-km buffer |
| Percentage of landscape (PLAND)[a] | percent | Percentage of 2-km buffer comprised of forest patches (codes 41, 42, and 43 in 2001 NLCD) |
| Shannon's diversity index (SHDI)[a] | – | Proportional abundance of forest patches (codes 41, 42, and 43 in 2001 NLCD) within 2 km buffer |
| Slope (SLP) | degrees | Slope (derived from 30-m DEM) |
| Distance to stream (STRM_D) | m | Distance to nearest stream (high resolution linear water features; National Hydrography Dataset [Simley and Carswell 2009]) |
| Total core area (TCA)[a] | ha | Amount of forest (codes 41, 42, and 43 in 2001 NLCD) core area (defined by 100-m threshold from forest edge) within 2-km buffer |
| Distance to wetland (WET_D) | m | Distance to nearest wetland (National Wetlands Inventory [NWI] updated by Ducks Unlimited [2009]) |

[a] Analyzed using FRAGSTATS (McGarigal et al. 2002)

### 3.2 Presence Data Set

The ODNR provided Stantec with values of environmental variables measured at each of the 43 identified Indiana bat roost trees and 1,124 telemetry points used in the model. Field methods used to derive these data varied and were conducted by multiple environmental consultants during 2008 and 2009. We prepared predictive models for foraging telemetry and roost tree data set separately for the following reasons:

1. Sample size was significantly larger for the telemetry dataset.

2. While roost trees can occur in foraging habitat, not all foraging occurs in roosting habitat. With unequal sample sizes, a model containing both data types would not properly identify potential roosting habitat.
3. There was disparity in the level of accuracy associated with roost and telemetry locations. Error is an inherent part of telemetry data and no consistent error estimation method was applied to telemetry data. However, there is much less or no error associated with roost tree locations because the presence of the tree is confirmed based on visual confirmation of the emerging radio-tagged bat.

### 3.3 Standard and Partitioned Mahalanobis $D^2$ Models

The standard Mahalanobis $D^2$ method measures the spatial distance between a vector of environmental variables measured at unsampled locations and the mean vector of the same environmental variables derived from all occupied locations (Clark et al. 1993a, Dunn and Duncan 2000, Rotenberry et al. 2002, Browning et al. 2005, Rotenberry et al. 2006). This distance is measured as (Rotenberry et al. 2002):

$$D^2(\boldsymbol{y}) = (\boldsymbol{y} - \boldsymbol{\mu})' \boldsymbol{\Sigma}^{-1} (\boldsymbol{y} - \boldsymbol{\mu})$$

where

**H** = a matrix of *p* variables measured at *n* points where a species was detected;
$\boldsymbol{y}$ = a $p$ X 1 vector of measurements on any point (occupied or unsampled);
$\boldsymbol{\mu}$ = a $p$ X 1 vector of mean measurements derived from **H;**
$\boldsymbol{y} - \boldsymbol{\mu}$ = a vector of deviations between a point and the mean vector;
$\boldsymbol{\Sigma}^{-1}$ = the inverse of the variance-covariance matrix of **H;**
$D^2$ = the squared standardized distance.

Thus, any location can be defined by its distance from the average environmental conditions associated with occupied Indiana bat habitat. As the distance between the vector at a location and the mean vector increases, the habitat at the location becomes less suitable.

This measurement of a standard $D^2$ assumes that **H**, the matrix derived from occupied locations, includes the full range of habitat variation in which the species can be found and that no unnecessary variables are included (Rotenberry et al. 2002, Browning et al. 2005, Rotenberry et al. 2006). In essence, we assume that **H** represents an optimum range of habitat configurations. These assumptions are not violated when the landscape from which **H** was derived is the same landscape where suitability is to be estimated (Rotenberry et al. 2002). However, these assumptions are often violated when the model is applied to areas not included in the original sample, or in changing landscapes (Rotenberry et al. 2002). It is also possible to violate the assumptions of the model if the selected environmental conditions are not truly representative of variables that influence species presence.

The standard $D^2$ model considers all habitat characteristics equally and limits suitability based on the average values of each variable in the model; it compares all points in a landscape to an *optimum* set of conditions. However, within a group of occupied sites, some environmental measures may remain relatively constant across all locations, while other measures are highly variable. Characteristics that are highly variable are less likely to be informative because they seemingly do not restrict species distribution in any way. Conversely, characteristics that are relatively constant across occupied sites presumably indicate features that are important to the species (Rotenberry et al. 2002, Rotenberry et al. 2006).

Rotenberry et al. (2002) presented a partitioned Mahalanobis $D^2$ model as an alternative to the standard Mahalanobis $D^2$ model. The partitioned $D^2$ model gives more weight to those characteristics that are constant across occupied sites, while allowing variation to occur for the remaining variables; it compares all points in a landscape to a basic, or *minimum* set of habitat requirements. Characteristics which are constant across occupied sites are thought to be more limiting to a species distribution and thus more informative (Rotenberry et al. 2002). Instead of measuring the distance between the vector at an unsampled location and the mean vector, as in the standard $D^2$ method, the partitioned $D^2$ distance is measured to a vector of minimum habitat characteristics, which restricts variability for important variables and allows flexibility for the remaining, less important variables.

For a species to occur at a given location (or point), the partitioned $D^2$ model assumes that the values of some combination of a subset of environmental variables measured at that point satisfies the basic requirements for the species. Using a principal components analysis (PCA), the standard $D^2$ distance can be partitioned into separate components, each explaining an incrementally smaller amount of variability in the model (Rotenberry et al. 2002):

$$D^2(\boldsymbol{y}) = d_j^2/\lambda_j + \ldots + d_k^2/\lambda_k + \ldots + d_p^2/\lambda_p$$

where

$d_j$ = the difference between a point and the mean vector $(\boldsymbol{y} - \boldsymbol{\mu})$ multiplied by the eigenvector associated with the *jth* component; and

$\lambda_j$ = the eigenvalue associated with the *jth* component.

The number of components produced by the PCA is equal to *p*, the total number of variables used in the model. Each component contains a vector of coefficients ("eigenvector"). The number of coefficients in each eigenvector is also equal to *p*, the total number of variables used in the model; thus, the sum ("linear combination") of each coefficient in the eigenvector multiplied by the value of its corresponding environmental variable measured at that location will return a partial $D^2$ distance. Within each component, the absolute value of each coefficient ("eigenvector values") indicates how important each variable is, with larger absolute values indicating more important variables.

In addition, each component has an associated "eigenvalue" (the amount of variability explained by the eigenvector). Each component is numbered 1 through *p*, with the first principal component ("PC 1") explaining the most variability and the last component ("PC *p*") explaining the least amount of variability. Environmental variables that are constant among occupied points, and therefore are assumed to represent basic habitat requirements, are emphasized in the last components (those explaining the least amount of variability). These variables will have the largest eigenvector values in components with the smallest eigenvalues. Environmental variables that exhibit a wide range of variability across occupied points are emphasized in the first components with the largest eigenvalues; i.e., they have the largest eigenvector values in components with the largest eigenvalues.

The partitioned distances are additive with the sum of all components equal to the standard $D^2$ measurement (Rotenberry et al. 2006). However, for the partitioned $D^2$ model, only a subset (or *k*, where $1 \leq k \leq p$) of components with the smallest eigenvalues are included in the sum, such that the predicted suitability emphasizes the most important (i.e., most constant) variables within each included component. Including only the components with the smallest eigenvalues (those explaining the least amount of variability) allows for less important variables to be included in the model, but have only a minimal effect on the prediction of suitable habitat (Rotenberry et al. 2002, Rotenberry et al. 2006).

$D^2$ values can range from zero to near infinity, and therefore are difficult to interpret. However, a $D^2$ distribution approximates a chi-squared ($\chi^2$) distribution, and can therefore be scaled to range between 0 and 1(Rotenberry et al. 2002):

$$\text{p-value for } D^2(\boldsymbol{y};\boldsymbol{k}) = 1 - \text{prob}\left(\chi^2_{(p+1-k)}\right)$$

Resulting "p-values" can be interpreted as the probability that a given location represents suitable habitat, with a value of 1 representing environmental conditions identical to those measured at occupied sites.

## 3.4 Model Development

We conducted a PCA on the correlation matrix derived from $p$ = 13 possible environmental variables (Table 3-1) measured at telemetry (n = 1,124) and roosting (n = 43) locations. We used SAS procedure PRINCOMP (SAS Institute Inc., Cary, North Carolina) to generate eigenvalues and eigenvectors. We considered variables with the highest absolute eigenvector value in the last component to be the most important habitat characteristics for each dataset (Dunn and Duncan 2000). Since a low ratio of observations to variables can result in an overfitted model (Rotenberry et al. 2006) and the roost tree dataset had a lower number of observations (n=43), we reduced the number of variables in the roosting model by selecting the top-ranking variables in the last component of the full, 13-variable model for further analysis. There is no quantitative way to determine the cut-off between important and unimportant variables (Rotenberry et al. 2006). However, there is often a demarcation between zero and nonzero eigenvector values (Dunn and Duncan 2000), which can be used to select variables by graphing the eigenvector values in the last component and noting the change in slope of the resulting line. We assumed that variables above the demarcation point were the best variables to use for the roosting habitat model.

We used SAS procedure SCORE to calculate linear combinations of the vector of environmental variables measured at each 30-m pixel in the Action Area and each eigenvector produced in the PCA. Using a SAS macro (Dunn and Duncan 2000, Rotenberry et al. 2006), we squared each linear combination and divided by the appropriate eigenvalue to calculate $p$ partitioned $D^2$ distances for each pixel. Starting with the partitioned $D^2$ associated with the smallest eigenvalue, then the 2 smallest, then the 3 smallest, and so on, we sequentially summed partitioned $D^2$ values. When all partitioned $D^2$ values were included in the sum, the result was the standard $D^2$ value for the pixel. We rescaled $D^2(\boldsymbol{y};\boldsymbol{k})$ values into p-values using a $\chi^2$distribution with $p + 1 - k$ degrees of freedom.

Choosing $k$, or the number of components to include in the calculation of a partitioned $D^2$ distance, is a subjective process (Dunn and Duncan 2000, Rotenberry et al. 2006). We assessed the magnitude and relative spacing of eigenvalues, and the success of the model in predicting areas of presence (Dunn and Duncan 2000) to choose $k$. We used 4 techniques for choosing $k$ in order to create predictive maps for the telemetry and roost tree data sets:

1. All components (standard $D^2$ distance; the most restrictive model);
2. Only components with eigenvalues less than 1 (Rencher 2002);
3. Only components with eigenvalues below a demarcation point (Dunn and Duncan 2000); and
4. Only the last component (the least restrictive model).

Model outcomes for $k$ components were imported into ArcMap 9.2 (Environmental Systems Research Institute, Redlands, CA). Models were evaluated based on site-specific knowledge of likely Indiana bat use of the area from mist netting surveys and Indiana bat habitat assessments conducted by Stantec in association with U.S. Fish and Wildlife Service (USFWS) biologists in the Action Area in 2008. Although Stantec was not provided with the specific locations of all roost and telemetry locations, the preparers of this document were familiar with their general locations based on ongoing consultation with the ODNR and USFWS from 2008 to 2010. Using this site-specific knowledge, we qualitatively assessed p-values at known Indiana bat locations in order to evaluate how well each model performed.

The full range of $\chi^2$ values was converted into quartiles[2] (Meinke et al. 2009), which resulted in 4 categories that represented most to least suitable habitat for Indiana bat roosting and foraging activities. The final roosting and foraging (telemetry) models were combined into a single predictive map by retaining the highest suitability category assigned to each pixel in either predictive map when a discrepancy occurred.

Turbines were each assigned a risk category based on their location relative to the 4 habitat suitability categories in the final predictive map of the Action Area. Category 1 represented the most suitable habitat for Indiana bats, while Category 4 represented the least suitable habitat for Indiana bats during the summer maternity season.

# 4.0 RESULTS

## 4.1 Roost Tree and Foraging Locations Relative to Forested Habitat

Roosts were located in 21 forest stands (only 6 roost trees were not located within a forest stand), with an average patch size of 100.5 ha ± 71.8 ha (248.3 ac ± 177.4 ac]; range 4.0 ha to 197.6 ha [9.9 ac to 488.3 ac]). The average forest stand size in the general tri-county (Champaign, Logan, Hardin) area was 4.2 ha ± 13.9 ha (10.4 ac ± 34.3 ac; range 0.1 ha to 360.4 ha [0.2 ac to 890.6 ac]). Similarly, the proportion of forested habitat within the 2-km buffer area surrounding roost locations was 23% ± 8% compared to an average of 9% for the tri-county area as a whole. The majority (30 roosts or 70%) were located within 182.9 m (600 ft) of a stream, within 182.9 m (600 ft) of a wetland (74%), and within 182.9 m (600 ft) of a forest associated with a stream (70%).

All roosts, whether located within or outside a forest patch, were located within 182.9 m (600 ft) of the nearest forest stand edge. The average distance from nighttime foraging locations to a forest edge was 60 m ± 110 m (198 ft ± 361 ft), which includes foraging distances from within or beyond the forest stand (Figure 4-1). Thus, 85% of telemetry locations were <170 m (559 ft; mean + 1 SD) from a forest patch edge. All 1,124 telemetry locations were within 701 m (2,300 ft) of a forest edge.

## 4.2 Environmental Variables Selected

Mahalanobis $D^2$ distances were calculated for every 30-m pixel in the Action Area. Seven FRAGSTATS variables (AREA_MN, COHSN, ENN, PARA, PLAND, SHDI, TCA; Table 3-1) were measured across the 2-km buffer surrounding each 30-m pixel. Six additional variables summarizing distances to several landscape elements (FOR_D, FORSTRM_D, STRM_D, WET_D; Table 3-1) and topographic features (ELEV, SLP; Table 3-1) were measured for each individual pixel in the Action Area.

All 13 environmental variables listed above were used in the foraging habitat model. Since a low ratio of observations to variables leads to an overfitted model (Rotenberry et al. 2006) and the roost tree data set

[2] A quartile is one of three points that divide a data set into four equal groups, each representing a fourth of the distributed sampled population.

had only 43 roost trees, the number of variables was reduced in the roosting habitat model. We identified the most important variables by first running a PCA with all 13 variables included, and selecting those variables which were most consistent across known locations. There were 7 variables in the last component with eigenvector values above a demarcation point: AREA_MN, COHSN, ELEV, FORSTRM_D, FOR_D, SHDI, and STRM_D.

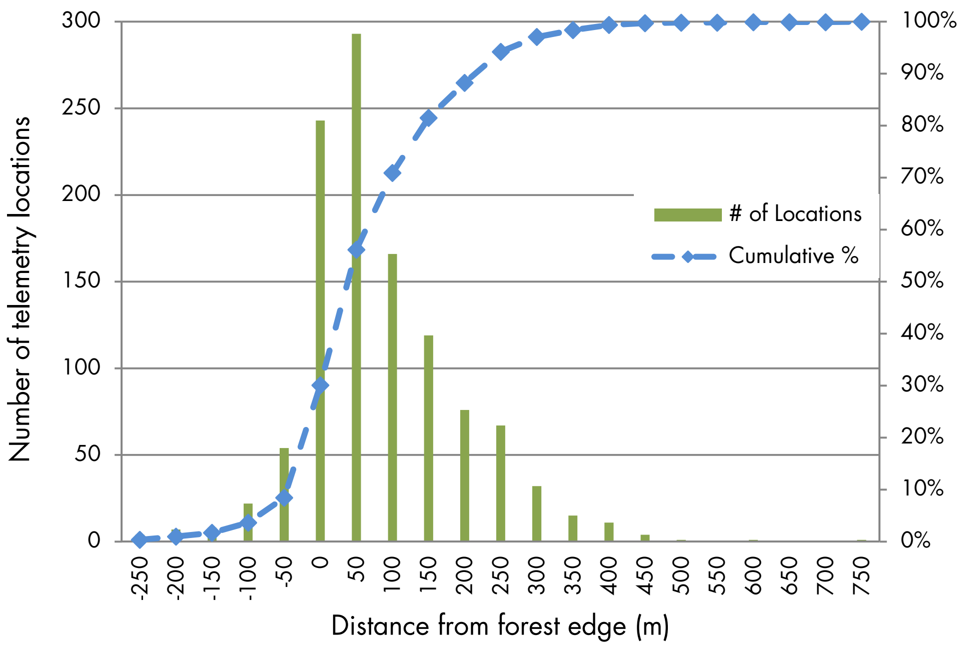



**Figure 4-1**. Number of telemetry locations within 50-m distance bins of the forest edge. Note negative distances indicate telemetry locations within a forest patch; positive distances inidicate locations outside of a forest patch.

## 4.3 Foraging Habitat Suitability Model

Results from the PCA analysis of 13 environmental variables measured at 1,124 telemetry points (Table 4-1) indicated that the first 3 principal components explained more than two-thirds (69.5%) of the total variation in the telemetry dataset (Table 4-2). The degree of forest fragmentation (PARA_AM) and the connectedness of forest patches (COHSN) were the 2 most important variables in the last component (with the highest absolute eigenvalues in the eigenvector), followed in order of importance by total core area (TCA), Shannon's diversity index (SHDI), forest patch area (AREA_MN), distance to forested stream (FORSTRM_D), percentage of landscape (PLAND), elevation (ELEV), distance to wetland (WET_D), distance to stream (STRM_D), distance to forest (FOR_D), Euclidean nearest neighbor (ENN_AM), and slope (SLP) (Table 4-3). The last 6 components (principal components [PCs] 6 through 13) had eigenvalues < 1; the same components had eigenvalues below a demarcation point (Table 4-2). We created predictive maps using PCs 1-13 ($D^2_{(k=13)}$), PCs 6-13 ($D^2_{(k=8)}$), and PC 13 ($D^2_{(k=1)}$). We selected the partitioned $D^2$ map using PCs 6-13 for the final foraging suitability model (Figure 4-2[3]); this model predicted high suitability at the most known roosting and foraging locations, as well as areas suspected of potential habitat.

[3] The grey area in the southwest corner of the map, that also occurs in subsequent suitability maps, is a byproduct of the spatial analysis process and results from not having data from one or more of the environmental variable data layers in that area.

**Table 4-1**. Mean and standard deviations (SD) for 13 environmental variables measured at 1,124 Indiana bat telemetry points in Champaign, Logan, and Hardin Counties, Ohio, 2008-2009

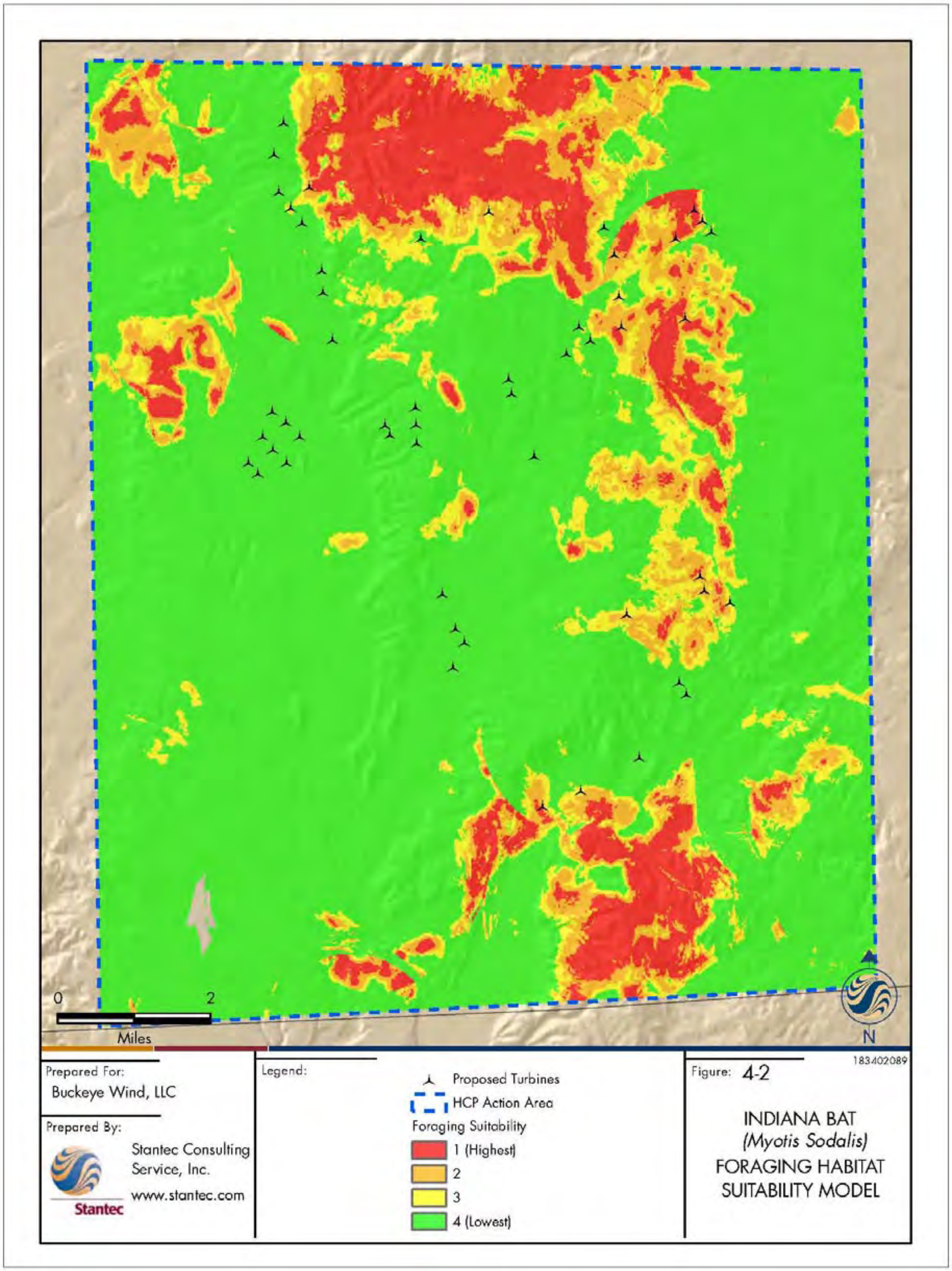
| Variable | Mean | SD |
|---|---|---|
| Forest patch area (AREA_MN) | 11.48 | 6.23 |
| Patch cohesion (COHSN) | 94.50 | 2.79 |
| Elevation (ELEV) | 376.48 | 29.63 |
| Euclidean nearest neighbor (ENN_AM) | 104.28 | 36.63 |
| Distance to forested stream (FORSTRM_D) | 295.63 | 216.52 |
| Distance to forest (FOR_D) | 86.80 | 98.26 |
| Perimeter to area ratio (PARA) | 212.46 | 52.78 |
| Percentage of landscape (PLAND) | 23.72 | 7.56 |
| Shannon's Diversity Index (SHDI) | 1.14 | 0.14 |
| Slope (SLP) | 2.84 | 2.50 |
| Distance to stream (STRM_D) | 192.64 | 163.59 |
| Total core area (TCA) | 66.45 | 48.88 |
| Distance to wetland (WET_D) | 205.40 | 139.55 |

**Table 4-2**. Results of principal components analysis of 13 environmental variables measured at 1,124 Indiana bat telemetry points in Champaign, Logan, and Hardin Counties, Ohio 2008-2009.

| Principal Component (PC) | Eigenvalue | Proportion of total variance |
|---|---|---|
| 13 | 0.026 | 0.002 |
| 12 | 0.05 | 0.004 |
| 11 | 0.076 | 0.006 |
| 10 | 0.088 | 0.007 |
| 9 | 0.221 | 0.017 |
| 8 | 0.314 | 0.024 |
| 7 | 0.396 | 0.03 |
| 6 | 0.637 | 0.049 |
| 5 | 1.035 | 0.08 |
| 4 | 1.122 | 0.086 |
| 3 | 1.42 | 0.109 |
| 2 | 2.095 | 0.161 |
| 1 | 5.522 | 0.425 |

**Table 4-3**. Eigenvectors for principal components 6 through 13 using 13 environmental variables measured at 1,124 Indiana bat telemetry points in Champaign, Logan, and Hardin Counties, Ohio, 2008-2009. Results for principal components 1 through 5 are not shown. Bold values indicate the most important variables.

| Variable | PC 6<br>k 8 | PC 7<br>k 7 | PC 8<br>k 6 | PC 9<br>k 5 | PC 10<br>k 4 | PC 11<br>k 3 | PC 12<br>k 2 | PC 13<br>k 1 |
|---|---|---|---|---|---|---|---|---|
| Forest patch area (AREA_MN) | 0.019 | 0.237 | 0.055 | 0.192 | 0.407 | 0.721 | 0.054 | -0.133 |
| Patch cohesion (COHSN) | 0 | 0.091 | 0.007 | 0.168 | 0.489 | 0.18 | 0.332 | **0.623** |
| Elevation (ELEV) | 0.323 | 0.162 | 0.775 | 0.022 | 0.017 | 0.019 | 0.145 | -0.051 |
| Euclidean nearest neighbor (ENN_AM) | 0.018 | 0.693 | 0.236 | 0.101 | 0.077 | 0.132 | 0.213 | 0.013 |
| Distance to forested stream (FORSTRM_D) | 0.059 | 0.062 | 0.282 | 0.633 | 0.228 | 0.115 | 0.007 | 0.079 |
| Distance to forest (FOR_D) | 0.657 | 0.029 | 0.104 | 0.359 | 0.031 | 0.038 | 0.01 | -0.015 |
| Perimeter to area ratio (PARA_AM) | 0.023 | 0.131 | 0.112 | 0.101 | 0.451 | 0.109 | 0.046 | **0.68** |
| Percentage of landscape (PLAND) | 0.021 | 0.053 | 0.026 | 0.056 | 0.417 | 0.535 | 0.577 | -0.061 |
| Shannon's Diversity Index (SHDI) | 0.032 | 0.565 | 0.006 | 0.118 | 0.318 | 0.077 | 0.015 | -0.167 |
| Slope (SLP) | 0.451 | 0.066 | 0.381 | 0.053 | 0.036 | 0.004 | 0.004 | -0.013 |
| Distance to stream (STRM_D) | 0.389 | -0.09 | -0.17 | 0.591 | 0.169 | 0.062 | 0.034 | -0.034 |
| Total core area (TCA) | 0.051 | 0.256 | 0.111 | 0.086 | 0.165 | 0.328 | 0.696 | **0.297** |
| Distance to wetland (WET_D) | 0.317 | 0.078 | 0.224 | 0.091 | 0.034 | 0.008 | 0.004 | -0.038 |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INDIANA BAT
(Myotis Sodalis)
FORAGING HABITAT
SUITABILITY MODEL

## 4.4 Roosting Habitat Suitability Model

Results from the PCA analysis of 7 environmental variables measured at 43 Indiana bat roost locations (Table 4-4) indicated that the first 2 principal components explained more than two-thirds (70.5%) of the total variation in the dataset (Table 4-5). The distance to forested streams (FORSTRM_D) and the distance to streams (STRM_D) were the two most important variables in the last component (with the highest absolute eigenvalues in the eigenvector), followed in order of importance by distance to forest (FOR_D), Shannon's diversity index (SHDI), forest patch area (AREA_MN), patch cohesion index (COHSN), and elevation (ELEV) (Table 4-6).

The last 4 components (PCs 4 through 7) had eigenvalues less than 1; the same components had eigenvalues below a demarcation point (Table 4-5). We created predictive maps using PCs 1-7 ($D^2_{(k=7)}$), PCs 4-7 ($D^2_{(k=4)}$), and PC 7 ($D^2_{(k=1)}$). We selected the partitioned $D^2$ map using PCs 4-7 for the final roosting suitability model (Figure 4-3); this model predicted high suitability at the most known roosting locations, as well as areas suspected of potential habitat.

**Table 4-4**. Mean and standard deviations (SD) for 7 environmental variables measured at 43 Indiana bat roosts in Champaign, Logan, and Hardin Counties, Ohio, 2008-2009.

| Variable | Mean | SD |
|---|---|---|
| Forest patch area (AREA_MN) | 12.37 | 5.42 |
| Patch cohesion (COHSN) | 95.15 | 2.77 |
| Elevation (ELEV) | 362.65 | 29.44 |
| Distance to forested stream (FORSTRM_D) | 179.99 | 204.69 |
| Distance to forest (FOR_D) | 11.99 | 31.78 |
| Shannon's Diversity Index (SHDI) | 1.04 | 0.21 |
| Distance to stream (STRM_D) | 155.80 | 180.14 |

**Table 4-5**. Results of PCA analysis of 7 environmental variables measured at 43 Indiana bat roosts in Champaign, Logan, and Hardin Counties, Ohio, 2008-2009.

| Principal Component (PC) | Eigenvalue | Proportion of total variance |
|---|---|---|
| 7 | 0.008 | 0.001 |
| 6 | 0.067 | 0.010 |
| 5 | 0.304 | 0.043 |
| 4 | 0.560 | 0.080 |
| 3 | 1.127 | 0.161 |
| 2 | 1.564 | 0.223 |
| 1 | 3.371 | 0.482 |

**Table 4-6**. Eigenvectors for principal components 4 through 7 using 7 environmental variables measured at 43 Indiana bat telemetry points in Champaign, Logan, and Hardin Counties, Ohio, 2008-2009. Results for principal components 1 through 3 are not shown. Bold values indicate the most important variables.

| Variable | PC 4<br>k 4 | PC 5<br>k 3 | PC 6<br>k 2 | PC 7<br>k 1 |
|---|---|---|---|---|
| Forest patch area (AREA_MN) | 0.653 | 0.32 | -0.447 | -0.065 |
| Patch cohesion (COHSN) | 0.165 | -0.098 | 0.798 | 0.05 |
| Elevation (ELEV) | -0.434 | 0.588 | -0.057 | 0.023 |
| Distance to forested stream (FORSTRM_D) | 0.149 | -0.041 | 0.092 | **-0.714** |
| Distance to forest (FOR_D) | 0.561 | 0.143 | 0.23 | 0.088 |
| Shannon's Diversity Index (SHDI) | -0.007 | -0.712 | -0.307 | -0.067 |
| Distance to stream (STRM_D) | 0.147 | -0.112 | -0.062 | **0.686** |

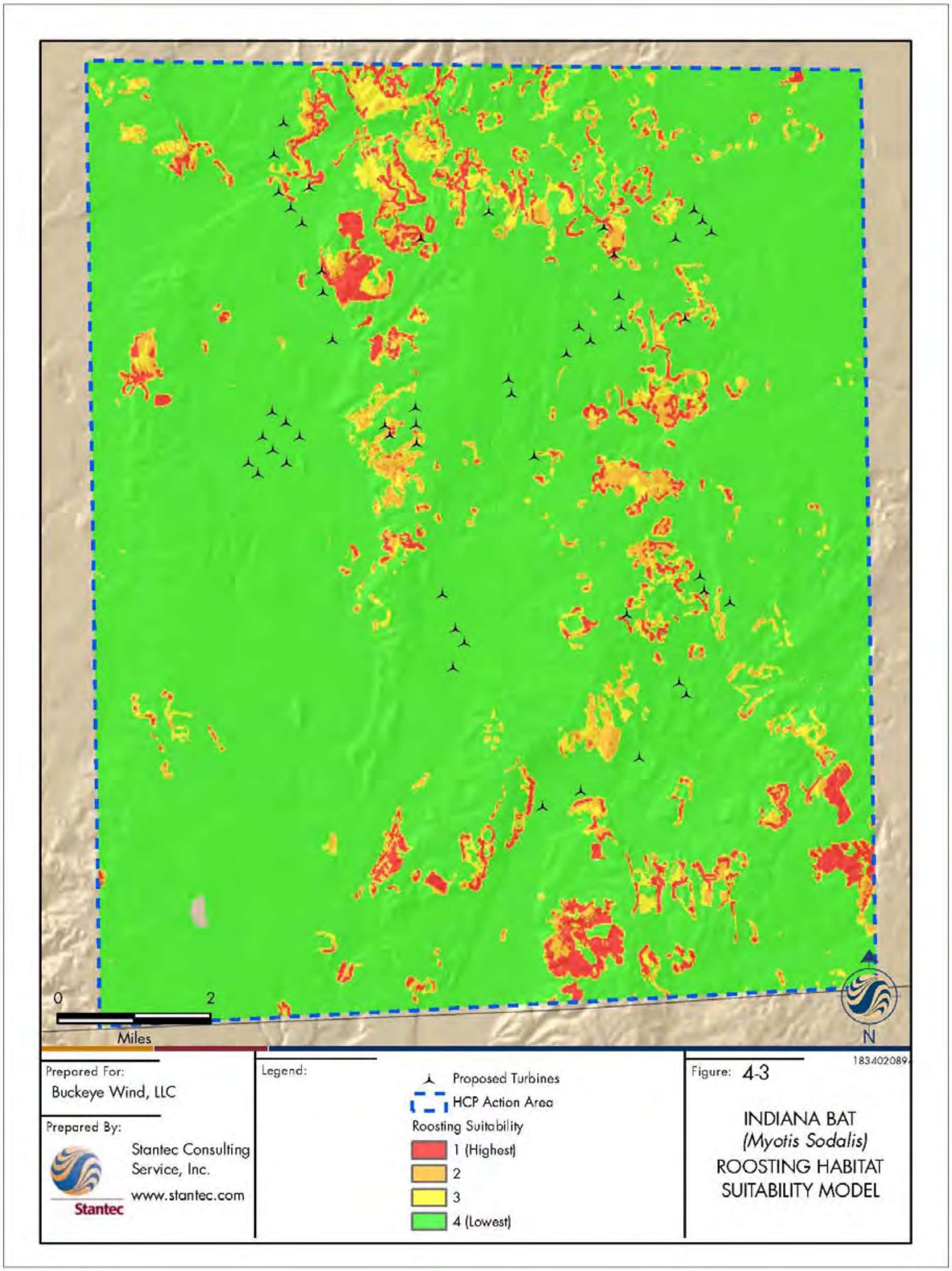
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Figure: 4-3
INDIANA BAT
(Myotis Sodalis)
ROOSTING HABITAT
SUITABILITY MODEL

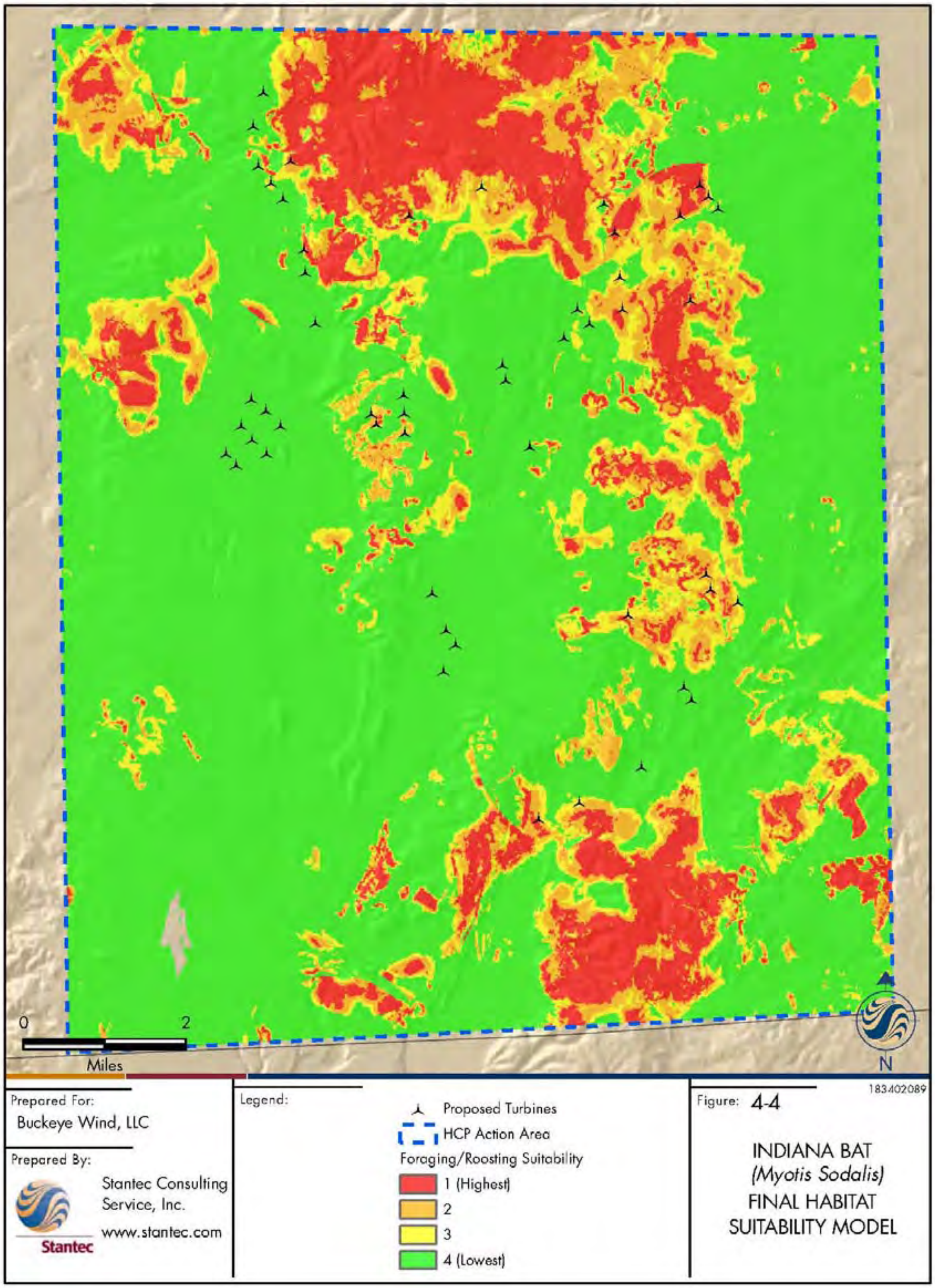
## 4.5 Final Habitat Suitability Model

The roosting and foraging (telemetry) models were combined into a single predictive map by retaining the highest suitability category assigned to each pixel in either predictive map when a discrepancy occurred (Figure 4-4). The roosting model classified 3% of the Action Area as having the highest roosting suitability, and the foraging model classified 10% of the Action Area as having the highest roosting suitability. While some areas ranked high for both roosting and foraging, most suitable habitat did not overlap between the two predictive maps. Therefore, when combined, 12% of the Action Area (4,016.1 ha [9,923.9 ac]) was categorized as having the highest suitability for Indiana bat roosting and foraging activities (Table 4-7).

Indiana bat foraging habitat suitability was strongly associated with the configuration and spatial relationships of forested patches; the 3 most important variables in the foraging habitat model were the degree of forest fragmentation (PARA_AM), the connectedness of forest patches (COHSN), and the total core area of forested habitat (TCA). The habitat diversity (SHDI), the amount of forested area (AREA_MN), and the distance to forested streams (FORSTRM_D) were also relatively important. This differed somewhat from roosting habitat suitability, which was driven largely by distance to forested streams (FORSTRM_D), distance to streams (STRM_D), and distance to the nearest forest edge (FOR_D), which were the 3 most important variables. Similar to foraging habitat suitability, habitat diversity (SHDI) and amount of forest area (AREA_MN) were also relatively important. When considering both foraging and roosting suitability, the spatial arrangement of forest patches, proximity to water sources, and amount of forested area were the most important habitat components.

Based on the 2001 NLCD, there are approximately 766 distinct forest patches in the Action Area[4] that average 3.6 ha ± 10.0 ha (9.0 ac ± 24.7 ac) in size and vary from 0.1 ha to 106.47 ha (0.2 ac to 263.09 ac). As reported previously, 82% of the forest patches in the Action Area were 4 ha (10 ac) or smaller and only 2% (n=13) were 40 ha (100 ac) or more. When the final Indiana bat habitat suitability map is overlaid by forest patches and streams (Figure 4-5), it is apparent that areas that were dominated by smaller (4 ha [10 ac] or less), isolated forest patches tended to be classified in the lowest habitat suitability category, while areas with relatively large forest patches (15 to 40 ha [37 to 100 ha] or more) that were in close proximity to other larger forest patches were most suitable for Indiana bats. While streams were fairly ubiquitous on the landscape, streams located in highly fragmented areas or large expanses on non-forested area were not classified as being highly suitable, while streams that intersected forested habitat were highly suitable.

[4] Excluding portions of 6 forest patches that only partially overlap the Action Area, totaling 0.4 ha (0.9 ac).



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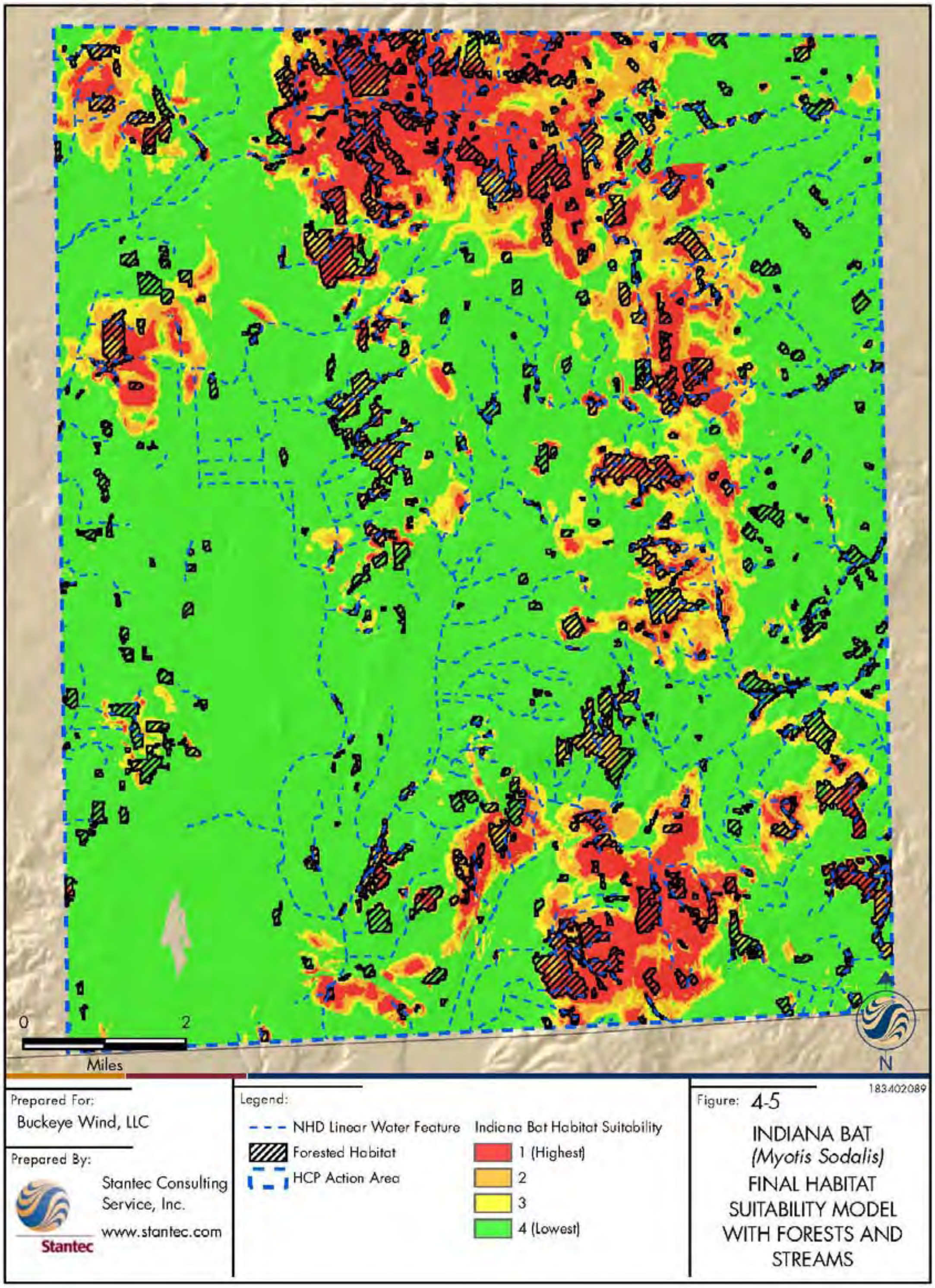
INDIANA BAT
(Myotis Sodalis)
FINAL HABITAT
SUITABILITY MODEL

**Table 4-7.** Areas classified as being most to least suitable in the roosting, foraging, and final habitat suitability models for Indiana bats in the Buckeye Wind Project Action Area.

| Suitability Category | Hectares | Acres | Percent of Action Area |
|---|---|---|---|
| Roosting Habitat Suitability Model | | | |
| 1 (Highest) | 1,094.30 | 2,704.10 | 3% |
| 2 | 1,213.90 | 2,999.70 | 4% |
| 3 | 1,460.80 | 3,609.70 | 5% |
| 4 (Lowest) | 28,614.60 | 70,708.20 | 88% |
| Foraging Habitat Suitability Model | | | |
| 1 (Highest) | 3,087.50 | 7,629.30 | 10% |
| 2 | 2,701.10 | 6,674.50 | 8% |
| 3 | 2,631.00 | 6,501.30 | 8% |
| 4 (Lowest) | 23,932.40 | 59,138.30 | 74% |
| Final Habitat Suitability Model | | | |
| 1 (Highest) | 4,016.10 | 9,923.90 | 12% |
| 2 | 2,973.90 | 7,348.60 | 9% |
| 3 | 2,856.60 | 7,058.80 | 9% |
| 4 (Lowest) | 22,505.40 | 55,612.10 | 69% |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INDIANA BAT
(Myotis Sodalis)
FINAL HABITAT SUITABILITY MODEL WITH FORESTS AND STREAMS

## 5. DISCUSSION

Partitioned Mahalanobis $D^2$ methods allow for prediction of suitable habitat across large landscapes using environmental variables located at nearby Indiana bat roosting and foraging locations. A larger area of suitable foraging habitat was identified than roosting habitat, which was not unexpected given that foraging areas typically extend over greater areas than those in which roost trees are located. This may also be associated to some extent with greater location error associated with telemetry points compared with roost tree locations. A larger area was included in the combined final habitat suitability map, indicating that not all areas of suitable habitat for roosting and foraging overlapped. This combined model therefore represents the maximal estimate of suitable Indiana bat habitat within the Action Area.

Similar to other studies of Indiana bat habitat use during summer foraging and commuting activities (Humphrey et al. 1977, LaVal et al. 1977, Brack 1983, Garner and Garner 1992, Carter 2003), telemetry data collected in the tri-county area indicated that Indiana bats used areas that could be characterized as closed to semi-open forested habitats and forest edges. These findings are consistent with other studies in fragmented habitats that have shown Indiana bats use forest edges, hedge rows, and other features on the landscape that provide cover as travel corridors between foraging areas and roosts (Gardner et al. 1991b, Kurta et al. 2002, Carter 2003, Murray and Kurta 2004, Kurta 2005, Winhold et al. 2005).

Spatial configuration of forested habitat has not been addressed in previous predictive Indiana bat habitat suitability models for the midwest (Rommé et al 2005, Farmer et al. 2002, Rittenhouse et al. 2007). Our model emphasized spatial pattern of forested habitat, rather than fine scale attributes such as roost tree dbh and canopy closure that are difficult to accurately estimate over large areas. Indiana bat foraging habitat suitability was most strongly associated with the spatial arrangement of forested areas including fragmentation, connectedness of forest patches, and the amount of forest core area. This makes sense, given that other studies have shown that Indiana bats typically do not cross large, open areas and instead follow tree lines or other linear habitat features that provide protective cover. For example, Murray and Kurta (2004) found that bats increased their commuting distance by 55% to follow tree-lined paths rather than flying over large agricultural fields, some of which were at least 1 km (0.6 mi) wide. Further studies by Kurta (2005) and Winhold et al. (2005) found that this colony used the same wooded fenceline as a commuting corridor that connected forested areas situated in largely agricultural area for at least 9 years.

Carter (2003) found that Indiana bat roost selection in southern Illinois in a large, open swamp was dependent on roost tree proximity to the forest edge. Indiana bats rarely used trees more than 50 m (164 ft) from the forest edge and once bats emerged at dusk, they flew directly into the forest and were not seen flying in the more open portion of the swamp (Carter 2003). Two radio telemetry studies in IL and IN assessed the types of habitats used by adult females while foraging compared to available habitat. Floodplain forest was the most preferred habitat in IL (Gardner et al. 1991*b*, Garner and Gardner 1992), and woodlots were used more often than other available habitats in IN (Sparks 2003; Sparks et al. 2005*a*, 2005*b*). Although it was difficult to document due to the errors inherent in conducting radio telemetry on a rapidly moving species, it appeared that bats likely were foraging most often along forest-field edges rather than in the interior of fields when they used open habitats (Sparks et al. 2005*b*). While visual observations suggest that foraging over open fields or bodies of water more than 50 m (150 ft) from a forest edge does occur, it appears to be less common than foraging within forested sites or along edges (Brack 1983, Menzel et al. 2001).

These findings are consistent with distances between roost tree and telemetry locations recorded for the 17 radio-tagged bats in this study (i.e., 85% of telemetry locations were <170 m (559 ft) from a forest edge). It is important to note that features such as a tree-lined hedgerow often do not show up as a forested pixel on a land cover spatial layer, and therefore a bat located at this spot would not be recognized as foraging at a forest edge; rather, it would be deemed some distance from the nearest forest patch. Furthermore, we did not have information on triangulation error, which also may have skewed the measured distances to forest edges.

While distance to forest edge was one of the three most important variables in the roosting suitability model, proximity to streams was most important. Water is important as a drinking source as well as for the insect populations found in and near water sources, both important elements in meeting the energetic demands of pregnant and nursing females with dependant young (Kurta 2001). Insectivorous bats typically obtain 20% to 26% of their daily water from drinking (Kurta et al. 1989, 1990). Trees used by an Indiana bat maternity colony in Illinois were closer to intermittent streams than to perennial streams, although no comparison was made with randomly selected points (Gardner et al. 1991b). In Michigan, Indiana bat roost trees were closer to perennial streams than random locations, but there was no difference between roosts and random points in distance to lakes/ponds (Kurta et al. 2002).

Although Indiana bat roosting suitability was strongly associated with proximity to forested streams and streams, neither suitable roosting or foraging habitat were strongly associated with proximity to wetlands identified by the NWI, which included several small ponds in the Action Area. The extent to which proximity to water features affects selection of roosting habitat is likely related to the availability of water within the larger landscape. Water sources tend to be ubiquitous in areas where Indiana bat maternity roosts have been found (Kurta 2001). This was also true for the Buckeye Action Area. Although distance to water features such as wetlands and ponds may not play a large role in day-to-day roost selection in areas where water is not limiting, it may influence habitat suitability for maternity colonies on a broader, landscape level (Carter et al. 2002). Further, not all wetland types may be useful as water sources, and an analysis which included separate variables for various wetland types may have resulted in higher importance for some types. However, we were limited by a small sample size and therefore could not increase the number of variables in the model without risking overfitting the model.

Some studies have also found roosts located in closer proximity to unpaved roads than paved roads (Gardner et al. 1991). Our roosting model did not address distance to roads. However, since our model accounted for the shape and configuration of forest habitat, which is largely influenced by road corridors in fragmented habitats such as the Action Area, many of our variables, such as the perimeter to area ratio of forest patches, likely captured important features related to road corridors.

Like all wildlife, Indiana bats require food, water, and shelter during the active portion of their annual cycle and the conditions at foraging areas, which provide food and water, and at roost trees, which provide shelter, are of interest when predicting the suitability of unsampled habitat. Indiana bats are opportunistic foragers, feeding on a variety of small insects. The diet of Indiana bats varies depending upon habitat, geographic location, season, sex, and age of the foraging bat (Belwood 1979, Brack and LaVal 1985, Kurta and Whitaker 1998; Murray and Kurta, 2002). Diets of Indiana bats may also vary from year to year within the same colony, and bats may take advantage or be "selectively opportunistic" when other types of insects are plentiful (Murray and Kurta 2002). The ephemeral nature of insect populations and the variation in Indiana bat diet make food requirements a difficult factor to include in a static, remotely developed habitat suitability model. However, a relationship exists between land cover types and the insects that inhabit them, and it is likely that a diversity of land cover is ideal, providing a continuous supply of asynchronously emerging insects throughout the summer months (Farmer et al. 2002). Thus, prey availability was indirectly assessed by including a measure of land cover diversity (SHDI) in the predictive model. SHDI was only moderately important in both the roosting and foraging models, indicating that other conditions such as the configuration of forest patches and water availability were more important in predicting suitability.

Although we were not able to incorporate measures of roost tree suitability and density in the Action Area, our model highlights areas that contain the same stand-level conditions as those found at identified roost trees. Like every statistical model, we are limited by the scale at which modeling occurs: for example, if a large forest patch is devoid of suitable roost trees, then it will be unsuitable for roosting. However, we felt that this model was the best way to balance the needs of using empirical data collected nearby to make suitability assessments across a large area. Furthermore, our model provides strong support for the importance of the spatial configuration of forested habitat. In areas where suitable roost trees are not limiting, landscape features such as fragmentation and the connectedness of forest patches may be as important or more important as other fine-scale differences in roost tree characteristics.

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# Appendix C

## USFWS Template Language to be Included in Easement and Fee Simple Conveyances

APPENDIX C

## USFWS TEMPLATE LANGUAGE
## TO BE INCLUDED IN EASEMENT AND FEE SIMPLE CONVEYANCES

**Real property deeds, transfers, and conservation easements take a variety of forms. To provide uniformity and consistency when implementing the Habitat Conservation Plan and Incidental Take Permit (HCP/ITP) mitigation requirements, this Template presents the legal text to be included when drafting those conveyance documents. Where indicated, there may be flexibility in terms of the language used or the content of a particular provision.**

**This Template reflects the organization and content of a standard conveyance document in that it includes recitals, purpose, rights, interpretation and miscellaneous provisions. Restrictions on uses and reserved rights appear at the end.**

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**The following legal recitals must be included in any legal document conveying a real property interest over conservation lands. Due to variations in state law and the type of conveyance that may be used, and the preferences of the parties as to the format of their documentation, the wording of these recitals may need to change, but must remain substantially similar in content. The parties are entitled to include other recitals that are not contradictory.**

RECITALS

WHEREAS, this _____________ [insert type of conveyance] is conveyed this _______ day of _______, from _______ [name], a _______ [description of entity], Grantor, with an address of_______, to _______ [name], a _______ [description of entity], Grantee, with an address of _______; and

WHEREAS, the Grantor is [the owner in fee simple of][current holder of an easement or lease, over, through and across] certain real property, hereinafter called the "Protected Property," which has ecological, scientific, educational and aesthetic value in its present state as a natural area which has not been subject to development or exploitation [or describe status with respect to development or exploitation] , which property is located in _______ and is more particularly described in Exhibit A, attached hereto and incorporated by this reference; and

**(If applicable)** WHEREAS, the Grantee, is a nonprofit corporation incorporated under the laws of [State, Commonwealth, or District] as a tax-exempt public charity under Section 501(c)(3) and/or 509(a)(1) of the Internal Revenue Code of 1986, as amended, and the regulations promulgated pursuant thereto (“IRC”); Grantee, whose purpose is to preserve natural areas for scientific, charitable, educational and aesthetic purposes, is qualified under section 170(h) of the IRC to receive qualified conservation contributions; and

APPENDIX C

**(If applicable)** WHEREAS, the Protected Property is a significant natural area which qualifies as a "...relatively natural habitat of fish, wildlife, or plants, or similar ecosystem," as that phrase is used in P.L. 96-541, 26 USC 170(h)(4)(A)(ii), as amended, and in regulations promulgated thereunder; specifically, the Protected Property is habitat for the _______ [ESA listed species for which mitigation is required]; and

WHEREAS, the Protected Property consists of _______ [general description of habitat] and conservation of the Protected Property will protect and enhance _______ [describe habitat values to be conserved], particularly as it relates to the [ESA listed species] with regard to _______ [discuss species needs and behaviors (e.g., breeding, feeding, sheltering, migration, etc.]; the Protected Property's_______ [describe habitat values] provides [or will provide] suitable ______ habitat for the_______ [ESA listed species]; and

WHEREAS, the United States Fish and Wildlife Service (the "USFWS") within the United States Department of the Interior, is authorized by federal law to administer the federal Endangered Species Act (hereinafter "ESA"), 16 U.S.C. § 1531 et seq., and other laws and regulations; and

WHEREAS, the _______ [ESA listed species] has been listed as _______ [insert species listing status; e.g., endangered or threatened] by the USFWS under the ESA; and

WHEREAS, ______ applied to the USFWS for the issuance of an Incidental Take Permit (the "ITP"), submitted a Habitat Conservation Plan ("HCP") pursuant to ESA Section 10 regarding its ______________, and was issued an ITP on _______ [insert date]; and

WHEREAS, ______ is required to mitigate for take of ESA listed species, including _______ [species to be conserved through this conveyance], in a manner and amount consistent with the terms of its HCP, and intends to accomplish said mitigation through acquisition and permanent preservation of the Protected Property, and implementation of mitigation measures on the Protected Property, if necessary; and

WHEREAS, the specific conservation values of the Protected Property are documented in an Easement Documentation Report, prepared by _______ [insert name of entity preparing report] and signed and acknowledged by the Grantor, establishing the baseline condition of the Protected Property at the time of this grant and including reports, maps, photographs, and other documentation; and

WHEREAS, the Grantor and Grantee have the common purpose of conserving the above-described conservation values of the Protected Property in perpetuity; and

**[If through a conservation easement]** WHEREAS, the State [or Commonwealth] of _______has authorized the creation of Conservation Easements pursuant to _______ [insert citation to state law] and Grantor and Grantee wish to avail themselves of the provisions of that law;

NOW, THEREFORE, the Grantor, for and in consideration of the facts above recited and of the mutual covenants, terms, conditions and restrictions herein contained and as an absolute and unconditional gift [or consideration of $1], does hereby give, grant, bargain, sell and convey unto the Grantee, a _______ [insert type of conveyance] in perpetuity over the Protected Property of the nature and character and to the extent hereinafter set forth.

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**The following provisions should be incorporated in their entirety. Any deviation must be both substantially similar and approved by U.S. Fish and Wildlife USFWS, in consultation with its Solicitor, prior to execution and recording.**

PURPOSE

It is the primary purpose of this _______ [insert type of conveyance] to assure that the Protected Property will be retained forever in its _______[insert type of habitat] as suitable for the_______ [insert ESA listed species], irrespective of the federal listing status of the species; *[**optional, depending on Grantor interest:** and also to the extent consistent with the primary purpose, to protect any other rare plants, animals, or plant communities on the Protected Property, and to ensure the Protected Property remains permanently in a natural, scenic and _____ [describe habitat , e.g., forested, etc.] condition*; and to prevent any use of the Protected Property that will significantly impair or interfere with the conservation values or interests of the Protected Property described above. Grantor intends that this _______ [insert type of conveyance] will confine the use of the Protected Property to such activities as are consistent with the purpose of this _______ [insert type of conveyance].

THE USFWS AS THIRD-PARTY BENEFICIARY: ENFORCEMENT AND REMEDIES

1. The parties hereto agree that, because of the USFWS's duties and powers arising under the ESA and consistent with _________'s commitments to its HCP and ITP, the USFWS has a clear and substantive interest in the preservation and enforcement of this_______ [insert type of conveyance]. Therefore, the parties grant to the USFWS, its agents, successors and assigns, the rights and standing to be noticed, to enter the Protected Property, to approve or disapprove requests, and to enforce this _______ [insert type of conveyance] as described in this section and according to its terms.

2. Grantor or Grantee, as appropriate, shall notify the USFWS in writing of the names and addresses of any party to whom the Protected Property, or any part thereof, is to be granted, conveyed or otherwise transferred, said notice to be provided at or prior to the time said transfer is consummated.

3. This _______ [insert type of conveyance] does not convey a general right of access to the public, except that the USFWS, its agents, contractors, and assigns, may enter onto the Protected Property at any time upon 24 hours notice to Grantor or Grantee, as appropriate, for the purpose of conducting inspections to determine compliance with the terms contained herein, for the purpose of assessing the _______ [ESA listed species] population status and vegetative habitat suitability, in accordance with the terms of the ITP, HCP and the ESA implementing regulations at 50 C.F.R. Parts 13, Subparts C and D, or for the purpose of conducting _______ [specific management or monitoring activities] in accordance with the terms of the HCP. This right of entry does not include a right to enter any buildings on the property that serve as residences or places of business.

4. In addition to any other rights and remedies available to the USFWS at law or in equity, the USFWS shall have the right, but not the obligation to enforce this _______ [insert type of conveyance] and is entitled to exercise the same remedies available to Grantee, identified in paragraph _______ [paragraph that lists Grantee enforcement rights]. The USFWS may do so upon the written request of Grantee or if Grantee fails to enforce the_______ [insert type of conveyance]. Prior to taking any enforcement action, the USFWS shall notify Grantee in writing of its intention and shall afford Grantee a reasonable opportunity to negotiate a remedial action and settlement with Grantor or commence its own enforcement action. No failure on the part of the USFWS to enforce any term, condition, or provision hereof shall discharge or invalidate such term, condition, or provision to affect its right or that of Grantee or Grantor to enforce the same.

## OTHER MANDATORY PROVISIONS

Assignment. The parties hereto recognize and agree that the benefits of this _______[insert type of conveyance] are in gross and assignable, and the Grantee hereby covenants and agrees that in the event it transfers or assigns _______ [property interest], it shall obtain written concurrence of the USFWS, and the organization receiving the interest will be a qualified organization as that term is defined in Section 170(h)(3) of the IRC (or any successor section) and the regulations promulgated thereunder, which is organized and operated primarily for one of the conservation purposes specified in Section 170(h)(4)(A) of the IRC, and Grantee further covenants and agrees that the terms of the transfer or assignment will be such that the transferee or assignee will be required to continue to carry out in perpetuity the conservation purposes which the contribution was originally intended to advance.

Subsequent Transfers. The Grantor agrees that the terms, conditions, restrictions and purposes of this grant or reference thereto will be inserted by Grantor in any subsequent deed or other legal instrument by which the Grantor divests any retained, reserved or reversionary interest and by Grantee if Grantee subsequently transfers any fee simple title or possessory interest in the Protected Property; and Grantor and Grantee further agree to notify Grantee or Grantor, as appropriate, and the USFWS of any pending transfer at least thirty (30) days in advance.

Government Permits and Approvals. The conveyance of this _______ [insert type of conveyance] by the Grantor to the Grantee does not replace, abrogate, or otherwise set aside any local, state or federal laws, requirements or restrictions applicable to the Protected Property and shall not relieve Grantor of the obligation and responsibilities to obtain any and all applicable federal, state, and local governmental permits and approvals, if necessary, to exercise Grantor's retained rights and uses of the Protected Property even if consistent with the conservation purposes of this_______ [insert type of conveyance].

Eminent Domain. Whenever all or part of the Protected Property is taken in exercise of eminent domain by public, corporate, or other authority so as to abrogate the restrictions imposed by this_______ [insert type of conveyance], the Grantor and the Grantee shall join in appropriate actions at the time of such taking to recover the full value of the taking and all incidental or direct damages resulting from the taking, which proceeds shall be divided_______ [insert method], and _______ [discuss how proceeds will be spent]. All expenses incurred by the Grantor and the Grantee in such action shall be paid out of the recovered proceeds.

Interpretation. This _______ [insert type of conveyance] shall be interpreted and performed pursuant to the laws of the State in which it is recorded, the federal Endangered Species Act, and other applicable federal laws.

Severability. If any provision in this instrument is found to be ambiguous, an interpretation consistent with the purposes of this _______ [insert type of conveyance] that would render the provision valid shall be favored over any interpretation that would render it invalid. If any provision of this _______ [insert type of conveyance] or the application thereof to any person or circumstance is found to be invalid, the remainder of the provisions of this _______ [insert type of conveyance] and the application of such provisions to persons or circumstances other than those as to which it is found to be invalid shall not be affected thereby.

Successors and Assigns. The term "Grantor" shall include the Grantor and the Grantor's successors and assigns and shall also mean the masculine, feminine, corporate, singular or plural form of the word as needed in the context of its use. The term "Grantee" shall include _______ and its successors and assigns.

Notices. Any notices, consents, approvals or other communications required in this _______ [insert type of conveyance] shall be sent by registered or certified mail to the appropriate party or its successor in interest at the following address or such address as may be hereafter specified by notice in writing:

Grantor:
Grantee:
USFWS:
**[**Others:]

Counterparts. The parties may execute this instrument in two or more counterparts, which shall, in the aggregate, be signed by both parties; each counterpart shall be deemed an original instrument as against any party who has signed it. In the event of any disparity between the counterparts produced, the recorded counterpart shall be controlling.

Captions. The captions herein have been inserted solely for convenience of reference and are not a part of this _______ [insert type of conveyance] and shall have no effect upon construction or interpretation.

**********************************************

**Additionally, each conveyance must include provisions to address the following topics. The contents of these provisions must be negotiated by the parties. They may therefore differ considerably depending on the property, values to be conserved, and the intensity of management and monitoring required. There is no prescribed template for the following provisions. But the USFWS has recommended language it can provide the parties if desired:**

Monitoring and Management;
Endowment [if applicable];
Cost and Liabilities;
Taxes;
Title;
Standing;
Extinguishment;
Merger;
Parties subject to the conveyance; and,
Grantee Rights of Entry and Enforcement [which must include, at a minimum, the right to: 1) prevent any activity on or use of the Protected Property that is inconsistent with the purpose of the conveyance and to require the restoration of such areas or features of the Protected Property that may be damaged by any inconsistent activity or use; 2) bring an action at law or equity in a court of competent jurisdiction to enforce the terms of the conveyance; 3) require the restoration of the Protected Property to its previous condition; 4) enjoin non-compliance by ex parte temporary or permanent injunction in a court of competent jurisdiction; and/or, 5) recover any damages arising from such noncompliance.]

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**Also, each conveyance *must* include the following text regarding force majeure. This text may be revised only to reflect any binding contingencies for adaptive management and changed circumstances, if any, memorialized in the HCP or ITP. But any changes must first be reviewed and approved by the USFWS in consultation with its Solicitor.**

Neither absence of [ESA listed species] from the Protected Property nor a loss of or significant injury to conservation values for the _______ [ESA listed species] due to circumstances including, but without limitation, fire, flood, storm, disease, or seismic events, shall be construed to render the purpose of this _____________ [insert type of conveyance] impossible to accomplish and shall not terminate or extinguish this ___________ [insert type of conveyance] in whole or in part. In the case of loss of or significant injury to any of the conservation values for the [ESA-listed species] due to fire, flood, storm, disease, seismic events or similar circumstances, the Grantor or Grantee may, but shall not be required to, seek to undertake measures in consultation with the USFWS to restore such conservation values, subject to the terms of the HCP/ITP.

APPENDIX C

## INDIANA BAT (SUMMER/SWARMING HABITAT)
## USE RESTRICTIONS AND RESERVED RIGHTS[1]

## RESTRICTIONS

| General Description | Legal Description to be included in Conveyance |
|---|---|
| **No Industrial Use** | No industrial activities, including but not limited to the construction or placement of buildings or parking areas, shall occur on the Protected Property |
| **No New Residential Use** | No new residential structures or appurtenances, including but not limited to the construction or placement of new homes, mobile homes or storage sheds, shall be constructed on the Protected Property. |
| **No Commercial Use** | No commercial activities shall occur on the Protected Property, except for the low impact recreational uses explicitly identified under Reserved Rights. |
| **No Agricultural Use** | No new agricultural activities that were not previously documented as part of the baseline conditions shall occur on the Protected Property, including the use of the Protected Property for cropland, waste lagoons, detention or collection ponds, or pastureland. |
| **No Vegetative Clearing** | No forestry or timbering activities shall occur on the Protected Property, except that 1) Grantee maintains the right to conduct silvicultural modifications with the intent to improve listed species habitat within the Protected Property through reforestation, afforestation or silvicultural management to improve the health of the Indiana bat habitat; and 2) limited vegetative clearing may occur as described under Reserved Rights only. |
| **Development Rights Extinguished** | No development rights which have been encumbered or extinguished by this _________ [insert type of conveyance] shall be transferred pursuant to a transferable development rights scheme or cluster development arrangement or otherwise. |
| **No Subdivision** | The Protected Property may not be divided or subdivided. Further, the Protected Property may not be divided, partitioned, nor conveyed except in its current configuration as an entity, without USFWS and Grantee’s written approval. All terms and conditions of this easement will apply to each subdivided portion. |

[1] USFWS acknowledges that there may be limited or extenuating circumstances that may warrant a deviation from this required boilerplate. The nature of the restrictions and consideration of allowable uses will necessarily depend on the land to be protected. Grantors or Grantees who wish to alter the language of these provisions bear the burden of demonstrating to the satisfaction of _____ and USFWS that doing so would not diminish or interfere with the conservation of Indiana bats and their habitat. Any such change(s) must be approved by USFWS in writing, after consulting with agency counsel, and prior to execution of the conveyancing document.

# *Appendix C*
# *ABPP*

# Avian and Bat Protection Plan for the Buckeye Wind Power Project

## Champaign County, Ohio

Prepared for:

EverPower Wind Holdings, Inc.

Prepared by:

Stantec Consulting Services, Inc.

June, 2012

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## 1.0 INTRODUCTION

Buckeye Wind LLC, a wholly owned subsidiary of EverPower Wind Holdings, Inc., (EverPower; hereafter referred to as Buckeye Wind) has proposed development of a wind-powered electric generation facility located in Champaign County in west central Ohio (Figure 1-1). The Buckeye Wind Project (the Project) would consist of up to 100 wind turbines, each with a nameplate capacity rating of 1.6 to 2.5 megawatts (MW), resulting in a total generating capacity of up to 250 MW. The locations of 52 turbines are currently known and the additional 48 turbines will be developed at a later time in accordance with all applicable local, state, and federal guidelines. The Project would also include development of access roads, transmission equipment, staging areas, a substation, and an operations and maintenance facility located within portions of Union, Wayne, Urbana, Salem, Rush, and Goshen Townships.

This Avian and Bat Protection Plan (ABPP) has been developed by Buckeye Wind to provide a detailed framework through which adverse impacts to migratory birds and non-federally listed bats[1] will be avoided and minimized during Project planning, siting, construction, operation, and decommissioning. The ABPP has been developed to address potential impacts that could result from the full 100-turbine project. Buckeye Wind began consultation with the Ohio Ecological Services Field Office of the United States Fish and Wildlife Service (USFWS) and the Ohio Department of Natural Resources Division of Wildlife (ODNR DOW) in 2006 to identify and minimize risks to avian and bat resources from the proposed Project. As part of due-diligence, Buckeye Wind conducted numerous pre-construction surveys for the proposed Project including, but not limited to: surveys for birds and bats, surveys of ecological communities and habitats, and surveys for threatened and endangered species. Pre-construction surveys were designed for an area that included portions of Champaign County and extended north into Logan County ("Initial Study Area"; see Figure 1-1). The pre-construction surveys were initiated in fall 2007 and continued throughout 2008. Project planning incorporated the results of pre-construction field surveys for birds and bats, as well as input from ongoing consultation with state and federal wildlife agencies. During pre-construction surveys, the presence of federally endangered Indiana bats (*Myotis sodalis*) in the northern portion of the Initial Study Area was documented. Two reproductive adult female and one non-reproductive adult male Indiana bats were captured as part of the 2008 survey. The Initial Study Area was subsequently reduced to be at least 8 km (5 mi) from the 2008 Indiana bat capture and roost locations and then adjusted to allow for replacement of potential turbine locations eliminated due to the southward shift ("Adjusted Project Area", Figure 1-1).

Mist-netting conducted in Champaign County during the summer of 2009 for an unrelated project resulted in the capture of Indiana bats within the Adjusted Project Area. Buckeye Wind subsequently prepared a Habitat Conservation Plan (HCP) in support of an Incidental Take Permit (ITP) application pursuant to Section 10(a)(1)(B) of the Endangered Species Act (ESA). The HCP describes the impacts to Indiana bats that are likely to result from the Project and the measures that will be undertaken to minimize and mitigate such impacts. An Environmental Impact Statement (EIS) was also prepared by the USFWS in compliance with the National Environmental Policy Act (NEPA) to evaluate the effects of the potential issuance of an ITP for Indiana bats. The HCP and associated EIS evaluated an area that included the Adjusted Project

[1] This ABPP will focus on non-federally listed species; a Habitat Conservation Plan (HCP) has been developed for federally listed species that may be impacted by the Project (i.e., Indiana bats).

Area, plus additional areas that were defined during the NEPA scoping process ("Action Area"; Figure 1-1). While the HCP and EIS consider the Action Area as a whole, all of the turbines and associated facilities will be located within the Adjusted Project Area

The Action Area comprises an area approximately 32,395 hectares (ha; 80,051 acres [ac]) that includes portions of Union, Wayne, Urbana, Salem, Rush, and Goshen Townships in Champaign County, OH (referred to hereafter as the Action Area) (Figure 1-1). Within the Action Area, the permanent footprint (the area of permanent disturbance) for the entire Project will be no more than 52.2 ha (128.9 ac), or 0.16% of the total Action Area. Development of the Project will include installation of up to 100 wind turbine generators (turbines), each with a nameplate capacity rating of 1.6 MW to 2.5 MW, resulting in a total generating capacity of up to 250 MW. The Project will also include development of service roads, electricity collection lines, staging areas, and an operations and maintenance (O&M) facility.

The design evaluated as the primary option in this ABPP includes approximately 113.5 kilometers (km; 70.5 miles [mi]) of 34.5 kilovolt (kV) interconnect lines that are to be built above ground on rebuilt poles in existing public road right-of ways. The lines would be over-hung on poles used by the local electric utilities to distribute power to local residences and businesses. Buckeye Wind has identified a possible re-design of the Project collection system that would allow a more efficient infrastructure, resulting in greater ease of construction. The potential redesign would move a portion of those lines to an underground system located on private land under easement ("Redesign Option"). This Redesign Option is under consideration and would require various state and local permits and amendments to those permits. As such, it is offered here as an optional Project design that would be implemented at Buckeye Wind's discretion. While the exact design is not known at this time, the Redesign Option would include 95.4 km (59.3 mi) of 34.5 kV interconnect lines. A reasonable estimate of impacts for the 100-turbine Project with the Redesign Option is presented in this document. No turbine locations would be altered except as otherwise required as part of normal project micro-siting (see HCP Section 7.3.2 – Additional Turbines). Throughout this document, impacts associated with the Redesign Option are presented where applicable. Unless indicated otherwise, the impacts and discussion in this ABPP would apply to either collection system design that is contemplated.



It is anticipated that development of the 100-turbine Project will include (also see HCP Section 2.2 - Table 2-1):

- 64.4 km; (40.0 mi) of new service roads that will connect wind turbines to existing access roads;
- 113.5 km (70.5 mi) of 34.5 kV electrical interconnect lines that will connect individual turbines to the substation, of which,
  - 56.7 km (35.2 mi) will be installed underground with the majority (approximately 84%) installed parallel to Project access roads, requiring no additional clearing or soil impacts beyond those required for access road construction, and
  - 56.8 km (35.3 mi) will be installed overhead in public road right-of-ways (mostly co-located with existing electric distribution facilities);
- Under the Redesign Option, there would be 95.4 km (59.3 mi) of 34.5 kV electrical interconnect lines that will connect individual turbines to the substation, of which;
  - 86.5 km (53.7 mi) will be installed underground with about 32% installed parallel to Project access roads.
  - 9.0 km (5.6 mi) will be installed overhead;
- Temporary crane paths totaling approximately 22.7 km (14.1 mi);
- Up to 4 temporary construction staging areas, occupying a cumulative area of approximately 9.2 ha (22.9 ac);

- 1 substation that will allow connection with the existing transmission line, occupying area of approximately 2.0 ha (5.0 ac);
- 1 O&M facility and associated storage yard (likely to be refurbishment of existing facility); and
- Up to 2 concrete batch plants occupying a cumulative area of 2.4 ha (6.0 ac).

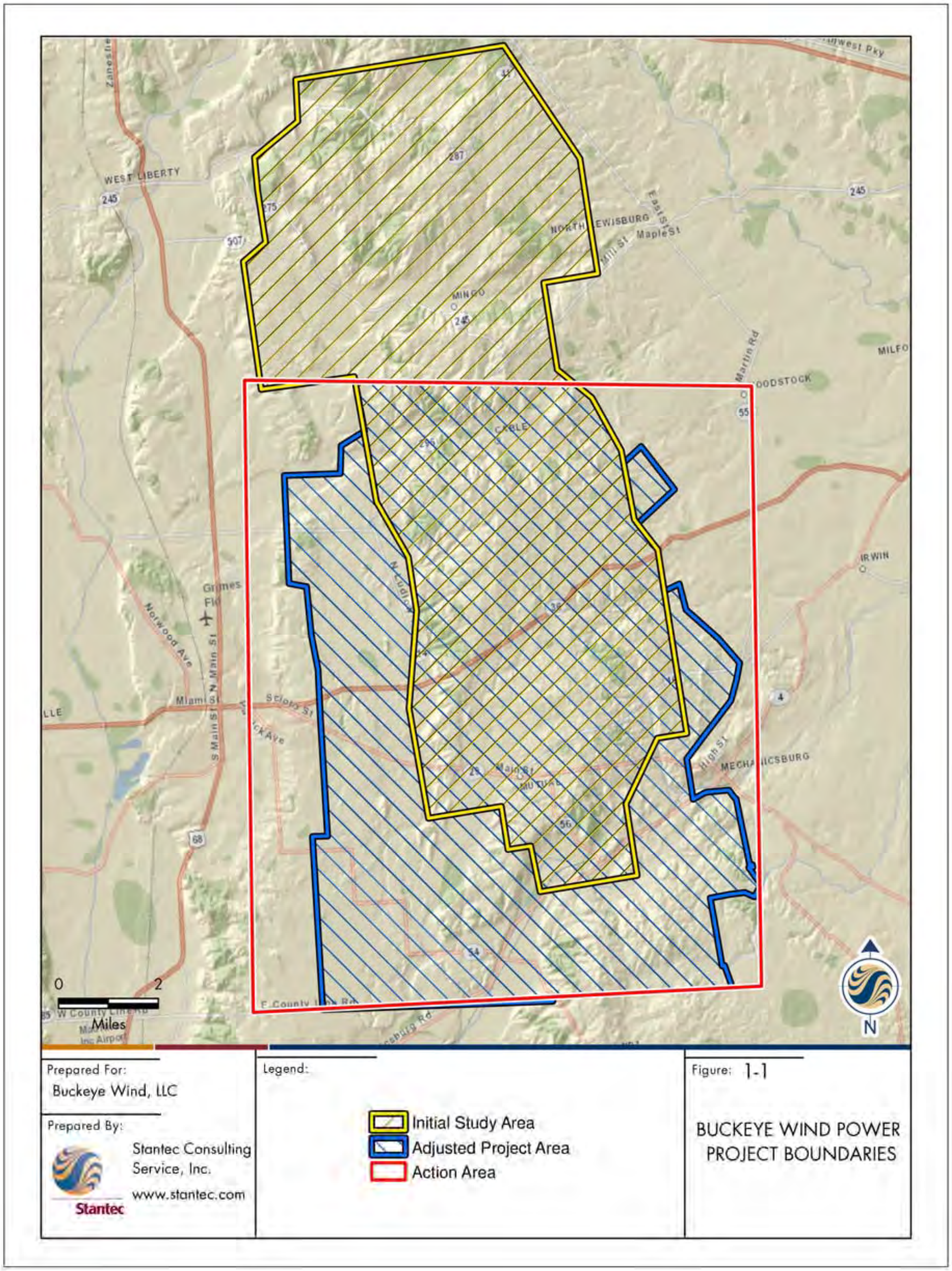
Areas where trees will be temporarily or permanently removed are anticipated to comprise approximately 6.5 ha (16.1 ac) for the 100-turbine Project, or 0.2% of the 2,744 ha (6,779 ac) of forested habitat available in the Action Area (6.8 ha [16.8 ac] for the Redesign Option)[2].

Avoidance and minimization measures that Buckeye Wind will implement to reduce impacts to Indiana bats are detailed in the HCP. In addition to evaluating impacts to Indiana bats, the EIS also assesses impacts to migratory birds, non-federally listed bats, and other wildlife species from the proposed Project. Avoidance and minimization measures included in the HCP for Indiana bats are expected to also minimize impacts to non-federally listed bat species, as well as birds.

This ABPP is structured around careful Project planning, siting, and construction. Several Project design and construction measures, described in more detail in the following sections, will be implemented to avoid and minimize impacts to birds and bats to the extent practicable. Mortality monitoring for Indiana bats will be conducted for the life of the Project as a condition of the ITP. Mortality monitoring of non-federally listed bat and bird species will be conducted throughout the life of the Project coincident with monitoring for Indiana bats, providing a much more robust monitoring Program for non-federally listed bats and bird species than is typically incorporated for wind projects.



[2] Note that much of this area is along the edge of woodlots or along thin/sparse tree lines separating parcels, resulting in a conservative estimate. Avoidance and minimization measures described in the HCP Section 6.0 – Conservation Program will likely reduce the area of tree removal to less than the estimated 6.5 ha (16.1 ac), or 6.8 ha (16.8 ac) for the Redesign Option, based on construction needs, landowner preference, and quality of habitat.


WEST LIBERTY
NORTH LEWISBURG
MINGO
CABLE
MECHANICSBURG
IRWIN
Miami St
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2
Miles
N
Prepared For:
Buckeye Wind, LLC
Prepared By:
Stantec Consulting Service, Inc.
www.stantec.com
Stantec
Legend:
Initial Study Area
Adjusted Project Area
Action Area
Figure: 1-1
BUCKEYE WIND POWER PROJECT BOUNDARIES

The results of post-construction monitoring may indicate that bird and bat mortality are not within one standard deviation above the current regional average (Mortality Threshold). The Mortality Threshold is suggested by the ODNR DOW's "On-Shore Bird and Bat Pre- and Post-Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio" (ODNR Protocol; ODNR DOW 2009; see ABPP Section 7.1 – Calculation of Threshold Levels). Should mortality of birds or bats exceed this threshold, Buckeye Wind will work with the ODNR DOW and USFWS to determine what additional measures could help bring mortality to within the Mortality Thresholds while maintaining the economic viability of the project. Additional minimization measures may be necessary to bring mortality to within threshold levels and Buckeye Wind may also implement off- or on-site mitigation to offset documented mortality. This adaptive management approach will allow adverse impacts to birds and bats to be addressed as new information becomes available over time.

This ABPP has adopted 4 primary components to avoid, minimize, and mitigate potential impacts to bird and bat species:

1) <u>Pre-Construction Site Assessment and Planning</u> – includes consultation with the USFWS and ODNR DOW regarding site selection; 2 years of pre-construction surveys to assess impacts to birds and bats; and incorporation of study results and agency consultation into Project siting decisions.

2) <u>Project Design and Construction</u> – includes design and construction measures that will be implemented to minimize and avoid impacts to birds and bats and their habitats.

3) <u>Project Operation</u> – includes use of feathering to reduce mortality of Indiana bats and other bats.

4) <u>Monitoring</u> – includes post-construction monitoring to document levels of bat and bird mortality and detect thresholds for adaptive management (see HCP Section 7 – Adaptive Management).

5) <u>Adaptive Management</u> – if post-construction monitoring indicates that estimated annual bird and bat mortality for the Project is greater than the Mortality Threshold (see Section 7.1 – Calculation of Threshold Levels), Buckeye Wind will work with the ODNR DOW and USFWS to determine what additional minimization, avoidance, or mitigation measures are practicable, while maintaining the economic viability of the project.

This ABPP is a good faith effort on behalf of Buckeye Wind to avoid impacts to birds and bats that may result from construction, operation, and decommissioning of the Project. It is recognized that this ABPP does not authorize bird and bat mortality that may result from the Project; rather its purpose is to develop a plan through which such mortality can be avoided and minimized to the extent practicable.

To ensure that development and implementation of this ABPP follows a focused process, input from representatives of the ODNR DOW, USFWS, and technical/legal advisory consultants has been actively pursued. The measures outlined in this document are based on the best available scientific information and were developed in coordination with state and federal agency representatives.

### 1.1 Impacts to Birds and Bats from Wind Energy

Wind energy provides a renewable source of clean energy that has been identified by state and federal policy makers as an important part of the country's energy future. The construction and operation of wind facilities can result in both direct (immediate) and indirect (separate in time) impacts to birds and bats and these species groups have been identified as being most at risk from wind power development (Arnett et al. 2008, Natural Resource Council [NRC] 2007, National Wind Coordinating Collaborative [NWCC] 2010). The rapid expansion of wind power development has prompted the need for increased scientific understanding of potential impacts and solutions to avoid and minimize those impacts.

There is a growing database of bird and bat impacts from wind facilities, particularly in the United States and Europe. Most post-construction monitoring studies have focused on bird and bat mortality from turbine collisions and there is less information about indirect impacts (i.e. displacement, decreased breeding success, etc.). In order to most accurately assess potential avian and bat impacts, and to outline the most applicable impact avoidance or minimization measures for the Buckeye Wind Project, this ABPP considers available scientific studies and published literature that are most applicable to the Buckeye Wind Project. Studies conducted at sites which are relatively proximal to the Project are given greater emphasis in this ABPP. While landscape settings at other regional projects may differ from the Buckeye Wind Project, generally the species, regional populations, and seasonal weather patterns among these sites are the most similar to the Project.



Direct impacts to birds caused by wind turbines and associated infrastructure (i.e., fatality resulting from collision) have received attention from local, state, and federal agencies, as well as the public. For raptors in particular, newer generation turbines have proven to cause fewer fatalities than older turbine designs (i.e., those at California wind facilities; NRC 2007). The more modern tubular towers, compared with older lattice tower design, and slower spinning blades may be factors associated with decreased mortality; although raptor abundance and behavior among different facilities is likely a compounding factor. Modern turbine towers and blades are increasing in height and blade length, and as turbine heights increase, nocturnally migrating songbirds (i.e., passerines) could be increasingly affected because they tend to migrate at heights above 122 m (400 ft), which overlaps with the rotor swept zone of many modern wind turbines.

Bird mortality at wind facilities is well documented by recent studies, with some facilities resulting in greater impacts to particular species or species groups than others. The majority of avian fatalities at wind turbines have primarily involved nocturnally migrating songbirds, although mortality at wind facilities has been much lower than that caused by other tall man-made structures and other sources of anthropogenic avian mortality (Erickson et al. 2005). In addition to direct impacts, bird species may be indirectly affected by wind facilities as a result of displacement caused by habitat alteration, habitat loss, or human disturbance (Dewitt and Langston 2006).

While Buckeye Wind is committed to reduce potential impacts to birds and bats, it is also important to recognize that wind energy in general is a minor contributor to bird mortality compared to other anthropogenic activities (see Table 1-1). There are a number of sources that make estimates for the total number of bird deaths caused by wind turbines. The National Academy of Science (NAS) estimated that wind energy is responsible for less than 0.003% (3 of every 100,000) bird deaths caused by human (and feline) activities (NAS 2007). Similarly, Erickson et al. (2005) estimated that about 20,000 to 37,000 birds are killed by wind turbines every year out of an estimated "500 million to possibly over 1 billion birds" killed by anthropogenic causes.

**Table 1-1.** Estimated annual avian mortality from anthropogenic causes in the United States.

| Mortality Source | Estimated Annual Mortality* |
|---|---|
| Collisions with buildings | 97-976 million |
| Collisions with power lines | 130-174 million |
| Depredation by domestic cats | 100 million |
| Automobiles | 80 million |
| Pesticides | 67 million |
| Communication towers | 4-50 million |
| Oil pits | 1.5-2 million |
| Wind turbines | 20,000-37,000 |

Source: various cited in Erickson et al. 2005.

Bat collisions and mortality at wind facilities are well documented in the United States (Johnson et al. 2003, Kunz et al. 2007*a*, Arnett et al. 2008, and Horn et al. 2008), although there are fewer estimates of overall turbine collision mortality, and no estimates of mortality from other anthropogenic sources. Kunz et al. (2007) estimated that approximately 33,000 to 62,000 bats will be killed annually by wind turbines in the year 2020 in the Mid-Atlantic Highlands, based on several assumptions and projections of wind facility build-out.

Among the 11 species documented in post-construction mortality monitoring studies, 3 species of long distance migratory bats have consistently been documented in the largest proportions at wind facilities across the United States and Canada: 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*b*, Arnett et al. 2008). Collectively, these species comprised approximately 75% of documented fatalities and hoary bats made up about half of all fatalities in 2008 (Arnett et al. 2008). The greatest number of fatalities among these and other bat species at wind facilities have occurred in late summer and early fall, coinciding with the migratory period (Kunz et al. 2007*b*, Arnett et al. 2008). Some studies have indicated that bats may be attracted to both moving and non-moving wind turbine blades and that many bat kills occur during periods of low wind (Kunz et al. 2007*b*, Arnett et al. 2008, Horne et al. 2008, Arnett et al. 2010).

## 1.2 Regulatory Framework

### 1.2.1 *Migratory Bird Treaty Act*

The Migratory Bird Treaty Act (MBTA) of 1918 decreed that all migratory birds and their parts (including eggs, nests, and feathers) were fully protected (16 U.S.C. 703). A migratory bird is any individual species or family of birds that crosses international borders at some point during their annual life cycle to live or reproduce. The MBTA implements four treaties that prohibit take, possession, transportation, and importation of all migratory, native birds (plus their eggs and active nests) occurring in the wild in the United States except for House Sparrow, European Starling, Rock Pigeon, any recently listed unprotected species in the Federal Register and non-migratory upland game birds, except when specifically authorized by the USFWS. In total, more than 1,000 bird species are protected by the Act, 58 of which can be legally hunted with a permit as game birds. The MBTA addresses take of individual birds, not population level impacts. Failure to comply with the MBTA can result in criminal penalties.

Although the MBTA does not include a provision authorizing incidental take of migratory birds, the USFWS recognizes that some level of mortality of migratory birds at wind projects can occur even if all reasonable measures to avoid mortality are implemented (USFWS 2010a). The USFWS has and continues to provide wind power project developers guidance in making a good-faith effort to comply with the MBTA. The USFWS has indicated that the Department of Justice has exercised discretion in enforcing provisions of the MBTA regarding companies who have made good faith efforts to avoid the take of migratory birds. This ABPP has been developed, in part, as a good faith effort on behalf of Buckeye Wind to comply with the MBTA.

### 1.2.2 *Bald and Golden Eagle Protection Act*

The Bald and Golden Eagle Protection Act (BGEPA) affords specific legal protection to bald eagles (*Haliaeetus leucocephalus)* and golden eagles (*Aquila chrysaetos*). Under this Act, it is a violation to "…take, possess, sell, purchase, barter, offer to sell, transport, export or import, at any time or in any manner, any bald eagle commonly known as the American eagle, or golden eagle, alive or dead, or any part, nest, or egg, thereof…." This Act defines take as pursuing, shooting, shooting at, poisoning, wounding, killing, capturing, trapping, collecting, molesting, and disturbing. "Disturb" is defined in regulation 50 CFR 22.3 as "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle, (2) a decrease in its productivity by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

In fall 2009, USFWS implemented two rules (50 CFR 22.26 and 22.27) authorizing limited legal take of bald and golden eagles "when the take is associated with, but not the purpose of an otherwise lawful activity, and cannot practicably be avoided" (USFWS 2010). Failure to comply with the BGEPA can result in criminal penalties.

On February 8, 2011, the U.S. Fish and Wildlife Service released Draft Eagle Conservation Plan Guidance that was published in the Federal Register and was available for public comment until May 19, 2011. The Draft Eagle Conservation Plan Guidance (ECP Guidance) was developed to provide interpretive guidance to wind developers, USFWS biologists who evaluate potential impacts on eagles from proposed wind energy projects, and others in applying the regulatory permit standards as specified by the Bald and Golden Eagle Protection Act and other federal laws.

Although take permits may be issued under these new rules, Buckeye Wind is not seeking a "non-purposeful eagle take" permit under the BGEPA at this time since the Project is not expected to result in activities that would incidentally take (harm or harass) eagles (see Section 4.1.3.1 - Eagles).

### 1.2.3 *State Regulations*

The ODNR DOW has legal authority over OH's fish and wildlife, which includes about 56 species of mammals, 200 species of breeding and migratory birds, 84 species and subspecies of amphibians and reptiles, 170 species of fish, 100 species of mollusks, and 20 species of crustaceans. Additionally, there are thousands of species of insects and other invertebrates which fall under the ODNR DOW's jurisdiction. Ohio Revised Code (RC) 1531.25 grants the chief of the ODNR DOW, with the approval of the wildlife council, the authority to adopt rules, modify and repeal rules restricting the taking or possession of native wildlife that is threatened with state-wide extinction. These rules may only provide for the taking of species for zoological, educational and scientific purpose, and for propagation in captivity to preserve the species. In OH, animals and plants listed as threatened or endangered receive regulatory protection under RC § 1518.01–99; 1531.25, 1531.99. At this time, the ODNR DOW does not have the explicit authority to authorize take for any listed-species, including Indiana bats, for commercial or business purposes such as the construction and operation of the Project.

The first list of OH's endangered wildlife was adopted in 1974 and included 71 species. An extensive examination of the list is conducted every 5 years using input from ODNR DOW staff and other wildlife experts across OH. In 2001, as part of their comprehensive management plan, the ODNR DOW initiated a reevaluation of the endangered species list. During this process, the need for an additional state-list category was recognized and was designated as "Special Interest." The name of the previous special interest category has been changed to "Species of Concern," but retains its original definition. The ODNR DOW now uses 6 categories to define the status of wildlife: endangered, threatened, species of concern, special interest, extirpated, and extinct. These categories are defined as follows:

- Endangered – A native species or subspecies threatened with extirpation from the state. The danger may result from 1 or more causes, such as habitat loss, pollution, predation, interspecific competition, or disease. There are currently 125 endangered species in the state.

- Threatened – A species or subspecies whose survival in OH is not in immediate jeopardy, but to which a threat exists. Continued or increased stress will result in its becoming endangered. There are currently 56 threatened species in the state.

- Species of Concern – A species or subspecies which might become threatened in OH under continued or increased stress. Also, a species or subspecies for which there is some concern, but for which information is insufficient to permit an adequate status evaluation. This category may contain species designated as a furbearer or game species, but whose statewide population is dependent on the quality and/or quantity of habitat and is not adversely impacted by regulated harvest. There are currently 101 species of concern in the state.

- Special Interest – A species that occurs periodically and is capable of breeding in OH. It is at the edge of a larger, contiguous range with viable population(s) within the core of its range. These species have no federal endangered or threatened status, are at low breeding densities in the state, and have not been recently released to enhance OH's wildlife diversity. With the exception of efforts to conserve occupied areas, minimal management efforts will be directed for these species because it is unlikely to result in significant increases in their populations within the state. There are currently 42 species of special interest in the state.

- Extirpated – A species or subspecies that occurred in OH at the time of European settlement and that has since disappeared from the state. Thirty-two species have been extirpated in the state.

- Extinct – A species or subspecies that occurred in OH at the time of European settlement and that has since disappeared from its entire range. Nine species have become extinct in the state.

These categories and the species contained within them are revised by the ODNR DOW as their knowledge of the status of OH's wildlife evolves.

### 1.2.4 *Relevant Federal and State Guidelines and Policies*

#### 1.2.4.1 *USFWS Guidelines for Wind Energy Projects*

The USFWS first addressed wind power and wildlife, specifically migratory birds, by adopting "Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines" in 2003 (USFWS 2003). These Interim guidelines were intended to assist USFWS staff in providing technical assistance to the wind industry to avoid or minimize impacts to wildlife and their habitats through the following measures:

- Proper evaluation of potential wind energy development sites;
- Proper location and design of turbines and associated structures within sites selected for development; and
- Pre- and post-construction research and monitoring to identify and/or assess impacts to wildlife.

The Wind Turbine Federal Advisory Committee (FAC) was established in 2007 by the Secretary of the Interior to provide advice and recommendations on developing effective measures to avoid or minimize impacts to wildlife and their habitats related to land-based wind energy facilities. The FAC drafted an initial set of Recommendations in 2009. In April 2010, the FAC provided to the Secretary a revised set of Recommendations (USFWS FAC 2010). The tiered approach set forth in the FAC's Recommendations is a biologically sound risk assessment approach that includes:

- Formulating appropriate questions regarding potential wildlife impacts;
- Collecting data in ever increasing detail to answer those questions;
- Making risk assumptions based on sufficient data prior to construction of wind facilities;
- Using best-management practices during construction, operation, and decommissioning;
- Testing assumptions after construction and during wind facility operations; and
- Adjusting operations and/or mitigation as needed (USFWS FAC 2010).

The USFWS then convened an internal working group to review the FAC's Recommendations. The working group used the recommendations as a basis to develop Draft Voluntary Land-Based Wind Energy Guidelines, which were released for public review and comment in February, 2011. These Draft Guidelines were available for public comment until May 19, 2011. Two subsequent Revised Draft Voluntary Land based Wind Energy Guidelines were released in July and September, 2011. Final Guidelines were published in March 2012.

The USFWS's July 2010 White Paper on Considerations for Avian and Bat Protection Plans suggests that wind power developers devise and implement an Avian Protection Plan (APP) or ABPP for their projects to demonstrate consideration of and attempts to comply with the MBTA. The intent is that the document should result in an understanding between the project proponent and the USFWS as a "good faith" effort to conserve birds and bats while still allowing for the environmentally friendly development of renewable energy projects.

It should be noted that the 2010 FAC Recommendations were developed after Buckeye Wind was well into the Project siting and permitting; therefore, while siting and environmental review processes were not based on the 2010 Recommendations, this ABPP outlines how processes utilized by Buckeye Wind were nonetheless consistent with the FAC Recommendations. The siting and review processes, pre-construction surveys, and post-construction monitoring protocols for the Buckeye Wind Project were developed in coordination with the USFWS and ODNR DOW.

#### 1.2.4.2 *ODNR DOW Cooperative Agreement*

The ODNR DOW has established the ODNR Protocol for on-shore wind facilities. The standardized procedures will allow the ODNR DOW to make comparisons in order to minimize wind and wildlife interactions in OH. The standardized procedures are made part of an ODNR DOW Terrestrial Wind Energy Voluntary Cooperative Agreement (WEVCA; ODNR DOW 2009) that is intended to establish a framework in which the ODNR DOW and the Cooperator would work collaboratively to ensure that wind-energy projects are developed in an environmentally conscientious manner.

It should be noted that the WEVCA and associated ODNR Protocol were developed after the project had completed a significant portion of pre-construction surveys. It should also be noted that Buckeye Wind – consistent with its corporate policy – nonetheless worked closely with the ODNR DOW to design appropriate pre-construction surveys informed by industry standards and responsible development. Buckeye will continue to work with the ODNR DOW to appropriately address any wildlife concerns.

## 1.3 Corporate Policy and Commitment to Environmental Protection

EverPower and its subsidiaries are dedicated to making environmental compliance and conservation an integral part of the company's operations. EverPower is a fully integrated energy company that develops, constructs, owns, and operates wind power projects across North America. EverPower is dedicated to developing clean energy resources with environmental benefits and delivering the highest values for their partners and the communities where they work, while exhibiting a strong commitment to promoting environmental stewardship and corporate responsibility. Sustainability is an integral part of EverPower's mission statement and minimizing the adverse environmental effects from project development is a key goal for the company. EverPower recognizes that development of its wind projects may have direct and indirect impacts on wildlife and their habitats. Therefore, it is EverPower's policy that project design, construction, and operation programs shall take into consideration measures to avoid and minimize impacts. This ABPP supports practices and processes intended to avoid and minimize impacts to birds and bats from the Project.

EverPower has a proven track record of operating its wind facilities in an environmentally sustainable manner, working cooperatively with state and federal agencies, using best management practices, and following state and federal guidelines to comply with environmental regulations. EverPower is committed to building environmentally responsible renewable energy projects and will continue to work closely with regulatory agencies to develop appropriate measures to minimize and avoid impacts to wildlife.

# 2.0 SITE SELECTION PROCESS

EverPower has a methodology for wind power project site selection that follows a specific process for screening, evaluating, and selecting potential sites. A site selection process was initiated in 2006 in Champaign and Logan Counties. Buckeye Wind relied on input and guidance from the USFWS and ODNR DOW, among other inputs, to inform their site selection process for the Buckeye Project. Though the initial FAC Recommendations (USFWS FAC 2009) were not available when the siting and environmental review process for the Project was initiated, the site evaluation and screening methodology for the Project is very similar to the FAC Recommendations for Tier One site selection (USFWS FAC 2010). The following sections describe how the process Buckeye Wind followed in selecting the Buckeye Project relates to the 5 tier framework set out in the FAC Recommendations.

## 2.1 Tier One – Preliminary Evaluation or Screening of Sites

The first tier in the FAC Recommendations includes a broad-level review of publicly-available information to evaluate potential development sites within a specific landscape area. In 2006, Buckeye Wind began evaluating land in west central OH for potential for wind energy development. Landscape-level screening identified several areas as having potentially suitable wind resources and land lease potential. The evaluation included screening for known and potential occurrence of state and federally listed species, presence of designated Critical Habitat, the location of Important Bird Areas, wildlife management areas, Conservation Reserve Areas, and general ecological context of the potential locations, including the degree of fragmentation, land ownership and land use.

This initial screening eliminated areas that were either adjacent to or part of large blocks of contiguous forested habitat and protected areas. Instead, areas in which prior agricultural practices had created a highly fragmented landscape where wind development would presumably pose less risk to potential species of concern were prioritized for further consideration. This Tier One evaluation identified several land parcels within Champaign and Logan Counties that potentially had adequate wind resources, transmission available within a reasonable distance, and where existing information indicated that risks to bird and bat breeding or migratory areas, important habitat areas, and federally and state listed species would be low.



## 2.2 Tier Two – Site Characterization

In Tier Two, available site-specific information is gathered to further characterize sites identified as potentially suitable in the Tier One evaluation. Site-specific information was obtained from public sources to identify the likelihood of occurrence of wildlife species of concern. Based on areas identified in the Tier One evaluation, the evaluation was further focused to identify areas that could present particular risk to particular species or species groups, such as known or suspected bat hibernacula, area of known raptor or eagle migratory corridors or nesting sites, or records of special status bird or bat species. Ecological resources in the vicinity of the Initial Study Area were also identified through analysis of existing data sources. Data were obtained from the ODNR DOW Ohio Biodiversity Database (OBD; formally the Natural Heritage Database); Ohio Breeding Bird Atlas II; the Ohio Aquatic Gap Analysis Program; the Ohio Frog and Toad Calling Survey; the Ohio Salamander Monitoring Program; and standard biological literature for the region. Additional information was obtained from personal communications with biologists familiar with the natural resources in the area from the Ohio Ecological Services Field Office of the USFWS and the ODNR DOW. These various sources of information were synthesized in order to establish a complete picture of potential species at the Initial Study Area.

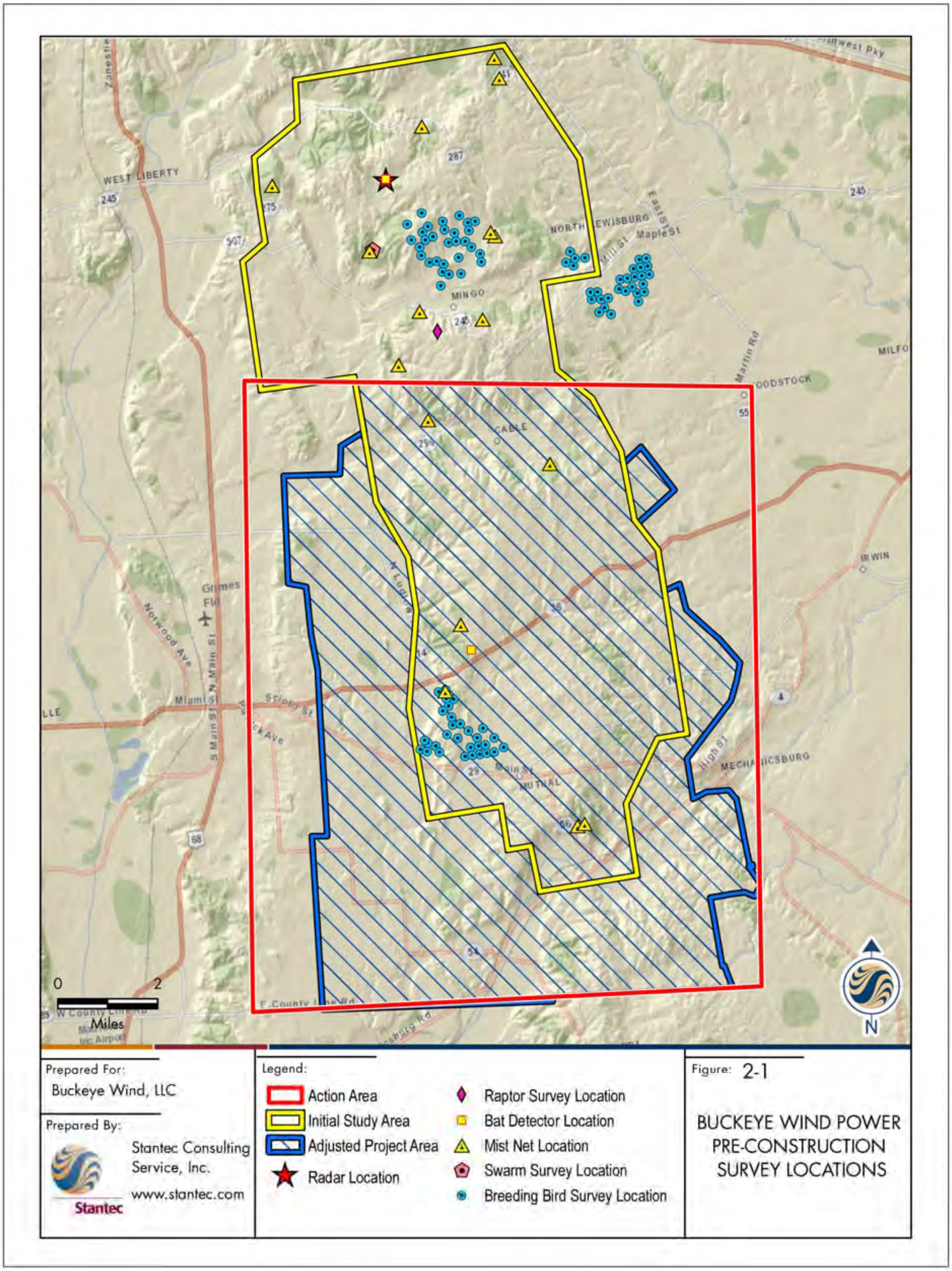
As a result of these evaluations, the Initial Study Area was found to have no known critical areas where wildlife congregate, was highly fragmented from previous and ongoing agricultural activities, and did not appear to contain any federal or state listed species. The area was also found to be sufficiently distant from any known Indiana bat hibernacula (the closest known hibernacula is the Lewisburg Limestone Mine in Preble County, OH, approximately 100 km [62.5 mi] southwest of the Initial Study Area) and did not have any known Indiana bat summer records (Indiana bat summer records in western OH were only known from Greene, Montgomery, and Miami Counties in OH prior to 2008). Thus, the Initial Study Area was considered suitable for further evaluation and in-depth studies to fully characterize the natural resources potentially at risk from development of the Project.

## 2.3 Tier Three – Field Studies to Document Site Wildlife Conditions and Predict Project Impacts

In Tier Three, the FAC Recommendations call for quantitative and scientifically rigorous studies to be conducted to assess the potential risk of a wind project to species and/or habitats of concern. A series of studies were designed based on work plans developed in consultation with the USFWS and ODNR DOW to evaluate bird and bat resources in the Initial Study Area (see Figure 2-1). Study work plans were discussed and shared with the USFWS and ODNR DOW beginning in fall 2007. Several meetings were held in 2007 and 2008 to receive and discuss agency comments, several field visits were conducted with agency representatives, and members of both the ODNR DOW and the USFWS participated in several of the field studies. Agency comments and feedback were subsequently incorporated into final study protocols.

The following baseline Tier Three studies were conducted, which are included as appendices to the EIS:

- Radar studies to document nocturnally migrating birds and bats in fall 2007;
- Bat acoustic surveys using 6 detectors at 2 meteorological (MET) towers in fall 2007, and spring through fall 2008;
- Diurnal raptor migration surveys in fall 2007, and spring and fall 2008;
- Breeding bird surveys in spring and summer 2008;
- Bat mist netting surveys in summer 2008;
- Sandhill crane (*Grus canadensis*) migration surveys in fall 2008;
- Bat swarming surveys at 2 caves openings in fall 2008;
- Surveys to detect potential hibernacula at 14 known/suspected karst areas in 2008; and
- General habitat and surface water mapping in 2009.


Prepared For:
Buckeye Wind, LLC
Prepared By:
Stantec Consulting Service, Inc.
www.stantec.com
Stantec
Legend:
Action Area
Initial Study Area
Adjusted Project Area
Radar Location
Raptor Survey Location
Bat Detector Location
Mist Net Location
Swarm Survey Location
Breeding Bird Survey Location
Figure: 2-1
BUCKEYE WIND POWER
PRE-CONSTRUCTION
SURVEY LOCATIONS
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WOODSTOCK
IRWIN
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These baseline studies were completed to characterize the distribution, relative abundance, behavior, and site use of species of concern identified in Tier One and Tier Two evaluations. As part of the Tier Three evaluations these baseline studies were used to identify to what extent, if any, the development of the Project would expose these species to risk and what additional studies or modeling were needed to assess those risks. Based on the identification of a new summer colony record for Indiana bats in Logan County, the Initial Project Area was adjusted southward to avoid this newly documented colony and adjusted to allow for replacement of potential turbine locations eliminated due to the southward shift (Adjusted Project Area). As a result of this southward shift, the Project will also avoid 2 hibernacula (not Indiana bat hibernacula) documented during pre-construction studies that were within the Initial Project Area. While the original Project designs did not propose to directly impact the hibernacula, the southward shift resulted in a 6.3 km (3.9 mi) buffer from the 2 hibernacula, where collectively 884 non-federally listed bats were captured during 5 swarming surveys in fall 2008 (see Section 3.2.3.2 – Swarming Survey at Hibernacula). The other studies collectively indicated a relatively low risk to breeding and migrating birds and non-federally listed bats (results of these studies are summarized in Section 3.2 – Tier Three Planning Studies).

Upon completion of the 2008 field season, Buckeye Wind, in consultation with the USFWS and ODNR DOW, made a Tier Three decision to proceed with the Project in its adjusted location based on wind resource, transmission availability, constructability, and because site specific baseline studies indicated that the Project site could be developed resulting in mortality rates consistent with other wind facilities within the Midwest region. Buckeye Wind then proceeded to develop an application for a Certificate of Environmental Compatibility and Public Need (CECPN) for approval through the Ohio Power Siting Board (OPSB).

Despite thorough pre-planning, due diligence, and ongoing consultation with state and federal agencies, Indiana bats were unexpectedly discovered in the Action Area in summer 2009 during mist netting surveys conducted as part of an unrelated project. As a result, Buckeye Wind, in coordination with the USFWS, decided to develop a HCP in compliance with Section 10 of the ESA and apply for an ITP, to be able to continue with development and operation of the Project. This decision was made because Buckeye Wind believes that specific avoidance and minimization methodologies are effective in reducing direct and indirect impacts to Indiana bats. The HCP and EIS will be available for public review and comment and this ABPP has been prepared consistent with these documents.

The CECPN for the known 52 turbine location and associated facilities was conditionally approved by the OPSB on 22 March 2010. One of the conditions included in the CECPN is that the Project secure an ITP for the Indiana bat before construction.

### 2.4 Tier Four – Post-Construction Fatality Studies

Post-construction mortality monitoring is recommended in the FAC Recommendations for multiple years for some wind projects, based on the outcome of the Tier Three studies. Tier Four studies for the Project will include post-construction mortality monitoring and potentially other post-construction studies, depending upon the results of initial monitoring. The focus of monitoring will be to document the number and species composition of bird and bat carcasses found beneath turbines. The post-construction mortality monitoring methods will specify the location and size of search areas, duration and frequency of searches, search protocol, staff training, and examples of field survey bias and error assessments that could be used. Mortality monitoring protocols will be developed in consultation with the ODNR DOW and USFWS.

## 2.5 Tier Five – Additional Post-Construction Studies

The FAC Recommendations do not provide specific study protocol recommendations for Tier Five studies because such studies need to be specific to individual sites and issues. With respect to non-federally listed bats and birds, the need for additional minimization, mitigation, or studies will be evaluated based on the results of the first 1 to 2 years of post-construction monitoring data. However, as previously stated, non-federally listed bat and bird mortality will continue to be monitored over the life of the Project, coincident with Indiana bat mortality monitoring that will be conducted as a condition of the ITP. If at any point during other monitoring years, mortality of non-federally listed bats or birds exceeds the Mortality Thresholds, Buckeye Wind will work with the ODNR DOW to determine if any additional mitigation measures are appropriate (see Section 7.0 – Adaptive Management).

# 3.0 ENVIRONMENTAL SETTING

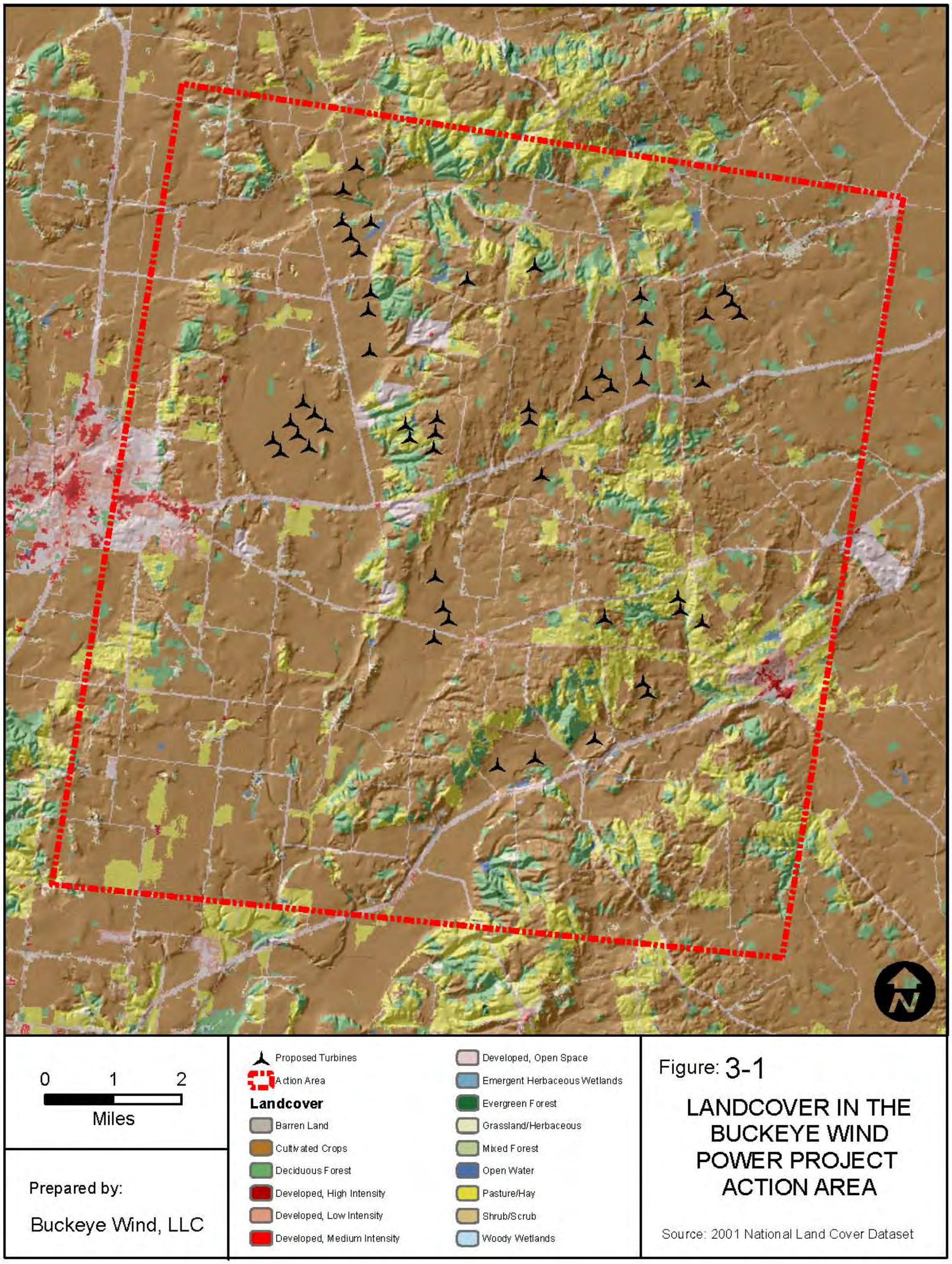
## 3.1 Project Setting

The proposed Project is located in the glaciated Till Plains Section of the Central Lowland Physiographic Province. The topography of the region is characterized by gently rolling hills and moderate slopes with elevations ranging from 396 m to 548 m (1,300 ft to 1,800 ft) above mean sea level. While all Project facilities will be located within the Adjusted Project Area, the Action Area was developed as part of the HCP and EIS process. The Action Area is characterized by a flat and rolling landscape (Figure 3-1). Agriculture (mainly corn and soybean crops) is the predominant land use. The Action Area also contains hayfields and pastureland, some of which are enrolled in the Conservation Reserve Program (CRP; the CRP program and its implications for wildlife habitat will be discussed further in Section 4.1.2 – Breeding Birds). The Action Area also contains scattered stands of mixed hardwood forest that range in size from (3.6 ha to 107 ha (0.2 ac to 263 ac), primarily bordered by agricultural fields, and dominated by oaks (*Quercus* spp.), maples (*Acer* spp.), hickories (*Carya* spp.), and ash (*Fraxinus* spp.). Table 3-1 contains the relative land cover composition within the Action Area.

**Table 3-1.** National Land Cover Database landcover types and size (ha and ac) identified in the Buckeye Project Action Area, Champaign County, OH.

| Landcover type | Hectares | Acres | Percent of action area |
|---|---|---|---|
| Cultivated crops | 22,408 | 55,372 | 69% |
| Hay/pasture | 4,163 | 10,287 | 13% |
| Deciduous forest | 2,744 | 6,779 | 9% |
| Developed, open space | 1,962 | 4,849 | 6% |
| Grassland/herbaceous | 445 | 1,099 | 1% |
| Developed, low intensity | 422 | 1,042 | 1% |
| Open water | 84 | 208 | 0% |
| Developed, medium intensity | 55 | 135 | 0% |
| Emergent herbaceous wetlands | 40 | 100 | 0% |
| Evergreen forest | 31 | 76 | 0% |
| Developed, high intensity | 26 | 65 | 0% |
| Barren land (rock/sand/clay) | 13 | 33 | <0.1% |
| Mixed forest | 2 | 6 | <0.1% |
| Totals | 32,395 | 80,051 | 100% |

Source: Homer et al. 2004




In terms of the amount of wooded area that would be cleared for the Project, 6.5 ha (16.1 ac; 6.8 ha [16.8 ac] for the Redesign Option) of tree clearing is planned for the 100-turbine Project.

This represents approximately 0.2% of the 2,744 ha (6,779.4 ac) of wooded habitat available in the Action Area[3]. These estimates are based on the known 52 turbine layout plus a reasonable estimate for the additional 48 turbines (see Table 3-2 and Table 3-3). Additionally, tree clearing is expected to be spread throughout the Action Area and is not expected to be extensive in any single area.

**Table 3-2**. Worst-case scenario impacts[a] to NLCD 2001 land cover types[b] for the 100-turbine Buckeye Wind Project, Champaign County, OH.

| | Area of disturbance | | | | | | |
|---|---|---|---|---|---|---|---|
| | Total | | | Temporary | | Permanent | |
| Land cover type | Hectares | Acres | Percent of total | Hectares | Acres | Hectares | Acres |
| Cultivated crops | 199.1 | 492.0 | 90.1% | 157.1 | 388.2 | 42.0 | 103.8 |
| Hay/pasture and herbaceous grassland | 0.6 | 1.5 | 0.3% | 0.2 | 0.5 | 0.4 | 1.0 |
| CRP (included in hay/pasture, grassland above) | 11.3 | 27.9 | 5.1% | 9.0 | 22.2 | 2.3 | 5.7 |
| Developed, open space | 3.2 | 7.9 | 1.4% | 2.3 | 5.7 | 0.9 | 2.2 |
| Deciduous forest[c] | 6.4 | 15.8 | 2.9% | 0.0 | 0.0 | 6.4 | 15.8 |
| Emergent herbaceous wetlands | 0.0 | 0.0 | 0.0% | 0.0 | 0.0 | 0.0 | 0.0 |
| Developed, low intensity | 0.2 | 0.4 | 0.1% | 0.1 | 0.2 | 0.1 | 0.2 |
| Evergreen forest | 0.1 | 0.3 | 0.1% | 0.0 | 0.1 | 0.1 | 0.2 |
| Open water | 0 | 0.0 | 0% | 0 | 0.0 | 0 | 0.0 |
| Barren land | 0 | 0.0 | 0% | 0 | 0.0 | 0 | 0.0 |
| Developed, medium intensity | 0 | 0.0 | 0% | 0 | 0.0 | 0 | 0.0 |
| Mixed forest | 0 | 0.0 | 0% | 0 | 0.0 | 0 | 0.0 |
| Developed, high intensity | 0 | 0.0 | 0% | 0 | 0.0 | 0 | 0.0 |
| Total | 220.9 | 545.8 | 100% | 168.8 | 416.9 | 52.2 | 128.9 |

Source: Homer et al. 2004
[a] Impacts are estimated from actual impacts calculations of the known 52 turbines and associated facilities and a reasonable estimate of impacts from the additional 48 turbines based on characteristics of the Action Area and the avoidance and minimization measures described in Sections 6.1 – Avoidance Measures and 6.2 – Minimization Measures.
[b] Numbers based on the NLCD and adjusted for impacts to wooded areas as determined with the 2010 NAIP and specific avoidance measures such as avoidance of wetlands.
[c] Include in the mitigation acres calculation as an offset for cleared wooded areas

[3] Note that much of this area is along the edge of woodlots or along thin/sparse tree lines separating parcels, resulting in a conservative estimate. Avoidance and minimization measures described in Section 5.2.1.1 will reduce the area of tree removal based on construction needs, landowner preference, and quality of habitat.

**Table 3-3**. The Redesign Option worst-case scenario impacts[a] to NLCD 2001 land cover types[b] for the 100-turbine Buckeye Wind Project, Champaign County, OH based on the collection system redesign.

| | Area of disturbance | | | | | | |
|---|---|---|---|---|---|---|---|
| | Total | | | Temporary | | Permanent | |
| Land cover type | Hectares | Acres | Percent of total | Hectares | Acres | Hectares | Acres |
| Cultivated crops | 196.8 | 486.4 | 89.5% | 154.8 | 382.6 | 42.0 | 103.8 |
| Hay/pasture and herbaceous grassland | 0.7 | 1.8 | 0.3% | 0.3 | 0.8 | 0.4 | 1.0 |
| CRP (included in hay/pasture, grassland above) | 12.4 | 30.7 | 5.6% | 10.1 | 25.0 | 2.3 | 5.7 |
| Developed, open space | 3.0 | 7.5 | 1.4% | 2.1 | 5.2 | 0.9 | 2.3 |
| Deciduous forest[c] | 6.7 | 16.5 | 3.0% | 0.0 | 0.0 | 6.7 | 16.5 |
| Emergent herbaceous wetlands | 0.0 | 0.0 | 0.0% | 0.0 | 0.0 | 0.0 | 0.0 |
| Developed, low intensity | 0.2 | 0.4 | 0.1% | 0.1 | 0.2 | 0.1 | 0.2 |
| Evergreen forest | 0.1 | 0.3 | 0.1% | 0.0 | 0.1 | 0.1 | 0.2 |
| Open water | 0 | 0.0 | 0% | 0 | 0.0 | 0 | 0.0 |
| Barren land | 0 | 0.0 | 0% | 0 | 0.0 | 0 | 0.0 |
| Developed, medium intensity | 0 | 0.0 | 0% | 0 | 0.0 | 0 | 0.0 |
| Mixed forest | 0 | 0.0 | 0% | 0 | 0.0 | 0 | 0.0 |
| Developed, high intensity | 0 | 0.0 | 0% | 0 | 0.0 | 0 | 0.0 |
| Total | 219.9 | 543.6 | 100% | 167.4 | 413.9 | 52.5 | 129.8 |

Source: Homer et al. 2004
[a] Impacts are estimated from actual impacts calculations of the known 52 turbines and associated facilities and a reasonable estimate of impacts from the additional 48 turbines based on characteristics of the Action Area and the avoidance and minimization measures described in Sections 6.1 – Avoidance Measures and 6.2 – Minimization Measures.
[b] Numbers based on the NLCD and adjusted for impacts to wooded areas as determined with the NAIP and specific avoidance measures such as avoidance of wetlands.
[c] Include in the mitigation acres calculation as an offset for cleared wooded areas

### 3.2 Tier Three Planning Studies

In order to establish baseline information about wildlife use of the Project area and to evaluate the potential impacts from construction and operation of the Project, a number of wildlife studies were conducted which will be summarized in the following sections. The studies were designed to assess species use within the Initial Study Area. A summary of the results of pre-construction bird and bat studies can be found in Appendix A Tables 1 to 10 and detailed descriptions of survey methods, results, and discussion can be found in the respective seasonal reports (Stantec 2008*a*, Stantec 2008*b*, Stantec 2009*a*, Hull 2009). Additional information regarding the biology of each species group has also been summarized in the EIS and impacts to Indiana bats have been analyzed and described in depth in the HCP.

### 3.2.1 *Habitat and Wetlands Mapping*

An assessment of ecological communities within a 0.4 km (0.25 mi) distance from known 52 turbines and related infrastructure was conducted in 2008 (Hull and Associates, Inc. [Hull] 2009[4]). This evaluation involved mapping and describing plant communities and compiling lists of animals likely to utilize each habitat. Hull (2009) identified and mapped 6 major plant community types: old field, scrub-shrub, young woods, upland ridge, upland woods, and riparian woods. In addition, the locations of the turbine and related infrastructure were screened for major species of biota, including those of commercial or recreational value, and those designated as state or federally threatened or endangered.

A surface water evaluation was performed at all proposed construction areas. Surveys for wetlands and other surface waters were conducted in the immediate vicinity of Project components, including the 52 known turbine locations, access roads, buried and above-ground electrical interconnect lines, and the substation (Hull 2009). Similar evaluations of surface water features will be completed when the 48 additional turbine locations are determined.

Wetlands and other surface waters were identified in accordance with the USACE Wetlands Delineation Manual (Environmental Laboratory 1987), subsequent regulatory guidance issued by the USACE (USACE 2010), and the OEPA guidance on evaluation of streams and wetlands (OEPA 2009).

No wetlands will be impacted by the 100-turbine Project. Limited impacts to streams are anticipated and appropriate state and federal permits will be secured by Buckeye Wind prior to any construction activities that will impact streams. A detailed description of the stream crossings and impacts are included in the EIS.

### 3.2.2 *Bird Studies*

Buckeye Wind worked proactively with the USFWS and ODNR DOW to conduct thorough pre-construction surveys to document spring and fall bird migration patterns through the Initial Study Area and Adjusted Project Area, and to document distribution and species composition of breeding birds within the Initial Study Area and Adjusted Project Area (see Figure 2-1). Buckeye Wind also conducted sandhill crane surveys, and habitat assessments for threatened and endangered species. Buckeye Wind first contacted USFWS and ODNR DOW in 2006 and 2007 when Tier I and Tier II site characterization was underway in order to gather information from these agencies to supplement information from online databases. Surveys analogous to Tier III surveys were developed in coordination with ODNR DOW and USFWS and conducted primarily during 2008 (prior to the ODNR Protocol). Experts from USFWS and ODNR DOW were actively involved in the survey design and execution. Appendix A Tables 3 through 6 include the breeding bird, raptor, and waterfowl and waterbird species detected within or in the vicinity of the Buckeye Wind Project during pre-construction field surveys. All pre-construction avian survey reports are included as Appendices to the EIS.

#### 3.2.2.1 *Breeding Bird Surveys*

Breeding bird surveys were conducted at 90 point count locations within and in the vicinity of the Initial Study Area and Adjusted Project Area (up to a distance of 5.2 km [3.2 mi]; Stantec

[4] The Hull 2009 study covers the known 52 turbine locations and associated infrastructure. Similar studies will be conducted for the remaining 48 and will be made part of the associated OPSB application.

2009*a*) and were sampled 4 times from 3 May 2008 to 29 July 2008. A total of 97 bird species were documented during surveys conducted in forested, agricultural, and hay/pasture habitat (Appendix A Table 3). The most commonly observed species were red-winged blackbird (Agelaius phoeniceus), horned lark (Eremophilia alpestris), American robin (Turdus migratorius), song sparrow (Melospiza melodia), American crow (Corvus brachyrhynchos), and European starling (Sturnus vulgaris).

No federally endangered or threatened species were detected during 2008 breeding bird surveys. One northern harrier (*Circus cyaneus*), listed as state endangered, and one least flycatcher (*Empidonax minimus*), listed as state threatened, were detected. Two state species of concern were detected: bobolink (*Dolichonyx oryzivorus*) (16) and northern bobwhite (*Colinus virginianus*) (2). Two state species of special interest were detected: magnolia warbler (*Setophaga magnolia*) (4) and blackburnian warbler (*Setophaga fusca*) (4). There were 11 species listed as federal species of conservation concern by the USFWS (2008): Acadian flycatcher (*Empidonax virescens*) (1), blue-winged warbler (*Vermivora cyanoptera*) (3), field sparrow (*Spizella pusilla*) (162), willow flycatcher (*Empidonax traillii*) (27), yellow-billed cuckoo (*Coccyzus americanus*) (15), grasshopper sparrow (*Ammodramus savannarum*) (10), horned lark (*Eremophila alpestris strigata*) (427), northern flicker (*Colaptes auratus*) (17), prairie warbler (*Setophaga discolor*) (1), red-headed woodpecker (*Melanerpes erythrocephalus*) (9), and wood thrush (*Hylocichla mustelina*) (39).

As per the ODNR Protocol, a similar breeding bird survey will be conducted for one year post-construction. This post construction survey will not be used for adaptive management purposes because the amount of data will be very low and it is not reasonable that an understanding of avoidance patterns will be deduced from one study. Rather, this study will be used in conjunction with other surveys from other projects and, over an extended time period, avoidance patterns may be able to be appropriately studied.

#### 3.2.2.2 *Raptor Migration Surveys*

Raptor migration surveys were conducted over 11 days from 30 August 2007 to 11 October 2007 (66 hr) from an observation point located within the Initial Study Area and 1.6 km (1.0 mi) north of the Adjusted Project Area (Stantec 2008*a*). After consultation with ODNR DOW, it was determined that additional raptor migration surveys were needed and were subsequently conducted over 32 days from 1 March 2008 to 15 May 2008 (216 hr) and over 24 days from 1 September 2008 to 15 November 2008 (167 hr). Surveys for sandhill cranes were conducted over 12 days from 16 November to 15 December 2008 (84 hr) (Stantec 2009a). All of the above referenced migration surveys were conducted from an observation point located 4.5 km (2.8 mi) north of the Adjusted Project Area. The raptor survey locations were within the Initial Study Area; however, when the Project boundary was shifted to the south to avoid impacts to Indiana bats documented in Logan County in the 2008 mist-netting surveys, the survey locations were outside the Adjusted Project Area boundary. However, as confirmed through consultation with the ODNR DOW, the raptor migration activity observed in the 2007 and 2008 surveys is believed to be representative of raptor migration activity in the Adjusted Project Area because the habitat and landscape features that occurred in the area surrounding the raptor survey locations that might influence raptor use of the area are very similar as those found throughout the Initial Study Area, which included the majority of the Adjusted Project Area.

The most common raptor species observed in all raptor migration surveys was turkey vulture (*Cathartes aura*), accounting for 90% of observations, and red-tailed hawk (*Buteo jamaicensis*) which accounted for 6% of observations (Appendix A Table 4). Fourteen other raptor species were observed in low numbers. There were 3 state listed raptor species observed during the fall 2007 raptor surveys: northern harrier (state endangered) (2), black vulture (*Coragyps atratus;*

state species of concern) (3) and sharp-shinned hawk (*Accipiter striatus; state* species of concern) (4). There were also 4 state listed raptor species observed during the spring 2008 surveys: sharp-shinned hawk (2), northern harrier (5), peregrine falcon (*Falco peregrines;* state threatened; also listed as a federal species of concern) (1) and bald eagle (state threatened, federal species of concern and protected under BGEPA and MBTA) (1); also observed during the 2008 spring raptor survey were 4 sandhill cranes (state endangered). During the fall 2008 raptor migration surveys, there were 3 state listed raptor species observed, bald eagle (1), northern harrier (4) and sharp-shinned hawk (4). One golden eagle, protected under BGEPA and MBTA, was observed in each of the spring and fall 2008 monitoring seasons.

#### 3.2.2.3 *Nocturnally Migrating Bird Surveys*

A fall 2007 radar survey was conducted from 1 September 2007 to 15 October 2007 which included 30 nights of sampling to detect night migrating birds (Stantec 2008*a*). Radar surveys were not required by the ODNR DOW, but were conducted by Buckeye Wind to proactively collect as much information about birds in the Initial Study Area as possible. Surveys were conducted from sunset to sunrise using X-band radar on nights when weather conditions permitted radar operation to adequately document bird movements. The radar was positioned approximately 6.4 km (4.0 mi) north of the Adjusted Project Area near the Champaign-Logan County line. It should be noted that the radar survey location was within the Initial Study Area; however, as the Project boundary was revised, the location was outside the Adjusted Project Area. However, due to proximity to the Adjusted Project Area and similar landscape features between the survey location and the Adjusted Project Area, the results from the radar survey location are believed to be representative of Adjusted Project Area. Moreover, nocturnally migrating passerines have consistently been documented in radar studies to migrate across a broad front, covering hundreds of miles each night, so the location of the survey point generally reflects the use pattern of the surrounding area.

The overall passage rate for the entire survey period was (mean ± standard error): 74 ± 15 targets per km per hr (t/km/hr). Nocturnal passage rates were highly variable among nights, ranging from 0 t/km/hr to 404 t/km/hr. The mean flight direction through the survey area was 194° ± 144° (i.e., slightly southwest). The mean flight altitude of all targets observed on the radar was 393 m ± 12 m (1290 ft ± 39 ft) above ground level (agl). The average nightly flight altitude ranged from 252 m ± 43 m (828 ft ± 140 ft) agl to 506 m ± 27 m (1661 ft ± 88 ft) agl. The percentage of targets observed flying below 150 m (492 ft) agl (maximum turbine height) varied by night from 2% to 38%; however, only 4 out of the 30 nights of sampling did targets flying below 150 m (492 ft) agl exceeded 10%. Passage rates on these four nights ranged from 0 t/km/hr[5] to 97 t/km/hr, with three of the nights having passage rates considerably below the seasonal mean level. The overall average for targets flying below 150 m (492 ft) during the entire survey period was 5% (Stantec 2008a). Radar surveys took place on 30 nights, which spanned the anticipated peak in fall nocturnal migration and sampled nights with a variety of weather conditions, wind speeds, and wind directions. Birds migrating at lower altitudes at night would be at higher risk of coming into contact with wind turbines than those birds flying at heights well above the height of wind turbines, however, no correlation between radar passage rates and risks to avian species has been established. Comparison of passage rates among sites must be done with caution, as differences in passage rates could be due to differences in radar view between sites. This limiting factor makes site-to-site comparisons difficult, and in turn limits ability to ascertain risk based on radar results. Comparison of flight altitudes between survey sites as measured by radar is generally less influenced by site characteristics, as the main portion of the radar beam is

[5] A passage rate of 0 t/km/hr indicates that no targets were observed while the radar was operating in horizontal mode. However, a small number of targets were observed in vertical mode, allowing calculation of the percentage of targets below 150 m.

directed skyward and the potential effects of surrounding vegetation on the radar's view can be more easily controlled. The emerging body of studies characterizing nocturnal migration shows a relatively consistent pattern in flight altitude, with most targets appearing to fly at altitudes of several hundred meters (m)or more above the level of the radar unit (see Stantec 2008a Table 2-1). Since turbines for this Project will be about 150 m tall, this would suggest that risk of collision with migrating birds is low.

##### 3.2.2.4 *Sandhill Crane Surveys*

Sandhill cranes are listed as state endangered. Surveys for sandhill cranes were conducted during 12 days (84 hr) from 16 November 2008 to 15 December 2008. No sandhill cranes were detected during surveys. Four sandhill cranes were observed during the spring 2008 raptor survey (Appendix A Table 6).

In general, few waterfowl or waterbird species were observed during avian field surveys, with the exception of several killdeer (*Charadrius vociferus*) observed during breeding bird surveys in 2008 and Canada geese (*Branta canadensis*) were occasionally detected flying overhead (Appendix A Table 6). Other waterbirds detected include mallard (*Anas platyrhynchos*), wood duck (*Aix sponsa*), and great blue heron (*Ardea herodias*) (Appendix A Table 6). Canada goose is the only waterbird species commonly detected on the Breeding Bird Survey route within the Adjusted Project Area. All of these species are expected to occur as transients within the Adjusted Project Area while en route to preferred habitats.

#### 3.2.3 *Bat Studies*

Buckeye Wind worked proactively with the USFWS and ODNR DOW to conduct thorough pre-construction surveys to document activity patterns of bats with acoustic surveys, bat mist-netting surveys, and swarm surveys at bat hibernacula, as well as habitat assessments for threatened and endangered species. All pre-construction bat survey reports are available as Appendices to the EIS. Buckeye Wind first contacted USFWS and ODNR DOW in 2007 when Tier II-analogous site characterization was underway in order to gather information from these agencies to supplement information from online databases. Tier III-analogous surveys were developed in coordination with ODNR DOW and USFWS, and experts from those agencies were actively involved in the survey design and execution

##### 3.2.3.1 *Mist Netting Surveys*

A total of 298 bats were captured during mist-netting surveys that were conducted on 75 net-nights between 17 June 2008 and 25 July 2008 (Stantec 2008b). Mist-net sampling effort was conducted in portions of both the current Adjusted Project Area and the Initial Study Area to the north. While the Initial Study Area to the north was originally assessed, it was later excluded from the Action Area when the presence of Indiana bats was detected in 2008 as described in Section 1 of this ABPP.

The average capture rate was 4.0 bats per net per night (b/n/n). A total of 7 bat species were captured, with big brown bats consisting of 66% of all captures, followed by northern bats (13%), eastern red bats (12%), little brown bats (6%), hoary bats (1%), tri-colored bats (1%), and Indiana bats (1%) (Table 3-4). All of these bats are state species of concern with the exception of the Indiana bat, which is state (and federal) endangered. Reproduction of all 7 species was documented through the capture of reproductive females. Two reproductive adult female Indiana bats and 1 non-reproductive adult male Indiana bat were captured and radio-tagged north of the Action Area, with the closest capture location approximately 7.8 km (4.8 mi) north, in Logan County.

**Table 3-4.** Bat species captured during summer 2008 mist-netting in the Buckeye Wind Power Project Action Area and Initial Study Area, Champaign and Logan Counties, OH (values in parentheses represent juvenile bats; values not in parentheses represent adults).

| Species | Males | Females | Unknown | Total (% of total) |
|---|---|---|---|---|
| Big brown bat | 51 (39) | 87 (19) | 1 | 197 (66%) |
| Northern | 21 | 16 (1) | 0 | 38 (13%) |
| Eastern red bat | 8 (4) | 12 (8) | 4 | 36 (12%) |
| Little brown bat | 12 (2) | 4 | 0 | 18 (6%) |
| Hoary bat | 0 | 1 (2) | 0 | 3 (1%) |
| Tri-colored bat | 1 | 2 | 0 | 3 (1%) |
| Indiana bat | 1 | 2 | 0 | 3 (1%) |
| All Species | 94 (45) | 124 (30) | 5 | 298 |

#### 3.2.3.2 *Swarming Surveys at Hibernacula*

Bat swarming surveys were conducted in fall 2008 at 2 cave openings (Sanborn's Cave and a nearby, unnamed cave) located approximately 6.3 km (3.9 mi) north of (outside) the Action Area and within the Initial Study Area (Stantec 2009a). At total of 884 bats were captured during 5 capture events from 15 September 2008 to 27 October 2008 using harp traps placed at cave openings and a mist-net across a nearby stream during 1 capture event. Northern bats were the most common species captured during swarming surveys (74%), with males representing 58% of all northern bats captured. The second most frequently captured species was the little brown bat, representing 23% of all bats captured (Table 3-5). Males represented the majority (82%) of all little brown bats captured. The least frequently captured bats were tri-colored bats (2%) and big brown bats (1%). No Indiana bats were captured during the fall 2008 swarming surveys. A survey of 14 areas with known or suspected karst geologic features was also conducted in the vicinity of the Action Area during 2008; no features capable of hosting bats were documented at any of the areas surveyed.

**Table 3-5.** Bat species captured during fall 2008 swarming surveys at Sanborn's Cave and a nearby, unnamed cave located in Logan County, OH, approximately 6.3 km (3.9 mi) north of the Buckeye Wind Power Project Action Area.

| Species | Males | Females | Unknown | Total (% of total) |
|---|---|---|---|---|
| Northern | 380 | 250 | 23 | 653 (74%) |
| Little brown bat | 164 | 37 | 0 | 201 (23%) |
| Tri-colored bat | 9 | 9 | 0 | 18 (2%) |
| Big brown bat | 10 | 2 | 0 | 12 (1%) |
| All Species | 563 | 298 | 23 | 884 |

#### 3.2.3.3 *Acoustic Surveys*

Acoustic bat call sequences were recorded using 6 Anabat SD1 detectors (Titley Electronics Pty Ltd.) at 2 MET towers from 28 August 2007 to 29 October 2007 (Stantec 2008a) and 29 March 2008 to 3 September 2008 (Stantec 2009a). One MET tower was located in the central portion of the Action Area, and another was located within the Initial Study Area, but 6.2 km (3.8 mi) north of the Action Area. Three acoustic bat detectors were placed at each of the "North" and "South" MET towers (Table 3-6) at heights of 2 m (7 ft; "Tree"), 20 m (66 ft "Low"), and 40 m (131 ft "High") agl.

A total of 1,522 bat call sequences were recorded over 226 detector-nights during fall 2007, for a mean nightly detection rate of 6.7 call sequences per detector per night (s/d/n) (Stantec 2008*a*; Table 3-2). The majority of recorded bat call sequences (48%) were identified to the unknown (UNKN) guild, followed by those identified to the big brown bat /silver-haired bat /hoary bat (BBSHHB) guild (34%), the eastern red bat /tri-colored bat (RBTB) guild (18%), and the *Myotis* (MYSP) guild (<1%). Twenty-six percent of call sequences across all guilds, and only 1 MYSP call sequence, were recorded at detectors at the 40 m (131 ft) height.

**Table 3-6.** Distribution of bat acoustic detections by guild at 2 60-m MET towers at the Buckeye Wind Power Project, Champaign County, OH and Initial Study Area, 28 August 2007 to 29 October 2007.

| Detector | Guild | | | | |
|---|---|---|---|---|---|
| | Big brown silver-haired hoary bat (BBSHHB) | Red bat tri-colored bat (RBTB) | Myotis (MYSP) | Unknown (UNKN) | Total |
| North High: 40 m (131 ft) | 101 | 5 | 1 | 69 | 176 |
| North Low: 20 m (66 ft) | 134 | 13 | 3 | 125 | 275 |
| North Tree: 2 m (6.5 ft) | 1 | 3 | 1 | 83 | 88 |
| South High: 40 m (131 ft) | 119 | 3 | 0 | 100 | 222 |
| South Low: 20 m (66 ft) | 45 | 2 | 1 | 32 | 80 |
| South Tree: 2 m (6.5 ft) | 110 | 253 | 0 | 318 | 681 |
| Total | 510 | 279 | 6 | 727 | 1,522 |
| Guild Composition | 34% | 18% | <1% | 48% | NA |

A total of 18,715 bat call sequences were recorded over 774 detector-nights during spring through fall 2008, for a mean nightly detection rate of 23.7 s/d/n (Stantec 2009a; Table 3-7). The majority of calls recorded across all detectors (60%) were identified to the big brown/silver-haired bat (BBSH) guild (separated from the BBSHHB guild in 2008), followed by the UNKN (32%), RBTB (4%), MYSP (3%), and hoary bat (HB; 1%) guilds. Four percent of call sequences across all guilds, and 1% of MYSP call sequences were recorded at detectors placed at 40 m (131 ft) agl. Mean nightly detection rate was variable across seasons, with the highest rates recorded during the fall sampling period.

**Table 3-7.** Distribution of bat acoustic detections by guild at 2 60-m MET towers at the Buckeye Wind Power Project, Champaign County, OH and surrounding vicinity, 29 March 2008 to 3 September 2008.

| | Guild | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Unknown | | | |
| Detector | Big brown silver-haired (BBSH) | Hoary (HB) | Red bat tri-colored bat (RBTB) | Myotis (MYSP) | High frequency (HFUN) | Low frequency (LFUN) | Unknown (UNKN) | Total |
| North High: 40 m (131 ft) | 91 | 9 | 20 | 4 | 35 | 112 | 1 | 272 |
| North Low: 20 m (66 ft) | 495 | 17 | 173 | 21 | 249 | 318 | 32 | 1,305 |
| North Tree: 2 m (6.5 ft) | 7,891 | 44 | 333 | 546 | 1,586 | 1,312 | 200 | 11,912 |
| South High: 40 m (131 ft) | 120 | 29 | 25 | 4 | 44 | 161 | 1 | 384 |
| South Low: 20 m (66 ft) | 343 | 24 | 70 | 4 | 102 | 304 | 3 | 850 |
| South Tree: 2 m (6.5 ft) | 2,298 | 25 | 96 | 24 | 423 | 1,046 | 80 | 3,992 |
| Total | 11,238 | 148 | 717 | 603 | 2,439 | 3,253 | 317 | 18,715 |
| Guild Composition | 60% | 1% | 4% | 3% | 13% | 17% | 2% | |

When comparing 2008 detection rates for Buckeye Wind to other wind project sites in the eastern United States for which data are publicly available (Tables 2-4 and 2-5 in Stantec 2008*a*), the average detection rate at the 4 MET detectors in fall (12.4 s/d/n) was within the range of those observed at other sites in recent years. The fall detection rate at the south tree detector (13.1 s/d/n) was also comparable to rates observed at other sites in the fall; however, the fall detection rate at the north tree detector (256.5 s/d/n) was higher than rates observed in other surveys.

Calls at the north tree detector were comprised mostly of call sequences identified to the BBSH guild (74%; n=3,228); 14% of these calls were identified as big brown bat. The majority of the remaining calls which were not able to be identified to species were likely also big brown bat calls, given that they were recorded at 2 m (7 ft) agl, below the typical flight height of silver-haired bats.

It is important to note that acoustic surveys cannot be used to predict risk of collision mortality at wind facilities. Numbers of recorded bat call sequences are not necessarily correlated with numbers of bats in an area because acoustic detectors do not allow for differentiation between a single bat making multiple passes, and multiple bats each recorded individually (Hayes 2000). Additionally, differences in methodology, sampling duration, annual variation, habitat, detector placement, and physiographic conditions among surveys limit our ability to make meaningful comparisons among studies. Further limiting the applicability of acoustic survey results to predicting risk at wind facilities is the fact that no studies to date have linked pre-construction acoustic activity rates with post-construction fatality rates.

Peak bat activity at almost all detectors was documented during the fall migratory period. When looking at detections of long-distance migratory species at high and low MET detectors from mid-August to early September in 2008, only eastern red bats displayed an obvious peak in activity, based on call files identified to this species (Because only 1% of the bats in this guild were positively identified as tri-colored, it is likely most are eastern red bats). Conversely, hoary and silver-haired bats did not display peak activity in the fall (based on hoary and silver-haired bat call files positively identified to species), but had high detection rates earlier in the survey, during the spring migratory or summer breeding season. Because eastern red bats were the only long-distance migratory species to show a peak in activity at MET detectors during the fall migratory period when bat fatalities have been found to be most numerous, it is possible that bat mortalities at the Project could be greatest in August and early September, and that these mortalities would consist mostly of eastern red bats because of the observed species composition of that guild.

# 4.0 AVIAN AND BAT CONCERNS

As discussed previously, the most likely direct (or immediate) effects to birds and bats from the proposed Project is turbine-associated collision mortality and/or barotrauma for bats (tissue damage to air-containing organs due to rapid-air pressure reduction at moving turbine blades). Other direct effects to birds and bats may also result from noise, increased human presence, and other disturbances associated with Project construction activities, or displacement effects from the operating wind facility. Because potential impacts and actions to manage those impacts will differ between species groups, bird and bat species are divided among the following groups:

- Birds
  - nocturnally migrating birds;
  - cranes, waterfowl and other water birds;
  - resident breeding birds; and
  - migrating raptors.
- Bats:
  - long-distance migratory bats; and
  - cave-hibernating bats (including Indiana bats).

For each species group, the potential impacts from the proposed Project will be described based on the results of Tier III-analogous pre-construction field surveys, as well as information from other studies and published literature. The specific Project design and construction measures, avoidance and minimization measures, and potential mitigation options to address impacts will be discussed in Sections 5.0 and 7.0.

## 4.1 Birds

Collision with various man-made structures is a significant source of bird mortality (Trapp 1998, Kerlinger 2000, Shire et al. 2000, and many others). Large, episodic mortality events, sometimes involving hundreds of birds at 1 location in 1 night, have been documented at tall structures such as guyed communication towers, lighted buildings, and lighthouses (Shire et al. 2000, Gehring et al. 2009, Avery 1979). Nationally, wind turbines are estimated to be responsible for 0.01% to 0.02% of all avian fatalities resulting from collision with anthropogenic structures (Erickson et al. 2005). Table 1-1 summarizes estimated annual avian mortality from anthropogenic causes, including wind turbines.

A recent publication from the USFWS estimates that 440,000 birds are killed by wind turbines annually (Manville 2009). However, that estimate implies a mortality rate of about 16 birds per MW (given an installed capacity of 25,000 MW in 2008), which is significantly higher than mortality rates actually reported from various projects throughout the Midwest.

More current information with most, if not all, studies accounting for searcher efficiency or carcass persistence, is available from eastern and Midwestern sites. The average avian mortality rate reported at wind facilities in the east and Midwest is approximately 3.93 b/t/y (Osborn et al. 2000; Johnson et al. 2000, 2002; Howe 2002; Kerns and Kerlinger 2004; Arnett 2005; Koford et al. 2004, 2005; Piorkowski 2006; Derby et al. 2007; Fiedler et al. 2007; Jain et al. 2007, 2008; Miller 2008; Stantec 2008*c;* Vlietstra 2008, 2009*abcd;* Arnett et al. 2009; Gruver 2009; NJ Audubon Society 2009; Stantec 2009*bc*; Tidhar 2009; Young et al. 2009; Stantec 2010*ab*; Drake et al. 2010). The highest reported avian mortality among these studies (11.8 b/t/y) was documented at the Blue

Sky Green Field Project in WI (Gruver et al. 2009). Bird fatality estimates for wind-energy facilities in the west and upper Midwest range from 0.4 to 11.8 b/t/y (multiple studies as cited in Poulton 2010). The correlation between habitat type and avian mortality remains unclear due to other confounding factors such as bird density and behavior.

Although avian collision mortality can occur during both the breeding and migration seasons, patterns in avian mortality at tall towers, buildings, wind turbines, and other man-made structures suggest that the majority of fatalities occur during the spring and fall migration periods (NRC 2007, NWCC 2010). Overall, no particular species has been identified as incurring greater numbers of fatalities at wind energy facilities. However, it has been documented that night-migrating passerines experience the highest frequency of fatalities (Lilley and Firestone 2008). In general though, and likely due to differences in abundance, use of habitat, and behavior, bird groups have experienced varied impacts from wind turbines. Table 4-1 provided below is the general distribution of fatalities across bird groups, as reported by 24 publicly available post-construction mortality studies conducted at 19 different locations and habitat types (e.g., agricultural, upland, forested ridgeline, coastal, and grassland) in the eastern and Midwestern United States. A total of 868 avian fatalities, comprised of at least 7 bird groups, were documented either during standard searches or as incidental observations. Songbirds account for the highest number of wind-related fatalities in the eastern and Midwestern United States (Table 4-1) and across the nation (NWCC 2010).

Although bird mortality rates have been found to be variable among facilities and regions (NWCC 2010), the number of avian fatalities at wind energy facilities has generally been low when compared to the total number of birds passing through these sites (Erickson et al. 2002, comparing results of radar surveys concurrent with mortality monitoring).



**Table 4-1**. Documented avian fatalities at wind energy facilities between 1994 and 2009 in the eastern and Midwestern United States. (Note: Data represent individuals found and are not estimates of annual fatality; fatality data were not corrected for biases related to searcher efficiency or carcass persistence.)

| Bird group | # individuals | % of total fatalities |
|---|---|---|
| Passerine | 628 | 72.4% |
| Unknown species | 108 | 12.4% |
| Raptor | 46 | 5.3% |
| Waterfowl | 21 | 2.4% |
| Gamebird | 41 | 4.7% |
| Shorebird | 14 | 1.6% |
| Seabird | 6 | 0.7% |
| Owl | 4 | 0.5% |
| **Total** | 868 | 100.0% |

**Sources:** Osborn et al. 2000; Johnson et al. 2000, 2002; Howe et al. 2002; Kerns and Kerlinger 2004; Koford et al. 2005; Arnett 2005; Piorkowski 2006; Derby et al. 2007; Fiedler et al. 2007; Jain et al. 2007, 2008, 2009*abcd;* Miller 2008; Stantec 2008*c*, 2009*bc*, 2010*b;* Vlietstra 2008; Arnett et al. 2009; Gruver et al. 2009; NJ Audubon Society 2009; Tidhar 2009; Young et al. 2009; and Drake et al. 2010.

### 4.1.1 *Nocturnally Migrating Songbirds*

Indirect effects (separated in time) to nocturnally migrating birds during Project siting and construction may include habitat loss or modification that occurs while the birds are not in the breeding season, though these indirect effects are minimal because the Action Area is not located in a major migratory pathway and the habitat disturbance due to the Project is minor (0.15% of the entire Action Area will be disturbed). Direct (immediate) effects could include collision with turbine blades, towers, or MET towers.

As previously stated, the majority of avian mortality at tall man-made structures, including wind turbines, has primarily involved nocturnally migrating songbirds (NWCC 2010). At existing wind facilities in the east and Midwest, approximately 72% of documented avian fatalities have consisted of songbirds (Table 4-1). Nocturnal migrant songbird fatalities most frequently documented at existing wind facilities in the east and Midwest are regionally common and abundant species, such as golden-crowned kinglet (*Regulus satrapa*) and red-eyed vireo (*Vireo olivaceus*) (Sauer et al. 2005). Among the eastern and Midwestern mortality monitoring studies referenced in Section 4.1 – Birds, there were 79 and 61 documented golden-crowned kinglet and red-eyed vireo fatalities, respectively, at all sites combined (note that these numbers include observed mortality and were not corrected for searcher efficiency or carcass persistence). The estimated North American population is 34 million and 140 million for golden-crowned kinglet and red-eyed vireo, respectively (Sauer et al. 2005).

Abundance alone may not necessarily result in increased collision risk. For example, at the Cohocton and Dutch Hill wind farms (agricultural and wooded habitat) in Stueben County, NY, horned lark were frequently observed in the project areas during pre- and post-construction surveys (Woodlot 2006*ab*, Stantec 2010*a*); however, there were no documented horned lark fatalities during 2 years of post-construction monitoring (Stantec 2010*a*, Stantec 2011). Trends observed for certain species in the western United States are not necessarily observed in the east. For example, while horned lark are among species most commonly reported during fatality studies at western wind facilities (WEST Inc. 2010, Poulton 2010), there have been relatively few horned lark fatalities at eastern and Midwestern sites (Poulton 2010). Among all eastern and Midwestern mortality monitoring studies referenced in Section 4.1 – Birds, there have been 16 horned lark fatalities (observed fatalities only and uncorrected for searcher efficiency and carcass persistence).



Although nocturnally migrating songbirds are expected to pass above the Action Area during spring and fall migration periods, most of these individuals are flying at consistently high altitudes above the height of the turbines, as has been documented in the vast majority of recent radar surveys conducted at proposed wind facilities in the northeast (Appendix B Table 1). The results of the radar study in the Initial Study Area indicate that passage rates were low when compared to other sites in the United States with publicly available data. Additionally, the mean flight altitude of targets (assumed to primarily consist of night-migrating passerines, but could also include bats) indicates that the majority of nocturnal migration in the area occurred well above the maximum height of the wind turbines. The average flight altitude was 393 m (1,289 ft) and only 5% of the targets flew below the maximum turbine height (150 m; Stantec 2008*a*). These findings indicate that the Project does not have a high potential for impacts to nocturnal migrants in comparison to other sites.

It is anticipated that certain Project design and management actions can reduce risk to nocturnal migrants. The measures that Buckeye Wind will be implementing are described in greater detail in Section 5.0 – Avoidance and Minimization Measures. Additionally, nighttime operational adjustments that will be implemented to reduce impacts to Indiana bats as a condition of the HCP are also expected to reduce risk of collision for nocturnally migrating birds, although the effectiveness of feathering for reducing bird mortality has not been tested.

Buckeye Wind anticipates generally low levels of seasonal songbird collision mortality during migration, which is consistent with documented avian fatalities at existing wind facilities. While it is clear that impacts to nocturnally migrating songbirds occur at wind energy facilities, the number of impacted birds is small relative to their total populations and to other anthropogenic sources (see Table 1-1). According to the NWCC (2010), a consensus-based collaborative comprised of representatives from state and federal government, the utility, wind industry, and environmental sectors (among others), wind turbine related mortality is unlikely to affect songbird population trends.

### 4.1.2 *Breeding Birds*

Indirect effects to breeding birds during Project siting and construction may include habitat loss or modification that occurs while the birds are not in the breeding season. Direct (immediate) effects include disturbances associated with increased human presence and noise associated with construction activities that may result in displacement. In addition, direct effects from construction include collision with construction and maintenance vehicles.

Although there will be some degree of loss of habitat and/or habitat alteration, over 90% of the total disturbed area during construction of the Project will occur in areas classified as cultivated crop land cover types. Agricultural land is generally thought to provide marginal quality habitat for wildlife because it is fragmented and subject to periodic disturbance from mowing, plowing, and harvesting. However, some habitat generalist and grassland breeding birds will use agricultural fields, hay fields, and pastures, particularly if they are not mowed until after June. If pastures contain seasonal sources of water, they can provide breeding habitat for some species of ducks and shorebirds.

Agricultural lands enrolled in the CRP program may also provide higher quality habitat for grassland and upland nesting species. The CRP program is a cost-share and rental payment program administered by the United States Department of Agriculture (USDA) Farm Service Agency (FSA) that encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to natural vegetative cover by planting native and non-native grasses and trees. The quality of habitat on CRP land for wildlife will depend on how long the land has been enrolled in the program and taken out of crop rotation and what type of habitat improvements have been made. For the 100-turbine Project, it is anticipated that not more than 6 turbines will be located in CRP land. Permanent impacts include 2.3 ha (5.7 ac), which represents 0.2% of CRP land in the Action Area (approximately 1250 ha [3,088 ac]). An additional 9.0 ha (22.2 ac) will be temporarily disturbed. For the Redesign Option, 2.3 ha (5.7 ac) of permanent disturbance and 10.1 ha (25.0 ac) of temporary disturbance will occur.

Project components sited in CRP land will result in temporary and permanent loss of grassland habitat that provide higher quality habitat for breeding grassland and upland bird species than active agricultural land. However, CRP designations are temporary in nature and dependent on landowner participation; contracts are issued for 10 or 15 years, but can be broken, subject to penalties. Landowner participation is strongly influenced by commodity prices (i.e., the price of corn, soybeans, and derived products, such as biofuels), which affect the relative financial benefits of participation in the program. As the price of commodities increase, there is a disincentive for farmers to keep their lands in CRP because the price of rental payments will decrease relative to economic rewards of active crop production. Therefore, the amount of land in CRP changes significantly over a relatively short period of time. The 11.3 ha (27.9 ac; 12.4 ha [30.7 ac] redesign) of total CRP land in the Action Area that will be temporarily and permanently removed as a result of Project development will not drastically change the landscape of the Action Area. Furthermore, CRP that is temporarily disturbed will be re-planted consistent with the CRP program established on the respective property. Additionally, this amount is small compared to variation of CRP participating land that would occur from normal land management practices in the Action Area over time (i.e., potential conversion of CRP land back to active crop). To further avoid and minimize potential effects to grassland birds, CRP land will be cleared only during the non-breeding season for grassland birds (before 1 Mar and after 15 Jul).

Potential impacts to forest-associated breeding birds are anticipated to be minimal because there will be a small amount of tree clearing during Project construction compared to forested habitat available in the Action Area. Construction impacts anticipated for the 100-turbine Project will affect up to 6.5 ha (16.1 ac) of forested habitat (National Land Cover Database [NLCD] and National Agriculture Imagery Program [NAIP]), which represents 0.2% of 2,743.5 ha (6,779.4 ac) of forested habitat in the Action Area (6.8 ha [16.8 ac] for the Redesign Option)[6]. Forest removal will be spread throughout the Adjusted Project Area and is not expected to be extensive in any single area. In order to avoid potential direct effects to Indiana bats, tree clearing activities will be conducted between 1 November and 31 March, which should also minimize impacts to forest-associated bird species which would not be breeding at this time. The largest forest area planned for removal is (1.1 ha [(2.7 ac]). In general, tree removal will occur at the edges of larger forest stands.

Impacts to breeding birds could occur as a result of increased human presence and noise associated with construction activities. The significance of these types of impacts will likely vary by species. Because most construction activities will occur in agricultural land and early successional habitat, species utilizing those habitats (such as grassland bird species) are most likely to be disturbed/displaced by construction activities. Disturbances associated with construction activities will be temporary, as the 52 and 48 turbine phases are expected to be commissioned 12 months to 18 months after initiation of construction. While the rate of displacement, if any, and the rate of re-colonization of displaced species and the impact of temporary or permanent displacement is not known, given the small area of disturbed habitat there is not expected to be significant adverse impacts to affected species.

Risk of collision with vehicles during construction of the Project is expected to be somewhat higher for birds than bats, as construction activity will occur mostly during the day when the majority of breeding birds are active. However, risk of collision for both birds and bats is expected to be low since construction vehicles are expected to be large, slow-moving trucks. Once the proposed Project is operational, maintenance associated with the Project will not significantly contribute to traffic on local roads. Additionally, given that increased vehicular traffic resulting from Project construction will occur over a limited time period, estimated to span less than 2 years, vehicle collision events are expected to be minimal and not result in significant impacts to bird species.

Available post-construction studies have indicated some level of displacement of breeding birds in locations in close proximity (50 m to 200 m [164 ft to 656 ft]) to operational turbines at projects in similar landscape settings; however, results have been mixed (Poulton 2010). Studies conducted at the Buffalo Ridge Wind Power Plant (Buffalo Ridge) in southwestern MN reported that birds in general avoided flying in areas with turbines and reported fewer individuals and species in survey plots with turbines, as compared to reference survey plots (Osborn et al. 1998).

[6] Note that much of this area is along the edge of woodlots or along thin/sparse tree lines separating parcels, resulting in a conservative estimate. Avoidance and minimization measures described in Section 6.0 will likely reduce the area of tree removal to less than the estimated 6.5 ha (16.1 ac), or 6.8 ha (16.8 ac) for the Redesign Option, based on construction needs, landowner preference, and quality of habitat.

Although the majority of grassland breeding birds decreased their use adjacent to turbines at Buffalo Ridge, waterfowl were observed to continue use of the area (Osborn et al. 1998). Also at Buffalo Ridge, male songbird densities were 4 times greater in reference CRP grasslands, as compared to CRP grasslands located within 180 m (591 ft) of turbines (Leddy et al. 1999). Johnson et al. (2002) reported 65% of bird groups were not displaced within 100 m (328 ft) of turbines at Buffalo Ridge; however, certain bird groups and species were displaced.

At the Maple Ridge Wind Power Project in northeastern NY, bobolink density was lower in hayfields within 75 m (246 ft) of turbines compared to hayfields without turbines, but no difference in bobolink density was detected in hayfields within 100 m to 400 m (328 ft to 1,312 ft) of turbines compared to hayfields without turbines (Kerlinger and Dowdell 2008). In a study at the Stateline Wind Project in OR and WA, grasshopper sparrows (*Ammodramus savannarum*) and western meadowlarks (*Sturnella neglecta*) showed a significant decrease in use within the first 50 m (164 ft) of the turbines (WEST and Northwest 2004).

Based on these studies, some degree of displacement of certain species of grassland birds in the vicinity of turbines is possible, with most impacts occurring within 50 - 200 m (164 - 656 ft) of the turbines. Assuming displacement within 50 - 200 m of Project turbines, birds could be displaced from approximately 110 ha (280 ac) – 1,300 ha (3,100 ac) for a 100-turbine project, which comprises 0.3% – 4.0% of the total Action Area size. However, given that clearing will be limited to non-breeding seasons and over 90% of the Action Area is agricultural land, the amount of any potential displacement is expected to be limited. Thus, displacement is not expected to significantly affect local breeding bird populations.

There is collision risk for breeding birds with turbine structures during the lifespan of the Project. While the majority of avian collisions at existing wind projects occurs during spring and fall migration and appears to be primarily nocturnally migrating songbirds, collisions are also known to occur during the breeding season. Post-construction monitoring will assess turbine collision impacts for breeding birds. Due to the siting of turbines largely in agricultural habitat and other avoidance and minimization measures described in Section 5.0 – Avoidance and Minimization Measures, impacts are not expected to adversely impact local populations of breeding birds. Should mortality of birds or bats exceed Mortality Thresholds (see Section 7.1 – Calculation of Threshold Levels, Buckeye Wind will work with the ODNR DOW and USFWS to determine what additional measures could help bring mortality to within the Mortality Thresholds while maintaining the economic viability of the Project (see Section 7.1 – Calculation of Threshold Levels).



### 4.1.3 *Migrating Raptors*

Potential impacts to migratory raptors include risk of collision during operation of the Project. Migratory raptors were observed in the Action Area but occurred in relatively low numbers compared to raptors observed at regional Hawk Migration Association of North America (HMANA) sites. During fall 2008, observation rates at regional HMANA sites ranged from 5.2 birds/hr to 3,082.8 birds/hr (Stantec 2009*a*). The most active site was Detroit River Hawk Watch (DRHW), Pointe Mouillee, MI, and is the HMANA site most near to the Action Area (approximately 217 km [135 mi] north from the center of the Action Area). At DRHW, 323,691 raptors were counted during 105 survey hours (3,082.8 birds/hr) during fall 2008. This was likely due to the close proximity of DRHW to Lake Erie, which is known to concentrate large numbers of raptors.

When compared to 14 other publicly available wind project spring pre-construction raptor surveys conducted from 1999 to 2006, the passage rate observed for the Project in spring 2008 (6.8 birds/hr) was similar to that of many projects in agricultural settings. The average passage rate for these sites was 5.2 birds/hr (rate range 0.9 birds/hr to 25.6 birds/hr) (see Appendix B,

Table 2). When compared to passage rates for 17 other wind project fall pre-construction surveys conducted from 1996 to 2007, the passage rate for the Project in fall 2008 (3.5 birds/hr) is among the lowest (see Appendix B, Table 3)[7]. Passage rates for other fall surveys averaged 4.4 birds/hr (rate range 3.0 birds/hr to 12.7 birds/hr). Geographical location and topography can affect the magnitude of raptor migration at a particular site. The lower passage rate at the Project is likely due to a lack of landscape features with dramatic relief or steep topography which may create updrafts that concentrate raptor migration, and lack of large bodies of water that may funnel some migrating raptors along shorelines.

Based on data collected in eastern and Midwestern avian mortality monitoring studies (Table 4-1), raptors have been found to represent approximately 5.3% of documented avian fatalities. Studies at wind energy facilities document increases in raptor mortality as levels of raptor use in the area increase (NWCC 2010). Table 4-2 shows the species most commonly found during fatality searches in the east and Midwest; red-tailed hawks and turkey vultures have comprised the majority of documented fatalities. These species forage in open country and are regionally common and abundant. For example, the North American population of red-tailed hawks and turkey vultures is estimated to be 1 million and over 3 million, respectively (Wheeler 2003). Note that numbers presented in Table 4-2 are reported individual fatalities and have not been corrected for searcher efficiency or carcass persistence, which presumably would result in higher numbers of raptor fatalities. Despite this, these data provide useful information on the relative rates of mortality for different raptor species.

**Table 4-2.** Species composition of documented raptor fatalities at wind facilities in the eastern and Midwestern United States (Note: Data represent observed mortality and have not been corrected for searcher efficiency or carcass persistence biases).

| Species | Number of fatalities |
|---|---|
| Red-tailed hawk | 16 |
| Turkey vulture | 16 |
| Sharp-shinned hawk | 5 |
| American kestrel | 4 |
| Broad-winged hawk | 2 |
| Osprey | 2 |
| Cooper's hawk | 1 |

Sources: Osborn et al. 2000; Johnson et al. 2000, 2002; Howe 2002; Kerns and Kerlinger 2004; Koford et al. 2004, 2005; Arnett 2005; Piorkowski 2006; Derby et al. 2007; Fiedler et al. 2007; Jain et al. 2007, 2008, 2009*abc;* Miller 2008; Stantec 2008*c*, 2009*bc*, 2010*a;* Vlietstra 2008; Arnett et al. 2009; Gruver 2009; NJ Audubon Society 2009; Tidhar 2009; Young et al. 2009; and Drake et al. 2010.

Estimated species-specific raptor mortality, based on the results of post-construction mortality monitoring at operational facilities within landscapes similar to the Project is presented in Table 4-4. These data, combined with the results of pre-construction surveys, indicate a low collision risk for raptors in the Action Area. The level of raptor mortality for the Project and the species

[7] While methodologies may differ among these surveys as it relates to level of effort (number of days surveys are conducted, number of points surveyed, number of hours surveyed, etc.), these data are reported in terms of birds/hr, providing sufficiently standardized data points and allowing for a reasonable comparison across the survey results.

involved in collisions are expected to be similar to those documented at operational facilities within similar landscapes in the eastern and Midwestern United States (i.e., generally less than 2 raptors per monitoring year [Poulton 2010, NWCC 2010], involving mostly red-tailed hawks and turkey vultures).

**Table 4-4.** Raptor mortality estimates per species at New York facilities in agricultural plateau/wooded landscapes.

| Project name | Survey year | Species | Search interval | Estimate/turbine/study period | Citation |
|---|---|---|---|---|---|
| Maple Ridge | 2006 | American kestrel | weekly | 0.07 | Jain et al. 2007 |
| Maple Ridge | 2007 | red-tailed hawk | weekly | 0.41 | Jain et al. 2008 |
| Maple Ridge | 2007 | sharp-shinned hawk | weekly | 0.00 | Jain et al. 2008 |
| Maple Ridge | 2008 | American kestrel | weekly | 0.02 | Jain et al. 2009a |
| Maple Ridge | 2008 | Cooper's hawk | weekly | 0.02 | Jain et al. 2009a |
| Maple Ridge | 2008 | sharp-shinned hawk | weekly | 0.02 | Jain et al. 2009a |
| Clinton | 2008 | broad-winged hawk | 3-day | 0.43 | Jain et al. 2009b |
| Ellenburg | 2008 | broad-winged hawk | daily | 0.48 | Jain et al. 2009c |
| Bliss | 2008 | red-tailed hawk | daily | 0.18 | Jain et al. 2009d |
| Bliss | 2008 | sharp-shinned hawk | 3-day | 0.28 | Jain et al. 2009d |



#### 4.1.3.1 *Eagles*

In November 2011, the USFWS provided results of a risk assessment for potential impacts to eagles from the Project. The USFWS considered the following sources of information in making its assessment:

- Buckeye Wind Fall 2007 Bird and Bat Migratory Survey Report - Visual, Radar, and Acoustic Bat Surveys for the Buckeye Wind Power Project in Champaign and Logan Counties, OH
- Spring, Summer, and Fall 2008 Bird and Bat Survey Report for the Buckeye Wind Power Project in Champaign and Logan Counties, OH
- Avian Studies for the Champaign Wind Farm Champaign County, Ohio Final Report September 4, 2008 – January 28, 2010 (study completed for an unrelated wind farm that was entirely within the Action Area)
- Site specific investigations by Service biologists during the summer and fall of 2011

The remainder of this section is a re-production of the USFWS's assessment (USFWS 2011):

"Surveys conducted for the Project collectively observed one bald eagle and one golden eagle during the fall migration period, and one bald eagle and one golden eagle during the spring migration period. The golden eagle in the spring and bald eagle in the fall were flying within the rotor-swept zone of the turbines (defined as below 150 m). The golden eagle in the fall and the bald eagle in the spring were flying above the rotor-swept zone of the turbines. Additionally breeding bird surveys were conducted in May, June, and July 2008 and no bald or golden eagles were observed."

"Similar surveys were conducted for another project within the current Buckeye Wind Action Area, also following recommendations provided by the Service and ODNR. For that project, passerine migration surveys were conducted at four point-count stations in the proposed Action Area. Surveys were conducted once per week from September 16 through November 14, 2008, April 2 through May 26, 2009, and August 21 through September 15, 2009. A total of 120 breeding bird surveys were conducted during summer of 2009 at 40 survey points established across the study area relative to the proportion of individual habitat types. Diurnal bird/raptor migration surveys were conducted three times per week during the fall 2008 (September 4 – October 31) and spring 2009 (March 18 – May 2) at four point-count stations for a total of 170 survey events within the Action Area. The four survey points were selected to maximize viewsheds in roughly 360º around the point. Sandhill crane migration surveys were an extension of weekly diurnal bird/raptor migration protocol. Surveys were conducted approximately three days per week from November 3 through December 14, 2009. Throughout all of these surveys, ten bald eagles were documented during the fall migration period. Two of these observations were of birds within the rotor swept zone (defined as between 20-120 m). A search for nesting raptors was conducted on March 24, 2009 encompassing approximately half of the current Buckeye Wind Action Area. No bald eagle nests were observed."



"USFWS biologists received incidental observations from local landowners that reported juvenile bald eagles within the action area during the summer and fall of 2011. USFWS biologists met with landowners to discuss and verify their observations. One sighting was verified with an audio/video recording[8]. The other sightings were unverified. An additional sighting of an adult bald eagle in November 2009 was verified with a photograph from the local newspaper. Although this information is noteworthy in our risk assessment and is mentioned below to support the notion that eagles occasionally use the habitat within and around the project area, it is not appropriate to include incidental observations in the predictive model with the formal pre-construction monitoring survey data outlined below. It is also noteworthy that, in an effort to verify these sightings and update the area nest survey data, USFWS biologists canvassed the western portions of the action area on October 25, 2011, searching for eagle nests in the area where residents had reported eagle observations. No eagle nests were observed."

*Breeding Season*

"As described above, raptor nest searching was conducted in March 2009 and October 2011, and ODNR's bald eagle monitor was contacted to determine if bald eagle nests exist within proximity to the Buckeye Wind project. No eagle nests were identified within

[8] After the risk assessment was provided by the USFWS, an additional photo-verified siting of an adult bald eagle on 23 Nov 2011 was received from a local resident. Additionally, there was a report in February 2012 of a bald eagle nest greater than 6.5 mi from the Action Area boundary although the exact location is not known. Given this distance, USFWS concluded that it does not think that this pair would be likely to forage or roost within the Action Area.

the Action Area. An analysis of the proposed site and surrounding area using 2011 nesting data provided by ODNR has located one known active bald eagle nest (an eagle use area) approximately 9 miles north of the Action Area. Although the movements of breeding eagles may vary drastically among adults and among territories, at this distance there is likely no overlap between the Action Area and the established territory of this pair. Non-breeding eagles (juveniles, sub-adults, or adult "floaters") have been reported by local landowners within the Action Area during the summer, and one report of a sub-adult eagle was verified with an audio/video recording. While some non-breeding eagle use was reported by residents, the formal surveys that were conducted within the action area most recently in 2009 did not detect any eagle use during the breeding season. Overall, based on this initial assessment, it appears that risk to eagles during the breeding season may be relatively low at this site. However, to our knowledge there are limited to no data during the courtship/nest building period (mid-Jan to Feb). Because of this, there is uncertainty in our eagle risk assessment during this time of the year."

*Winter Season*
"There is not substantial information on winter eagle concentration areas and winter eagle movements in Ohio. According to the Avian Knowledge Network (Munson et al. 2011), which compiles bird data from various sources made publically available, the data for Champaign, Logan and Clark Counties do not indicate any records for wintering bald eagles in these Counties from 1991-2011. Madison and Union Counties, which border the Action Area to the east, each have 0-2 wintering eagle observations total since 1991. Further the Sandhill crane surveys conducted within the Action Area from November 3 through December 14, 2009 did not detect any eagles. No large water bodies such as reservoirs or major river corridors exist within the Action Area that could serve as feeding areas during the winter for bald eagles. From the details above, it appears that risk to eagles during the winter may be relatively low at this site. However, there are no data available on eagle use from mid-December until the start of the breeding season (mid-January) and the November-December data that is available was collected over approximately one-half of the Action Area. Because of this, there is uncertainty in our eagle risk assessment during this time of year."



*Migration Season*
"Migration surveys were conducted during fall 2007, spring and fall 2008, and spring and early fall 2009, as described in detail above. During all of these survey events one bald eagle and one golden eagle were observed during spring migration, and 11 bald eagles and one golden eagle were observed during fall migration. Three of the bald eagles during the fall migration period were flying within the rotor-swept zone. One golden eagle in spring was flying within the rotor-swept zone."

"As mentioned previously, these surveys were conducted prior to the release of the ECP Guidelines (see Section 1.2.2 – Bald and Golden Eagle Protection Act) and are not optimally designed to document eagle use of the Action Area and rotor-swept zone. It is apparent that both bald and golden eagles are present within the Action Area during the migratory period. The migration survey data was used as described below to assess potential risk to eagles during the migratory period."

The USFWS also used a predictive model that is it developing in collaboration with modeling experts from outside and within the USFWS. The model predicts the following risks to eagles (USFWS 2011):

- A fatality estimate of 0.059 bald eagles per year, with a 95% confidence interval between 0 eagles and 0.127 eagles per year.
- A fatality estimate of 0.019 golden eagles per year, with a 95% confidence interval between 0 eagles and 0.059 eagles per year.

The risk summary concludes that, "there are no "important eagle use areas" (including "eagle nests, foraging areas, or communal roost site that eagles rely on for breeding, sheltering, or feeding, and the landscape features surrounding such nest, foraging area, or roost site that are essential for the continued viability of the site for breeding, feeding, or sheltering eagles") (Service 2009b) or migration corridors within the Action Area. We have determined that there is low risk to eagles during the breeding and winter seasons" (USFWS 2011).

While the USFWS concludes that the risk to eagles is low, they acknowledge that there is uncertainty in the predicted model results, and the assessment includes the following recommendations (USFWS 2011):

1. A commitment to monitor for and report eagle mortality for the life of the project.
2. An operational plan to minimize, where appropriate, the likelihood that eagles will use the project site (e,g., carcass management, maintain vegetation heights around turbines to reduce prey availability and raptor foraging).
3. A plan to periodically update the predicted risk of the project to eagles utilizing the best available sources of information such as updated nest location information, post-construction fatality monitoring data, migration data, incidental observations, and other sources of information. This may also include new research, monitoring, and surveys if the above information is not available.
4. Adaptive management plans that initiate action (i.e., minimization or mitigation) if risk to eagles is found to increase to moderate or high levels in the future. Specifically, the management plan should identify methodologies and quantitative risk assessment methods that will be used to identify changing risk and describe criteria that will trigger adaptive management. Thresholds for applying for a take permit under the Eagle Act in the future should also be outlined, along with any "advanced conservation practices" (see ECP Guidance) that may be employed to avoid take should risk to eagles increase.
5. A commitment to consider and incorporate, where appropriate, the latest research findings and minimization measures concerning eagle mortality at wind power projects.
6. Ground wires and any guy wires (e.g., on met towers) used in the project should be marked with deflectors.
7. Follow APLIC guidelines for overhead utilities.

Buckeye Wind intends to follow the USFWS recommendations:

1. Mortality monitoring for eagles will occur for the life of the Project, coincident with Indiana bat mortality monitoring as described in the HCP.
2. The minimization measures described in Section 5.2 – Construction and Maintenance will constitute an operation plan that will reduce the likelihood that eagles or other birds will use the Action Area. The majority of the Action Area is in agricultural use, which does not promote raptor use. However, areas that are pasture land or CRP will be left in the desired land use of the landowner.
3. Buckeye Wind will work with USFWS and ODNR to develop a plan to periodically update the predicted risk of the Project. In order to have an appropriate basis for the plan, it will be developed once the ECP Guidance is finalized and will incorporate portions of the ECP Guidance as appropriate for the level of risk and for a Project that is in the advanced stages of development or has completed the development process.

4. Buckeye Wind is committed to implementing any practicable advanced conservation practices. Buckeye will consider adaptive management plans and advanced conservation practices once the ECP Guidance is final. Any application of the final ECP Guidance will consider Project risk and Project economics and any specific treatment for already operating wind projects contained in the final ECP Guidance.
5. Buckeye Wind will consider and incorporate any new research findings and minimization measures concerning eagle mortality at wind power projects where appropriate and as practicable considering costs to the Project.
6. Any guy wires used for MET towers will be marked with deflectors or other acceptable bird/raptor diverters.
7. While Buckeye Wind would own the wires carry electricity from the turbines, the above ground collection lines, including distribution poles, will be owned and maintained by DPL and subject to DPL construction guidelines. While it is likely that DPL will utilize APLIC guidelines, or similar, and Buckeye Wind will encourage the use of APLIC guidelines, it is not possible for Buckeye to commit to such measures. In the Redesign Option, above ground collection lines will not be used, except for in very limited circumstances.

#### 4.1.4 *Sandhill Cranes, Waterfowl, and other Waterbirds*

Waterbird (i.e., shorebirds, seabirds, waterfowl) mortality at wind facilities has been found to be relatively low (Osborn et al. 2000; Johnson et al. 2000, 2002; Howe 2002; Kerns and Kerlinger 2004; Koford et al. 2004, 2005; Arnett 2005; Piorkowski 2006; Derby et al. 2007; Fiedler et al. 2007; Jain et al. 2007, 2008, 2009*abcd;* Miller 2008; Stantec 2008*c*, 2009*bc*, 2010*a;* Vlietstra 2008; Arnett et al. 2009; Gruver 2009; NJ Audubon Society 2009; Tidhar 2009; Young et al. 2009; and Drake et al. 2010). Based on post-construction mortality data collected at eastern and midwestern wind facilities (Table 4-2), waterbirds have been found to represent approximately 4.7% of documented avian fatalities.



Agricultural fields and pastures may be used by breeding and migrating shorebirds, waterfowl, and other waterbirds, particularly during periods with seasonal sources of water. However, due to the limited amount of wetlands, streams, and open water habitats in the Action Area, the lack of significant breeding or stop-over habitat in the vicinity of the Project, and results of pre-construction field surveys (see Section 3.2.2 – Bird Surveys), waterbird activity in the Action Area is expected to be low (Stantec 2009a).

Sandhill cranes may occur in the Action Area during spring and fall migration but they are not expected to occur in the Adjusted Project Area during breeding season. Sandhill crane migration movements typically begin 1.5 hr to 0.5 hr after sunrise and cease from 2 hr before to 15 min after sunset. They will occasionally migrate at night (Tacha et al. 1992) and the majority of migration movement occurs, or is initiated, during clear to partly cloudy conditions. Sandhill cranes will often roost overnight in fields and wetlands during migration. Most documented sandhill crane migratory flight heights are less than 1,600 m (5,249 ft), with 75% of documented flights between 150 m and 760 m (492 ft and 2,493 ft).

There is a risk of collision mortality for sandhill cranes during migration seasons. As opposed to some passerines, sandhill cranes are diurnal migrants, so their collision risk may be lessened because collision risk has been found to be greatest for nocturnal migrants traveling during inclement weather (NRC 2007). Adverse impacts to sandhill crane are not anticipated to result from the Project, based on lack of suitable habitat within the Action Area, low numbers of sandhill crane observations during pre-construction studies, and the majority of sandhill crane migratory movements occurs during good visibility and at heights above the proposed rotor swept zone.

#### 4.1.5 *Other Bird Species*

As detailed in the previous sections (see Section 3.2.2 – Bird Studies), during breeding bird, raptor migration, and sandhill crane surveys, the following quantities of state-listed birds were observed: 4 endangered, 7 threatened, 6 federal species of concern, and 13 species of special interest. Additionally, there were 13 avian species of conservation concern observed during pre-construction surveys conducted for the Project. Post-construction monitoring (as described in Section 6.0 – Tier Four Post-Construction Mortality Monitoring) will document fatalities of species of conservation concern. However, as described in the previous sections, the likelihood of substantial adverse impacts to state listed species is low. In the event that mortality of a state endangered or threatened species is documented, ODNR DOW will be notified and appropriate next steps will be discussed.

### 4.2 Bats

#### 4.2.1 *Long-Distance Migratory Bat Species*

Long-distance migratory bat species are thought to be the most vulnerable to collision mortality at wind projects based on results of mortality surveys at operational projects (Kunz et al. 2007*b*, Arnett et al. 2008). Three species of long distance migratory bats have consistently comprised the largest proportions of fatalities at wind facilities to date: the foliage-roosting hoary bat and eastern red bat, and the cavity-roosting silver-haired bat (Kunz et al. 2007*b*, Arnett et al. 2008). All these bat species are listed as state species of concern. Collectively, these species comprised approximately 75% of documented fatalities and hoary bats made up about half of all fatalities in 2008 (Arnett et al. 2008). Silver-haired bats have been recorded more frequently at sites in western Canada, IA, WI, and the Pacific Northwest relative to the eastern United States (Arnett et al. 2008, Gruver et al. 2009). Eastern red bats have most commonly been found at wind facilities located in forested landscapes in the eastern United States, as well as in the Midwestern United States (Arnett et al. 2008). See HCP Section 4.5.5.2.1 – Species Distribution for more information.

Long-distance migratory bats captured during mist-netting surveys and/or detected during bat acoustic surveys in the Initial Project Area include all 3 species that occur in the region: silver-haired bat (<1%), hoary bat (1.0%), and eastern red bat (12.1%) (Appendix A Tables 6 through 9). However, it should be cautioned that no studies have effectively linked pre-construction acoustic activity rates with post-construction fatality rates. As there will be minimal impacts to forested habitats associated with Project construction, impacts to long-distance migratory bats would mainly consist of collision mortality and barotrauma, particularly during fall migration and periods of low wind.

Long-distance migratory bat mortality during the spring migration period has consistently been lower than mortality documented during the fall. One noted species-specific exception to this that has been documented is silver-haired bats. At Buffalo Mountain, TN, 15 of 18 silver-haired bats (83%) were found between mid-April and early-June 2005 (Fiedler et al. 2007), although this pattern was not observed in studies conducted from 2000 to 2003 at the same site. Spring mortality of silver-haired bats was also documented, though in lesser numbers, at Summerview, Alberta; 16 of 272 (6%) silver-haired bat fatalities were found in May and June. These studies suggest that spring migration may be a period of risk particularly for silver-haired bats (and not the other species of long-distance migrants [i.e., hoary bats, eastern red bats, and western red bats]) at some wind facilities.

Prior to implementing feathering and cut-in speeds, levels of mortality of long-distance migrants associated with the Project would be expected to be similar to those observed at existing facilities in similar landscape settings in the region (see HCP Section 4.5.5 – Collision Mortality at Wind Facilities for a detailed discussion on mortality of bats at wind projects). However, feathering and cut-in speeds will be used, so mortality of long-distance migrants should be substantially less (68% less based on an average of 3 curtailment studies). Based on patterns of bat activity documented during the 2008 acoustic survey, eastern red bats may experience the highest levels of mortality among the 3 species of long-distance migrants. Risk of collision or barotrauma mortality is expected to be greatest in the fall and during periods of low wind.

Other potential impacts posed by the Project to long distance migrants may include habitat loss or alteration, disturbance due to construction activities, and mortality resulting from vehicle collision. Impacts from habitat loss are expected to be minimal, as 96% of the area impacted by construction will occur in active agricultural areas, or hay/pasture habitats. During the summer reproductive period, long-distant migrant bat species in the region are closely associated with forested areas, which provide roosts, foraging opportunities, and cover from predators. A very small amount of forested area (6.5 ha (16.1 ac) or 6.8 ha [16.8 ac] for the Redesign Option) will be impacted by construction of the Project. Construction impacts anticipated for the 100-turbine Project will affect approximately 0.2% of forested habitat in the Action Area. This habitat will be cleared during the winter, when bats are not present or using these areas to avoid mortality from construction activities. Therefore, impacts to long-distance migratory bats from habitat loss associated with construction activities are expected to be minimal and temporary.

Impacts from vehicle collisions are also considered unlikely because of the timing and duration of construction activities. Construction will be temporary, as the 52 and 48 turbines phases are expected to be commissioned 12 months to 18 months after initiation of construction and will occur almost exclusively during daytime hours when bats are not active. In addition, speed limits for construction and other personnel will be posted, further reducing possible impacts. Similar characteristics will be applicable during decommissioning and vehicular traffic during operation will discountable.



### 4.2.2 *Cave-hibernating Bat Species*

Within the region, cave-hibernating bat species include Indiana, little brown, evening (*Nyctisceius humeralis)* northern long-eared, big brown, tri-colored, Rafinesque's big-eared (*Corynorhinus rafinesquii*), and eastern small-footed (*Myotis leibii*) bats. All of these bats are listed as state species of concern (while the Indiana bat is a federally and state listed endangered species). All cave-hibernating bat species in the region were detected during pre-construction bat surveys, except for eastern-small footed and Rafinesque's big-eared bats. Rafinesque's big-eared bat is known to occur in 1 county in southern OH and is not known to occur in west-central OH where the Project is located. The range of the eastern small-footed bat extends into southern OH, but is not known to occur in west-central OH. Therefore, these 2 species of concern are not expected to be impacted by the Project.

Suitable summer roosting and foraging habitat for cave-hibernating species that occur in the region exists in the Adjusted Project Area. Cave-hibernating species may also travel through the Adjusted Project Area during spring or fall migration. As discussed in Section 3.2.3.2 – Swarming Surveys at Hibernacula, swarming surveys at 2 caves located approximately 6.3 km (3.9 mi) north of the Adjusted Project Area resulted in the capture of 653 northern long-eared, 201 little brown, 18 tri-colored, and 12 big brown bats during 5 capture events. The Lewisburg Limestone Mine is another hibernaculum within migrating distance of the Adjusted Project Area (approximately 100 km [62.5 mi] to the southwest) where substantial numbers of cave-hibernating bats have been documented (i.e., 24,931 bats, including 9,007 Indiana bats in 2009). In 2012, it was reported that 9,243 Indiana bats used the Lewisburg Limestone Mine for hibernaculum, though the 2012 survey did not include a census of all bat species (M. Seymour, USFWS, personal communication).

Potential impacts posed by the Project to cave-hibernating species may include habitat loss or alteration, disturbance due to construction activities, and mortality resulting from vehicle collision, turbine collision and barotrauma. Impacts from habitat loss are expected to be minimal, as 96% of the area impacted by construction will occur in active agricultural areas, or hay/pasture habitats. During the summer reproductive period, cave-hibernating bat species in the region are closely associated with forested areas, which provide roosts, foraging opportunities, and cover from predators. A very small amount of forested area (6.5 ha (16.1 ac) or 6.8 ha [16.8 ac] for the Redesign Option) will be impacted by construction of the Project. Construction impacts anticipated for the 100-turbine Project will affect approximately 0.2% of forested habitat in the Action Area. This habitat will be cleared during the winter, when bats are not present or using these areas to avoid mortality from construction activities. Additionally, there are no hibernacula within the Adjusted Project Area and therefore, no hibernaculum will be impacted by the Project. Therefore, impacts to cave-hibernating bats from habitat loss associated with construction activities are expected to be minimal and temporary.

Impacts from vehicle collisions are also considered unlikely because of the timing and duration of construction activities. Construction will be temporary, as the 52 and 48 turbines phases are expected to be commissioned 12 months to 18 months after initiation of construction and will occur almost exclusively during daytime hours when bats are not active. In addition, speed limits for construction and other personnel will be posted, further reducing possible impacts. Similar characteristics will be applicable during decommissioning and vehicular traffic during operation will discountable.

Data from post-construction studies compiled by the USFWS provide mortality rates for certain cave-hibernating species within the range of the Indiana bat (Jennifer Szymansky and Megan Seymour, USFWS, personal communication). Of 3,433 fatalities from 26 studies, only 587 (17%) were cave-hibernating species. Little brown bats accounted for 225 (38%) of the cave-hibernating fatalities. Within the Midwest, 145 (7%) of 2,046 fatalities were cave-hibernating of which 37% were little brown bats. Thus, it is expected that mortality from turbine collision and barotrauma will be significantly less for cave-hibernating species than migratory species. Furthermore, implementing the feathering and cut-in speed regime outlined in the HCP should further reduce mortality of these species.

While the majority of the documented fatalities at existing wind facilities have involved long-distance migratory bat species (Arnett et al. 2007), the relative significance of impacts to cave-hibernating species could increase over time if populations of these species are substantially reduced due to white-nose syndrome (WNS), described in the following section. For additional information of potential future listing of cave-hibernating bats see the HCP Section 7.2.1.1.

#### 4.2.2.1 *White-Nose Syndrome*

WNS is a condition that is responsible for millions of bat fatalities in the eastern United States from 2006 to 2010 (United States Geological Survey [USGS] 2010). An estimated 5.7 million to 6.7 million bat fatalities have occurred since WNS was first recorded in 2007 (USFWS 2012). Recent studies have discovered that WNS is associated with a newly-described 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. The skin infection caused by *G. destructans* is thought to act as a chronic disturbance during hibernation. Infected bats exhibit premature arousals, aberrant behavior, and premature loss of critical fat reserves (Frick et al. 2010).

Although it is not certain whether *G. destructans* is the primary cause of death or a secondary infection (Blehert et al. 2009), the fungus is directly associated with bat mortality (Puechmaille et al. 2010) and is widely considered to be the causal agent of WNS (USGS 2010).

WNS was first documented in bats in Schoharie County, NY, and mortality was confirmed at 4 sites in eastern NY in winter 2006-2007. WNS continued to spread and by the end of winter 2008-2009, all known WNS-affected hibernacula were in states located within USFWS Region 5 (R5; the Northeast Region). However, by March 2010, the presence of *G. destructans* had been confirmed or suspected within the following 15 states in USFWS Regions R2 (Southwest), R3 (Midwest), R4 (Southeast), and R5: CT, DE, MA, MD, MO, NH, NJ, NY, OK, PA, RI, TN, VA, VT, and WV. WNS was confirmed in one hibernaculum in southern OH, as well as sites in IN, KY, NC and ME during winter 2010-2011. Winter 2011-2012 hibernacula surveys resulted in six counties in OH that tested positive for WNS (Preble, Lawrence, Cuyahoga, Portage, Summit, and Geauga). The origin of WNS remains uncertain, although anthropogenic introduction of the disease, via commerce or travel from Europe, is a plausible hypothesis (Frick et al. 2010).

In Canada, WNS was documented in southern Ontario and Quebec in 2010 (Ontario Ministry of Natural Resources [OMNR] 2010). In Europe, WNS has been detected in southwestern France (Puechmaille et al. 2010), Switzerland, Hungary, and Germany (Wibbelt et al. 2010). However, no mass casualties have been detected among infected bats in Europe (Puechmaille et al. 2010, Wibbelt et al. 2010). Wibbelt et al. (2010) hypothesize *G. destructans* is present throughout Europe and European bats may be more immunologically or behaviorally resistant to *G. destructans* than their North American congeners because they potentially coevolved with the fungus.

WNS is causing unprecedented mortality among at least 6 cave-hibernating species in North America (Frick et al. 2010): Indiana bat, eastern small-footed bat, little brown bat, northern long-eared bat, tricolored bat, and big brown bat (USGS 2010). Other affected species include the cave Myotis (*Myotis velifer*) and gray bat (*Myotis grisescens)*. The 25 bats species of North American that rely on winter hibernacula may potentially be affected by WNS (USGS 2010). Infected hibernacula are experiencing annual population decreases ranging from 30% to 99%, with a mean of 73% throughout eastern North America (Frick et al. 2010). Total mortality averaged 95% at closely monitored WNS hibernaculum that had multiple years of infection in NY, MA, and VT in 2009 (A. Hicks, New York State Department of Environmental Conservation, personal communication, as cited by Turner and Reeder 2009).

While it had been estimated that WNS is spreading at a rate of 24.1 km (15 mi) to 32.2 km (20 mi) per year (Turner and Reeder 2009), the recent documentation of WNS across large and disjunctive geographic areas indicates that the spread is more rapid and far-reaching than originally thought. The mechanisms for persistence and transmission of the fungus during summer and fall months are currently unknown, but the spread of the fungus to new geographic regions and between species may result from social and spatial mixing of individuals across space and time, particularly at winter hibernacula (Frick et al. 2010). Laboratory experiments have observed bat-to-bat transmission of *G. destructans*. Additionally, the fungus has been collected from soils of affected hibernacula, indicating that environmental factors may play a role in WNS transmission (BCI 2010b).

Avoidance and minimization measures implemented to reduce impacts to Indiana bats, as described in the HCP, are expected to also substantially reduce mortality of cave-hibernating species. Mitigation and conservation measures, as outlined in HCP Chapter 6.0 – Conservation Program, that will be implemented as part of the HCP are also expected to offset potential take and enhance the reproductive potential and survival of species that share hibernacula, summer foraging, and roosting areas with the Indiana bat, including the northern long-eared and little brown bat. Additionally, conservation measures implemented under the HCP, including research on bat-wind interactions or deterrent techniques, may increase the effectiveness of avoidance and minimization measures and decrease risk to long-distance migrant and cave-hibernating bat species over time.

#### 4.2.3 Potential Listing of New Species Under the ESA

Although not yet quantified, other bat species are experiencing similar mortality from WNS and may also be at risk of population collapse, most notably northern long-eared bats, eastern small-footed bats, and Indiana bats (USGS 2010). The Center for Biological Diversity (CBD) recently petitioned the United States Secretary of the Interior to list the eastern small-footed bat and northern long-eared bat as threatened or endangered species under the ESA and to designate critical habitat for these species concurrent with listing (CBD 2010; filed 21 January 2010). On 29 June 2011, the USFWS announced that the eastern small-footed and northern long-eared bats may warrant Federal protection as threatened or endangered under the ESA pursuant to 16 U.S.C. § 1533(b)(3)(B) (76 Fed. Reg. 38095-38106). The USFWS has thus initiated a more thorough status review of these species. Further, a status assessment of the little brown bat (*M. lucifugus*) is being completed to determine if threats to the species warrant listing. The USFWS is also collecting information on additional species susceptible to WNS (USFWS 2011b).

The CBD petition states that the eastern small-footed bat and the northern long-eared bat are threatened by 4 of 5 factors identified by the ESA to warrant listing: the loss and curtailment of their habitat or range; disease (i.e., WNS); numerous natural and anthropogenic factors (e.g., environmental contaminants, climate change, wind energy development); and inadequacy of existing regulatory mechanisms. Although many bat species in the eastern United States are experiencing threats discussed above, the CBD petition (2010) argues that the life histories, habitat associations, and current population statuses of the eastern small-footed bat and northern long-eared bat make these species especially vulnerable to severe population declines and local extinctions. These 2 species were added to the USFWS Region 3 federal list of Species of Concern, an informal term indicating species that Region 3 feels might be in need of conservation activities and are listed as Species of Concern by ODNR DOW.



The range of the eastern small-footed bat does overlap the Action Area, however no suitable habitat exists within the Action Area and therefore potential future declines of this species would not have direct relevance to ongoing management of the Project. However, northern long-eared bats occur in the Adjusted Project Area and were captured during pre-construction mist-netting surveys (38 bats or 13% of all species captured) and during swarming surveys (653 bats or 74% of all species captured). During the swarming surveys bats were marked with a temporary white paint on their wings to identify bats that were captured in traps or nets more than once (recaptures). Twenty-four bats (3%) were recaptures from previous surveys or from an earlier time during the same survey night. Northern long-eared bat fatalities have been recorded at wind energy facilities, but generally constitute a small fraction of overall bat fatalities; from 1996 to 2006, 8 northern long-eared bat fatalities were reported nationwide (Arnett et al. 2008). However, this number represents observed fatality only and does not include bias correction estimates for searcher efficiency and carcass persistence.

Due to WNS or other factors, the conservation status of non-federally listed cave-hibernating bat species may change over the life of the Project. In the event that the USFWS determines that the listing of the northern long-eared bat, little brown bat and/or other bat or bird species is warranted under 16 U.S.C § 1533(b)(3)(B)(ii) or (5)(A)(i), Buckeye Wind, in coordination with the USFWS, will evaluate the potential for the Project to result in incidental take of those species. The same coordination will occur for any other species for which the Service determines listing is warranted under 16 U.S.C § 1533(b)(3)(B)(ii) or (5)(A)(i), either through a petition action or through a status assessment absent a petition action, that is expected to occur within the Action Area. The evaluation will consider the known occurrence of the species and habitat within the Action Area and results of post-construction mortality monitoring in the Action Area and at other wind facilities. As previously stated, the avoidance, minimization, mitigation, and conservation measures that will be implemented for the Indiana bat as part of this HCP will result in similar minimization of impacts and benefits to the other bats that share similar life history characteristics, roosting and foraging behavior, and habitat with the Indiana bat. If incidental take is deemed to be likely, the ITP will be amended or other avenues for take coverage will be explored. In the case that the northern long-eared bat or little brown bat is listed before an amendment is obtained, Buckeye Wind will take the appropriate actions pursuant to the ESA to avoid take.

# 5.0 AVOIDANCE AND MINIMIZATION MEASURES

Buckeye Wind will implement measures to avoid and minimize impacts to birds and bats in the design, construction, operation, and decommissioning phases of the Project, presented in the following sections.

## 5.1 Project Siting and Design

The Tier III surveys support the initial assessment that the Project presents a relatively low risk for most species, except for the detection of the federally and state endangered Indiana bat (which was not documented in the Adjusted Project Area during Tier III studies conducted for the Project, but was documented in conjunction with a different proposed development project that overlapped the Adjusted Project Area). The impacts of bat mortality at wind projects throughout the eastern and Midwestern United States is still being assessed. The Project is not expected to have a greater impact to bats than other projects in the Midwest, and the minimization measures implemented as part of this ABPP and the HCP are expected to significantly decrease bat mortality. Prudent avoidance and minimization measures have been incorporated into this ABPP and will be incorporated into actual Project siting and design in order to minimize risk to bird and bat species. The following general conclusions can be made regarding risk to avian and bat species and their habitat, as documented during Tier III studies:

- Land in the Action Area is highly fragmented due to previous and ongoing agricultural practices and agricultural land comprises over 90% of the Action Area. In general, agricultural land provides marginal quality and highly fragmented habitat for most bird and bat species.
- Pre-construction studies and results of other post-construction mortality surveys indicate the Project, in general, is not expected to result in substantial risks to bird species, their breeding or migratory areas, or other important habitats.
- Pre-construction studies and results of other post-construction mortality surveys indicate that the Project, in general and prior to implementing feathering to protect Indiana bats, would be expected to result in mortality rates to bird and bat species similar to those observed for other similarly situated wind projects. Because of the minimal clearing of wooded areas, impacts to bat breeding or foraging habitat, or other important habitats, will be minimal.

As such, the conversion of land proposed for wind turbine development will not result in substantial impacts to bird and bat habitat, and those impacts that may occur will be minimized to the greatest extent practical. In order to minimize impacts to wildlife, Buckeye Wind has incorporated the following avoidance and minimization measures into siting decisions for the 52 turbines and associated infrastructure currently known and planned for construction. In addition, Buckeye Wind will incorporate the following measures and any newly available monitoring information into siting and design decisions for the additional 48 turbines and associated infrastructure.

1. Project siting will avoid and/or minimize impacts to habitat used by forest-dwelling birds and bats to the maximum extent practicable;
    a. Over 90% of total disturbed area will occur in previously disturbed areas, mainly consisting of cultivated crop;
    b. 0.2% of the 2,743.5 ha (6,779.4 ac) of forested habitat available in the Action Area will be cleared for construction; no more than 6.4 ha (15.8 ac) of deciduous

forest habitat will be cleared for the 100-turbine facility (6.7 ha [16.5 ac] for the Redesign Option).
    c. Project siting will avoid development in large contiguous tracts of deciduous forested habitat; tree removal will occur at the edges of relatively small forest blocks, hedgerows, or woodlots; minimizing fragmentation and reduction of forest patch size.
    d. Project siting will avoid forested stream crossings to the maximum extent practicable.
    e. Project siting will avoid wetland habitats.
    f. Turbines and components for the entire 100-turbine Project will be contained within a portion of the Action Area that further excludes potential impacts to wooded areas and other resources (the Adjusted Project Area; see Section1.0 – Introduction)

2. Project siting will minimize impacts to habitat used by grassland birds to the maximum extent practicable;
    a. Siting turbines largely in agricultural fields is likely to minimize impacts to grassland bird species.
    b. For the full 100-turbine layout, a maximum of 11.3 ha (27.9 ac) of CRP land (12.4 ha [30.4 ac] in the Redesign Option) will be permanently or temporarily disturbed, or 0.9% of the 1,252.9 ha (3,096.1 ac) of land currently in CRP in the 6 townships included in the Action Area.

3. Creation of new roads will be minimized to the maximum extent practicable;
    a. Existing roads or farm lanes will be utilized to the extent practical.
    b. No more than 64.4 km (40.0 mi) of new service roads will be created to connect wind turbines (for the 100-turbine facility) to existing access roads.
    c. The permanent footprint of new access roads will be kept to a minimum width (6.1 m [20 ft]) in an effort to minimize disturbance to surrounding cropland or other vegetation.

4. Tower design will minimize opportunities for bird perching;
    a. Tubular tower supports rather than lattice supports are incorporated into the Project design to minimize bird perching and nesting opportunities.
    b. Internal ladders and platforms on tubular towers are part of the Project design to minimize perching and nesting of birds.

5. Underground transmission lines have been incorporated into the Project design to the extent practical, minimizing potential for avian and bat collisions and electrocutions;
    a. 56.8 km (35.3 mi) of the 34.5 kV interconnects will be above ground (on rebuilt distribution poles in public road right-of-ways) and 56.7 km (35.2 mi) buried underground for the 100-turbine facility.
        - In the Redesign Option, 86.5 km (53.7 mi) of interconnection lines will be built underground, with 9.0 km (5.6 mi) installed overhead.
    b. Power lines, if not underground, will be equipped with insulated and shielded wire to avoid electrocution of birds and bats.
    c. Placement of transmission lines will avoid impacts to wetlands.
    d. APLIC (2006) guidelines will be followed for the siting of above ground lines, where possible and as dictated by DPL construction guidelines[9].



[9] While Buckeye Wind would own the wires carry electricity from the turbines, the above ground collection lines, including distribution poles, will be owned and maintained by DPL and subject to

    e. New distribution poles will be fitted with bird perch deterrents, where possible and as dictated by DPL construction guidelines.

6. Operational lighting will be minimized to the maximum extent practicable;
    a. Unnecessary lighting on the operations and maintenance building and substation at night will be eliminated to reduce attraction of birds and bats.
    b. No steady burning lights will be left on at the facility buildings or turbines unless necessary for safety or security; in such cases, the lights will be shielded downward and utilize motion detectors, infrared light sensors or "auto-off" switches that will automatically be extinguished after 2 hours to avoid continuous lighting.

7. Federal Aviation Administration (FAA) lighting will be minimized to the maximum extent practicable;
    a. Attached to the top of some of the nacelles, per specifications of the FAA, will be a single, medium intensity aviation warning light.
    b. The minimum amount of pilot warning and obstruction avoidance lighting specified by the FAA will be used (FAA 2007); approximately 1 in every 5 turbines will be lit, and all lights within the facility will illuminate synchronously.
    c. FAA lights are anticipated to be flashing red strobes (L-864) that operate only at night. Buckeye Wind will use the lowest intensity lighting as allowed by FAA.
    d. To the extent possible, USFWS recommended lighting schemes will be used on the nacelles, including reduced intensity lighting and lights with short flash durations that emit no light during the "off phase".
    e. MET towers will also utilize the minimum lighting as required by the FAA.

8. MET tower design will minimize opportunities for avian collision;
    a. Guy lines on new MET towers will be equipped with recommended bird deterrent devices in accordance with the APLIC (2006) guidelines.
    b. Permanent MET towers will be non-guyed.

## 5.2 Construction and Maintenance

The following construction phase measures have been incorporated into the ABPP to avoid construction activities in the vicinity of sensitive habitats during critical periods in bird and bat life cycles, and to minimize impacts to wildlife habitat and resources.

1. Tree clearing activities will minimize impacts to bats and birds;
    a. Tree clearing will be conducted between 1 November and 31 March during the non-active period for bats and the non-breeding season for many species of migratory birds.
        i. Timing of tree removal will avoid mortality of roosting bats and their young in the event that maternity roost trees are felled.
        ii. Timing of tree removal will avoid mortality of breeding birds and their young that nest in trees.
    b. Any potential Indiana bat roost trees, including bat maternity roost trees, which are observed within the clearing zone will be flagged prior to clearing and during

DPL construction guidelines. While it is likely that DPL will utilize APLIC guidelines, or similar, and Buckeye Wind will encourage the use of APLIC guidelines, it is not possible for Buckeye to commit to such measures. In the Redesign Option, above ground collection lines will not be used, except for in very limited circumstances.

construction, and all practical efforts will be made to avoid impacts to potential roost trees.

c. Prior to any tree removal, the limits of proposed clearing will be clearly demarcated with orange construction fencing, flags or similar markers to prevent inadvertent over-clearing of the site.
d. A natural resource specialist, approved by ODNR DOW and USFWS, who is familiar with bird and bats habitat requirements, will be present when construction is being performed in or near sensitive wildlife areas to help ensure the appropriate resources are protected.

2. Clearing and construction practices will reduce soil disturbance and allow for the reestablishment of natural vegetation;
   a. Where possible, vegetation will be cleared without grubbing or removal of stumps or tree roots.
   b. All construction equipment will be restricted to designated travel areas to minimize ground disturbance.
   c. Construction clearings, storage yards, staging areas, or temporary roads not needed for long-term operation of the Project will be allowed to revegetate after commissioning of the Project.
   d. If turbines require substantial maintenance involving large cranes or other heavy equipment, the same measures used during construction to limit clearing of vegetation and disturbance of soil will be used.
   e. Initial clearing of CRP land will be conducted before 1 March and after 15 July to avoid disturbance during nesting periods.
   f. Areas where mowing will be conducted for post-construction monitoring will be cleared and mowed prior to 1 March, if needed. Regular mowing will occur to prevent establishment of habitat suitable for nesting activities throughout the breeding season.



3. Best management practices will be used to avoid the introduction and spread of invasive species;
   a. Construction vehicles and equipment that arrive from other areas will be regularly cleaned.
   b. Non-agricultural areas will be re-seeded and stabilized using native seed, to the extent possible pending seed availability and landowner preferences, following construction in an effort to preserve natural habitat to the extent possible. Re-seeding will be consistent with state permit requirements to avoid the introduction of invasive plant species.

4. Best Management Practices for construction activities will minimize degradation of water quality from storm water runoff and sediment from construction;
   a. A plan note will be incorporated into the construction contract requiring that contractors adhere to all provisions of National Pollutant Discharge Elimination System permits and the Storm Water Pollution and Prevention Plan.
   b. Federal and state measures will be adhered to for handling toxic substances to minimize danger to water and wildlife resources from spills.
   a. The Project was designed to avoid stream crossings whenever possible. Due to the nature of this type of project, there is some flexibility in selecting turbine locations and, more so, access road and electric collection line locations. As such, great care was taken to design Project facilities to avoid tree clearing and in-water work associated with stream crossings to the maximum extent practicable. See HCP Section 5.2.1.2 – Impacts to Aquatic Habitats).

   b. Horizontal directional boring for collection lines will be used to avoid impacts to all perennial streams.
   c. Only streams that are not designated Coldwater Habitat or Exceptional Warmwater Habitat[10] will be impacted. A Nationwide permit will be secured for each stream crossing involving in-water work.

5. Maintenance activities will help to avoid the creation of foraging opportunities for raptors and/or scavengers, or availability of materials that could be harmful to birds;
   a. Rock and brush piles that could create habitat for raptor prey will be removed from turbine areas.
   b. Any observed road-kill or other dead animals that may attract scavenging raptors such as vultures or eagles will be cleared from within turbine areas, and access roads;
      i. To avoid disruption of the post-construction monitoring, no dead animals will be removed from within the monitoring transects that overlap turbine areas and access roads.
   c. Food waste littering by construction/maintenance staff will be prohibited;
   d. Garbage containers for disposal of packing material during construction will have covers, as such debris (i.e., Styrofoam) is prone to wind blowing and can be harmful to birds.

6. Maintenance of overhead utilities will minimize impacts to birds;
   a. Buckeye Wind will follow APLIC (2006) guidelines for overhead utilities maintenance, where possible and as dictated by DPL construction guidelines[11].

7. Fire potential will be minimized;
   a. Spark arrestors will be used on all electrical equipment;
   b. Smoking will be restricted to designated areas on site.



[10] According to Ohio Revised Code, Exceptional Warmwater Habitat streams are capable of maintaining an exceptional or unusual community of warmwater aquatic organisms with the general characteristics of being highly intolerant of adverse water quality conditions and/or being rare, threatened, endangered or species of special status. This is the most protective use designation assigned to warmwater rivers and streams in OH. A Coldwater Habitat stream is capable of supporting populations of coldwater aquatic organisms on an annual basis and/or put-and-take salmonid fishing. These water bodies are not necessarily capable of supporting the successful reproduction of salmonids and may be periodically stocked with these species. Both are afforded special protections under OH's CWA provisions.

[11] While Buckeye Wind would own the wires carry electricity from the turbines, the above ground collection lines, including distribution poles, will be owned and maintained by DPL and subject to DPL construction guidelines. While it is likely that DPL will utilize APLIC guidelines, or similar, and Buckeye Wind will encourage the use of APLIC guidelines, it is not possible for Buckeye to commit to such measures. In the Redesign Option, above ground collection lines will not be used, except for in very limited circumstances (see Section 1.1 – Overview and Purpose of the HCP).

### 5.3 Operation

As described in Section 4.0 – Avian and Bat Concerns, significant effects to non-federally listed bats and birds due to forested habitat removal, disturbance from construction activities, noise from operating turbines are unlikely. No disturbance to lands, streams, and wetlands beyond that which is necessary for Project construction will occur. Many areas impacted by construction will be restored after construction. The following actions will be taken to minimize adverse effects to non-federally listed bats and birds from operations activities for the 100-turbine Project:

a. Minimal FAA lighting will be utilized.
b. Any ground-based lighting at the turbines or substation necessary for safety or security will be controlled by motion detectors or infrared sensors.
c. Any scheduled tree trimming for maintenance and safety will be conducted between 31 October and 31 March. Only trees that are either live or fallen will be cleared or trimmed during the active period.
d. Access roads built for the Project will be posted with a 25 mile per hour speed limit to minimize risk of collision with Indiana bats and other wildlife.

Operational restrictions described in the Project HCP will be employed to minimize the impacts to Indiana bats. These operational restrictions will also avoid and minimize potential impacts to non-federally listed bats and bird.

Operational restrictions will dictate that turbines are feathered (i.e., not spinning) until a designated cut-in speed is reached. This cut-in speed is generally higher than the wind speed at which the turbine is technically able to begin spinning and producing power. A number of studies have now shown that increased cut-in speeds can be expected to reduce mortality of bats (see Table 5-1). It is expected that the overall reduction in mortalities from feathering that has been observed at other sites will be realized at the Project.

Three studies that evaluated the effects of increasing turbine cut-in speed on bat fatalities (PA [Arnett et al. 2010], Alberta [Baerwald et al. 2009], and IN [Good et al. 2011]) found that reductions between 38% and 93% (median of 68.3% across all studies) were achieved by curtailing or feathering turbine operations at wind speeds of 5.0 m/s and 6.5 m/s (Table 5-1). Although site-specific factors such as turbine model, local weather patterns, and bat populations may affect the relative effectiveness of operational adjustments at different wind facilities, the finding that similar reductions in bat mortality were achieved in areas as geographically diverse as PA, Alberta, and IN holds promising support for broad application of curtailing or feathering as a minimization technique.

Results from post-construction mortality monitoring suggest non-operating turbines pose little to no risk to bats; of 44 wind turbines studied at the Mountaineer facility, the only turbine with no reported fatalities was non-operational during the study period (Kerns et al. 2005). Although no studies to date have empirically tested the effectiveness of feathering for birds, Manville (2009) suggested that turbine feathering can benefit both birds and bats when risk of collision is high[12].

[12] As discussed in Section 4.1 – Birds, the risk of bird collisions at the Project are not high.

**Table 5-1.** Observed range in reductions in bat fatalities and median values for 4 operational effectiveness studies. Turbines were feathered at Casselman and in Southwest Alberta, and curtailed at Fowler Ridge.

| Study | Observed fatality reduction[a] | | | Source |
|---|---|---|---|---|
| | Min | Max | Average | |
| Casselman 2008[b] | 52.0% | 93.0% | 82.0% | Arnett et al. 2010 |
| Casselman 2009[b] | 44.0% | 86.0% | 72.0% | Arnett et al. 2010 |
| Fowler Ridge 2010[c] | 38.0% | 85.0% | 64.5%[d] | Good et al. 2011 |
| Southwest Alberta[e] | NA | NA | 60.0% | Baerwald et al. 2009 |
| Median fatality reduction | 44.0% | 86.0% | 68.3% | |

[a]All studies used a combination of cut-in speeds of 5.0 m/s to 6.5 m/s except Baerwald et al. 2009, which used 5.5 m/s
[b]Based on a 95% confidence interval
[c]Based on a 90% confidence interval
[d]Based on the median of the reported average reductions from each treatment (5.0 m/s = 50%; 6.5 m/s = 79%)
[e]Study did not provide confidence intervals for appropriate min and max comparison to other studies

Turbine feathering during the active season for Indiana bats (1 Apr through 31 Oct) will be implemented as a condition of the Buckeye HCP to minimize take of Indiana bats to the maximum extent practicable; feathering will also minimize collision-related mortality for non-listed bat and possibly bird species (although minimization affects for bird species has not been established). Feathering will be applied to all turbines as detailed in the HCP Section 6.2.3 – Feathering Plan Phases, with the highest cut-in speed applied to turbines located in areas expected to present the greatest risk; those located in areas with high quality Indiana bat foraging and roosting habitat; and during seasons of high or uncertain risk, such as fall and summer, respectively. Adaptive management will be used to implement changes to cut-in speeds over time, as appropriate, and as new information on impacts to Indiana bats and other bats and birds becomes available through ongoing mortality monitoring and from other studies or sources (see Section 7.0 – Adaptive Management and HCP Section 6.5.3 – Adaptive Management for Minimization).



## 5.4 Decommissioning

Once the Project has reached the end of its operational life, and if the appropriate permits and permissions for repower are not secured, decommissioning will target restoration of the baseline ecosystem to the extent practicable and will be completed in coordination with appropriate regulatory agencies. Buckeye Wind will comply with the recommendations and conditions from the FAC Recommendations and/or the OPSB CECPN, as required:

1. Decommissioning activities will avoid additional site disturbances and removal of native vegetation to the extent possible.
2. Foundations will be removed to a depth of 91 cm (3 ft) below the surrounding grade and covered with soil to allow for reestablishment of native plants or crops and to prevent subsurface structures from substantially disrupting ground water movements.
3. If topsoil is removed during decommissioning, it will be stockpiled and used as topsoil for replanting. Once decommissioning activities are complete, topsoil will be restored, reseeded, and stabilized. Re-seeding with native species will be consistent with state permit requirements to avoid the introduction and spread of invasive plant species.

4. Surface water flows will be restored to baseline conditions, including removal of stream crossings, roads, and turbine pads, consistent with storm water management objectives and requirements.
5. Overhead pole lines that are no longer needed will be removed.
6. Erosion control measures will be implemented in all disturbance areas where potential for erosion exists, consistent with storm water management objectives and requirements.
7. Any fencing erected for the Project will be removed unless in use by the landowner.
8. Petroleum or chemical soil contamination will be remediated prior to completion of decommissioning.

# 6.0 TIER FOUR POST-CONSTRUCTION MORTALITY MONITORING

Post-construction mortality monitoring will be conducted to meet the requirements of the HCP and will follow the ODNR Standardized Protocol or as agreed with the ODNR DOW to accommodate project-specific characteristics. The goals of post-construction monitoring specific to the Indiana bat are described in the HCP. As described in the WEVCA, the goals of post-construction monitoring include:

- Determine if project operations are causing an unacceptable level of impact so that additional minimization or mitigation can be employed if needed; and
- Assess predictive value of pre-construction monitoring, minimization, and avoidance measures by comparing those results with post-construction mortality.

Monitoring will be conducted to detect mortality of Indiana bats for the ITP term (i.e., 30 years); these monitoring efforts for Indiana bats will also document annual bird and other non-federally listed bat mortality and provide substantial information that will help the ODNR DOW, the USFWS, and the wind industry in general to better understand wind and wildlife interaction. Post-construction monitoring methods, analysis, and reporting are summarized below.

Buckeye Wind will enlist the services an independent consultant to conduct mortality monitoring. Buckeye Wind will select the consultant based on qualifications, experience and costs and will receive a scope of work proposal from the selected consultant that provides detailed information on consultant's qualifications. The scope will include detail on adequate implementation of the monitoring methods described in this Section 6.0 – Tier Four Post-Construction Mortality Monitoring. A qualified project manager (PCM Manager) and field technicians will be assigned to oversee the day-to-day monitoring efforts. Before awarding a contract, Buckeye Wind will provide the proposal to the FWS and ODNR DOW for approval.

If Buckeye Wind decides to change the consultant at any point during the Project life, the same process for selection and FWS and ODNR DOW approval will be followed.

## 6.1 Monitoring Phases

Post-construction mortality monitoring for Indiana bat mortality will be conducted within 3 phases: the Evaluation Phase, Implementation Phase, and Re-evaluation Phase. Monitoring will be most intensive during the first years of Project operation, during the Evaluation Phase. It is expected that the Evaluation Phase will provide sufficient information to meet the specific goals of the ODNR Protocol and of the HCP. The Evaluation Phase will last for a minimum of 2 years.

The Evaluation Phase will help demonstrate that impacts to non-federally listed bats or birds do not exceed Mortality Thresholds (see Section 7.1 – Calculation of Threshold Levels). If at any point during other monitoring phases, mortality of non-federally listed bats or birds exceeds the Mortality Thresholds, Buckeye Wind will work with the ODNR DOW to determine if any additional measures are appropriate.

## 6.2 Survey Period

Initial monitoring efforts will involve mortality searches conducted for approximately 32 consecutive weeks within 3 seasonal periods that correspond to unique seasonal behaviors of Indiana bats: spring (1 Apr to 31 May), summer (1 Jun to 31 Jul), and fall (1 Aug to 15 Nov). After two years of study, if no Indiana bat mortality is documented at the site after 31 October, and if equal to or less than 5% of all documented *Myotis* mortality occurs after 31 October, the monitoring period will be shortened to end on October 31. If operation begins after 1 April, monitoring will proceed at the beginning of operation and continue for the remainder of the active period.

### 6.3 Sample Size and Search Frequency

Searches will be conducting using a 3-day search interval for every turbine. Under a 3-day search interval, mortality searches will occur every day of the week throughout the survey period, with approximately one third of the turbines searched every day (i.e., turbines searched on Monday would have 3 nights of potential mortality and would then be searched again on Thursday). By using a 3-day search frequency and searching every turbine, there is a positive probability of detecting an Indiana bat fatality if it occurs; whereas, if only a subset of turbines is searched, the probability of detecting an Indiana bat at the non-searched turbines is necessarily zero. The former method is therefore preferable when the goal of monitoring is to detect a rare event, such as an Indiana bat fatality (M. Huso, Oregon State University, personal communication).

In order to balance the objective of assessing Indiana bat mortality at all turbines while also providing the ODNR DOW with annual data that is more closely compatible with current ODNR Protocol (ODNR 2009), during the first 1 to 2 years of monitoring, a portion of the turbines will be searched using a 1-day search interval.

The first 1 – 2 years of monitoring will involve searches at 20% of the turbines with a 1-day search interval and the remaining 80% of turbines on a 3-day search interval. In total, 46.7% of the turbines will be searched on any given day (or a 3 day cycle of 46, 47 and 47 turbines searched each day if 100 turbines are in operation). This combination of search intervals is designed to meet the data needs of the ODNR DOW while also meeting the objectives of the HCP. ODNR DOW will re-evaluate the combined search intervals after the first year of monitoring and determine what percent of the turbines, if any, would still need to be searched using a 1-day search interval.

Mortality searches will also be conducted at all MET towers in the Action Area during the first year of Project operation, as recommended in the ODNR Protocol. Depending on the results of the first year of monitoring, Buckeye Wind and ODNR DOW will determine if monitoring at MET towers during the optional second year of post-construction monitoring may be waived, reduced or continued. Since MET towers are not expected to pose risks to Indiana bats (See HCP Section 4.5.5.6 – Bat Collisions with Other Structure), monitoring will not continue past the first or second year after erection.

Searches will be initiated at sunrise and end by 1:00 PM in an effort to recover carcasses before removal by diurnal scavengers, as well as to increase the chances of recovering live Indiana bats (coincidentally, chances of recovering live birds and non-federally listed bats will also be increased).

### 6.4 Search Area

Plot size will include an area that extends 2.0 times the blade length from the base of the turbine (i.e., radius of 100 m (328 ft) for a 50 m [164 ft] blade). After 2 years of study, the search area will be adjusted to the distance within which 90% of the total bat carcasses and 100% of Indiana bat carcasses were found, not to exceed the size of the original search area. In this way, any reduction in search area will include the maximum distance that any Indiana bat carcass was found from a turbine. If the search area is reduced during Evaluation Phase monitoring, the reduced area will be utilized for any Re-evaluation Phase monitoring that may occur.

Search transects will be positioned north-to-south and will be spaced 5 m (16 ft) apart across search plots. In an attempt to standardize time spent searching each turbine, carcasses will be marked in the field when they are found, and will be processed after the turbine search is complete.

The entire plot size will be searched, subject to a measurable probability of finding carcasses and worker safety. In many cases, the full plot size at each turbine cannot be completely searched because of factors that make areas within the plot too difficult or too dangerous to search (Strickland et al. 2011, USFWS 2011c). Areas will be considered too difficult to search if there is little to no bare ground cover and more than 25% of the ground cover is over 12 inches in height. The PCM Manager will determine what areas and conditions present environments too dangerous to search.

Wind facilities located largely in agricultural settings, such as the Project, can present difficult searching conditions (e.g., 3 m [10 ft] tall corn). Pesticide use in agricultural settings can make conditions unsafe for workers for short periods of time after pesticide application. ODNR Protocol (2009) states that transects should not venture into hazardous areas such as steep slopes or water. Further, vegetative conditions such as tall corn can make searching difficult. In conditions of tall corn, the probability of finding a carcass along the transect line itself will be similar to the probability found in other vegetative cover; however, the probability of finding a carcass off the transect line will be close to 0. Searcher efficiency trials (see Section 6.7.1 – Searcher Efficiency Trials) are designed to adjust observed mortality by the probability that a searcher will find a carcass, given it is present. However, these trials are conducted under the assumption that a searcher is walking a transect line and searching several meters off each side of the line, which cannot be done in extremely low visibility such as tall corn. If the probability of detecting a carcass is un-measureable or extremely low given current searcher efficiency methods, searching these areas will likely bias mortality estimates.

ODNR Protocol (2009) requires that an estimate of searchable area be provided for each searched turbine. Most post-construction mortality monitoring uses an area correction factor to adjust mortality estimates by the amount of area searched beneath turbines (for example, see Kerns et al. 2005, Arnett et al. 2009, and Strickland et al. 2011). A simple adjustment by the proportion of areas searched below turbines cannot be used, as density of carcasses is known to decrease as distance from turbine increases (Kerns et al. 2005) – unsearched areas tend to be farthest from turbines in areas of low carcass density, so a simple adjustment based on proportion of area searched would over-estimate mortality (Arnett et al. 2009). Therefore, a function is used to relate density of observed carcasses with distance from the turbine. Within each standardized search plot, searches will therefore be focused within areas where probability of detection is measurable and search areas will be delineated by the area around each turbine that is clear of dense crops, shrubs, forested habitat, open water, large rock or rubble, or conditions that otherwise prohibit effective or safe searching conditions. For these reasons, searchable area may vary by turbine and month

### 6.4.1 *Vegetation Management and Mapping*

Because vegetation influences carcass detectability, 25% of turbines' search plots (i.e., 13 for the 52-turbine Project and 25 for the 100-turbine Project) will be regularly mowed or chemically treated to remove vegetation. The 20% of turbines that will be searched on a 1- day search interval will be included within the 25% of turbine search plots that will be mowed. For those turbines where mowing will be utilized, vegetation will be maintained at a height of 4 inches or less, with less than 2% of interspersed vegetation no higher than 12 inches. Should mowing be used, Buckeye Wind will ensure scheduled mowing occurs during the day in which the turbine was searched, and after the search is completed, to avoid carcasses being destroyed by mowing. Should other acceptable means to maintain searcher efficiency become available during the ITP Term, Buckeye Wind may change its methods (See HCP Section 7.2.1.9 – Use of New Methods, Information, or Technological Advances).

Vegetation in all search plots will be monitored on a weekly basis by a Buckeye Wind employee or contractor hired by Buckeye Wind; the aerial extent of each ground cover type and respective vegetation heights will be recorded. Any significant changes in ground cover type will be noted (e.g., plowing, mowing, harvesting). Once during each of the seasonal periods in which searches are conducted, the aerial extent of each cover type within search plots will be mapped using a global positioning system (GPS) unit. Vegetation height and percent cover will be recorded at 10 m (33 ft) distances along each transect of the search plot. Additional GPS points will be taken at points of abrupt ground cover transition and to document conditions that cause the searchable area to be reduced (e.g., forest edge). All records and documentation will be kept on file and/or in electronic format and may be provided to USFWS on request. See Section 6.7.1 – Searcher Efficiency Trials and Section 6.7.2 – Carcass Persistence Trials for information on how ground cover will be used as a factor to estimate unobserved mortality.

### 6.5 Weather Monitoring

On nights preceding mortality searches, general weather conditions in the vicinity of the Project (i.e., precipitation, cloud type, cloud height, percent cloud cover, and moon phase) and notable weather events (e.g., storm or passage of a front) will be recorded on standardized datasheets. Additional weather data (i.e., wind speed, wind direction, temperature, and barometric pressure) will be downloaded from an on-site met tower and/or a turbine nacelle for the entire survey period. At the beginning of each turbine search effort, the surveyor will record weather conditions including estimated wind speed, wind direction, temperature, sky conditions, precipitation events, and visibility. In addition, the surveyor will record his/her name, date, and time searches are initiated and completed.

### 6.6 Carcass Information

During searches, surveyors will walk slowly looking for carcasses on either side of the search transect. All intact bird and bat carcasses or remnants of scavenged carcasses (e.g., a cluster of feathers representing more than a molt, or a patch of skin and bone) will be photographed (before the carcass is moved), collected, and documented as fatalities. To the extent possible, turbine-related fatalities will be distinguished from those that occurred as a result of collisions with met towers, electrical collection lines, vehicles, or other sources of mortality.

All carcasses should be collected in individual re-sealable plastic bags, and the carcass identification number written in pencil on a piece of write-in-the-rain paper enclosed with the carcass. All information on ODNR's Fatality Reporting Form should be recorded, including:

- Date, time, and surveyor identification;
- Search type during which carcass was found (i.e., turbine search, met tower search, or incidentally);
- Distance (determined with a laser range finder) and compass direction of carcass from tower;
- GPS location of carcass;
- Ground cover type, height, and condition (e.g., wet, dry) where carcass was found;

- Carcass species identification, age (juvenile or adult), sex, and reproductive condition (to the extent possible);
- Carcass condition (estimate of number of days decomposed and/or scavenging activity);
- If applicable, notes will be recorded to indicate why a carcass was not believed to be a turbine-related fatality; and
- Evidence of scavenger activity (e.g., tracks or scat) in the vicinity of the carcass.

Mortalities encountered outside the bounds of an official search should be collected, and the above information recorded, but "Incidental" should be written into the notes area. These will not be used in the calculation of site mortality rates, but may (depending on species) be used in searcher efficiency or carcass removal trials.

Prior to initiation of fatality searches, Buckeye Wind and its contractors will obtain the appropriate state and federal permits necessary for the collection and possession of Indiana bats (and other bats and birds). Any individual that handles live bats will maintain an up-to-date rabies vaccination. If injured animals are encountered, the closest licensed wildlife rehabilitator able to take that species will be notified. A list of local, licensed wildlife rehabilitators capable of accepting regional bird and bat species will be developed and provided to searchers. Every attempt will be made for timely transportation of injured animals to a rehabilitation center to ensure that the animal has the best chance of survival. If successful rehabilitation is not likely, then the individual will be humanely euthanized through cervical dislocation. Buckeye Wind will bear the costs of any rehabilitation or euthanasia. If the species in question is a state or federally threatened or endangered species, the individual will not be euthanized and will be taken to a rehabilitation center and the appropriate agency will be contacted.



The ODNR DOW and USFWS OH field office supervisor and project biologist will be notified within 24 hours via email if a suspected or confirmed Indiana bat carcass or other federally listed species carcass is found. All *Myotis* bats that are not suspected or confirmed to be an Indiana bat will be collected and provided to ODNR DOW for inspection and identification verification. These carcasses should be frozen and given to the ODNR DOW at a prearranged date (at least annually). Bats within the *Myotis* genus are difficult to differentiate, and will not be used for scavenging rate or searcher efficiency trials unless negative identification is achieved and approved by ODNR DOW and USFWS. Identification of *Myotis* carcasses will be verified by the USFWS and ODNR DOW through agreed upon means, which may include, but not be limited to, DNA testing by an appropriate lab (as determined in coordination with the USFWS), examination by recognized expert or some other mutually agreeable method. Genetic testing may be performed if the species of a bat is unclear and it is necessary to confirm the carcass identification.

Any other federally or state threatened or endangered species found will be reported to the USFWS an ODNR DOW within 48 hours of discovery and arrangements will be made to submit the carcass(es) to the appropriate agency personnel. Per the ODNR Protocol, agency contact will also be made within 48 hours if a "significant mortality event" occurs, defined as greater than 5 birds or bats found at any 1 turbine, or if greater than 20 birds or bats are found at all searched turbines combined.

## 6.7 Estimating Annual Mortality

### 6.7.1 *Searcher Efficiency Trials*

Searcher efficiency rates are variable among studies at wind facilities in the United States and are largely dependent on ground cover conditions. Searcher recovery rates have ranged from

25% to 56% for small carcasses and as high as 100% for large carcasses (Arnett 2005, Erickson et al. 2003a, Jain et al. 2007). Therefore, trials will be conducted by the PCM Manager in each year that mortality monitoring is performed to estimate searcher efficiency and carcass removal rates. Both searcher efficiency and carcass removal trial methods will remain the same during the Evaluation, Implementation, and Re-evaluation phases.

Trials will involve the placement of a minimum of 200 carcasses over the course of the monitoring year (where 1 carcass equals 1 trial) per ODNR Protocol. The same individual trial carcasses will be re-used in multiple trials over the course of the study period, and up to 20 trial carcasses may be used on a single trial day. "Over-seeding" may occur if too many trial carcasses are placed in a small area (which may increase scavenger activity). Therefore, no more than 2 trial carcasses will be placed at any time at a single turbine (Strickland et al. 2011, USFWS 2011c). On trial days, carcasses will be placed at multiple turbines scheduled to be searched that day and will be placed at random distances from turbine towers and in a variety of cover types.

Multiple trials (at least 200) will be conducted throughout the survey period to account for changes in ground cover conditions. Recommended placement procedures range from distributing carcasses equally across ground cover types (USFWS 2011c) to having higher sample sizes in low visibility ground cover in order to obtain more precise estimates of searcher efficiency in areas contributing to higher uncertainty in overall fatality estimates (Strickland et al. 2011). No studies to date have suggested a preferred method for stratifying trial carcass placement (Strickland et al. 2011). As ground cover conditions will be highly variable throughout the survey period and from year to year, and trial schedule will be dependent upon carcass availability, the PCM Manager will attempt to distribute trials evenly across ground cover types to his or her best ability.



Bat trial carcasses in varying stages of decomposition will be marked by the PCM Manager so that trial carcasses may be distinguished from actual fatalities without the surveyor's knowledge. Non-bat surrogates (for example, mice or birds) will not be used to estimate searcher efficiency for bats. If a sufficient number of trial carcasses cannot be obtained from on-site mortality, then Buckeye Wind will attempt to obtain carcasses from outside sources. Buckeye Wind will first consult with the USFWS and ODNR DOW to identify whether either agency has a source of additional carcasses. If not, then Buckeye Wind will attempt to find a source of additional carcasses from other sources, such as academia, the Ohio Department of Health, or other wind facilities, as long as precautions can be followed to avoid spreading WNS. These precautions will follow USFWS and ODNR Protocol. To the extent that it is feasible (i.e., carcasses are in good condition and do not show signs of WNS), carcasses from Project fatalities or carcasses from elsewhere that are of species expected to be encountered during the searches will be used in trials. If nothing else is available, non-bat surrogates may be used if necessary in coordination with USFWS and ODNR DOW.

A *Myotis* carcass will not be used in a trial unless its identification has been verified. Negative identification of the carcass will be verified by the USFWS and ODNR DOW through agreed upon means, which may include, but not be limited to, DNA testing by an appropriate lab (as determined in coordination with the USFWS), examination by recognized expert or some other mutually agreeable method.

Surveyors being tested will be unaware of trial dates and locations. The PCM Manager will leave carcasses out before sunrise at search turbines and will make every effort to leave no evidence of trial set-up (e.g., vehicle or foot prints in wet grass or mud). The PCM Manager will record the following information for each carcass placed and will use the Searcher Efficiency Form as provided in the ODNR Protocol:

- Date, time of set-up, PCM Manager, and surveyor being tested;
- Turbine number;
- Carcass identification;
- Carcass distance and direction from tower;
- Ground cover type and vegetation height where carcass was placed; and
- GPS location.

After searches are completed on trial days, the PCM Manager will determine how many trial carcasses were recovered. Trial carcasses that were not found the first day will be left in place for possible detection on subsequent days. The presence of the carcass (i.e., availability for detection) will be determined by the PCM Manager each day immediately after the completion of each searcher efficiency trial day.

Searcher efficiency rate will be expressed as the proportion of trial carcasses found by searchers (the number of trial carcasses found by searchers divided by the total number of trial carcasses placed during searcher efficiency trials (i.e., searcher efficiency = number found/total number placed). Searcher efficiency will be calculated separately by season and by vegetation cover type (such as cleared versus uncleared plots) as trial carcasses are available and as sample sizes allow. Each trial carcass collected during mortality surveys will be associated with a searcher efficiency value specific to the season, trial carcass type, and cover type in which it was found. If alternative formulas are developed over time, the formula determined to be most applicable to the Project and most accurate at the time of analysis will be chosen in coordination with the USFWS and ODNR DOW (see HCP Section 6.5.2.7 – Estimating Unobserved Mortality). Separate searcher efficiency rates will be developed for all bats and *Myotis* bats, as trial carcasses are available and as sample sizes allow.

### 6.7.2 *Carcass Removal Trials*

Trials will be conducted to estimate the carcass persistence rate or the average length of time carcasses remain in the area prior to removal by scavengers. Per ODNR Protocol (2009), a minimum of 50 trial carcasses will be placed at random distances and directions from turbines over the course of each monitoring year (subject to carcass availability). Several trial carcasses will be placed per month during the course of the survey year in order to account for seasonal changes of scavenger activity, per ODNR protocol (2009). Carcasses in fresh condition will be used in trials and will be marked to differentiate them from actual fatalities. Non-bat surrogates (for example, mice or birds) will not be used to estimate carcass persistence rates for bats, unless nothing else is available. If nothing else is available, non-bat surrogates may be used in coordination with USFWS and ODNR DOW. Preferably, carcasses used for trials will be those collected from the site (ODNR 2009).

Trial carcasses will be randomly placed and stratified across various habitat types in proportion to their occurrence (for example, if 90% of the area under turbines is agricultural, then 90% of trial carcasses will be randomly placed in agricultural settings). Carcasses will be placed at cleared and uncleared search plots. Trial carcasses will be randomly placed at multiple turbines throughout the monitoring area and will be checked daily for the first 7 days, then every 2 days until the trial carcass is removed or completely decomposed, per ODNR (2009) protocol. On each day the trial carcass is checked, surveyors will indicate whether the trial carcass is present (intact or partially scavenged but readily detectable) or absent (completely removed or with so few feathers or tissue that they are not readily detectable). The following additional information will be recorded on standardized datasheets for each trial carcass:

- Date, time of set-up, PCM Manager;

- Turbine number;
- Carcass identification;
- Carcass distance and direction from tower;
- Ground cover type and vegetation height where carcass was placed; and
- Detailed notes describing any scavenging and evidence of scavenger identification.
- GPS location

There are several formulas currently available to estimate carcass persistence rate, and new methods are continuously being developed. In coordination with the USFWS, the formula determined to be most applicable to the Project and most accurate at the time of analysis will be used. Using an example estimator employed by Erickson et al. (2004) and Tidhar (2009), the average number of days a carcass remained at a site before it was removed by scavengers (*t*) was expressed as:

$$\bar{t} = \frac{\sum_{i=1}^{s} t_i}{s - s_c}$$

- Where *s* is the number of test carcasses used in the search trials;
- $s_c$ is the number of test carcasses remaining in the study area at the end of the trial; and
- $t_i$ is the number of days carcass *i* remained in the study area.

If all trial carcasses are removed before the end of the 14 day trial, then $s_c$ is equal to 0, and *t* is equal to the arithmetic average number of days each carcass remained in the study area.

Other methods currently in use calculate the number of trial carcasses remaining after the average time between impact and discovery (Jain et al 2009a) or calculate the probability that a trial carcass was not removed in the interval between searches (Arnett et al. 2010). The formula determined to be the most applicable to the Project and the most accurate at the time of analysis will be used, pending USFWS approval (USFWS 2011c). Separate carcass persistence rates will be developed for all bats and *Myotis* bats, as trial carcasses are available and as sample sizes allow. Carcass persistence will also be calculated separately by season and by vegetation cover type (such as cleared versus uncleared plots) as trial carcasses are available and as sample sizes allow. Each carcass collected during mortality surveys will be associated with a carcass persistence value specific to the season, carcass size, and cover type in which it was found.

It is expected that, as recommended by the USFWS draft guidance document (2011c), the most contemporary and most accurate equations for estimating fatality available at the time of analysis will be used. In the case that other formulas will be more appropriate, Buckeye Wind would propose to utilize those formulas for estimating unobserved mortality. The utilization of any new formulas will be made in coordination with and with the approval of the USFWS and will be based on site-specific information.

#### 6.7.3 *Searchable Area*

Searchable area around each turbine may vary by turbine and month, and therefore vegetation mapping will be conducted on a weekly basis to record the aerial extent of each ground cover type and respective vegetation heights. There are several methods currently available to adjust estimated mortality by searchable area, and new methods are continuously being developed (see Section 6.5.2.7 – Estimating Unobserved Mortality). In coordination with the USFWS and ODNR DOW, the method and formula determined to be most applicable to the Project and most accurate at the time of analysis will be used.

One method is to adjust mortality estimates to account for area searched and distribution of carcasses around turbines following Young et al. (2009a). Density of carcasses decreases as distance from turbines increases (Kerns et al. 2005). Therefore, an area adjustment calculates the density of carcasses within distance bands, centered on the turbine. The adjustment relates the density of carcasses within each distance band with the proportion of area searched in the same band, resulting in a factor by which estimated mortality is adjusted to account for unsearched areas.

With this example method, a multiplier, *A*, is calculated based on the percentage of area searched within circular bands of fixed radius surrounding each turbine, searcher efficiency, and numbers of carcasses found within each band. An estimate of *A* is then calculated according to the following formula:

$$A = \frac{\sum_{k'=1}^{7} \frac{c_{k'}}{p_{k'} s_{k'}}}{\sum_{k'=1}^{7} \frac{c_{k'}}{p_{k'}}}$$



- Where $c_k$ = the number of carcasses within the kth distance band;
- $p_k$ = searcher efficiency; and
- $s_k$ = the proportion of area searched within the kth distance band across turbines.

Estimates of *A* are calculated separately for season and carcass type. Estimated mortality is derived by multiplying total observed mortality "*m*" (see Section 6.5.2.8.2 – Data Analysis) by *A.*

### 6.8 Reporting and Consultation

Buckeye Wind will implement post-construction monitoring in accordance with the final HCP post-construction monitoring plan and in accordance with OPSB Certificate conditions, with possible increased rigor during the first 1 – 2 years to accommodate ODNR's monitoring protocol at the time of implementation. Work plans that describe the field, analysis, and reporting methods used during monitoring will be developed in consultation with the ODNR DOW and USFWS and will be approved by these agencies prior to initiation of monitoring studies. An annual report describing the methods and results of mortality monitoring will be submitted to the ODNR DOW and USFWS by 31 December of each calendar year that monitoring is actively conducted.

Concurrent with reporting as required under the HCP, annual reports will including the following:
Intermittent Construction Reports will include:

- A written notification of the turbine number, location and date placed in commercial operation for each turbine(s). This notification will be submitted at least 30 days prior to the turbine(s) being placed in commercial operation.

Seasonal Reports will include:

- Quantity and species composition of observed bat and bird mortality, including Indiana bat mortality during reporting period;
- Review of adaptive management measures implemented, if any, in response to observed mortality.

Annual Reports will include:

- Quantity and species composition of observed bat and bird mortality, including Indiana bat mortality during reporting period;
- Estimates of total mortality of all bats, all birds, Myotis species, and Indiana bats using searcher efficiency trials, carcass persistence trials, and searchable area adjustments. All estimates will include 95% confidence intervals;
- Report on weather conditions monitored during nights preceding mortality searches and weather conditions during searches;
- Review of adaptive management measures implemented in response to observed and/or estimated mortality;
- Annual operating parameters (cut-in speeds at each turbine during each season) and compilation of mortality data as it relates to those parameters;
- Raw carcass data of bat fatalities in Excel spreadsheet format (raw date for bird fatalities will also be provided);
- Fatality Reporting Forms;
- A calendar reflecting dates, times, and locations of searches;
- Injured bat and bird reporting forms and rehabilitator reports;
- A description of the subsequent year's monitoring efforts based on the monitoring phase and any adaptive management measures that will be implemented; and
- A cost estimate of the subsequent year's monitoring;

Meetings will be held with the USFWS and ODNR DOW in January of each calendar year to review the results of the previous year's monitoring. Additional meetings may be called by either the USFWS or Buckeye Wind to discuss new information or research that may be relevant to ongoing monitoring.

## 7.0 ADAPTIVE MANAGEMENT

Based on the best scientific information available, Buckeye Wind expects that the proposed Project will not pose significant risk to bird and bat populations. However, if fatality estimates are greater than the Mortality Thresholds defined below, adaptive management will be used to develop additional avoidance and minimization measures to reduce the number of fatalities. These adaptive management measures will be implemented in addition to, and consistent with, any adaptive management measures required in the HCP for the Indiana bat. Such measures, pending the specific circumstances resulting in increased collision risk, might include:

1. Project structures, such as stairways leading up to tower doors, may be modified if being used for perching or nesting by birds.

2. Lighting may be modified if it contributes to bird mortality events.
3. Additional feathering may be implemented to reduce mortality of birds or bats; specific methods will be dependent on species being impacted and will be determined based on results of scientifically driven reports that have demonstrated effectiveness of feathering for reducing impacts to birds or bats and will allow for the continued economically viable operation of the Project. Any further operational adjustments will be implemented in consultation with ODNR DOW and USFWS.
    a. Additional modification of feathering will be based on the following criteria:
        - It will be limited to periods of higher risk (seasonal and time of day/night) as established through examination of previous years' monitoring results and other applicable data from other projects.
        - It will be limited to certain weather considerations (wind speed, temperature, barometric pressure, humidity) as established through examination of previous years' monitoring results and other applicable data from other projects.
        - It will limited to just those turbines that have demonstrated higher levels of impact.
        - Additional adjustments will be made commensurate with the degree to which the Mortality Thresholds are exceeded.

4. Technology proven to decrease bird/bat mortality without affecting the financial viability of the Project may be applied.

The specific management actions to be taken will be developed in coordination with USFWS and ODNR DOW. The second year of post-construction searches will be used to assess the effectiveness of additional avoidance and minimization measures. If such measures decrease the number of fatalities to below Mortality Threshold levels, the use of these measures will continue through the life of the Project or until Buckeye Wind offers additional information or minimization measures that reduce mortality rates below Mortality Threshold levels. As there will be long-term monitoring for Indiana bat fatalities, the opportunity will exist to monitor the need for and effectiveness of management actions for other species of bats and birds as well. If at any point during other monitoring years, mortality of non-federally listed bats or birds exceeds the Mortality Thresholds, Buckeye Wind will work with the ODNR DOW to determine if any additional mitigation measures are appropriate. It making this determination, consideration will be given for the fact that other projects in OH are not providing mortality data beyond 1 or 2 years.

If avoidance and minimization measures are found to be ineffective at reducing impacts and mortality continues to exceed the Mortality Threshold, Buckeye Wind will consider mitigation options including, but not limited to, the following actions to offset impacts to birds and bats:

1. Contribute to funding for protection, enhancement or restoration of habitat which is of particular importance to the impacted species.

2. Contribute to funding of on-site or off-site research, such as bird displacement studies or acoustic bat studies to better understand the specific Project design, environmental, or behavioral factors contributing to mortality.

3. Contribute to funding of off-site research that would contribute to knowledge of survival or breeding success of the impacted species.

4. Contribute to funding for retrofitting of communication towers with bird flight diverters on guy lines, and/or retrofitting communication towers with lighting schemes that are less of an attraction to nocturnal migrants.

5. Contribute to funding for the installation of off-site nesting platforms or nest boxes to increase breeding success of the impacted species.

6. Other, unknown mitigation measures, determined in coordination with ODNR DOW and USFWS, which may satisfy a recently discovered (previously unforeseen) need in the area.

The specific measures to be taken would be developed in cooperation with ODNR DOW and the USFWS, would consider the best available science, and would occur in Ohio. The amount of funding available would be commensurate with the level of mortality relative to the thresholds and will not exceed $100,000 for the life of the Project. It should be recognized that there are adaptive management and mitigation measures outlined in the HCP that are geared toward mitigating impacts to Indiana bats, such as conservation and restoration of forested habitat and turbine feathering, that will coincidentally benefit other species of bats and birds. Any measures employed through the HCP will also be considered as mitigation measures in this ABPP to the extent that the Indiana bat mitigation also provided benefits to the affected species.



## 7.1 Calculation of Threshold Levels

The results of post-construction monitoring may indicate that bird and bat mortality are not below the Mortality Thresholds. Should mortality of birds or bats exceed this Mortality Threshold, Buckeye Wind will work with the ODNR DOW and USFWS to determine what additional measures could help bring mortality to within the Mortality Threshold while maintaining the economic viability of the project. This adaptive management approach will allow adverse impacts to birds and bats to be addressed as new information becomes available over time.

In order to most accurately assess potential avian and bat impacts, and to outline the most applicable avoidance or minimization measures for the Project, calculation of this threshold should consider available scientific studies and published literature that are most applicable to the Project. Data from different geographic regions that had markedly different species assemblages and habitats, different seasonal bird and bat behavioral patterns, different seasonal weather patterns, and, in some cases, markedly different turbine models, such as the Altamont Pass Wind Resource Area, CA, other western wind facilities, and wind facilities in Europe, should not be used. Rather, only studies conducted at sites in the Midwestern United

States should be included. While landscape settings at other regional projects may differ from the Project, generally the species, regional populations, and seasonal weather patterns among these sites are the most similar to the Project. Threshold levels for birds and bats will be calculated as the mean estimated number of fatalities per turbine per year plus one standard deviation. The calculation for mean is as follows:

$$\overline{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Where n is the sample size and $x_i$.denotes the $i^{th}$ observation. Standard deviation is calculated as follows:

$$sd = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \overline{x})^2}{n-1}}$$

Where n is the sample size, $x_i$.denotes the $i^{th}$ observation, and $\overline{x}$ is the mean.

### 7.1.1 *Threshold levels for bats*

Data compiled in Table 7-1 was used to calculate a regional average of 9.6 bats per turbine per year and a standard deviation of 14.5. Given the current set of monitoring results, Adaptive Management will be considered if Project related bat mortality is greater than 24.1 bats per turbine per year.

**Table 7-1.** Estimated bat mortality rates reported at Midwestern wind-energy facilities in the United States.

| Project Location | Year | No. of turbines at site | Estimated no. bats per turbine/yr | 90% confidence interval (per no. b/t/yr) | Study period | Source |
|---|---|---|---|---|---|---|
| Blue Sky Green Field, WI | 2008 | 88 | 35.6 | 30.98-51.16 [a] | 21 Jul - 31Oct 2008; 15 Mar - 31 May 2009 | Gruver et al. 2009 |
| Buffalo Ridge, MN (Phase I) | 1999 | 73 | 0.26 | 0.06-0.46 | 15 Mar - 15 Nov 1999 | Johnston et al. 2003a |
| Buffalo Ridge, MN (Phase II) | 1998 | 143 | 1.62 | 1.21-2.03 | 15 Mar - 15 Nov 1998 | Johnston et al. 2003a |
| Buffalo Ridge, MN (Phase II) | 1999 | 143 | 1.94 | 1.53-2.35 | 15 Mar - 15 Nov 1999 | Johnston et al. 2003a |
| Buffalo Ridge, MN (Phase III) | 1999 | 138 | 2.04 | 1.46-2.62 | 15 Mar - 15 Nov 1999 | Johnston et al. 2003a |
| Buffalo Ridge, MN (Phase II) | 2001 | 143 | 3.26 | 2.25-4.48 | 15 Jun - 15 Sep 2001 | Johnston et al. 2004 |
| Buffalo Ridge, MN (Phase III) | 2001 | 138 | 2.78 | 1.96-3.71 | 15 Jun - 15 Sep 2001 | Johnston et al. 2004 |
| Buffalo Ridge, MN (Phase II) | 2002 | 143 | 1.36 | 0.82-2.00 | 15 Jun - 15 Sep 2002 | Johnston et al. 2004 |
| Buffalo Ridge, MN (Phase III) | 2002 | 138 | 1.3 | 0.89-1.77 | 15 Jun - 15 Sep 2002 | Johnston et al. 2004 |
| Cedar Ridge, WI | 2009 | 41 | 50.5 [c] | NR | Mar-May 2009; July-Nov 2009 | BHE 2010 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Crescent Ridge, IL | 2005/2006 | 33 | 0.18-2.67 | 4.36-5.46 | Sep-Nov 2005; Mar-May 2006; Aug 2006 | Kerlinger et al. 2007 |
| Fowler Ridge, IN | 2010 | 355 | 22.2 | 19.32-29.17 | 13 Apr - 5 May 2010; 1 Aug - 15 Oct 2010 | Good et al. 2011 |
| Forward Energy Center, WI | 2008-2009 | 86 | NR | NR | 15 Jul 2008 - 15 Oct 2009 | Drake et al. 2010 |
| Kewaunee County, WI | 1999-2001 | 31 | 4.26 | NR | Jul 1999 - Jul 2001 | Howe et al. 2002 |
| NPPD Ainsworth, NE | 2006 | 36 | 1.91 [b] | 0.91-3.37 | 13 Mar - 4 Nov 2006 | Derby et al. 2007 |
| Top of Iowa, IA | 2003 | 89 | 3.74-8.08[b] | NR | 15 Apr - 15 Dec 2003 | Jain 2005 |
| Top of Iowa, IA | 2004 | 89 | 7.19-13.14[b] | NR | 15 Apr - 15 Dec 2004 | Jain 2005 |
| AVERAGE | | 112.2 | 9.6 | | | |

[a] estimation includes incidental fatalities

[b] estimation based on study period, not bats per turbine/yr

### 7.1.2 *Threshold levels for birds*

ODNR DOW data compiled in Table 7-2 was used to calculate a regional average of 2.5 birds per turbine per year and a standard deviation of 3.0. (Note these results only represent data from 6 distinct wind farms.) Given the current set of monitoring results, Adaptive Management will be considered if Project-related bird mortality is greater than 5.5 birds per turbine per year.

**Table 7-2.** Estimated bird mortality rates reported at wind-energy facilities in the Midwestern United States.

| Project Location | Year | No. of turbines at site | Estimated no. birds per turbine/yr | 90% confidence interval (per no. b/t/yr) | Study period | Source |
|---|---|---|---|---|---|---|
| Buffalo Ridge, MN (Phase I) | 1995 | 73 | 0.33 - 0.66 | n/a | Jan - Dec 1995 | Osborn et al 2000 |
| Buffalo Ridge, MN (Phase I) | 1996 | 73 | 1.45 | 0.33-2.57 | 15 March -15 Nov 1996 | Johnson et al. 2002 |
| Buffalo Ridge, MN (Phase I) | 1997 | 73 | 0.88 | 0.09-1.67 | 15 March - 15 Nov 1997 | Johnson et al. 2002 |
| Buffalo Ridge, MN (Phase I) | 1998 | 73 | 1.1 | 0.21-1.99 | 15 March - 15 Nov 1998 | Johnson et al. 2002 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Buffalo Ridge, MN (Phase I) | 1999 | 73 | 0.5 | 0.05-1.2 | 15 March - 15 Nov 1999 | Johnson et al. 2002 |
| Buffalo Ridge, MN (Phase I) | 1996-1999 | 73 | 0.98 | 0.42-1.54 | 15 March - 15 Nov (overall) | Johnson et al. 2002 |
| Buffalo Ridge, MN (Phase II) | 1998 | 143 | 1.85 | 0.55-3.20 | 15 March - 15 Nov | Johnson et al. 2002 |
| Buffalo Ridge, MN (Phase II) | 1999 | 143 | 2.68 | 0.63-4.73 | 15 March - 15 Nov | Johnson et al. 2002 |
| Buffalo Ridge, MN (Phase II) | 1998-1999 | 143 | 2.27 | 1.67-2.86 | 15 March - 15 Nov (overall) | Johnson et al. 2002 |
| Buffalo Ridge, MN (Phase III) | 1999 | 138 | 4.45 | 0.11-8.78 | 15 March - 15 Nov | Johnson et al. 2002 |
| Blue Sky Green Field, WI | 2008-2009 | 88 | 11.83 | 9.08-16.43 | 21 Jul - 31Oct 2008; 15 Mar – 31 May 2009 | Gruver et al. 2009 |
| Cedar Ridge, WI | 2009 | 41 | 10.8 [a] | NR | 15 Mar - 31 May; 15 July - 15 Nov 2009 | BHE 2010 |
| Forward Energy Center, WI | 2008-2009 | 86 | NR | NR | 15 Jul 2008 - 15 Oct 2009 | Drake et al. 2010 |
| NPPD Ainsworth, NE | 2006 | 36 | 2.68 | 1.48-4.43 | 13 Mar - 4 Nov 2006 | Derby et al. 2007 |
| Kewaunee County, WI | 1999-2001 | 31 | 1.29 | NR | Jul 1999 - Jul 2001 | Howe et al. 2002 |
| Top of Iowa, IA | 2003 | 89 | 39.47 [a] | 34.87 - 44.07 | 15 Apr - 15 Dec 2003 | Jain 2005 |
| Top of Iowa, IA | 2004 | 89 | 85.38 [a] | 77.6-93.16 | 15 Apr - 15 Dec 2004 | Jain 2005 |
| AVERAGE | | 86.2 | 2.5 | | | |

[a] estimation of total fatalities per study period, not per turbine/yr

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# Appendix A

**Appendix A Table 1.** Federal- and State-listed Threatened and Endangered Wildlife Species with Potential to Occur in the Vicinity of the Action Area

| Species[a] | Listing Status | General Habitat Description[a] | Occurrence in Action Area Vicinity |
|---|---|---|---|
| Indiana bat *Myotis sodalis* | FE SE | Winter hibernacula are in caves and abandoned mines and summer roosts are in trees and tree hollows. | Maternity colonies documented in Logan County and in Champaign County.[c] Captured during 2009 mist net surveys in Action Area. [e] |
| Northern harrier *Circus cyaneus* | SE | Large contiguous grasslands, marshes, low intensity agriculture. | Not observed on BBS survey route in Action Area during 15 years of survey (1992-2007) [b]. Observed in Action Area during migration.[e] Marginal habitat for this species exists within the Action Area. **Not expected to regularly occur or breed in Action Area – transient use only.** |
| Sandhill crane *Grus Canadensis* | SE | Large contiguous wetlands, shallow/standing water, agricultural land. | Observed in the Action Area during migration.[e] Marginal habitat for this species exists within the Action Area. **Not expected to regularly occur or breed in Action Area – transient use only.** |
| Loggerhead shrike *Lanius ludovicianua* | SE | Large, relatively contiguous grasslands and open areas with scattered trees. | One breeding record since 1980 in 5-county area.[b] Not observed on BBS survey route in Action Area during 15 years of survey (1992-2007) [b]. Marginal habitat for this species exists within the Action Area. **Not expected to regularly occur or breed in Action Area – transient use only.** |
| Upland sandpiper *Bartramia longicauda* | ST | Large expanses of grasslands, pastures, unkempt agricultural land with a mosaic of old fields and crop lands, grassy expanses of airports. | Recent records of probable nesting in Clark County.[b]. Not observed on BBS survey route in Action Area during 15 years of survey (1992-2007) [b]. Marginal habitat for this species exists within the Action Area. **Not expected to occur in Action Area.** |

| Species[a] | Listing Status | General Habitat Description[a] | Occurrence in Action Area Vicinity |
|---|---|---|---|
| Least flycatcher *Empidonax minimus* | ST | Deciduous forests. | Possible breeding records 1982-1987 and 2006-2010 in 5-county area. Not observed on BBS survey route in Action Area during 15 years of survey (1992-2007)[b] but observed in Action Area during breeding season in 2008[e]. |
| Bald eagle *Haliaeetus leucocephalus* | ST | Lakes, reservoirs, rivers. | Observed in Action Area during the spring 2008 and fall 2008 migration surveys.[e] Marginal habitat for this species exists within the Action Area. |
| Yellow-bellied sapsucker *Sphyrapicus varius* | SE | Breeds in young forests and along streams, especially in aspen and birch. Winters in variety of forests, especially semi open forests. | Incidental observations recorded in Action Area during surveys for another wind project.[g] |
| Black-crowned night heron *Nycticorax nycticorax* | ST | Various wetland habitats, including salt, brackish, and freshwater marshes, streams, lakes, and agricultural fields. | As cited in West 2010, this species was observed during BBS although no nesting was documented.[g] Not expected to regularly occur or breed in Action Area – transient use only. |
| Dark-eyed junco *Junco hyemalis* | ST | Breed in coniferous and deciduous forests. During winter and migration they use a variety of habitats including open woodlands, grasslands/pasture, roadsides, and gardens. | Incidental sightings recorded in migration period in Action Area during surveys for another wind project.[g] |
| Hermit thrush *Catharus guttatus* | ST | Open areas inside forests, such as trails, pond edges, or areas partially opened up by fallen trees. In winter, this species occupies forests with dense understory and berry bushes. | Incidental sightings recorded in migration period in Action Area during surveys for another wind project.[g] |
| Osprey *Pandion haliaetus* | ST | Nest platform or forest near (within 12 miles) shallow, fish-filled water, including rivers, lakes, reservoirs, lagoons, swamps, and marshes. | Incidental sightings recorded in migration period in Action Area during surveys for another wind project.[g] Not expected to regularly occur or breed in Action Area – transient use only. |

Listing Status: FE = Federally Endangered, FE = Federally Threatened, FC = Candidate for Federal Listing, ST = State Threatened, SE = State Endangered

[a] Species status and habitat descriptions based on ODNR DOW Division of Wildlife (ODNR DOW 2008).

[b] Ohio Breeding Bird Atlas (2009) and BBS data for Route 66031 from 1992-2007

[c] K. Lott (2009, ODNR DOW Biologist, personal communication)

[e] Based on pre-construction surveys conducted for Project (Stantec 2008a, 2009)
[g] WEST 2010
[h] USFWS, Species Assessment and Listing Priority Assignment Form – *Quadrula cylindrical cylindrica*, 2009
[i] Hull 2009

**Appendix A Table 2.** State-listed Species of Concern and Special Interest Species Known to Occur in the Action Area and Vicinity.

| Species | General Habitat Description | Occurrence within Action Area and Vicinity |
|---|---|---|
| **State Species of Concern** | | |
| Sharp-shinned hawk<br>*Accipiter striatus* | Forests, agricultural, and suburban areas | • Possible breeding records 1982-1987 and 2006-2010 in 5-county area [a]<br>• Observed in Action Area during migration [b]<br>• Not observed on the BBS survey route that crosses the northern portion of the Action Area during 15 years of survey (1992-2007) [c] |
| Henslow's sparrow<br>*Ammodramus henslowii* | Large, continuous blocks of grassland habitat | • Rare in Champaign County, some records in Clark, Union, and Madison counties [a]<br>• Observed in Action Area during breeding season [b]<br>• Not observed on the BBS survey route that crosses the northern portion of the Action Area during 15 years of survey (1992-2007) [c] |
| Northern bobwhite<br>*Colinus virginianus* | Forested edges | • Confirmed breeding record 1982-1987 and probable breeding records 2006-2010 in 5-county area and recent records exist for Champaign County [a]<br>• Not detected during surveys within and near the Action Area from 2007- 2009 [b]<br>• Observed on the BBS survey route that crosses the northern portion of the Action Area [c] |
| Black vulture<br>*Coragypus atratus* | Lowlands along rivers and open landscapes | • Possible breeding records 2006-2010 in 5-county area [a]<br>• Observed in Action Area during migration season [b]<br>• Not observed on the BBS survey route that crosses the northern portion of the Action Area during 15 years of survey (1992-2007) [c] |

| | | |
|---|---|---|
| Bobolink *Dolichonyx oryzivorus* | Grassy fields, hayfields, wet prairies, grassy marshes | • Confirmed breeding records 2006-2010 in 5-county area [a]<br>• Observed in Action Area during breeding season [b]<br>• Observed on the BBS survey route that crosses the northern portion of the Action Area [c] |
| Great egret *Ardea alba* | Shrubs and trees near freshwater pools and lakes, marshes | • Observed in Action Area during surveys for other wind project [d] |
| Tri-colored bat *Perimyotis subflavus* | Edge habitats near mixed agricultural use areas; roost in foliage or tree cavities. Hibernate in caves and mines in winter. | • Observed 4 miles north of Action Area during fall [b]<br>• Observed in Action Area during summer [b] |
| Big brown bat *Eptesicus fuscus* | Feed over water, fields, forest openings, urban and suburban areas; roost on buildings and under bridges. Hibernate in caves and mines in winter. | • Observed 4 miles north of Action Area during fall [b]<br>• Observed in Action Area during summer[b] |
| Northern long-eared bat *Myotis septentrionalis* | Caves and mines are used for hibernation in winter and tree cavities are used in summer. | • Observed 4 miles north of Action Area during fall [b]<br>• Observed in Action Area during summer [b] |
| Little brown bat *Myotis lucifugus* | Caves and mines are used for hibernation in winter and tree cavities are used in summer. | • Observed 4 miles north of Action Area during fall [b]<br>• Observed in Action Area during summer [b] |
| Silver-haired bat *Lasionycteris noctivagans* | Roosts in trees during the summer and winter | • Observed in Action Area during fall [b]<br>• Observed in Action Area during summer [b] |
| Hoary bat *Lasiurus cinereus* | Roosts in trees during the summer and winter | • Observed in Action Area during fall [b]<br>• Observed in Action Area during summer [b] |
| Red bat *Lasiurus borealis* | Roosts in trees and shrubs in the summer. Overwinters in trees and tree cavities | • Observed in Action Area during fall [b]<br>• Observed in Action Area during summer [b] |

| **State Species of Special Interest** | | |
|---|---|---|
| Blackburnian warbler *Dendroica fusca* | Forests | • Observed in Action Area during breeding season [b]<br>• Not observed on the BBS survey route that crosses the northern portion of the Action Area during 15 years of survey (1992-2007) [c] |
| Brown creeper *Certhia americana* | Forests | • Observed in Action Area during surveys for other wind project [d] |
| Northern waterthrush *Parkesia noveboracensis* | Forests, generally near water. | • Observed in Action Area during surveys for other wind project [d] |
| Golden-crowned kinglet *Regulus satrapa* | Forests | • Observed in Action Area during surveys for other wind project [d] |
| Pine siskin *Spinus pinus* | Open woodland | • Observed in Action Area during surveys for other wind project [d] |
| Winter wren *Troglodytes troglodytes* | Forests | • Observed in Action Area during surveys for other wind project [d] |
| Wilson's snipe *Gallinago delicata* | Marshlands | • Observed in Action Area during surveys for other wind project [d] |
| American wigeon *Anas americana* | Shallow freshwater wetlands, including ponds, marshes, and rivers | • Observed in Action Area during surveys for other wind project [d] |
| Western meadowlark *Sturnella neglecta* | Open grasslands, prairies, meadows, and some agricultural fields | • Observed in Action Area during surveys for other wind project [d] |
| Mourning warbler *Geothlypis philadelphia* | Disturbed second-growth forested areas, with moderately closed canopy and thick understory | • Observed in Action Area during surveys for other wind project [d] |
| Purple finch *Carpodacus purpureus* | Forests | • Observed in Action Area during surveys for other wind project [d] |
| Red-breasted nuthatch *Sitta canadensis* | Forests | • Observed in Action Area during surveys for other wind project [d] |
| Magnolia warbler *Dendroica magnolia* | Forests | • Observed in Action Area during breeding season [b]<br>• Not observed on the BBS survey route that crosses the northern portion of the Action Area during 15 years of survey (1992-2007) [c] |

[a] Ohio Breeding Bird Atlas (2009)
[b] Based on pre-construction surveys conducted for Project (Stantec 2008a, 2009)
[c] BBS data for Route 66031 from 1992-2007 (USGS 2010)
[d] WEST 2010

**Appendix A Table 3.** Breeding birds observed at the Buckeye Wind Project and vicinity in spring 2008.

| Species | Number of breeding birds observed | | |
|---|---|---|---|
| | Spring BBS 2008 | State listing status | Federal listing status |
| Red-winged blackbird | 1,324 | None | Conservation Concern |
| Horned lark | 427 | None | None |
| American robin | 304 | None | None |
| Song sparrow | 297 | None | None |
| American crow | 246 | None | None |
| European starling | 206 | None | None |
| Barn swallow | 195 | None | None |
| American goldfinch | 191 | None | None |
| Blue jay | 191 | None | None |
| Indigo bunting | 186 | None | None |
| Field sparrow | 162 | None | Conservation Concern |
| Brown-headed cowbird | 160 | None | None |
| Mourning dove | 158 | None | None |
| Northern cardinal | 156 | None | None |
| Common grackle | 155 | None | None |
| House wren | 126 | None | None |
| Common yellowthroat | 80 | None | None |
| Gray catbird | 71 | None | None |
| Tufted titmouse | 60 | None | None |
| Red-bellied woodpecker | 54 | None | None |
| Vesper sparrow | 49 | None | None |
| Chipping sparrow | 45 | None | None |
| Baltimore oriole | 43 | None | None |
| Carolina chickadee | 40 | None | None |
| Eastern meadowlark | 40 | None | None |
| Wood thrush | 39 | None | Conservation Concern |
| Great crested flycatcher | 38 | None | None |
| Eastern wood-pewee | 36 | None | None |
| Red-eyed vireo | 34 | None | None |
| Brown thrasher | 33 | None | None |
| Savannah sparrow | 32 | None | None |
| Cedar waxwing | 28 | None | None |
| Downy woodpecker | 28 | None | None |

**Appendix A Table 3.** Breeding birds observed at the Buckeye Wind Project and vicinity in spring 2008.

| Species | Number of breeding birds observed | | |
| --- | --- | --- | --- |
| | Spring BBS 2008 | State listing status | Federal listing status |
| Willow flycatcher | 27 | None | Conservation Concern |
| Eastern towhee | 24 | None | None |
| House sparrow | 24 | None | None |
| Tree swallow | 24 | None | None |
| White-breasted nuthatch | 21 | None | None |
| Blue-gray gnatcatcher | 18 | None | None |
| Northern flicker | 17 | None | Conservation Concern |
| Bobolink | 16 | Species of Concern | None |
| Chimney swift | 16 | None | None |
| Red-tailed hawk | 15 | None | None |
| Yellow-billed cuckoo | 15 | None | Conservation Concern |
| Yellow warbler | 15 | None | None |
| Eastern kingbird | 14 | None | None |
| Carolina wren | 12 | None | None |
| Rock pigeon | 11 | None | None |
| Grasshopper sparrow | 10 | None | Conservation Concern |
| Orchard oriole | 10 | None | None |
| Red-headed woodpecker | 9 | None | Conservation Concern |
| Ring-necked pheasant | 8 | None | None |
| Rose-breasted grosbeak | 8 | None | None |
| Scarlet tanager | 8 | None | None |
| Yellow-rumped warbler | 8 | None | None |
| Unidentified sp. | 6 | None | None |
| Warbling vireo | 6 | None | None |
| American redstart | 4 | None | None |
| Blackburnian warbler | 4 | Special Interest | None |
| Magnolia warbler | 4 | Special Interest | None |
| Tennessee warbler | 4 | None | None |
| White-eyed vireo | 4 | None | None |
| Wild turkey | 4 | None | None |
| Woodpecker sp. | 4 | None | None |
| Blue-winged warbler | 3 | None | Conservation |

**Appendix A Table 3.** Breeding birds observed at the Buckeye Wind Project and vicinity in spring 2008.

| Species | Number of breeding birds observed | | |
|---|---|---|---|
| | Spring BBS 2008 | State listing status | Federal listing status |
| | | | Concern |
| Chestnut-sided warbler | 3 | None | None |
| Palm warbler | 3 | None | None |
| Ruby-throated hummingbird | 3 | None | None |
| Black-and-white warbler | 2 | None | None |
| Eastern bluebird | 2 | None | None |
| Nashville warbler | 2 | None | None |
| Northern bobwhite | 2 | special concern | None |
| Northern mockingbird | 2 | None | None |
| Northern parula | 2 | None | None |
| Northern rough-winged swallow | 2 | None | None |
| Acadian flycatcher | 1 | None | Conservation Concern |
| Black-throated green warbler | 1 | None | None |
| Flycatcher sp. | 1 | None | None |
| House finch | 1 | None | None |
| Least flycatcher | 1 | Threatened | None |
| Louisiana waterthrush | 1 | None | None |
| Merlin | 1 | None | None |
| Northern lapwing | 1 | None | None |
| Ovenbird | 1 | None | None |
| Prairie warbler | 1 | None | Conservation Concern |
| Swamp sparrow | 1 | None | None |
| White-throated sparrow | 1 | None | None |
| Yellow-breasted chat | 1 | None | None |
| **Total** | **5,643** | | |

Source: Based on data provided in Stantec 2008*a*.

**Appendix A Table 4.** Raptors observed at the Buckeye Wind Project and vicinity in 2007 and 2008.

| Species | Number of raptors observed | | | | | State listing status | Federal listing status |
|---|---|---|---|---|---|---|---|
| | Fall Raptor 2007 | Spring Raptor 2008 | Fall Raptor 2008 | Spring BBS 2008 | Total | | |
| Turkey vulture | 380 | 1,347 | 537 | 46 | 2,310 | None | None |
| Red-tailed hawk | 14 | 98 | 42 | 0 | 154 | None | None |
| American kestrel | 1 | 7 | 10 | 1 | 19 | None | None |
| Cooper's hawk | 3 | 4 | 8 | 3 | 18 | None | None |
| Unidentified raptor | 12 | 2 | 0 | | 14 | None | None |
| Northern harrier | 2 | 5 | 7 | 1 | 15 | Endangered | None |
| Sharp-shinned hawk | 4 | 2 | 0 | 0 | 6 | Species of Concern | None |
| Black vulture | 3 | 0 | 0 | 0 | 3 | Species of Concern | None |
| Unidentified accipiter | 1 | 2 | 0 | 0 | 3 | None | None |
| Bald eagle | 0 | 1 | 1 | 0 | 2 | Threatened | Protected by BGEPA, MBTA and Conservation Concern |
| Merlin | 0 | 2 | 0 | 0 | 2 | None | None |
| Northern goshawk | 1 | 0 | 1 | 0 | 2 | None | None |
| Unidentified buteo | 0 | 1 | 1 | 0 | 2 | None | None |
| Broad-winged hawk | 0 | 1 | 0 | 0 | 1 | None | None |
| Golden eagle | 0 | 1 | 1 | 0 | 2 | None | Protected by BGEPA and MBTA |
| Peregrine falcon | 0 | 1 | 0 | 0 | 1 | Threatened | Conservation Concern |
| Red-shouldered hawk | 0 | 1 | 0 | 0 | 1 | None | None |
| Unidentified falcon | 0 | 1 | 0 | 0 | 1 | None | None |
| **Totals** | **421** | **1,476** | **608** | **51** | **2,556** | | |

Source: Based on data provided in Stantec 2008*a*.

**Appendix A Table 5.** Summary of mean flight altitudes of nighttime migrants recorded during 2007 radar surveys conducted immediately north of the Adjusted Project Area.

| Sample Night | Mean Altitude (m) | Standard Error (SE) | Percent of targets below 150 m |
|---|---|---|---|
| 9/5/2007 | 506 | 27 | 4% |
| 9/6/2007 | 455 | 10 | 2% |
| 9/9/2007 | 485 | 13 | 2% |
| 9/10/2007 | 466 | 32 | 8% |
| 9/11/2007 | 490 | 22 | 4% |
| 9/12/2007 | 395 | 36 | 10% |
| 9/13/2007 | 445 | 17 | 3% |
| 9/14/2007 | 444 | 15 | 2% |
| 9/15/2007 | 387 | 16 | 5% |
| 9/16/2007 | 284 | 48 | 33% |
| 9/17/2007 | 268 | 32 | 38% |
| 9/18/2007 | 421 | 16 | 2% |
| 9/21/2007 | 415 | 16 | 7% |
| 9/22/2007 | 376 | 20 | 6% |
| 9/23/2007 | 382 | 32 | 14% |
| 9/24/2007 | 409 | 22 | 5% |
| 9/25/2007 | 396 | 12 | 5% |
| 9/27/2007 | 399 | 23 | 2% |
| 10/1/2007 | 346 | 12 | 5% |
| 10/2/2007 | 382 | 8 | 4% |
| 10/3/2007 | 424 | 23 | 3% |
| 10/4/2007 | 408 | 16 | 7% |
| 10/5/2007 | 389 | 9 | 7% |
| 10/6/2007 | 396 | 14 | 3% |
| 10/7/2007 | 441 | 18 | 3% |
| 10/9/2007 | 378 | 19 | 5% |
| 10/10/2007 | 252 | 43 | 19% |
| 10/11/2007 | 372 | 6 | 4% |
| 10/12/2007 | 292 | 7 | 6% |
| 10/13/2007 | 296 | 21 | 8% |
| **Entire Sampling Period** | 393 | 10 | 5% |

Source: Based on data provided in Stantec 2008*a*.

**Appendix A Table 6.** Waterfowl and waterbirds observed at the Buckeye Wind Project and vicinity in spring 2008.

| Species | Number of waterfowl/water birds observed | | | | |
|---|---|---|---|---|---|
| | **Spring Raptor 2008** | **Spring BBS 2008** | **Total** | **State listing status** | **Federal listing status** |
| Killdeer | 0 | 146 | 146 | None | None |
| Canada goose | 0 | 90 | 90 | None | None |
| Mallard duck | 0 | 7 | 7 | None | None |
| Great blue heron | 0 | 5 | 5 | None | None |
| Wood duck | 0 | 5 | 5 | None | None |
| Sandhill crane | 4 | 0 | 4 | Endangered | None |
| **Total** | **4** | **253** | **257** | | |

Source: Based on data provided in Stantec 2008*a*.



**Appendix A Table 7.** Mist-netting capture results by species at the Buckeye Wind Project and surrounding vicinity, summer 2008.

| Species | Number of adults and juveniles captured | OH State listing status | Federal listing status |
|---|---|---|---|
| Big brown bat | 197 | special concern | None |
| Northern long-eared bat | 38 | special concern | federal species of concern |
| Eastern red bat | 36 | special concern | None |
| Little brown bat | 18 | special concern | None |
| Indiana bat | 3 | Endangered | Endangered |
| Hoary bat | 3 | special concern | None |
| Tri-colored bat | 3 | special concern | None |
| **Total** | **298** | | |

Source: Based on data provided in Stantec 2008*b*.

**Appendix A Table 8.** Species captured at swarm surveys located at 2 cave openings approximately 6.3 km (3.9 mi) north of the Buckeye Wind Adjusted Project Area in fall 2008.

| Species | Sex | Swarm survey date (2008) | | | | | Subtotals | Totals |
|---|---|---|---|---|---|---|---|---|
| | | 9/15 | 9/24 | 10/6 | 10/20 | 10/27 | | |
| Big brown bat | Female | 10 | | | | | 10 | |
| | Male | 2 | | | | | 2 | 12 |
| Little brown bat | Female | 20 | 12 | 5 | | | 37 | |
| | Male | 88 | 48 | 17 | 8 | 3 | 164 | 201 |
| Northern long-eared bat | Female | 109 | 60 | 63 | 16 | 2 | 250 | |
| | Male | 131 | 41 | 132 | 73 | 3 | 380 | |
| | Unknown | | | 22 | 1 | | 23 | 653 |
| Tri-colored bat | Female | 2 | 3 | 3 | 1 | | 9 | |
| | Male | 3 | 4 | 2 | | | 9 | 18 |
| **Totals** | | 365 | 168 | 244 | 99 | 8 | | 884 |

Source: Based on data provided in Stantec 2008a.



**Appendix A Table 9.** Distribution of bat acoustic detections by species guild at the Buckeye Wind Project and surrounding vicinity, fall 2007.

| Detector | Guild | | | | Total |
|---|---|---|---|---|---|
| | Big brown/silver-haired/hoary bat guild (BBSHHB) | Red bat / tri-colored bat (RBTB) | *Myotis* (MYSP) | Unknown (UNKN) | |
| North High | 101 | 5 | 1 | 69 | 176 |
| North Low | 134 | 13 | 3 | 125 | 275 |
| North Tree | 1 | 3 | 1 | 83 | 88 |
| South High | 119 | 3 | 0 | 100 | 222 |
| South Low | 45 | 2 | 1 | 32 | 80 |
| South Tree | 110 | 253 | 0 | 318 | 681 |
| **Total** | **510** | **279** | **6** | **727** | **1,522** |

Source: Based on data provided in Stantec 2007.

**Appendix A Table 10.** Distribution of bat acoustic detections by species guild at the Buckeye Wind Project and surrounding vicinity, spring through fall, 2008

| Detector | Guild | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Big brown / silver-haired (BBSH) | Hoary (HB) | Red bat / tri-colored bat (RBTB) | *Myotis* (MYSP) | Unknown | | | Total |
| | | | | | High frequency (HFUN) | Low frequency (LFUN) | Unknown (UNKN) | |
| North High | 91 | 9 | 20 | 4 | 35 | 112 | 1 | 272 |
| North Low | 495 | 17 | 173 | 21 | 249 | 318 | 32 | 1,305 |
| North Tree | 7,891 | 44 | 333 | 546 | 1,586 | 1,312 | 200 | 11,912 |
| South High | 120 | 29 | 25 | 4 | 44 | 161 | 1 | 384 |
| South Low | 343 | 24 | 70 | 4 | 102 | 304 | 3 | 850 |
| South Tree | 2,298 | 25 | 96 | 24 | 423 | 1,046 | 80 | 3,992 |
| **Total** | **11,238** | **148** | **717** | **603** | **2,439** | **3,253** | **317** | **18,715** |

Source: Based on data provided in Stantec 2008*a*.

# Appendix B

**Appendix B Table 1**. Summary of available avian fall radar survey results conducted at proposed (preconstruction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

| Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Reference |
|---|---|---|---|---|---|---|---|---|---|
| **Fall 2004** | | | | | | | | | |
| Sheffield, Caledonia Cty, VT | 18 | 176 | Forested ridge | 91 | 19-320 | 200 | 566 | (125 m) 1% | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| Casselman, Somerset Cty, PA | 30 | n/a | Forested ridge | 174 | n/a | n/a | 436 | (125 m) 7% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Dans Mountain, Allegany Cty, MD | 34 | 318 | Forested ridge | 188 | 2-633 | 193 | 542 | (125 m) 11% | Woodlot Alternatives, Inc. 2004. A Fall 2004 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force. |
| Prattsburgh, Steuben Cty, NY | 30 | 315 | Agricultural plateau | 193 | 12-474 | 188 | 516 | (125 m) 3% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC. |
| Franklin, Pendleton Cty, WV | 34 | 349 | Forested ridge | 229 | 7-926 | 175 | 583 | (125 m) 8% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC. |
| **Fall 2005** | | | | | | | | | |
| Dairy Hills, Clinton Cty, NY | 57 | n/a | Agricultural plateau | 64 | n/a | 180 | 466 | (n/a) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Perry, Wyoming Cty, NY | n/a | n/a | Agricultural plateau | 64 | n/a | 180 | 466 | (125 m) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Alabama, Genesee Cty, NY | 59 | n/a | Agricultural plateau | 67 | n/a | 219 | 489 | (125 m) 11% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Alabama, Genesee Cty, NY | 40 | n/a | Agricultural plateau | 111 | n/a | 35 | 413 | (125 m) 14% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Churubusco, Clinton Cty, NY | 38 | 414 | Great Lakes plain/ADK foothills | 152 | 9-429 | 193 | 438 | (120 m) 5% | Woodlot Alternatives, Inc. 2005. A Fall Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation. |
| Maple Ridge, Lewis Cty, NY | 57 | n/a | Agricultural plateau | 158 | n/a | 195 | 415 | (125 m) 8% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Swallow Farm, PA | 58 | n/a | Forested ridge | 166 | n/a | n/a | 402 | (125 m) 5% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Sheldon, Wyoming Cty, NY | 36 | 347 | Agricultural plateau | 197 | 43-529 | 213 | 422 | (120 m) 3% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy. |
| Ellenberg, Clinton Cty, NY | 57 | n/a | Great Lakes plain/ADK foothills | 197 | n/a | 162 | 333 | (125 m) 12% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Prattsburgh-Italy, NY | 41 | n/a | Agricultural plateau | 200 | n/a | 177 | 365 | (125 m) 9% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Kibby, Franklin Cty, ME (Range 1) | 12 | 101 | Forested ridge | 201 | 12-783 | 196 | 352 | (125 m) 12% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| Fayette Cty, PA | 26 | n/a | Forested ridge | 297 | n/a | n/a | 426 | (125 m) 5% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Stamford, Delaware Cty, NY | 48 | 418 | Forested ridge | 315 | 22-784 | 251 | 494 | (110 m) 3% | Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD. |
| Preston Cty, WV | 26 | n/a | Forested ridge | 379 | n/a | n/a | 420 | (125 m) 10% | Plissner, J.H., T.J Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Preston Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC. |
| Jordanville, Herkimer Cty, NY | 38 | 404 | Agricultural plateau | 380 | 26-1019 | 208 | 440 | (125 m) 6% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Highland, VA | 58 | n/a | Forested ridge | 385 | n/a | n/a | 442 | (125 m) 12% | Plissner, J.H., T.J Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Highland New Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC. |
| Clayton, Jefferson Cty, NY | 37 | 385 | Agricultural plateau | 418 | 83-877 | 168 | 475 | (150 m) 10% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable. |
| Bliss, Wyoming Cty, NY | 8 | n/a | Agricultural plateau | 440 | 52-1392 | n/a | 411 | (125 m) 13% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Kibby, Franklin Cty, ME (Valley) | 5 | 13 | Forested ridge | 452 | 52-995 | 193 | 391 | (125 m) 16% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| Mars Hill, Aroostook Cty, ME | 18 | 117 | Forested ridge | 512 | 60-1092 | 228 | 424 | (120 m) 8% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC. |
| Howard, Steuben Cty, NY | 39 | 405 | Agricultural plateau | 481 | 18-1434 | 185 | 491 | (125 m) 5% | Woodlot Alternatives, Inc. 20065 A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global. |
| Deerfield, Bennington Cty, VT | 32 | 324 | Forested ridge | 559 | 3-1736 | 221 | 395 | (100 m) 13% | Woodlot Alternatives, Inc. 2006. Fall 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc. |
| Kibby, Franklin Cty, ME (Mountain) | 12 | 115 | Forested ridge | 565 | 109-1107 | 167 | 370 | (125 m) 16% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| Fairfield, Herkimer Cty, NY | 38 | 423 | Agricultural plateau | 691 | 116-1351 | 198 | 516 | (145 m) 6%1 | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable. |
| Munnsville, Madison Cty, NY | 31 | 292 | Agricultural plateau | 732 | 15-1671 | 223 | 644 | (118 m) 2% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC. |

*cont*

*Appendix B Table 1 continued*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Fall 2006** | | | | | | | | | |
| Villenova, Chautauqua Cty, NY | 36 | n/a | Great Lakes plain | 189 | 16-604 | 216 | 353 | (120 m) 9% | Stantec Consulting Services Inc. 2008. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment. |
| Wethersfield, Wyoming Cty, NY | 56 | n/a | Agricultural plateau | 256 | 31-701 | 208 | 344 | (125 m) 11% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Centerville, Allegany Cty, NY | 57 | n/a | Agricultural plateau | 259 | 12-877 | 208 | 350 | (125 m) 12% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Somerset Cty, PA | 29 | n/a | Forested ridge | 316 | n/a | n/a | 374 | (125 m) 8% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Cape Vincent, Jefferson Cty, NY | 63 | 508 | Great Lakes plain | 346 | n/a | 209 | 490 | (125 m) 8% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Bedford Cty, PA | 29 | n/a | Forested ridge | 438 | n/a | n/a | 379 | (125 m) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Stetson, Washington Cty, ME | 12 | 77 | Forested ridge | 476 | 131-1192 | 227 | 378 | (125 m) 13% | Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC. |
| Dutch Hill, Steuben Cty, NY | 21 | n/a | Agricultural plateau | 535 | n/a | 215 | 358 | (125 m) 11% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Lempster, Sullivan Cty, NH | 32 | 290 | Forested ridge | 620 | 133-1609 | 206 | 387 | (125 m) 8% | Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Nocturnal Bird Migration, Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC. |
| Chateaugay, Franklin Cty, NY | 35 | 327 | Agricultural plateau | 643 | 38-1373 | 212 | 431 | (120 m) 8% | Woodlot Alternatives, Inc. 2006. Fall 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. |
| **Fall 2007** | | | | | | | | | |
| **Buckeye, Champaign and Logan Cty, OH** | **30** | **n/a** | **Agricultural plateau** | **74** | **0-404** | **194** | **393** | **(150 m) 5%** | **Stantec Consulting Services Inc. 2008. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar, and Acoustic Bat Surveys for the Buckeye Wind Power Project in Champaign and Logan Counties, Ohio. Prepared for EverPower Renewables.** |
| New Grange, Chautauqua Cty, NY | 57 | n/a | Great Lakes plain | 112 | n/a | 208 | 458 | (125 m) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Laurel Mountain, Barbour Cty, WV | 20 | 212 | Forested ridge | 321 | 76-613 | 209 | 533 | (130 m) 6% | Stantec Consulting Services Inc. 2007. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC. |
| Errol, Coos County, NH | 29 | 232 | Forested ridge | 366 | 54 to 1234 | 223 | 343 | (125 m) 15% | Stantec Consulting Inc. 2007. Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC. |
| Rollins, Lincoln, Penobscot Cty, ME | 22 | 231 | Forested ridge | 368 | 82-953 | 284 | 343 | (120 m) 13% | Woodlot Alternatives, Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the Rollins Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC. |
| Roxbury, Oxford Cty, ME | 20 | 220 | Forested ridge | 420 | 88-1006 | 227 | 365 | (130 m) 14% | Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC. |
| Allegany, Cattaraugus Cty, NY | 46 | n/a | Forested ridge | 451 | n/a | 230 | 382 | (150 m) 14% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| New Creek, Grant Cty, WV | 20 | n/a | Forested ridge | 811 | 263-1683 | 231 | 360 | (130 m) 17% | Stantec Consulting Services Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the New Creek Wind Project, West Virginia. Prepared for AES New Creek, LLC. |
| Wolfe Island, Ontario, Canada* | n/a | n/a | Great Lakes island | n/a | n/a | 95 | 233 | (125m) 23% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| **Fall 2008** | | | | | | | | | |
| Hounsfield, Jefferson Cty, NY | 60 | 674 | Great Lakes island | 281 | 64-835 | 207 | 298 | (125 m) 17% | Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Hounsfield Wind Project, New York. Prepared for American Consulting Professionals of New York, PLLC. |
| Georgia Mountain, VT | 21 | n/a | Forested ridge | 326 | 56-700 | 230 | 371 | (120 m) 7% | Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Georgia Mountain Wind Project, Vermont. Prepared for Georgia Mountain Community Wind. |
| Oakfield, Penobscot Cty, ME | 20 | n/a | Forested ridge | 501 | 116-945 | 200 | 309 | (125 m) 18% | Woodlot Alternatives, Inc. 2008. A Fall 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC. |
| Tenney, Grafton Cty, NH | 45 | 509 | Forested ridge | 470 | 94-1174 | 260 | 342 | (125m) 13% | Stantec Consulting Services Inc. 2008. Fall 2008 Radar Survey Report for the Groton Wind Project. Prepared for Groton Wind, LLC. |
| Highland, Somerset Cty, ME | 20 | 216 | Forested ridge | 549 | 68-1201 | 227 | 348 | (130.5m) 17% | Stantec Consulting. 2009. Fall 2008 Bird and Bat Migration Survey Report: Radar and Acoustic Avian and Bat Surveys for the Highland Wind Project Highland Plantation, Maine. Prepared for Highland Wind LLC |
| **Fall 2009** | | | | | | | | | |
| Sisk (Kibby Expansion) Franklin Cty, ME | 20 | 210 | Forested ridge | 458 | 44-1067 | 206 | 287 | (125m) 23% | Stantec Consulting Services. 2009. Fall 2009 Nocturnal Migration Survey Report. Prepared for TRC Engineers LLC. |
| Vermont Community Wind Farm, Orleans Cty, VT | 20 | 227 | Forested ridge | 443 | 110-1029 | 215 | 330 | (130m) 15% | Stantec Consulting Services. 2009. Fall 2009 Bird and Bat Survey Report. Nocturnal Radar, Acoustic, and Diurnal Raptor Surveys performed for the Vermont Community Wind Farm Project in Rutland County, Vermont. Prepared for Vermont Community Wind Farm, LLC. |
| Stetson, Washington Cty, ME | 18 | 201 | Forested ridge | 457 | 106-1746 | 227 | 420 | (119m) 2% | Stantec Consulting Services. 2010. Stetson I Mountain Wind Project Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC. |

Note:

[1] The percent targets below turbine height can be found in the addendum to the report "Effect of Top Notch (now Hardscrabble) Wind Project revision to turbine layout and model changes on the spring and fall 2005 nocturnal radar survey reports." Prepared August 26, 2009, by Stantec Consulting Services Inc.

**Appendix B Table 2.** Summary of publicly available raptor survey results for wind projects

| Year | Season | Project Site | State | Landscape | Survey Period | # Survey Days | # Survey Hours | # Birds Observed | # Species Observed | Passage Rate (b/hr) | % Below Turbine Height | Citation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1996 | Fall | Searsburg, Bennington County | VT | Forested ridge | 9/11-11/13 | 20 | 80 | 430 | 12 | 5.4 | n/a | Kerlinger 1996 |
| 1998 | Fall | Harrisburg, Lewis County | NY | Great Lakes plain | 9/2-10/1 | 13 | 68 | 554 | 12 | 8.1 | n/a (47 m mean flight height) | Cooper & Mabee 2000 |
| 1998 | Fall | Wethersfield, Wyoming County | NY | Agricultural plateau | 9/2-10/1 | 24 | 107 | 256 | 12 | 2.4 | n/a (48 m mean flight height) | Cooper & Mabee 2000 |
| 2004 | Fall | Prattsburgh, Steuben County | NY | Agricultural plateau | 9/2-10/28 | 13 | 73 | 220 | 10 | 3.0 | (125 m) 62% | Woodlot 2005b |
| 2004 | Fall | Cohocton, Steuben County | NY | Agricultural plateau | 9/2-10/28 | 8 | 41 | 128 | 8 | 3.1 | (125 m) 80% | ED&R 2006b |
| 2004 | Fall | Deerfield, Bennington County | VT | Forested ridge | 9/2-10/31 | 10 | 60 | 147 | 11 for sites combined | 2.5 | (100 m) 9% for sites combined | Woodlot 2005c |
| 2004 | Fall | Deerfield, Bennington County | VT | Forested ridge | 9/2-10/31 | 10 | 57 | 725 | 11 for sites combined | 12.7 | (100 m) 9% for sites combined | Woodlot 2005c |
| 2004 | Fall | Sheffield, Caledonia County | VT | Forested ridge | 9/11-10/14 | 10 | 60 | 193 | 10 | 3.2 | (125 m) 31% | Woodlot 2006a |
| 2005 | Fall | Cohocton, Steuben County | NY | Agricultural plateau | 9/7-10/1 | 7 | 40 | 131 | 10 | 3.3 | (125) 63% | ED&R 2006b |
| 2005 | Fall | Churubusco, Clinton County | NY | Great Lakes plain | 10/6-10/22 | 10 | 60 | 217 | 15 | 3.6 | (120 m) 69% | Woodlot 2005l |
| 2005 | Fall | Dairy Hills, Clinton County | NY | Great Lakes Shore | 9/11-10/10 | 4 | 16 | 48 | 7 | 3.0 | n/a | Young et al. 2006 |
| 2005 | Fall | Howard, Steuben County | NY | Agricultural plateau | 9/1-10/28 | 10 | 57 | 206 | 12 | 3.6 | (91 m) 65% | Woodlot 2005o |
| 2005 | Fall | Munnsville, Madison County | NY | Agricultural plateau | 9/6-10/31 | 11 | 65 | 369 | 14 | 5.7 | (118 m) 51% | Woodlot 2005r |
| 2005 | Fall | Mars Hill, Aroostook County | ME | Forested ridge | 9/9-10/13 | 8 | 43 | 115 | 13 | 1.5 | (120 m) 42% | Woodlot 2005t |
| 2005 | Fall | Lempster, Sullivan County | NH | Forested ridge | Fall | 10 | 80 | 264 | 10 | 3.3 | (125 m) 40% | Woodlot 2007c |
| 2005 | Fall | Clayton, Jefferson County | NY | Agricultural plateau | 9/9-10/16 | 11 | 64 | 575 | 13 | 9.1 | (150 m) 89% | Woodlot 2005m |
| 2006 | Fall | Stetson, Penobscot County | ME | Forested ridge | 9/14-10/26 | 7 | 42 | 86 | 11 | 2.1 | (125 m) 63% | Woodlot 2007b |
| 2007 | Fall | Buckeye, Champaign and Logan Counties | OH | Agricultural plateau | 8/30-10/11 | 11 | 66 | 421 | 8 | 6.4 | (125) 78%; (150) 84% | *Not publicly available* |
| 2008 | Fall | Buckeye, Champaign and Logan Counties | OH | Agricultural plateau | 9/1-12/15 | 24 | 167 | 581 | 7 | 3.5 | (150 m) 93% | *this report* |
| 1999 | Spring | Wethersfield, Wyoming County | NY | Agricultural plateau | 4/20-5/24 | 24 | 97 | 348 | 12 | 3.6 | n/a (23 m mean flight height) | Cooper and Mabee 2000 |
| 2003 | Spring | Westfield, Chautaugua | NY | Great Lakes shore | 4/16-5/15 | 50 | 101 | 2578 | 17 | 25.6 | n/a (278 m mean flight height) | Cooper et al.2004c |
| 2005 | Spring | Churubusco, Clinton County | NY | Great Lakes plain | Spring | 10 | 60 | 170 | 11 | 2.8 | (120 m) 69% | Woodlot 2005a |
| 2005 | Spring | Dairy Hills, Clinton County | NY | Great Lakes Shore | 4/15-4/26 | 5 | 20 | 50 | 7 | 3.0 | n/a | ED&R 2006b |
| 2005 | Spring | Clayton, Jefferson County | NY | Agricultural plateau | 3/30-5/7 | 10 | 58 | 700 | 14 | 12.1 | (150 m) 61% | Woodlot 2005b |
| 2005 | Spring | Prattsburgh, Steuben County | NY | Agricultural plateau | Spring | 10 | 60 | 314 | 15 | 5.2 | (125 m) 83% | Woodlot 2005u |
| 2005 | Spring | Cohocton, Steuben County | NY | Agricultural plateau | Spring | 10 | 60 | 164 | 11 | 2.7 | (125 m) 77% | ED&R 2006b |
| 2005 | Spring | Munnsville, Madison County | NY | Agricultural plateau | 4/5-5/16 | 10 | 60 | 375 | 12 | 6.3 | (118 m) 78% | Woodlot 2005d |
| 2005 | Spring | Sheffield, Caledonia County | VT | Forested ridge | April - May | 10 | 60 | 98 | 10 | 1.6 | (125 m) 69% | Woodlot 2006b |
| 2005 | Spring | Deerfield, Bennington County | VT | Forested ridge | 4/9-4/29 | 7 | 42 | 44 | 11 (for both sites combined) | 1.1 | (125 m) 83% (at both sites combined) | Woodlot 2005g |
| 2005 | Spring | Deerfield, Bennington County | VT | Forested ridge | 4/9-4/29 | 7 | 42 | 38 | 11 (for both sites combined) | 0.9 | (125 m) 83% (at both sites combined) | Woodlot 2005g |
| 2006 | Spring | Lempster, Sullivan County | NH | Forested ridge | Spring | 10 | 78 | 102 | n/a | 1.3 | 125 m (18%) | Woodlot 2007c |
| 2006 | Spring | Howard, Steuben County | NY | Agricultural plateau | 4/3-5/19 | 9 | 53 | 260 | 11 | 5.0 | (125 m) 64% | Woodlot 2006d |
| 2006 | Spring | Mars Hill, Aroostook County | ME | Forested ridge | 4/12-5/18 | 10 | 60 | 64 | 9 | 1.1 | (120 m) 48% | Woodlot 2006g |
| 2008 | Spring | Buckeye, Champaign and Logan Counties | OH | Agricultural plateau | 3/1-5/15 | 32 | 216 | 1476 | 12 | 6.8 | (150 m) 95% | *this report* |

*Appendix D*
*EIS Scoping Comments*

# Buckeye EIS NEPA Scoping Comment Summary

| Commenter | Date | Topic | Theme | Comment Summary | Comment Page # | Treatment of Comment in EIS |
|---|---|---|---|---|---|---|
| Diane McConnell | February 9, 2010 | Bat habitat | Potential habitat locations | Includes map with caves that could be winter habitat for Indiana Bats in Salem Twp., Champaign County. | 1 | |
| Ohio Power Siting Board Staff | March 1, 2010 | Expedient review | Financial advantages to commencing construction | There may be financial advantages, both at the state and federal level, to commencing construction of the proposed project by a certain date. | 3 | |
| Ohio Power Siting Board Staff | March 1, 2010 | Renewable energy | Compliance with renewable energy requirements | Renewable generation from the proposed wind facility could be used to assist in complying with the renewable energy requirements. | 3 | |
| Ohio Power Siting Board Staff | March 1, 2010 | Operations | Limitations on project operation | Limitations on project operation (such as curtailment regimes for turbines during prime activity) may impact the economics of the project and may also reduce the amount of renewable energy credits (RECs) generated by the facility.<br>Recommends that any consideration of cut-in speeds rely on the scientific data available to date on the topic. | 4 | |
| Ohio Power Siting Board Staff | March 1, 2010 | Administrative | Ohio Department of Natural Resources | Requests that the Ohio Department of Natural Resources (ODNR), be consulted during the course of the development of any Habitat Conservation Plan. | 4 | |
| Ohio Power Siting Board Staff | March 1, 2010 | Conditions for any permit | Staff recommended conditions | Staff recommended conditions from Staff Report in Case No. 08-666-EL-BGN. (Case was pending at the date of the letter). Conditions relate to:<br>- Compliance with all applicable permits and authorizations<br>- stream crossing plan | | |

| Commenter | Date | Topic | Theme | Comment Summary | Comment Page # | Treatment of Comment in EIS |
|---|---|---|---|---|---|---|
| | | | | - electric collection system plan<br>- tree clearing plan<br>- access plan<br>- erosion and sedimentation control measures<br>- best management practices (BMPs) when working in the vicinity of environmentally-sensitive areas<br>- develop and implement a post-construction avian and bat mortality survey plan<br>- if applicable, develop a Habitat<br>Conservation Plan (HCP) and obtain the associated Incidental Take Permit (ITP) from the USFWS<br>- prepare a Phase I cultural resources survey program for archeological work<br>- conduct an architectural survey of the project area | | |
| Van K1ey & Walker, LLC, for Union Neighbors United, | March 1, 2010 | Habitat | Need to protect forested ridge tops and agricultural/fragmented forest habitats | Protection of both forested ridge tops and agricultural/fragmented forest habitats is vitally important for this species, and both are located in the area in and around EverPower's turbine sites. | 3 | |
| Van K1ey & Walker, LLC, for Union Neighbors United, | March 1, 2010 | Presence of bats | Bats are prevalent in nearby areas | Indiana bats are also prevalent in nearby areas, from which they can fly into EverPower's turbines. | 4 | |
| Van K1ey & Walker, LLC, for Union Neighbors United, | March 1, 2010 | Cumulative impacts | EverPower's turbines will exacerbate the population losses already being experienced. | Indiana bat populations are under assault from a variety of threats, including White-Nose Syndrome and the loss of summer and winter habitats. | 4 | |
| Van K1ey & Walker, LLC, for Union | March 1, 2010 | Environmental Impact | Environmental Impact Statement | There is potential for significant impacts on the Indiana bat; an Environmental Impact Statement | 5 | EIS is being prepared |

| Commenter | Date | Topic | Theme | Comment Summary | Comment Page # | Treatment of Comment in EIS |
|---|---|---|---|---|---|---|
| Neighbors United, | | Statement | (EIS) should be prepared | (EIS) is the appropriate level of review for the EverPower project and the other wind energy projects proposed for western Ohio. | | |
| Conservation Law Center | March 1, 2010 | Environmental Impact Statement | Environmental Impact Statement (EIS) should be prepared | This request for an ITP requires an EIS under NEPA. | 2 | EIS is being prepared |
| Conservation Law Center | March 1, 2010 | Environmental Impact Statement | Uncertainties; information gaps can be filled within the time frame of an EIS | There are many uncertainties regarding the local impacts of the Project on the Indiana bat. Several of these information gaps can be filled within the time frame of an EIS and all of the gaps should be analyzed in detail within an EIS.<br>1. uncertainty about Indiana bat habitat needs and use;<br>2. uncertainty about how many Indiana bats will be killed by the Project's wind turbines over the next several decades;<br>3. uncertainty about the relationship between local features of the Project site and Indiana bat mortality at that site;<br>4. uncertainty about the technical specifications of the facility and bat mortality at the site;<br>5. uncertainty about the impacts of the Project on Indiana bat migration and summer habitat degradation;<br>6. uncertainty about the ability of possible mitigation and minimization strategies to compensate for the loss of bat individuals and reproductive potential.<br>7. Cumulative impacts; - 11 additional uncertainties<br>- demographic parameters, population trends, and habitat needs and use;<br>- local features of a site and bat mortality | 5-6 | |

| Commenter | Date | Topic | Theme | Comment Summary | Comment Page # | Treatment of Comment in EIS |
|---|---|---|---|---|---|---|
| | | | | - technical specifications of wind energy facilities and bat mortality<br>- impacts of wind energy development on Indiana bat migration and summer habitat degradation;<br>- mitigation and minimization strategies to compensate for the loss of bat individuals and reproductive potential;<br>- degree of wind energy development in the Eastern and Midwestern U.S. over next several decades;<br>- how many Indiana bat individuals will be killed by wind turbines over the next several decades;<br>- impact and spread of White Nose Syndrome;<br>- impact of climate change on Indiana bat habitat and hibernacula;<br>- aggregate impact of multiple other threats, such as pathogens and climate change, to the Indiana bat and the availability of high quality summer habitats, migration pathways, hibernacula, and swarming sites over the next several decades | | |
| Van K1ey & Walker, LLC, for Union Neighbors United, | March 1, 2010 | Combined or programmatic EIS | These projects should be jointly evaluated through a combined or "programmatic" EIS | If constructed, this and the other projects proposed for western Ohio would present unique risks to the Indiana bat insofar as they would be the first wide-scale wind energy facilities in this portion of the species' range.<br>Potential effects of the wind projects on Indiana bats is highly uncertain and unknown.<br>Action may establish a precedent for future actions with significant effects or represent a decision in principle about a future | 5 | |

| Commenter | Date | Topic | Theme | Comment Summary | Comment Page # | Treatment of Comment in EIS |
|---|---|---|---|---|---|---|
| | | | | consideration.<br>Action is related to other actions with individually insignificant but cumulatively significant impacts. | | |
| Van K1ey & Walker, LLC, for Union Neighbors United, | March 1, 2010 | Categorical exclusion | Project should not be eligible for any categorical exclusion | The individual and cumulative effects of the EverPower project taking into account the effects of White Nose Syndrome and the additional wind energy projects proposed for western Ohio cannot be deemed to be "minor or negligible." | 6 | |
| Van K1ey & Walker, LLC, for Union Neighbors United, | March 1, 2010 | Other bat species | EverPower's project will also harm other species of bats | EverPower's bat consultant found seven bat species in the project area. | 7 | |
| Van K1ey & Walker, LLC, for Union Neighbors United, | March 1, 2010 | Human environment | impacts on the quality of the human environment, including noise, health effects, and shadow flicker, and adverse socioeconomic impacts | The EverPower project will have significant impacts on the quality of the human environment, including noise, health effects, and shadow flicker, and adverse socioeconomic impacts such as diminution in property values. | 7 | |
| Van K1ey & Walker, LLC, for Union Neighbors United, | March 1, 2010 | Conditions for any permit | If the USFWS issues an incidental take permit, the<br>permit should contain the conditions necessary to<br>protect the Indiana Bats | 1. prohibit EverPower from damaging any caves that could serve as bat hibernacula<br>2. protect the trees in which Indiana bats reside while not in hibemacula.<br>3. no tree clearing should occur between April I and November 30 in areas in which Indiana bats may reside<br>4. require all turbines to be at least five miles away from Indiana bat capture and roost locations, including maternity colonies to prevent Indiana bats from flying into wind | 7-9 | |

| Commenter | Date | Topic | Theme | Comment Summary | Comment Page # | Treatment of Comment in EIS |
|---|---|---|---|---|---|---|
| | | | | turbines or dying of barotraumas - that is the Indiana bat's travel range from summer roost sites for foraging<br>5. require a 10-mile setback from hibernacula.<br>6. establish a suitable setback between riparian corridors and streams habitat and the turbines<br>7. shut down turbines at night during low wind so that Indiana bats will not be struck by the blades during calmer conditions in which they are more likely to fly.<br>8. submit a meaningful post-construction bat mortality plan that not only counts and records the number of bat deaths, but also prevents excessive bat deaths.<br>9. use a phased approach to project development. For the first two years, EverPower should be allowed to construct and operate 1/5 of the planned turbines while monitoring the turbines' effects | | |
| Conservation Law Center | March 1, 2010 | Research | Research | Intensive multi-year surveys using the latest technology are needed to identify whether and to what extent Indiana bats may use the Project area for migration and/or summer foraging or roosting | | |
| Jim & Karel Davis | June 14, 2010 | Wildlife | Endangered Species Act. | Do not exempt the project from the Endangered Species Act. Protect the endangered species from all possible threats from mankind. | 1 | |
| Piqua Shawnee Tribe, Gene Park, Elder, | June 24, 2010 | Cultural resources | Sacred Indian Mound and archeological sites | Requests protection of sacred sites including Indian Mounds and archeological sites. Requesting a complete site test. One Turbine will be located very close to the Sacred Mound; concerned about the construction footprint at that location (map enclosed with comments).<br>Requests that the Siting Board allow the necessary Archeological surveys to be | 1,2 | |

| Commenter | Date | Topic | Theme | Comment Summary | Comment Page # | Treatment of Comment in EIS |
|---|---|---|---|---|---|---|
| | | | | conducted within all wind turbine sites. | | |
| Van K1ey & Walker, LLC, for Union Neighbors United, | June 25, 2010 | Conditions for any permit | night curtailment in low wind | Emphasize that night curtailment in low wind will not adequately protect the bats unless accompanied by five-mile setbacks separating the turbines from roost or capture locations and ten-mile setbacks from hibernacula.<br>If turbines are allowed in areas frequented by Indiana bats , the Maximally Restricted Operations Alternative should be employed. | 2 | |
| Van K1ey & Walker, LLC, for Union Neighbors United, | June 25, 2010 | Conditions for any permit | Maximally Restricted Operations Alternative | Maximally Restricted Operations Alternative should be used if EverPower does not substantially supplement its efforts to find the existing Indiana bat roosts, maternity colonies, and hibernacula in the project area. | 3 | |
| Van K1ey & Walker, LLC, for Union Neighbors United, | June 25, 2010 | Conditions for any permit | southern meteorological tower | Southern meteorological tower is a hot spot of bat activity. USFWS should not allow EverPower to install wind turbines within a setback distance of five miles of this tower. | 4 | |
| Lindsay Masters, Jon Ippolito, & Aubrey Coffey-Urban | June 25, 2010 | Permit issuance - research need | If the USFWS cannot determine what the effect on the endangered species will be, it cannot grant the permit | More research should be conducted in order to determine: (1) what attracts bats to the area, (2) how many bats would be killed both directly and indirectly by the wind turbines; and, (3) potential ways to deter bats from the area.<br>Other harmful factors that could negatively affect the survival of the species. | 2, 4 | |
| Lindsay Masters, Jon Ippolito, & Aubrey Coffey-Urban | June 25, 2010 | Conditions for any permit | Habitat | The best way to increase the amount of summer roosting habitat available would be to create a new section of forest with a diverse age structure in a riparian environment. | 2 | |
| Lindsay Masters, Jon Ippolito, & Aubrey Coffey-Urban | June 25, 2010 | Conditions for any permit | Research | The USFWS should use the Champaign County wind energy site as a bat-wind turbine study location throughout the course of its development. | 5 | |

| Commenter | Date | Topic | Theme | Comment Summary | Comment Page # | Treatment of Comment in EIS |
|---|---|---|---|---|---|---|
| DiAnne Doss | Undated (file date 7-19-10) | Need | Energy efficiency | These 490 foot wind turbines are not efficient. They have a massive environmental footprint and any energy generated by them is miniscule. | 1 | |
| DiAnne Doss | Undated (file date 7-19-10) | Wildlife | Takes | Application will potentially lead to the destruction of not only the Indiana Bat population, but to numerous wildlife species. | 1 | |
| Julie Scordato | Undated (file date 7-19-10) | Wildlife | Takes | Very wary of the idea that a take permit can mitigate the impact of the turbines on our bat population. Besides the endangered species factor, the Indiana Bat, like honey bees, and other native pollinators/pest controllers are integral to Champaign County's agricultural well being. | | |
| Vicci Weeks | Undated (file date 7-19-10) | Wildlife | Takes | A HCP should not be allowed for this facility due to the lack of information regarding endangered Indiana Bat migration. Ohio is bordered by 2 states having the largest over-wintering populations of endangered Indiana bats…Indiana and Kentucky.<br>We should not be sacrificing endangered species for wind power, regardless of how much money is involved. Because of the amount of land fragmented by wind power along with its invasion of air space, these species are particularly at risk from the implementation of a HPC. | | |
| Robert Wagner, President Board of Directors, International Dark-Sky Association | Undated (file date 7-19-10) | Lighting impacts | Model Lighting Ordinance | Recommends a Model Lighting Ordinance be developed for the Indiana Bat, comparable to model ordinances developed for Marine Turtles. | | |
| Robert Wagner, President Board of Directors, International | Undated (file date 7-19-10) | Lighting and birds | Obstacle Collision Avoidance Systems technologies | Recommends investigating Obstacle Collision Avoidance Systems technologies that can operate FAA lights in passive mode until | | |

| Commenter | Date | Topic | Theme | Comment Summary | Comment Page # | Treatment of Comment in EIS |
|---|---|---|---|---|---|---|
| Dark-Sky Association | | | | needed. Such a system will also reduce incidental takes of migrating birds that may be attracted to FAA lighting. | | |
| Paul Friesema | Undated (file date 7-19-10) | Administrative | | Request to be on mailing list. | 1 | |

# *Appendix E*
# *Vegetation and Wildlife Data for the Action Area*

**Appendix E Common and Scientific Names of Aquatic and Terrestrial Animals with Potential to Occur in the Vicinity of the Buckeye Wind Power Project**

| <u>**Common Name**</u> | <u>***Scientific Name***</u> |
|---|---|
| **Mollusks** | |
| Creek heelsplitter | *Lasmigona compressa* |
| Creeper | *Strophitus undulatus* |
| Fatmucket | *Lampsilis siliquoidea* |
| Giant floater | *Pyganodon grandis* |
| Kidneyshell | *Ptychobranchus fasciolaris* |
| Lilliput | *Toxolasma lividus* |
| Paper pondshell | *Utterbackia imbecillis* |
| Pondhorn | *Unimerus tetralasmus* |
| Rabbitsfoot | *Quadrula cylindrica cylindrica* |
| Ridgeback peaclam | *Pisidium compressum* |
| Slippershell | *Alasmidonta viridis* |
| Snuffbox | *Epioblasma triquetra* |
| Threehorn wartyback | *Obliquaria reflexa* |
| Wabash pigtoe | *Fusconaia flava* |
| Wavy-rayed lampmussel | *Lampsilis fasciola* |
| | |
| **Fishes** | |
| Western blacknose dace | *Rhinichthys obtusus* |
| Blackside darter | *Percina maculata* |
| Bluntnose minnow | *Pimephales notatus* |
| Bluegill sunfish | *Lepomis macrochirus* |
| Brook stickleback | *Culaea inconstans* |
| Brown bullhead | *Ameiurus nebulosus* |
| Central mudminnow | *Umbra limi* |
| Central stoneroller | *Campostoma anomalum* |
| Creek chub | *Semotilus atromaculatus* |
| Golden shiner | *Notemigonus crysoleucas* |
| Green sunfish | *Lepomis cyanellus* |
| Largemouth bass | *Micropterus salmoides salmoides* |
| Mottled sculpin | *Cottus bairdii* |
| Northern hogsucker | *Hypentelium nigricans* |
| Pumpkinseed sunfish | *Lepomis gibbosus* |
| Rainbow darter | *Etheostoma caeruleum* |
| Rock bass | *Ambloplites rupestris* |
| Silverjaw minnow | *Notropis buccatus* |
| Yellow perch | *Perca flavescens* |
| | |
| **Amphibians** | |
| Mudpuppy | *Necturus maculosus* |
| Smallmouth salamander | *Ambystoma texanum* |
| Eastern tiger salamander | *Ambystoma tigrinum* |
| Redback salamander | *Plethodon cinereus* |
| Northern ravine salamander | *Plethodon richmondi* |
| Four-toed salamander | *Hemidactylium scutatum* |

| Common Name | Scientific Name |
|---|---|
| Southern two-lined salamander | *Eurycea cirrigera* |
| Longtail salamander | *Eurycea longicauda* |
| American toad | *Anaxyrus americanus* |
| Bullfrog | *Lithobates catesbeiana* |
| Eastern cricket frog | *Acris crepitans crepitans* |
| Fowler's toad | *Anaxyrus fowleri* |
| Gray treefrog | *Hyla versicolor* |
| Green frog | *Lithobates clamitans melanota* |
| Northern leopard frog | *Lithobates pipiens* |
| Northern spring peeper | *Pseudacris crucifer crucifer* |
| Pickerel frog | *Lithobates palustris* |
| Western chorus frog | *Pseudacris triseriata* |
| **Reptiles** | |
| Midland painted turtle | *Chrysemys picta marginata* |
| Eastern musk turtle | *Sternotherus odoratus* |
| Spotted turtle | *Clemmys guttata* |
| Eastern box turtle | *Terrapene carolina carolina* |
| Eastern spiny softshell | *Apalone spinifera spinifera* |
| Common five-lined skink | *Plestiodon fasciatus* |
| Queen snake | *Regina septemvittata* |
| Kirtland's snake | *Clonophis kirtlandii* |
| Common water snake | *Nerodia sipedon sipedon* |
| Brown snake | *Storeria dekayi* |
| Northern red-bellied snake | *Storeria occipitomaculata occipitomaculata* |
| Blue racer | *Coluber constrictor foxii* |
| Eastern rat snake | *Pantherophis alleghaniensis* |
| Eastern milksnake | *Lampropeltis triangulum triangulum* |
| Eastern garter snake | *Thamnophis sirtalis sirtalis* |
| Butler's garter snake | *Thamnophis butleri* |
| **Birds** | |
| Canada goose | *Branta canadensis* |
| Wood duck | *Aix sponsa* |
| Mallard duck | *Anas platyrhynchos* |
| Northern bobwhite | *Colinus virginianus* |
| Ring-necked pheasant | *Phasianus colchicus* |
| Wild turkey | *Meleagris gallopavo* |
| Great blue heron | *Ardea herodias* |
| Black vulture | *Coragyps atratus* |
| Turkey vulture | *Cathartes aura* |
| Bald eagle | *Haliaeetus leucocephalus* |
| Northern harrier | *Circus cyaneus* |
| Sharp-shinned hawk | *Accipiter striatus* |
| Cooper's hawk | *Accipiter cooperii* |
| Northern goshawk | *Accipiter gentilis* |
| Red-shouldered hawk | *Buteo lineatus* |
| Broad-winged hawk | *Buteo platypterus* |

| Common Name | Scientific Name |
|---|---|
| Red-tailed hawk | *Buteo jamaicensis* |
| Golden eagle | *Aquila chrysaetos* |
| American kestrel | *Falco sparverius* |
| Merlin | *Falco columbarius* |
| Peregrine falcon | *Falco peregrinus* |
| Sandhill crane | *Grus canadensis* |
| Killdeer | *Charadrius vociferus* |
| Rock pigeon | *Columba livia* |
| Mourning dove | *Zenaida macroura* |
| Yellow-billed cuckoo | *Coccyzus americanus* |
| Chimney swift | *Chaetura pelagica* |
| Ruby-throated hummingbird | *Archilochus colubris* |
| Red-headed woodpecker | *Melanerpes erythrocephalus* |
| Red-bellied woodpecker | *Melanerpes carolinus* |
| Downy woodpecker | *Picoides pubescens* |
| Northern flicker | *Colaptes auratus* |
| Eastern wood-pewee | *Contopus virens* |
| Acadian flycatcher | *Empidonax virescens* |
| Willow flycatcher | *Empidonax traillii* |
| Least flycatcher | *Empidonax minimus* |
| Great crested flycatcher | *Myiarchus crinitus* |
| Eastern kingbird | *Tyrannus tyrannus* |
| White-eyed vireo | *Vireo griseus* |
| Warbling vireo | *Vireo gilvus* |
| Red-eyed vireo | *Vireo olivaceus* |
| Blue jay | *Cyanocitta cristata* |
| American crow | *Corvus brachyrhynchos* |
| Horned lark | *Eremophilia alpestris* |
| Tree swallow | *Tachycineta bicolor* |
| Northern rough-winged swallow | *Stelgidopteryx serripennis* |
| Barn swallow | *Hirundo rustica* |
| Carolina chickadee | *Poecile carolinensis* |
| Tufted titmouse | *Baeolophus bicolor* |
| White-breasted nuthatch | *Sitta carolinensis* |
| Carolina wren | *Thryothorus ludovicianus* |
| House wren | *Troglodytes aedon* |
| Blue-gray gnatcatcher | *Polioptila caerulea* |
| Eastern bluebird | *Sialia sialis* |
| Wood thrush | *Hylocichla mustelina* |
| American robin | *Turdus migratorius* |
| Gray catbird | *Dumetella carolinensis* |
| Northern mockingbird | *Mimus polyglottos* |
| Brown thrasher | *Toxostoma rufum* |
| European starling | *Sturnus vulgaris* |
| Cedar waxwing | *Bombycilla cedrorum* |
| Blue-winged warbler | *Vermivora pinus* |
| Tennessee warbler | *Vermivora peregrina* |
| Nashville warbler | *Vermivora ruficapilla* |
| Northern parula | *Parula americana* |

| **Common Name** | ***Scientific Name*** |
|---|---|
| Yellow warbler | *Dendroica petechia* |
| Chestnut-sided warbler | *Dendroica pensylvanica* |
| Magnolia warbler | *Dendroica magnolia* |
| Yellow-rumped warbler | *Dendroica coronata* |
| Black-throated green warbler | *Dendroica virens* |
| Blackburnian warbler | *Dendroica fusca* |
| Prairie warbler | *Dendroica discolor* |
| Palm warbler | *Dendroica palmarum* |
| Black-and-white warbler | *Mniotilta varia* |
| American redstart | *Setophaga ruticilla* |
| Ovenbird | *Seiurus aurocapillus* |
| Louisiana waterthrush | *Seiurus motacilla* |
| Common yellowthroat | *Geothlypis trichas* |
| Yellow-breasted chat | *Ictera virens* |
| Eastern towhee | *Pipilo erythrophthalmus* |
| Chipping sparrow | *Spizella passerina* |
| Field sparrow | *Spizella pusilla* |
| Vesper sparrow | *Pooecetes gramineus* |
| Savannah sparrow | *Passerculus sandwichensis* |
| Grasshopper sparrow | *Ammodramus savannarum* |
| Song sparrow | *Melospiza melodia* |
| Swamp sparrow | *Melospiza georgiana* |
| White-throated sparrow | *Zonotrichia albicollis* |
| Scarlet tanager | *Piranga olivacea* |
| Northern cardinal | *Cardinalis cardinalis* |
| Rose-breasted grosbeak | *Pheucticus ludovicianus* |
| Indigo bunting | *Passerina cyanea* |
| Bobolink | *Dolichonyx oryzivorus* |
| Red-winged blackbird | *Agelaius phoeniceus* |
| Eastern meadowlark | *Sturnella magna* |
| Common grackle | *Quiscalus quiscula* |
| Brown-headed cowbird | *Molothrus ater* |
| Orchard oriole | *Icterus spurius* |
| Baltimore oriole | *Icterus galbula* |
| House finch | *Carpodacus mexicanus* |
| American goldfinch | *Carduelis tristis* |
| House sparrow | *Passer domesticus* |
| **Mammals** | |
| Virginia opossum | *Didelphis virginiana* |
| Big brown bat | *Eptesicus fuscus* |
| Eastern red bat | *Lasiurus borealis* |
| Hoary bat | *Lasiurus cinereus* |
| Indiana bat | *Myotis sodalis* |
| Northern bat | *Myotis septentrionalis* |
| Little brown bat | *Myotis lucifugus* |
| Tri-colored bat | *Perimyotis subflavus* |
| Short-tailed shrew | *Blarina brevicauda* |

| **Common Name** | ***Scientific Name*** |
|---|---|
| Least shrew | *Cryptotis parva* |
| Eastern mole | *Scalopus aquaticus* |
| Eastern cottontail | *Sylvilagus floridanus* |
| Beaver | *Castor canadensis* |
| Prairie vole | *Microtus ochrogaster* |
| Meadow vole | *Microtus pennsylvanicus* |
| Woodland vole | *Microtus pinetorum* |
| House mouse | *Mus musculus* |
| Muskrat | *Ondatra zibethicus* |
| White-footed mouse | *Peromyscus leucopus* |
| Deer mouse | *Peromyscus maniculatus* |
| Norway rat | *Rattus norvegicus* |
| Southern flying squirrel | *Glacomys volans* |
| Woodchuck | *Marmota monax* |
| Thirteen-lined ground squirrel | *Spermophilus tridecemlineatus* |
| Meadow jumping mouse | *Zapus hudsonius* |
| Coyote | *Canis latrans* |
| Gray fox | *Urocyon cinereoargenteus* |
| Red fox | *Vulpes vulpes* |
| Raccoon | *Procyon lotor* |
| Striped skunk | *Mephitis mephitis* |
| Long-tailed weasel | *Mustela frenata* |
| Least weasel | *Mustela nivalis* |
| Mink | *Mustela vison* |
| Badger | *Taxidea taxus* |
| White-tailed deer | *Odocoileus virginiana* |

**Breeding Bird Survey Data – Kings Creek Survey Route Located Within Buckeye Project Action Area**

USGS science for a changing world

Patuxent Wildlife Research Center

# Species List

## North American Breeding Bird Survey Route

## KINGS CREEK

| Species | Birds/route | Route Change | Regional Change | Id Tips |
|---|---|---|---|---|
| Great Blue Heron *Ardea herodias* | 2.09 | Route Change | Regional Change | Id Tips |
| Green Heron *Butorides virescens* | 0.18 | Route Change | Regional Change | Id Tips |
| Turkey Vulture *Cathartes aura* | 3.18 | Route Change | Regional Change | Id Tips |
| Canada Goose *Branta canadensis* | 26.82 | Route Change | Regional Change | Id Tips |
| Wood Duck *Aix sponsa* | 1.91 | Route Change | Regional Change | Id Tips |
| Mallard *Anas platyrhynchos* | 2.18 | Route Change | Regional Change | Id Tips |
| Cooper's Hawk *Accipiter cooperii* | 0.27 | Route Change | Regional Change | Id Tips |
| Red-tailed Hawk *Buteo jamaicensis* | 1.73 | Route Change | Regional Change | Id Tips |
| American Kestrel *Falco sparverius* | 1.73 | Route Change | Regional Change | Id Tips |
| Ring-necked Pheasant *Phasianus colchicus* | 5.91 | Route Change | Regional Change | Id Tips |
| Wild Turkey *Meleagris gallopavo* | 0.36 | Route Change | Regional Change | Id Tips |
| Northern Bobwhite *Colinus virginianus* | 2.00 | Route Change | Regional Change | Id Tips |

| | | | | |
|---|---|---|---|---|
| Killdeer<br>*Charadrius vociferus* | 13.73 | Route Change | Regional Change | Id Tips |
| Rock Dove<br>*Columba livia* | 2.64 | Route Change | Regional Change | Id Tips |
| Mourning Dove<br>*Zenaida macroura* | 42.36 | Route Change | Regional Change | Id Tips |
| Black-billed Cuckoo<br>*Coccyzus erythropthalmus* | 0.18 | Route Change | Regional Change | Id Tips |
| Yellow-billed Cuckoo<br>*Coccyzus americanus* | 0.09 | Route Change | Regional Change | Id Tips |
| Barred Owl<br>*Strix varia* | 0.18 | Route Change | Regional Change | Id Tips |
| Chimney Swift<br>*Chaetura pelagica* | 6.73 | Route Change | Regional Change | Id Tips |
| Ruby-thr. Hummingbird<br>*Archilochus colubris* | 0.55 | Route Change | Regional Change | Id Tips |
| Belted Kingfisher<br>*Ceryle alcyon* | 0.09 | Route Change | Regional Change | Id Tips |
| Red-headed Woodpecker<br>*Melanerpes erythrocephalus* | 1.18 | Route Change | Regional Change | Id Tips |
| Red-bellied Woodpecker<br>*Melanerpes carolinus* | 3.36 | Route Change | Regional Change | Id Tips |
| Downy Woodpecker<br>*Picoides pubescens* | 2.18 | Route Change | Regional Change | Id Tips |
| Northern Flicker<br>*Colaptes spp.* | 3.18 | Route Change | Regional Change | Id Tips |
| Eastern Wood-Pewee<br>*Contopus virens* | 2.18 | Route Change | Regional Change | Id Tips |
| Willow Flycatcher<br>*Empidonax traillii* | 2.27 | Route Change | Regional Change | Id Tips |
| Willow-Alder Flycatcher<br>*Empidonax spp.* | 2.27 | Route Change | Regional Change | Id Tips |
| Eastern Phoebe<br>*Sayornis phoebe* | 0.27 | Route Change | Regional Change | Id Tips |
| Grt. Crested Flycatcher<br>*Myiarchus crinitus* | 0.36 | Route Change | Regional Change | Id Tips |
| Eastern Kingbird<br>*Tyrannus tyrannus* | 1.27 | Route Change | Regional Change | Id Tips |
| Yellow-throated Vireo<br>*Vireo flavifrons* | 0.36 | Route Change | Regional Change | Id Tips |

| | | | | |
|---|---|---|---|---|
| Warbling Vireo<br>*Vireo gilvus* | 0.73 | Route Change | Regional Change | Id Tips |
| Red-eyed Vireo<br>*Vireo olivaceus* | 0.55 | Route Change | Regional Change | Id Tips |
| Blue Jay<br>*Cyanocitta cristata* | 8.64 | Route Change | Regional Change | Id Tips |
| American Crow<br>*Corvus brachyrhynchos* | 18.82 | Route Change | Regional Change | Id Tips |
| Horned Lark<br>*Eremophila alpestris* | 14.91 | Route Change | Regional Change | Id Tips |
| Purple Martin<br>*Progne subis* | 0.09 | Route Change | Regional Change | Id Tips |
| Tree Swallow<br>*Tachycineta bicolor* | 7.73 | Route Change | Regional Change | Id Tips |
| N. Rough-winged Swallow<br>*Stelgidopteryx serripennis* | 0.73 | Route Change | Regional Change | Id Tips |
| Bank Swallow<br>*Riparia riparia* | 0.45 | Route Change | Regional Change | Id Tips |
| Barn Swallow<br>*Hirundo rustica* | 20.82 | Route Change | Regional Change | Id Tips |
| Carolina Chickadee<br>*Poecile carolinensis* | 1.36 | Route Change | Regional Change | Id Tips |
| Tufted Titmouse<br>*Baeolophus bicolor* | 5.00 | Route Change | Regional Change | Id Tips |
| White-breasted Nuthatch<br>*Sitta carolinensis* | 1.27 | Route Change | Regional Change | Id Tips |
| Carolina Wren<br>*Thryothorus ludovicianus* | 1.18 | Route Change | Regional Change | Id Tips |
| House Wren<br>*Troglodytes aedon* | 11.36 | Route Change | Regional Change | Id Tips |
| Blue-gray Gnatcatcher<br>*Polioptila caerulea* | 0.36 | Route Change | Regional Change | Id Tips |
| Eastern Bluebird<br>*Sialia sialis* | 3.45 | Route Change | Regional Change | Id Tips |
| Wood Thrush<br>*Hylocichla mustelina* | 0.09 | Route Change | Regional Change | Id Tips |
| American Robin<br>*Turdus migratorius* | 57.00 | Route Change | Regional Change | Id Tips |
| Gray Catbird<br>*Dumetella carolinensis* | 3.91 | Route Change | Regional Change | Id Tips |

| | | | | |
|---|---|---|---|---|
| Northern Mockingbird<br>*Mimus polyglottos* | 4.91 | Route Change | Regional Change | Id Tips |
| Brown Thrasher<br>*Toxostoma rufum* | 2.73 | Route Change | Regional Change | Id Tips |
| European Starling<br>*Sturnus vulgaris* | 106.91 | Route Change | Regional Change | Id Tips |
| Cedar Waxwing<br>*Bombycilla cedrorum* | 4.55 | Route Change | Regional Change | Id Tips |
| Yellow Warbler<br>*Dendroica petechia* | 2.64 | Route Change | Regional Change | Id Tips |
| Common Yellowthroat<br>*Geothlypis trichas* | 5.36 | Route Change | Regional Change | Id Tips |
| Yellow-breasted Chat<br>*Icteria virens* | 0.27 | Route Change | Regional Change | Id Tips |
| Scarlet Tanager<br>*Piranga olivacea* | 0.18 | Route Change | Regional Change | Id Tips |
| Eastern Towhee<br>*Pipilo erythrophthalmus* | 0.36 | Route Change | Regional Change | Id Tips |
| Chipping Sparrow<br>*Spizella passerina* | 16.45 | Route Change | Regional Change | Id Tips |
| Field Sparrow<br>*Spizella pusilla* | 9.82 | Route Change | Regional Change | Id Tips |
| Vesper Sparrow<br>*Pooecetes gramineus* | 0.64 | Route Change | Regional Change | Id Tips |
| Savannah Sparrow<br>*Passerculus sandwichensis* | 13.55 | Route Change | Regional Change | Id Tips |
| Grasshopper Sparrow<br>*Ammodramus savannarum* | 3.82 | Route Change | Regional Change | Id Tips |
| Song Sparrow<br>*Melospiza melodia* | 32.09 | Route Change | Regional Change | Id Tips |
| Northern Cardinal<br>*Cardinalis cardinalis* | 15.09 | Route Change | Regional Change | Id Tips |
| Rose-breasted Grosbeak<br>*Pheucticus ludovicianus* | 0.18 | Route Change | Regional Change | Id Tips |
| Indigo Bunting<br>*Passerina cyanea* | 15.27 | Route Change | Regional Change | Id Tips |
| Dickcissel<br>*Spiza americana* | 1.55 | Route Change | Regional Change | Id Tips |
| Bobolink<br>*Dolichonyx oryzivorus* | 2.36 | Route Change | Regional Change | Id Tips |

| | | | | |
|---|---|---|---|---|
| Red-winged Blackbird<br>*Agelaius phoeniceus* | 89.45 | Route Change | Regional Change | Id Tips |
| Eastern Meadowlark<br>*Sturnella magna* | 17.36 | Route Change | Regional Change | Id Tips |
| Common Grackle<br>*Quiscalus quiscula* | 53.73 | Route Change | Regional Change | Id Tips |
| Brown-headed Cowbird<br>*Molothrus ater* | 7.45 | Route Change | Regional Change | Id Tips |
| Orchard Oriole<br>*Icterus spurius* | 0.18 | Route Change | Regional Change | Id Tips |
| Baltimore Oriole<br>*Icterus galbula* | 2.09 | Route Change | Regional Change | Id Tips |
| House Finch<br>*Carpodacus mexicanus* | 4.73 | Route Change | Regional Change | Id Tips |
| American Goldfinch<br>*Carduelis tristis* | 13.73 | Route Change | Regional Change | Id Tips |
| House Sparrow<br>*Passer domesticus* | 62.00 | Route Change | Regional Change | Id Tips |

Use Back Arrow to Return to Browser

*Appendix F*
*Radar Survey Data at Proposed Wind Projects Throughout the East between 1998 and 2007*

| Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Average Flight Direction | Average Flight Height (m) | (Turbine Ht) % Targets Below Turbine Height | Reference |
|---|---|---|---|---|---|---|---|---|---|
| **Fall 2004** | | | | | | | | | |
| Sheffield, Caledonia Cty, VT | 18 | 176 | Forested ridge | 91 | 19-320 | 200 | 566 | (125 m) 1% | Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC. |
| Casselman, Somerset Cty, PA | 30 | n/a | Forested ridge | 174 | n/a | n/a | 436 | (125 m) 7% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Dans Mountain, Allegany Cty, MD | 34 | 318 | Forested ridge | 188 | 2-633 | 193 | 542 | (125 m) 11% | Woodlot Alternatives, Inc. 2004. A Fall 2004 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force. |
| Prattsburgh, Steuben Cty, NY | 30 | 315 | Agricultural plateau | 193 | 12-474 | 188 | 516 | (125 m) 3% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC. |
| Franklin, Pendleton Cty, WV | 34 | 349 | Forested ridge | 229 | 7-926 | 175 | 583 | (125 m) 8% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC. |
| **Fall 2005** | | | | | | | | | |
| Dairy Hills, Clinton Cty, NY | 57 | n/a | Agricultural plateau | 64 | n/a | 180 | 466 | (n/a) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Perry, Wyoming Cty, NY | n/a | n/a | Agricultural plateau | 64 | n/a | 180 | 466 | (125 m) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Alabama, Genesee Cty, NY | 59 | n/a | Agricultural plateau | 67 | n/a | 219 | 489 | (125 m) 11% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Alabama, Genesee Cty, NY | 40 | n/a | Agricultural plateau | 111 | n/a | 35 | 413 | (125 m) 14% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Churubusco, Clinton Cty, NY | 38 | 414 | Great Lakes plain/ADK foothills | 152 | 9-429 | 193 | 438 | (120 m) 5% | Woodlot Alternatives, Inc. 2005. A Fall Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation. |
| Maple Ridge, Lewis Cty, NY | 57 | n/a | Agricultural plateau | 158 | n/a | 195 | 415 | (125 m) 8% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Swallow Farm, PA | 58 | n/a | Forested ridge | 166 | n/a | n/a | 402 | (125 m) 5% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Sheldon, Wyoming Cty, NY | 36 | 347 | Agricultural plateau | 197 | 43-529 | 213 | 422 | (120 m) 3% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy. |
| Ellenberg, Clinton Cty, NY | 57 | n/a | Great Lakes plain/ADK foothills | 197 | n/a | 162 | 333 | (125 m) 12% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Prattsburgh-Italy, NY | 41 | n/a | Agricultural plateau | 200 | n/a | 177 | 365 | (125 m) 9% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Kibby, Franklin Cty, ME (Range 1) | 12 | 101 | Forested ridge | 201 | 12-783 | 196 | 352 | (125 m) 12% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| Fayette Cty, PA | 26 | n/a | Forested ridge | 297 | n/a | n/a | 426 | (125 m) 5% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Stamford, Delaware Cty, NY | 48 | 418 | Forested ridge | 315 | 22-784 | 251 | 494 | (110 m) 3% | Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD. |
| Preston Cty, WV | 26 | n/a | Forested ridge | 379 | n/a | n/a | 420 | (125 m) 10% | Plissner, J.H., T.J. Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Preston Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC. |
| Jordanville, Herkimer Cty, NY | 38 | 404 | Agricultural plateau | 380 | 26-1019 | 208 | 440 | (125 m) 6% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Highland, VA | 58 | n/a | Forested ridge | 385 | n/a | n/a | 442 | (125 m) 12% | Plissner, J.H., T.J. Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Highland New Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC. |
| Clayton, Jefferson Cty, NY | 37 | 385 | Agricultural plateau | 418 | 83-877 | 168 | 475 | (150 m) 10% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable. |
| Bliss, Wyoming Cty, NY | 8 | n/a | Agricultural plateau | 440 | 52-1392 | n/a | 411 | (125 m) 13% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Kibby, Franklin Cty, ME (Valley) | 5 | 13 | Forested ridge | 452 | 52-995 | 193 | 391 | (125 m) 16% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| Mars Hill, Aroostook Cty, ME | 18 | 117 | Forested ridge | 512 | 60-1092 | 228 | 424 | (120 m) 8% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC. |
| Howard, Steuben Cty, NY | 39 | 405 | Agricultural plateau | 481 | 18-1434 | 185 | 491 | (125 m) 5% | Woodlot Alternatives, Inc. 20065 A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global. |
| Deerfield, Bennington Cty, VT | 32 | 324 | Forested ridge | 559 | 3-1736 | 221 | 395 | (100 m) 13% | Woodlot Alternatives, Inc. 2006. Fall 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc. |
| Kibby, Franklin Cty, ME (Mountain) | 12 | 115 | Forested ridge | 565 | 109-1107 | 167 | 370 | (125 m) 16% | Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine. |
| Fairfield, Herkimer Cty, NY | 38 | 423 | Agricultural plateau | 691 | 116-1351 | 198 | 516 | (145 m) 6%1 | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable. |
| Munnsville, Madison Cty, NY | 31 | 292 | Agricultural plateau | 732 | 15-1671 | 223 | 644 | (118 m) 2% | Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC. |

*cont*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Fall 2006** | | | | | | | | | |
| Villenova, Chautauqua Cty, NY | 36 | n/a | Great Lakes plain | 189 | 16-604 | 216 | 353 | (120 m) 9% | Stantec Consulting Services Inc. 2008. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment. |
| Wethersfield, Wyoming Cty, NY | 56 | n/a | Agricultural plateau | 256 | 31-701 | 208 | 344 | (125 m) 11% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Centerville, Allegany Cty, NY | 57 | n/a | Agricultural plateau | 259 | 12-877 | 208 | 350 | (125 m) 12% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Somerset Cty, PA | 29 | n/a | Forested ridge | 316 | n/a | n/a | 374 | (125 m) 8% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Cape Vincent, Jefferson Cty, NY | 63 | 508 | Great Lakes plain | 346 | n/a | 209 | 490 | (125 m) 8% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Bedford Cty, PA | 29 | n/a | Forested ridge | 438 | n/a | n/a | 379 | (125 m) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Stetson, Washington Cty, ME | 12 | 77 | Forested ridge | 476 | 131-1192 | 227 | 378 | (125 m) 13% | Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC. |
| Dutch Hill, Steuben Cty, NY | 21 | n/a | Agricultural plateau | 535 | n/a | 215 | 358 | (125 m) 11% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Lempster, Sullivan Cty, NH | 32 | 290 | Forested ridge | 620 | 133-1609 | 206 | 387 | (125 m) 8% | Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Nocturnal Bird Migration, Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC. |
| Chateaugay, Franklin Cty, NY | 35 | 327 | Agricultural plateau | 643 | 38-1373 | 212 | 431 | (120 m) 8% | Woodlot Alternatives, Inc. 2006. Fall 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC. |
| **Fall 2007** | | | | | | | | | |
| **Buckeye, Champaign and Logan Cty, OH** | **30** | **n/a** | **Agricultural plateau** | **74** | **0-404** | **194** | **393** | **(150 m) 5%** | **Stantec Consulting Services Inc. 2008. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar, and Acoustic Bat Surveys for the Buckeye Wind Power Project in Champaign and Logan Counties, Ohio. Prepared for EverPower Renewables.** |
| New Grange, Chautauqua Cty, NY | 57 | n/a | Great Lakes plain | 112 | n/a | 208 | 458 | (125 m) 10% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| Laurel Mountain, Barbour Cty, WV | 20 | 212 | Forested ridge | 321 | 76-513 | 209 | 533 | (130 m) 6% | Stantec Consulting Services Inc. 2007. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC. |
| Errol, Coos County, NH | 29 | 232 | Forested ridge | 366 | 54 to 1234 | 223 | 343 | (125 m) 15% | Stantec Consulting Inc. 2007. Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC. |
| Rollins, Lincoln, Penobscot Cty, ME | 22 | 231 | Forested ridge | 368 | 82-953 | 284 | 343 | (120 m) 13% | Woodlot Alternatives, Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the Rollins Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC. |
| Roxbury, Oxford Cty, ME | 20 | 220 | Forested ridge | 420 | 88-1006 | 227 | 365 | (130 m) 14% | Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC. |
| Allegany, Cattaraugus Cty, NY | 46 | n/a | Forested ridge | 451 | n/a | 230 | 382 | (150 m) 14% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| New Creek, Grant Cty, WV | 20 | n/a | Forested ridge | 811 | 263-1683 | 231 | 360 | (130 m) 17% | Stantec Consulting Services Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the New Creek Wind Project, West Virginia. Prepared for AES New Creek, LLC. |
| Wolfe Island, Ontario, Canada* | n/a | n/a | Great Lakes island | n/a | n/a | 95 | 233 | (125m) 23% | New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf |
| **Fall 2008** | | | | | | | | | |
| Hounsfield, Jefferson Cty, NY | 60 | 674 | Great Lakes island | 281 | 64-835 | 207 | 298 | (125 m) 17% | Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Hounsfield Wind Project, New York. Prepared for American Consulting Professionals of New York, PLLC. |
| Georgia Mountain, VT | 21 | n/a | Forested ridge | 326 | 56-700 | 230 | 371 | (120 m) 7% | Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Georgia Mountain Wind Project, Vermont. Prepared for Georgia Mountain Community Wind. |
| Oakfield, Penobscot Cty, ME | 20 | n/a | Forested ridge | 501 | 116-945 | 200 | 309 | (125 m) 18% | Woodlot Alternatives, Inc. 2008. A Fall 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC. |
| Tenney, Grafton Cty, NH | 45 | 509 | Forested ridge | 470 | 94-1174 | 260 | 342 | (125m) 13% | Stantec Consulting Services Inc. 2008. Fall 2008 Radar Survey Report for the Groton Wind Project. Prepared for Groton Wind, LLC. |
| Highland, Somerset Cty, ME | 20 | 216 | Forested ridge | 549 | 68-1201 | 227 | 348 | (130.5m) 17% | Stantec Consulting. 2009. Fall 2008 Bird and Bat Migration Survey Report: Radar and Acoustic Avian and Bat Surveys for the Highland Wind Project Highland Plantation, Maine. Prepared for Highland Wind LLC |
| **Fall 2009** | | | | | | | | | |
| Sisk (Kibby Expansion) Franklin Cty, ME | 20 | 210 | Forested ridge | 458 | 44-1067 | 206 | 287 | (125m) 23% | Stantec Consulting Services. 2009. Fall 2009 Nocturnal Migration Survey Report. Prepared for TRC Engineers LLC. |
| Vermont Community Wind Farm, Orleans Cty, VT | 20 | 227 | Forested ridge | 443 | 110-1029 | 215 | 330 | (130m) 15% | Stantec Consulting Services. 2009. Fall 2009 Bird and Bat Survey Report. Nocturnal Radar, Acoustic, and Diurnal Raptor Surveys performed for the Vermont Community Wind Farm Project in Rutland County, Vermont. Prepared for Vermont Community Wind Farm, LLC. |
| Stetson, Washington Cty, ME | 18 | 201 | Forested ridge | 457 | 106-1746 | 227 | 420 | (119m) 2% | Stantec Consulting Services. 2010. Stetson I Mountain Wind Project Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC. |

Note:

[1] The percent targets below turbine height can be found in the addendum to the report "Effect of Top Notch (now Hardscrabble) Wind Project revision to turbine layout and model changes on the spring and fall 2005 nocturnal radar survey reports." Prepared August 26, 2009, by Stantec Consulting Services Inc.

*Appendix G*
*Seasonal Bird and Bat Survey Reports for the Buckeye Wind Project - Stantec reports*

# Fall 2007 Bird and Bat Migration Survey Report

## Visual, Radar, and Acoustic Bat Surveys for the Buckeye Wind Power Project in Champaign and Logan Counties, Ohio

Prepared for

EverPower Renewables
75 9th Avenue, Suite 3G
New York, New York 10011

Prepared by

Stantec Consulting
(formerly Woodlot Alternatives, Inc.)
30 Park Drive
Topsham, ME  04086

February 2008

# Executive Summary

During fall 2007, Stantec, (Stantec), formerly Woodlot Alternatives, Inc. (Woodlot)[1], conducted field surveys of bird and bat migration activity at the proposed Buckeye Wind Energy Project in Champaign and Logan Counties, Ohio (Project). The surveys are part of the planning process by EverPower Renewables (EverPower) for a proposed wind project, which will include erection of a 300 megawatt (MW) wind farm located on mostly open agricultural lands. These surveys represented the first season of investigation undertaken at this site and included diurnal raptor surveys as well as nighttime surveys of birds and bats using radar and bat echolocation detectors. The results of the field surveys provide useful information about site-specific migration activities and patterns in the vicinity of the Buckeye Project, especially when considered along with upcoming spring and summer 2008 surveys.

*Nocturnal Radar Survey*

The fall 2007 radar survey included 30 nights of sampling from September 1 to October 15, 2007. Surveys were conducted from sunset to sunrise using X-band radar on nights when weather conditions permitted radar operation to adequately document bird movements. Within each hour of sampling, radar video files were recorded while the radar was positioned both horizontally and vertically. The radar site provided an acceptable view of the northern portion of the Project area.

The overall passage rate for the entire survey period was (mean ± standard error [SE]: 74 ± 15 targets/km/hr [t/km/hr]). Nocturnal passage rates were highly variable among nights, ranging from 0 to 404 t/km/hr. The mean flight direction through the Project area was 194º ± 144º (i.e., slightly southwest). The mean flight altitude of targets observed on the radar was 393 meters (m) ± 12 m (1290 feet [ft] ± 39') above ground level (agl). The average nightly flight altitude ranged from 252 m ± 43 m agl (828 ft ± 140 ft) to 506 m ± 27 m agl (1661 ft ± 88 ft). The mean percentage of nocturnal targets observed flying below 125 m agl (410 ft) ranged from 1 to 38 percent by night. The percentage of targets observed flying below 150 m (492 ft) also varied by night, from 2 to 38 percent. The seasonal average for targets flying below 125 m and 150 m was 4 and 5 percent, respectively.

The results of the radar analysis indicate that nocturnally migrating birds and bats in the vicinity of the Project are flying using a broad front migration pattern across the landscape, rather than in a concentrated manner in response to local topography. This is based on the mean flight direction and qualitative analysis of the topography and landscape surrounding the radar location. This type of broad front movement suggests that risk of bird and bat collision with

[1] All field work and any reporting and permitting activities performed prior to October 1, 2007, were conducted as Woodlot Alternatives, Inc. and will be herein referenced as work done by Woodlot. On October 1, 2007, Woodlot Alternatives, Inc. was acquired by Stantec Consulting Services, Inc. Work conducted on or after October 1, 2007, is herein referenced as work done by Stantec.

turbines or their associated infrastructure during migration may be relatively low. Additionally, the mean flight altitude of targets indicates that the majority of nocturnal migration in the area occurred well above the maximum altitude of the proposed wind turbines.

*Fall Acoustic Bat Survey*

The fall 2007 acoustic bat survey documented bat activity using six Anabat detectors during passive surveys that occurred on 63 nights from August 28 to October 29, 2007. The operation period of individual detectors ranged from a maximum of 57 nights to a minimum of 11 nights, for a total survey of 226 detector nights. Three detectors were deployed at three altitudes (high, low, and at tree level) at each of two meteorological (met) towers in the Project area, for a total of six detectors. The majority of the recorded bat call sequences (48%) were identified as unknown, followed by those identified to the big brown guild (34% of all call sequences), the red bat/eastern pipistrelle guild (18% of all call sequences), and the *Myotis* guild (< 1%). Throughout the migration season, bat activity was highest during the 10:00 pm hour (16% of all calls were recorded during this hour) and declined thereafter.

The mean number of bat calls/detector night for all six Anabat detectors deployed across the Project area was 7.54. Of the six detectors, the south tree detector recorded the highest number of bat call sequences (681) during the 24 days of operation, with a detection rate of 28.38 total calls/detector night. The north low detector followed with 57 nights of operation, 275 bat passes and a detection rate of 4.82 total calls/detector night. The south high detector operated for 57 nights, recorded 222 bat passes with a detection rate of 3.89 total calls/detector night. The north high detector operated for 52 nights, recorded 176 bat call sequences and had an overall detection rate of 3.38 bat passes/detector night. The north tree detector (88 total calls or 3.52 calls/ detector night) and the south low detector (80 total calls or 7.27 calls/ detector night) collected the least number of bat calls, but only operated for 25 and 11 nights respectively.

*Raptor Migration Survey*

Eleven days of diurnal raptor surveys were conducted from August 30 to October 11, 2007 to document the species migrating through the Project area, as well as behavioral characteristics such as flight altitude and direction relative to the Project area. Surveys were conducted on an open hillside in the central portion of the Project area near a communication tower, which provided a reference for determining raptor flight altitudes. A total of 421 individual raptors were observed during diurnal surveys, representing eight species. No federally threatened or endangered species were observed during the survey period. Three species listed by the Ohio Department of Natural Resources were observed however; two northern harriers (*Circus cyaneus*), listed as endangered, were observed in October; one sharp-shinned hawk (*Accipiter striatus*), listed as a species of concern, was observed in September; and three black vultures (*Coragyps atratus*), also listed as a species of concern, were detected in September and October.

The majority (n = 380; 90%) of raptors observed during the survey period were turkey vultures (*Carthartes aura*). Red-tailed hawks (*Buteo jamaicensis*) represented 3 percent of all observations (n = 14) and were the second most abundant species observed during the survey. The majority of observed raptors were flying below 125 m and 150 m. However, migrating raptor numbers were relatively low, and raptors do not appear to concentrate within the Project area. Thus, impacts to raptor populations migrating through the Project area are not expected to be adverse.

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**Tables**



**Figures**



**Appendices**



PN195600164/WAI# 107239

# 1.0 Introduction

This report has been prepared to summarize results of fall 2007 avian and bat surveys conducted by Woodlot Alternatives, Inc. (Woodlot), now Stantec Consulting (Stantec)[2], within the proposed Buckeye Wind Energy Project (Project) area. Following is a brief description of the Project; a review of the methods used to conduct scientific surveys and the results of those surveys; a discussion of those results; and the conclusions reached based on those results.

## 1.1 PROJECT CONTEXT

EverPower Renewables (EverPower) has proposed to develop a 300 MW wind power facility in central Ohio, in Champaign and Logan counties. The facility would include construction of turbine towers and pads, transmission lines, and access roads. The Project will be located on approximately 53,760 acres (84 square miles; $mi^2$) of privately owned, predominantly agricultural lands near the towns of Mutual, Mechanicsburg, Mingo, Woodstock, and North Lewisburg. The Project is still in the preliminary stages of design, but is expected to consist of 120 turbines, three meteorological (met) towers and associated access roads, transmission lines, and an electrical substation. The turbines will likely be 2 MW machines mounted on tubular steel towers. The height specifications of proposed turbines have not yet been determined, but turbines could range from a maximum height of either 125 meter (m; 410 feet [ft]; 80 m hub height with 45 m blade length), to a maximum of 150 m (492 ft; 100 m hub height with 50 m blade length).

In advance of permitting activities for the Project, EverPower contracted Stantec to conduct a nocturnal radar survey, a raptor migration survey, and a bat acoustic echolocation detector survey. These surveys will provide data to help assess the potential impacts to birds and bats from the proposed Project. The scope of avian and bat surveys reported herein was based on standard pre-construction survey methods that have been developed by stakeholders within the wind power industry, as well as guidelines developed by the Ohio Department of Natural Resources (OH DNR) and the Reynoldsburg Ohio Ecological Services Field Office of the Unites States Fish and Wildlife Service (OH USFWS). The protocol used to conduct fall 2007 avian and bat surveys for this Project are consistent with the survey protocols approved for several other wind energy projects conducted recently in Pennsylvania, New York, and other states within the Northeast region of the United States.

This document, and all field surveys conducted in support of this document, are in accordance with the work plan developed by Stantec on November 27, 2007. Meetings were held between Stantec, EverPower, OH DNR, and OH USFWS on October 3 and November 28 , 2007, to

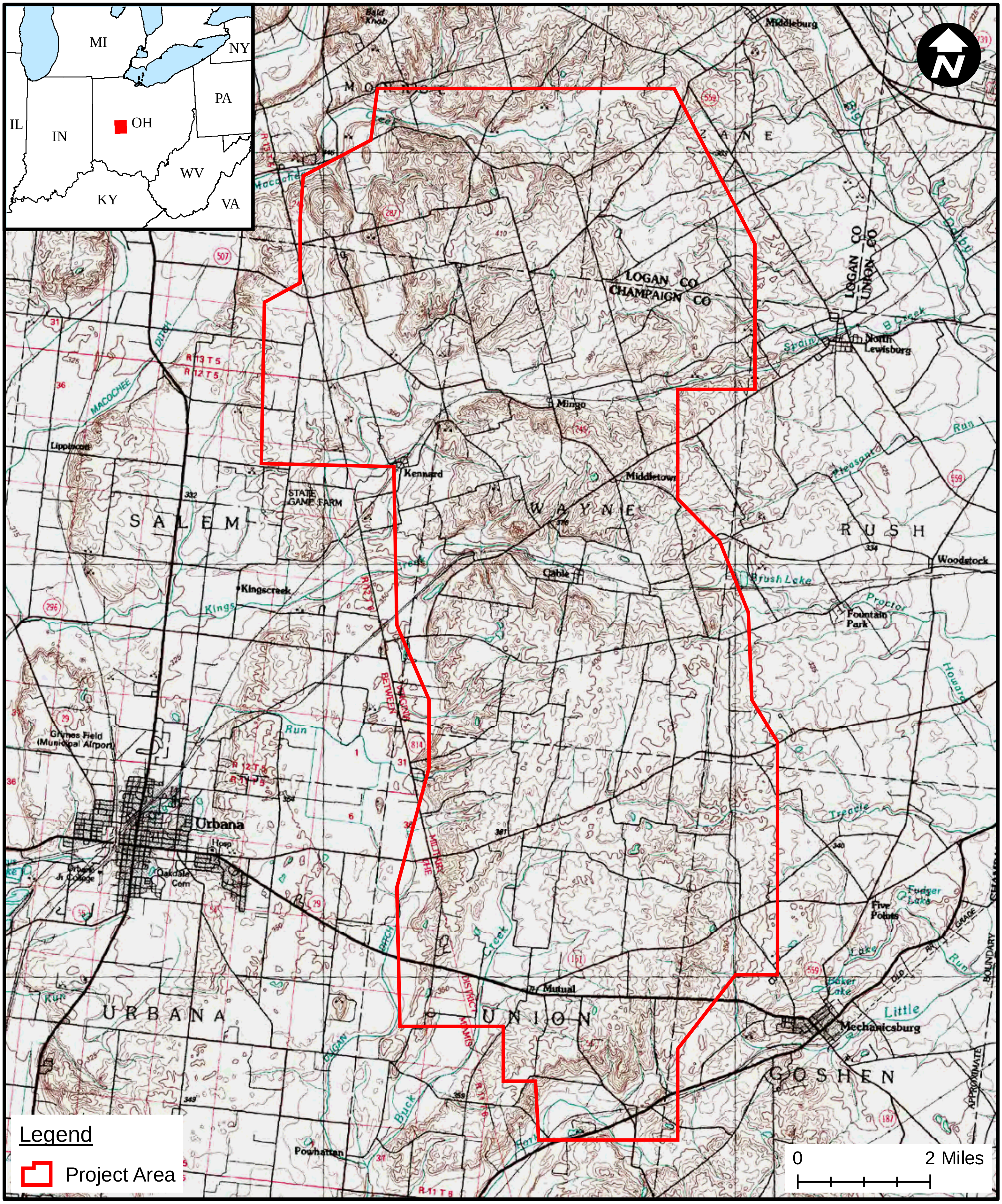
[2] All field work and any reporting and permitting activities performed prior to October 1, 2007, were conducted as Woodlot Alternatives, Inc. and will be herein referenced as work done by Woodlot. On October 1, 2007, Woodlot Alternatives, Inc. was acquired by Stantec Consulting Services, Inc. Work conducted on or after October 1, 2007, is herein referenced as work done by Stantec.

review the work plan and receive any agency comments to be incorporated into future work. A final work plan for avian and bat surveys is expected to be approved in the winter of 2008 that will be the result of this collaborative process.

## 1.2 PROJECT AREA DESCRIPTION

The Project area is a mosaic of active agricultural lands, mostly corn and soybean, interspersed with stands of mixed hardwood forest. The geology of the Project area is dominated by karst topography with subterranean drainages, sinkholes, and small rolling hills. It lies on an approximately 396 m (1,300 ft) plateau that rises 91 to 152 m (300 to 500 ft) from the surrounding landscape. The northern portion of the Project area has more karst topography features and a greater density of woodlots bordering agricultural fields than the southern sections. Land use in the area involves active agricultural operations, low density residential developments, and some tourist activity at historical sites.

The area is comprised of predominantly agricultural habitat, with scattered areas of upland and riparian forests, as well as shrub habitats. Forested habitat that supports water features such as streams comprises only 4,052 acres (6.31 $mi^2$) or 7 percent of the total Project area. Turbines are proposed to be located on hilltops, most of which consist of open agricultural lands. Forest stands surrounding these large agricultural areas are structurally diverse; containing large shagbark hickories (*Carya ovata*), ash (*Fraxinus* spp.), and oaks (*Quercus* spp.) intermixed with younger hardwood stands. These stands contain both live and dead trees and likely provide habitat for a variety of bird and bat species (Figure 1-1).




Prepared By:

Stantec

WOODLOT

107239-F11-ProjectLocation.mxd

Sheet Title:

Project Location Map

Project:

Buckeye Wind Power Project, Ohio



Date: 12/17/2007

Scale: 1" = 2 Miles

Proj. No.: 107239

Figure:

1-1

### 1.3 SURVEY OVERVIEW

Woodlot conducted field investigations, or surveys, for bird and bat migration during fall 2007. The overall goals of the investigations were to document:

- passage rates for nocturnal migration in the vicinity of the Project area, including the number of migrants, their flight direction, and their flight altitude;
- activity patterns of bats in the Project area, including the rate of occurrence and relationship with weather factors;
- species composition of bats within the Project area, and where possible, the presence of any rare, threatened, or endangered species; and
- passage rates and species composition of raptors migrating through the Project area.

The following sections outline the survey methodology and results contributing toward the achievement of survey goals. Discussion of survey results and subsequent conclusions follow each section.

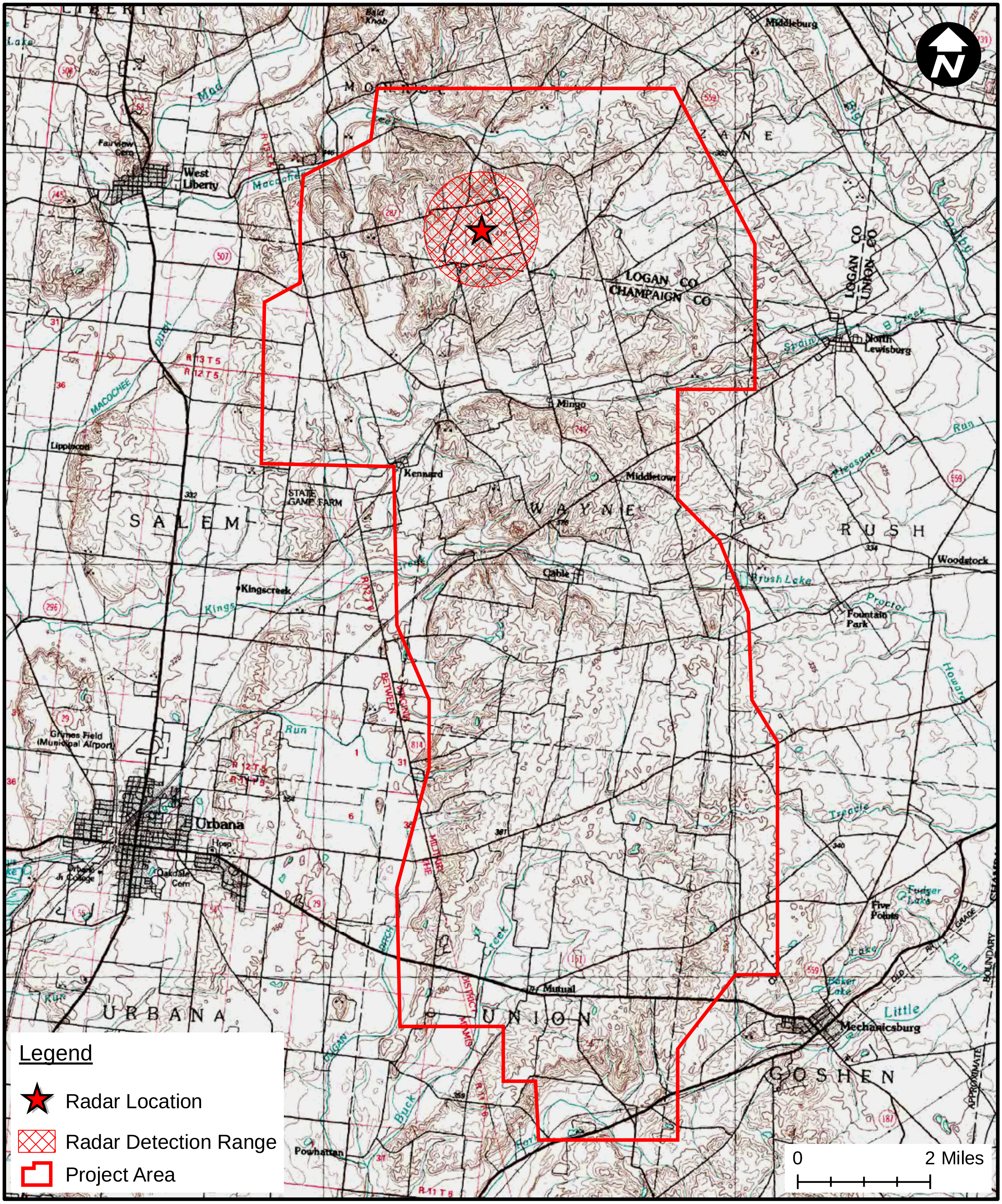
## 2.0 Nocturnal Radar Survey

### 2.1 INTRODUCTION

The majority of North American passerines migrate at night. The strategy to migrate at night may have evolved to take advantage of more stable atmospheric conditions for flapping flight (Kerlinger 1995). Additionally, night migration may provide a more efficient medium to regulate body temperature during active, flapping flight and could reduce the potential for predation while in flight (Alerstam 1990, Kerlinger 1995). Conversely, species, such as raptors, that use soaring flight migrate during the day to take advantage of warm rising air in thermals and laminar flow of air over the landscape, which can create updrafts along hillsides and ridgelines. Whereas raptor migration can be documented by visual daytime surveys, documenting the patterns of nocturnally migrating birds requires the use of radar or other non-visual technologies. Nocturnal radar surveys were conducted in the Project area to characterize fall nocturnal migration patterns. The goal of the surveys was to document the overall passage rates for nocturnal migration in the vicinity of the Project area, including the number of migrants, their flight direction, and their flight altitude.

## 2.2 METHODS

The radar survey was conducted near the northern met tower along the edge of a small valley (Figure 2-1). This site provided the best views in the northern section of the Project area and was chosen in order to intercept as much of the broad front movement of south bound migrants as possible. The site was at an elevation of approximately 418 m (1370 ft) and provided a generally good view in all directions.




Prepared By:

Stantec

WOODLOT

107239-F21-RadarLocation.mxd

Sheet Title:

Radar Location Map

Project:

Buckeye Wind Power Project, Ohio



Date: 12/17/2007

Scale: 1" = 2 Miles

Proj. No.: 107239

Figure:

2-1

The radar was placed at an altitude of approximately 4.2 m (14 ft) above the ground in a clearing adjacent to a small willow (*Salix* spp.) hedgerow, within a larger agricultural field opening. This opening was in a slight depression between two hills crested with hedgerows. These adjacent hills provided topographic relief that masked out the lower portion of the radar beam and allowed for less ground clutter and greater detection of small targets flying near or at tree line throughout the entire radar coverage area (Figure 2-2).

Marine surveillance radar, similar to that described by Cooper *et al.* (1991), was used during field data collection. The radar has a peak power output of 12 kilowatts (kW) and has the ability to track small animals, including birds, bats, and even insects, based on settings selected for the radar functions. It cannot, however, readily distinguish between different types of animals being detected. Consequently, all animals observed on the radar screen were identified as "targets." The radar has an "echo trail" function which captures past echoes of flight trails, enabling determination of flight direction. During all operations, the radar's echo trail was set to 30 seconds. The radar was equipped with a 2 m (6.5 ft) waveguide antenna. The antenna has a vertical beam altitude of 20º (10º above and below horizontal), and the front end of the antenna was inclined approximately 5º to increase the proportion of the beam directed into the sky.

Objects on the ground detected by the radar cause returns on the radar screen (echoes) that appear as blotches called ground clutter. Large amounts of ground clutter reduce the ability of the radar to track birds and bats flying over those areas. However, vegetation and hilltops near the radar can be used to reduce or eliminate ground clutter by "hiding" clutter-causing objects from the radar. These nearby features also cause ground clutter, but their proximity to the radar antenna generally limits the ground clutter to the center of the radar screen (Figure 2-2). The presence or reduction of potential clutter producing objects was carefully considered during site selection and radar station configuration.

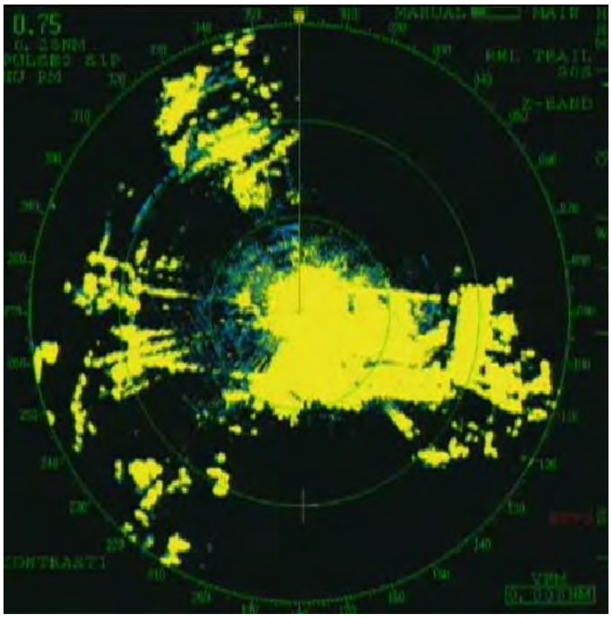



**Figure 2-2.** Ground clutter at Buckeye Wind Project- Fall 2007

Radar surveys were conducted from sunset to sunrise for 30 nights between September 1 and October 15, 2007. Because the anti-rain function of the radar must be turned down to detect small songbirds and bats, surveys could not be conducted during periods of inclement weather. Therefore, surveys were planned largely for nights without rain. However, in order to characterize migration patterns during nights without optimal conditions, some nights with weather forecasts including occasional showers were sampled.

The radar was operated in two modes throughout the night. In surveillance mode, the antenna spins horizontally to survey the airspace around the radar and detects targets moving through the area. By analyzing the echo trail, the flight direction of targets can be determined. In vertical mode, the radar unit is tilted 90º to vertically survey the airspace above the radar (Harmata *et al.* 1999). In vertical mode, target echoes do not provide directional data, but do provide information on the altitude of targets passing through the vertical, 20º radar beam. Both modes of operation were used during each hour of sampling.

The radar was operated at a range of 1.4 km (0.75 nautical miles). At this range, the echoes of small birds can be easily detected, observed, and tracked. At greater ranges, larger birds can be detected, but the echoes of small birds are reduced in size and restricted to a smaller portion of the radar screen, thus limiting the ability to observe the movement pattern of individual targets.

### 2.2.1 Data Collection

The radar display was connected to the video recording software of a computer enabling digital archiving of the radar data for subsequent analysis. Approximately 25 minutes of video samples were recorded during each hour of radar surveys, based on a random schedule for each night. These included 15 one-minute horizontal samples and 10 one-minute vertical samples. This sampling schedule allowed for randomization of sample collection and prevented double-counting of targets due to the 30-second echo trail used to determine the flight path vector.

During each hour, additional information was also recorded, including weather conditions and ceilometer observations. Ceilometer observations involved directing a one-million candlepower spotlight vertically into the sky in a manner similar to that described by Gauthreaux (1969). The ceilometer beam was observed by eye for 5 minutes to document and characterize low-flying targets. The ceilometer was held in-hand so that any birds, bats, or insects passing through it could be tracked for several seconds, if needed; surveys were conducted from the radar survey site. Observations from each ceilometer observation period were recorded, including the number of birds, bats, and insects observed. This information was used during data analysis to help characterize activity of insects, birds, and bats.

### 2.2.2 Data Analysis

Video samples were analyzed using a digital analysis software tool developed by Woodlot. For horizontal samples, targets (either birds or bats) were differentiated from insects based on their flight speed. Following adjustment for wind speed and direction, targets traveling faster than approximately 6 m (20 ft) per second were identified as a bird or bat target (Larkin 1991, Bruderer and Boldt 2001). The software tool recorded the time, location, and flight vector for each target traveling fast enough to be a bird or bat within each horizontal sample, and these results were output to a spreadsheet. For vertical samples, the software tool recorded the entry point of targets passing through the vertical radar beam, the time, and flight altitude above the radar location, and then subsequently outputs the data to a spreadsheet. These datasets were then used to calculate passage rate (reported as targets per kilometer of migratory front per hour), flight direction, and flight altitude of targets.

Mean target flight directions (± 1 circular standard deviation) were summarized using software designed specifically to analyze directional data (Oriana2© Kovach Computing Services). The statistics used for this analysis are based on those used by Batschelet (1965) because they take into account the circular nature of the data. Nightly wind direction was also summarized using similar methods and data, which was collected from the nearest met tower to the radar.

Flight altitude data were summarized using linear statistics. Mean flight altitudes (± 1 standard error [SE]) were calculated by hour, night, and overall season. The percentages of targets flying below 125 m and 150 m, the potential range of maximum turbine height, were also calculated hourly, nightly, and for the entire survey period.

## 2.3 RESULTS

Radar surveys were conducted during 30 nights between September 1 and October 15, 2007 (Appendix A, Table 1).

### 2.3.1 Passage Rates

The overall passage rate for the entire survey period was (mean ± SE; 74 ± 15 targets/kilometer/hour [t/km/hr]). Nightly passage rates varied from 0 ± 0 t/km/hr on October 10 to 404 ± 64 t/km/hr on September 10 (Figure 2-3; also Appendix A, Table 1). Individual hourly passage rates varied from 0 to 675 t/km/hr (Appendix A, Table 1). For the entire season, passage rates were highest during the first three hours after sunset and then decreased steeply thereafter (Figure 2-4). Mean nightly wind speeds varied from 2.3 to 8.0 meters/second (m/s) throughout the season, while mean nightly temperature ranged from 4.8 to 23.9 Celsius (41 to 75 º F). There was no correlation between wind speed and passage rate (n=30, r = -0.06, p=0.76) and a low correlation between temperature and passage rate (n=30, r=0.58, p=<0.01).

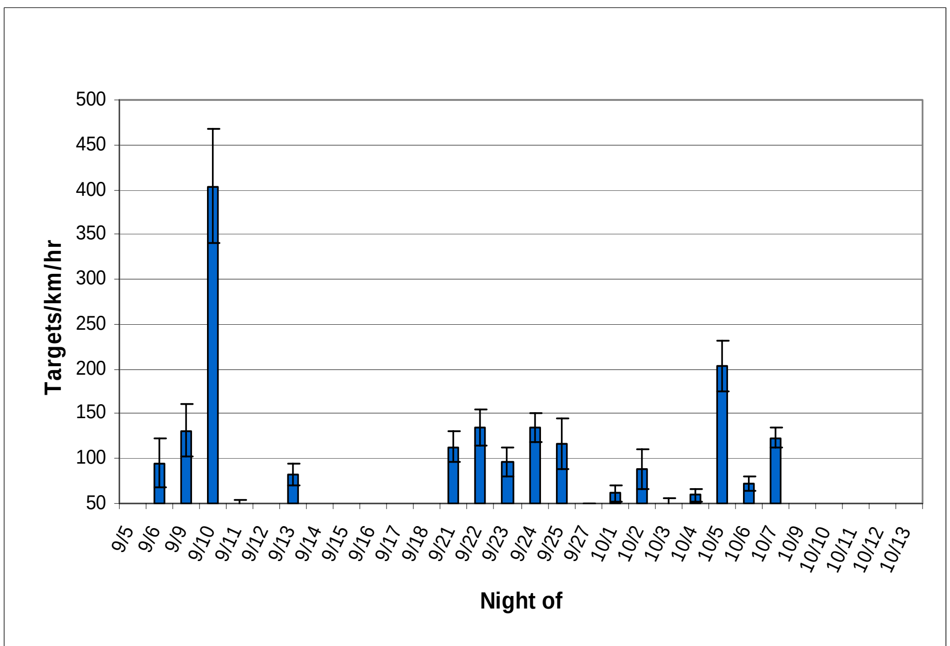



**Figure 2-3.** Nightly passage rates observed (error bars ± 1 SE) at Buckeye Wind Project, fall 2007

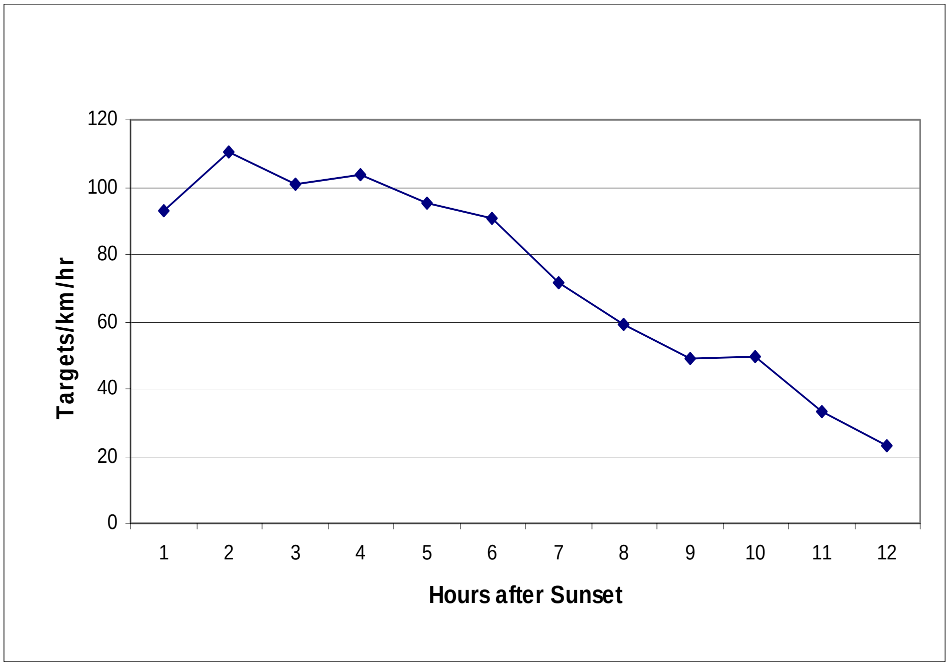



**Figure 2-4.** Hourly passage rates for entire season at Buckeye Wind Project, fall 2007

### 2.3.2 Flight Direction

Mean flight direction through the Project area was (mean ± circular standard deviation) 194° ± 144° (Figure 2-5). There was significant directional variation between nights (Appendix A, Table 2).

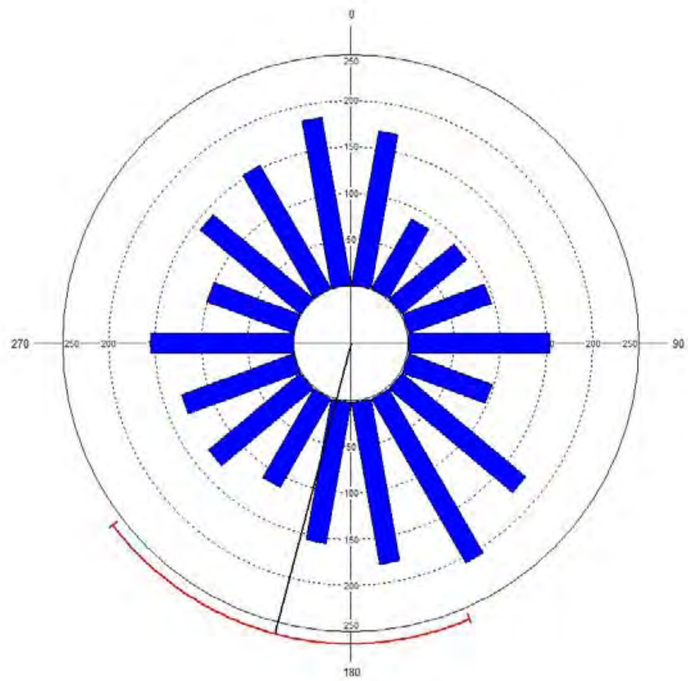



**Figure 2-5.** Mean flight direction for the entire season (the bracket along the margin of the histogram is the 95% confidence interval) at Buckeye Wind Project, fall 2007

### 2.3.3 Flight Altitude

The seasonal average mean flight altitude of targets was 393 m ± 12 m (1290 ft ± 39 ft) above the radar site. The average nightly flight altitude ranged from 252 m ± 43 m (828 ft ± 140 ft) on October 10 to 506 m ± 27 m (1661 ft ± 88 ft) on September 5 (Figure 2-6; Appendix A, Table 3). The percent of targets observed flying below 125 m (410 ft) also varied by night, from 1 percent to 38 percent. The seasonal average percentage of targets flying below 125 m was 4 percent (Figure 2-7). The percent of targets observed flying below 150 m (492 ft) also varied by night, from 2 percent to 38 percent. The seasonal average percentage of targets flying below 150 m was 6 percent (Figure 2-8). Hourly flight altitude was consistent throughout the night (Figure 2-8).

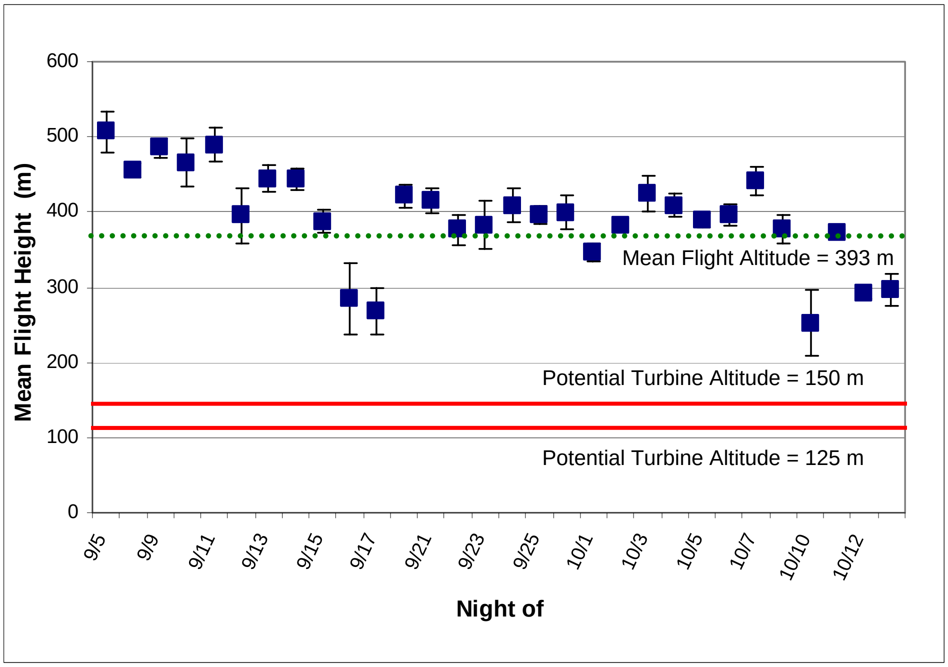



**Figure 2-6.** Mean nightly flight altitude of targets (error bars ± 1 SE) at Buckeye Wind Project - Fall 2007

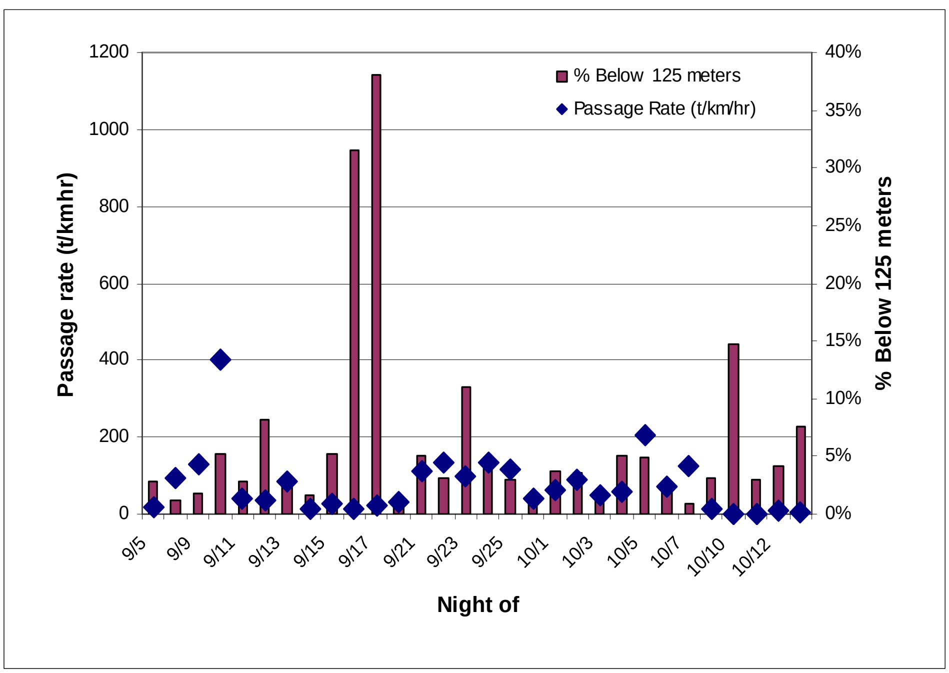



**Figure 2-7.** Percent of targets observed flying below an altitude of 125 m (410 ft) at Buckeye Wind Project, fall 2007

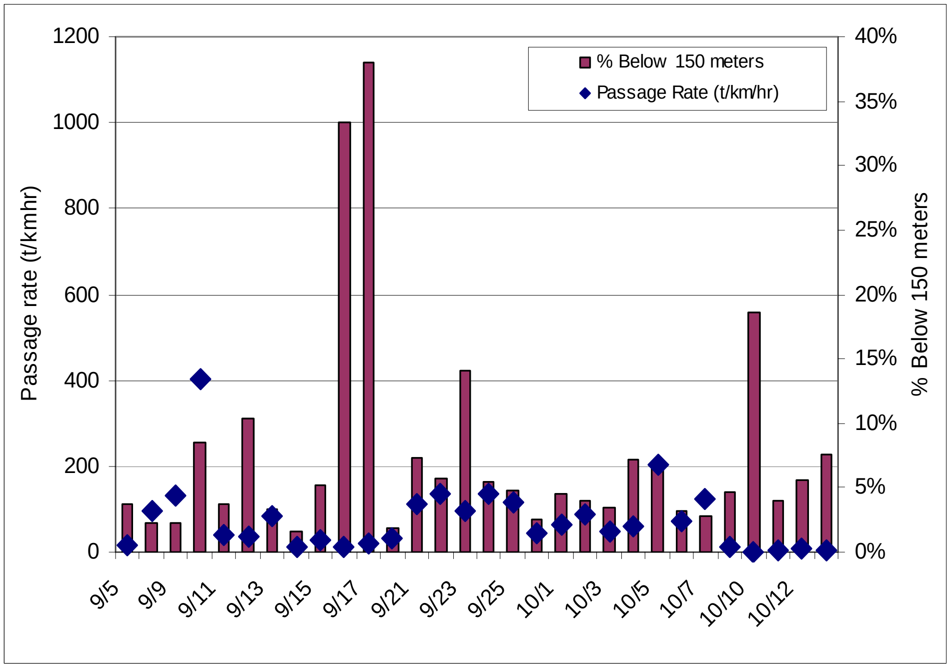



**Figure 2-8.** Percent of targets observed flying below an altitude of 150 m (492 ft) at Buckeye Wind Project, fall 2007

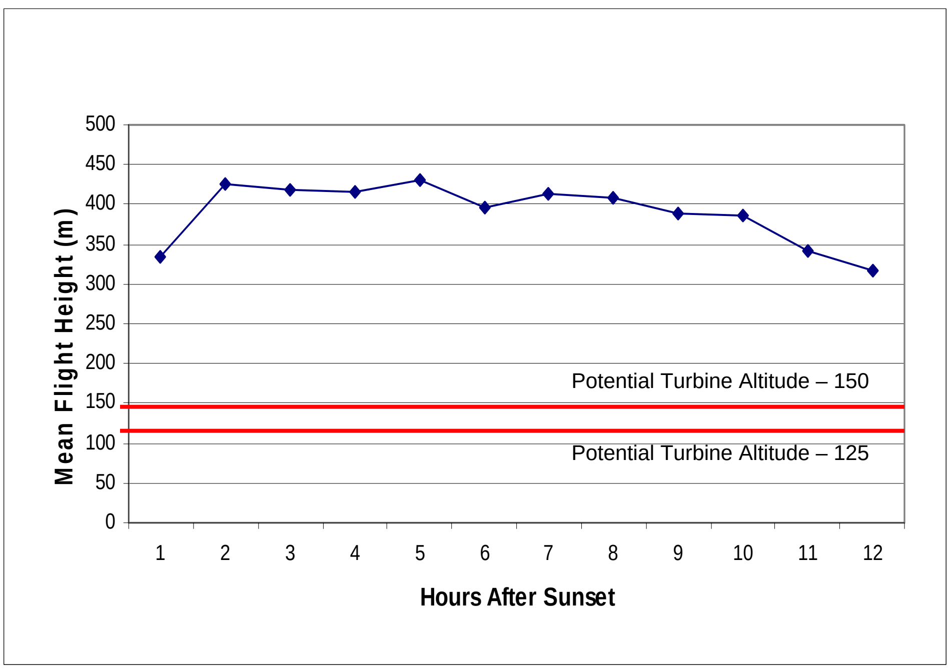



**Figure 2-9.** Hourly target flight altitude distribution at Buckeye Wind Project, fall 2007

### 2.3.4 Ceilometer Observations

Ceilometer data collected during the radar survey yielded a total of 277 5-minute observations, which included no birds and one bat in the ceilometer beam.

## 2.4 DISCUSSION

Nightly variation in the magnitude and flight characteristics of nocturnal migrants is not uncommon and is often attributed to weather patterns, such as cold fronts and winds aloft (Hassler *et al.* 1963, Gauthreaux and Able 1970, Richardson 1972, Able 1973, Bingman *et al.* 1982, Gauthreaux 1991). Data from regional surveys using similar methods and equipment conducted within the last several years are rapidly becoming available and provide an opportunity to compare the results from other wind projects. There are limitations in comparing data from previous years with data from 2007, as year-to-year variation in continental bird populations may influence how many birds migrate through an area. Additionally, differing site characteristics such as topography, local landscape conditions, and vegetation surrounding a radar survey location can play a large role in the radar's ability to detect targets and the subsequent calculation of passage rate. These differences should be recognized when making direct site-to-site comparisons in passage rates.

Regardless of potential differences between radar survey locations, of the publicly available results from 36 other radar surveys, only one survey in fall 2005 in Wyoming County, New York, had a lower mean passage rate than that observed at Buckeye Wind Project (Table 2-1). There is currently no accurate quantitative method of directly correlating pre-construction passage rates at wind farms to operational impacts to birds and bats, although conventional wisdom would suggest that risk of collision would increase as passage rates of nocturnal migrants increases.

Some research suggests that bird migration may be affected by landscape features, such as coastlines, large river valleys, and mountain ranges. This has been documented for diurnally migrating birds such as raptors, but is not as well established for nocturnally migrating birds (Sielman *et al*. 1981; Bingman 1980; Bingman *et al*. 1982; Bruderer and Jenni 1990; Richardson 1998; Fortin *et al*. 1999; Williams *et al.* 2001; Diehl *et al*. 2003). However, surveys suggesting night-migrating birds are influenced by topography have typically been conducted in areas of steep topography, such as the most rugged areas of the northern Appalachians and the Alps. , There were no noticeable topographic influences on migration within the Project area.

The emerging body of surveys characterizing nocturnal bird movements shows a relatively consistent pattern in flight altitude, with most birds appearing to fly at altitudes of several hundred meters or more above the ground (Table 2-1). Comparison of flight altitude between survey sites as measured by radar is generally less influenced by site characteristics as the main portion of the radar beam is directed skyward, and the potential effects of surrounding vegetation on the radar's view can be more easily controlled. The flight altitude at Buckeye was very consistent with the altitudes observed at all other sites, regardless of landscape (Table 2-1).

**Table 2-1.** Summary of available fall avian radar survey results

| Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Avg. Flight Direction | Avg. Flight Altitude (m) | % Targets Below Turbine Altitude | Citation |
|---|---|---|---|---|---|---|---|---|---|
| **Fall 1998** | | | | | | | | | |
| Harrisburg, NY | 35 | n/a | Great Lakes plain/ADK foothills | 122 | n/a | 181 | 182 | 45 | Cooper and Mabee 2000 |
| Wethersfield, Wyoming Cty, NY | 35 | n/a | Agricultural plateau | 168 | n/a | 179 | 154 | 57 | Cooper and Mabee 2000 |
| **Fall 2003** | | | | | | | | | |
| Westfield Chautauqua Cty, NY | 30 | 180 | Great Lakes shore | 238 | 10-905 | 199 | 532 | (125 m) 4 % | Cooper *et al.* 2004c |
| Mt. Storm, Grant Cty, WV | 45 | 270 | Forested ridge | 241 | 8-852 | 184 | 410 | n/a | Cooper *et al.* 2004b |
| **Fall 2004** | | | | | | | | | |
| Franklin, Pendleton Cty, WV | 34 | 349 | Forested ridge | 229 | 18-643 | 175 | 583 | (125 m) 8% | Woodlot 2005a |
| Prattsburgh, Steuben Cty, NY | 30 | 315 | Agricultural plateau | 193 | 12-474 | 188 | 516 | (125 m) 3% | Woodlot 2005b |
| Prattsburgh, Steuben Cty, NY | 45 | 292.5 | Agricultural plateau | 200 | 18-863 | 177 | 365 | (125 m) 9.2% | Mabee *et al.* 2005a |
| Martindale, Lancaster, Cty, PA | n/a | n/a | Reclaimed minelands | 187 | n/a | 188 | 436 | (n/a) 8% | Young 2006 |
| Casselman, Somerset Cty, PA | n/a | n/a | Reclaimed minelands | 174 | n/a | 219 | 448 | (n/a) 7% | Young 2006 |
| Deerfield, Bennington Cty, VT (Existing Facility) | 28 | 300 | Forested ridge | 175 | 7-519 | 194 | 438 | (100 m) <1% | Woodlot 2005c |
| Deerfield, Bennington Cty, VT (Western Expansion) | 14 | 159 | Forested ridge | 193 | 8-1121 | 223 | 624 | (100 m) 5% | Woodlot 2005c |
| Deerfield, Bennington Cty, VT (Valley Site) | 13 | 136 | Forested ridge | 150 | 58-404 | 214 | 503 | (100 m) < 1% | Woodlot 2005c |
| Deerfield, Bennington Cty, VT (3 sites combined) | 28 | 595 | Forested ridge | 178 | 7-1121 | 212 | 611 | (100 m) 3% | Woodlot 2005c |
| Sheffield, Caledonia Cty, VT | 18 | 176 | Forested ridge | 114 | 19-320 | 200 | 566 | (125 m) 1% | Woodlot 2006a |

**Table 2-1.** Summary of available fall avian radar survey results (cont.)

| Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Avg. Flight Direction | Avg. Flight Altitude (m) | % Targets Below Turbine Altitude | Citation |
|---|---|---|---|---|---|---|---|---|---|
| **Fall 2005** | | | | | | | | | |
| Churubusco, Clinton Cty, NY | 38 | 414 | Great Lakes plain/ADK foothills | 152 | 9-429 | 193 | 438 | (120 m) 5% | Woodlot 2005l |
| Ellenberg, Clinton Cty, NY | n/a | n/a | Great Lakes plain/ADK foothills | 197 | n/a | 162 | 333 | (n/a) 12% | Mabee *et al.* 2006a |
| Dairy Hills, Clinton Cty, NY | n/a | n/a | Agricultural plateau | 94 | n/a | 180 | 466 | (n/a) 10% | Young *et al.* 2006 |
| Flat Rock, Lewis Cty, NY | n/a | n/a | Great Lakes plain/ADK foothills | 158 | n/a | 184 | 415 | (n/a) 8% | ED&R 2006a |
| Clayton, Jefferson Cty, NY | 37 | 385 | Agricultural plateau | 418 | 83-877 | 168 | 475 | (150 m) 10% | Woodlot 2005m |
| Bliss, Wyoming Cty, NY | 8 | n/a | Agricultural plateau | 440 | 52-1392 | n/a | 411 | (125 m) 13% | Young 2006 |
| Perry, Wyoming Cty, NY | n/a | n/a | Agricultural plateau | 64 | n/a | 180 | 466 | (125 m) 10% | Young 2006 |
| Sheldon, Wyoming Cty, NY | 36 | 347 | Agricultural plateau | 197 | 43-529 | 213 | 422 | (120 m) 3% | Woodlot 2005n |
| Howard, Steuben Cty, NY | 39 | 405 | Agricultural plateau | 481 | 18-1434 | 185 | 491 | (125 m) 5% | Woodlot 2005o |
| Fairfield, Herkimer Cty, NY | 38 | 423 | Agricultural plateau | 691 | 116-1351 | 198 | 516 | (125 m) 4% | Woodlot 2005p |
| Jordanville, Herkimer Cty, NY | 38 | 404 | Agricultural plateau | 380 | 26-1019 | 208 | 440 | (125 m) 6% | Woodlot 2005q |
| Munnsville, Madison Cty, NY | 31 | 292 | Agricultural plateau | 732 | 15-1671 | 223 | 644 | (118 m) 2% | Woodlot 2005r |
| Deerfield, Bennington Cty, VT | 32 | 324 | Forested ridge | 559 | 3-1736 | 221 | 395 | (100 m) 13% | Woodlot 2005s |
| Kibby, Franklin Cty, ME (Mountain) | 12 | 115 | Forested ridge | 565 | 109-1107 | 167 | 370 | (125 m) 16% | Woodlot 2006d |
| Kibby, Franklin Cty, ME (Range 1) | 12 | 101 | Forested ridge | 201 | 12-783 | 196 | 352 | (125 m) 12% | Woodlot 2006d |
| Kibby, Franklin Cty, ME (Valley Site) | 5 | 13 | Forested valley | 452 | 52-995 | 193 | 391 | (125 m) 16% | Woodlot 2006d |
| Mars Hill, Aroostook Cty, ME | 18 | 117 | Forested ridge | 512 | 60-1092 | 228 | 424 | (120 m) 8% | Woodlot 2005t |

**Table 2-1.** Summary of available fall avian radar survey results (cont.)

| Project Site | Number of Survey Nights | Number of Survey Hours | Landscape | Average Passage Rate (t/km/hr) | Range in Nightly Passage Rates | Avg. Flight Direction | Avg. Flight Altitude (m) | % Targets Below Turbine Altitude | Citation |
|---|---|---|---|---|---|---|---|---|---|
| **Fall 2006** | | | | | | | | | |
| Chateaugay, Franklin Cty, NY | 35 | 327 | Agricultural plateau | 643 | 38-1373 | 212 | 431 | (120 m) 8% | Woodlot 2006j |
| Wethersfield, Wyoming Cty, NY | 56 | n/a | Agricultural plateau | 256 | 31-701 | 208 | 344 | (125 m) 11% | Mabee *et al.* 2006c |
| Centerville, Allegany Cty, NY | 57 | n/a | Agricultural plateau | 259 | 12-877 | 208 | 350 | (125 m) 12% | Mabee *et al.* 2006c |
| Lempster, Sullivan Cty, NH | 32 | 290 | Forested ridge | 620 | 133-1609 | 206 | 387 | (125 m) 8% | Woodlot 2007a |
| Stetson, Penobscot Cty, ME | 12 | 77 | Forested ridge | 476 | 131-1192 | 227 | 378 | (125 m) 13% | Woodlot 2007b |
| **Fall 2007** | | | | | | | | | |
| Buckeye Wind Power Project, Champaign and Logan Cty, OH | 30 | n/a | Agricultural plateau | 74 | 1-404 | 194 | 393 | (125m) 5% | This Report |

### 2.5 CONCLUSIONS

Radar surveys during the fall 2007 migration period suggest that bird migration patterns in the vicinity of the Buckeye Wind Project are generally similar to patterns observed at other sites in the region. Migration activity varied throughout the season, which is probably largely attributable to weather patterns. The mean passage rate in the Project area was the second lowest when compared with passage rates for 36 publicly available radar survey results. Flight altitude and flight direction data indicate that nocturnal migrants were flying at altitudes well above the proposed maximum turbine heights (seasonal mean was 393 m) and were unimpeded by topography. The percent of targets flying below the proposed turbine altitudes was near the low end of the ranges observed at other sites.

## 3.0 Acoustic Bat Survey

A total of eleven bat species are known to occur in the state of Ohio, based on their normal geographic ranges. These include *Mytois* species; Indiana bat (*Myotis sodalis*), little brown bat (*M. lucifugus*), northern long-eared bat (*M. septentrionalis*), eastern small-footed bat (*M. leibii*), as well as other Microchiroptera species; silver-haired bat (*Lasionycteris noctivagans*), eastern pipistrelle (*Pipistrellus subflavus*)[3], big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus*), evening bat (*Nycticeius humeralis*), and Rafinesque's big-eared bat (*Corynorhinus rafinesquii*). Of these, the Indiana bat is listed as a federally endangered species, and the eastern small-footed bat and the Rafinesque's big-eared bat are listed as endangered by the OH DNR. Although the Project area is slightly north of Rafinesque's big-eared bat's normal distribution, there is some potential for its occurrence in the vicinity of the Project area.

### 3.1 INTRODUCTION

To document bat activity patterns in the proposed Project area, Stantec conducted acoustic monitoring surveys with Anabat detectors during the fall migration season. Acoustic bat detectors allow for long-term monitoring of activity patterns of bats in a variety of habitats, including the air space approaching the rotor-swept zone of modern wind turbines. The acoustic bat survey conducted at the Buckeye Project was designed to document bat activity patterns near the rotor zone of the proposed turbines, at an intermediate altitude, and near the ground. Acoustic surveys were also intended to document bat activity patterns in relation to weather factors including wind speed, temperature, and relative humidity.

[3] The scientific name of the eastern pipistrelle is in the process of being changed to *Perimyotis subflavus*. However, the species is referred to as *Pipistrellus subflavus* and abbreviated as "PISU" throughout this report.

## 3.2 METHODS

### 3.2.1 Field Surveys

Anabat II detectors (Titley Electronics Pty Ltd.) were used for the duration of the fall 2007 acoustic survey. Each Anabat detector was coupled with CF Storage ZCAIM (Titley Electronics Pty Ltd.), which programmed the on/off times and stored data on removable compact flash cards. Anabat detectors are frequency division detectors, dividing the frequency of ultrasonic calls made by bats by a factor of 16 so that they are audible to humans, which record the bat calls for subsequent analysis. Anabat detectors were selected based upon their widespread use for this type of survey, their ability to be deployed for long periods of time, and their ability to detect a broad frequency range, which allows detection of all species of bats that could occur in the Project area.

Six detectors were deployed in the Project area and were programmed to passively record from 7:00 pm to 7:00 am from August 28 through October 29. Three detectors were deployed at each of the two 60 m met towers on site and were positioned to record calls of bats flying within the met tower openings. One met tower was located in the northern portion of the Project area, approximately nine miles due north of the southern met tower (Figure 3-1). Detectors were placed at each met tower in the following locations: high detectors were deployed on met towers at a height approaching the rotor sweep zone; low detectors were positioned on met towers approximately 10 m (33 ft) below the high detectors; and tree detectors were placed in trees approximately 3 m (9 ft) above the ground at the edge of the met tower clearings. The habitat surrounding the met towers was open agriculture, with the northern tower adjacent to an active corn field and the southern tower within a pasture.

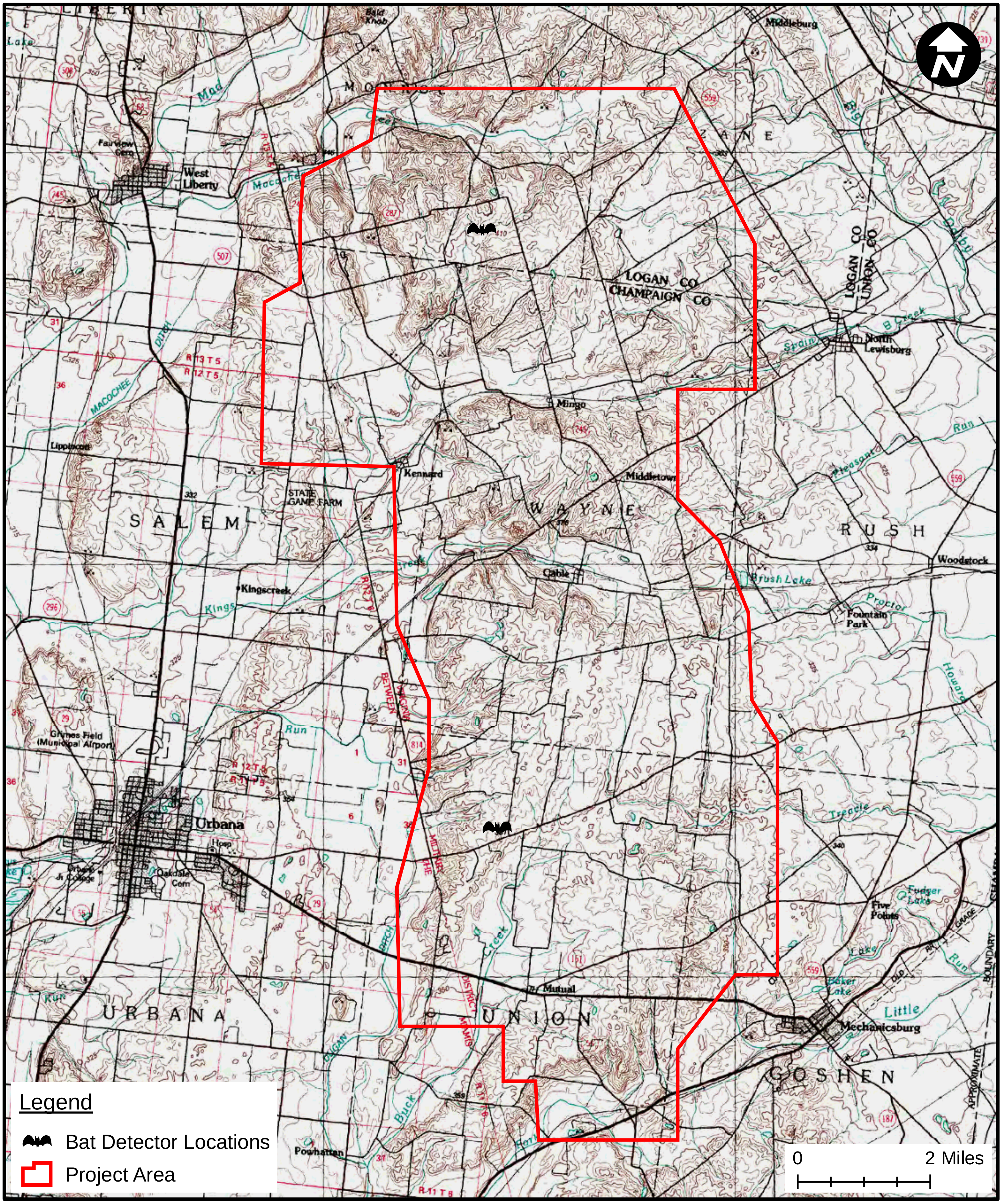
Each solar-powered Anabat system was deployed in a waterproof housing that enabled the detector to record while unattended for the duration of the survey. The housing suspended the Anabat microphone downward to give maximum protection from precipitation. To compensate for the downward position, a reflector shield of smooth plastic was placed at a 45-degree angle directly below the microphone. The angled reflector allowed the microphone to record the airspace horizontally surrounding the detector and was only slightly less sensitive than an unmodified Anabat unit.

Maintenance visits were conducted approximately every two weeks to check on the condition of the detectors and download data to a computer for analysis. The sensitivity of each Anabat system was set at between six and seven to maximize sensitivity while limiting ambient background noise and interference. The sensitivity of individual detectors was tested using an ultrasonic Bat Chirp (Reno, NV) to ensure that the detectors would be able to detect bats up to a distance of at least 10 m (33 ft).

### 3.2.2 Data Analysis

Potential call files were extracted from data files using CFCread© software. The default settings for CFCread© were used during this file extraction process, as these settings are recommended for the calls that are characteristic of northeastern bats. This software screens all data recorded by the bat detector and extracts call files using a filter. Using the default settings for this initial screen also ensures comparability between data sets. Settings used by the filter include a max TBC (time between calls) of 5 seconds, a minimum line length of 5 milliseconds, and a smoothing factor of 50. The smoothing factor refers to whether or not adjacent pixels can be connected with a smooth line. The higher the smoothing factor, the less restrictive the filter is, and the more noise files and poor quality call sequences are retained within the data set. A call is a single pulse of sound produced by a bat. A call sequence is a combination of two or more pulses recorded in a call file.

Following extraction of call files, each file was visually inspected to ensure that files created by static or some other form of interference that were still within the frequency range of Ohio bats were not included in the data set. Call sequences were identified based on visual comparison of call sequences to reference calls provided by Chris Corben, developer of the Anabat system. Bat calls typically include a series of pulses characteristic of normal flight or prey location (“search phase” calls) and capture periods (feeding “buzzes”) and visually look very different than static, which typically forms a diffuse band of dots at either a constant frequency or widely varying frequency, caused by wind, vibration, or other interference. Using these characteristics, bat call files are easily distinguished from non-bat files.




Prepared By:

Stantec

WOODLOT

107239-F31-BatLocation.mxd

Sheet Title:

Bat Detector Map

Project:

Buckeye Wind Power Project, Ohio



Date: 12/17/2007

Scale: 1" = 2 Miles

Proj. No.: 107239

Figure:

3-1

Bat call sequences were individually marked and categorized by species group, or “guild” based on visual comparison to reference calls. Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species (O’Farrell *et al*. 1999, O’Farrell and Gannon 1999). A call sequence was considered of suitable quality and duration if the individual call pulses were “clean” (i.e., consisting of sharp, distinct lines) and at least five pulses were included within the sequence. Call sequences were classified to species whenever possible, using the reference calls described above. However, due to similarity of call signatures between several species, all classified calls have been categorized into four guilds for presentation in this report. This classification scheme follows that of Gannon *et al.* (2003) and is as follows:

- **Unknown (UNKN)** – all call sequences with too few pulses (less than five) or of poor quality (such as indistinct pulse characteristics or background static). These calls were further identified as either “high frequency unknown” (HFUN) for calls above 35 kHz or “low frequency unknown” (LFUN) for calls below 35 kHz; all potential evening bat call sequences would be grouped under the high frequency unknown category.

- **Myotid (MYSP)** – All bats of the genus *Myotis*. While there are some general characteristics believed to be distinctive for several of the species in this genus, these characteristics do not occur consistently enough for any one species to be relied upon at all times when using Anabat recordings;

- **Red bat/pipistrelle (RBEP)** – Eastern red bats and eastern pipistrelles. Like many of the other northeastern bats, these two species can produce calls distinctive only to each species. However, significant overlap in the call pulse shape, frequency range, and slope can also occur. Evening bats would also be included in this guild; and

- **Big brown/silver-haired/hoary bat (BBSHHB)** – This guild will be referred to as the big brown guild. These species’ call signatures commonly overlap and have therefore been included as one guild in this report. Although the presence of Rafinesque’s big-eared bat was not confirmed, their occurrence should also not be ruled out as there is some potential for this species to occur in the vicinity of the Project area, any big-eared call sequences would be included in this guild.

This guild grouping represents a conservative approach to bat call identification (Hayes 2000). Since some species do sometimes produce calls unique only to that species, all calls were identified to the lowest possible taxonomic level before being grouped into the listed guilds. Tables and figures in the body of this report will reflect those guilds. However, since species-specific identification did occur in some cases, each guild will also be briefly discussed with respect to potential species composition of recorded call sequences.

Once all of the call files were identified and categorized in appropriate guilds, nightly tallies of detected calls were compiled. Mean detection rates (number of calls/detector-night) for the entire sampling period were calculated for each detector and for all detectors combined. It is important to note that detection rates indicate only the number of calls detected and do not necessarily reflect the number of individual bats in an area. For example, a single individual can produce one or many call files recorded by the bat detector, but the bat detector cannot differentiate between individuals of the same species producing those calls. Consequently, detections recorded by the bat detector system likely over-represent the actual number of bats that produced the recorded calls.

### 3.2.3 Ceilometer and Radar Data

Nocturnal radar surveys and hourly ceilometer surveys were also conducted concurrently with the acoustic bat monitoring on 25 nights during the fall sampling period. While conclusive differentiation between bats and birds is not possible using radar, work conducted by Woodlot using radar and thermal imaging cameras indicates that nocturnal targets that move erratically or in curving paths are typically bats, while those with straight flight paths are birds. Additionally, while bats can create radar flight paths more similar to birds (i.e., straight flight path), no birds were observed creating the erratic radar flight paths observed to be created by some bats (Woodlot, unpublished observations).

Targets with erratic flight paths, similar to those previously observed to be created by bats were noted during the analysis of the radar video data. Nightly tallies of these targets were then made. Additionally, the ceilometer observations made during the radar survey were an opportunity to document birds and bats flying at low altitude over the radar site. Any bats observed during the ceilometer surveys were recorded.

### 3.2.4 Weather Data

Weather data was collected by EverPower at both the northern and southern met tower locations. Met towers collect wind speed and temperature at an elevation of 60 m above the proposed development area. A passive data logger was also deployed by Woodlot at the south met tower location. This data logger collected temperature, relative humidity, and dew point data from September 1 to October 29. Data was collected at 10-minute intervals by data loggers (HOBO Pro v2 U23-001, Onset Computer Corporation) placed on the tree bat detector system. The mean, maximum, and minimum temperature, relative humidity, and dew point were calculated for each night.

## 3.3 RESULTS

### 3.3.1 Detector Call Analysis

Detectors were deployed August 28 and continued to record data through October 29, for a total of 226 detector-nights (2,712 hours), although survey effort varied between detectors (Table 3-1). Each site recorded a large quantity of data, and some of the detectors recorded with little interruption. It is important to note that Anabat detectors occasionally power-down or experience other unexpected technical problems, and recordings are interrupted resulting in data loss. This is a typical issue with Anabat detectors. Four of the six detectors were not operational due to technological problems at various times during the survey (Appendix B, Table 6). However, this data loss is not considered to be of significant concern. It is expected that no major bat movements were missed, as there was always at least one detector functioning at both the north and south sample locations at all times during the survey (Appendix B; Table 6). All equipment issues were resolved before the end of the migration season resulting in adequate data collection at the deployment sites.

A total of 1,522 bat calls sequences were recorded at the six bat detectors across the Project area (Table 3-1). The south tree detector operated for 24 days and recorded 681 bat passes with an overall detection rate of 28.38 bat passes/detector night. The north low detector recorded 57 nights of operation and 275 bat passes with an overall detection rate of 4.82 bat passes/detector night. The south high detector operated for 57 nights and recorded 222 bat passes with an overall detection rate of 3.89 bat passes/detector night. The north high detector operated for 52 nights, recorded 176 bat call sequences and had an overall detection rate of 3.38 bat passes/detector night. The north tree detector operated for 25 nights and recorded 88 bat calls with an overall detection rate of 3.52 bat passes/detector night. The south low detector operated for 11 nights and recorded 80 bat passes with an overall detection rate of 7.27 bat passes/detector night.

**Table 3-1.** Summary of bat detector field survey effort and results, fall 2007.

| Location | Dates | # Detector-Nights* | # Recorded Sequences | Detection Rate ** | Maximum # Calls Recorded *** |
|---|---|---|---|---|---|
| North High | 8/28 – 9/11 & 9/23 – 10/29 | 52 | 176 | 3.38 | 41 |
| North Low | 8/28 – 10/23 | 57 | 275 | 4.82 | 35 |
| North Tree | 8/28 – 9/21 | 25 | 88 | 3.52 | 13 |
| South High | 8/29 – 10/24 | 57 | 222 | 3.89 | 17 |
| South Low | 8/29 - 9/8 | 11 | 80 | 7.27 | 37 |
| South Tree | 9/24 & 10/2 - 10/24 | 24 | 681 | 28.38 | 311 |
| ***Overall*** | 8/28 -10/24 | 226 | 1522 | 6.73 | -- |

* Detector-night is a sampling unit during which a single detector is deployed overnight. On nights when two detectors are deployed, the sampling effort equals two detector-nights, etc.

** Number of bat passes recorded per detector-night.

*** Maximum number of bat passes recorded from any **single** detector for a 12-hour sampling period.

Appendix B provides a series of tables with more specific information on the nightly timing, number, and species composition of recorded bat call sequences. Specifically, Appendix B Tables 1 through 6 provide information on the number of call sequences by guild and species (where possible) recorded at each detector and the weather conditions for that night. The numbers of calls per night detected by all detectors varied from night to night. During the fall migration season there appeared to be an increase in bat passes at the functioning detectors from October 2 to October 9. This increase in activity was observed at four of the six detectors (two detectors were malfunctioning during this time). Temperatures during the eight days ranged from a nightly mean of 13.5°C to 23.1°C (56 to 74ºF) then the nightly mean dropped as low as 4.8°C (41ºF) three days after the increased activity. Throughout the fall migration season, the number of call sequences peaked around the 8:00 pm hour and again at 11:00 pm followed by a decline in recorded call sequences for the remainder of the night (Figure 3-2).

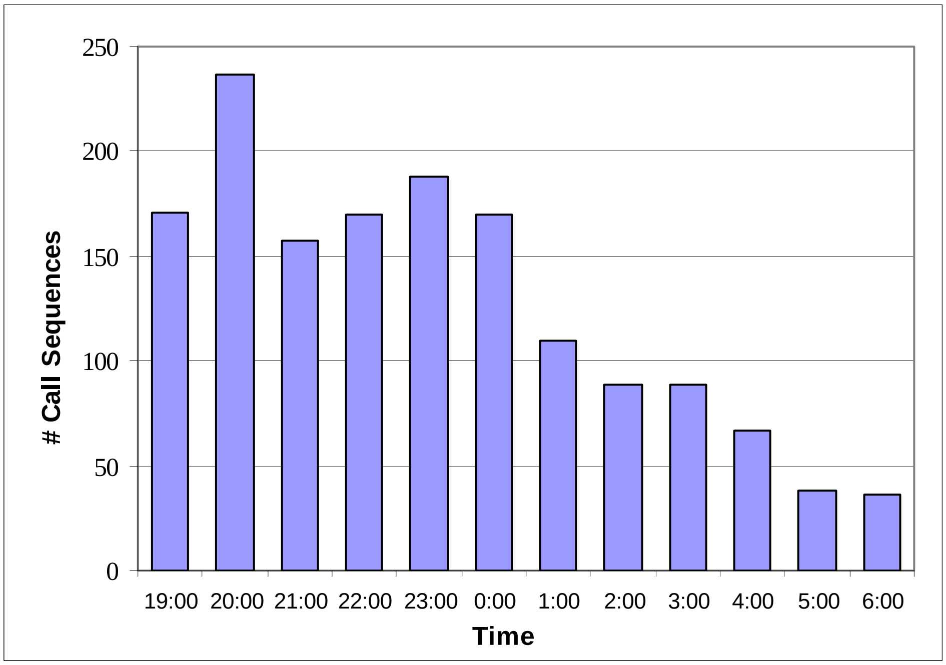



**Figure 3-2.** Timing of bat call sequences recorded by hour, fall 2007

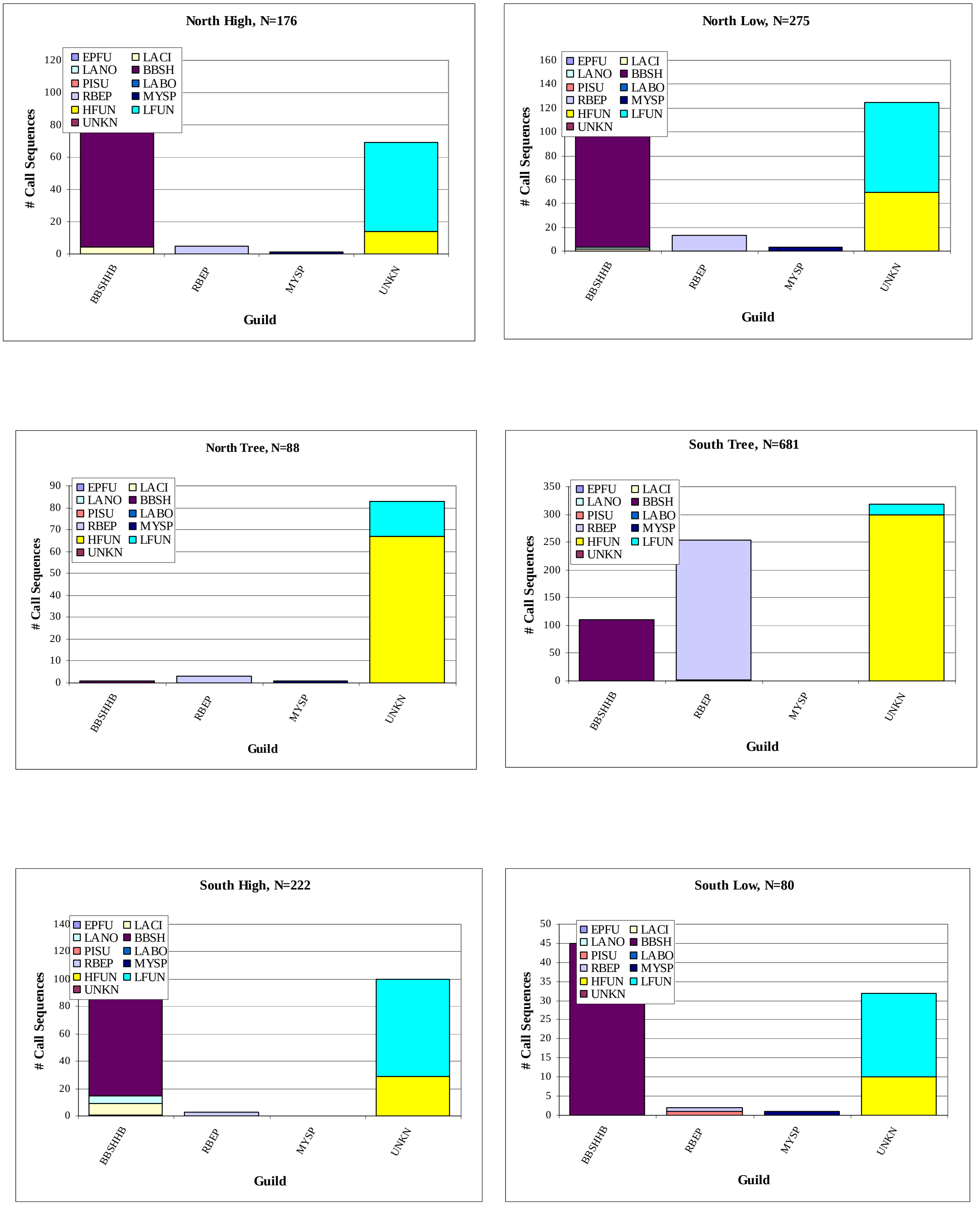
The majority of the recorded call sequences (48%) recorded at all six detectors were labeled as unknown due to very short call sequences (less than five pulses) or poor call signature formation (probably due to a bat flying at the edge of the detection zone of the detector or flying away from the microphone) (Table 3-2). Of the calls that were identified to species or guild, those of the big brown guild were the most common (34% of all call sequences), followed by the species within the red bat/eastern pipistrelle guild (18% of all call sequences). Less than 1 percent of all call sequences were attributable to *Myotis* species.

| **Table 3-2.** Summary of the composition of recorded bat call sequences, fall 2007 | | | | | |
|---|---|---|---|---|---|
| **Detector** | **Guild** | | | | **Total** |
| | **Big brown guild** | **Red bat/ E. pipistrelle** | **Myotis** | **Unknown** | |
| North High | 101 | 5 | 1 | 69 | 176 |
| North Low | 134 | 13 | 3 | 125 | 275 |
| North Tree | 1 | 3 | 1 | 83 | 88 |
| South High | 119 | 3 | 0 | 100 | 222 |
| South Low | 45 | 2 | 1 | 32 | 80 |
| South Tree | 110 | 253 | 0 | 318 | 681 |
| ***Total*** | ***510*** | ***279*** | ***6*** | ***727*** | ***1,522*** |

Both the north high and the south high detectors recorded similar species compositions during the fall migration season. More than half of the call sequences recorded at the northern high detector were from species of the BBSHHB guild (57%) and low frequency unknown (31%) calls. Only one *Myotis* call sequence was recorded at the north high detector and no *Myotis* calls were recorded at the south high detector (Figure 3-3).

Although the south low detector only operated for 11 nights, the majority of observed species were a similar species composition as the north low detector. The north low and the south low detectors also saw similar patterns of guild presence. The BBSHHS guild comprised the majority of species call sequences recorded at the north detector (49%), followed by low frequency unknown species (28%) (Figure 3-3). The southern low detector saw a similar species composition despite the limited time of operation (56% BBSHHB and 28% low frequency unknown). The results for the high and low detectors at both the north and south ends of the Project area are consistent with results from other acoustic bat survey sites across the northeast.

**FIGURE 3-3**. Summary of suspected bat call sequence species composition, by detector.



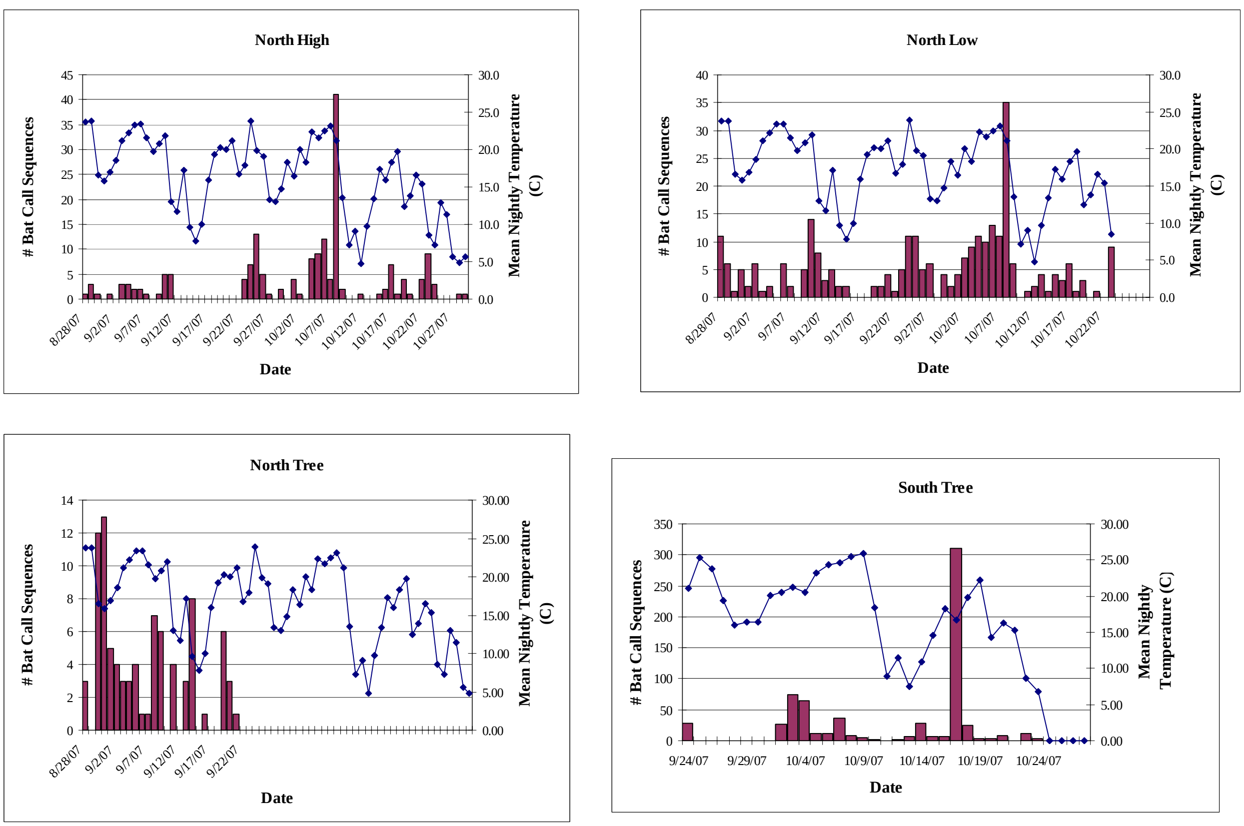
### 3.3.2 Ceilometer and Radar Surveys

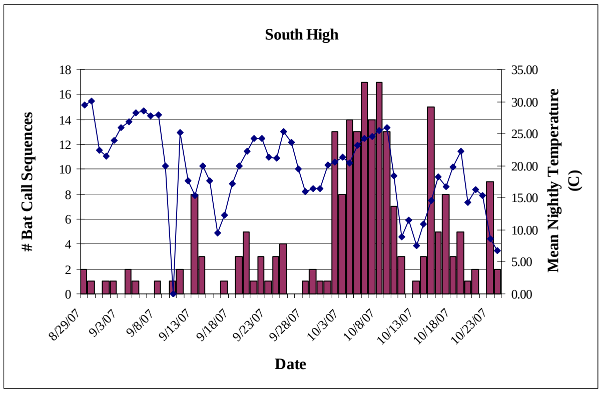
Eleven bats were observed during the course of 276 five-minute ceilometer observation periods conducted during the course of the radar surveys. During analysis of the radar survey video data, of the total 4,183 targets, 0.19 percent of target trails were identified as potential bats. These observations were generally distributed throughout the sampling period. Stantec could see no correlation between the total number of recorded bat call sequences and ceilometer, radar target, or radar passage rates.

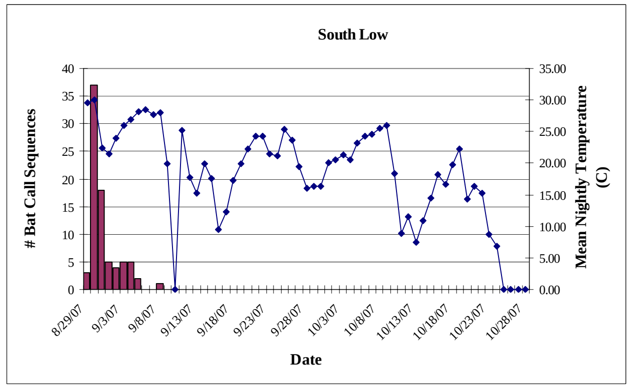
### 3.3.3 Weather Data

Mean nightly wind speeds in the Project area from August 28 through October 29, 2007, varied between 2.3 and 9.8 m/s at the northern met tower and 0.6 and 9.6 m/s at the southern met tower. Mean nightly temperatures varied between 4.8 ºC (40 ºF) and 23.9 ºC (75 ºF) at the northern met tower and 13.5 ºC (56 ºF) and 23.1 ºC (74 ºF) at the southern met tower (Figure 3-4).

**Figure 3-4.** Nightly mean temperature (blue line) and bat detections (red bars).






## 3.4 DISCUSSION

Bat echolocation surveys in fall migration season provide some insight into activity patterns, possible species composition, and timing of movements of bats in the Project area. Bat activity seemed to peak at all of the detector sights by early to mid October and decreased for the remaining of the survey season. The overall mean detection rate during the fall survey period was 6.73 calls/detector night. This rate is similar to other fall bat detector surveys conducted recently (Table 3-4). The north tree and the south low detectors were not operating during a period of increased bat activity from October 2 to October 9 which could have affected the overall detection rate.

**Table 3-4.** Summary of available fall bat detector survey results

| Project Site | Landscape | Calls/Detector Night | Citation |
|---|---|---|---|
| **Fall 2004** | | | |
| Prattsburgh, Steuben County, NY | Agricultural plateau | 2.22 | Woodlot 2005b |
| Cohocton, Steuben County, NY | Agricultural plateau | 2.00 | Woodlot 2005b |
| Sheffield, Caledonia County, VT | Forested ridge | 1.76 | Woodlot 2006a |
| Franklin, Pendleton County, WV | Forested ridge | 9.24 | Woodlot 2005a |
| **Fall 2005** | | | |
| Churubusco, Clinton County, NY | Great Lakes plain/ADK foothills | 5.56 | Woodlot 2005l |
| Clayton, Jefferson County, NY | Agricultural plateau | 4.70 | Woodlot 2005m |
| Sheldon, Wyoming County, NY | Agricultural plateau | 34.92 | Woodlot 2005n |
| Howard, Steuben County, NY | Agricultural plateau | 31.06 | Woodlot 2006o |
| Cohocton, Steuben County, NY | Agricultural plateau | 1.57 | Woodlot 2006c |
| Fairfield, Herkimer County, NY | Agricultural plateau | 1.70 | Woodlot 2005p |
| Jordanville, Herkimer County, NY | Agricultural plateau | 4.79 | Woodlot 2005q |
| Munnsville, Madison County, NY | Agricultural plateau | 2.32 | Woodlot 2005r |
| Sheffield, Caledonia County, VT | Forested ridge | 1.18 | Woodlot 2006a |
| Deerfield, Bennington County, VT | Forested ridge | 0.52 | Woodlot 2005s |
| Redington, Franklin County, ME | Forested ridge | 4.20 | Woodlot 2005u |
| Mars Hill, Aroostook County, ME | Forested ridge | 0.83 | Woodlot 2005t |
| **Fall 2006** | | | |
| Chateaugay, Clinton County, NY | Agricultural plateau | 5.10 | Woodlot 2006j |
| Brandon, Franklin County, NY | Agricultural plateau | 13.10 | Woodlot 2006j |
| Wethersfield, Wyoming Co., NY | Agricultural plateau | 0.30 | Woodlot 2006l |
| Centerville, Allegany County, NY | Agricultural plateau | 0.06 | Woodlot 2006l |
| Sheffield, Caledonia County, VT | Forested ridge | 1.10 | Woodlot 2006a |
| Lempster, Sullivan County, NH | Forested ridge | 3.47 | Woodlot 2007a |
| Kibby, Franklin County, ME | Forested ridge | 0.20 | Woodlot 2006m |
| Stetson, Penobscot County, ME | Forested ridge | 2.60 | Woodlot 2007b |

Bat calls were identified to guild within this report, although calls were provisionally categorized by species when possible during analysis. Certain species, such as the eastern red bat and hoary bat have easily identifiable calls, whereas other species, such as the big brown bat and silver-haired bat are difficult to distinguish acoustically. Similarly, certain Myotids, such as the little brown bat, are far more common and have slightly more distinguishable calls than other species. The following paragraphs discuss each guild separately and address likely species composition of recorded bats within each guild.

The MYSP guild includes all four species of *Myotis* potentially occurring in the Project area, including the little brown bat, northern long-eared bat, eastern small-footed bat, and the federally endangered Indiana bat. Of these species, the little brown bat and northern long-eared bat are by far the most common and have calls that tend to be slightly more distinguishable using the Anabat system. All six detectors operating during the fall migration season only captured six *Myotis* species calls. These calls lacked specific detailed to be identified to a specific *Myotis* species.

The RBEP guild includes the eastern pipistrelle and eastern red bat. Eastern red bats have relatively unique calls which span a wide range of frequency and have a characteristic hooked shape and variable minimum frequency. Eastern pipistrelles tend to have relatively uniform calls, with a constant minimum frequency and a sharply curved profile. Of the 279 calls classified as RBEP, only two calls could be identified as eastern pipistrelle. The remaining calls lacked specific detail to be classified as either a red bat or a pipistrelle and were placed in the RBEP guild. Eastern pipistrelles tend to be solitary foragers, often feeding over water and emerging around sunset, whereas eastern red bats will occasionally forage in groups of 20-30 individuals and emerge one to two hours after sunset (DeGraaf and Yamasaki 2001). High numbers of RBEP call sequences were recorded at the southern low detector. In one night 157 RBEP were recorded. This may have been a group of feeding bats passing the detector several times as they foraged in the met tower clearing. The BBSHHB guild includes the big brown bat, silver-haired bat, and hoary bat.

Within this grouping, the hoary bat has easily distinguishable calls characterized by highly variable minimum frequencies often extending below 20 kHz, and a hooked profile similar to the eastern red bat. Calls of silver-haired bats and big brown bats are occasionally distinguishable, but often overlap in range and can be difficult to distinguish, especially when comparing short duration calls typical of those recorded during passive monitoring. Of the 510 calls classified as BBSHHB, 14 were hoary bats and seven were silver-haired bats. The majority of the BBSHHB calls could only be identified to guild because of the poor call quality. Calls in this guild were more frequently detected at the high and low detectors than the two tree detectors.

Of the 1,522 total calls recorded at the Project area, 727, or 48% were classified as UNKN, due to their short duration or poor quality. However, these calls were identified as “high frequency” or “low frequency”. For the purposes of this analysis, “high frequency” call fragments were defined as having a minimum frequency above 30 kHz, and “low frequency” calls were defined as having a minimum frequency below 30 kHz. For the northern and southern high and low detectors, low frequency unknown calls were more common than high frequency unknown calls.

The opposite was true for both the northern and southern tree detectors where unknown high frequency calls were more common than unknown low frequency calls.

Differences in detection rates between guilds at the various detectors deployed in the Project area may reflect varying vertical distribution and habitat preferences of bat species (Hayes 2000). Recent research (Arnett 2006) found that small *Myotis* species were more frequently recorded at lower altitudes while larger, low frequency species were typically recorded more often at higher altitudes. In forested habitat, both large and small species were recorded in greater numbers at a medium altitude of 22 m, rather than at 1.5 m or 44 m. Although 48% of all calls recorded during the fall season were unknown, the low frequency and high frequency calls seen in the Project area fit a similar pattern. The higher passage rates observed at lower detectors should be interpreted with caution; those numbers could be a result of multiple passes from a single bat during nightly feeding activities. Consequently the number of call sequences may not reflect the actual number of individual bats.

Bat activity patterns during migration seem to be related to weather conditions based on mortality surveys and acoustic surveys. Acoustic surveys have documented a decrease in bat activity rates as wind speed increase and temperatures decrease, and bat activity has been shown to correlate negatively to low nightly mean temperatures (Hayes 1997, Reynolds 2006). Similarly, weather factors appeared related to bat collision mortality rates documented at two facilities in the southeastern United States, with mortality rates negatively correlated with both wind speed and relative humidity, and positively correlated to barometric pressure (Arnett 2005). These patterns suggest that bats are more likely to migrate on nights with low wind speeds (less than 4-6 m/s) and generally favorable weather (warm temperatures, low humidity, high barometric pressure). At all of the six detectors the highest nightly peak of bat activity was usually followed by a sharp drop in mean nightly temperature. This association provides anecdotal evidence of a relationship between temperature and bat activity levels recorded by Anabat detectors.

Statistical relationships were established between nightly call sequence totals and weather variables as determined from onsite met towers and HOBO data loggers. A small negative correlation was observed between wind speed and nightly call sequences at both low detectors (-0.2). A small positive correlation was observed between relative humidity and nightly call sequences at the South High detectors (0.2). A slightly large correlation was documented between temperature and nightly call sequences at the North Low detector (0.36). It is expected that a more complete data set with a full years worth of data would exhibit stronger correlations between relative levels of bat activity and weather variables. From what was documented during the fall 2007 survey period there is some quantitative and some qualitative evidence that bat activity increases with an increase in mean nightly temperature, decreases with an increase in mean nightly wind speed, and increases with rises in relative humidity. These observations are deduced from the small correlations exhibited by four of the detectors.

Although several surveys have documented heavy bat activity in the first few hours after sunset (Anthony *et al*. 1981), temporal variation in activity levels is considerable (Hayes 1997). Hourly distribution of activity may be a result of weather variables and not strongly linked to hour after sunset.

Results of acoustic surveys must be interpreted with caution. Considerable room for error exists in identification of bats based upon acoustic calls alone, especially if a site or regionally specific library of recorded reference calls is not available. Also, detection rates are not necessarily correlated with the actual numbers of bats in an area, because it is not possible to differentiate between individual bats (Hayes 2000). Stantec can provide a digital file of all acoustic calls, including all information about species identification and timing of calls from each detector on an hourly and nightly basis, should that information be desired.

### 3.5 CONCLUSIONS

The acoustic bat survey conducted at the Project area provided a valuable dataset which established general trends in species composition, fall bat migration characteristics and bat behavior in relation to weather patterns. The results of this survey should be interpreted with caution, as there is room for error in the identification of bat species based on the characteristics of their echolocation call sequences alone. The grouping of call sequences into guild categories represents a conservative approach to this type of analysis and likely provides the most realistic depiction of the species detected in the Project area. The data serve to provide a baseline of bat activity patterns and probable species composition in the Project area. It is expected that the results of this survey will help provide an accurate portrayal of the general characteristics of the local bat community, when viewed in conjunction with the results of the future bat echolocation surveys.

## 4.0 Diurnal Raptor Survey

### 4.1 INTRODUCTION

The Project area is located in the Central Continental Hawk Flyway. Geography and topography are major factors in shaping migration dynamics in this flyway. The orientation of the Great Lakes and inland mountain ranges influence diurnal migrants in central Canada and the mid-West to fly generally southwestward to their wintering grounds in fall and northeastward in the spring, with considerable east to west movement along the Great Lake shorelines (Kerlinger 1989, Kellogg 2004). The juxtaposition of the Appalachian mountain ranges and large bodies of water influence the distribution of raptor migration. Away from features such as the Lake Erie shore, the Alleghany and Appalachian plateaus may provide "leading lines" for hawks to follow (Kellogg 2004). Away from plateau “leading lines” and shores, raptors may utilize low relief upland areas; however, migration is not expected to concentrate in landscapes suboptimal for migration, such as the interior of the mid-west. There are twenty species of raptors typically observed in this flyway.

In order to minimize energy expenditure, raptors typically use ridgelines or shorelines to gain altitude via thermal development or ridge-generated updrafts (Kerlinger 1989). Areas of northern Ohio, on and near Lake Erie, support concentrations of migrant raptors which typically avoid lengthy water crossings. The topography surrounding the Buckeye Wind Project does not contain any outstanding features that typically concentrate raptors by providing reliable updrafts, such as high relief ridges and plateaus. Raptor migration through central Ohio is likely less concentrated than in other areas of the Central flyway because ridges and lake shores are not prevalent.

The Project is located in the south-central portion of the state in the Bellefontaine Uplands physiographic region, a sub-region of the Central Ohio Till Plains. This region is characterized by low to moderate relief (250 ft) hills formed by glacial processes during the last glacial maximum. Well to the east of the Project area, the Alleghany Plateaus rise to slightly higher elevations with much greater relief. It is suspected that the majority of raptor migration, away from the Lake Erie shoreline, would occur along the escarpments and leading lines of the Alleghany Plateau area.

It is probable that raptors migrating through central Ohio exhibit broad front migratory behavior, in which the migrants move across the landscape with little or no deviation due to topographic features. Therefore, it was suspected that raptor migration at the proposed Project would not be in great magnitudes or high diversity.

There is potential conflict between wind power and raptors because raptor migration is generally in and along higher elevations (Mueller and Berger 1967), such as ridge tops and areas that have a steep or substantial difference in topographic relief. These areas can provide updrafts to facilitate raptor movements and can also be productive locations for wind power generation. Raptor mortality at wind farms in the U.S. has been low at wind farms with modern turbine models, ranging from 0 to 0.07 raptors/turbine/year (Erickson *et al* 2002).

Woodlot conducted a fall raptor survey to determine if significant raptor migration occurred in the vicinity of the proposed Project. The survey was conducted on 11 days during the months of August, September and October. The goal of the survey was to document the occurrence of raptors in the vicinity of the Project area, including the number and species, approximate flight altitude, general direction and flight path, as well as other notable flight behavior.

## 4.2 RAPTOR METHODS

### 4.2.1 Field Surveys

Raptor surveys were conducted from a hill top south west of Mingo, Ohio at an elevation of approximately 402 m (1,320 ft) (Figure 4-1). The observation point offered good views to the north, west, and east. The observation site was in open and active pastureland, in a region central to the Project area. The observation site provided optimal visibility and was near a 100 m communication tower which provided an excellent reference by which to judge individual raptor flight altitudes.

Raptor surveys occurred on 11 days from August 30 to October 11, 2007, and were generally conducted from 9:00 am to 3:00 pm in order to include the time of day when the strongest thermal updrafts are typically produced and when the majority of raptor migration activity generally occurs. Days with favorable flight conditions, produced by high-pressure systems bringing northerly winds, and days following the passage of a weather front were targeted.

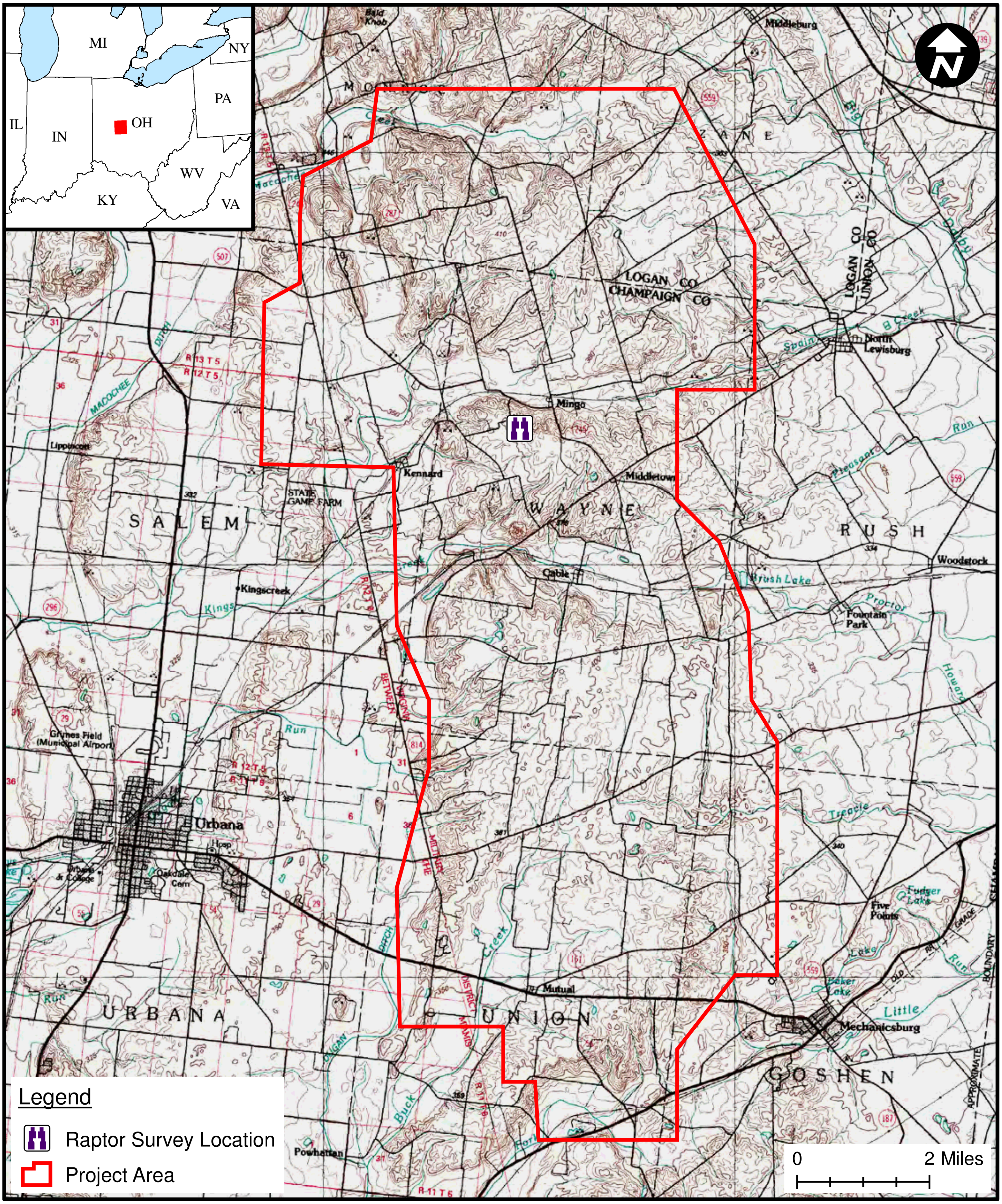
Surveys were based on methods developed by the Hawk Migration Association of North America (HMANA 2007). Observers scanned the sky and surrounding landscape for raptors flying through the area. Observations were recorded onto HMANA data sheets, which summarize the data by hour. Detailed notes on each observation, including location and flight path, flight altitude, and activity of the bird, were recorded. Flight altitudes were categorized as less than or greater than 125 m (412 ft) and 150 m (492 ft) above ground, the proposed maximum heights of the proposed wind turbines with blades oriented straight up. Nearby objects with known altitudes, such as the large communication tower and surrounding trees, were used to gauge flight altitudes. Information regarding the raptors' behavior, and whether a raptor was observed in the same locations throughout the survey period, was used to differentiate between migrant and resident birds. When possible, general flight paths and flight altitudes of individuals observed were plotted on topographic maps of the Project area.

Hourly weather observations, including wind speed, wind direction, temperature, percent cloud cover, and precipitation, were recorded on HMANA data sheets. Birds that flew too rapidly or were too far to accurately identify were recorded as unidentified to genus.

### 4.2.2 Data Analysis

Field observations were summarized by species for each survey day and for the whole survey period. This included a tally of the total number of individuals observed for each species, the observation rate (birds/hour), and an estimate of how many observations were suspected residents. The total number of birds, by species and by hour, was also calculated, as was the species composition of birds observed flying below and above 125 m (412 ft) and 150 m (492 ft). Finally, the mapped flight locations of individuals were reviewed to identify any overall patterns for migrating raptors.

Raptor observations from the Project area were compared to fall 2007 hawk watch count data (Appendix C, Table 4) from 14 sites (Figure 4-2); data are made available on the HMANA web site or from HMANA yearly reports. Comparisons were also made to 17 fall diurnal raptor surveys conducted from 1996 to 2006 that were publicly available for other wind projects through the northeast (Appendix C, Table 5).




Prepared By:

Stantec

WOODLOT

107239-F41-RaptorObsv.mxd

*Sheet Title:*

*Raptor Survey Location Map*

*Project:*

*Buckeye Wind Power Project, Ohio*



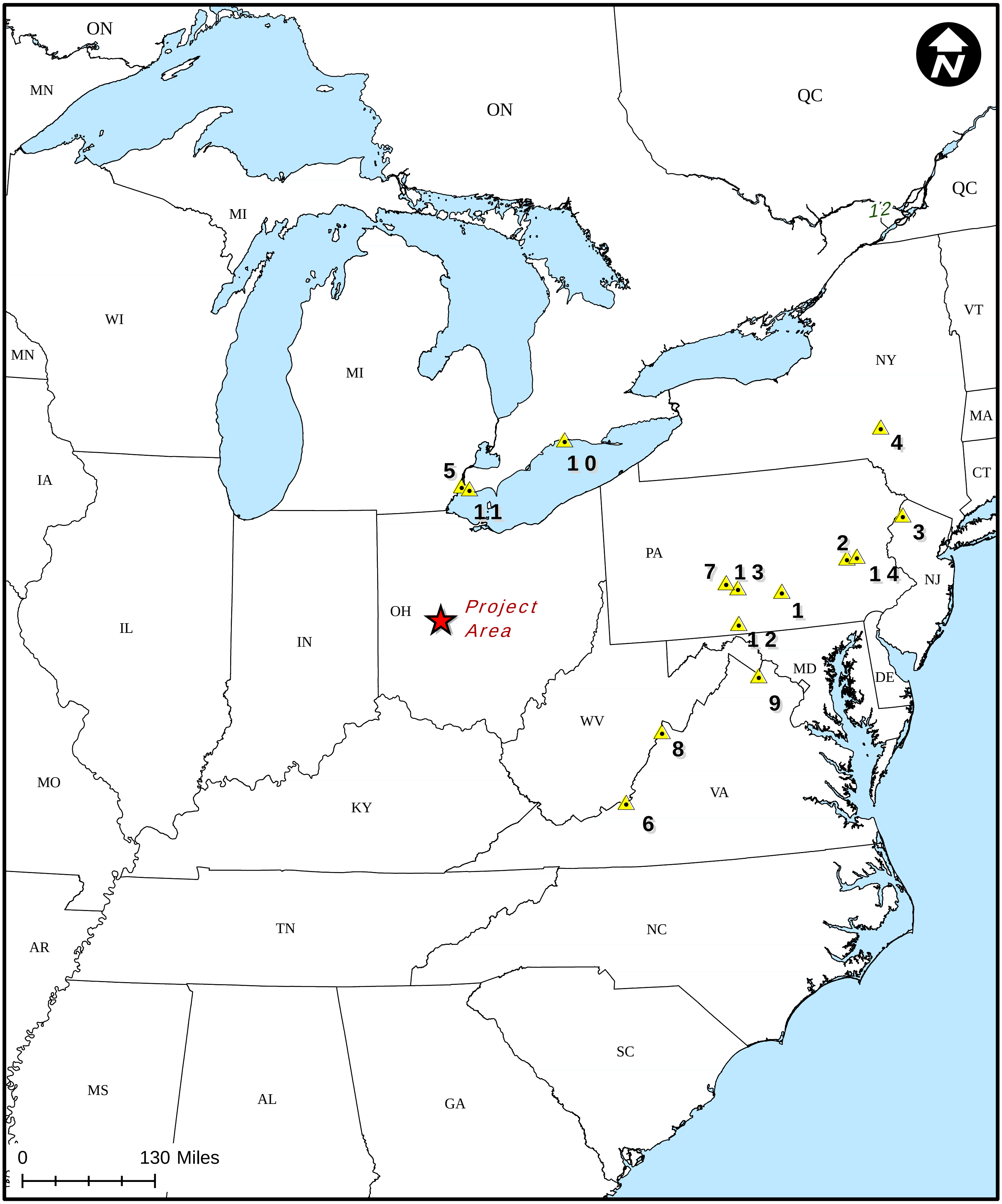
*Date:* *12/10/2007*

*Scale: 1" = 2 Miles*

*Proj. No.: 107239*

*Figure:*

*4-1*




Prepared By:

Stantec

WOODLOT

107239-F42-HawkWatch.mxd

Sheet Title:

Hawk Watch Observation Sites

Project:

Buckeye Wind Power Project



Date: January 2008

Scale: 1" = 130 Miles

Proj. No.: 107239

Figure:

4-2

## 4.3 RAPTOR RESULTS

Surveys were conducted on mostly clear to partly cloudy days with no precipitation, allowing for optimal visibility. The survey location had exceptional views, and birds were seen in all areas to the outer edges of the observer's capability. During the survey in August temperatures averaged 22 ºC (72 ºF) with moderate winds from the north and northeast. Temperatures ranged from 13 ºC to 33 ºC (55 to 91 ºF) during the five survey days in September, and from 11 ºC to 31ºC (52 to 88 ºF) during October, with an overall mean temperature of 23 ºC (73 ºF) during the entire 11 day survey period.

The development of thermals on survey days was evident as temperatures increased and cumulus clouds developed. Although days with predominantly north winds were targeted, winds were variable throughout the survey period. The majority of survey days had winds from the north or northwest, with a few days averaging more southwesterly winds, wind speed were generally moderate throughout the survey period (0 – 25 km/hr).

Surveys were conducted for a total of 66 hours during the 11 survey days. A total of 421 raptors, representing eight species, were observed during that time, yielding an overall observation rate of 6.4 birds/hour (Figure 4-3). Throughout the 11 survey days, the range of passage rates varied from 2.5 to 11.8 birds/hour. Daily count totals ranged from 15 to 67 raptors. The high count of 67 raptors occurred on September 28 when winds were moderate (1 – 11 km/hr) and predominantly northwest. Temperatures during this survey ranged from 20 ºC to 27 ºC (68 to 81 ºF).

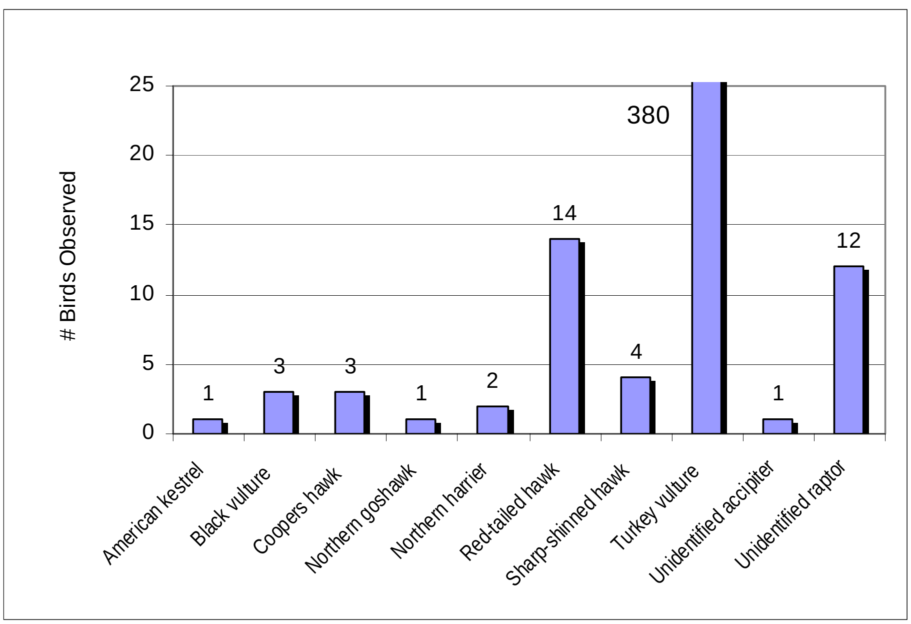



**Figure 4-3.** Species composition of raptors observed during raptor surveys fall 2007

Turkey vulture (*Cathartes aura)* [4] was by far the most abundant species observed in the area during the fall survey period (N=380, 90%). Red-tailed hawk (*Buteo jamaicensis*) was the second most commonly observed species accounting for 3 percent of the total observations (N=14). A number of unidentified raptors were seen; these were too far from the observer to accurately determine genus. Other species observed in low numbers included three species of accipiter [Cooper's hawk (*Accipiter cooperii*), sharp-shinned hawk (*Accipiter striatus*), and northern goshawk (*Accipiter gentilis*)]. A single American kestrel (*Falco sparverius*) and two northern harriers (*Circus cyaneus*) were seen hunting along some of the open pasturelands. Three black vultures (*Coragyps atratus*) were observed flying over the Project area. Of the species observed during the fall survey period, the northern harrier is state-listed as endangered, and the sharp-shinned hawk and black vulture are state species of concern (Ohio Department of Natural Resources 2007).

Three percent of all reported observations were of birds believed to be resident to the Project area. Most residents were repeatedly observed foraging and perching at consistently similar locations throughout the survey period. In these cases, a particular individual may have been observed flying back and forth across a section of hillside or perching in an area repeatedly during the same day or on more than one survey day. However, for the most part (97%), raptors that were observed were believed to be actively migrating southward. The high numbers of turkey vulture seen during the survey are believed to have been a combination of migrants and residents using the area prior to or during the onset of migration which typically occurs in October (Kirk and Mossman 1998). It is assumed that some specific food resource concentration may have been near the observation point and attracted increased turkey vulture activity.

In addition to varying daily counts, the timing of raptor observations varied within each survey day. On average, raptor counts throughout the season peaked between 10:00 and 11:00 (Figure 4-4). Observations of raptors declined as the day progressed (Appendix A, Table 2). This pattern was consistent for most of the species observed in the Project area.

Flight altitudes were categorized as below 125 m (412 ft) and below 150 m (492 ft), two approximate proposed altitudes for the turbines. Overall, 78 percent of the raptors observed were flying less than 125 m agl, and 84 percent were observed below 150 m agl. Differences in flight altitudes between species were observed (Figures 4-5 and 4-6). The mean flight altitude (n= 380) of turkey vultures was less than 28 m; with 78 percent flying below 125 m and 84 percent flying below 150 m. The mean flight altitude (n = 14) of red-tailed hawks was 166 m, with 50 percent flying below 125 m, and 58 percent flying below 150 m. The flight habits of raptors in the Project area were variable, though migrants were often in similar locations within the observable airspace.

[4] While turkey vultures are not true raptors, they are diurnal migrants that exhibit flight characteristics similar to hawks and other raptors and are typically included during hawk watch surveys.

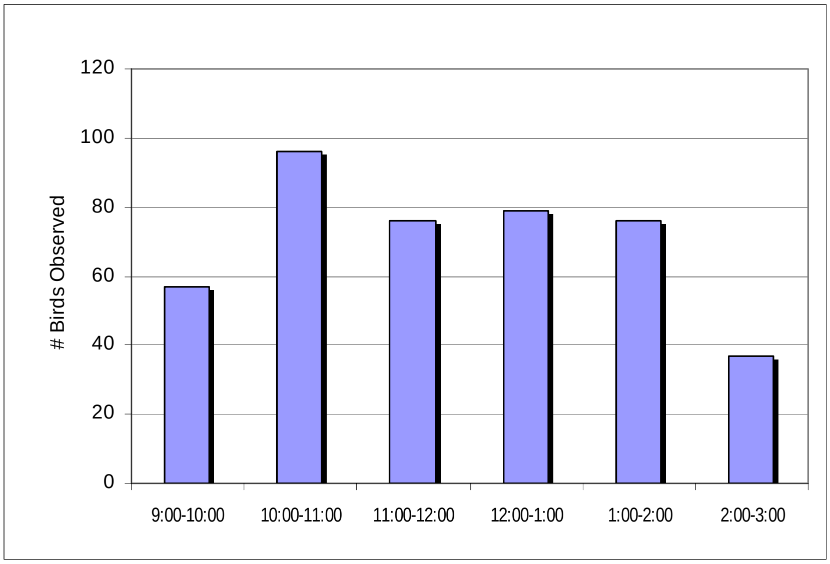



**Figure 4-4.** Hourly observation rates of raptors, fall 2007

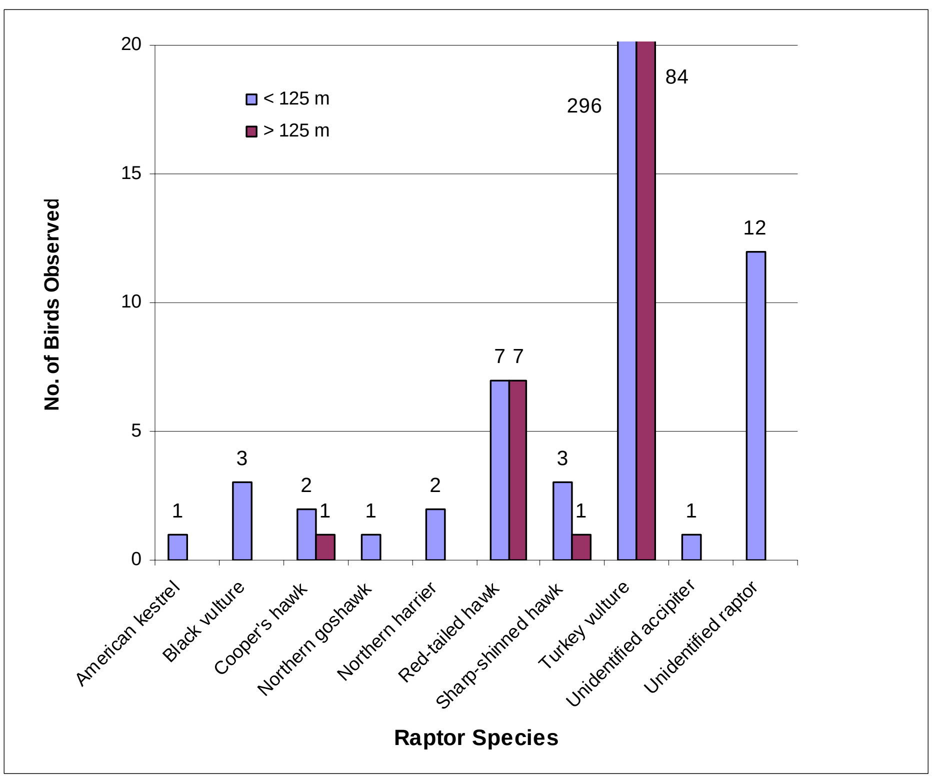



**Figure 4-5.** Summary of flight altitudes and number of individuals observed below 125 m during fall 2007 raptor migration surveys

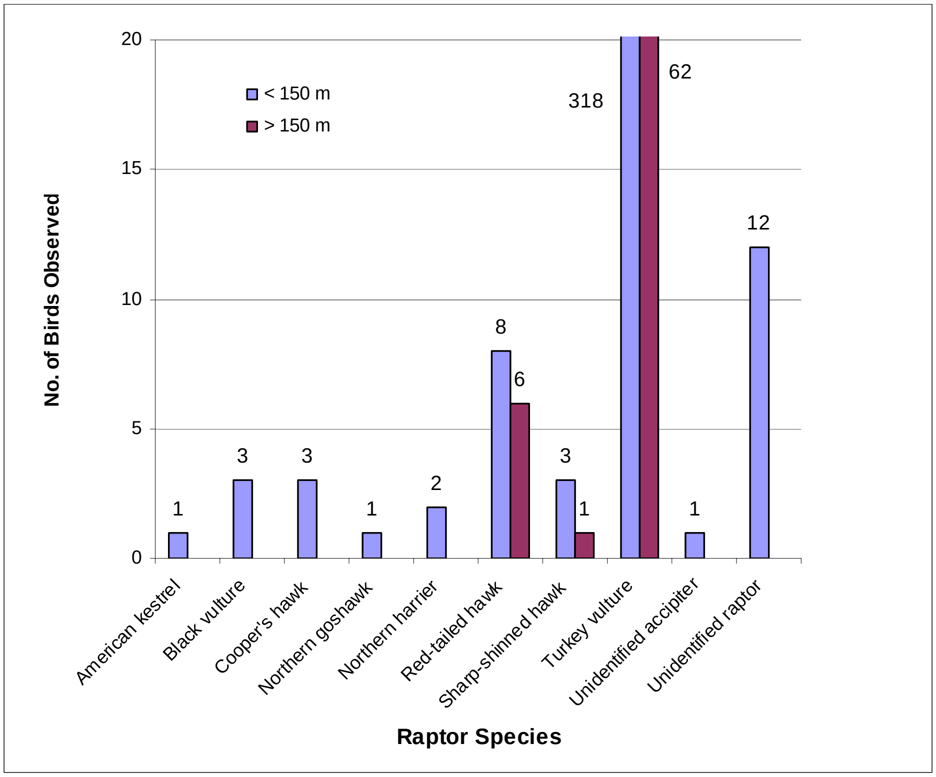



**Figure 4-6.** Summary of flight altitudes and number of individuals observed below 150 m during fall 2007 raptor migration surveys

## 4.4 RAPTOR DISCUSSION

A total of 421 individuals from eight different species of raptors were observed during 11 days and 66 hours of observation. Turkey vulture, which accounted for 90 percent of all raptor observations, was by far the most commonly observed species on site. Turkey vulture is considered one of the most common raptor species in the eastern United States (Wheeler 2003). No federally threatened or endangered species were observed during the diurnal raptor surveys. Two northern harriers (one adult, one juvenile), a state-listed endangered species, were observed on October 10, hunting the fields near the observation site. A total of four sharp-shinned hawks were also observed. Also, three black vultures were detected flying over the Project area. The sharp-shinned hawks and black vultures are state species of concern.

The overall number of raptors observed in the Project area was low relative to the numbers observed at regional hawk watch sites. Observation rates at regional hawk watch sites ranged from 6.4 to 261.4 birds/hour during fall 2007 (Appendix C, Table 4). The most active site was at SMRR Lake Erie, Metro Park, Michigan, which is also the closest hawk watch site to the Project area (Site No. 5, Figure 4-2). At SMRR, a total of 156,295 raptors were counted during 598 survey hours (261.4 birds/hour). This was likely due to the close proximity of the site to Lake Erie, which is historically known to concentrate large numbers of raptors. The passage rate of 6.4 birds/hour for the Buckeye raptor survey was among the lowest reported in the Central Continental Flyway (Appendix C, Table 4) during fall 2007. It is important to note that survey effort at most hawk watch sites is much greater than that of the surveys conducted at the proposed Buckeye Wind Project. The inclusion of hawk watch counts is considered a tool for comparison when other suitably comparable data are not available.

In addition to differing levels of effort, there are several potential reasons for the observed differences in passage rates between those observed in the Project area and at hawk watch sites in fall 2007. Geographic location can affect the magnitude of raptor migration occurring at a particular site. Sites that are located at prominent topographical points, such as Waggoner's Gap and Hawk Mountain, Pennsylvania, are situated along long ridgelines which tend to concentrate migrant use. Sites along Lake Erie and Lake Ontario also see a greater magnitude of migrants due to migration routes following shorelines. Organized hawk count locations typically target areas of known concentrated raptor migration activity. The lower passage rate at the Buckeye Project area is likely due to a lack of prominent landscape features that concentrate raptor migration.

When compared to 17 other publicly available raptor surveys conducted for wind projects with more comparable levels of effort than the hawk watch sites, the passage rate observed for the Buckeye Project (6.4 raptors/hour) was slightly above the average observed rate (mean = 4.4 ± 0.71). Passage rates for the 17 other surveys ranged from a low of 3.0 raptors/hour in Clinton County, New York in fall 2005, to a high of 12.72 raptors /hour in Bennington County, Vermont in fall 2004 (Appendix C, Table 5). Flight altitudes of raptors in the Project area indicate that percent of the raptors observed flying below 125 m, the height of most modern wind turbines, was similar to results of other fall raptor surveys for wind projects.

Differences between the average flight altitudes of different species were observed and could be due to differing flight altitude preferences, species behavior, or to limitations in species visibility. In general resident birds flew at lower altitudes than migrants because they typically undertake localized movements while foraging. Many residents were observed flying exclusively below the blade-swept area of proposed turbines (i.e. less than 40 m). Different species of raptors have a greater or lesser risk of collision with wind turbines, depending on various behavioral, stochastic, or environmental factors. For example, some species of raptors (e.g., northern goshawk and red-tailed hawk) migrate during time periods when thermal production is generally low and must rely on topographical features, such as side slopes and narrow ridge-tops that produce updrafts (Brandes 2005).

It is largely unknown what avoidance behavior raptors might exhibit when migrating near wind turbines. Unpublished observations of hawk migration activity at an existing facility in New England (Woodlot, unpublished data) indicate that the passage of small raptors (such as sharp-shinned hawks) often occurs below the blade-swept area of turbines, and the passage of larger raptors occurs well above the turbines. Birds have also been observed rising above operating turbines and then decreasing altitude between turbines. It is unclear if this type of presumed avoidance behavior would be characteristic of raptors in general or could be expected at other wind turbine facilities in North America.

## 4.5 RAPTOR CONCLUSIONS

The results of the field surveys indicate that fall raptor migration at the proposed Project is roughly average or low when compared to other sites in the region. It is likely that the geographical location of the Project area and its regional topography create conditions that are not optimal for raptor migration, causing relatively small concentrations of migrants flying through the Project area. Some raptors, specifically turkey vultures, use the Project area’s low relief hills to gain altitude via updrafts and thermals during migration, and likely hunt the open agricultural lands during seasonal movements. The frequent observation of turkey vultures relative to the other raptor species observed was notable but not unexpected. Turkey vultures have been known to historically occur in central Ohio in relatively high densities (Coles 1944). Regional hawk watch counts often indicate a high incidence of turkey vultures (Appendix C, Table 4).

In general, migrants observed passing near or through the Project area flew higher than resident birds. Migrating birds were consistently observed gaining altitude near hillsides before following straight flight paths south and southeast. Thus, it is presumed that they were taking advantage of thermals and updrafts flowing up these hillsides. Based on the flight paths of migrants observed, it is likely that the low relief hills, where most wind turbines are being proposed, receive low use by migrating raptors. However, actual collision risk to migrating raptors at modern wind facilities remains largely unknown. Raptor migration, and indeed all avian migration behavior, is a complex phenomenon dependent on a number of variables that can differ from year to year. By undertaking diurnal raptor surveys, however, a greater understanding of the site specific migration occurring in the Project area may be gained, and a baseline of raptor migration activity can be documented.

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# Appendix A

Radar survey results

**Appendix A Table 1.** Survey dates, results, level of effort, and weather at Buckeye Wind Project- Fall 2007

| Date | Passage rate | Flight Direction | Flight Altitude (m) | % below 125m | Hours of Survey | Temperature (c) | Wind Speed (m/s) | Wind Direction (from) |
|---|---|---|---|---|---|---|---|---|
| 9/5/2007 | 16 | 310 | 506 | 3% | 11 | 23.3 | 7.3 | 147 |
| 9/6/2007 | 95 | 84 | 455 | 1% | 11 | 23.4 | 5.9 | 194 |
| 9/9/2007 | 131 | 183 | 485 | 2% | 11 | 20.8 | 4.6 | 167 |
| 9/10/2007 | 404 | 291 | 466 | 5% | 11 | 21.9 | 4.0 | 55 |
| 9/11/2007 | 39 | 98 | 490 | 3% | 11 | 13.0 | 5.0 | 209 |
| 9/12/2007 | 34 | 238 | 395 | 8% | 10 | 11.7 | 6.3 | 356 |
| 9/13/2007 | 83 | 21 | 445 | 3% | 10 | 17.2 | 6.3 | 128 |
| 9/14/2007 | 12 | 231 | 444 | 2% | 11 | 9.7 | 5.9 | 264 |
| 9/15/2007 | 27 | 200 | 387 | 5% | 11 | 7.8 | 4.1 | 1 |
| 9/16/2007 | 14 | 321 | 284 | 31% | 11 | 10.0 | 5.9 | 120 |
| 9/17/2007 | 22 | 300 | 268 | 38% | 10 | 15.9 | 7.4 | 135 |
| 9/18/2007 | 30 | 310 | 421 | 1% | 11 | 19.3 | 6.9 | 156 |
| 9/21/2007 | 114 | 62 | 415 | 5% | 10 | 21.2 | 7.0 | 176 |
| 9/22/2007 | 135 | 202 | 376 | 3% | 11 | 16.7 | 7.0 | 270 |
| 9/23/2007 | 97 | 275 | 382 | 11% | 11 | 17.9 | 7.6 | 96 |
| 9/24/2007 | 135 | 208 | 409 | 5% | 11 | 23.9 | 6.0 | 158 |
| 9/25/2007 | 117 | 166 | 396 | 3% | 11 | 19.8 | 5.4 | 238 |
| 9/27/2007 | 42 | 147 | 399 | 1% | 11 | 13.3 | 5.0 | 281 |
| 10/1/2007 | 62 | 133 | 346 | 4% | 11 | 16.4 | 5.1 | 217 |
| 10/2/2007 | 88 | 42 | 382 | 4% | 11 | 20.0 | 8.0 | 231 |
| 10/3/2007 | 47 | 313 | 424 | 1% | 11 | 18.3 | 3.1 | 199 |
| 10/4/2007 | 59 | 290 | 408 | 5% | 11 | 22.3 | 5.6 | 170 |
| 10/5/2007 | 204 | 70 | 389 | 5% | 11 | 21.6 | 5.5 | 188 |
| 10/6/2007 | 72 | 98 | 396 | 2% | 11 | 22.5 | 3.6 | 207 |
| 10/7/2007 | 123 | 80 | 441 | 1% | 7 | 23.1 | 2.3 | 250 |
| 10/9/2007 | 14 | 144 | 378 | 3% | 10 | 13.5 | 5.8 | 278 |
| 10/10/2007 | 0 | -- | 252 | 15% | 11 | 7.2 | 5.0 | 299 |
| 10/11/2007 | 2 | 20 | 372 | 3% | 11 | 9.1 | 4.5 | 302 |
| 10/12/2007 | 9 | 95 | 292 | 4% | 9 | 4.8 | 2.9 | 334 |
| 10/13/2007 | 4 | 90 | 296 | 8% | 10 | 9.7 | 3.6 | 306 |
| Averages | **74** | **194** | **393** | **4%** | **318** | | | |

**Appendix A Table 2.** Passage rates by hour, night, and for entire season-Buckeye Wind Project- Fall 2007

| Night of | Passage Rate (targets/km/hr) by hour after sunset | | | | | | | | | | | | Entire Night | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Mean | Stdev | SE |
| 9/5/2007 | 0 | 21 | 64 | 4 | 21 | 0 | 0 | 21 | 14 | 9 | 21 | -- | **16** | 18 | 6 |
| 9/6/2007 | 163 | 171 | 257 | 193 | 129 | 43 | 14 | 7 | 39 | 21 | 5 | -- | **95** | 90 | 27 |
| 9/9/2007 | 77 | 200 | 274 | 253 | 250 | 121 | 36 | 193 | 43 | 86 | 0 | 43 | **131** | 98 | 29 |
| 9/10/2007 | 621 | 479 | 525 | 614 | 675 | 593 | 268 | 225 | 355 | 327 | 86 | 75 | **404** | 211 | 64 |
| 9/11/2007 | 11 | 11 | 21 | 0 | 79 | 171 | 54 | 43 | 21 | 21 | 0 | -- | **39** | 50 | 15 |
| 9/12/2007 | 21 | 21 | 46 | 43 | 54 | 34 | 40 | 43 | 21 | 54 | -- | 0 | **34** | 17 | 5 |
| 9/13/2007 | -- | 100 | 137 | 120 | 89 | 107 | 100 | 64 | 43 | 46 | 21 | -- | **83** | 37 | 12 |
| 9/14/2007 | 21 | 32 | 21 | 30 | 21 | 11 | 0 | 0 | 11 | 0 | 0 | 0 | **12** | 12 | 4 |
| 9/15/2007 | 86 | 50 | 51 | 34 | 11 | 29 | 14 | 7 | 0 | 11 | 0 | | **27** | 27 | 8 |
| 9/16/2007 | 54 | 11 | 7 | 34 | 14 | 0 | 10 | 21 | 5 | 0 | 7 | 0 | **14** | 16 | 5 |
| 9/17/2007 | 16 | 56 | 50 | 36 | 21 | 11 | 17 | 11 | 7 | -- | 14 | 0 | **22** | 18 | 6 |
| 9/18/2007 | 43 | 99 | 32 | 57 | 21 | 0 | 21 | 29 | 18 | 21 | 0 | 21 | **30** | 27 | 8 |
| 9/21/2007 | -- | 257 | 86 | 121 | 96 | 116 | 118 | 134 | 71 | 64 | 71 | -- | **114** | 56 | 18 |
| 9/22/2007 | 193 | 171 | 225 | 211 | 79 | 139 | 182 | 129 | 134 | 114 | 38 | 0 | **135** | 69 | 21 |
| 9/23/2007 | 77 | 139 | 171 | 93 | 118 | 171 | 150 | 75 | 43 | 0 | 64 | 64 | **97** | 54 | 16 |
| 9/24/2007 | 188 | 200 | 171 | 150 | 75 | 139 | 120 | 86 | 157 | 129 | 193 | 11 | **135** | 56 | 17 |
| 9/25/2007 | 182 | 257 | 94 | 188 | 300 | 60 | 68 | 50 | 64 | 114 | 32 | 0 | **117** | 94 | 28 |
| 9/27/2007 | 50 | 86 | 64 | 71 | 71 | 46 | 48 | 43 | 14 | 4 | 0 | 7 | **42** | 29 | 9 |
| 10/1/2007 | 29 | 43 | 43 | 59 | 86 | 94 | 114 | 96 | 21 | 39 | 64 | 54 | **62** | 30 | 9 |
| 10/2/2007 | 289 | 150 | 64 | 114 | 75 | 71 | 64 | 64 | 21 | 59 | 32 | 50 | **88** | 72 | 22 |
| 10/3/2007 | 27 | 79 | 107 | 75 | 36 | 43 | 64 | 27 | 21 | 21 | 34 | 34 | **47** | 27 | 8 |
| 10/4/2007 | 21 | 64 | 75 | 16 | 61 | 100 | 86 | 43 | 69 | 64 | 71 | 43 | **59** | 25 | 7 |
| 10/5/2007 | 193 | 343 | 129 | 321 | 266 | 307 | 230 | 204 | 118 | 139 | 139 | 54 | **204** | 92 | 28 |
| 10/6/2007 | 86 | 86 | 54 | 107 | 43 | 129 | 75 | 86 | 59 | 43 | 43 | 50 | **72** | 28 | 8 |
| 10/7/2007 | 73 | 124 | 134 | 132 | 150 | 152 | 95 | -- | -- | -- | -- | -- | **123** | 29 | 11 |
| 10/9/2007 | 50 | 43 | 13 | 34 | 0 | 0 | -- | 5 | 7 | 0 | 0 | 0 | **14** | 19 | 6 |
| 10/10/2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -- | **0** | 0 | 0 |
| 10/11/2007 | 11 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 4 | 0 | 0 | **2** | 4 | 1 |
| 10/12/2007 | 16 | 16 | 4 | 0 | 16 | 21 | -- | 9 | -- | 4 | 0 | 0 | **9** | 8 | 3 |
| 10/13/2007 | 0 | 11 | -- | 0 | 5 | 5 | 16 | 0 | 0 | 0 | 0 | 4 | **4** | 5 | 2 |
| **Entire Season** | **93** | **111** | **101** | **104** | **95** | **91** | **72** | **59** | **49** | **50** | **33** | **23** | **74** | **81** | **15** |

**Appendix A Table 3.** Mean Nightly Flight Direction at Buckeye Wind Project - Fall 2007

| Night of | Mean Flight Direction | Circular Standard Deviation |
|---|---|---|
| 9/5/2007 | 310.397° | 114.1° |
| 9/6/2007 | 84.273° | 81.796° |
| 9/9/2007 | 182.629° | 67.207° |
| 9/10/2007 | 291.257° | 86.237° |
| 9/11/2007 | 98.056° | 79.951° |
| 9/12/2007 | 237.977° | 72.835° |
| 9/13/2007 | 21.461° | 69.91° |
| 9/14/2007 | 231.471° | 74.965° |
| 9/15/2007 | 200.248° | 86.27° |
| 9/16/2007 | 320.784° | 109.408° |
| 9/17/2007 | 299.784° | 57.714° |
| 9/18/2007 | 310.024° | 58.705° |
| 9/21/2007 | 61.874° | 82.683° |
| 9/22/2007 | 201.964° | 56.166° |
| 9/23/2007 | 274.886° | 83.704° |
| 9/24/2007 | 208.015° | 152.866° |
| 9/25/2007 | 166.478° | 90.017° |
| 9/27/2007 | 147.363° | 65.029° |
| 10/1/2007 | 133.157° | 64.56° |
| 10/2/2007 | 42.116° | 95.886° |
| 10/3/2007 | 313.464° | 106.266° |
| 10/4/2007 | 289.812° | 105.202° |
| 10/5/2007 | 69.693° | 101.872° |
| 10/6/2007 | 97.799° | 113.082° |
| 10/7/2007 | 79.557° | 101.863° |
| 10/9/2007 | 143.651° | 56.563° |
| 10/11/2007 | 20° | 74.131° |
| 10/12/2007 | 95.05° | 77.796° |
| 10/13/2007 | 90° | ***** |
| **Entire Season** | **194** | **144** |

**Appendix A Table 4. Summary of mean flight altitudes by hour, night, and for entire season at Buckeye Wind Project - Fall 2007**

| Night of | Mean Flight Altitude (m) by hour after sunset | | | | | | | | | | | | Entire Night | | | % of targets below 125 meters | % of targets below 150 meters |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Mean | STDV | SE | | |
| 9/5/07 | 329 | 460 | 454 | 506 | 592 | 609 | 609 | 553 | 437 | 573 | 448 | -- | 506 | 89 | 27 | 3% | 4% |
| 9/6/07 | 419 | 439 | 483 | 425 | 420 | -- | 459 | 514 | 459 | 448 | 481 | -- | 455 | 31 | 10 | 1% | 2% |
| 9/9/07 | 495 | 539 | 526 | 502 | 437 | 557 | 489 | 459 | 450 | 466 | 421 | -- | 485 | 43 | 13 | 2% | 2% |
| 9/10/07 | 374 | 453 | 501 | 499 | 499 | 527 | -- | 438 | 430 | 365 | 316 | 720 | 466 | 107 | 32 | 5% | 8% |
| 9/11/07 | 388 | 562 | 607 | 542 | 539 | 523 | 491 | 481 | 433 | 405 | 414 | -- | 490 | 72 | 22 | 3% | 4% |
| 9/12/07 | 388 | 532 | 408 | 407 | 452 | 385 | 368 | 443 | 461 | 466 | 408 | 20 | 395 | 126 | 36 | 8% | 10% |
| 9/13/07 | 357 | 495 | 520 | 442 | 544 | 463 | 447 | 400 | 401 | 434 | 389 | -- | 445 | 58 | 17 | 3% | 3% |
| 9/14/07 | 506 | 549 | 431 | 459 | 453 | 434 | 442 | 431 | 395 | 363 | 418 | -- | 444 | 50 | 15 | 2% | 2% |
| 9/15/07 | 289 | 417 | 445 | 374 | 438 | 410 | 382 | 416 | 364 | 416 | 302 | -- | 387 | 52 | 16 | 5% | 5% |
| 9/16/07 | 92 | 149 | 254 | 405 | 530 | 204 | 479 | 368 | 182 | -- | 174 | -- | 284 | 151 | 48 | 31% | 33% |
| 9/17/07 | 158 | 373 | 302 | 218 | 217 | 179 | 239 | -- | 468 | 325 | 350 | 117 | 268 | 105 | 32 | 38% | 38% |
| 9/18/07 | 407 | 477 | 394 | 331 | 512 | 406 | 477 | 409 | 443 | 415 | 363 | -- | 421 | 53 | 16 | 1% | 2% |
| 9/21/07 | 460 | 545 | 420 | 451 | 434 | 419 | 401 | 350 | 375 | 364 | 353 | 405 | 415 | 55 | 16 | 5% | 7% |
| 9/22/07 | 435 | 474 | 476 | 425 | 386 | 401 | 379 | 315 | 321 | 321 | 329 | 255 | 376 | 69 | 20 | 3% | 6% |
| 9/23/07 | 448 | 399 | -- | 413 | 386 | 365 | 370 | 333 | 504 | 533 | 132 | 319 | 382 | 106 | 32 | 11% | 14% |
| 9/24/07 | 379 | 492 | 507 | 541 | 454 | 393 | 416 | 395 | 338 | 308 | 321 | 365 | 409 | 75 | 22 | 5% | 5% |
| 9/25/07 | 309 | -- | 459 | 371 | 374 | 421 | 411 | 412 | 365 | 380 | 420 | 431 | 396 | 41 | 12 | 3% | 5% |
| 9/27/07 | 401 | 479 | 471 | 492 | 458 | 393 | 432 | 418 | 378 | 351 | 301 | 216 | 399 | 80 | 23 | 1% | 2% |
| 10/1/07 | 297 | 375 | 367 | 292 | 349 | 391 | 401 | 359 | 359 | 314 | 300 | -- | 346 | 39 | 12 | 4% | 5% |
| 10/2/07 | 340 | 376 | 396 | 396 | 404 | 362 | 365 | 392 | 394 | 417 | 331 | 414 | 382 | 28 | 8 | 4% | 4% |
| 10/3/07 | 200 | 402 | 418 | 426 | 472 | 490 | 519 | 481 | 448 | 386 | 446 | 404 | 424 | 81 | 23 | 1% | 3% |
| 10/4/07 | 318 | 457 | 441 | 455 | 456 | 376 | 420 | 399 | 496 | 341 | 361 | 380 | 408 | 54 | 16 | 5% | 7% |
| 10/5/07 | 401 | 390 | 391 | 399 | 411 | 382 | 448 | 384 | 382 | 410 | 356 | 318 | 389 | 32 | 9 | 5% | 7% |
| 10/6/07 | 310 | 427 | 406 | 399 | 329 | 405 | 402 | 482 | 361 | 410 | 456 | 367 | 396 | 49 | 14 | 2% | 3% |
| 10/7/07 | 345 | 452 | 447 | 505 | 457 | 443 | 438 | -- | -- | -- | -- | -- | 441 | 48 | 18 | 1% | 3% |
| 10/9/07 | 359 | 410 | 362 | 427 | 431 | 338 | 458 | 414 | 414 | 391 | 322 | 209 | 378 | 67 | 19 | 3% | 5% |
| 10/10/07 | 95 | 307 | 272 | 312 | 486 | 163 | 134 | 549 | 275 | 230 | 95 | 111 | 252 | 148 | 43 | 15% | 19% |
| 10/11/07 | -- | 360 | 372 | 356 | 387 | 366 | 413 | 341 | 374 | 370 | 371 | 381 | 372 | 18 | 6 | 3% | 4% |
| 10/12/07 | 265 | 293 | 315 | 304 | 302 | 268 | 295 | 321 | 272 | 317 | 260 | -- | 292 | 22 | 7 | 4% | 6% |
| 10/13/07 | 158 | 291 | 283 | 406 | 323 | 384 | 375 | 187 | 308 | 276 | 299 | 268 | 296 | 73 | 21 | 8% | 8% |
| Entire Season | 335 | 427 | 418 | 416 | 431 | 395 | 412 | 409 | 389 | 386 | 343 | 317 | 393 | 35 | 10 | 4% | 5% |

-- Indicates no data for that hour.

| **Appendix A Table 5.** Survey dates, results, level of effort, and weather at Buckeye Wind Project- Fall 2007 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Night of** | **Radar Results** | | | **Ceilometer Results** | | | | **Weather Conditions** | | |
| | **Possible Bird Targets** | **Possible Bat Targets** | **Likely Insects** | **# of Obs Periods** | **Birds** | **Bats** | **Insects** | **Temp** | **Wind Speed (m/s)** | **Wind Direction (from)** |
| 9/5/2007 | 100% | 0% | 0% | n/a | n/a | n/a | n/a | 23.3 | 7.3 | 147 |
| 9/6/2007 | 100% | 0% | 0% | 11 | 1 | 4 | 511 | 23.4 | 5.9 | 194 |
| 9/9/2007 | 100% | 0% | 0% | 11 | 1 | 3 | 396 | 20.8 | 4.6 | 167 |
| 9/10/2007 | 100% | 0% | 0% | 11 | 0 | 1 | 557 | 21.9 | 4.0 | 55 |
| 9/11/2007 | 98% | 2% | 0% | 11 | 0 | 1 | 463 | 13.0 | 5.0 | 209 |
| 9/12/2007 | 97% | 3% | 14% | 11 | 0 | 0 | 359 | 11.7 | 6.3 | 356 |
| 9/13/2007 | 100% | 0% | 0% | 11 | 0 | 0 | 327 | 17.2 | 6.3 | 128 |
| 9/14/2007 | 100% | 0% | 0% | 11 | 0 | 0 | 357 | 9.7 | 5.9 | 264 |
| 9/15/2007 | 98% | 2% | 0% | 11 | 0 | 0 | 49 | 7.8 | 4.1 | 1 |
| 9/16/2007 | 100% | 0% | 0% | 11 | 0 | 0 | 69 | 10.0 | 5.9 | 120 |
| 9/17/2007 | 100% | 0% | 0% | 11 | 0 | 0 | 107 | 15.9 | 7.4 | 135 |
| 9/18/2007 | 100% | 0% | 0% | 11 | 0 | 0 | 278 | 19.3 | 6.9 | 156 |
| 9/21/2007 | 111% | 0% | 0% | 11 | 0 | 0 | 516 | 21.2 | 7.0 | 176 |
| 9/22/2007 | 100% | 0% | 0% | 11 | 0 | 0 | 448 | 16.7 | 7.0 | 270 |
| 9/23/2007 | 100% | 0% | 0% | 11 | 0 | 0 | 399 | 17.9 | 7.6 | 96 |
| 9/24/2007 | 100% | 0% | 0% | 11 | 0 | 0 | 417 | 23.9 | 6.0 | 158 |
| 9/25/2007 | 99% | 1% | 0% | 11 | 0 | 0 | 185 | 19.8 | 5.4 | 238 |
| 9/27/2007 | 100% | 0% | 0% | 11 | 0 | 0 | 225 | 13.3 | 5.0 | 281 |
| 10/1/2007 | 99% | 1% | 0% | 11 | 0 | 0 | 239 | 16.4 | 5.1 | 217 |
| 10/2/2007 | 100% | 0% | 0% | n/a | n/a | n/a | n/a | 20.0 | 8.0 | 231 |
| 10/3/2007 | 100% | 0% | 0% | 11 | 0 | 1 | 324 | 18.3 | 3.1 | 199 |
| 10/4/2007 | 100% | 0% | 0% | 11 | 0 | 0 | 288 | 22.3 | 5.6 | 170 |
| 10/5/2007 | 99% | 1% | 0% | 11 | 0 | 0 | 285 | 21.6 | 5.5 | 188 |
| 10/6/2007 | 100% | 0% | 0% | 11 | 0 | 0 | 257 | 22.5 | 3.6 | 207 |
| 10/7/2007 | 100% | 0% | 0% | 3 | 0 | 0 | 169 | 23.1 | 2.3 | 250 |
| 10/9/2007 | 100% | 0% | 0% | 11 | 0 | 0 | 472 | 13.5 | 5.8 | 278 |
| 10/10/2007 | n/a | n/a | n/a | 10 | 0 | 0 | 75 | 7.2 | 5.0 | 299 |
| 10/11/2007 | 100% | 0% | 0% | 11 | 0 | 0 | 114 | 9.1 | 4.5 | 302 |
| 10/12/2007 | 100% | 0% | 0% | n/a | n/a | n/a | n/a | 4.8 | 2.9 | 334 |
| 10/13/2007 | 100% | 0% | 0% | n/a | n/a | n/a | n/a | 9.7 | 3.6 | 306 |
| **Total** | **100%** | **0%** | **0%** | **277** | **2** | **10** | **7886** | **17** | **5** | **204** |

# Appendix B

Bat survey results

**Appendix B Table 1**. Summary of acoustic bat data and weather during each survey night at the North High detector – Fall 2007

| | | **BBSHHB** | | | | **RBEP** | | | **MYSP** | **UNKN** | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Night of** | **Operated Okay?** | **big brown bat** | **hoary bat** | **silver-haired bat** | **silver-haired/big brown** | **eastern pipistrelle** | **eastern red bat** | **pipistrelle/red bat** | **MYSP** | **high-frequency** | **low-frequency** | **unknown** | **Total** | **Wind Speed (m/s)** | **Relative Humidity (%)** | **Temperature (celsius)** |
| 8/28/07 | Y | | | | | | | | | | 1 | | **1** | 5.2 | n/a | 23.7 |
| 8/29/07 | Y | | 2 | | | | | | | | 1 | | **3** | 4.6 | n/a | 23.8 |
| 8/30/07 | Y | | | | 1 | | | | | | | | **1** | 6.6 | n/a | 16.5 |
| 8/31/07 | Y | | | | | | | | | | | | **0** | 7.4 | n/a | 15.9 |
| 9/1/07 | Y | | | | | | | | | | 1 | | **1** | 6.3 | 47.3 | 16.9 |
| 9/2/07 | Y | | | | | | | | | | | | **0** | 2.4 | 45.9 | 18.5 |
| 9/3/07 | Y | | 1 | | 1 | | | | | | 1 | | **3** | 3.7 | 49.7 | 21.2 |
| 9/4/07 | Y | | | | 1 | | | | | | 2 | | **3** | 3.2 | 34.0 | 22.2 |
| 9/5/07 | Y | | 1 | | | | | | | | 1 | | **2** | 7.3 | 35.7 | 23.3 |
| 9/6/07 | Y | | | | | | | | | | 2 | | **2** | 5.9 | 45.4 | 23.4 |
| 9/7/07 | Y | | | | | | | | 1 | | | | **1** | 6.3 | 46.5 | 21.5 |
| 9/8/07 | Y | | | | | | | | | | | | **0** | 4.7 | 52.5 | 19.8 |
| 9/9/07 | Y | | | | | | | | | | 1 | | **1** | 4.6 | 48.4 | 20.8 |
| 9/10/07 | Y | | | | 3 | | | | | | 2 | | **5** | 4.0 | 54.0 | 21.9 |
| 9/11/07 | Y | | | | 3 | | | 1 | | | 1 | | **5** | 5.0 | 46.5 | 13.0 |
| 9/12/07 | N | | | | | | | | | | | | **n/a** | 6.3 | 85.7 | 11.7 |
| 9/13/07 | N | | | | | | | | | | | | **n/a** | 6.3 | 56.7 | 17.2 |
| 9/14/07 | N | | | | | | | | | | | | **n/a** | 5.9 | 78.7 | 9.7 |
| 9/15/07 | N | | | | | | | | | | | | **n/a** | 4.1 | 77.1 | 7.8 |
| 9/16/07 | N | | | | | | | | | | | | **n/a** | 5.9 | 76.7 | 10.0 |
| 9/17/07 | N | | | | | | | | | | | | **n/a** | 7.4 | 59.4 | 15.9 |
| 9/18/07 | N | | | | | | | | | | | | **n/a** | 6.9 | 58.4 | 19.3 |
| 9/19/07 | N | | | | | | | | | | | | **n/a** | 3.6 | 59.3 | 20.2 |
| 9/20/07 | N | | | | | | | | | | | | **n/a** | 5.8 | 86.1 | 20.0 |
| 9/21/07 | N | | | | | | | | | | | | **n/a** | 7.0 | 64.6 | 21.2 |
| 9/22/07 | N | | | | | | | | | | | | **n/a** | 7.0 | 64.8 | 16.7 |
| 9/23/07 | Y | | | | 3 | | | | | | 1 | | **4** | 7.6 | 57.8 | 17.9 |
| 9/24/07 | Y | | | | 5 | | | | | | 2 | | **7** | 6.0 | 64.0 | 23.9 |
| 9/25/07 | Y | | | | 10 | | | | | | 3 | | **13** | 5.4 | 92.8 | 19.8 |
| 9/26/07 | Y | | | | 4 | | | | | | 1 | | **5** | 3.7 | 98.6 | 19.1 |
| 9/27/07 | Y | | | | | | | 1 | | | | | **1** | 5.0 | 89.6 | 13.3 |
| 9/28/07 | Y | | | | | | | | | | | | **0** | 5.1 | 70.3 | 13.0 |
| 9/29/07 | Y | | | | 1 | | | | | | 1 | | **2** | 7.4 | 69.5 | 14.7 |
| 9/30/07 | Y | | | | | | | | | | | | **0** | 8.0 | 51.9 | 18.3 |
| 10/1/07 | Y | | | | 3 | | | | | | 1 | | **4** | 5.1 | 74.0 | 16.4 |
| 10/2/07 | Y | | | | 1 | | | | | | | | **1** | 8.0 | 68.9 | 20.0 |
| 10/3/07 | Y | | | | | | | | | | | | **0** | 3.1 | 80.9 | 18.3 |
| 10/4/07 | Y | | | | 6 | | | | | | 2 | | **8** | 5.6 | 75.9 | 22.3 |
| 10/5/07 | Y | | | | 6 | | | | | | 3 | | **9** | 5.5 | 80.9 | 21.6 |
| 10/6/07 | Y | | | | 8 | | | | | 1 | 3 | | **12** | 3.6 | 73.9 | 22.5 |
| 10/7/07 | Y | | | | 2 | | | | | | 2 | | **4** | 2.3 | 70.3 | 23.1 |
| 10/8/07 | Y | | | | 26 | | | | | | 15 | | **41** | 6.0 | 68.3 | 21.1 |
| 10/9/07 | Y | | | | 2 | | | | | | | | **2** | 5.8 | 65.6 | 13.5 |
| 10/10/07 | Y | | | | | | | | | | | | **0** | 5.0 | 79.4 | 7.2 |
| 10/11/07 | Y | | | | | | | | | | | | **0** | 4.5 | 85.1 | 9.1 |
| 10/12/07 | Y | | | | | | | | | | 1 | | **1** | 2.9 | 81.5 | 4.8 |
| 10/13/07 | Y | | | | | | | | | | | | **0** | 3.6 | 69.0 | 9.7 |
| 10/14/07 | Y | | | | | | | | | | | | **0** | 7.6 | 72.4 | 13.4 |
| 10/15/07 | Y | | | | | | | | | 1 | | | **1** | 6.8 | 64.6 | 17.3 |
| 10/16/07 | Y | | | | 1 | | | | | | 1 | | **2** | 4.7 | 98.0 | 15.9 |
| 10/17/07 | Y | | | | 5 | | | | | 1 | 1 | | **7** | 7.5 | 88.1 | 18.3 |
| 10/18/07 | Y | | | | 1 | | | | | | | | **1** | 9.8 | 85.8 | 19.7 |
| 10/19/07 | Y | | | | | | | 1 | | 3 | | | **4** | 7.7 | 80.6 | 12.4 |
| 10/20/07 | Y | | | | | | | 1 | | | | | **1** | 8.8 | 55.5 | 13.8 |
| 10/21/07 | Y | | | | | | | | | | | | **0** | 8.5 | 49.3 | 16.5 |
| 10/22/07 | Y | | | | | | | | | 4 | | | **4** | 5.0 | 98.0 | 15.4 |
| 10/23/07 | Y | | | | 3 | | | 1 | | 1 | 4 | | **9** | 3.3 | 97.9 | 8.5 |
| 10/24/07 | Y | | | | 1 | | | | | 1 | 1 | | **3** | 9.2 | 91.2 | 7.3 |
| 10/25/07 | Y | | | | | | | | | | | | **0** | 6.9 | 50.6 | 12.9 |
| 10/26/07 | Y | | | | | | | | | | | | **0** | 6.8 | 40.6 | 11.4 |
| 10/27/07 | Y | | | | | | | | | | | | **0** | 5.0 | 47.1 | 5.6 |
| 10/28/07 | Y | | | | | | | | | 1 | | | **1** | 3.0 | 40.1 | 4.8 |
| 10/29/07 | Y | | | | | | | | | 1 | | | **1** | 5.3 | n/a | 5.6 |
| **By Species** | | **0** | **4** | **0** | **97** | **0** | **0** | **5** | **1** | **14** | **55** | **0** | **176** | **n/o indicates detector was not operating on that night** | | |
| **By Guild** | | **101** | | | | **5** | | | **1** | **69** | | | | | | |
| | | **BBSHHB** | | | | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | |

**Appendix B Table 2.** Summary of acoustic bat data and weather during each survey night at the North Low detector – Fall 2007

| | | BBSHHB | | | | RBEP | | | MYSP | UNKN | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Night of** | **Operated Okay?** | **big brown bat** | **hoary bat** | **silver-haired bat** | **silver-haired/big brown** | **eastern pipistrelle** | **eastern red bat** | **pipistrelle/red bat** | **MYSP** | **high-frequency** | **low-frequency** | **unknown** | **Total** | **Wind Speed (m/s)** | **Relative Humidity (%)** | **Temperature (celsius)** |
| 8/28/07 | Y | | | | 2 | | | 1 | | 4 | 4 | | **11** | 5.2 | n/a | 23.7 |
| 8/29/07 | Y | | | | 1 | | | | 1 | 2 | 2 | | **6** | 4.6 | n/a | 23.8 |
| 8/30/07 | Y | | | | | | | | | 1 | | | **1** | 6.6 | n/a | 16.5 |
| 8/31/07 | Y | | | | | | | | 2 | 3 | | | **5** | 7.4 | n/a | 15.9 |
| 9/1/07 | Y | | | | 1 | | | | | 1 | | | **2** | 6.3 | 47.3 | 16.9 |
| 9/2/07 | Y | | 1 | | 1 | | | 1 | | 2 | 1 | | **6** | 2.4 | 45.9 | 18.5 |
| 9/3/07 | Y | | | | | | | | | | 1 | | **1** | 3.7 | 49.7 | 21.2 |
| 9/4/07 | Y | | | 1 | 1 | | | | | | | | **2** | 3.2 | 34.0 | 22.2 |
| 9/5/07 | Y | | | | | | | | | | | | **0** | 7.3 | 35.7 | 23.3 |
| 9/6/07 | Y | | | | 2 | | | | | 2 | 2 | | **6** | 5.9 | 45.4 | 23.4 |
| 9/7/07 | Y | | | | | | | | | 2 | | | **2** | 6.3 | 46.5 | 21.5 |
| 9/8/07 | Y | | | | | | | | | | | | **0** | 4.7 | 52.5 | 19.8 |
| 9/9/07 | Y | | | | 1 | | | 1 | | 3 | | | **5** | 4.6 | 48.4 | 20.8 |
| 9/10/07 | Y | | 1 | | 5 | | | 1 | | 3 | 4 | | **14** | 4.0 | 54.0 | 21.9 |
| 9/11/07 | Y | | | | 6 | | | | | | 2 | | **8** | 5.0 | 46.5 | 13.0 |
| 9/12/07 | Y | | | | | | | 1 | | | 2 | | **3** | 6.3 | 85.7 | 11.7 |
| 9/13/07 | Y | | | | 2 | | | | | 1 | 2 | | **5** | 6.3 | 56.7 | 17.2 |
| 9/14/07 | Y | | | | | | | | | | 2 | | **2** | 5.9 | 78.7 | 9.7 |
| 9/15/07 | Y | | | | | | | | | 2 | | | **2** | 4.1 | 77.1 | 7.8 |
| 9/16/07 | Y | | | | | | | | | | | | **0** | 5.9 | 76.7 | 10.0 |
| 9/17/07 | Y | | | | | | | | | | | | **0** | 7.4 | 59.4 | 15.9 |
| 9/18/07 | Y | | | | | | | | | | | | **0** | 6.9 | 58.4 | 19.3 |
| 9/19/07 | Y | | | | | | | | | | 2 | | **2** | 3.6 | 59.3 | 20.2 |
| 9/20/07 | Y | | | | 2 | | | | | | | | **2** | 5.8 | 86.1 | 20.0 |
| 9/21/07 | Y | | | | 2 | | | 1 | | | 1 | | **4** | 7.0 | 64.6 | 21.2 |
| 9/22/07 | Y | | | | | | | | | | 1 | | **1** | 7.0 | 64.8 | 16.7 |
| 9/23/07 | Y | | | | 4 | | | | | | 1 | | **5** | 7.6 | 57.8 | 17.9 |
| 9/24/07 | Y | | | | 5 | | | | | 3 | 3 | | **11** | 6.0 | 64.0 | 23.9 |
| 9/25/07 | Y | | | | 7 | | | 1 | | 1 | 2 | | **11** | 5.4 | 92.8 | 19.8 |
| 9/26/07 | Y | | | | 1 | | | 1 | | 2 | 1 | | **5** | 3.7 | 98.6 | 19.1 |
| 9/27/07 | Y | | | | 2 | | | | | 3 | 1 | | **6** | 5.0 | 89.6 | 13.3 |
| 9/28/07 | Y | | | | | | | | | | | | **0** | 5.1 | 70.3 | 13.0 |
| 9/29/07 | Y | | | | 4 | | | | | | | | **4** | 7.4 | 69.5 | 14.7 |
| 9/30/07 | Y | | | | 1 | | | | | | 1 | | **2** | 8.0 | 51.9 | 18.3 |
| 10/1/07 | Y | | | | 4 | | | | | | | | **4** | 5.1 | 74.0 | 16.4 |
| 10/2/07 | Y | | | | 5 | | | 1 | | | 1 | | **7** | 8.0 | 68.9 | 20.0 |
| 10/3/07 | Y | | | | 5 | | | | | | 4 | | **9** | 3.1 | 80.9 | 18.3 |
| 10/4/07 | Y | | | | 9 | | | | | 1 | 1 | | **11** | 5.6 | 75.9 | 22.3 |
| 10/5/07 | Y | | | | 6 | | | | | | 4 | | **10** | 5.5 | 80.9 | 21.6 |
| 10/6/07 | Y | | | | 9 | | | | | | 4 | | **13** | 3.6 | 73.9 | 22.5 |
| 10/7/07 | Y | | | | 7 | | | | | | 4 | | **11** | 2.3 | 70.3 | 23.1 |
| 10/8/07 | Y | | | | 22 | | | | | 1 | 12 | | **35** | 6.0 | 68.3 | 21.1 |
| 10/9/07 | Y | | | | 1 | | | | | 1 | 4 | | **6** | 5.8 | 65.6 | 13.5 |
| 10/10/07 | Y | | | | | | | | | | | | **0** | 5.0 | 79.4 | 7.2 |
| 10/11/07 | Y | | | | 1 | | | | | | | | **1** | 4.5 | 85.1 | 9.1 |
| 10/12/07 | Y | | | | | | | | | 2 | | | **2** | 2.9 | 81.5 | 4.8 |
| 10/13/07 | Y | | | | 1 | | | | | 2 | 1 | | **4** | 3.6 | 69.0 | 9.7 |
| 10/14/07 | Y | | | | | | | 1 | | | | | **1** | 7.6 | 72.4 | 13.4 |
| 10/15/07 | Y | | | | 2 | | | | | 2 | | | **4** | 6.8 | 64.6 | 17.3 |
| 10/16/07 | Y | | | | | | | | | 2 | 1 | | **3** | 4.7 | 98.0 | 15.9 |
| 10/17/07 | Y | | | | 6 | | | | | | | | **6** | 7.5 | 88.1 | 18.3 |
| 10/18/07 | Y | | | | | | | | | | 1 | | **1** | 9.8 | 85.8 | 19.7 |
| 10/19/07 | Y | | | | 1 | | | | | 1 | 1 | | **3** | 7.7 | 80.6 | 12.4 |
| 10/20/07 | Y | | | | | | | | | | | | **0** | 8.8 | 55.5 | 13.8 |
| 10/21/07 | Y | | | | | | | 1 | | | | | **1** | 8.5 | 49.3 | 16.5 |
| 10/22/07 | Y | | | | | | | | | | | | **0** | 5.0 | 98.0 | 15.4 |
| 10/23/07 | Y | | | | 2 | | | 2 | | 2 | 3 | | **9** | 3.3 | 97.9 | 8.5 |
| 10/24/07 | N | | | | | | | | | | | | n/a | 9.2 | 91.2 | 7.3 |
| 10/25/07 | N | | | | | | | | | | | | n/a | 6.9 | 50.6 | 12.9 |
| 10/26/07 | N | | | | | | | | | | | | n/a | 6.8 | 40.6 | 11.4 |
| 10/27/07 | N | | | | | | | | | | | | n/a | 5.0 | 47.1 | 5.6 |
| 10/28/07 | N | | | | | | | | | | | | n/a | 3.0 | 40.1 | 4.8 |
| **By Species** | | **0** | **2** | **1** | **131** | **0** | **0** | **13** | **3** | **49** | **76** | **0** | **275** | **n/o indicates detector not operating on that night** | | |
| **By Guild** | | **134** | | | | **13** | | | **3** | **125** | | | | | | |
| | | **BBSHHB** | | | | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | |

**Appendix B Table 3**. Summary of acoustic bat data and weather during each survey night at the North Tree detector – Fall 2007

| | | BBSHHB | | | | RBEP | | | MYSP | UNKN | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Night of** | **Operated Okay?** | **big brown bat** | **hoary bat** | **silver-haired bat** | **silver-haired/big brown** | **eastern pipistrelle** | **eastern red bat** | **pipistrelle/red bat** | **MYSP** | **high-frequency** | **low-frequency** | **unknown** | **Total** | **Wind Speed (m/s)** | **Relative Humidity (%)** | **Temperature (celsius)** |
| 8/28/07 | Y | | | | | | | | | 3 | | | **3** | 5.18 | n/a | 23.71 |
| 8/29/07 | Y | | | | | | | | | | | | **0** | 4.6 | n/a | 23.8 |
| 8/30/07 | Y | | | | | | | 2 | | 4 | 6 | | **12** | 6.6 | n/a | 16.5 |
| 8/31/07 | Y | | | | | | | 1 | | 12 | | | **13** | 7.4 | n/a | 15.9 |
| 9/1/07 | Y | | | | | | | | 1 | 3 | 1 | | **5** | 6.3 | 47.3 | 16.9 |
| 9/2/07 | Y | | | | | | | | | 4 | | | **4** | 2.4 | 45.9 | 18.5 |
| 9/3/07 | Y | | | | | | | | | 3 | | | **3** | 3.7 | 49.7 | 21.2 |
| 9/4/07 | Y | | | | | | | | | 2 | 1 | | **3** | 3.2 | 34.0 | 22.2 |
| 9/5/07 | Y | | | | | | | | | 3 | 1 | | **4** | 7.3 | 35.7 | 23.3 |
| 9/6/07 | Y | | | | | | | | | | 1 | | **1** | 5.9 | 45.4 | 23.4 |
| 9/7/07 | Y | | | | | | | | | 1 | | | **1** | 6.3 | 46.5 | 21.5 |
| 9/8/07 | Y | | | | | | | | | 7 | | | **7** | 4.7 | 52.5 | 19.8 |
| 9/9/07 | Y | | | | | | | | | 5 | 1 | | **6** | 4.6 | 48.4 | 20.8 |
| 9/10/07 | Y | | | | | | | | | | | | **0** | 4.0 | 54.0 | 21.9 |
| 9/11/07 | Y | | | | 1 | | | | | 3 | | | **4** | 5.0 | 46.5 | 13.0 |
| 9/12/07 | Y | | | | | | | | | | | | **0** | 6.3 | 85.7 | 11.7 |
| 9/13/07 | Y | | | | | | | | | 2 | 1 | | **3** | 6.3 | 56.7 | 17.2 |
| 9/14/07 | Y | | | | | | | | | 7 | 1 | | **8** | 5.9 | 78.7 | 9.7 |
| 9/15/07 | Y | | | | | | | | | | | | **0** | 4.1 | 77.1 | 7.8 |
| 9/16/07 | Y | | | | | | | | | 1 | | | **1** | 5.9 | 76.7 | 10.0 |
| 9/17/07 | Y | | | | | | | | | | | | **0** | 7.4 | 59.4 | 15.9 |
| 9/18/07 | Y | | | | | | | | | | | | **0** | 6.9 | 58.4 | 19.3 |
| 9/19/07 | Y | | | | | | | | | 4 | 2 | | **6** | 3.6 | 59.3 | 20.2 |
| 9/20/07 | Y | | | | | | | | | 2 | 1 | | **3** | 5.8 | 86.1 | 20.0 |
| 9/21/07 | Y | | | | | | | | | 1 | | | **1** | 7.0 | 64.6 | 21.2 |
| 9/22/07 | N | | | | | | | | | | | | **n/a** | 7.0 | 64.8 | 16.7 |
| 9/23/07 | N | | | | | | | | | | | | **n/a** | 7.6 | 57.8 | 17.9 |
| 9/24/07 | N | | | | | | | | | | | | **n/a** | 6.0 | 64.0 | 23.9 |
| 9/25/07 | N | | | | | | | | | | | | **n/a** | 5.4 | 92.8 | 19.8 |
| 9/26/07 | N | | | | | | | | | | | | **n/a** | 3.7 | 98.6 | 19.1 |
| 9/27/07 | N | | | | | | | | | | | | **n/a** | 5.0 | 89.6 | 13.3 |
| 9/28/07 | N | | | | | | | | | | | | **n/a** | 5.1 | 70.3 | 13.0 |
| 9/29/07 | N | | | | | | | | | | | | **n/a** | 7.4 | 69.5 | 14.7 |
| 9/30/07 | N | | | | | | | | | | | | **n/a** | 8.0 | 51.9 | 18.3 |
| 10/1/07 | N | | | | | | | | | | | | **n/a** | 5.1 | 74.0 | 16.4 |
| 10/2/07 | N | | | | | | | | | | | | **n/a** | 8.0 | 68.9 | 20.0 |
| 10/3/07 | N | | | | | | | | | | | | **n/a** | 3.1 | 80.9 | 18.3 |
| 10/4/07 | N | | | | | | | | | | | | **n/a** | 5.6 | 75.9 | 22.3 |
| 10/5/07 | N | | | | | | | | | | | | **n/a** | 5.5 | 80.9 | 21.6 |
| 10/6/07 | N | | | | | | | | | | | | **n/a** | 3.6 | 73.9 | 22.5 |
| 10/7/07 | N | | | | | | | | | | | | **n/a** | 2.3 | 70.3 | 23.1 |
| 10/8/07 | N | | | | | | | | | | | | **n/a** | 6.0 | 68.3 | 21.1 |
| 10/9/07 | N | | | | | | | | | | | | **n/a** | 5.8 | 65.6 | 13.5 |
| 10/10/07 | N | | | | | | | | | | | | **n/a** | 5.0 | 79.4 | 7.2 |
| 10/11/07 | N | | | | | | | | | | | | **n/a** | 4.5 | 85.1 | 9.1 |
| 10/12/07 | N | | | | | | | | | | | | **n/a** | 2.9 | 81.5 | 4.8 |
| 10/13/07 | N | | | | | | | | | | | | **n/a** | 3.6 | 69.0 | 9.7 |
| 10/14/07 | N | | | | | | | | | | | | **n/a** | 7.6 | 72.4 | 13.4 |
| 10/15/07 | N | | | | | | | | | | | | **n/a** | 6.8 | 64.6 | 17.3 |
| 10/16/07 | N | | | | | | | | | | | | **n/a** | 4.7 | 98.0 | 15.9 |
| 10/17/07 | N | | | | | | | | | | | | **n/a** | 7.5 | 88.1 | 18.3 |
| 10/18/07 | N | | | | | | | | | | | | **n/a** | 9.8 | 85.8 | 19.7 |
| 10/19/07 | N | | | | | | | | | | | | **n/a** | 7.7 | 80.6 | 12.4 |
| 10/20/07 | N | | | | | | | | | | | | **n/a** | 8.8 | 55.5 | 13.8 |
| 10/21/07 | N | | | | | | | | | | | | **n/a** | 8.5 | 49.3 | 16.5 |
| 10/22/07 | N | | | | | | | | | | | | **n/a** | 5.0 | 98.0 | 15.4 |
| 10/23/07 | N | | | | | | | | | | | | **n/a** | 3.3 | 97.9 | 8.5 |
| 10/24/07 | N | | | | | | | | | | | | **n/a** | 9.2 | 91.2 | 7.3 |
| 10/25/07 | N | | | | | | | | | | | | **n/a** | 6.9 | 50.6 | 12.9 |
| 10/26/07 | N | | | | | | | | | | | | **n/a** | 6.8 | 40.6 | 11.4 |
| 10/27/07 | N | | | | | | | | | | | | **n/a** | 5.0 | 47.1 | 5.6 |
| 10/28/07 | N | | | | | | | | | | | | **n/a** | 3.0 | 40.1 | 4.8 |
| **By Species** | | **0** | **0** | **0** | **1** | **0** | **0** | **3** | **1** | **67** | **16** | **0** | **88** | **n/o indicates detector not operating that night** | | |
| **By Guild** | | **1** | | | | **3** | | | **1** | **83** | | | | | | |
| | | **BBSHHB** | | | | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | |

**Appendix B Table 4**. Summary of acoustic bat data and weather during each survey night at the South High detector – Fall 2007

| | | BBSHHB | | | | RBEP | | | MYSP | UNKN | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Night of | Operated Okay? | big brown bat | hoary bat | silver-haired bat | silver-haired/big brow | eastern pipistrelle | eastern red bat | pipistrelle/red bat | MYSP | high-frequency | low-frequency | unknown | Total | Wind Speed (m/s) | Relative Humidity (%) | Temperature (celsius) |
| 8/29/07 | Y | | | | | | | 1 | | | 1 | | **2** | 1.6 | n/a | 29.54 |
| 8/30/07 | Y | | | | | | | | | | 1 | | **1** | 2.4 | n/a | 30.05 |
| 8/31/07 | Y | | | | | | | | | | | | **0** | 5.5 | n/a | 22.44 |
| 9/1/07 | Y | | | | 1 | | | | | | | | **1** | 6.4 | 47.3 | 21.42 |
| 9/2/07 | Y | | | | 1 | | | | | | | | **1** | 5.4 | 45.9 | 23.98 |
| 9/3/07 | Y | | | | | | | | | | | | **0** | 3.1 | 49.7 | 25.97 |
| 9/4/07 | Y | | | | 1 | | | | | | 1 | | **2** | 4.2 | 34.0 | 26.87 |
| 9/5/07 | Y | | | | 1 | | | | | | | | **1** | 2.6 | 35.7 | 28.22 |
| 9/6/07 | Y | | | | | | | | | | | | **0** | 5.4 | 45.4 | 28.51 |
| 9/7/07 | Y | | | | | | | | | | | | **0** | 4.4 | 46.5 | 27.76 |
| 9/8/07 | Y | | | | | | | | | 1 | | | **1** | 6.6 | 52.5 | 27.99 |
| 9/9/07 | Y | | | | | | | | | | | | **0** | 5.4 | 48.4 | 19.91 |
| 9/10/07 | Y | | | | 1 | | | | | | | | **1** | n/a | 54.0 | n/a |
| 9/11/07 | Y | | | | 2 | | | | | | | | **2** | 2.1 | 46.5 | 25.23 |
| 9/12/07 | Y | | | | | | | | | | | | **0** | 6.9 | 85.7 | 17.66 |
| 9/13/07 | Y | | | | 4 | | | | | | 4 | | **8** | 6.4 | 56.7 | 15.32 |
| 9/14/07 | Y | | | | 3 | | | | | | | | **3** | 5.2 | 78.7 | 19.96 |
| 9/15/07 | Y | | | | | | | | | | | | **0** | 7.2 | 77.1 | 17.61 |
| 9/16/07 | Y | | | | | | | | | | | | **0** | 3.7 | 76.7 | 9.54 |
| 9/17/07 | Y | | | | | | | | | | 1 | | **1** | 4.5 | 59.4 | 12.36 |
| 9/18/07 | Y | | | | | | | | | | | | **0** | 6.5 | 58.4 | 17.22 |
| 9/19/07 | Y | | | | 1 | | | | | | 2 | | **3** | 6.7 | 59.3 | 19.91 |
| 9/20/07 | Y | | | | 2 | | | 1 | | | 2 | | **5** | 2.7 | 86.1 | 22.21 |
| 9/21/07 | Y | | | | 1 | | | | | | | | **1** | 4.3 | 64.6 | 24.28 |
| 9/22/07 | Y | | | | 2 | | | | | | 1 | | **3** | 4.5 | 64.8 | 24.33 |
| 9/23/07 | Y | | | | 1 | | | | | | | | **1** | 6.6 | 57.8 | 21.40 |
| 9/24/07 | Y | | | | 1 | | | | | | 2 | | **3** | 6.4 | 64.0 | 21.15 |
| 9/25/07 | Y | | | | 4 | | | | | | | | **4** | 5.8 | 92.8 | 25.36 |
| 9/26/07 | Y | | | | | | | | | | | | **0** | 6.7 | 98.6 | 23.72 |
| 9/27/07 | Y | | | | | | | | | | | | **0** | 2.9 | 89.6 | 19.44 |
| 9/28/07 | Y | | | | | | | | | | 1 | | **1** | 2.8 | 70.3 | 15.98 |
| 9/29/07 | Y | | | | 2 | | | | | | | | **2** | 5.4 | 69.5 | 16.40 |
| 9/30/07 | Y | | | | | | | | | | 1 | | **1** | 6.4 | 51.9 | 16.41 |
| 10/1/07 | Y | | | | 1 | | | | | | | | **1** | 6.7 | 74.0 | 20.10 |
| 10/2/07 | Y | | 2 | | 7 | | | | | 2 | 2 | | **13** | 7.4 | 68.9 | 20.52 |
| 10/3/07 | Y | | | | 2 | | | | | | 6 | | **8** | 6.1 | 80.9 | 21.27 |
| 10/4/07 | Y | | | 4 | 3 | | | | | 2 | 5 | | **14** | 1.4 | 75.9 | 20.46 |
| 10/5/07 | Y | | | | 8 | | | | | | 5 | | **13** | 4.8 | 80.9 | 23.19 |
| 10/6/07 | Y | | | 1 | 10 | | | | | | 6 | | **17** | 5.0 | 73.9 | 24.31 |
| 10/7/07 | Y | | | 1 | 7 | | | | | | 6 | | **14** | 1.4 | 70.3 | 24.63 |
| 10/8/07 | Y | | 3 | | 8 | | | | | | 6 | | **17** | 0.6 | 68.3 | 25.46 |
| 10/9/07 | Y | | | | 7 | | | | | 2 | 4 | | **13** | 5.7 | 65.6 | 25.91 |
| 10/10/07 | Y | | | | 1 | | | | | 1 | 5 | | **7** | 7.0 | 79.4 | 18.36 |
| 10/11/07 | Y | | | | 1 | | | | | 1 | 1 | | **3** | 4.1 | 85.1 | 8.87 |
| 10/12/07 | Y | | | | | | | | | | | | **0** | 5.9 | 81.5 | 11.44 |
| 10/13/07 | Y | | | | 1 | | | | | | | | **1** | 3.8 | 69.0 | 7.45 |
| 10/14/07 | Y | | | | 1 | | | | | | 2 | | **3** | 5.1 | 72.4 | 10.86 |
| 10/15/07 | Y | | 2 | | 6 | | | | | 4 | 3 | | **15** | 6.3 | 64.6 | 14.54 |
| 10/16/07 | Y | | | | 1 | | | 1 | | 3 | | | **5** | 5.2 | 98.0 | 18.21 |
| 10/17/07 | Y | | | | 4 | | | | | 3 | 1 | | **8** | 4.6 | 88.1 | 16.69 |
| 10/18/07 | Y | | | | 1 | | | | | 2 | | | **3** | 5.6 | 85.8 | 19.78 |
| 10/19/07 | Y | | | | 2 | | | | | 3 | | | **5** | 9.6 | 80.6 | 22.27 |
| 10/20/07 | Y | | | | 1 | | | | | | | | **1** | 7.9 | 55.5 | 14.24 |
| 10/21/07 | Y | | 1 | | 1 | | | | | | | | **2** | n/a | 49.3 | 16.3 |
| 10/22/07 | Y | | | | | | | | | | | | **0** | n/a | 98.0 | 15.3 |
| 10/23/07 | Y | 1 | | | 2 | | | | | 5 | 1 | | **9** | n/a | 97.9 | 8.6 |
| 10/24/07 | Y | | | | 1 | | | | | | 1 | | **2** | n/a | 91.2 | 6.8 |
| 10/25/07 | N | | | | | | | | | | | | n/a | n/a | n/a | n/a |
| 10/26/07 | N | | | | | | | | | | | | n/a | n/a | n/a | n/a |
| 10/27/07 | N | | | | | | | | | | | | n/a | n/a | n/a | n/a |
| 10/28/07 | N | | | | | | | | | | | | n/a | n/a | n/a | n/a |
| **By Species** | | **1** | **8** | **6** | **104** | **0** | **0** | **3** | **0** | **29** | **71** | **0** | **222** | **n/o indicates detector not operating that night** | | |
| **By Guild** | | **119** | | | | **3** | | | **0** | **100** | | | | | | |
| | | **BBSHHB** | | | | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | |

**Appendix B Table 5**. Summary of acoustic bat data and weather during each survey night at the South Low detector – Fall 2007

| | | BBSHHB | | | | RBEP | | | MYSP | UNKN | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Night of** | **Operated Okay?** | **big brown bat** | **hoary bat** | **silver-haired bat** | **silver-haired/big brow** | **eastern pipistrelle** | **eastern red bat** | **pipistrelle/red bat** | **MYSP** | **high-frequency** | **low-frequency** | **unknown** | **Total** | **Wind Speed (m/s)** | **Relative Humidity (%)** | **Temperature (celsius)** |
| 8/29/07 | Y | | | | 1 | | | | 1 | 1 | | | **3** | 1.6 | n/a | 29.54 |
| 8/30/07 | Y | | | | 25 | | | | | | 12 | | **37** | 2.4 | n/a | 30.05 |
| 8/31/07 | Y | | | | 12 | | | | | 1 | 5 | | **18** | 5.5 | n/a | 22.44 |
| 9/1/07 | Y | | | | | | | | | 3 | 2 | | **5** | 6.4 | 47.3 | 21.42 |
| 9/2/07 | Y | | | | 2 | | | | | 2 | | | **4** | 5.4 | 45.9 | 23.98 |
| 9/3/07 | Y | | | | 2 | | | | | 3 | | | **5** | 3.1 | 49.7 | 25.97 |
| 9/4/07 | Y | | | | 2 | | | 1 | | | 2 | | **5** | 4.2 | 34.0 | 26.87 |
| 9/5/07 | Y | | | | | 1 | | | | | 1 | | **2** | 2.6 | 35.7 | 28.22 |
| 9/6/07 | Y | | | | | | | | | | | | **0** | 5.4 | 45.4 | 28.51 |
| 9/7/07 | Y | | | | | | | | | | | | **0** | 4.4 | 46.5 | 27.76 |
| 9/8/07 | Y | | | | 1 | | | | | | | | **1** | 6.6 | 52.5 | 27.99 |
| 9/9/07 | N | | | | | | | | | | | | **n/a** | 5.4 | 48.4 | 19.91 |
| 9/10/07 | N | | | | | | | | | | | | **n/a** | n/a | 54.0 | n/a |
| 9/11/07 | N | | | | | | | | | | | | **n/a** | 2.1 | 46.5 | 25.23 |
| 9/12/07 | N | | | | | | | | | | | | **n/a** | 6.9 | 85.7 | 17.66 |
| 9/13/07 | N | | | | | | | | | | | | **n/a** | 6.4 | 56.7 | 15.32 |
| 9/14/07 | N | | | | | | | | | | | | **n/a** | 5.2 | 78.7 | 19.96 |
| 9/15/07 | N | | | | | | | | | | | | **n/a** | 7.2 | 77.1 | 17.61 |
| 9/16/07 | N | | | | | | | | | | | | **n/a** | 3.7 | 76.7 | 9.54 |
| 9/17/07 | N | | | | | | | | | | | | **n/a** | 4.5 | 59.4 | 12.36 |
| 9/18/07 | N | | | | | | | | | | | | **n/a** | 6.5 | 58.4 | 17.22 |
| 9/19/07 | N | | | | | | | | | | | | **n/a** | 6.7 | 59.3 | 19.91 |
| 9/20/07 | N | | | | | | | | | | | | **n/a** | 2.7 | 86.1 | 22.21 |
| 9/21/07 | N | | | | | | | | | | | | **n/a** | 4.3 | 64.6 | 24.28 |
| 9/22/07 | N | | | | | | | | | | | | **n/a** | 4.5 | 64.8 | 24.33 |
| 9/23/07 | N | | | | | | | | | | | | **n/a** | 6.6 | 57.8 | 21.40 |
| 9/24/07 | N | | | | | | | | | | | | **n/a** | 6.4 | 64.0 | 21.15 |
| 9/25/07 | N | | | | | | | | | | | | **n/a** | 5.8 | 92.8 | 25.36 |
| 9/26/07 | N | | | | | | | | | | | | **n/a** | 6.7 | 98.6 | 23.72 |
| 9/27/07 | N | | | | | | | | | | | | **n/a** | 2.9 | 89.6 | 19.44 |
| 9/28/07 | N | | | | | | | | | | | | **n/a** | 2.8 | 70.3 | 15.98 |
| 9/29/07 | N | | | | | | | | | | | | **n/a** | 5.4 | 69.5 | 16.40 |
| 9/30/07 | N | | | | | | | | | | | | **n/a** | 6.4 | 51.9 | 16.41 |
| 10/1/07 | N | | | | | | | | | | | | **n/a** | 6.7 | 74.0 | 20.10 |
| 10/2/07 | N | | | | | | | | | | | | **n/a** | 7.4 | 68.9 | 20.52 |
| 10/3/07 | N | | | | | | | | | | | | **n/a** | 6.1 | 80.9 | 21.27 |
| 10/4/07 | N | | | | | | | | | | | | **n/a** | 1.4 | 75.9 | 20.46 |
| 10/5/07 | N | | | | | | | | | | | | **n/a** | 4.8 | 80.9 | 23.19 |
| 10/6/07 | N | | | | | | | | | | | | **n/a** | 5.0 | 73.9 | 24.31 |
| 10/7/07 | N | | | | | | | | | | | | **n/a** | 1.4 | 70.3 | 24.63 |
| 10/8/07 | N | | | | | | | | | | | | **n/a** | 0.6 | 68.3 | 25.46 |
| 10/9/07 | N | | | | | | | | | | | | **n/a** | 5.7 | 65.6 | 25.91 |
| 10/10/07 | N | | | | | | | | | | | | **n/a** | 7.0 | 79.4 | 18.36 |
| 10/11/07 | N | | | | | | | | | | | | **n/a** | 4.1 | 85.1 | 8.87 |
| 10/12/07 | N | | | | | | | | | | | | **n/a** | 5.9 | 81.5 | 11.44 |
| 10/13/07 | N | | | | | | | | | | | | **n/a** | 3.8 | 69.0 | 7.45 |
| 10/14/07 | N | | | | | | | | | | | | **n/a** | 5.1 | 72.4 | 10.86 |
| 10/15/07 | N | | | | | | | | | | | | **n/a** | 6.3 | 64.6 | 14.54 |
| 10/16/07 | N | | | | | | | | | | | | **n/a** | 5.2 | 98.0 | 18.21 |
| 10/17/07 | N | | | | | | | | | | | | **n/a** | 4.6 | 88.1 | 16.69 |
| 10/18/07 | N | | | | | | | | | | | | **n/a** | 5.6 | 85.8 | 19.78 |
| 10/19/07 | N | | | | | | | | | | | | **n/a** | 9.6 | 80.6 | 22.27 |
| 10/20/07 | N | | | | | | | | | | | | **n/a** | 7.9 | 55.5 | 14.24 |
| 10/21/07 | N | | | | | | | | | | | | **n/a** | n/a | 49.3 | 16.3 |
| 10/22/07 | N | | | | | | | | | | | | **n/a** | n/a | 98.0 | 15.3 |
| 10/23/07 | N | | | | | | | | | | | | **n/a** | n/a | 97.9 | 8.6 |
| 10/24/07 | N | | | | | | | | | | | | **n/a** | n/a | 91.2 | 6.8 |
| 10/25/07 | N | | | | | | | | | | | | **n/a** | n/a | n/a | n/a |
| 10/26/07 | N | | | | | | | | | | | | **n/a** | n/a | n/a | n/a |
| 10/27/07 | N | | | | | | | | | | | | **n/a** | n/a | n/a | n/a |
| 10/28/07 | N | | | | | | | | | | | | **n/a** | n/a | n/a | n/a |
| **By Species** | | **0** | **0** | **0** | **45** | **1** | **0** | **1** | **1** | **10** | **22** | **0** | **80** | **n/o indicates detector not operating that night** | | |
| **By Guild** | | **45** | | | | **2** | | | **1** | **32** | | | | | | |
| | | **BBSHHB** | | | | **RBEP** | | | **MYSP** | **UNKN** | | | **Total** | | | |

Appendix B Table 6. Period of operation for six Anabat detectors deployed for the Buckeye Wind Project – Fall 2007

| Date | North High | NorthLow | NorthTree | SouthHigh | SouthLow | SouthTree |
|---|---|---|---|---|---|---|
| 8/28/07 | Y | Y | Y | N | N | N |
| 8/29/07 | Y | Y | Y | Y | Y | N |
| 8/30/07 | Y | Y | Y | Y | Y | N |
| 8/31/07 | Y | Y | Y | Y | Y | N |
| 9/1/07 | Y | Y | Y | Y | Y | N |
| 9/2/07 | Y | Y | Y | Y | Y | N |
| 9/3/07 | Y | Y | Y | Y | Y | N |
| 9/4/07 | Y | Y | Y | Y | Y | N |
| 9/5/07 | Y | Y | Y | Y | Y | N |
| 9/6/07 | Y | Y | Y | Y | Y | N |
| 9/7/07 | Y | Y | Y | Y | Y | N |
| 9/8/07 | Y | Y | Y | Y | Y | N |
| 9/9/07 | Y | Y | Y | Y | N | N |
| 9/10/07 | Y | Y | Y | Y | N | N |
| 9/11/07 | Y | Y | Y | Y | N | N |
| 9/12/07 | N | Y | Y | Y | N | N |
| 9/13/07 | N | Y | Y | Y | N | N |
| 9/14/07 | N | Y | Y | Y | N | N |
| 9/15/07 | N | Y | Y | Y | N | N |
| 9/16/07 | N | Y | Y | Y | N | N |
| 9/17/07 | N | Y | Y | Y | N | N |
| 9/18/07 | N | Y | Y | Y | N | N |
| 9/19/07 | N | Y | Y | Y | N | N |
| 9/20/07 | N | Y | Y | Y | N | N |
| 9/21/07 | N | Y | Y | Y | N | N |
| 9/22/07 | N | Y | N | Y | N | N |
| 9/23/07 | Y | Y | N | Y | N | N |
| 9/24/07 | Y | Y | N | Y | N | Y |
| 9/25/07 | Y | Y | N | Y | N | N |
| 9/26/07 | Y | Y | N | Y | N | N |
| 9/27/07 | Y | Y | N | Y | N | N |
| 9/28/07 | Y | Y | N | Y | N | N |
| 9/29/07 | Y | Y | N | Y | N | N |
| 9/30/07 | Y | Y | N | Y | N | N |
| 10/1/07 | Y | Y | N | Y | N | N |
| 10/2/07 | Y | Y | N | Y | N | Y |
| 10/3/07 | Y | Y | N | Y | N | Y |
| 10/4/07 | Y | Y | N | Y | N | Y |
| 10/5/07 | Y | Y | N | Y | N | Y |
| 10/6/07 | Y | Y | N | Y | N | Y |
| 10/7/07 | Y | Y | N | Y | N | Y |
| 10/8/07 | Y | Y | N | Y | N | Y |
| 10/9/07 | Y | Y | N | Y | N | Y |
| 10/10/07 | Y | Y | N | Y | N | Y |
| 10/11/07 | Y | Y | N | Y | N | Y |
| 10/12/07 | Y | Y | N | Y | N | Y |
| 10/13/07 | Y | Y | N | Y | N | Y |
| 10/14/07 | Y | Y | N | Y | N | Y |
| 10/15/07 | Y | Y | N | Y | N | Y |
| 10/16/07 | Y | Y | N | Y | N | Y |
| 10/17/07 | Y | Y | N | Y | N | Y |
| 10/18/07 | Y | Y | N | Y | N | Y |
| 10/19/07 | Y | Y | N | Y | N | Y |
| 10/20/07 | Y | Y | N | Y | N | Y |
| 10/21/07 | Y | Y | N | Y | N | Y |
| 10/22/07 | Y | Y | N | Y | N | Y |
| 10/23/07 | Y | Y | N | Y | N | Y |
| 10/24/07 | Y | N | N | Y | N | Y |
| 10/25/07 | Y | N | N | N | N | N |
| 10/26/07 | Y | N | N | N | N | N |
| 10/27/07 | Y | N | N | N | N | N |
| 10/28/07 | Y | N | N | N | N | N |
| 10/29/07 | Y | N | N | N | N | N |

# Appendix C

Raptor survey results

**Appendix C Table 1.** Summary of daily raptor migration surveys at Buckeye Wind Project in fall 2007

| Species | 8/30/07 | 9/11/07 | 9/13/07 | 9/18/07 | 9/19/07 | 9/28/07 | 10/2/07 | 10/3/07 | 10/4/07 | 10/10/07 | 10/11/07 | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| American kestrel | | | 1 | | | | | | | | | 1 |
| Black vulture | | | | 1 | | | | | | 1 | 1 | 3 |
| Cooper's hawk | 2 | | | | | | | 1 | | | | 3 |
| Northern goshawk | | | | | | 1 | | | | | | 1 |
| Northern harrier | | | | | | | | | | 2 | | 2 |
| Red-tailed hawk | 2 | 1 | 1 | 3 | | 1 | 4 | | 1 | | 1 | 14 |
| Sharp-shinned hawk | 1 | | 2 | | | 1 | | | | | | 4 |
| Turkey vulture | 34 | 18 | 53 | 39 | 50 | 64 | 67 | 23 | 19 | 5 | 8 | 380 |
| Unidentified raptor | | | | | | | | | | 7 | 5 | 12 |
| Unidentified accipiter | | | | | | | | | | 1 | | 1 |
| Grand Total | 39 | 19 | 57 | 43 | 50 | 67 | 71 | 24 | 20 | 16 | 15 | 421 |

**Appendix C Table 2.** Summary of hourly raptor observations at Buckeye Wind Project in fall 2007

| Species | 9:00-10:00 | 10:00-11:00 | 11:00-12:00 | 12:00-1:00 | 1:00-2:00 | 2:00-3:00 | Grand total |
|---|---|---|---|---|---|---|---|
| American kestrel | | | | | | 1 | 1 |
| Black vulture | | | | 2 | 1 | | 3 |
| Coopers hawk | 1 | | | 1 | | 1 | 3 |
| Northern goshawk | 1 | | | | | | 1 |
| Northern harrier | 1 | | | 1 | | | 2 |
| Red-tailed hawk | 4 | 1 | 3 | 4 | 2 | | 14 |
| Sharp-shinned hawk | | | 1 | 1 | 2 | | 4 |
| Turkey vulture | 45 | 93 | 69 | 69 | 70 | 34 | 380 |
| Unidentified accipiter | | | 1 | | | | 1 |
| Unidentified raptor | 5 | 2 | 2 | 1 | 1 | 1 | 12 |
| Grand total | 57 | 96 | 76 | 79 | 76 | 37 | 421 |

**Appendix C Table 3.** Flight height distribution of raptors observed during fall surveys at the Buckeye Wind Project, fall 2007

| SPECIES | Flight Height | | | | |
|---|---|---|---|---|---|
| | **< 125 m** | **> 125 m** | **< 150 m** | **> 150 m** | **Total** |
| American kestrel | 1 | | 1 | | **1** |
| Black vulture | 3 | | 3 | | **3** |
| Cooper's hawk | 2 | 1 | 3 | | **3** |
| Northern goshawk | 1 | | 1 | | **1** |
| Northern harrier | 2 | | 2 | | **2** |
| Red-tailed hawk | 7 | 7 | 8 | 6 | **14** |
| Sharp-shinned hawk | 3 | 1 | 3 | 1 | **4** |
| Turkey vulture | 296 | 84 | 318 | 62 | **380** |
| Unidentified accipiter | 1 | | 1 | | **1** |
| Unidentified raptor | 12 | | 12 | | **12** |
| **Total** | **328** | **93** | **352** | **69** | **421** |

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**Appendix C Table 4.** Summary of regional fall 2007 migration surveys in relation to the results of the Buckeye Wind Project raptor survey

| Site Number[1] | Location | Survey Period - Fall 2007 | Survey Hours | BV | TV | OS | BE | NH | SS | CH | NG | RS | BW | RT | RL | GE | AK | ML | PG | UA | UB | UF | UE | UR | Total | Birds/ Hour |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Waggoner's Gap, PA | Aug 1 - Dec 18 | 1089.5 | 72 | 1369 | 658 | 327 | 443 | 9720 | 1110 | 91 | 260 | 6957 | 3873 | 5 | 209 | 393 | 138 | 72 | 73 | 21 | 9 | 3 | 98 | 25,901 | 23.8 |
| 2 | Hawk Mountain, PA | Aug 13 - Dec 18 | 1066.3 | 140 | 636 | 717 | 239 | 279 | 5099 | 750 | 43 | 223 | 7836 | 2410 | 4 | 106 | 526 | 232 | 38 | 56 | 31 | 18 | 0 | 52 | 19,437 | 18.2 |
| 3 | Kittatinny Mountain, NJ | Sept 3 - Nov 8 | 258.8 | 0 | 0 | 121 | 31 | 40 | 683 | 91 | 1 | 16 | 746 | 174 | 0 | 0 | 118 | 21 | 8 | 14 | 6 | 10 | 0 | 46 | 2,126 | 8.2 |
| 4 | Franklin Mountain, NY | Aug 18 - Dec 18 | 795.8 | 0 | 483 | 140 | 138 | 109 | 835 | 162 | 25 | 93 | 1639 | 2141 | 10 | 163 | 89 | 38 | 25 | 7 | 5 | 1 | 0 | 48 | 6,151 | 7.7 |
| 5 | Lake Erie, Metro Park, MI | Sept 1 – Nov 30 | 598 | 0 | 62882 | 195 | 211 | 818 | 9909 | 724 | 6 | 1026 | 69574 | 9406 | 29 | 124 | 1275 | 41 | 67 | 0 | 0 | 0 | 0 | 8 | 156,295 | 261.4 |
| 6 | Hanging Rock, WV | Aug 18 - Nov 18 | 266 | 0 | 0 | 34 | 42 | 16 | 317 | 88 | 3 | 7 | 1725 | 361 | 1 | 17 | 39 | 3 | 2 | 9 | 5 | 1 | 2 | 1 | 2,673 | 10 |
| 7 | Stone Mountain, PA | Sept 1 - Dec 4 | 338 | 19 | 93 | 97 | 57 | 79 | 943 | 211 | 11 | 66 | 986 | 1624 | 0 | 107 | 74 | 27 | 16 | 1 | 1 | 0 | 0 | 84 | 4,497 | 13.3 |
| 8 | Bear Mountain Farm, VA | Sept 1 - Oct 30 | 70.9 | 0 | 5 | 8 | 23 | 11 | 52 | 7 | 0 | 13 | 256 | 11 | 0 | 6 | 17 | 0 | 0 | 8 | 2 | 1 | 3 | 30 | 453 | 6.4 |
| 9 | Snickers Gap, VA | Aug 26 - Dec 1 | 348.5 | 0 | 0 | 184 | 224 | 168 | 1653 | 267 | 12 | 150 | 8110 | 1625 | 0 | 17 | 133 | 46 | 21 | 21 | 16 | 4 | 0 | 22 | 12,674 | 36.4 |
| 10 | Hawk Cliff, ON | Aug 31 – Dec 8 | 615.3 | 0 | 21315 | 209 | 406 | 2116 | 16643 | 637 | 34 | 1134 | 41018 | 11148 | 43 | 151 | 4431 | 265 | 148 | 3 | 7 | 2 | 1 | 6 | 99,717 | 162.1 |
| 11 | Holiday Beach, ON | Sept 1 – Nov 30 | 635.5 | 0 | 31339 | 186 | 175 | 1280 | 12389 | 730 | 16 | 509 | 18400 | 6470 | 20 | 79 | 1611 | 108 | 95 | 4 | 38 | 4 | 0 | 7 | 73,460 | 115.6 |
| 12 | Tuscarora Summit, PA | Sept. 4 - Nov 14 | 297.8 | 2 | 195 | 90 | 30 | 85 | 1017 | 88 | 3 | 23 | 724 | 631 | 1 | 20 | 26 | 8 | 17 | 23 | 8 | 8 | 0 | 42 | 3,041 | 10.2 |
| 13 | Jacks Mountain, PA | Aug 24 - Nov 5 | 190 | 7 | 103 | 45 | 26 | 28 | 650 | 58 | 1 | 9 | 1878 | 374 | 0 | 7 | 37 | 11 | 7 | 1 | 1 | 0 | 0 | 3 | 3,246 | 17.1 |
| 14 | Little Gap, PA | Aug 15 - Nov 25 | 551.8 | 88 | 579 | 478 | 141 | 178 | 3636 | 475 | 41 | 86 | 7231 | 1422 | 0 | 52 | 198 | 76 | 33 | 18 | 21 | 7 | 1 | 96 | 14,857 | 26.9 |
| *15* | *Buckeye Wind, OH* | *Aug 30 – Oct 11* | *66* | *3* | *380* | *0* | *0* | *2* | *4* | *3* | *1* | *0* | *0* | *14* | *0* | *0* | *1* | *0* | *0* | *1* | *0* | *0* | *0* | *12* | *421* | *6.4* |

[1] Refer to Figure 4-2 for raptor survey location. Sites 1-14 reflect Hawk Migration Association of North America (HMANA) count data.
HMANA collects hawk count data from almost two hundred affiliated raptor monitoring sites throughout the United States, Canada, and Mexico.
The HMANA count data used to construct this table included unusual species, such as Swainson's hawks and gyrfalcons. These numbers were not incorporated here.

**Abbreviation Key:**

BV - Black vulture
TV - Turkey vulture
OS - Osprey
BE - Bald eagle
NH - Northern harrier
SS - Sharp-shinned hawk
CH - Cooper's hawk
NG - Northern goshawk
RS - Red-shouldered hawk
BW - Broad-winged hawk
RT - Red-tailed hawk
RL - Rough-legged hawk
GE - Golden eagle
AK - American kestrel
ML - Merlin
PG – Peregrine falcon
UA – Unidentified accipiter
UB – Unidentified buteo
UF – Unidentified falcon
UE – Unidentified eagle
UR – Unidentified raptor

**Appendix C Table 5.** Summary of available fall diurnal raptor survey results

| Project Site | Survey Period | # of Survey Days | # of Survey Hours | Landscape | Total # Observed | # of Species Observed* | Ave. Passage Rate (Raptors/Hr) | (Turbine Ht) % Raptors Below Turbine Height | Citation |
|---|---|---|---|---|---|---|---|---|---|
| **Fall 1996** | | | | | | | | | |
| Searsburg, Bennington County, VT | 9/11 - 11/3 | 20 | 80 | Forested ridge | 430 | 12 | 5.4 | n/a | Kerlinger 1996 |
| **Fall 1998** | | | | | | | | | |
| Harrisburg, Lewis County, NY | 9/2 -10/1 | 13 | 68 | Great Lakes plain/ADK foothills | 554 | 12 | 8.1 | n/a (47 m mean flight height) | Cooper & Mabee 2000 |
| Wethersfield, Wyoming Cty, NY | 9/2 - 10/1 | 24 | 107 | Agricultural plateau | 256 | 12 | 2.4 | n/a (48 m mean flight height) | Cooper & Mabee 2000 |
| **Fall 2004** | | | | | | | | | |
| Prattsburgh, Steuben Cty, NY | 9/2- 10/28 | 13 | 73 | Agricultural plateau | 220 | 10 | 3.0 | (125 m) 62% | Woodlot 2005b |
| Cohocton, Stueben, Cty, NY | 9/2 - 10/28 | 8 | 41 | Agricultural plateau | 128 | 8 | 3.1 | (125 m) 80% | Woodlot 2005u |
| Deerfield, Bennington Cty, VT (Existing Facility) | 9/2 - 10/31 | 10 | 60 | Forested ridge | 147 | 11 for sites combined | 2.5 | (100 m) 9% for sites combined | Woodlot 2005c |
| Deerfield, Bennington Cty, VT (Western Expansion) | 9/2 - 10/31 | 10 | 57 | Forested ridge | 725 | 11 for sites combined | 12.7 | (100 m) 9% for sites combined | Woodlot 2005c |
| Sheffield, Caledonia Cty, VT | 9/11 - 10/14 | 10 | 60 | Forested ridge | 193 | 10 | 3.2 | (125 m) 31% | Woodlot 2006a |
| **Fall 2005** | | | | | | | | | |
| Cohocton, Stueben, Cty, NY | 9/7 - 10/1 | 7 | 40 | Agricultural plateau | 131 | 10 | 3.3 | (125) 63% | Woodlot 2005u |
| Churubusco, Clinton Cty, NY | 10/6-10/22 | 10 | 60 | Great Lakes plain/ADK foothills | 217 | 15 | 3.6 | (120 m) 69% | Woodlot 2005l |
| Dairy Hills, Clinton Cty, NY | 9/11 - 10/10 | 4 | 16 | Agricultural plateau | 48 | 7 | 3.0 | n/a | Young *et al.* 2006 |
| Howard, Steuben Cty, NY | 9/1 - 10/28 | 10 | 57 | Agricultural plateau | 206 | 12 | 3.6 | (91 m) 65% | Woodlot 2005o |
| **Fall 2005** | | | | | | | | | |
| Munnsville, Madison Cty, NY | 9/6 - 10/31 | 11 | 65 | Agricultural plateau | 369 | 14 | 5.7 | (118 m) 51% | Woodlot 2005r |
| Mars Hill, Aroostook Cty, ME | 9/9 - 10/13 | 8 | 43 | Forested ridge | 115 | 13 | 1.5 | (120 m) 42% | Woodlot 2005t |
| Lempster, Sullivan County, NH | Fall 2005 | 10 | 80 | Forested ridge | 264 | 10 | 3.3 | (125 m) 40% | Woodlot 2007c |
| Clayton, Jefferson Cty, NY | 9/9 - 10/16 | 11 | 64 | Agricultural plateau | 575 | 13 | 9.1 | (150 m) 89% | Woodlot 2005m |
| **Fall 2006** | | | | | | | | | |
| Stetson, Penobscot Cty, ME | 9/14 - 10/26 | 7 | 42 | Forested ridge | 86 | 11 | 2.1 | (125 m) 63% | Woodlot 2007b |
| **Fall 2007** | | | | | | | | | |
| *Champaign and Logan Ctys, OH* | *8/30 - 10/11* | *11* | *66* | *Agricultural plateau* | *421* | *8* | *6.4* | *(125) 78%; (150) 84%* | *n/a* |

# Spring, Summer, and Fall 2008 Bird and Bat Survey Report

for the Buckeye Wind Power Project

in Champaign and Logan Counties, Ohio

Prepared for

EverPower Wind Holdings, Inc.
44 East 30th Street
New York, New York 10016

Prepared by

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February 2009

## Executive Summary

This report has been prepared to summarize results of spring, summer, and fall 2008 avian and bat surveys conducted by Stantec Consulting (Stantec) to characterize activity of birds and bats in the vicinity of the proposed Buckeye Wind facility in Champaign and Logan Counties, Ohio (Project). The surveys are part of the planning process by EverPower Wind Holdings, Inc. (EverPower) for a proposed wind project, which will include erection of a wind farm located primarily on open agricultural lands.

These surveys represent the second year of investigation undertaken at this site. Pre-construction assessments of the Project area began in fall 2007 when Stantec conducted nocturnal radar, raptor migration, and bat acoustic surveys. To further characterize use of the Project area by birds and bats, Stantec conducted acoustic bat, diurnal raptor, breeding bird, and hibernacula/swarm surveys in 2008, the results of which will be the basis of discussion for this report. The results of these field surveys provide useful information about site-specific migration patterns and breeding activities in the vicinity of the Project, especially when considered along with the results from the 2007 surveys.

*Passive Acoustic Bat Survey*

Acoustic bat surveys were conducted from March 29 through September 3, 2008 using six Anabat detectors. Two detectors were deployed in each of two meteorological (met) towers in the Project area at two different heights (high [40 meters {m}; 131 feet {ft}], low [20 m; 66 ft]). One detector was deployed in a tree within the met tower clearing at approximately ground-level [2 m; 7 ft]) at each of the met towers, for a total of six bat detectors. The habitat surrounding both met towers was open agriculture or pasture, with scattered hedgerows and isolated trees. Recordings of acoustic bat call sequences occurred on 774 of 954 potential detector-nights (81% success rate). Individual detector success ranged from 69% to 95% for the total survey period.

A total of 18,715 bat calls sequences were recorded during the March through September survey period, with a mean nightly detection rate of 23.9 call sequences/detector/night (s/d/n) for the entire survey period. Number of nightly detections varied from 0 to 688 across detectors. Detection rates were generally higher at north met tower detectors than at south met tower detectors. Mean nightly detection rate was variable across seasons, with the highest rates recorded during the fall sampling period (August 15 to September 3) at all detectors except the South Tree detector.

Bat call sequences were identified to the lowest possible taxonomic level and were grouped into five guilds based on similarity in call characteristics between species. The majority of the recorded bat call sequences (60%) were identified as the BBSH (big brown/silver-haired bat) guild, followed by those identified to the UNKN (unknown) guild (32%), the RBTB (red/tri-colored bat) guild (4%), the MYSP (*Myotis*) guild (3%), and the HB (hoary bat) guild (1%). Throughout the survey period, bat activity was highest one to two hours after sunset and declined thereafter.

Based on qualitative analysis of the average number of call sequences recorded during spring, summer, and fall 2008, a possible relationship existed between average nightly temperature and bat activity, such that the number of call sequences recorded remaining relatively low at temperatures less than 10 ºC (50 ºF). Activity also appeared to be related to wind speed, with few calls sequences recorded at wind speeds greater than 7.5 m/s (16.8 mph).

When comparing detection rates in the Project area to other wind project sites for which data are publicly available, average detection rates at the four met tower detectors (1.8 s/d/n in spring; 12.4 s/d/n in fall) were within the range of those recorded during acoustic surveys at other wind project sites in the east in recent years. While the average detection rate recorded at the two tree detectors (17.7 s/d/n) during the spring was also similar to rates observed at other wind project sites, an exceptionally high number of calls recorded at the North Tree detector (256.5 s/d/n) accounted for a high average detection rate at tree detectors during the fall (128.0 s/d/n). The call sequences recorded at the North Tree detector during the fall were mostly identified to the BBSH guild (74%; n=3228), with the majority likely produced by big brown bats. Thus, it is likely that the North Tree detector was placed in close proximity to a big brown maternity colony.

*Raptor and Sandhill Crane Migration Survey*

Diurnal surveys were conducted to document raptor species and sandhill cranes (*Grus canadensis*) migrating through the Project area, as well as behavioral characteristics such as flight altitude and direction relative to the Project area. Thirty-two days (216 hours) of raptor surveys were conducted from March 1 to May 15, 2008, and again for 24 days (167 hours) from September 1 to November 15, 2008. Sandhill crane surveys occurred on 12 days (84 hours) from November 16 to December 15, 2008. All surveys were conducted on an open hillside in the central portion of the Project area near a communication tower which provided a reference for determining raptor flight altitudes.

A total of 1,476 raptors representing twelve species were observed in the spring, yielding an observation rate of 6.8 birds/hour. A total of 581 raptors representing seven species were observed during the fall, yielding an observation rate of 3.5 birds/hour. During the sandhill crane survey, 27 raptors representing six species were observed, yielding an observation rate of 0.3 birds/hour during this period. No federally threatened or endangered species were observed during the survey period. Four raptor species observed during the survey are listed by the Ohio Department of Natural Resources: the northern harrier (*Circus cyaneus*) is state-listed as endangered, the peregrine falcon and bald eagle are state-listed as threatened, and the sharp-shinned hawk (*Accipiter striatus*) is a state species of concern. Although no sandhill cranes were observed from November 15 to December 15, four sandhill cranes, a state endangered species, were observed during a raptor survey on March 6, 2008.

The majority (spring n=1,347, 91%; fall n=527, 91%) of raptors observed during the survey period were turkey vultures (*Carthartes aura*). Red-tailed hawks (*Buteo jamaicensis*) were the second most commonly observed species, accounting for 7% of the total observations (n=98) in the spring, and 6% (n=32) in the fall. The majority of raptors (95% in spring and 93% in fall) were observed flying below 150 m. However, migrating raptor numbers were relatively low compared to other regional hawk counts, and raptors do not appear to concentrate within the Project area.

*Breeding Bird Survey*

A breeding bird survey (BBS) was conducted in spring 2008 to document the use of the Project area by breeding birds. One round of surveys was conducted in May, two rounds were conducted in June and early July, and one was conducted in July. Surveys consisted of 90 10-minute point count surveys positioned throughout the Project area in agricultural or forested habitat in one control plot and two treatment plots. Point count surveys documented a total of 97 species. The habitat with the greatest species richness (SR =39) and relative abundance (RA=7.67) in the control plot was forested habitat. The habitat with the greatest species richness (SR=47) and relative abundance (RA=9.22) in the treatment plots was agricultural habitat.

No federally endangered or threatened species were detected in the Project area during the spring 2008 breeding bird surveys. One state endangered species, the northern harrier, was detected, and one state threatened species, the least flycatcher (*Empidonax minimus*), was detected. Two state species of concern were detected: the bobolink (*Dolichonyx oryzivorus*) and the northern bobwhite (*Colinus virginianus*). Two state species of special interest were also detected: the magnolia warbler (*Dendroica magnolia*) and the blackburnian warbler (*Dendroica fusca*).

*Hibernacula and Fall Swarm Survey*

Stantec conducted a hibernacula survey in late winter 2008 and a swarm survey in fall 2008 to document the species composition and number of bats using Sanborn's Cave/Streng Cave and another nearby, unnamed cave in the Project area. In addition to these caves, 11 potential or documented karst locations, identified by the ODNR's Natural Areas Program (DNAP) were evaluated for use by bats. Of the 11 potential karst features surveyed, only one had evidence of karst geology, and no openings were discovered.

A hibernacula survey was conducted on March 4, 2008 at Sanborn's Cave and the nearby, unnamed cave. Only a partial survey of Sanborn's Cave and the unnamed cave were conducted due to landowner access restrictions or cave entry related safety issues. Only four tri-colored bats (*Perimyotis subflavus*) were observed on the ceiling of Sanborn's Cave during the partial survey of the cave. Biologists were not able to get far enough into the interior of the unnamed cave to document the presence of any hibernating bats.

Swarm surveys were conducted at both cave openings in fall 2008. A total of 884 bats were captured using harp traps and mist-nets during five swarm surveys at both cave openings on

September 15 (365 bats captured), September 24 (168 bats captured), October 6 (244 bats captured), October 20 (99 bats captured), and October 27 (8 bats captured). Three species were captured in harp traps: tri-colored bats, little brown bats (*Myotis lucifugus*), and northern long-eared bats (*Myotis septentrionalis*). Big brown bats (*Eptesicus fuscus*) were captured only in mist-nets placed over a stream during the September 15 survey.

Northern long-eared bats were the most common species captured at the cave openings (74%; n= 653), with males representing 58% of all northern long-eared bats captured. The second most frequently captured species was the little brown bat, representing 23% (n= 201) of all bats captured. Males represented the majority (82%) of all little brown bats captured. The least frequently captured bats were tri-colored bats (n=18; 2%) and big brown bats (n=12; 1%).

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PN195600164

# 1.0 Introduction

This report has been prepared to summarize results of spring, summer, and fall 2008 avian and bat surveys conducted by Stantec Consulting (Stantec) to characterize activity of birds and bats in the vicinity of the proposed Buckeye Wind facility (Project). Following is a brief description of the Project, a review of methods used to conduct scientific surveys and their results, and a brief discussion of the implications of survey results.

## 1.1 PROJECT CONTEXT

EverPower Wind Holdings, Inc. (EverPower) has proposed to develop a wind power facility in central Ohio, in Champaign County. The facility would include construction of turbine towers and pads, transmission lines, and access roads. The Project was originally proposed to be located on approximately 21,756 hectares (53,760 acres) of privately owned, predominantly agricultural lands near the towns of Mutual, Mechanicsburg, Mingo, Woodstock, and North Lewisburg. The first phase of the Project is still in the preliminary stages of design, but is expected to consist of 70 turbines, meteorological (met) towers and associated access roads, transmission lines, and an electrical substation. The turbines will likely be 1.8 to 2.5 megawatt (MW) machines mounted on tubular steel towers. The height specifications of proposed turbines have not yet been determined, but turbines are expected to have a maximum height of 150 meter (m; 492 feet [ft]; 100 m hub height with 50 m blade length).

In advance of permitting activities for the Project, EverPower contracted Stantec to conduct wildlife surveys to provide data to help assess the potential impacts to birds and bats from the proposed Project. Pre-construction assessments of the Project area began in fall 2007 when Stantec conducted nocturnal radar, raptor migration, and bat acoustic surveys. To further characterize use of the Project area by birds and bats, Stantec conducted acoustic bat, diurnal raptor, breeding bird, and hibernacula/swarm surveys in 2008, the results of which will be the basis of discussion for this report.

This document and all field surveys conducted in support of this document, are in accordance with the work plan that was developed cooperatively and approved by the Ohio Department of Natural Resources (ODNR) and the Reynoldsburg Ohio Ecological Services Field Office of the Unites States Fish and Wildlife Service (OH USFWS) in May 2008. Surveys were also conducted in accordance with standard methods that are developing within the wind power industry and are consistent with the survey protocols approved for several other wind energy projects conducted recently in the eastern region of the United States.

## 1.2 PROJECT AREA DESCRIPTION

The Project area (Figure 1-1) is a mosaic of active agricultural lands, mostly corn and soybean, interspersed with relatively small stands of mixed hardwood forest. It lies on an approximately 396 m (1,300 ft) plateau that rises 91 to 152 m (300 to 500 ft) above the surrounding landscape.

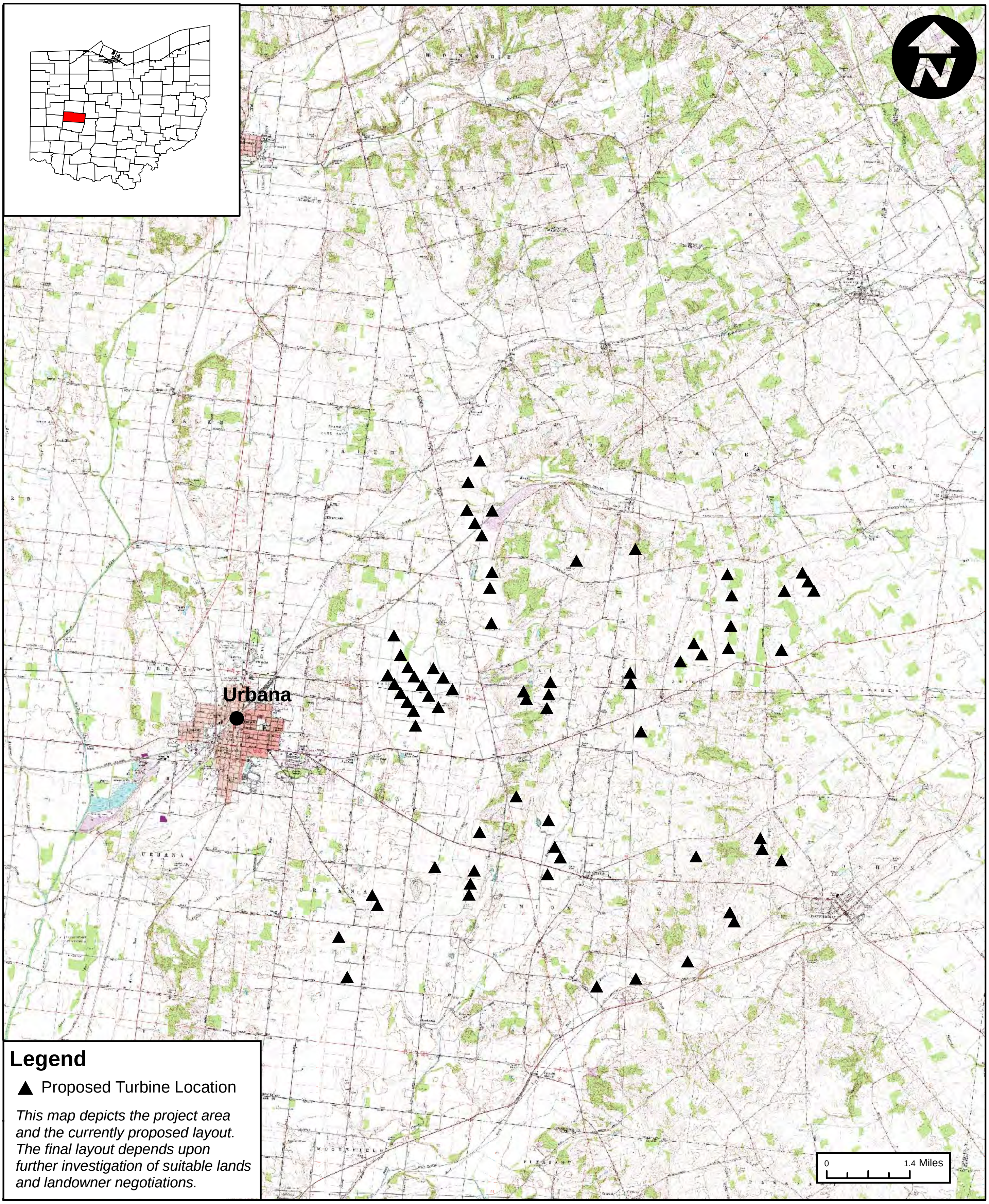
The local topography is characterized by small rolling hills. Many areas are underlain by karst geological features, or those formed by the dissolution of layers of soluble bedrock that creates subterranean drainages and sinkholes. The northern portion of the study area has more karst topography features and a greater density of woodlots bordering agricultural fields than the southern portion. Land use in the area includes active agricultural operations, low density residential developments, and some tourist activity at historical sites.

The area is comprised of predominantly agricultural habitat, with scattered areas of upland and riparian forests, as well as shrub habitats. Forested habitat that supports water features such as streams comprises 1,640 hectares (4,052 acres) or 7% of the total Project area. Most of the forest stands are mixed hardwood dominated by oaks (*Quercus* spp.), maples (*Acer* spp.), hickories (*Carya* spp.), and ash (*Fraxinus* spp.), with few conifer trees. Many forest stands are even-aged, while some are more structurally diverse. Many stands contain both live and dead trees and provide potential habitat for birds and bats. The majority, if not all, of the turbines currently proposed are to be located in open agricultural settings.

## 1.3 SURVEY OVERVIEW

Stantec conducted field investigations, or surveys, for bird and bat migration during spring, summer, and fall 2008. The overall goals of the surveys were to document:

- activity patterns of bats in the Project area, including the seasonal peaks in detections rate, guild and species composition, and relationship with weather factors;
- passage rates for diurnal raptor and sandhill crane (*Grus canadensis*) migration in the vicinity of the Project area, including the number and species of migrants, their flight direction, and their flight altitude;
- species composition and abundance of breeding birds within the Project area, and where possible, the presence of any rare, threatened, or endangered species; and
- species composition and abundance of bats swarming and/or hibernating within the Project area.




## Legend

▲ Proposed Turbine Location

*This map depicts the project area and the currently proposed layout. The final layout depends upon further investigation of suitable lands and landowner negotiations.*

| Prepared By: Stantec | Sheet Title: Project Area Location Map | Date: February 2009 |
|---|---|---|
| | Project: Buckeye Wind Power Project, Ohio | Scale: 1" = 2.2 Miles |
| | | Proj. No.: 195600164 |
| | | Figure: 1-1 |

# 2.0 Acoustic Bat Survey

## 2.1 INTRODUCTION

Stantec conducted passive acoustic surveys during spring, summer, and fall 2008 to supplement 2007 acoustic survey efforts. The goal of spring and fall acoustic surveys was to document migratory bat activity patterns in the proposed Project area, and the goal of the summer survey was to document bat activity in the Project area during the breeding season. Acoustic bat detectors allow for passive and long-term monitoring of bat activity in a variety of habitats, including the air space approaching the rotor-swept zone of modern wind turbines. The acoustic bat survey conducted at the Project was designed to document bat activity patterns near the rotor zone of the proposed turbines, at an intermediate altitude, and near the ground. Acoustic surveys were also intended to document bat activity patterns in relation to weather factors including wind speed, temperature, and relative humidity.

A total of eleven bat species known to occur in the state of Ohio, based on their normal geographic ranges, have potential to be documented in acoustic surveys. These include *Mytois* species: Indiana bat (*Myotis sodalis*), little brown bat (*M. lucifugus*), northern long-eared bat (*M. septentrionalis*), eastern small-footed bat (*M. leibii*); as well as other Microchiroptera species: silver-haired bat (*Lasionycteris noctivagans*), tri-colored bat (*Perimyotis subflavus*)[1], big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus*), evening bat (*Nycticeius humeralis*), and Rafinesque's big-eared bat (*Corynorhinus rafinesquii*). Of these, the Indiana bat is listed as a federally endangered species, and the eastern small-footed bat and the Rafinesque's big-eared bat are listed as state-endangered by the ODNR. Although the Project area is slightly north of Rafinesque's big-eared bat's normal distribution, there is some potential for its occurrence in the vicinity of the Project area.

## 2.2 METHODS

### 2.2.1 Field Surveys

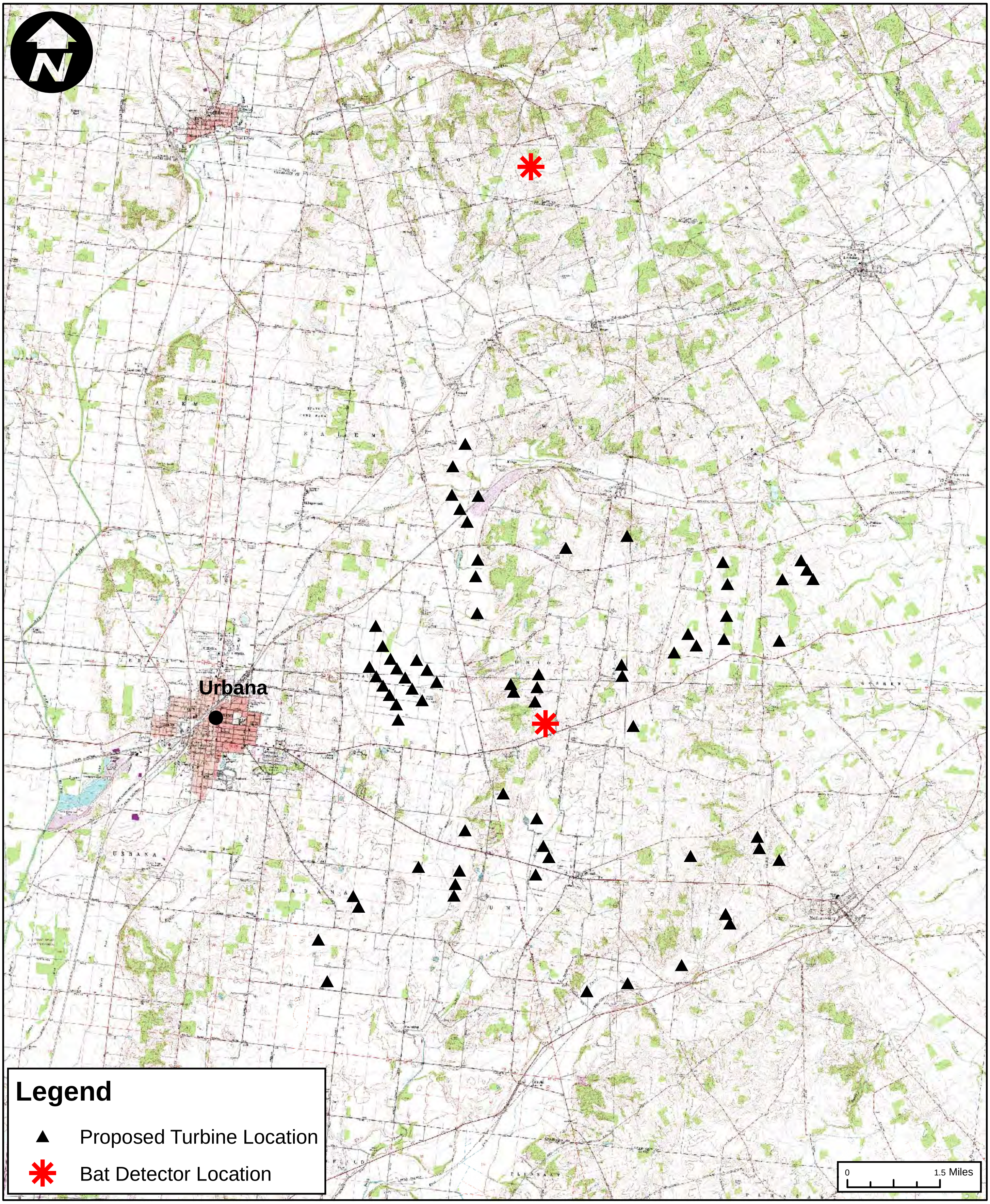
Anabat SD1 and Anabat II detectors (Titley Electronics Pty Ltd.) were used to record bat echolocation calls. Anabat detectors were selected based upon their widespread use for this type of survey, their ability to be deployed for long periods of time, and their ability to detect a broad frequency range which allows detection of all species of bats that could occur in the Project area. Anabat detectors are frequency division detectors that divide the frequency of ultrasonic calls made by bats by a factor of 16 so that they are audible to humans, and then record the calls for subsequent analysis. The audio sensitivity setting of each Anabat system was set at between six and seven (on a scale of one to ten) to maximize sensitivity while limiting ambient background noise and interference. The sensitivity of individual detectors was then tested using an ultrasonic Bat Chirp (Reno, NV) to ensure that the detectors would be able to

[1] The common and scientific name of the tri-colored bat was recently changed from eastern pipistrelle (*Pipistrellus subflavus*).

detect bats to a minimum distance of at least 10 m (33 ft). Each Anabat detector was coupled with CF Storage ZCAIMs (Titley Electronics Pty Ltd.), which programmed the detector to record from a half hour before sunset to a half hour after sunrise. Data were stored on removable 1 GB compact flash cards.

Detectors were powered by 12-volt batteries charged by solar panels. Each solar-powered Anabat system was deployed in a waterproof housing enabling the detector to record while unattended for the duration of the survey. The housing directed the Anabat microphone downward to give maximum protection from precipitation. To compensate for the downward position, a reflector shield of smooth plastic was placed at a 45-degree angle directly below the microphone. The angled reflector allowed the microphone to record the airspace horizontally surrounding the detector and was only slightly less sensitive than an unmodified Anabat unit. Maintenance visits were conducted approximately every one to two weeks to check on the condition of the detectors and to download data to a computer for analysis.

Six detectors were deployed in the Project area and were programmed to passively record from a half hour before sunset until a half hour after sunrise from March 29 through September 3, 2008. Three detectors were deployed at each of the two 60 m (197 ft) met towers and were positioned to record calls of bats flying within and adjacent to the met tower clearings. One met tower was located in the northern portion of the Project area (Figures 2-1 and 2-2) and another was located approximately nine miles due south in the southern portion of the Project area (Figures 2-1 and 2-3). The habitat surrounding the met towers was mostly open agriculture or pasture, with scattered hedgerows and isolated trees. Both towers were within 100 to 200 m (328 to 656 ft) of mixed hardwood, second-growth forest stands.




Prepared By:

Stantec

Sheet Title:

Bat Acoustic Survey Location Map

Project:

Buckeye Wind Power Project, Ohio



Date: February 2009

Scale: 1" = 2.1 Miles

Proj. No.: 195600164

Figure:

2-1

**Figure 2-2.** View looking northwest from the north meteorological tower

**Figure 2-3.** View looking south from the south meteorological tower

Detectors at each met tower were placed in the following locations: 'high' detectors were deployed at a height of approximately 40 m (131 ft) in met towers; 'low' detectors were positioned at a height of 20 m (66 ft); and 'tree' detectors were placed in nearby trees approximately 1.5 to 3 m (5 to 10 ft) above the ground at the base of the met towers. The individual detectors will be referred to as "North High", "North Low", "North Tree", "South High", "South Low", and "South Tree" throughout this report.

### 2.2.2 Data Analysis

Potential call files were extracted from data files using CFCread© software which screens all data recorded by the bat detector and extracts call files using a filter. A call is a single pulse of sound produced by a bat. A call sequence is a combination of two or more pulses recorded in a call file. The default settings for CFCread© were used during this file extraction process, as these settings are recommended for northeastern bats and they increase comparability between data sets. Settings used by the filter include a max TBC (time between calls) of 5 seconds, a minimum line length of 5 milliseconds, and a smoothing factor of 50. The smoothing factor refers to whether or not adjacent pixels can be connected with a smooth line. The higher the smoothing factor, the less restrictive the filter is and the more noise files and poor quality call sequences (sequences) are retained within the data set. Understanding the parameters of these settings is important in terms of determining when individual calls are classified as "unknown".

Following extraction of call files, each file was visually inspected to ensure that files created by static or some other form of interference that were still within the frequency range of Ohio bats were not included in the data set. Bat calls typically include a series of pulses characteristic of normal flight or prey location ("search phase" calls) and capture periods (feeding "buzzes"). Bat calls look very different than static, which typically forms a diffuse band of dots at either a constant frequency or widely varying frequency, caused by wind, vibration, or other interference. Using these characteristics, bat call files are easily distinguished from non-bat files.

Bat call sequences were individually marked and categorized by species group, or "guild" based on visual comparison to reference calls. Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species (O'Farrell *et al*. 1999, O'Farrell and Gannon 1999). A call sequence was considered of suitable quality and duration if the individual call pulses were "clean" (i.e., consisting of sharp, distinct lines) and at least five pulses were included within the sequence. Call sequences were classified to species whenever possible, based on criteria developed from review of reference calls collected by Chris Corben, the developer of the Anabat system, and other bat researchers. However, due to similarity of call signatures between several species, all classified calls have been categorized into five guilds for presentation in this report. This classification scheme has been modified from Gannon *et al.* (2003) as follows:

- **Unknown (UNKN)** – All call sequences with too few pulses (less than five) or of poor quality (such as indistinct pulse characteristics or background static). These calls were further identified as either "high frequency unknown" (HFUN) for call fragments with a minimum frequency above 30 to 35 kHz; or “low frequency unknown” (LFUN) calls for call fragments with a minimum frequency below 30 to 35 kHz.

- **Myotid (MYSP)** – All four species of *Myotis* potentially occurring in the Project area: little brown bat, northern long-eared bat, eastern small-footed bat, and Indiana bat. Of these species, the little brown bat and northern long-eared bat have calls that tend to be slightly more distinguishable using the Anabat system. While there are some general characteristics believed to be distinctive for several of the species in this genus, these characteristics do not occur consistently enough for any one species to be relied upon at all times when using Anabat recordings.

- **Red bat/tri-colored bat (RBTB)** – Eastern red bats and tri-colored bats. Eastern red bats have relatively unique calls which span a wide range of frequency and have a characteristic hooked shape and variable minimum frequency. Tri-colored bats tend to have relatively uniform calls, with a constant minimum frequency and a sharply curved profile. These two species can produce calls distinctive only to each species. However, significant overlap in the call pulse shape, frequency range, and slope can also occur. This guild would include evening bats if they occurred in the Project area.

- **Big brown/silver-haired/hoary bat (BBSH)** – Big brown and silver-haired bats. Calls of silver-haired bats and big brown bats are occasionally distinguishable, but often overlap in range and can be difficult to distinguish, especially when comparing short duration calls typical of those recorded during passive monitoring. These species’ call signatures commonly overlap and have therefore been included as one guild in this report.

- **Hoary bat (HB)** – Hoary bats. The hoary bat has easily distinguishable calls characterized by highly variable minimum frequencies, often extending below 20 kHz, and a hooked profile similar to the eastern red bat.

This method of guild grouping is a conservative approach to bat call identification. Bat calls were identified to guild within this report, although calls were provisionally categorized by species when possible during analysis. Certain species, such as the eastern red bat and hoary bat have easily identifiable calls; whereas other species, such as the big brown bat and silver-haired bat are difficult to distinguish acoustically. Similarly, certain members of the *Myotis* genus, such as the northern long-eared bat, are far more common and have slightly more distinguishable calls than other species.

Since some species sometimes produce calls unique only to that species, calls were identified to the lowest possible taxonomic level before being grouped into the listed guilds. Tables and figures in the body of this report will reflect those guilds. However, since species-specific identification did occur in some cases, each guild will also be briefly discussed with respect to potential species composition of recorded call sequences. Once all of the call files were identified and categorized in appropriate guilds, nightly tallies of detected calls were compiled. Mean detection rates (number of call sequences/detector-night) for the entire sampling period were calculated for each detector and for all detectors combined.

### 2.2.3 Weather Data

Weather data was collected at 10-minute intervals by instruments placed in the north and south met towers by EverPower. The 10-minute sample data were averaged to derive nightly estimates of temperature and wind speed, which were then qualitatively compared with numbers of bat call sequences recorded at each detector.

## 2.3 RESULTS

### 2.3.1 Detector Operation

Detectors were operational for a total of 774 of 954 potential detector-nights (81%) between March 29 and September 3, 2008 (Table 3-1). Each detector recorded a large quantity of data, and some of the detectors experienced data loss due to occasional power-down or other unexpected technical problems. Detector success ranged from 69% at the North Tree detector, to 95% at the South Tree detector. Data loss in this survey is not considered to be of significant concern because there was always at least one detector functioning at both the north and south sample locations at all times during the survey (Appendix A; Tables 1-6).

### 2.3.2 Detection Rates

A total of 18,715 bat calls sequences were recorded at the six bat detectors, with a mean nightly detection rate of 23.8 call sequences/detector/night (s/d/n; Tables 2-1 and 2-2) for the entire survey period. Mean nightly detection rate was variable for individual detectors (Table 2-1), with the highest mean detection rate recorded at the North Tree detector (108.3 s/d/n for the entire survey). Detection rates at the four detectors suspended from the met towers ranged from 0.2 s/d/n (South High - spring) to 24.3 s/d/n (North Tree - fall). Detection rates at the two tree detectors ranged from 12.5 s/d/n (North Tree - spring) to 256.5 s/d/n (North Tree -fall). Number of nightly detections varied from 0 to 688 across detectors (Figures 2-4 through 2-8; Appendix A, Tables 1 through 6).

**Table 2-1.** Seasonal summary of 2008 acoustic survey results at Buckeye Anabat detectors

| Detector / Season* | Dates | Number of Nights | Detector-nights** | Sequences Recorded | Detection Rate *** | Max Recorded**** |
|---|---|---|---|---|---|---|
| **North High** | | | | | | |
| Spring | 29 Mar–15 May | 48 | 25 | 24 | 1.0 | 7 |
| Summer | 16 May–15 Aug | 92 | 85 | 158 | 1.9 | 6 |
| Fall | 16 Aug–3 Sep | 19 | 19 | 90 | 4.7 | 14 |
| **North Low** | | | | | | |
| Spring | 29 Mar–15 May | 48 | 24 | 66 | 2.8 | 13 |
| Summer | 16 May–15 Aug | 92 | 85 | 778 | 9.2 | 26 |
| Fall | 16 Aug–3 Sep | 19 | 19 | 461 | 24.3 | 46 |
| **North Tree** | | | | | | |
| Spring | 29 Mar–15 May | 48 | 24 | 300 | 12.5 | 94 |
| Summer | 16 May–15 Aug | 92 | 69 | 7251 | 105.1 | 688 |
| Fall | 16 Aug–3 Sep | 19 | 17 | 4361 | 256.5 | 682 |
| **South High** | | | | | | |
| Spring | 29 Mar–15 May | 48 | 13 | 2 | 0.2 | 1 |
| Summer | 16 May–15 Aug | 92 | 79 | 259 | 3.3 | 14 |
| Fall | 16 Aug–3 Sep | 19 | 19 | 123 | 6.5 | 16 |
| **South Low** | | | | | | |
| Spring | 29 Mar–15 May | 48 | 48 | 108 | 2.3 | 9 |
| Summer | 16 May–15 Aug | 92 | 92 | 477 | 5.2 | 22 |
| Fall | 16 Aug–3 Sep | 19 | 19 | 265 | 13.9 | 33 |
| **South Tree** | | | | | | |
| Spring | 29 Mar–15 May | 48 | 47 | 957 | 20.4 | 204 |
| Summer | 16 May–15 Aug | 92 | 85 | 2787 | 32.8 | 480 |
| Fall | 16 Aug–3 Sep | 19 | 19 | 248 | 13.1 | 95 |
| **Overall Results** | | | | | | |
| **Spring Met Average** | 29 Mar–15 May | 48 | 28 | 50 | **1.8** | -- |
| **Spring Tree Average** | | 96 | 71 | 1257 | **17.7** | |
| **Summer Met Average** | 16 May–15 Aug | 92 | 85 | 418 | **4.9** | -- |
| **Summer Tree Average** | | 184 | 154 | 10038 | **65.2** | |
| **Fall Met Average** | 16 Aug–3 Sep | 19 | 19 | 235 | **12.4** | -- |
| **Fall Tree Average** | | 38 | 36 | 4609 | **128.0** | |
| **Survey Totals** | | 954 | 788 | 18715 | **23.8** | |

*Seasons are not equal in length: spring = March 29 to May 15; summer = May 16 to August 15; fall = August 16 to September 3

** Detector-night is a sampling unit during which a single detector is deployed overnight. On nights when two detectors are deployed, the sampling effort equals two detector-nights, etc.

*** Number of ultrasound sequences recorded per detector-night.

**** Maximum number of ultrasound sequences recorded from any **single** detector for a 12-hour sampling period.

**Table 2-2.** Monthly summary of 2008 acoustic survey results at Buckeye Anabat detectors

| Detector / Month | Dates | Number of Nights | Detector-nights* | Sequences Recorded | Detection Rate ** | Max Recorded *** |
|---|---|---|---|---|---|---|
| **North High** | | | | | | |
| March | 29 Mar–31 Mar | 3 | 3 | 0 | 0.0 | 0 |
| April | 01 Apr–30 Apr | 30 | 7 | 0 | 0.0 | 0 |
| May | 01 May–31 May | 31 | 31 | 35 | 1.1 | 7 |
| June | 01 Jun–30 Jun | 30 | 30 | 59 | 2.0 | 6 |
| July | 01 Jul–31 Jul | 31 | 24 | 49 | 2.0 | 5 |
| August | 01 Aug–31 Aug | 31 | 31 | 111 | 3.6 | 14 |
| September | 01 Sep–03 Sep | 3 | 3 | 18 | 6.0 | 10 |
| **North Low** | | | | | | |
| March | 29 Mar–31 Mar | 3 | 3 | 0 | 0.0 | 0 |
| April | 01 Apr–30 Apr | 30 | 6 | 6 | 1.0 | 6 |
| May | 01 May–31 May | 31 | 31 | 118 | 3.8 | 13 |
| June | 01 Jun–30 Jun | 30 | 30 | 205 | 6.8 | 21 |
| July | 01 Jul–31 Jul | 31 | 24 | 329 | 13.7 | 26 |
| August | 01 Aug–31 Aug | 31 | 31 | 581 | 18.7 | 46 |
| September | 01 Sep–03 Sep | 3 | 3 | 66 | 22.0 | 37 |
| **North Tree** | | | | | | |
| March | 29 Mar–31 Mar | 3 | 3 | 0 | 0.0 | 0 |
| April | 01 Apr–30 Apr | 30 | 6 | 17 | 2.8 | 7 |
| May | 01 May–31 May | 31 | 26 | 768 | 29.5 | 95 |
| June | 01 Jun–30 Jun | 30 | 29 | 1980 | 68.3 | 398 |
| July | 01 Jul–31 Jul | 31 | 23 | 2713 | 118.0 | 517 |
| August | 01 Aug–31 Aug | 31 | 20 | 4733 | 236.7 | 688 |
| September | 01 Sep–03 Sep | 3 | 3 | 1701 | 567.0 | 682 |
| **South High** | | | | | | |
| March | 29 Mar–31 Mar | 3 | 0 | 0 | 0.0 | 0 |
| April | 01 Apr–30 Apr | 30 | 12 | 2 | 0.2 | 1 |
| May | 01 May–31 May | 31 | 17 | 23 | 1.4 | 5 |
| June | 01 Jun–30 Jun | 30 | 17 | 50 | 2.9 | 6 |
| July | 01 Jul–31 Jul | 31 | 31 | 118 | 3.8 | 14 |
| August | 01 Aug–31 Aug | 31 | 31 | 167 | 5.4 | 16 |
| September | 01 Sep–03 Sep | 3 | 3 | 24 | 8.0 | 11 |
| **South Low** | | | | | | |
| March | 29 Mar–31 Mar | 3 | 3 | 0 | 0.0 | 0 |
| April | 01 Apr–30 Apr | 30 | 30 | 63 | 2.1 | 9 |
| May | 01 May–31 May | 31 | 31 | 84 | 2.7 | 9 |
| June | 01 Jun–30 Jun | 30 | 30 | 109 | 3.6 | 7 |
| July | 01 Jul–31 Jul | 31 | 31 | 163 | 5.3 | 18 |
| August | 01 Aug–31 Aug | 31 | 31 | 401 | 12.9 | 33 |
| September | 01 Sep–03 Sep | 3 | 3 | 30 | 10.0 | 11 |
| **South Tree** | | | | | | |
| March | 29 Mar–31 Mar | 3 | 2 | 0 | 0.0 | 0 |
| April | 01 Apr–30 Apr | 30 | 30 | 354 | 11.8 | 106 |
| May | 01 May–31 May | 31 | 31 | 2446 | 78.9 | 480 |
| June | 01 Jun–30 Jun | 30 | 30 | 337 | 11.2 | 182 |
| July | 01 Jul–31 Jul | 31 | 24 | 499 | 20.8 | 113 |
| August | 01 Aug–31 Aug | 31 | 31 | 316 | 10.2 | 95 |
| September | 01 Sep–03 Sep | 3 | 3 | 40 | 13.3 | 24 |
| **Overall Results** | | **954** | **788** | **18715** | **23.8** | -- |

* Detector-night is a sampling unit during which a single detector is deployed overnight. On nights when two detectors are deployed, the sampling effort equals two detector-nights, etc.

** Number of ultrasound sequences recorded per detector-night.

*** Maximum number of ultrasound sequences recorded from any **single** detector for a 12-hour sampling period.

#### 2.3.2.1 Detection Rates per Guild Group and Species

The majority of the recorded call sequences for all detectors combined belonged to the BBSH guild (n = 11,238; 60.0%; Table 2-3). Calls identified as BBSH consisted primarily of calls that could not be identified as either species (n = 9148; 82%), followed by calls identified as big brown bats (n= 1948; 17%) and silver-haired bats (n = 106; 1%). The majority of call sequences at each individual detector was also identified as BBSH, except for the North and South High detectors, where LFUN calls were the most common (n= 112; 41% and n= 161; 42%, respectively; Table 2-3 and Figure 2-4 through Figure 2-7). Together, LFUN, HFUN, and unknown calls (the UNKN guild) comprised 32% (n=6009) of call sequences recorded at all detectors. When considered separately, the LFUN guild was the second most commonly identified guild across all detectors (n=3253; 17%), followed by the HFUN guild (n=2439; 13%; Table 2-3).

Calls identified as RBTB consisted primarily of call sequences identified as red bats (n = 496; 69%), followed by calls that could not be identified as either red bats or tri-colored bats (n = 213; 30%; Figure 2-7; Appendix A). Only 1% (n=9) of call sequences in the RBTB guild were identified as tri-colored bats. Only 3% of all calls were identified to the MYSP guild and 91% (n=546) of these call sequences were recorded at the North Tree detector. Call sequences identified as HB comprised only 1% of all calls sequences (n=148). The majority of HB calls (n=44; 30%) were recorded at the North Tree detector (Table 2-3). The detection rates of Lasurine species recorded at high and low positions within met towers showed peaks in silver-haired bat activity in early May and mid June, peaks in hoary bat activity in early June and mid July, and peaks in red bat activity in mid to late August (Figure 2-8).

Appendix A provides a series of tables with more specific information on the nightly timing, number, and species composition of recorded bat call sequences. Specifically, Appendix A Tables 1 through 6 provide information on the number of call sequences, by guild and suspected species, recorded at each detector and the weather conditions for that night. Stantec can provide a digital file of all acoustic calls, including all information about species identification and timing of calls from each detector on an hourly and nightly basis, should that information be desired.

**Table 2-3.** Distribution of detections by guild, March - September, 2008.

| Detector | Guild | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | BBSH | HB | RBTB | MYSP | UNKN | | | |
| | | | | | HFUN | LFUN | Unknown | |
| North High | 91 | 9 | 20 | 4 | 35 | 112 | 1 | 272 |
| North Low | 495 | 17 | 173 | 21 | 249 | 318 | 32 | 1,305 |
| North Tree | 7891 | 44 | 333 | 546 | 1586 | 1312 | 200 | 11,912 |
| South High | 120 | 29 | 25 | 4 | 44 | 161 | 1 | 384 |
| South Low | 343 | 24 | 70 | 4 | 102 | 304 | 3 | 850 |
| South Tree | 2298 | 25 | 96 | 24 | 423 | 1046 | 80 | 3,992 |
| **Total** | **11238** | **148** | **717** | **603** | **2439** | **3253** | **317** | **18715** |
| **Guild Composition %** | **60%** | **1%** | **4%** | **3%** | **13%** | **17%** | **2%** | |

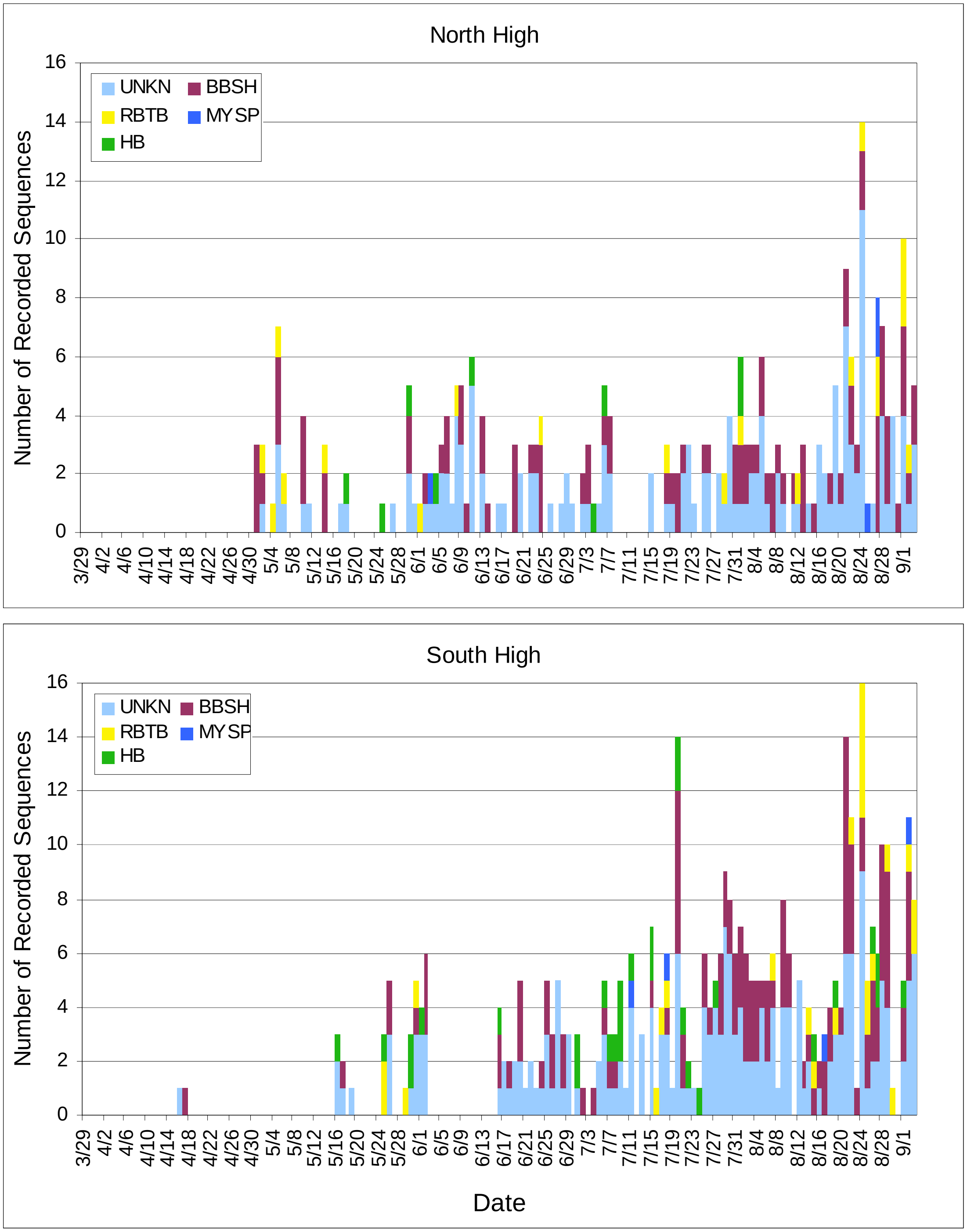
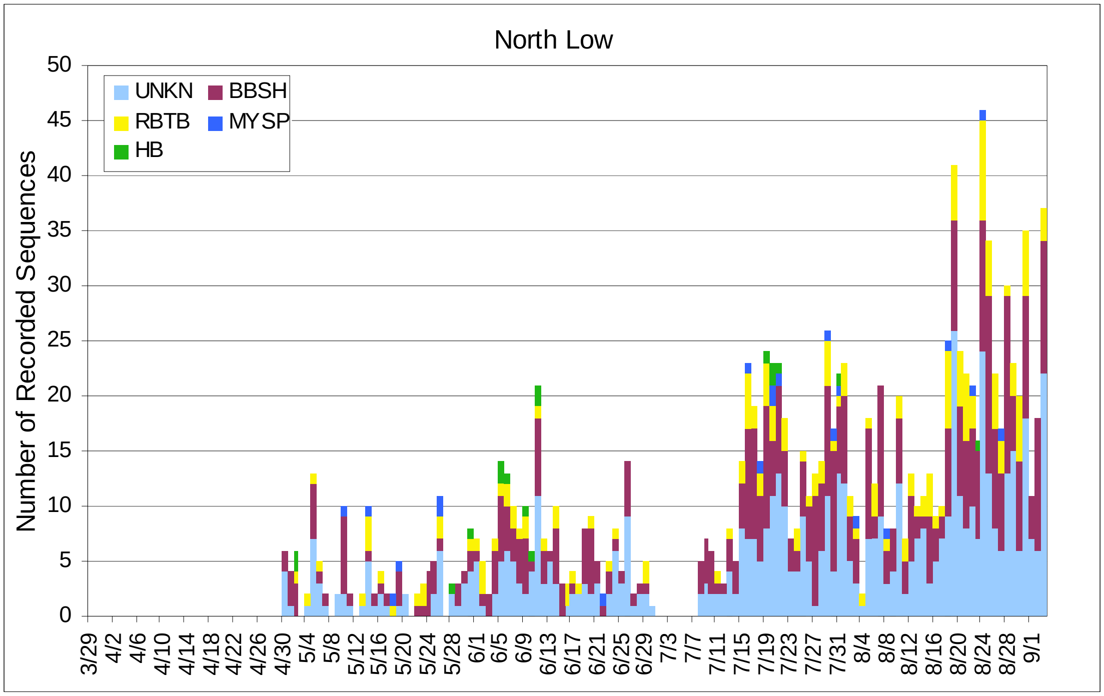



**Figure 2-4.** Nightly detections at the North and South High met detectors from March through September, 2008. *Guild codes: UNKN (unknown); RBTB (red bat/tri-colored bat); BBSH (big brown/silver haired); MYSP (*Myotis*); and HB (hoary bat).



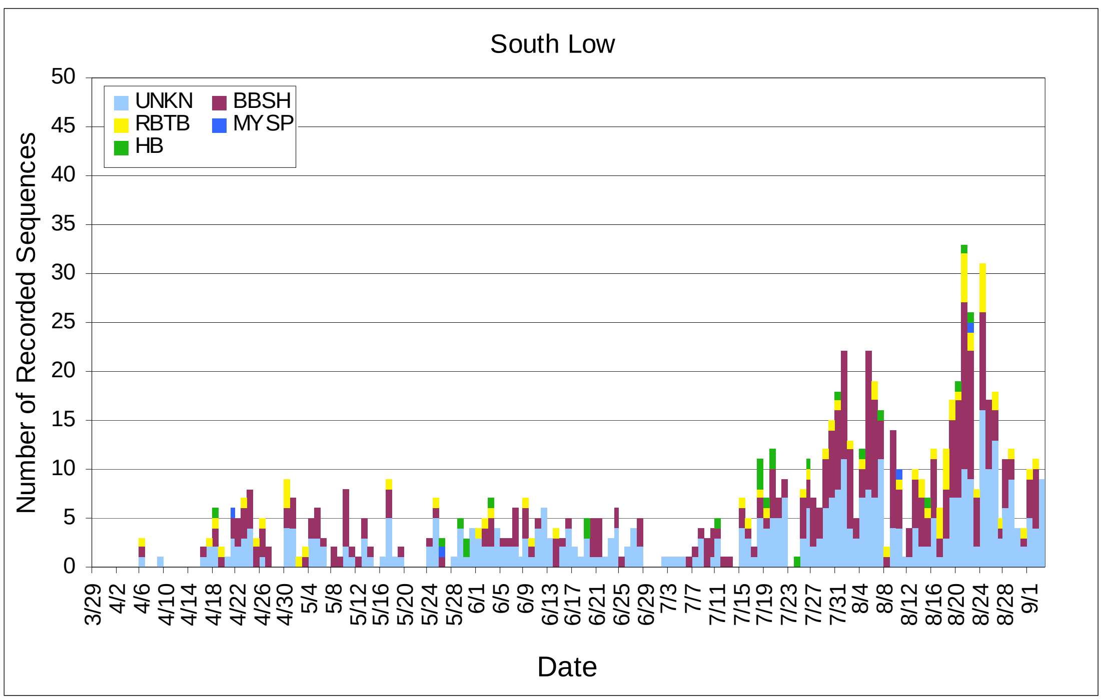
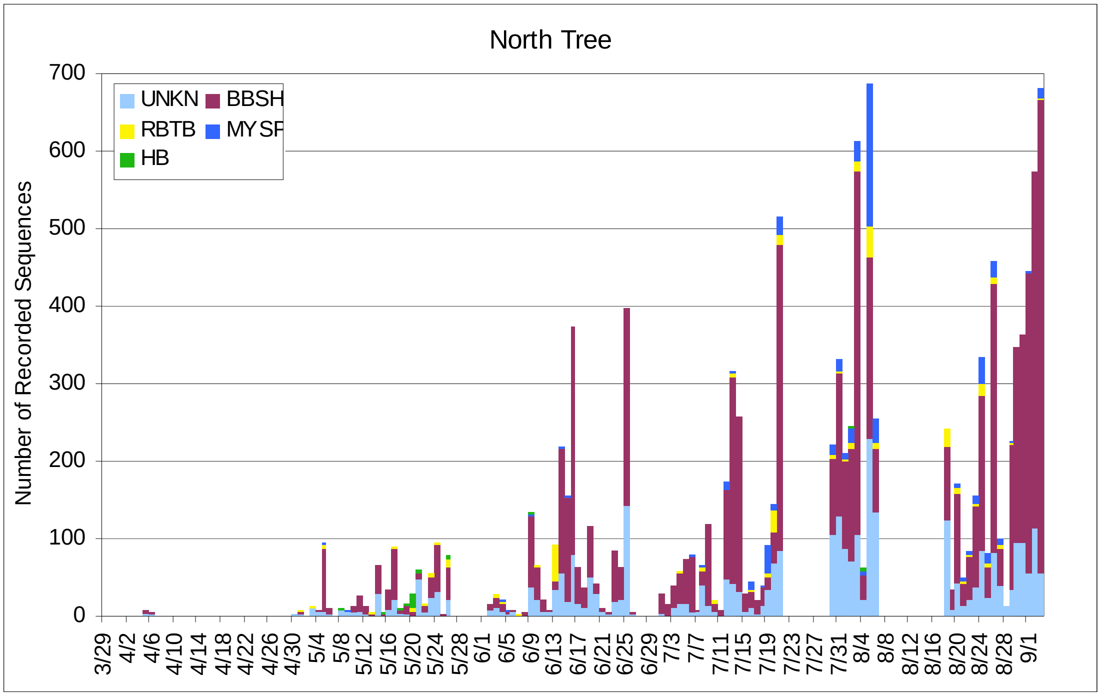




**Figure 2-5.** Nightly detections at the North and South Low met detectors from March through September, 2008. *Guild codes: UNKN (unknown); RBTB (red bat/tri-colored bat); BBSH (big brown/silver haired); MYSP (*Myotis*); and HB (hoary bat).



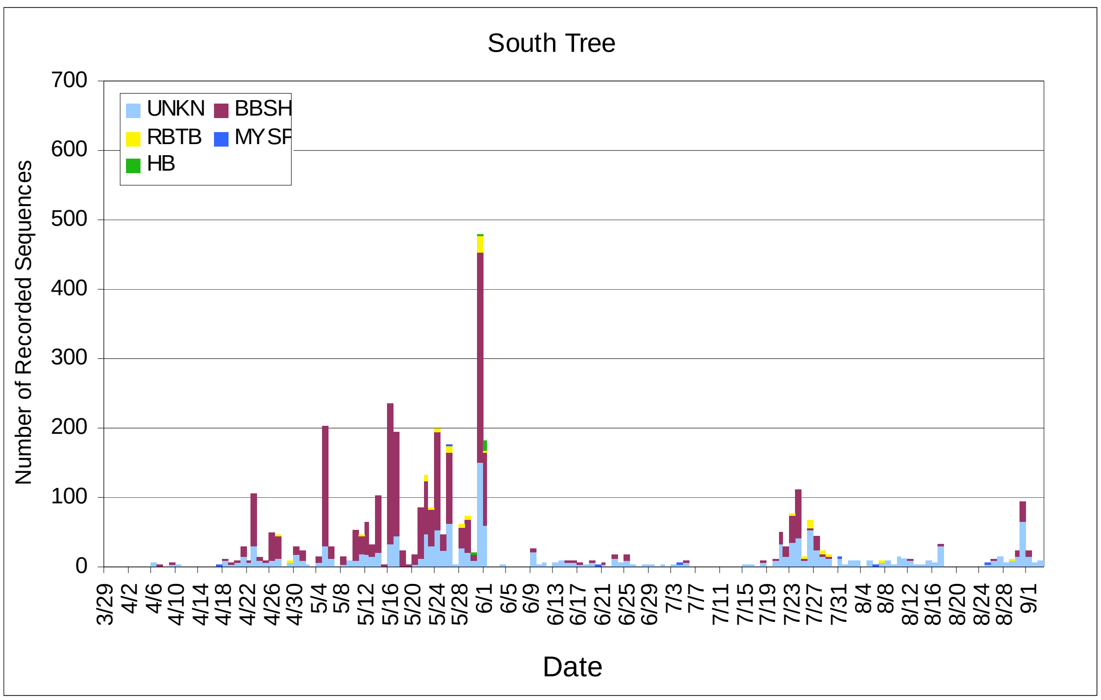




**Figure 2-6.** Nightly detections at the North and South Tree detectors from March through September, 2008. *Guild codes: UNKN (unknown); RBTB (red bat/tri-colored bat); BBSH (big brown/silver haired); MYSP (*Myotis*); and HB (hoary bat).

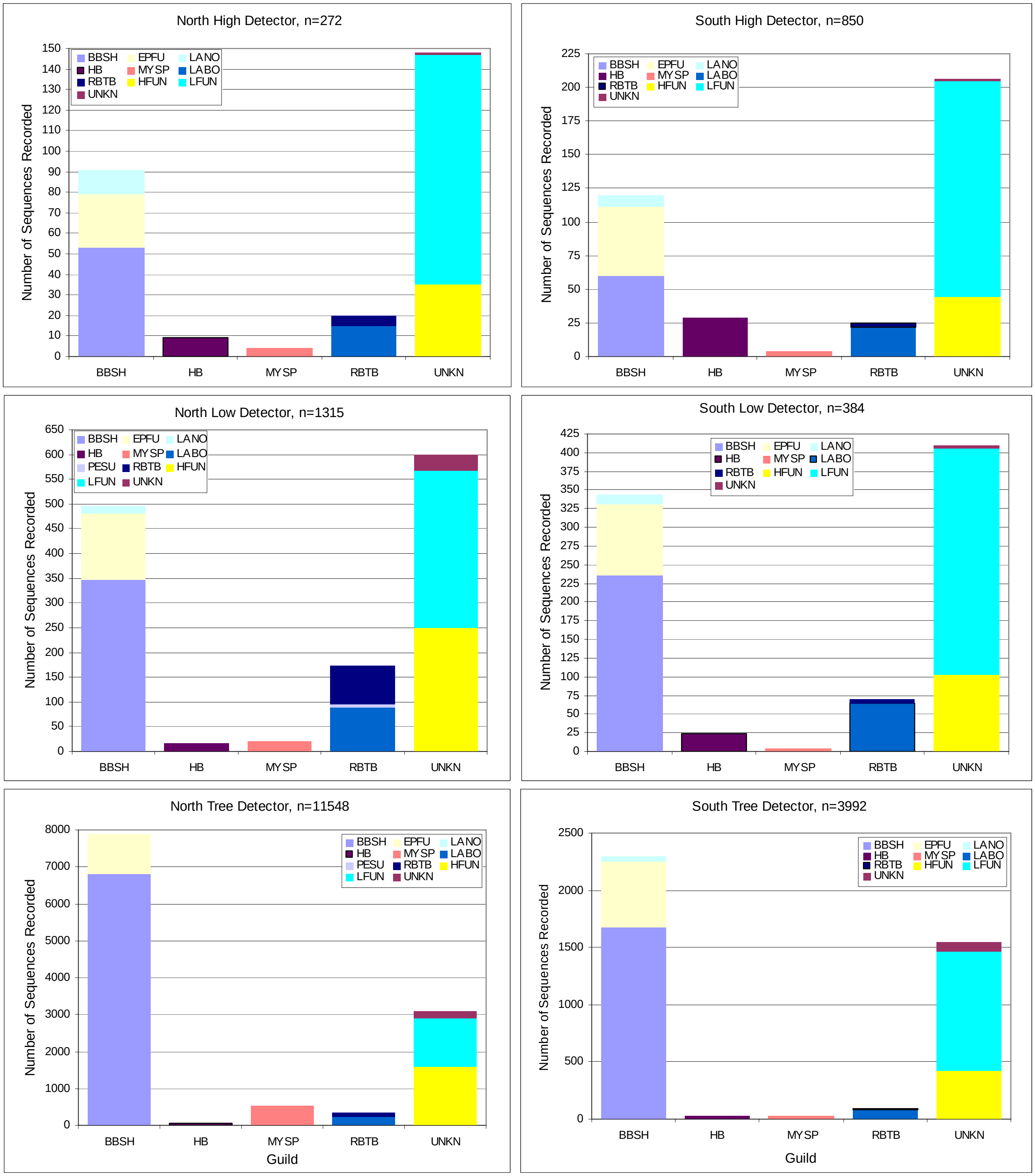



**Figure 2-7.** Summary of call sequences recorded during from March to September, 2008 by guild and species in the Project area. *Species codes: EPFU = big brown bat; LANO = silver-haired bat; PESU = tri-colored bat; LACI = hoary bat; LABO = red bat. *Guild codes: RBTB = red bat/ tri-colored bat; BBSH = big brown/ silver-haired bat; HB = hoary bat; MYSP = *Myotis*; UNKN = unknown; HFUN = high frequency unknown; LFUN = low frequency unknown.

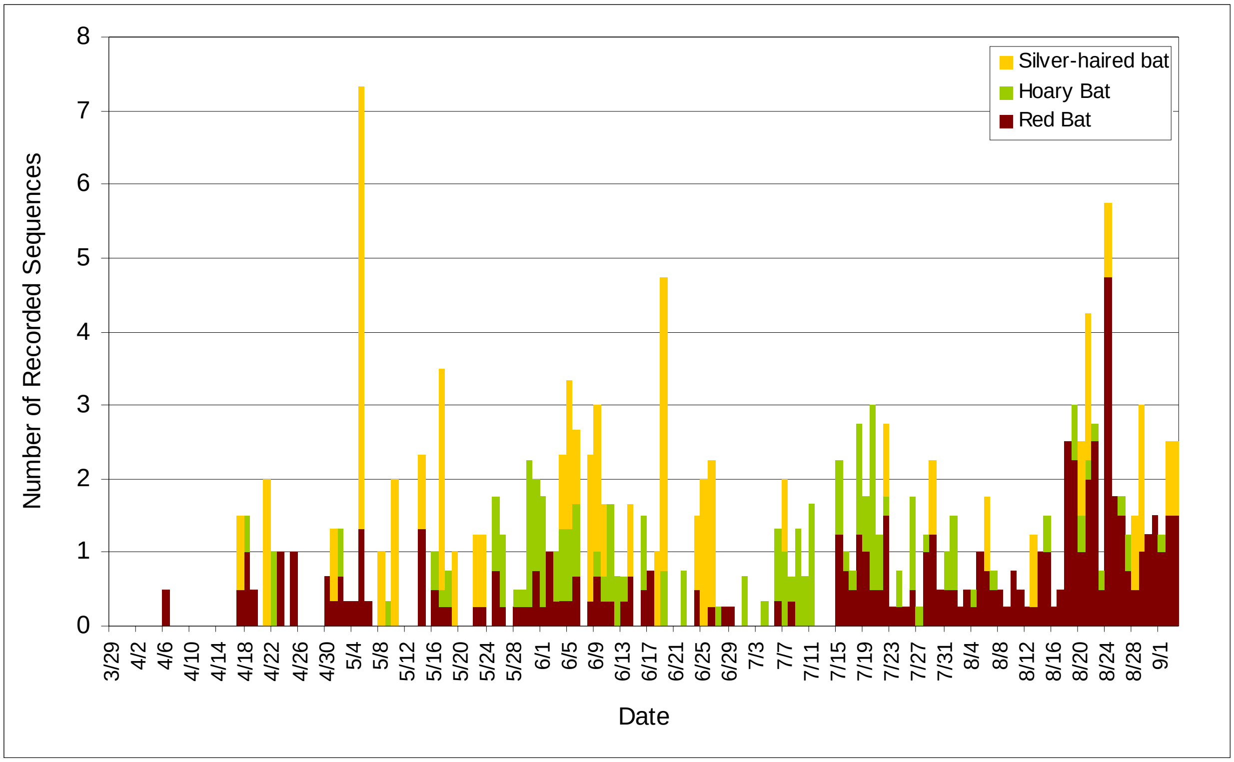



**Figure 2-8.** Nightly detections of Lasiurine species (silver-haired, red, and hoary bats) at met tower detectors from March through September, 2008.

### 2.3.2.2 Seasonal and Nightly Variation in Detection Rates

When comparing the total number of call sequences recorded in each month during the spring (March 29 through May 15), summer (May 16 through August 15), and fall (August 16 through September 3), all detectors, with the exception of the South Tree detector, showed similar trends in seasonal activity, whereby activity increased steadily throughout the sampling period and was the greatest in the fall (Figures 2-9 a and b). Detection rates at the South Tree detector dropped sharply in early June (Figure 2-9 b). This is not consistent with what would be expected, given typical bat activity associated with summer breeding and foraging activities. The sharp drop in detection rates after June 1 is difficult to explain. Although careful examination of field data sheets and detector status files did not indicate any problems, it is possible that some unknown malfunction (e.g., reduced microphone sensitivity as a result of water damage) was responsible for this unexpected trend, rather than a real biological phenomenon.

During the spring, call sequences recorded per night for all detectors combined ranged from a minimum of zero (nine nights) to 324 call sequences (May 5). During the summer, call sequences ranged from a minimum of 3 (June 30) to 749 call sequences (August 5). During the fall, call sequences ranged from a minimum of 32 (August 16) to 751 call sequences (September 3). Peaks in call volume varied with time of night, with the greatest activity occurring one and two hours after sunset (Figure 2-10).

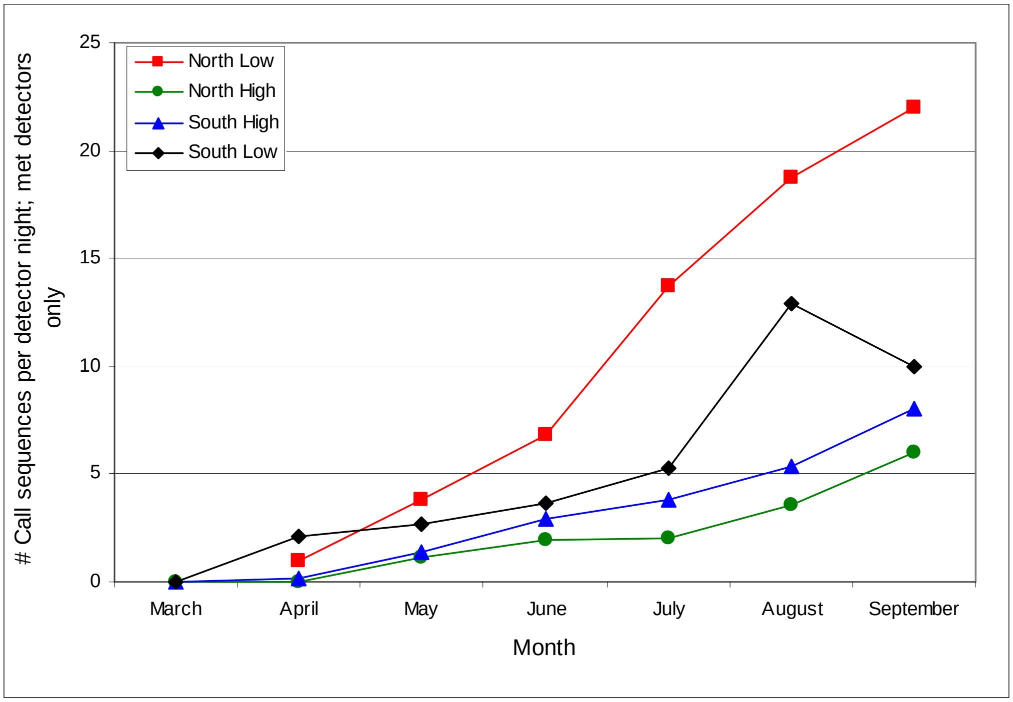



**Figure 2-9a.** Mean nightly detection rate summarized by month for all detectors suspended in met towers in the Project area from March through September 2008 (*note that March and September each included only three possible detector-nights).

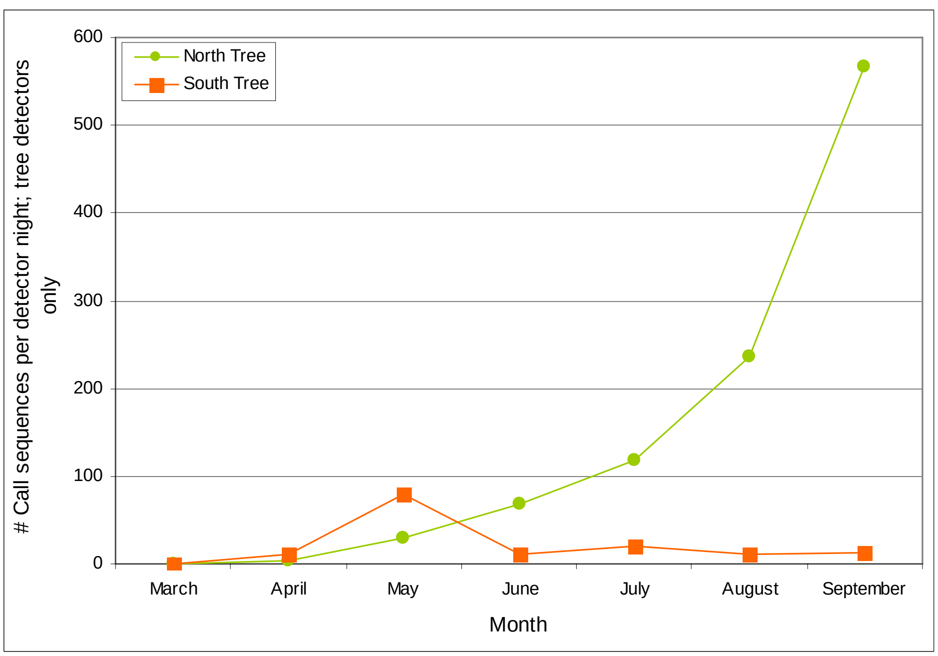



**Figure 2-9b.** Mean monthly detection rate for all tree detectors from March through September, 2008.
*Note that March and September each included only three possible detector-nights.

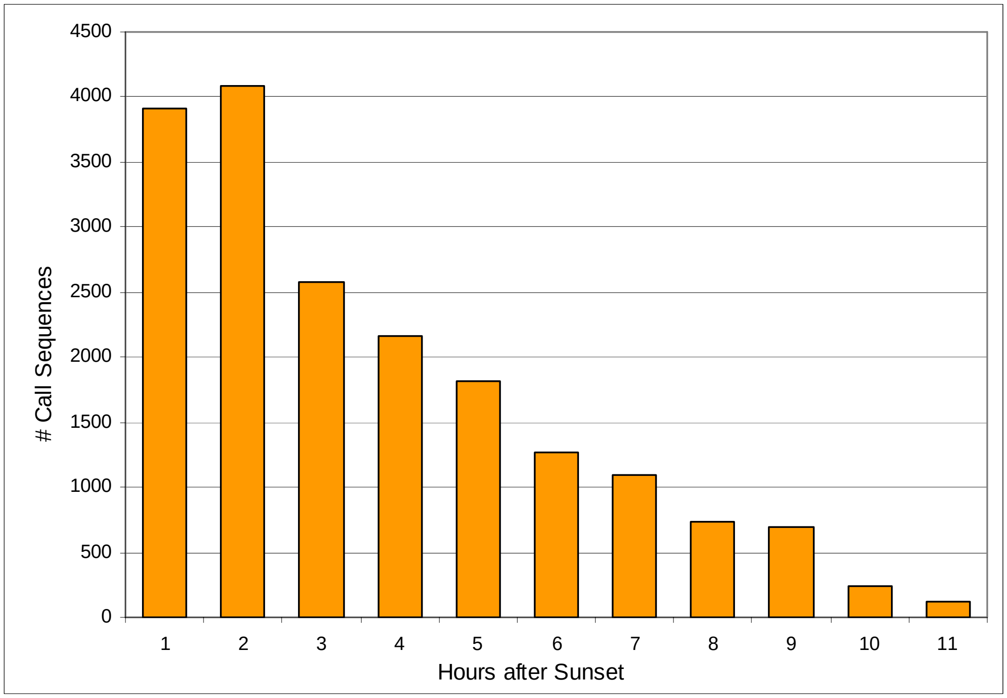



**Figure 2-10**. Distribution of hourly recorded call sequences at all detectors, March through September, 2008.

When the total number of call sequences recorded per night for all detectors combined is plotted against mean nightly temperatures, some patterns appear (Figure 2-11). Based on qualitative analysis, the number of recorded call sequences appears to remain relatively low at temperatures less than 10 ºC (50 ºF) and nights with peak activity were all recorded at temperatures greater than this. Similarly, when the total number of call sequences recorded per night for all detectors combined is plotted against mean nightly wind speeds, the number of call sequences recorded tended to be low at wind speeds greater than approximately 7.5 m/s (16.8 mph), although there were relatively few nights that had wind speeds greater than this (Figure 2-12).

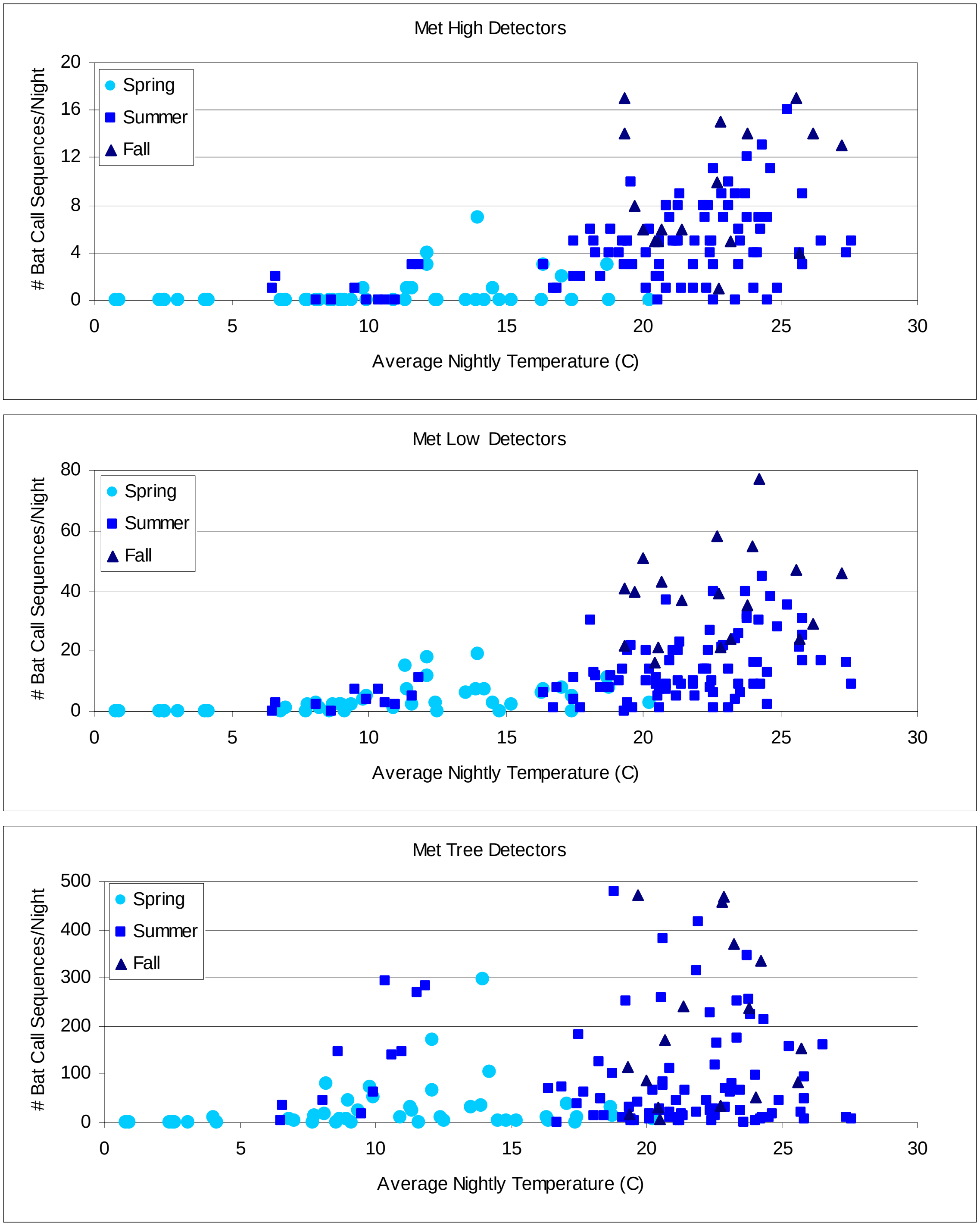



**Figure 2-11.** Total number of bat call sequences recorded each night at Met High, Low, and Tree detectors during spring, summer, and fall 2008, plotted against average nightly temperature (°C). *Note that weather data were not available from 3/29 through 3/31.

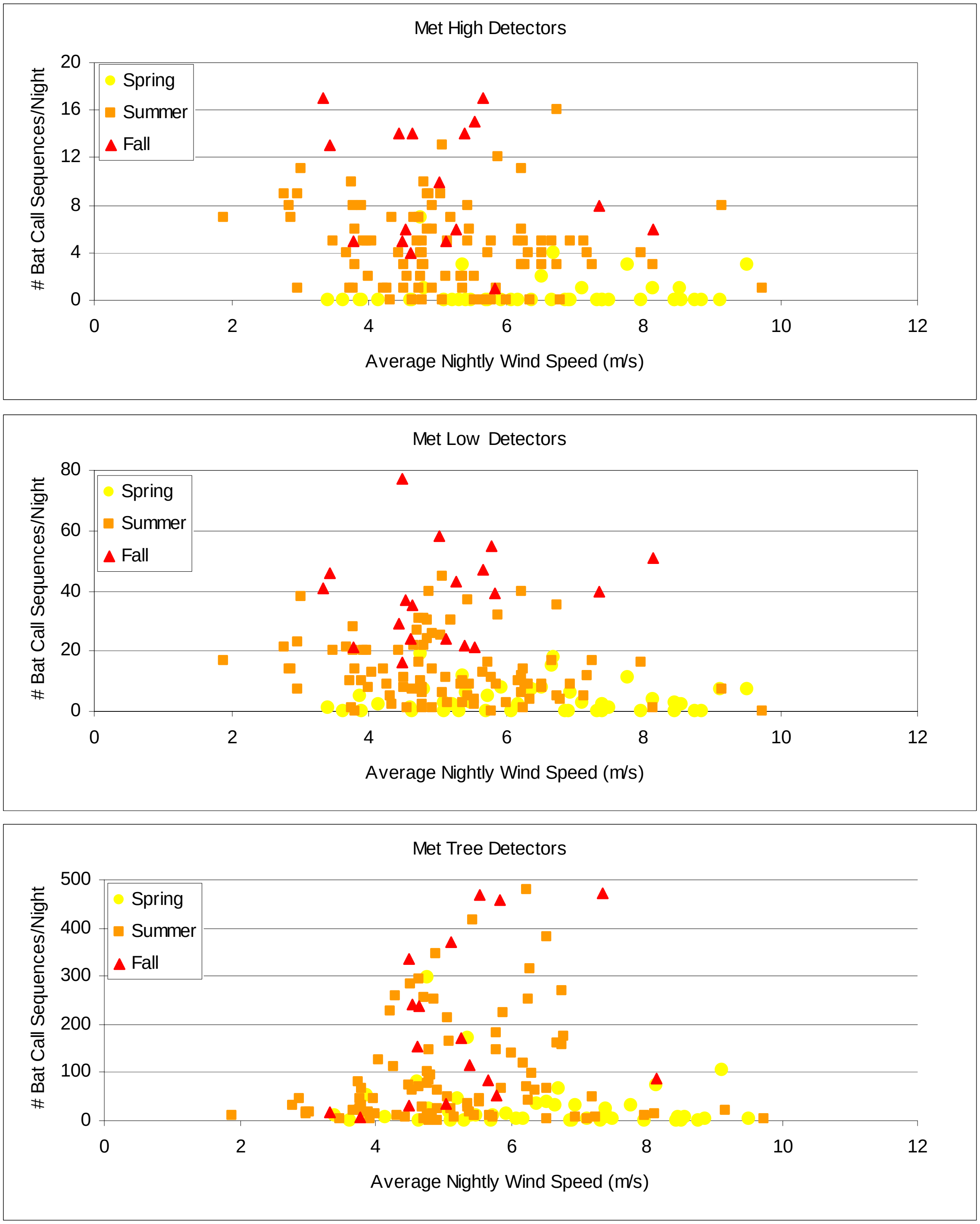



**Figure 2-12.** Total number of bat call sequences recorded each night at Met High, Low, and Tree detectors during spring, summer, and fall 2008, plotted against average nightly wind speed (m/s). *Note that weather data were not available from 3/29 through 3/31.

## 2.4 DISCUSSION AND CONCLUSIONS

Bat echolocation surveys provide insight into activity patterns, possible species composition, and timing of movements of bats in the Project area. In general, activity decreased with increasing detector height, with the highest activity recorded at ground-level detectors and the lowest activity recorded at the highest detectors suspended from the met towers. The highest overall numbers of call sequences per detector-night were recorded at the North Tree detector and the lowest numbers were recorded at the North High detector.

Differences in detection rates between guilds at the various detectors deployed in the Project area may reflect varying vertical distribution, habitat preferences, and unique foraging characteristics and behaviors of different bat species (Hayes 2000). The majority of *Myotis* call sequences were recorded at the tree detectors. This is not surprising since bats in the MYSP guild generally forage at lower altitudes and thus are more often picked up by ground-level detectors. Recent research using Anabat detectors recorded *Myotis* species more frequently at lower heights and larger species such as big brown and hoary bats were more frequently at higher heights (Arnett *et al*. 2006). While the *Myotis* calls in this survey followed this trend, the detection rates for big brown and hoary bats did not, as these species were most frequently recorded at tree detectors as well.

The interpretation of guild composition is confounded by the high number of UNKN call sequences. Unknown call sequences could not be identified to guild or species due to short call sequences (less than five pulses) or poor call signature formation, often a result of bats flying at the edge of the detection zone of the detector or flying away from the microphone. The relatively small area sampled by bat detectors makes scenarios leading to un-identifiable call sequences common, but some information can still be gleaned from these poor recordings. Specifically, 41% of UNKN sequences were identified as being HFUN, which likely consisted of red bats, tri-colored bats, and *Myotis* species, since these species nearly always produce ultrasound sequences greater than 30 kHz. Eighty-two percent of HFUN calls of were recorded at ground-level detectors. Because *Myotis* species are more frequently detected beneath the canopy level (Arnett *et al*. 2006), we suspect that the majority of HFUN sequences represent *Myotis* species. Thus, the *Myotis* species are likely more common in the Project area than the 3% detection rate of the MYSP guild suggests.

Recent studies have found that bat activity patterns are influenced by weather conditions (Arnett *et al*. 2006, Arnett *et al*. 2008, Reynolds 2006). Acoustic surveys have documented a decrease in bat activity rates as wind speed increase and temperatures decrease, and bat activity has been shown to correlate negatively to low nightly mean temperatures (Hayes 1997, Reynolds 2006). Similarly, weather factors appeared related to bat collision mortality rates documented at two facilities in the southeastern United States, with mortality rates negatively correlated with both wind speed and relative humidity, and positively correlated to barometric pressure (Arnett 2005). These patterns suggest that bats are more likely to be active on nights with low wind speeds (less than 4-6 m/s) and generally favorable weather (warm temperatures, low humidity, high barometric pressure). Thus, several weather variables individually affect bat activity, as does the interaction among variables (i.e., warm nights with low wind speeds, and high pressure).

A qualitative look at trends in weather conditions and detection rates (Figures 2-11 and 2-12) shows a potential relationship between temperature, wind speed, and bat activity rates. However, modeling these effects and interactions in a scientifically robust manner would require a substantially larger sample size and replication across the landscape. Sampling at the spatial and temporal scales used in this acoustic survey is not capable of showing interactions among conditions and the role of seasonal behaviors.

Additionally, nightly trends in mean detections and mean weather conditions mask small-scale variation that occurs within a night. There are many factors driving such small-scale variation in hourly number of recordings. Most North American bats species emerge from their roosts in large numbers shortly after dusk, periodically returning to their roosts for short periods during the night (see Hayes 1997 and cited references). This night-roosting behavior results in relatively higher activity levels shortly after dusk, when bats have not eaten or drank in many hours, and again just before dawn when many individuals will forage and drink again before returning to their roost for daylight hours. The observed hourly distribution of bat activity documented at acoustic detectors in the Project area is largely consistent with this literature, although a peak in activity before dawn was not observed.

Detection rates were generally higher at north met tower detectors than at the south met tower detectors. When comparing detection rates in the Project area to other wind project sites for which data are publicly available (Tables 2-4 and 2-5), average detection rates at the four met tower detectors (1.8 s/d/n in spring; 12.4 s/d/n in fall) were within the range of those observed at other sites in recent years. The average detection rates at the north and south tree detectors (17.7 s/d/n in spring; 128.0 s/d/n in fall) were relatively high when compared to other sites (although very few sites were available for comparison during the spring [n=4]).

Although the fall detection rate at the South Tree detector (13.1 s/d/n) was comparable to rates observed at other sites in the east, the rate at the North Tree detector (256.5 s/d/n) was very high. Calls at the North Tree detector were comprised mostly of call sequences identified to the BBSH guild (74%; n=3228). Fourteen percent of these calls were identified to species as big brown bat, and the majority of the remaining calls were likely also big brown bats, given that no silver-haired bats were captured during summer mist-netting surveys and big brown bats were the most frequently captured species, comprising 57% of all individuals captured (Stantec 2008). Given the exceptionally high number of call sequences recorded, it is likely that the North Tree detector was placed in close proximity to a big brown maternity colony and the detector was picking up local activity of bats foraging along the field edge where the detector was placed.

Only recently have acoustic surveys been conducted during the summer months and therefore, there are no publicly available surveys at other locations for comparison of rates documented during the breeding season.

**Table 2-4.** Summary of available spring bat detector surveys (results reported for individual detectors)

| Year | Project | State | City | Habitat | Height (m) | Detector Nights | Start | End | Calls | Rate | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tree or low tower detectors (10 m or below)** | | | | | | | | | | | |
| 2006 | Lempster | NH | Lempster | forest edge | 5 | 21 | 4/5 | 6/12 | 16 | 0.8 | Woodlot 2007a |
| 2006 | Howard | NY | Howard | field | 8 | 35 | 4/15 | 6/3 | 29 | 0.8 | Woodlot 2006f |
| *2008* | *Buckeye* | *OH* | *Urbana* | *field* | *2* | *24* | *3/29* | *5/15* | *300* | *12.5* | *this report* |
| *2008* | *Buckeye* | *OH* | *Urbana* | *field* | *2* | *47* | *3/29* | *5/15* | *957* | *20.4* | *this report* |
| 2005 | Sheffield | VT | Sheffield | forest edge | 10 | 4 | 5/12 | 5/29 | 0 | 0 | Woodlot 2006a |
| 2006 | Sheffield | VT | Sheffield | forest edge | 8 | 38 | 4/24 | 6/13 | 840 | 22.1 | Woodlot 2006a |
| 2006 | Sheffield | VT | Sheffield | forest edge | 9 | 37 | 4/24 | 6/13 | 90 | 2.4 | Woodlot 2006a |
| 2006 | Sheffield | VT | Sheffield | forest edge | 8 | 34 | 4/24 | 6/13 | 178 | 5.2 | Woodlot 2006a |
| 2006 | Deerfield | VT | Searsburg | forest edge | 2 | 37 | 4/14 | 6/11 | 4 | 0.1 | Woodlot 2005c |
| **Met tower detectors** | | | | | | | | | | | |
| 2006 | Kibby | ME | Eustis | forest edge | 50 | 14 | 5/4 | 6/19 | 0 | 0 | Woodlot 2006h |
| 2006 | Kibby | ME | Eustis | forest edge | 50 | 24 | 5/4 | 6/19 | 0 | 0 | Woodlot 2006h |
| 2006 | Kibby | ME | Eustis | forest edge | 20 | 35 | 5/4 | 6/19 | 31 | 0.7 | Woodlot 2006h |
| 2006 | Kibby | ME | Eustis | forest edge | 50 | 35 | 5/4 | 6/19 | 0 | 0 | Woodlot 2006h |
| 2006 | Lempster | NH | Lempster | forest edge | 40 | 60 | 4/5 | 6/12 | 7 | 0.1 | Woodlot 2007a |
| 2006 | Lempster | NH | Lempster | forest edge | 20 | 50 | 4/5 | 6/12 | 3 | 0.1 | Woodlot 2007a |
| 2005 | Cohocton | NY | Cohocton | field | 30 | 29 | 5/2 | 5/30 | 21 | 0.7 | Woodlot 2006c |
| 2005 | High Sheldon | NY | Sheldon | field | 30 | 36 | 4/21 | 5/30 | 6 | 0.2 | Woodlot 2006b |
| 2005 | Jordanville | NY | Jordanville | field | 30 | 29 | 4/14 | 5/13 | 15 | 0.5 | Woodlot 2005n |
| 2005 | Marble River | NY | Churubusco | field | 30 | 46 | 4/14 | 5/30 | 12 | 0.3 | Woodlot 2005l |
| 2005 | Prattsburgh | NY | Prattsburgh | field | 30 | 17 | 4/15 | 5/10 | 8 | 0.5 | Woodlot 2005b |
| 2005 | Prattsburgh | NY | Prattsburgh | field | 15 | 20 | 4/11 | 5/30 | 8 | 0.4 | Woodlot 2005b |
| 2005 | West Hill/Munnsville | NY | Munnsville | field | 30 | 22 | 5/10 | 5/31 | 6 | 0.3 | Woodlot 2005g |
| 2006 | Chateaugay | NY | Chateaugay | field | 40 | 54 | 4/16 | 6/8 | 117 | 2.2 | Woodlot 2006e |
| 2006 | Chateaugay | NY | Chateaugay | field | 20 | 54 | 4/16 | 6/8 | 103 | 1.9 | Woodlot 2006e |
| 2006 | Howard | NY | Howard | field | 50 | 36 | 4/15 | 6/4 | 5 | 0.1 | Woodlot 2005o |
| 2006 | Howard | NY | Howard | field | 20 | 45 | 4/15 | 6/7 | 16 | 0.4 | Woodlot 2005o |
| 2005 | Clayton | NY | Clayton | forest edge | 20 | 42 | 4/20 | 5/31 | 55 | 1.3 | Woodlot 2005m |
| 2005 | Clayton | NY | Clayton | forest edge | 15 | 36 | 4/20 | 5/31 | 12 | 0.3 | Woodlot 2005m |
| 2005 | Stamford/Moresville | NY | Stamford | forest edge | 30 | 27 | 4/12 | 5/8 | 8 | 0.3 | Woodlot 2005e |
| *2008* | *Buckeye* | *OH* | *Urbana* | *field* | *40* | *25* | *3/29* | *5/15* | *24* | *1.0* | *this report* |
| *2008* | *Buckeye* | *OH* | *Urbana* | *field* | *20* | *24* | *3/29* | *5/15* | *66* | *2.8* | *this report* |
| *2008* | *Buckeye* | *OH* | *Urbana* | *field* | *40* | *13* | *3/29* | *5/15* | *2* | *0.2* | *this report* |
| *2008* | *Buckeye* | *OH* | *Urbana* | *field* | *20* | *48* | *3/29* | *5/15* | *108* | *2.3* | *this report* |
| 2005 | Deerfield | VT | Searsburg | forest edge | 15 | 40 | 4/19 | 6/15 | 4 | 0.1 | Woodlot 2005j |
| 2005 | Sheffield | VT | Sheffield | forest edge | 20 | 31 | 5/1 | 5/31 | 6 | 0.2 | Woodlot 2006a |
| 2006 | Deerfield | VT | Searsburg | forest edge | 35 | 60 | 4/14 | 6/13 | 4 | 0.1 | Woodlot 2005s |
| 2006 | Deerfield | VT | Searsburg | forest edge | 15 | 47 | 4/14 | 5/31 | 0 | 0 | Woodlot 2005s |
| 2006 | Deerfield | VT | Searsburg | forest edge | 30 | 29 | 4/14 | 5/20 | 0 | 0 | Woodlot 2005s |
| 2006 | Deerfield | VT | Searsburg | forest edge | 15 | 21 | 4/14 | 5/16 | 7 | 0.3 | Woodlot 2005s |
| 2006 | Sheffield | VT | Sheffield | forest edge | 31 | 36 | 4/24 | 6/13 | 5 | 0.14 | Woodlot 2005a |
| 2005 | Liberty Gap | WV | Harper | forest edge | 30 | 21 | 4/17 | 6/7 | 2 | 0.1 | Woodlot 2005k |
| 2005 | Liberty Gap | WV | Harper | forest edge | 15 | 21 | 4/17 | 6/7 | 19 | 0.9 | Woodlot 2005k |

**Table 2-5.** Summary of available fall bat detector surveys (results reported for individual detectors)

| Year | Project | State | City | Habitat | Height (m) | Detector Nights | Start | End | Calls | Rate | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tree or Low Tower detectors (10 m or below)** | | | | | | | | | | | |
| 2005 | Lempster | NH | Lempster | forest edge | 7.5 | 34 | 9/20 | 10/31 | 27 | 0.8 | Woodlot 2005d |
| 2005 | Lempster | NH | Lempster | forest edge | 2 | 42 | 9/20 | 10/31 | 2 | 0 | Woodlot 2005d |
| 2006 | Lempster | NH | Lempster | forest edge | 10 | 29 | 9/9 | 10/24 | 2 | 0.1 | Woodlot 2007a |
| 2006 | Lempster | NH | Lempster | forest edge | 3 | 44 | 9/9 | 10/24 | 384 | 8.7 | Woodlot 2007a |
| 2005 | High Sheldon | NY | Sheldon | field | 2 | 49 | 8/1 | 10/4 | 5535 | 113 | Woodlot 2005n |
| 2005 | Howard | NY | Howard | field | 2 | 25 | 8/3 | 8/27 | 1493 | 51.5 | Woodlot 2005o |
| 2005 | Jordanville | NY | Jordanville | field | 2 | 34 | 8/12 | 9/22 | 124 | 4.4 | Woodlot 2005q |
| 2005 | Marble River/Churubusco | NY | Churubusco | field | 10 | 34 | 8/1 | 10/11 | 150 | 4.4 | Woodlot 2005l |
| 2005 | Marble River/Churubusco | NY | Churubusco | field | 2 | 18 | 8/1 | 10/11 | 113 | 6.3 | Woodlot 2005l |
| 2005 | Top Notch | NY | Fairfield | field | 2 | 34 | 8/19 | 9/21 | 44 | 1.3 | Woodlot 2005p |
| 2005 | West Hill | NY | Munnsville | field | 2 | 30 | 8/1 | 10/21 | 10 | 0.3 | Woodlot 2005r |
| 2005 | Clayton | NY | Clayton | forest edge | 2 | 33 | 8/19 | 9/20 | 154 | 4.7 | Woodlot 2005m |
| 2005 | Stamford/Moresville | NY | Stamford | forest edge | 2 | 58 | 8/15 | 10/15 | 280 | 4.8 | Woodlot 2005e |
| *2008* | *Buckeye* | *OH* | *Urbana* | *field* | *2* | *17* | *8/15* | *9/3* | *4361* | *256.5* | *this report* |
| *2008* | *Buckeye* | *OH* | *Urbana* | *field* | *2* | *19* | *8/15* | *9/3* | *248* | *13.1* | *this report* |
| **MET Tower Detectors** | | | | | | | | | | | |
| 2005 | Dans Mountain | MD | Loarville | forest edge | 11 | 53 | 8/1 | 9/22 | 574 | 10.8 | Woodlot 2005a |
| 2005 | Dans Mountain | MD | Loarville | forest edge | 23 | 31 | 8/1 | 9/22 | 388 | 12.5 | Woodlot 2005a |
| 2006 | Kibby | ME | Eustis | forest edge | 45 | 72 | 6/20 | 10/25 | 18 | 0.3 | Woodlot 2006m |
| 2006 | Kibby | ME | Eustis | forest edge | 45 | 76 | 6/20 | 10/25 | 0 | 0 | Woodlot 2006m |
| 2006 | Kibby | ME | Eustis | forest edge | 20 | 44 | 6/20 | 10/25 | 4 | 0.1 | Woodlot 2006m |
| 2006 | Kibby | ME | Eustis | forest edge | 45 | 20 | 6/20 | 10/25 | 0 | 0 | Woodlot 2006m |
| 2006 | Redington | ME | Redington | forest edge | 15 | 21 | 8/10 | 10/24 | 0 | 0 | Woodlot 2005u |
| 2006 | Redington | ME | Redington | forest edge | 15 | 48 | 8/10 | 10/24 | 0 | 0 | Woodlot 2005u |
| 2006 | Redington | ME | Redington | forest edge | 30 | 29 | 8/10 | 10/24 | 0 | 0 | Woodlot 2005u |
| 2006 | Redington | ME | Redington | forest edge | 30 | 37 | 8/10 | 10/24 | 0 | 0 | Woodlot 2005u |
| 2006 | Stetson | ME | Danforth | forest edge | 30 | 73 | 6/28 | 10/16 | 8 | 0.1 | Woodlot 2007b |
| 2006 | Stetson | ME | Danforth | forest edge | 30 | 76 | 6/28 | 10/16 | 170 | 2.2 | Woodlot 2007b |
| 2006 | Stetson | ME | Danforth | forest edge | 15 | 105 | 6/28 | 10/16 | 108 | 1 | Woodlot 2007b |
| 2006 | Stetson | ME | Danforth | forest edge | 15 | 107 | 6/28 | 10/16 | 651 | 6.1 | Woodlot 2007b |
| 2005 | Lempster | NH | Lempster | forest edge | 15 | 42 | 9/20 | 10/31 | 14 | 0.3 | Woodlot 2005d |
| 2006 | Lempster | NH | Lempster | forest edge | 40 | 43 | 9/9 | 10/24 | 16 | 0.4 | Woodlot 2007a |
| 2005 | High Sheldon | NY | Sheldon | field | 15 | 65 | 8/1 | 10/4 | 335 | 5.2 | Woodlot 2005n |
| 2005 | High Sheldon | NY | Sheldon | field | 30 | 58 | 8/1 | 10/4 | 137 | 2.4 | Woodlot 2005n |
| 2005 | Howard | NY | Howard | field | 30 | 13 | 8/3 | 8/19 | 30 | 2.3 | Woodlot 2005o |
| 2005 | Howard | NY | Howard | field | 27 | 15 | 8/3 | 8/14 | 30 | 2 | Woodlot 2005o |
| 2005 | Jordanville | NY | Jordanville | field | 15 | 34 | 8/12 | 9/22 | 143 | 4.2 | Woodlot 2005q |
| 2005 | Jordanville | NY | Jordanville | field | 30 | 41 | 8/12 | 9/22 | 255 | 6.2 | Woodlot 2005q |
| 2005 | Marble River/Churubusco | NY | Churubusco | field | 20 | 39 | 8/1 | 10/11 | 243 | 6.2 | Woodlot 2005l |
| 2005 | Top Notch | NY | Fairfield | field | 15 | 34 | 8/19 | 9/21 | 30 | 0.9 | Woodlot 2005p |
| 2005 | Top Notch | NY | Fairfield | field | 30 | 34 | 8/19 | 9/21 | 99 | 3 | Woodlot 2005p |
| 2005 | West Hill | NY | Munnsville | field | 15 | 47 | 8/1 | 10/21 | 179 | 3.8 | Woodlot 2005r |
| 2005 | West Hill | NY | Munnsville | field | 30 | 52 | 8/1 | 10/21 | 106 | 2 | Woodlot 2005r |
| 2006 | Steuben | NY | Hartsville | field | 15 | 76 | 7/26 | 10/10 | 119 | 1.6 | EDR 2006b |
| 2006 | Steuben | NY | Hartsville | field | 30 | 49 | 7/26 | 10/10 | 84 | 1.7 | EDR 2006b |
| 2006 | Wethersfield | NY | Wethersfield | field | 15 | 54 | 7/25 | 10/9 | 0 | 0 | Woodlot 2006l |
| 2006 | Wethersfield | NY | Wethersfield | field | 30 | 26 | 7/25 | 10/9 | 22 | 0.8 | Woodlot 2006l |
| 2006 | Centerville | NY | Centerville | field | 15 | 48 | 7/25 | 10/10 | 2 | 0 | Woodlot 2006l |
| 2006 | Centerville | NY | Centerville | field | 35 | 41 | 7/25 | 10/10 | 3 | 0.1 | Woodlot 2006l |
| 2006 | Chateaugay | NY | Chateaugay | field | 40 | 58 | 7/25 | 10/4 | 173 | 3 | Woodlot 2006j |
| 2006 | Chateaugay | NY | Chateaugay | field | 20 | 44 | 7/25 | 10/4 | 345 | 7.8 | Woodlot 2006j |
| 2006 | Dutch Hill | NY | Cohocton | field | 15 | 43 | 8/12 | 10/11 | 46 | 1.1 | Woodlot 2006c |
| 2006 | Dutch Hill | NY | Cohocton | field | 30 | 47 | 8/12 | 10/11 | 57 | 1.2 | Woodlot 2006c |
| 2005 | Clayton | NY | Clayton | forest edge | 30 | 0 | 8/19 | 9/20 | 0 | 0 | Woodlot 2005m |
| 2005 | Stamford/Moresville | NY | Stamford | forest edge | 15 | 43 | 8/15 | 10/15 | 293 | 6.8 | Woodlot 2005e |
| 2005 | Stamford/Moresville | NY | Stamford | forest edge | 30 | 54 | 8/15 | 10/15 | 285 | 5.3 | Woodlot 2005e |
| *2008* | *Buckeye* | *OH* | *Urbana* | *field* | *40* | *19* | *8/15* | *9/3* | *90* | *4.7* | *this report* |
| *2008* | *Buckeye* | *OH* | *Urbana* | *field* | *20* | *19* | *8/15* | *9/3* | *461* | *24.3* | *this report* |
| *2008* | *Buckeye* | *OH* | *Urbana* | *field* | *40* | *19* | *8/15* | *9/3* | *123* | *6.5* | *this report* |
| *2008* | *Buckeye* | *OH* | *Urbana* | *field* | *20* | *19* | *8/15* | *9/3* | *265* | *13.9* | *this report* |

The detection rates at individual detectors during fall 2008 were different than those recorded at the same locations during fall 2007 from August 28 to October 29, 2007 (Stantec 2007). For example, the South Tree detector had the highest call rate (28.4 s/d/n) in fall 2007, while the North Tree detector had the lowest call rate (3.5 s/d/n) of all six detectors in fall 2007. However, the North Tree detector suffered from a large number of malfunctions during fall 2007 and only operated on 25 of the 63 potential detector nights (40% success rate), making it difficult to interpret and compare results. Differences in survey results between years is somewhat expected, given that the survey periods only overlapped slightly and each survey likely captured different biological phenomena, such as migration peaks of different species. Additionally, it is expected that year to year variation in local bat populations and weather conditions will also affect acoustic survey results.

Thus, caution should be used when comparing the levels of activity among different years, or to rates detected in other acoustic surveys. Numbers of recorded bat call sequences are not necessarily correlated with numbers of bats in an area because acoustic detectors do not allow for differentiation between a single bat making multiple passes, and multiple bats each recorded individually (Hayes 2000). Additionally, differences in methodology, sampling duration, habitat, detector placement, and physiographic conditions among surveys limit our ability to make meaningful comparisons. Further limiting our interpretation of acoustic survey results, in terms of predicting risk to bats, is the fact that no studies to date have linked pre-construction acoustic activity rates with post-construction fatality rates.

Despite these limitations, the discussed patterns in peak timing of detection rates, and patterns of species at different detector heights may be useful for predicting peak timing of potential bat fatalities and the species that are most at risk during those times. Recent studies of mortalities at wind developments have found bat mortality rates are highest among the Lasiurines (red, silver-haired, and hoary bats) known to be long-distance migrants (Cryan 2003, Kunz *et al*.2007a, Arnett *et al*. 2008). This pattern in mortality has led some to suggest that it is related to the species' migratory behavior (Cryan and Brown 2007). Peak mortality rates beginning around August 1 is typical among post-construction studies from the eastern United States (Arnett *et al*. 2008, Kunz *et al*. 2007a).

Trends in bat activity suggest that there is migratory activity occurring in the Project area. This is evidenced by a peak in total bat detections at almost all detectors during the period from mid August to early September. However, when looking at detections of Lasiurine species at high and low detectors in met towers from mid August to early September, only red bats displayed an obvious peak in activity. Conversely, hoary and silver-haired bats did not display peak activity during this time, but rather had high detection rates earlier in the survey, during the spring migratory or summer breeding season. Because red bats were the only Lasiurine species to show a peak in activity at met tower detectors during the early fall migratory period when bat fatalities have been found to be most numerous, it is possible that bat mortalities at the Project could be greatest in mid to late August and early September, and that these mortalities could consist mostly of red bats.

However, it is important to note that sampling was not continued beyond September 3, 2008 because an acoustic survey in the Project area was conducted from September 1 through October 15, 2007, as per the approved ODNR work plan (Stantec 2007). Therefore, it is possible that silver-haired bats and hoary bats experienced peaks later in the fall that were not captured in the 2008 survey. Results from the fall 2007 survey showed minimal hoary bat activity overall, with no conspicuous peaks in activity during the fall (Stantec 2007). However, there was a peak in silver-haired detections in early October, 2007, which could indicate increased risk for this species later in the fall. On the other hand, it is very important to acknowledge that precise estimates of mortality are not possible, and number of bat call sequence recordings per night may not be as useful in predicting mortality as are the results of post-construction surveys at nearby wind developments.

# 3.0 Diurnal Raptor and Sandhill Crane Survey

## 3.1 INTRODUCTION

The Project area is located in the Central Continental Hawk Flyway. Geography and topography are major factors in shaping migration dynamics in this flyway. The orientation of the Great Lakes and inland mountain ranges influence diurnal migrants in central Canada and the mid-west to fly generally southwestward to their wintering grounds in fall and northeastward in the spring, with considerable east to west movement along the Great Lake shorelines (Kerlinger 1989, Kellogg 2004). The juxtaposition of the Appalachian Mountain ranges and large bodies of water influence the distribution of raptor migration. Away from features such as the Lake Erie shore, the Alleghany and Appalachian plateaus may provide "leading lines" for hawks to follow (Kellogg 2004). Away from “leading lines” and shores, raptors may utilize low relief upland areas; however, migration is not expected to concentrate in landscapes suboptimal for migration, such as the interior of the mid-west. There are twenty species of raptors typically observed in this flyway.

In order to minimize energy expenditure, raptors typically use ridgelines or shorelines to gain altitude via thermal development or ridge-generated updrafts (Kerlinger 1989). Areas of northern Ohio, on and near Lake Erie, support concentrations of migrant raptors which typically avoid lengthy water crossings. The topography surrounding the Project does not contain any outstanding features that typically concentrate raptors by providing reliable updrafts, such as high relief ridges and plateaus. Raptor migration through central Ohio is likely less concentrated than in other areas of the Central flyway because ridges and lake shores are not prevalent.

The Project is located in the south-central portion of the state in the Bellefontaine Uplands physiographic region, a sub-region of the Central Ohio Till Plains. This region is characterized by low to moderate relief (76 m; 250 ft) hills formed by glacial processes during the last glacial maximum. Well to the east of the Project area, the Alleghany Plateaus rise to slightly higher elevations with much greater relief. It is suspected that the majority of raptor migration, away from the Lake Erie shoreline, would occur along the escarpments and leading lines of the

Alleghany Plateau area. It is therefore likely that raptors migrating through central Ohio exhibit broad front migratory behavior, in which the migrants move across the landscape with little or no deviation due to topographic features.

Stantec conducted raptor surveys on 11 days in 2007 during August, September, and October to determine if significant raptor migration occurs in the vicinity of the proposed. The ODNR subsequently requested that Stantec perform additional surveys in spring and fall 2008 to provide additional information on raptor activity in the Project area. In addition to this, the ODNR requested that sandhill crane surveys (*Grus canadensis*) be conducted, following the same protocol as the raptor surveys, during late winter 2008 to document their use of the Project area. The goal of both surveys was to document the occurrence of diurnally migrating birds in the vicinity of the Project area, including the number and species, approximate flight altitude, general direction and flight path, as well as other notable flight behavior.

## 3.2 METHODS

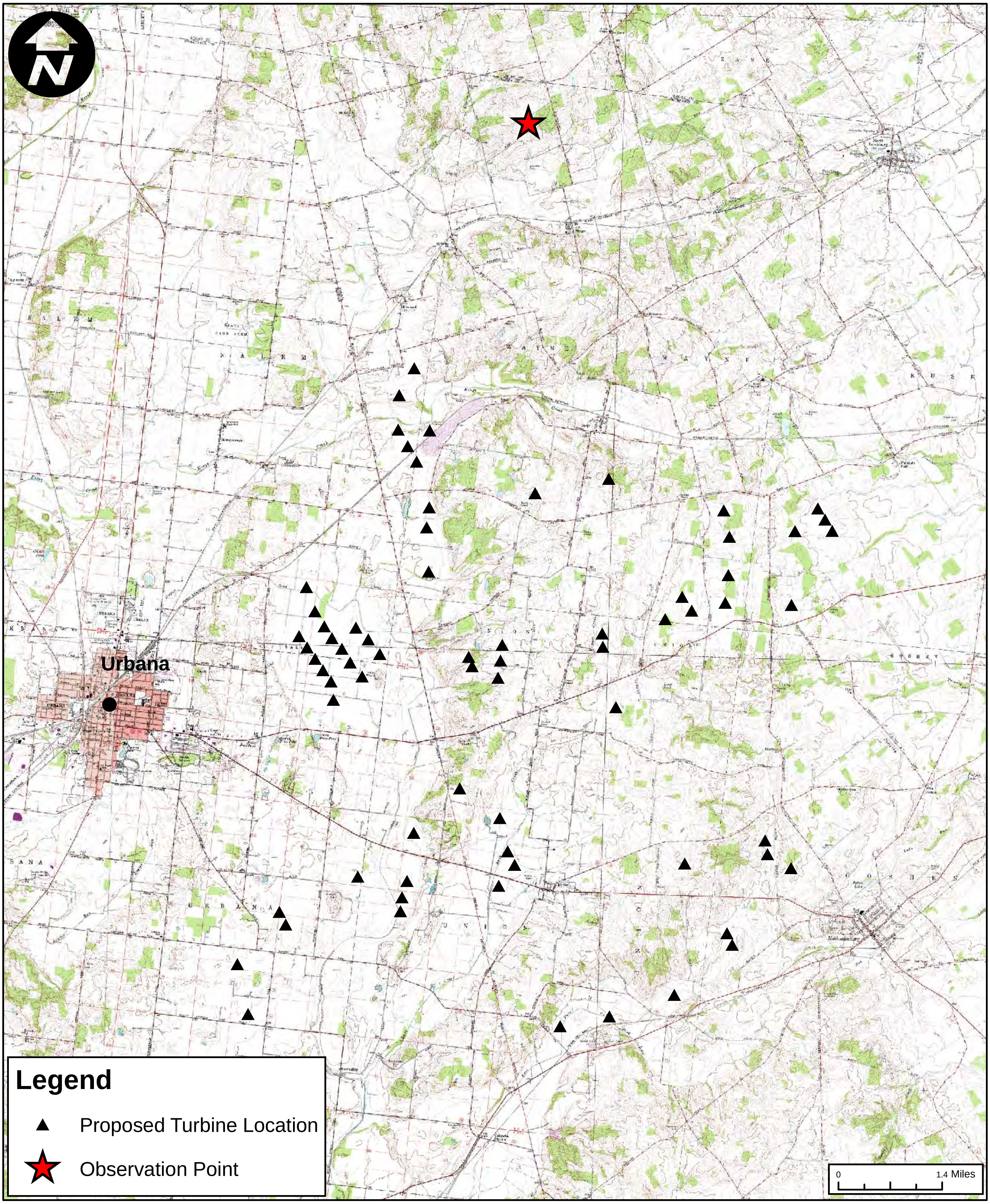
### 3.2.1 Field Surveys

Surveys were conducted from a hill top clearing northwest of Mingo, Ohio at an elevation of approximately 442 m (1,450 ft) (Figure 3-1). The observation site was in open and active pastureland in the central region of the Project area that offered excellent views to the south, east, and west, and good views to the north. The observation site was near a 100 m (328 ft) communication tower that provided a reference point for judging bird flight altitudes.

Raptor surveys were targeted to occur at least three days per week from March 1 to May 15, 2008 and from September 1 to November 15, 2008. Sandhill crane surveys were targeted to occur at least three days per week from November 16 to December 15, 2008. Surveys were conducted from 9:00 am to 5:00 pm in order to include the time of day when the strongest thermal updrafts are typically produced and when the majority of raptor migration activity generally occurs. Days with favorable flight conditions, produced by high-pressure systems and the passage of weather fronts were targeted.

Surveys were based on methods developed by the Hawk Migration Association of North America (HMANA 2007). Observers scanned the sky and surrounding landscape for raptors flying through the area. Observations were recorded onto HMANA data sheets, which summarize data by hour. Detailed notes on each observation, including location and flight path, flight altitude, and activity of the bird were recorded.

Flight altitudes were categorized as less than or greater than 150 m (492 ft) above ground, the proposed maximum height of the proposed wind turbines with blades oriented straight up. Nearby objects with known altitudes, such as a communication tower and surrounding trees, were used to gauge flight altitudes. Information regarding the bird's behavior, and whether a bird was observed in the same locations throughout the survey period, was used to differentiate between migrant and resident raptors. The general flight paths of observed individuals were plotted on topographic maps of the Project area.




Prepared By:

Stantec

Sheet Title:

Raptor and Sandhill Crane Survey Location Map

Project:

Buckeye Wind Power Project, Ohio



Date: February 2009

Scale: 1" = 1.8 Miles

Proj. No.: 195600164

Figure:

3-1

Hourly weather observations, including wind speed, wind direction, temperature, percent cloud cover, and precipitation were also recorded on HMANA data sheets. Birds that flew too rapidly or were too far to accurately identify were recorded as unidentified to their genus or, if the identification of genus was not possible, unidentified raptor.

### 3.2.2 Data Analysis

Field observations were summarized by species for each survey day and for the entire survey period. This included a tally of the total number of individuals observed for each species, the observation rate (birds/hour), and an estimate of how many observations were suspected residents. The total number of birds, by species and by hour, was also calculated, as was the species composition of birds observed flying below and above 150 m (492 ft). Finally, the mapped flight locations of individuals were reviewed to identify any overall patterns for migrating raptors.

Raptor observations from the Project area were compared to the closest HMANA hawk watch sites for which data were available (HMANA 2007; Appendix B, Table 4). Comparisons were also made to 14 spring and 17 fall diurnal raptor surveys conducted from 1996 to 2006 that were publicly available for other wind projects through the northeast (Appendix B, Table 5).

## 3.3 RESULTS

Raptor surveys occurred on 32 days (216 hours) from March 1 to May 15, 2008, and on 24 days (167 hours) from September 1 to November 15, 2008. Sandhill crane surveys occurred on 12 days (84 hours) from November 16 to December 15, 2008. A total of 1,476 raptors representing twelve species were observed in the spring, yielding an observation rate of 6.8 birds/hour (Figures 3-2a and 3-2b; Appendix B, Table 1a). A total of 581 raptors representing seven species were observed during the fall raptor survey, yielding an observation rate of 3.5 birds/hour (Figures 3-2a and 3-2b; Appendix B, Table 1b).

Although no sandhill cranes were observed from November 15 to December 15, four sandhill cranes were observed during a raptor survey on March 6, 2008. During the sandhill crane survey, 27 raptors representing six species were observed, yielding an observation rate of 0.3 birds/hour during this period (Appendix B, Table 1c). Throughout the spring and fall, daily count totals ranged from 1 to 94 observed raptors and passage rates ranged from 0.1 to 14.3 birds/hour. The high count of 94 raptors occurred on May 6 when winds were moderate (3.4 – 7.5 km/hr) and predominantly from the southwest.

Surveys were conducted on mostly clear to partly cloudy days with no or minimal precipitation, allowing for optimal visibility. The development of thermals on survey days was evident as temperatures increased and cumulus clouds developed. Winds were variable throughout the survey period, wind speed was generally moderate to high (0 – 8 m/s; 18 mph), and temperatures ranged from -5 ºC (23 ºF) to 32 ºC (90 ºF).

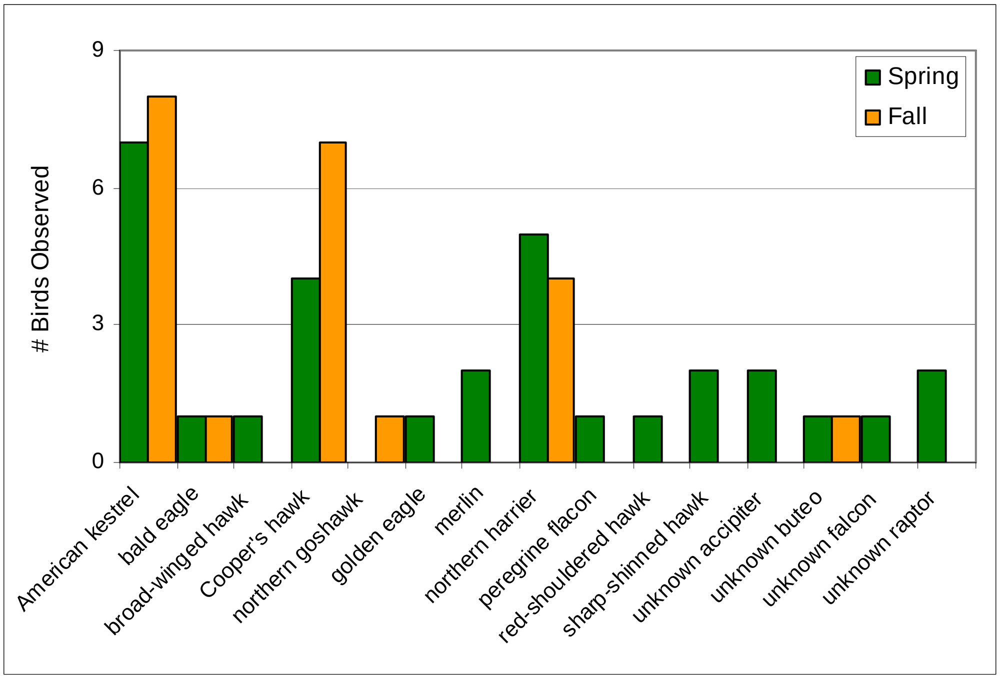



**Figure 3-2a.** Species composition of low-occurrence raptor species observed during spring (March 1 through May 15) and fall (September 1 through November 15) 2008 raptor surveys.

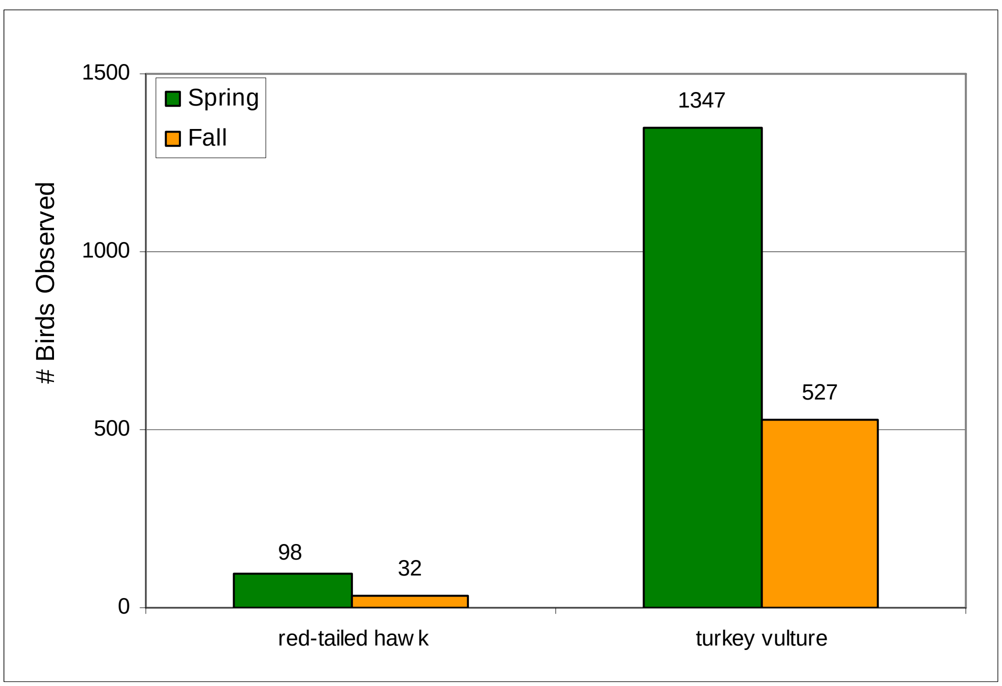



**Figure 3-2b.** Species composition of high-occurrence raptor species observed during spring (March 1 through May 15) and fall (September 1 through November 15) 2008 raptor surveys.

Turkey vulture (*Cathartes aura)*[2] was by far the most abundant species observed in the area during both the spring and fall survey period (spring n=1,347, 91%; fall n=527, 91%). Red-tailed hawks (*Buteo jamaicensis*) were the second most commonly observed species accounting for 7% of the total observations (n=98) in the spring, and 6% (n=32) in the fall. A number of unidentified raptors were observed that were too far from the observer to accurately determine genus. Other species observed in low numbers in the spring or fall included three species of accipiter [Cooper's hawk (*Accipiter cooperii*), sharp-shinned hawk (*Accipiter striatus*), and northern goshawk (*Accipiter gentilis*)]; two species of buteo [broad-winged hawk (*Buteo platypterus*) and red-shouldered hawk (*Buteo lineatus*)];three species of falcon [merlin (*Falco columbarius*), peregrine falcon (*Falco peregrinus*), and American kestrel (*Falco sparverius*)]; two species of eagle [bald eagle (*Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos*)]; and northern harriers (*Circus cyaneus*). Of the species observed during the survey, the northern harrier is state-listed as endangered, the peregrine falcon and bald eagle are state-listed as threatened, and the sharp-shinned hawk is a state species of concern in Ohio (ODNR 2007).

Eight percent of observed raptors were believed to be residents of the Project area because they were seen repeatedly foraging and perching at consistently similar locations throughout the survey period. In these cases, a particular individual may have been repeatedly observed flying back and forth across a section of hillside or perching in an area during the same day or on more than one survey day. However, for the most part (92%), raptors that were observed were believed to be actively migrating.

In addition to varying daily counts, the timing of raptor observations varied within each survey day. On average, raptor counts peaked between 10:00 and 11:00 am during the spring, and between 11:00 am and 12:00 pm during the fall (Figure 3-3; Appendix B, Tables 2a and 2b). Observations of raptors during the spring remained relatively consistent between 10:00 am and 4:00 pm, but during the fall observations declined steadily after 12:00 pm as the day progressed (Appendix B, Tables 2a and 2b).

During the spring, 95% of the observed raptors were flying less than 150 m agl and during the fall 93% of raptors were observed below 150 m agl (Appendix B, Tables 3a and 3b). Differences in flight altitudes between species were also observed (Figures 3-4a, 3-4b, 3-5a, and 3-5b). The mean flight altitude of turkey vultures was less than 39 m (128 ft); with 94% flying below 150 m. The mean flight altitude of red-tailed hawks was 38 m (125 ft), with 99% flying below 150 m.

Only four sandhill cranes were observed during the spring raptor survey, all seen on March 6, 2008. The first pair of cranes was observed between 2:00 and 3:00 pm flying at approximately 100 m (328 ft) agl at an azimuth of 50 degrees. The pair attempted to land in a nearby field, but then continued to fly through the Project area. The second pair of cranes was observed between 3:00 and 4:00 pm flying at approximately 200 m (656 ft) agl at an azimuth of 10 degrees.

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[2] While turkey vultures are not true raptors, they are diurnal migrants that exhibit flight characteristics similar to hawks and other raptors and are typically included during hawk watch surveys.

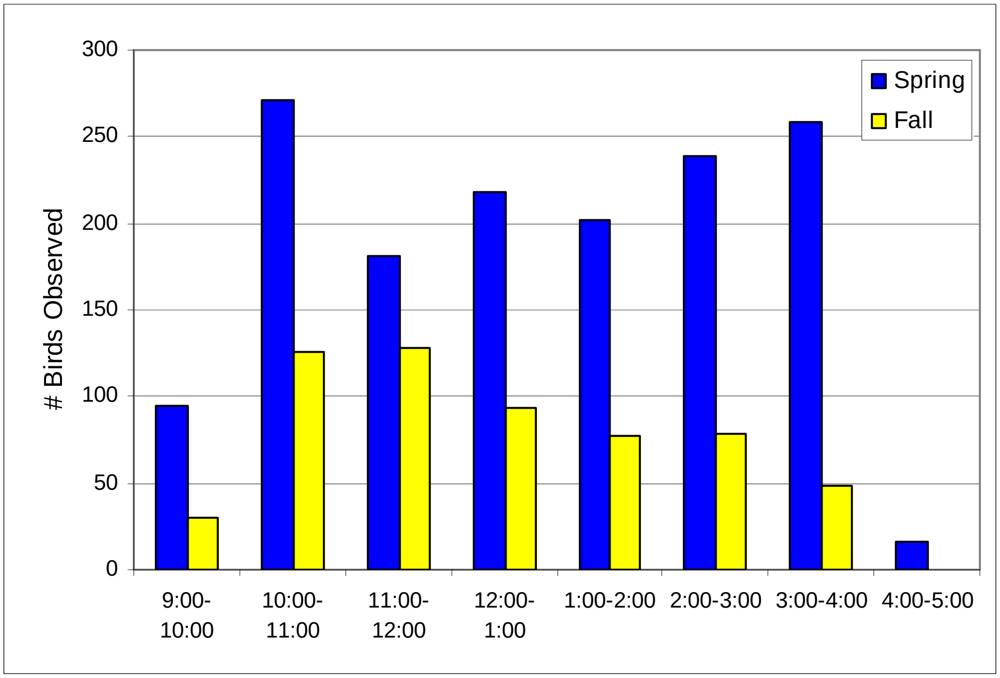



**Figure 3-3.** Hourly observation rates of raptors, fall 2007

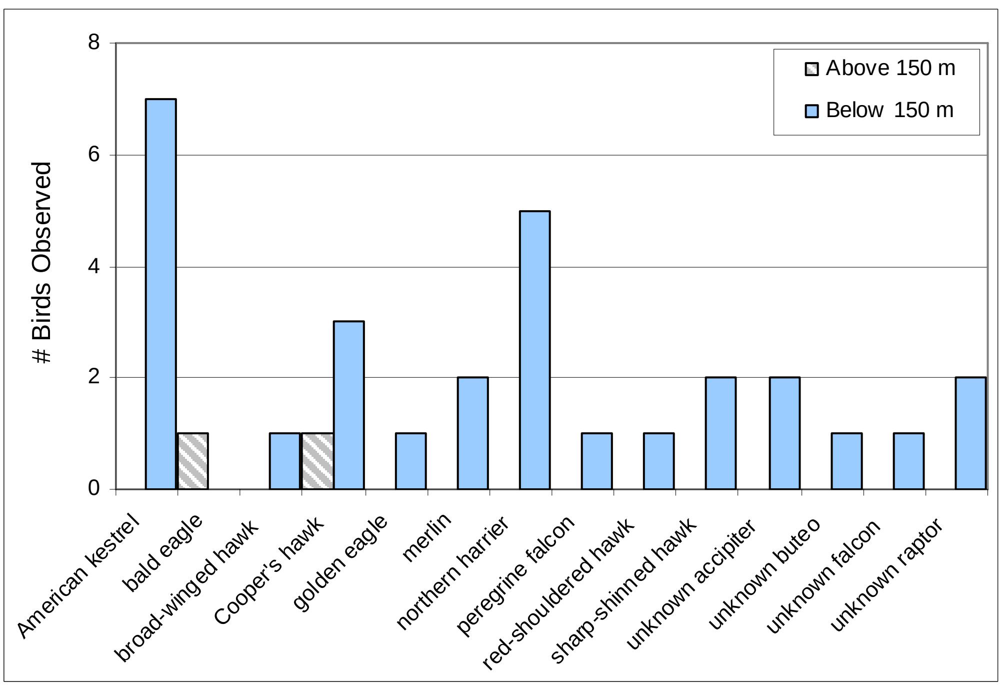



**Figure 3-4a.** Summary of flight altitudes and number of individuals for low-occurrence species observed above and below 150 m during spring 2008 raptor migration surveys

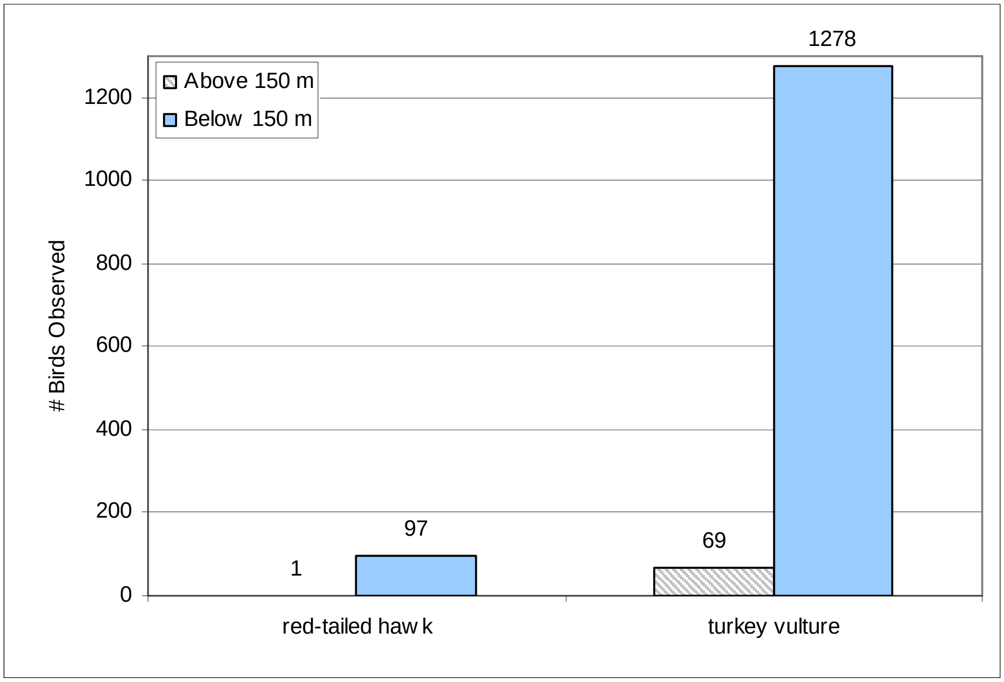



**Figure 3-4b.** Summary of flight altitudes and number of individuals for high-occurrence species observed above and below 150 m during spring 2008 raptor migration surveys

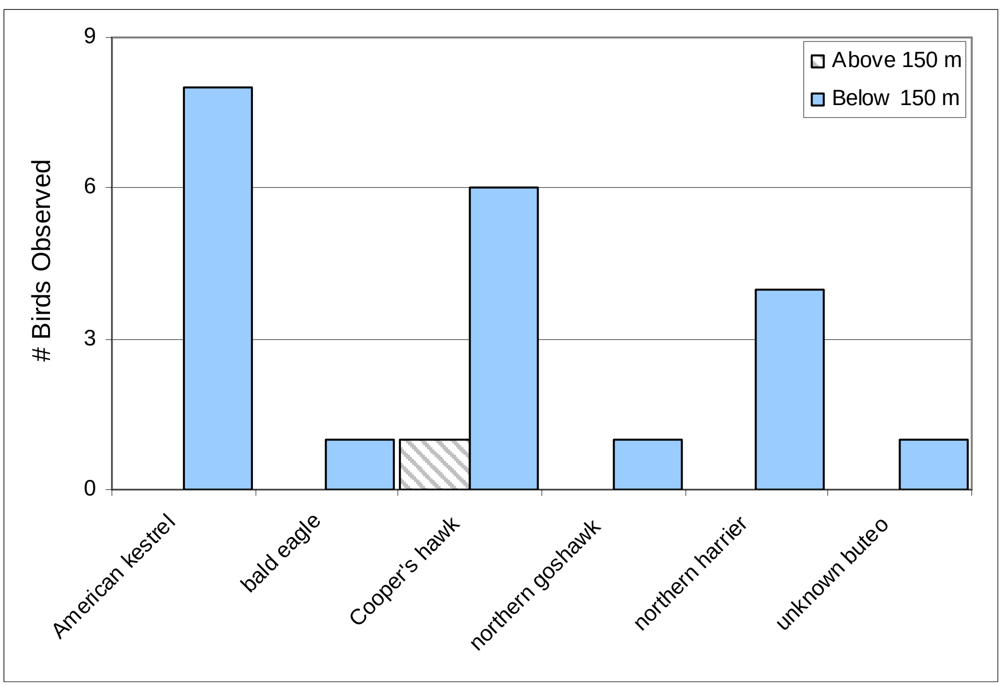



**Figure 3-5a.** Summary of flight altitudes and number of individuals for low-occurrence species observed above and below 150 m during fall 2008 raptor migration surveys

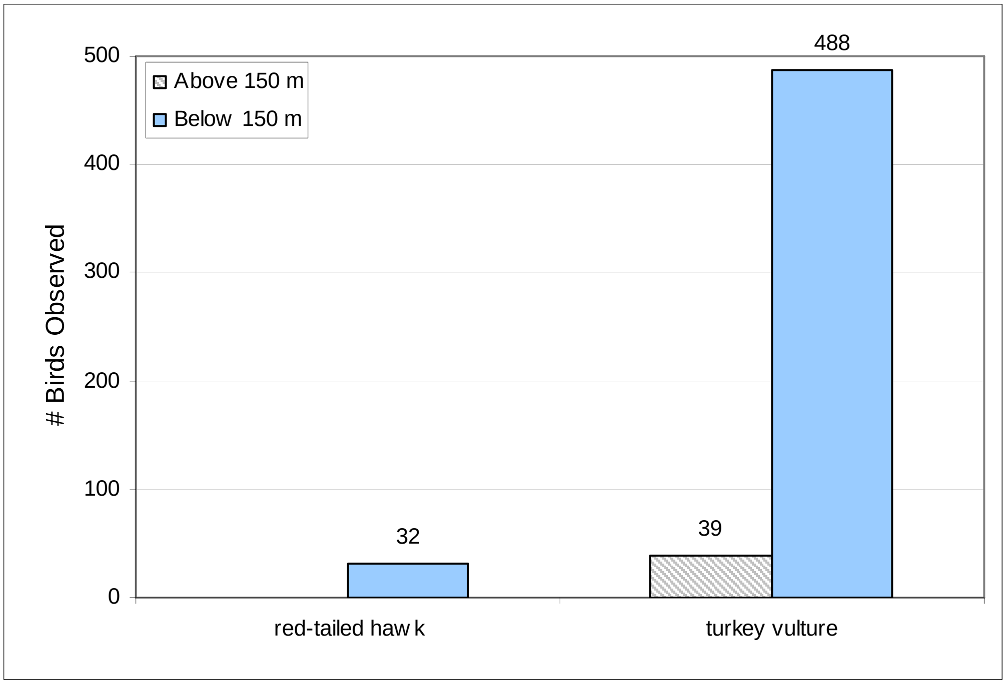



**Figure 3-5b.** Summary of flight altitudes and number of individuals for high-occurrence species observed above and below 150 m during fall 2008 raptor migration surveys

## 3.4 DISCUSSION AND CONCLUSIONS

During spring and fall 2008, a total of 2,084 individuals representing thirteen different species of raptors were observed during 68 days and 467 hours of observation, for a total observation rate of 4.5 birds/hour. Turkey vultures, considered one of the most common raptor species in the eastern United States (Wheeler 2003), accounted for 91% of all raptor observations and was the most commonly observed species during the survey. No federally threatened or endangered species were observed during the diurnal raptor surveys. Five northern harriers, a state-listed endangered species, were observed in the spring and four were observed in the fall. Four sandhill cranes, also a state endangered species, were observed in the spring. State threatened species observed included two bald eagles, one in the spring and one in the fall, and one peregrine falcon observed in the fall. Two sharp-shinned hawks, a state species of concern, were observed in the spring.

The overall number of raptors observed in the Project area was low relative to the numbers observed at other regional hawk watch sites. Observation rates at regional HMANA hawk watch sites ranged from 5.2 to 3082.8 birds/hour during fall 2007 (Appendix B, Table 4). The most active site was at Detroit River Hawkwatch (DRHW) Pointe Mouillee, Michigan, which is also the closest hawk watch site to the Project area (Site No. 5, Appendix B, Table 4). At DRHW, a total of 323,691 raptors were counted during 105 survey hours (3,082.8 birds/hour) during fall 2008. This was likely due to the close proximity of the site to Lake Erie, which is historically known to concentrate large numbers of raptors. The average passage rate of 4.5 birds/hour for the spring and fall raptor surveys in the Project area was lower than that for all other HMANA hawk watch sites in the region for which data were available during spring and fall 2008, despite having comparable or greater survey effort in most cases.

There are several reasons for the variations in numbers of raptors observed among hawk watch sites including survey effort, geographical location, weather, and visibility. Organized hawk count locations typically occur in areas of known concentrated raptor migration activity. Geographical location and topography can affect the magnitude of raptor migration at a particular site. Many of the regional hawk watch sites are located in areas of known concentrated raptor migration, such as those along the shores of the Great Lakes. The lower passage rate at the Project area is likely due to a lack of prominent landscape features that concentrate raptor migration.

When compared to 14 other publicly available spring raptor surveys conducted from 1999 to 2006 for wind projects, the passage rate observed for the Project (6.5 birds/hour) was similar to many in agricultural settings. The average passage rate for these sites was 5.2 birds/hr, with a range of 0.9 birds/hr at Deerfield, Vermont, to 25.6 birds/hr at Westfield, New York (Appendix B, Table 5). When compared to passage rates for 17 other fall surveys conducted from 1996 to 2007 for wind projects, the passage rate observed in the Project area (3.5 birds/hour) is among the lowest. Passage rates at other fall surveys averaged 4.4 birds/hour and ranged from a low of 3.0 raptors/hour in Clinton County, New York, to a high of 12.72 raptors /hour in Bennington County, Vermont (Appendix B, Table 6).

Flight heights of raptors observed in the Project area indicate that the majority of migrating raptors occur within the zone of the blade-swept area of the proposed turbines. This trend has also been observed at other proposed wind sites in the east, where the majority of raptors have been observed below the height of proposed turbines (Tables 3-1 and 3-2). Variation in flight heights is due to the particular flight behaviors of different raptor species, as well as daily weather conditions. Typically, accipiters and falcons use up-drafts from side slopes to gain lift and, therefore, usually fly low over ridgelines. Buteos tend to use lift from thermals that develop over side slopes and valleys and tend to fly high during hours of peak thermal development. Raptors (accipiters in particular) typically fly lower than usual during windy or inclement conditions.

The high percentage of low flight heights was likely influenced by the large number of observed turkey vultures which typically fly at lower heights than other migrants, as they are undertaking relatively small-scale movements while foraging. The frequent observation of turkey vultures relative to the other raptor species observed was notable but not unexpected. Turkey vultures have been known to historically occur in central Ohio in relatively high densities (Coles 1944) and regional hawk watch counts often have high numbers of turkey vulture observations (Appendix B, Table 4).

Although the greater occurrence of migrants at low altitudes increases the potential for migrating raptors to come into the vicinity of the proposed wind turbines, raptor mortality in the United States, outside of California, has been documented to be very low. For example, mortality rates found at onshore wind developments, outside of Altamont Pass in California, have documented 0 to 0.07 fatalities/turbine/year from 2000-2004 (GAO 2005). A more recent study at the Maple Ridge Wind Power facility in New York also documented very low raptor mortality. A single American kestrel was found during the 2006 study which surveyed 50 of 120 operational turbine sites (Jain *et al* 2007). The second year of monitoring at 64 of 195 turbines at Maple Ridge documented at total of 6 raptors (including those found incidentally and not during standard surveys): 1 sharp-shinned hawk and 5 red-tailed hawks (Jain *et al.* 2008). Raptors represented 6% (Jain *et al*. 2008) of the 96 total birds found during the second year of monitoring at Maple Ridge.

Out of more than a dozen sites surveyed in the U.S. in recent years, few had greater than 20 documented raptor fatalities (Osborn *et al*. 2000, Johnson *et al*. 2002, Kerlinger 2002, Young *et al*. 2003, Erickson *et al*. 2000, Kerlinger 2006, Erickson *et al*. 2002, Johnson *et al*. 2003, Kerns and Kerlinger 2004, Arnett *et al*. 2005, Koford *et al*. 2005, Fiedler *et al*. 2007, Jain *et al*. 2007, Jain *et al.* 2008). Studies have documented avoidance behaviors of raptors in response to turbines at modern wind facilities (Whitfield and Madders 2006, Chamberlain *et al.* 2006). Because most raptors are diurnal, they are likely able to visually, as well as acoustically, detect turbines during periods of fair weather, thereby reducing the chances of collision.

The results of the spring and fall 2008 surveys indicate that spring raptor migration at the proposed Project site is comparable or low relative to other sites in the region. The results of the 2008 survey indicates that raptors do not concentrate in large numbers through the Project area, probably because the site lacks the major topographical features that occur in other locations of the Central Continental Flyway which concentrate raptor activity. Only four sandhill cranes were observed incidentally during the spring raptor survey. The relatively low numbers of migrating raptors and sandhill cranes observed in the Project area decreases the potential risk of collision with the proposed turbines during migration.

# 4.0 Breeding Bird Survey

## 4.1 INTRODUCTION

Stantec conducted a breeding bird survey (BBS) during spring and summer 2008 to document the species composition, abundance, and distribution of breeding birds in the Project area.

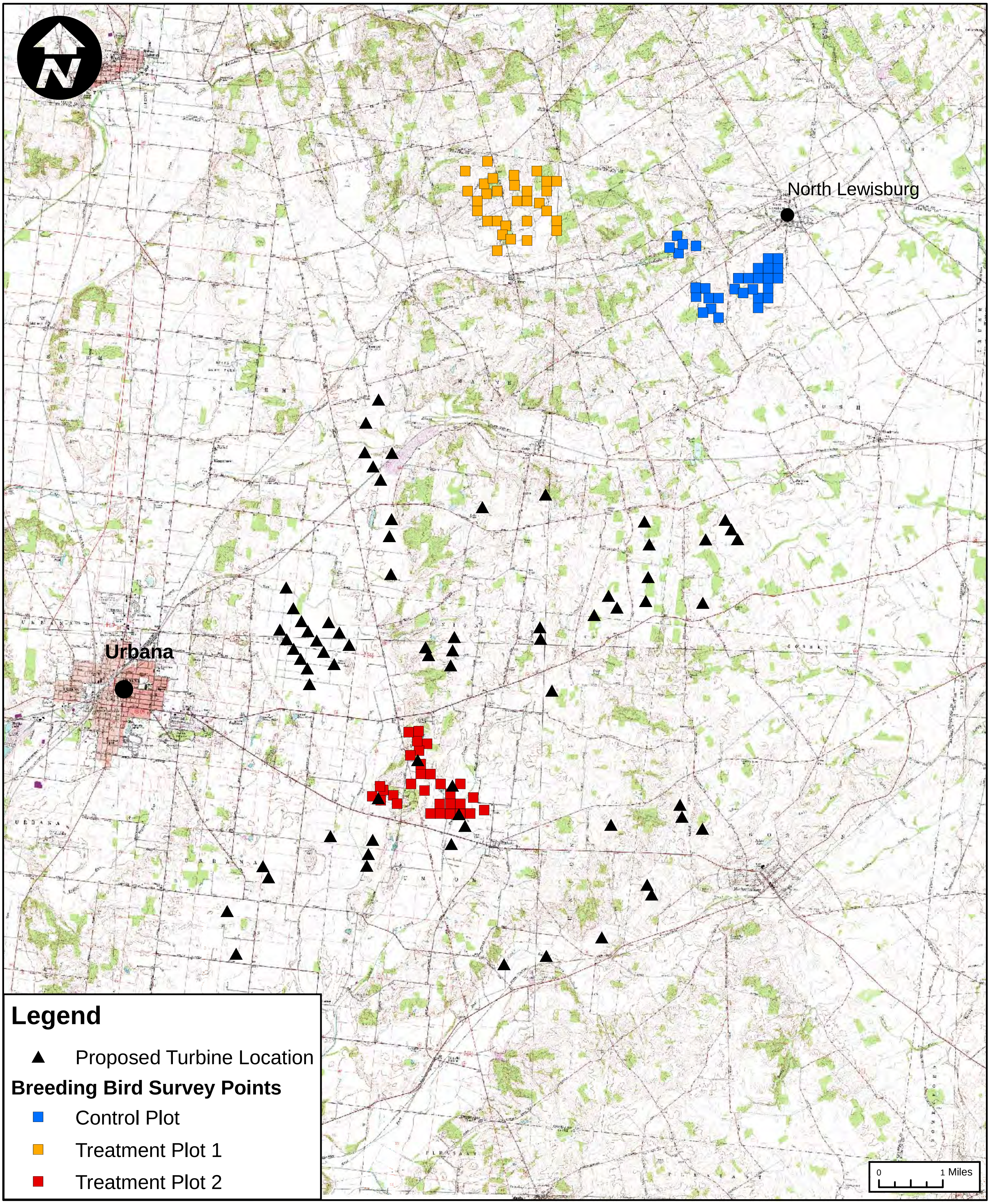
## 4.2 METHODS

### 4.2.1 Field Surveys

Stantec biologists conducted breeding bird surveys within the Project area once during May, twice in June, and once again in July 2008. Survey timing and methods were based on recommended protocol developed by the ODNR and modified from the USGS North American Breeding Bird Survey protocol as described by Sauer *et al.* (1997). Surveys focused on assessing the presence or absence of state or federally-listed species, but also documented all species of breeding birds either heard or visually detected within the Project area.

The point count method was used to count individuals of each species located at a series of survey points located in three survey grids positioned in the north, central, and southern portions of the Project area (Figure 4-1). Two sample plots were designed to survey breeding bird activity as close to the proposed turbines as possible, referred to as “treatment plots”. One sampling grid was designed to survey breeding bird activity that would not be affected by the development of the Project, and was referred to as the “control plot”. The control plot was positioned as far as possible from any proposed turbines, based on the best knowledge of long term project design. However, turbine locations are subject to change based on changing circumstances, such as land access and wind resources.

Each grid had a 10 x 10 configuration, with each cell 250 m by 250 m (820 ft by 820 ft) in size, and a sampling point located at or near the center of each cell. Thus, each grid was composed of 100 cells with 100 points, each a minimum of 250 m (820 ft) apart. The points were designed to sample available habitats in proportion to their availability. The ODNR specified in their recommended sampling protocol that no more than 20 points need be sampled in agricultural habitats, regardless of whether or not it comprised greater than 20% of the habitat in the sampling grid. The habitat in each of the sampling grids (and the larger Project area in general) consisted of approximately 10 to12% forested habitat, and 88 to 90% agricultural habitat. Thus, proportionally there were 10 to12 points sampled in forested habitat, and 18 to 20 points sampled in agricultural habitat in each sample grid. There was a total of 30 points sampled in each grid, for a total of 90 points sampled during the BBS. At least 25% of all points in each grid were placed at least 100 m from a roadway to minimize effects of roads and related disturbance on breeding birds.




Prepared By:

Stantec

Sheet Title:

Breeding Bird Survey Location Map

Project:

Buckeye Wind Power Project, Ohio



Date: February 2009

Scale: 1" = 2 Miles

Proj. No.: 195600164

Figure:

4-1

Surveys were targeted to begin 30 minutes before sunrise and to be complete four hours after sunrise. Surveys were only conducted on days with suitably clear weather, with mild temperatures, and when rain or wind would not inhibit the detection of birds. GPS location, time, weather, habitat, species, number of individuals, and other behavioral notes were recorded during each point count. For each 10-minute point count, a 50 m (164 ft) radius circle around the observer was estimated and the area was divided into four quadrants. During the point count, the observers oriented themselves toward the north and plotted the location of each bird heard or seen within one of the four quadrants.

Each point count was broken into three time periods: the first three minutes, the following two minutes, and the final five minutes. For the duration of the 10-minute count surveys, the species and the number of individuals occurring between 0-50 m (0-164 ft), 50-100 m (164 – 328 ft), or greater than 100 m (328 ft) from the observer, or flying overhead, were recorded in the period during which they were first heard. During each consecutive time period, observers determined the location of previously recorded birds and tracked any movements within the count circle in order to avoid recounting birds. Other notes related to breeding behavior, weather conditions and habitat descriptions were recorded. When possible, observers made digital recordings of rare or unusual birds for purposes of documentation.

### 4.2.2 Data Analysis

Observational data collected during each round of point count surveys were used to determine species composition and distribution. Quantitative data collected during the second, third and fourth rounds of surveys were used to calculate the species richness (e.g., total number of species observed), relative abundance (e.g., evenness of species observed), and frequency of breeding birds within the available habitats of the project area. The control plot was analyzed separately from the treatment plots, and the surveyed habitats were summarized into two types: agricultural and forested. Data collected during the first survey round (May 1 -21) were not included in the statistical analysis due the large numbers of migrants included in point counts. Birds recorded as flyovers and greater than 100 m (328 ft) from the observer were also not included in statistical analyses; however these data were used to determine overall species richness and the total number of birds observed.

## 4.3 RESULTS

One round of surveys was conducted in May (May 3, 4, 6, 7, 9, 15, 20, and 21), one was conducted in June (June 1, 2, 4-7), one was conducted in both June and July (June 10-13, 24, 29 and July 7), and one was conducted in July (July 19, 20, 23-25, 27 and 29). Surveys were conducted when wind or rain conditions had no adverse effect on bird detection. Wind conditions during the surveys were predominantly calm to 5.4 m/s (12 mph); wind speeds did not exceed 10.7 m/s (24 mph) during the surveys. Weather conditions ranged from clear to overcast skies, although there were periods of fog during point count surveys on June 2 and June 13. Temperatures during the surveys ranged from 7 to 27º C (45º to 81º F).

A total of 90 breeding bird survey point counts were sampled during the site visits. A total of 5947 individual birds representing 97 species were observed during the point count surveys. The species most commonly observed among the 90 points included the red-winged blackbird (*Agelaius phoeniceus*) (n=1324), horned lark (*Eremophilia alpestris*) (n=427), American robin (*Turdus migratorius*) (n=304), song sparrow (*Melospiza melodia*) (n=297), American crow (*Corvus brachyrhynchos*) (n=246), and European starling (*Sturnus vulgaris)* (n=206) (Appendix C, Table 1).

The majority of birds (n=1996; 34%) were detected outside of the 100 m distance zone. Twenty-eight percent of birds (n=1663) were detected within the 50 to 100 m distance zone (Appendix C, Table 1). Birds that were detected outside of the 100 m zone or were observed flying overhead (n=1003; 17%) were not included in the species richness, abundance, or frequency analyses for each habitat due to the probability that they were not breeding within the 100 m circle. The habitat with the greatest species richness (SR) (SR=39) and relative abundance (RA) (RA=7.67) in the control plot was forested habitat (Appendix C, Table 2). The habitat with the greatest species richness (SR=47) and relative abundance (RA=9.22) in the treatment plots was agricultural habitat (Appendix C, Table 3).

In the control plot, 10 points were located in forested habitat and 20 points were located in agricultural habitat. SR among 10 points in forested habitat was 39. The species with the greatest relative abundances among these points included the indigo bunting (*Passerina cyanea*) (RA=0.90), American robin (RA=0.63), and song sparrow (RA=0.60). The species with the greatest frequency among forested points were the indigo bunting (Fr=100%), American robin (Fr=90%), blue jay (Fr=70%), downy woodpecker (*Picoides pubescens*) (Fr=70%) and song sparrow (Fr=70%) (Appendix C, Table 2). The twenty points in the control plot located in agricultural habitat had a SR score of 27. The species with the greatest relative abundances at the agricultural points in the control plot included the red-winged blackbird (RA=2.17), horned lark (RA=1.15), and song sparrow (RA=0.5). The species with the greatest frequency (Fr) among agricultural points were the red-winged blackbird (Fr=90%), horned lark (Fr=80%), and song sparrow (Fr=70%) (Appendix C, Table 2).

Between the two treatment plots, 37 points were located in agricultural habitat and 23 points were located in forested habitat. SR among these agricultural points was 47. The species that exhibited the greatest relative abundances in agricultural habitat were the red-winged blackbird (RA=3.95), horned lark (RA=0.87) and song sparrow (RA=0.70). The species with the greatest frequency among agricultural points were the song sparrow (Fr=81%), red-winged blackbird (Fr=70%) and horned lark (Fr=65%) (Appendix C, Table 3). The 23 points located in forested habitat in the in treatment plots had a SR score of 45. The species that demonstrated the greatest relative abundances among these points included the northern cardinal (*Cardinalis cardinalis*) (RA=0.78), American robin (RA=0.72), and house wren (*Troglodytes aedon*) (RA=0.39). The species with the greatest frequencies were also the American robin (Fr=100%), northern cardinal (Fr=96%), and house wren (RA=70%) (Appendix C, Table 3).

No federally endangered or threatened species were detected during the surveys. One state endangered species, the northern harrier, was detected, and one state threatened species, the least flycatcher (*Empidonax minimus*), was detected (ODNR 2007). Two state species of concern were also detected: the bobolink (*Dolichonyx oryzivorus*) and the northern bobwhite (*Colinus virginianus;* ODNR 2007). Two state species of special interest were also detected: the magnolia warbler (*Dendroica magnolia*) and the blackburnian warbler (*Dendroica fusca*; ODNR 2007).

## 4.4 DISCUSSION AND CONCLUSIONS

Breeding bird surveys documented a total of 97 species in the Project area. Surveys were conducted during the peak of the nesting season, in the morning when detection of birds is greatest, and during optimal weather conditions for detection. Therefore, it is likely that the species richness detected during surveys is a suitable reflection of the species composition of breeding birds in the area. However, certain species that make infrequent vocalizations, such as some species of woodpeckers, can be underrepresented during bird surveys (Farnsworth *et al.* 2002). It is also important to note that some surveys were conducted before and after the peak of the nesting season; therefore, it is possible that some birds detected during the earlier and later survey dates were not breeding in the Project area.

Species richness represents the total number of species observed, while relative abundance takes into account the evenness of the distribution of species. The control plot and the treatment plots differed in terms of the habitat types that yielded the highest species richness and relative abundance. In the control plot, points counts located in forested habitat yielded a higher value for species richness than points in agricultural habitat. Conversely, points counts located in agricultural habitat in the treatment plots had a higher value for species richness (although only slightly) than points in forested habitat. Species richness can be affected by a number of factors including proportion of forest cover, heterogeneity of habitat types, spatial arrangement of forest and agricultural patches (e.g., fragmentation), and proximity to riparian and wetland areas. Although a detailed habitat characterization was not included as part of this study, these factors may have influenced the different species richness and abundance values observed in different portions of the Project area.

Another important factor in understanding the species richness and relative abundance of birds in different habitat types is to consider the functional role of observed birds, or the ecological guild group to which they belong. For example, the higher species richness value in forested areas within the control plot was attributed to large numbers of common forest-dwelling species such as the indigo bunting, American robin, and blue jay. This was contrasted by large numbers of common field-dwelling species, such as red-winged blackbirds, horned larks, and song sparrows that were observed in agricultural areas in the treatment plots.

In general, the species observed in the Project area are common to the region and are typical of habitats in which they were observed. The exceptions to this were several birds detected during the first round of surveys in May (May 3 to 21), before the peak of the breeding season. A white-throated sparrow (*Zonotrichia albicollis*) was detected during this period, even though white-throated sparrows typically winter in the area and breed in more northern latitudes. A Louisiana waterthrush (*Seiurus motacilla*) was also detected during this period, however they are typically known to breed in riparian habitats and not the habitats sampled in the Project area. Several other birds detected during the first survey round are also suspected to be migrants based on their early observation dates and the fact that they were not observed during consecutive surveys. These include an Acadian flycatcher (*Empidonax virescens*), a least flycatcher, a black-throated green warbler (*Dendroica virens*), and a prairie warbler (*Dendroica discolor*).

# 5.0 Bat Hibernacula and Swarm Survey

## 5.1 INTRODUCTION

Hibernation is a physiological state undergone by many species of North American bats that reduces energy expenditure during the winter months when food (i.e., insects) is not available and when water availability is reduced. The length of hibernation in Ohio for many cave dwelling species, including Indiana bat, is roughly the period from mid October to mid April, with the exact timing influenced by insect availability and seasonal temperatures and weather conditions, among other things.

Stantec conducted a hibernacula survey in late winter (March 2008) and a swarm survey in fall 2008 to document the species composition and number of bats using Sanborn's Cave/Streng Cave (hereafter Sanborn's Cave) and one other unnamed cave in the Project area (Figure 5-1). In addition to these caves, 13 potential karst geological features identified in the Ohio Natural Heritage Database, maintained by the ODNR's Division of Natural Areas and Preserve (DNAP) were evaluated for use by bats. If any of these karst features were suspected to be suitable for use by bats, a fall swarm survey or winter hibernacula survey was to be subsequently completed.

## 5.2 METHODS

Stantec used the criteria established in the document "Bat Survey Protocol for Assessing Use of Potential Hibernacula" (USFWS 2008) to determine the suitability of potential hibernacula in the Project area. Potential hibernacula identified in the Project area were investigated in one of two ways: 1) if the potential hibernaculum was safely accessible by human beings, it was surveyed during the winter to document the presence/absence of hibernating bats of any species as well as species composition; or 2) if human access was not possible or safe, any area determined to be a potential hibernaculum was subject to a fall swarming survey to determine if bats of any species are using the area for swarming or hibernation. The timing and frequency of fall swarming surveys followed the protocol identified by the ODNR and took place once every two weeks from September 15 to November 15, 2008.

Fall swarming surveys were conducted using harp traps that were either 91 cm wide by a maximum of 112 cm tall (36 in X 44 in), or 183 cm wide by a maximum of 229 cm tall (72 in X 90 in), depending on the size of the cave opening. Harp traps were placed in the openings of caves and netting or plastic tarps were secured around the traps to close off as much of the flyway in and out of the cave as possible. During the first swarm survey on September 15, 2008, bats were also captured in 38 mm (1.5 in) diameter polyester mist-nets (Avinet, Inc., Dryden, NY) placed over the stream adjacent to the cave openings, to catch bats that were foraging over the stream. Mist-nets 9 m (30 ft) in width were vertically stacked up to three nets high (7.8 m [25.6 ft]) in order to more completely fill the flight corridor. Nets and harp traps were in place approximately 30 minutes before sunset and remained open for a minimum of five hours. In accordance with the USFWS protocol (2008), surveys were targeted to occurred on nights with temperatures greater than or equal to 10°C (50° F) for at least the first two hours of sampling, temperatures that remained above 1.7°C (35° F) for the first five hours of sampling, and were free of heavy rain for at least three hours of the survey period.

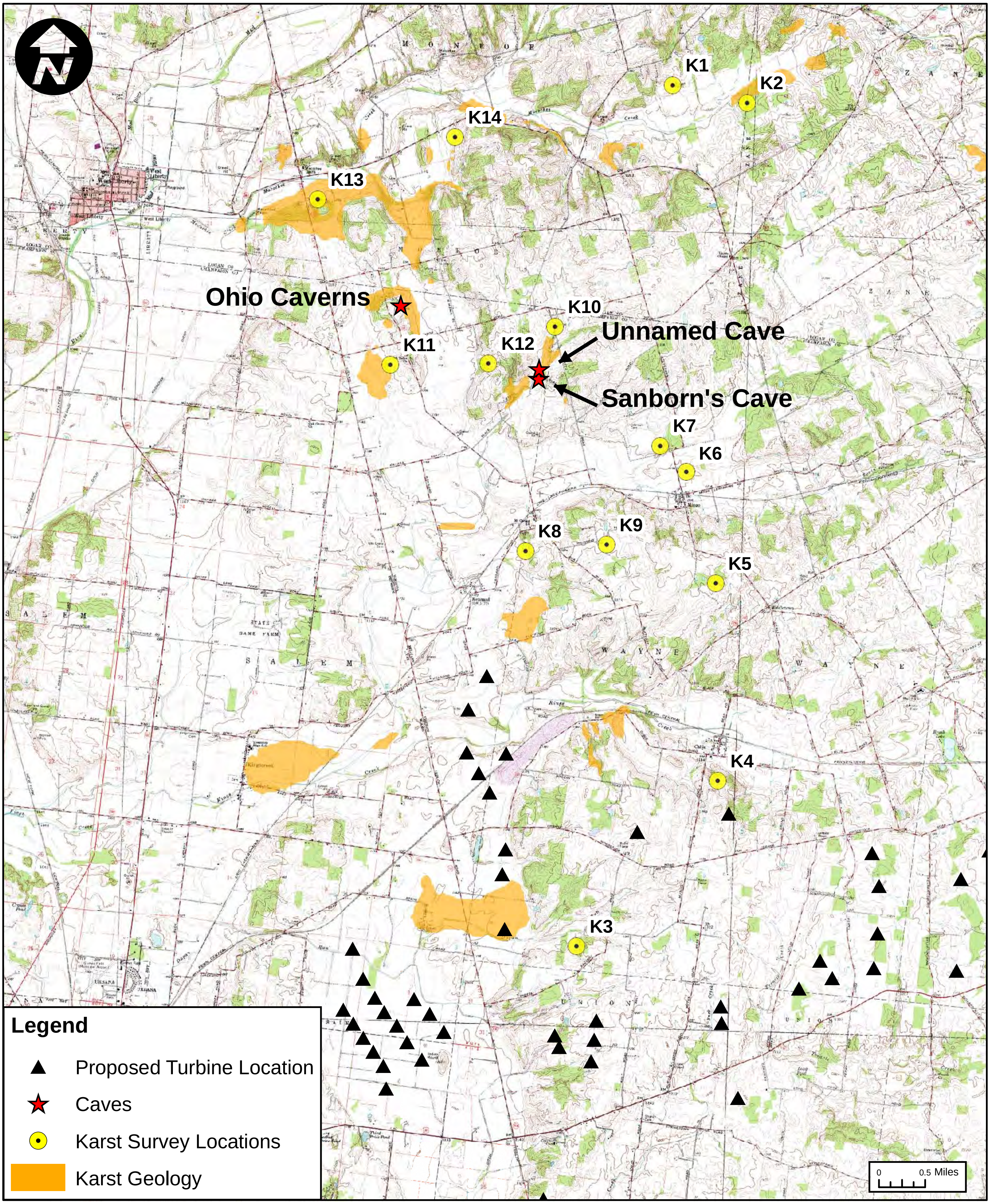
All bats captured during surveys were identified to species. If there was sufficient time to safely process bats as well as record additional information, the following data were recorded: age, sex, reproductive condition, and right forearm length. Because of concern regarding the potential spread of “white nose syndrome” (WNS), Stantec did not use any nets or holding bags from projects in those states, or any bordering states. Harps traps used were either new, or had never been used outside the Midwest. Additionally, Stantec followed mist-netting guidelines and bat handling procedures currently being developed by the USFWS for minimizing the spread of WNS. Swarming survey efforts were completed under Ohio Division of Wildlife Wild Animal Permit # 11-139, and Federal USFWS Permit #’s TE152002-1 and TE174547-0.

Documented and potential karst areas in the Project area identified by the ODNR DNAP were visited to determine if there were any openings in the ground that were indicative of the presence of a cave that could be used for hibernation by bats. An approximately 100 m (328 ft) area around the indicated feature on the map was searched for any potential openings, where landowner permission allowed. If any opening was discovered, a GPS location and physical description of the site was taken to identify and locate the opening for a subsequent swarming survey.

## 5.3 RESULTS

### 5.3.1 Karst Survey

A total of 10 of 14 potential karst features in the Project area documented by DNAP were visited to determine if the features had any openings that could be used by hibernating bats (Figure 5-1; Table 5-1). Only one of the 14 features was identified as being a “documented karst” by DNAP. This feature (K13 in Figure 5-1) was visited on March 3, 2008, and was found to have extensive exposed rock faces, but no openings were discovered. A total of ten additional features identified as being “faux karst” were visited on September 15, 2008. Table 5-1 lists each of these sites and provides a description of what was found during the survey.




Prepared By:

Stantec

Sheet Title:

*Karst Survey Location Map*

Project:

*Buckeye Wind Power Project, Ohio*

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| | |
|---|---|
| Date: | February 2009 |
| Scale: | 1" = 1.1 Miles |
| Proj. No.: | 195600164 |
| Figure: | 5-1 |

| **Table 5-1.** Survey of potential and document karst features in the Project area | | |
|---|---|---|
| **Karst ID** | **DNAP Description** | **Karst Survey Notes** |
| K1 | Faux Karst - pit or burrow | No evidence of karst features |
| K2 | Faux Karst - glacial depression | No evidence of karst features |
| K3 | Faux Karst??? | There's a pond and a sink in an adjacent field; no openings |
| K4 | Faux Karst | Not searched |
| K5 | Faux Karst | Not searched |
| K6 | Faux Karst | Large sink in field; no openings |
| K7 | Faux Karst | Sink in field - gravel pit; no openings |
| K8 | Faux Karst | Searched from road and saw no evidence of karst features |
| K9 | Faux Karst | Searched from road and saw no evidence of karst features |
| K10 | Documented Karst Feature | Old gravel pit; looks like something may have been filled in; no openings |
| K11 | Faux Karst - Soils Spring | This is in the middle of an agricultural field; looks like just a depression; no openings |
| K12 | Faux Karst - Soils Spring | Soil spring; no openings |
| K13 | Karst Feature | Investigated March 08;extensive exposed rock faces, but no openings were discovered |
| K14 | Faux Karst - glacial depression | Not searched |

Three additional faux karst areas were not visited during the survey. This decision was made because the characterization of karst features by DNAP as being “faux” rather than “documented” was accurate, based on the 10 areas that were visited during the survey. It was therefore assumed that the remaining three features would also be faux karst areas and would not have any evidence of true karst topography or any openings that could be used by bats. In order to better utilize staff time and project resources, the remaining three faux karst features (K4, K5, and K14 in Figure 5-1) were not searched.

### 5.3.2 Hibernacula Survey

A hibernacula survey was conducted on March 4, 2008 at Sanborn’s Cave. Megan Seymour of the USFWS and Erin Hazleton of DNAP participated in the visit to Sanborn’s Cave. During the visit to Sanborn’s Cave, another nearby cave located approximately 150 m (492 ft) north of Sanborn’s Cave was brought to Stantec’s attention by a local landowner. Only a partial survey of Sanborn’s Cave and the nearby, unnamed cave were conducted due to landowner access restrictions or cave entry related safety issues. Only four tri-colored bats were observed on the ceiling of Sanborn’s Cave at the time of the partial survey. Biologists were not able to get far enough into the interior of the unnamed cave to document the presence of any hibernating bats. Consequently, due to safety issues and logistical constraints, a swarm survey was planned for both opening for the following fall.

### 5.3.3 Swarm Survey

A total of 884 bats were captured during five nights of swarm surveys that were conducted simultaneously at both cave openings on September 15 (365 bats captured), September 24 (168 bats captured), October 6 (244 bats captured), October 20 (99 bats captured), and October 27 (8 bats captured; Table 5-2). Temperatures remained above 7.2°C (45° F) for all nights surveys were conducted, except during the October 6 survey when the temperature dropped to 1.6°C (35° F) at approximately 11:00 pm and remained approximately at this temperature until the end of the survey at 12:30 am.

**Table 5-2.** Species captured at two cave locations in fall 2008 swarm surveys.

| | | Date | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Species** | **Sex** | **9/15** | **9/24** | **10/6** | **10/20** | **10/27** | **Subtotals** | **Totals** |
| **Big brown bat** | Female | 10 | | | | | 10 | |
| | Male | 2 | | | | | 2 | 12 |
| **Little brown bat** | Female | 20 | 12 | 5 | | | 37 | |
| | Male | 88 | 48 | 17 | 8 | 3 | 164 | 201 |
| **Northern long-eared bat** | Female | 109 | 60 | 63 | 16 | 2 | 250 | |
| | Male | 131 | 41 | 132 | 73 | 3 | 380 | |
| | Unknown | | | 22 | 1 | | 23 | 653 |
| **Tri-colored bat** | Female | 2 | 3 | 3 | 1 | | 9 | |
| | Male | 3 | 4 | 2 | | | 9 | 18 |
| **Total** | | 365 | 168 | 244 | 99 | 8 | 884 | |

Three species were captured in harp traps: tri-colored bats, little brown bats, and northern long-eared bats (Table 5-2). Big brown bats were captured only in mist-nets placed over the stream during the first survey. The majority of bats were captured in the harp trap placed at the opening of the unnamed cave (n=704; 80%). Thirteen percent of bats (n=111) were captured in the harp trap placed at the opening of Sanborn's Cave and 6% of bats (n=52) were captured in mist-nets placed over a stream adjacent to Sanborn's Cave. Two percent (n=17) of bats were not identified as to whether they were captured in the unnamed cave, Sanborn's Cave, or in mist-nets due to rapid handling and processing of bats during peak swarming activity. Bats were marked with a temporary white paint on their wings to identify bats that were captured in traps or nets more than once, or recaptures. Twenty-four bats (3%) were recaptures from previous surveys or from an earlier time during the same survey night.

Northern long-eared bats were the most common species captured at the cave openings (74%; n= 653), with males representing 58% of all northern long-eared bats captured. The second most frequently captured species was the little brown bat, representing 23% (n= 201) of all bats captured. Males represented the majority (82%) of all little brown bats captured. The least frequently captured bats were tri-colored bats (n=18), followed by big brown bats (n=12).

## 5.4 DISCUSSION AND CONCLUSIONS

The species captured in the fall 2008 swarm surveys are bats that commonly hibernate in Ohio's caves during the winter. No state or federally listed bats, including the endangered Indiana bat, were captured in swarm surveys. The results of the swarm survey indicate that the two caves surveyed are used by swarming bats during the fall and probably provide suitable habitat for winter hibernation. However, the interpretation of swarm survey capture results is not always clear. Little is known about the behavior of bats during the spring and autumn migration period, and bats may visit and explore caves and mines during this period, but not hibernate in them during winter. Thus, it is not clear whether the bats captured in the fall 2008 swarm surveys are using these same caves for winter hibernation. However, the consistent capture of relatively high numbers of bats at these two caves throughout the fall swarming period and as late as October 6, and the relatively high total number of bats captured (n=884), strongly suggest that these caves provide suitable habitat for several species of bats for winter hibernation.

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# Appendix A

Acoustic survey results

**Appendix A Table 1**. Summary of acoustic bat data and weather during each survey night at the North High detector – 2008

| | | BBSH | | | HB | MYSP | RBTP | | | UNKN | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Night of | Functional? | BBSH | Big brown | Silver-haired | Hoary | MYSP | Eastern red | Tri-colored | RBTB | HFUN | LFUN | UNKN | Total | Wind Speed (m/s) | Temperature (celsius) |
| 3/29/08 | Y | | | | | | | | | | | | 0 | | |
| 3/30/08 | Y | | | | | | | | | | | | 0 | | |
| 3/31/08 | Y | | | | | | | | | | | | 0 | | |
| 4/1/08 | Y | | | | | | | | | | | | 0 | 5.7 | 0.8 |
| 4/2/08 | Y | | | | | | | | | | | | 0 | 7.3 | 2.4 |
| 4/3/08 | Y | | | | | | | | | | | | 0 | 8.0 | 8.6 |
| 4/4/08 | Y | | | | | | | | | | | | 0 | 3.6 | 4.2 |
| 4/5/08 | Y | | | | | | | | | | | | 0 | 7.4 | 6.8 |
| 4/6/08 | Y | | | | | | | | | | | | 0 | 5.5 | 12.5 |
| 4/7/08 | N | | | | | | | | | | | | | 6.1 | 12.5 |
| 4/8/08 | N | | | | | | | | | | | | | 8.8 | 17.4 |
| 4/9/08 | N | | | | | | | | | | | | | 7.5 | 7.0 |
| 4/10/08 | N | | | | | | | | | | | | | 8.9 | 14.8 |
| 4/11/08 | N | | | | | | | | | | | | | 8.5 | 9.2 |
| 4/12/08 | N | | | | | | | | | | | | | 6.9 | 2.6 |
| 4/13/08 | N | | | | | | | | | | | | | 5.3 | 0.9 |
| 4/14/08 | N | | | | | | | | | | | | | 4.6 | 2.6 |
| 4/15/08 | N | | | | | | | | | | | | | 6.9 | 7.7 |
| 4/16/08 | N | | | | | | | | | | | | | 8.5 | 11.6 |
| 4/17/08 | N | | | | | | | | | | | | | 7.1 | 14.5 |
| 4/18/08 | N | | | | | | | | | | | | | 5.4 | 16.3 |
| 4/19/08 | N | | | | | | | | | | | | | 4.1 | 8.7 |
| 4/20/08 | N | | | | | | | | | | | | | 3.4 | 10.9 |
| 4/21/08 | N | | | | | | | | | | | | | 7.0 | 13.5 |
| 4/22/08 | N | | | | | | | | | | | | | 5.7 | 17.4 |
| 4/23/08 | N | | | | | | | | | | | | | 9.1 | 14.2 |
| 4/24/08 | N | | | | | | | | | | | | | 5.9 | 18.8 |
| 4/25/08 | N | | | | | | | | | | | | | 8.5 | 20.2 |
| 4/26/08 | N | | | | | | | | | | | | | 3.9 | 10.0 |
| 4/27/08 | N | | | | | | | | | | | | | 5.2 | 9.0 |
| 4/28/08 | N | | | | | | | | | | | | | 5.1 | 3.1 |
| 4/29/08 | N | | | | | | | | | | | | | 3.9 | 4.1 |
| 4/30/08 | Y | | | | | | | | | | | | 0 | 6.7 | 11.3 |
| 5/1/08 | Y | 2 | 1 | | | | | | | | | | 3 | 7.8 | 18.7 |
| 5/2/08 | Y | 1 | | | | | | | 1 | | 1 | | 3 | 9.5 | 16.4 |
| 5/3/08 | Y | | | | | | | | | | | | 0 | 7.4 | 7.8 |
| 5/4/08 | Y | | | | | | 1 | | | | | | 1 | 4.8 | 11.4 |
| 5/5/08 | Y | | | 3 | | | 1 | | | | 3 | | 7 | 4.8 | 14.0 |
| 5/6/08 | Y | | | | | | 1 | | | 1 | | | 2 | 6.5 | 17.1 |
| 5/7/08 | Y | | | | | | | | | | | | 0 | 6.2 | 15.2 |
| 5/8/08 | Y | | | | | | | | | | | | 0 | 7.4 | 9.4 |
| 5/9/08 | Y | | | | | | | | | | | | 0 | 5.1 | 8.1 |
| 5/10/08 | Y | 3 | | | | | | | | | 1 | | 4 | 6.7 | 12.1 |
| 5/11/08 | Y | | | | | | | | | 1 | | | 1 | 8.2 | 9.8 |
| 5/12/08 | Y | | | | | | | | | | | | 0 | 4.6 | 8.2 |
| 5/13/08 | Y | | | | | | | | | | | | 0 | 6.4 | 13.9 |
| 5/14/08 | Y | 1 | | 1 | | | 1 | | | | | | 3 | 5.4 | 12.1 |
| 5/15/08 | Y | | | | | | | | | | | | 0 | 8.6 | 9.0 |
| 5/16/08 | Y | | | | | | | | | | | | 0 | 6.7 | 11.6 |
| 5/17/08 | Y | | | | | | | | | | 1 | | 1 | 4.5 | 11.9 |
| 5/18/08 | Y | | | | 1 | | | | | | 1 | | 2 | 5.4 | 6.6 |
| 5/19/08 | Y | | | | | | | | | | | | 0 | 3.0 | 9.5 |
| 5/20/08 | Y | | | | | | | | | | | | 0 | 5.5 | 8.1 |
| 5/21/08 | Y | | | | | | | | | | | | 0 | 5.8 | 8.6 |
| 5/22/08 | Y | | | | | | | | | | | | 0 | 4.8 | 11.0 |
| 5/23/08 | Y | | | | | | | | | | | | 0 | 6.0 | 10.6 |
| 5/24/08 | Y | | | | | | | | | | | | 0 | 4.6 | 10.4 |
| 5/25/08 | Y | | | | 1 | | | | | | | | 1 | 7.2 | 18.3 |
| 5/26/08 | Y | | | | | | | | | | | | 0 | 6.3 | 19.2 |
| 5/27/08 | Y | | | | | | | | | 1 | | | 1 | 9.7 | 6.5 |
| 5/28/08 | Y | | | | | | | | | | | | 0 | 6.4 | 9.9 |
| 5/29/08 | Y | | | | | | | | | | | | 0 | 4.5 | 16.9 |
| 5/30/08 | Y | 2 | | | 1 | | | | | | 2 | | 5 | 9.2 | 20.9 |
| 5/31/08 | Y | | | | | | | | | | 1 | | 1 | 6.2 | 18.8 |
| 6/1/08 | Y | | | | | | | | 1 | | | | 1 | 5.8 | 17.5 |
| 6/2/08 | Y | 1 | | | | | | | | | 1 | | 2 | 3.9 | 21.3 |
| 6/3/08 | Y | | | | | 1 | | | | | 1 | | 2 | 5.4 | 20.5 |
| 6/4/08 | Y | | | | 1 | | | | | | 1 | | 2 | 5.1 | 20.5 |
| 6/5/08 | Y | | | 1 | | | | | | | 2 | | 3 | 7.3 | 25.8 |
| 6/6/08 | Y | | 2 | | | | | | | | 2 | | 4 | 8.0 | 27.4 |
| 6/7/08 | Y | | | | | | | | | | 1 | | 1 | 4.7 | 24.1 |
| 6/8/08 | Y | | | | | | 1 | | | | 4 | | 5 | 7.0 | 27.6 |
| 6/9/08 | Y | 1 | | 1 | | | | | | 1 | 2 | | 5 | 6.7 | 26.5 |
| 6/10/08 | Y | 1 | | | | | | | | | | | 1 | 5.9 | 21.4 |
| 6/11/08 | Y | | | | 1 | | | | | 1 | 4 | | 6 | 4.9 | 23.5 |
| 6/12/08 | Y | | | | | | | | | | | | 0 | 5.7 | 24.5 |
| 6/13/08 | Y | 2 | | | | | | | | 1 | 1 | | 4 | 6.3 | 24.1 |
| 6/14/08 | Y | 1 | | | | | | | | | | | 1 | 4.2 | 22.3 |
| 6/15/08 | Y | | | | | | | | | | | | 0 | 5.1 | 22.6 |
| 6/16/08 | Y | | | | | | | | | | 1 | | 1 | 6.5 | 20.6 |
| 6/17/08 | Y | | | | | | | | | 1 | | | 1 | 6.2 | 16.4 |
| 6/18/08 | Y | | | | | | | | | | | | 0 | 5.6 | 17.5 |
| 6/19/08 | Y | | | 3 | | | | | | | | | 3 | 4.0 | 18.2 |
| 6/20/08 | Y | | | | | | | | | 1 | 1 | | 2 | 2.9 | 22.3 |
| 6/21/08 | Y | | | | | | | | | | | | 0 | 5.4 | 20.1 |
| 6/22/08 | Y | 1 | | | | | | | | | 2 | | 3 | 5.2 | 19.4 |
| 6/23/08 | Y | | 1 | | | | | | | | 2 | | 3 | 4.8 | 18.8 |
| 6/24/08 | Y | 1 | 1 | 1 | | | 1 | | | | | | 4 | 3.8 | 20.3 |
| 6/25/08 | Y | | | | | | | | | | | | 0 | 5.4 | 21.9 |
| 6/26/08 | Y | | | | | | | | | | 1 | | 1 | 5.7 | 24.2 |
| 6/27/08 | Y | | | | | | | | | | | | 0 | 4.8 | 23.6 |
| 6/28/08 | Y | | | | | | | | | | 1 | | 1 | 6.5 | 22.4 |
| 6/29/08 | Y | | | | | | | | | 1 | 1 | | 2 | 7.1 | 21.2 |
| 6/30/08 | Y | | | | | | | | | 1 | | | 1 | 4.9 | 16.7 |
| 7/1/08 | Y | | | | | | | | | | | | 0 | 3.8 | 19.4 |
| 7/2/08 | Y | 1 | | | | | | | | | 1 | | 2 | 8.1 | 22.6 |
| 7/3/08 | Y | 2 | | | | | | | | | 1 | | 3 | 6.3 | 19.7 |
| 7/4/08 | Y | | | | 1 | | | | | | | | 1 | 4.6 | 17.7 |
| 7/5/08 | Y | | | | | | | | | | 1 | | 1 | 4.8 | 20.6 |
| 7/6/08 | Y | | 1 | | 1 | | | | | | 3 | | 5 | 3.8 | 23.1 |
| 7/7/08 | Y | | 2 | | | | | | | | 2 | | 4 | 4.3 | 24.5 |
| 7/8/08 | N | | | | | | | | | | | | | 6.5 | 23.5 |
| 7/9/08 | N | | | | | | | | | | | | | 6.2 | 22.5 |
| 7/10/08 | N | | | | | | | | | | | | | 3.7 | 21.9 |
| 7/11/08 | N | | | | | | | | | | | | | 5.5 | 24.3 |
| 7/12/08 | N | | | | | | | | | | | | | 6.8 | 23.4 |
| 7/13/08 | N | | | | | | | | | | | | | 6.3 | 21.9 |
| 7/14/08 | N | | | | | | | | | | | | | 4.3 | 20.5 |
| 7/15/08 | Y | | | | | | | | | | 2 | | 2 | 2.8 | 22.9 |
| 7/16/08 | Y | | | | | | | | | | | | 0 | 3.8 | 24.9 |
| 7/17/08 | Y | | | | | | | | | | | | 0 | 3.7 | 25.7 |
| 7/18/08 | Y | 1 | | | | | 1 | | | | 1 | | 3 | 5.1 | 25.8 |
| 7/19/08 | Y | | 1 | | | | | | | | 1 | | 2 | 4.8 | 25.9 |
| 7/20/08 | Y | 2 | | | | | | | | | | | 2 | 6.8 | 25.3 |
| 7/21/08 | Y | 1 | | | | | | | | 1 | 1 | | 3 | 5.2 | 24.2 |
| 7/22/08 | Y | | | | | | | | | 1 | 2 | | 3 | 4.7 | 22.5 |
| 7/23/08 | Y | | | | | | | | | | 1 | | 1 | 4.8 | 20.6 |
| 7/24/08 | Y | | | | | | | | | | | | 0 | 4.3 | 20.9 |
| 7/25/08 | Y | 1 | | | | | | | | 1 | 1 | | 3 | 3.0 | 21.4 |
| 7/26/08 | Y | | 1 | | | | | | | | 2 | | 3 | 4.7 | 22.9 |
| 7/27/08 | Y | | | | | | | | | | | | 0 | 4.0 | 21.1 |
| 7/28/08 | Y | | | | | | | | | | 2 | | 2 | 3.8 | 22.4 |
| 7/29/08 | Y | | | | | | 1 | | | | 1 | | 2 | 3.0 | 24.6 |
| 7/30/08 | Y | | | | | | | | | | 4 | | 4 | 5.9 | 23.8 |
| 7/31/08 | Y | 2 | | | | | | | | 1 | | | 3 | 4.9 | 23.7 |
| 8/1/08 | Y | 2 | | | 2 | | 1 | | | | 1 | | 6 | 5.1 | 24.3 |
| 8/2/08 | Y | 1 | 1 | | | | | | | | 1 | | 3 | 4.9 | 23.4 |
| 8/3/08 | Y | 1 | | | | | | | | | 2 | | 3 | 2.9 | 22.2 |
| 8/4/08 | Y | 1 | | | | | | | | | 2 | | 3 | 4.9 | 23.1 |
| 8/5/08 | Y | 2 | | | | | | | | 1 | 3 | | 6 | 6.2 | 22.5 |
| 8/6/08 | Y | 1 | | | | | | | | | 1 | | 2 | 4.7 | 23.8 |
| 8/7/08 | Y | 1 | 1 | | | | | | | | | | 2 | 5.5 | 20.9 |
| 8/8/08 | Y | 1 | | | | | | | | | 2 | | 3 | 4.8 | 19.2 |
| 8/9/08 | Y | | 1 | | | | | | | | 1 | | 2 | 4.8 | 19.6 |
| 8/10/08 | Y | | | | | | | | | | | | 0 | 4.8 | 18.1 |
| 8/11/08 | Y | 1 | | | | | | | | | 1 | | 2 | 4.0 | 18.5 |
| 8/12/08 | Y | | | | | | | | 1 | | 1 | | 2 | 1.9 | 21.0 |
| 8/13/08 | Y | 2 | 1 | | | | | | | | | | 3 | 3.5 | 21.3 |
| 8/14/08 | Y | | | | | | | | | 1 | | | 1 | 3.9 | 19.5 |
| 8/15/08 | Y | 1 | | | | | | | | | | | 1 | 4.5 | 20.1 |
| 8/16/08 | Y | | | | | | | | | | 3 | | 3 | 3.8 | 20.5 |
| 8/17/08 | Y | | | | | | | | | | 2 | | 2 | 4.5 | 20.4 |
| 8/18/08 | Y | 1 | | | | | | | | 1 | | | 2 | 4.5 | 21.4 |
| 8/19/08 | Y | | | | | | | | | 2 | 3 | | 5 | 5.0 | 22.7 |
| 8/20/08 | Y | | 1 | | | | | | | | 1 | | 2 | 5.3 | 20.7 |
| 8/21/08 | Y | 1 | | 1 | | | | | | 1 | 6 | | 9 | 5.8 | 24.0 |
| 8/22/08 | Y | | 2 | | | | 1 | | | 1 | 2 | | 6 | 5.7 | 25.6 |
| 8/23/08 | Y | | 1 | | | | | | | | 2 | | 3 | 4.6 | 25.7 |
| 8/24/08 | Y | 1 | 1 | | | | 1 | | | 7 | 4 | | 14 | 4.5 | 24.2 |
| 8/25/08 | Y | | | | | 1 | | | | | | | 1 | 8.2 | 20.0 |
| 8/26/08 | Y | | | | | | | | | | 1 | | 1 | 7.4 | 19.7 |
| 8/27/08 | Y | 2 | 2 | | | 2 | 1 | | 1 | | | | 8 | 5.4 | 19.3 |
| 8/28/08 | Y | 3 | | | | | | | | 4 | | | 7 | 3.3 | 19.4 |
| 8/29/08 | Y | 2 | 1 | | | | | | | | 1 | | 4 | 4.6 | 23.8 |
| 8/30/08 | Y | | | | | | | | | 1 | 3 | | 4 | 5.1 | 23.2 |
| 8/31/08 | Y | | 1 | | | | | | | | | | 1 | 5.9 | 22.8 |
| 9/1/08 | Y | 2 | 1 | | | | 2 | | 1 | 1 | 2 | 1 | 10 | 5.5 | 22.9 |
| 9/2/08 | Y | | 1 | | | | 1 | | | | 1 | | 3 | 4.5 | 26.2 |
| 9/3/08 | Y | | 1 | 1 | | | | | | 1 | 2 | | 5 | 3.4 | 27.2 |
| By Species | | 53 | 26 | 12 | 9 | 4 | 15 | 0 | 5 | 35 | 112 | 1 | 272 | | |
| By Guild | | 91 | | | 9 | 4 | 20 | | | 148 | | | | | |
| | | BBSH | | | HB | MYSP | RBTB | | | UNKN | | | Total | | |

**Appendix A Table 2.** Summary of acoustic bat data and weather during each survey night at the North Low detector – 2008

| | | BBSH | | | HB | MYSP | RBTP | | | UNKN | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Night of | Functional? | BBSH | Big brown | Silver-haired | Hoary | MYSP | Eastern red | Tri-colored | RBTB | HFUN | LFUN | UNKN | Total | Wind Speed (m/s) | Temperature (celsius) |
| 03/29/08 | Y | | | | | | | | | | | | **0** | | |
| 03/30/08 | Y | | | | | | | | | | | | **0** | | |
| 03/31/08 | Y | | | | | | | | | | | | **0** | | |
| 04/01/08 | Y | | | | | | | | | | | | **0** | 5.7 | 0.8 |
| 04/02/08 | Y | | | | | | | | | | | | **0** | 7.3 | 2.4 |
| 04/03/08 | Y | | | | | | | | | | | | **0** | 8.0 | 8.6 |
| 04/04/08 | Y | | | | | | | | | | | | **0** | 3.6 | 4.2 |
| 04/05/08 | Y | | | | | | | | | | | | **0** | 7.4 | 6.8 |
| 04/06/08 | Y | | | | | | | | | | | | **0** | 5.5 | 12.5 |
| 04/07/08 | N | | | | | | | | | | | | | 6.1 | 12.5 |
| 04/08/08 | N | | | | | | | | | | | | | 8.8 | 17.4 |
| 04/09/08 | N | | | | | | | | | | | | | 7.5 | 7.0 |
| 04/10/08 | N | | | | | | | | | | | | | 8.9 | 14.8 |
| 04/11/08 | N | | | | | | | | | | | | | 8.5 | 9.2 |
| 04/12/08 | N | | | | | | | | | | | | | 6.9 | 2.6 |
| 04/13/08 | N | | | | | | | | | | | | | 5.3 | 0.9 |
| 04/14/08 | N | | | | | | | | | | | | | 4.6 | 2.6 |
| 04/15/08 | N | | | | | | | | | | | | | 6.9 | 7.7 |
| 04/16/08 | N | | | | | | | | | | | | | 8.5 | 11.6 |
| 04/17/08 | N | | | | | | | | | | | | | 7.1 | 14.5 |
| 04/18/08 | N | | | | | | | | | | | | | 5.4 | 16.3 |
| 04/19/08 | N | | | | | | | | | | | | | 4.1 | 8.7 |
| 04/20/08 | N | | | | | | | | | | | | | 3.4 | 10.9 |
| 04/21/08 | N | | | | | | | | | | | | | 7.0 | 13.5 |
| 04/22/08 | N | | | | | | | | | | | | | 5.7 | 17.4 |
| 04/23/08 | N | | | | | | | | | | | | | 9.1 | 14.2 |
| 04/24/08 | N | | | | | | | | | | | | | 5.9 | 18.8 |
| 04/25/08 | N | | | | | | | | | | | | | 8.5 | 20.2 |
| 04/26/08 | N | | | | | | | | | | | | | 3.9 | 10.0 |
| 04/27/08 | N | | | | | | | | | | | | | 5.2 | 9.0 |
| 04/28/08 | N | | | | | | | | | | | | | 5.1 | 3.1 |
| 04/29/08 | N | | | | | | | | | | | | | 3.9 | 4.1 |
| 04/30/08 | Y | 2 | | | | | | | | 2 | 2 | | **6** | 6.7 | 11.3 |
| 05/01/08 | Y | 2 | | 1 | | | | | | 1 | | | **4** | 7.8 | 18.7 |
| 05/02/08 | Y | 3 | | | 2 | | 1 | | | | | | **6** | 9.5 | 16.4 |
| 05/03/08 | Y | | | | | | | | | | | | **0** | 7.4 | 7.8 |
| 05/04/08 | Y | | | | | | | | 1 | | 1 | | **2** | 4.8 | 11.4 |
| 05/05/08 | Y | 3 | | 2 | | | 1 | | | 2 | 4 | 1 | **13** | 4.8 | 14.0 |
| 05/06/08 | Y | | 1 | | | | | | 1 | 1 | 2 | | **5** | 6.5 | 17.1 |
| 05/07/08 | Y | | 1 | | | | | | | 1 | | | **2** | 6.2 | 15.2 |
| 05/08/08 | Y | | | | | | | | | | | | **0** | 7.4 | 9.4 |
| 05/09/08 | Y | | | | | | | | | 1 | 1 | | **2** | 5.1 | 8.1 |
| 05/10/08 | Y | 5 | | 2 | | 1 | | | | 1 | 1 | | **10** | 6.7 | 12.1 |
| 05/11/08 | Y | | 1 | | | | | | | 1 | | | **2** | 8.2 | 9.8 |
| 05/12/08 | Y | | | | | | | | | | | | **0** | 4.6 | 8.2 |
| 05/13/08 | Y | | | | | | | 1 | | 1 | | | **2** | 6.4 | 13.9 |
| 05/14/08 | Y | | 1 | | | 1 | 3 | | | 2 | 3 | | **10** | 5.4 | 12.1 |
| 05/15/08 | Y | 1 | | | | | | | | | 1 | | **2** | 8.6 | 9.0 |
| 05/16/08 | Y | 1 | | | | | 1 | | | 1 | 1 | | **4** | 6.7 | 11.6 |
| 05/17/08 | Y | | | 1 | | | | | | | 1 | | **2** | 4.5 | 11.9 |
| 05/18/08 | Y | | | | | 1 | 1 | | | | | | **2** | 5.4 | 6.6 |
| 05/19/08 | Y | 1 | 1 | 1 | | 1 | | | | | 1 | | **5** | 3.0 | 9.5 |
| 05/20/08 | Y | | | | | | | | | 1 | 1 | | **2** | 5.5 | 8.1 |
| 05/21/08 | Y | | | | | | | | | | | | **0** | 5.8 | 8.6 |
| 05/22/08 | Y | | | 1 | | | 1 | | | | | | **2** | 4.8 | 11.0 |
| 05/23/08 | Y | | | 1 | | | 1 | 1 | | | | | **3** | 6.0 | 10.6 |
| 05/24/08 | Y | 3 | 1 | | | | | | | | | | **4** | 4.6 | 10.4 |
| 05/25/08 | Y | 2 | 1 | | | | | | | | 2 | | **5** | 7.2 | 18.3 |
| 05/26/08 | Y | 1 | | | | 2 | 1 | | 1 | 1 | 5 | | **11** | 6.3 | 19.2 |
| 05/27/08 | Y | | | | | | | | | | | | **0** | 9.7 | 6.5 |
| 05/28/08 | Y | | | | 1 | | | | | 2 | | | **3** | 6.4 | 9.9 |
| 05/29/08 | Y | | 2 | | | | | | | | 1 | | **3** | 4.5 | 16.9 |
| 05/30/08 | Y | 1 | | | | | | | | 2 | 1 | | **4** | 9.2 | 20.9 |
| 05/31/08 | Y | 2 | | | 1 | | 1 | | | 1 | 3 | | **8** | 6.2 | 18.8 |
| 06/01/08 | Y | 1 | | | | | | | 1 | 2 | 3 | | **7** | 5.8 | 17.5 |
| 06/02/08 | Y | | 1 | | | | 2 | 1 | | 1 | | | **5** | 3.9 | 21.3 |
| 06/03/08 | Y | 2 | | | | | | | | | | | **2** | 5.4 | 20.5 |
| 06/04/08 | Y | 2 | 2 | | | | 1 | | | 1 | 1 | | **7** | 5.1 | 20.5 |
| 06/05/08 | Y | 3 | 2 | 1 | 2 | | 1 | | | 2 | 3 | | **14** | 7.3 | 25.8 |
| 06/06/08 | Y | 3 | | 1 | 1 | | 2 | | | 2 | 4 | | **13** | 8.0 | 27.4 |
| 06/07/08 | Y | 2 | 1 | | | | | 1 | 1 | 3 | 2 | | **10** | 4.7 | 24.1 |
| 06/08/08 | Y | 3 | | 1 | | | | | 1 | 1 | 2 | | **8** | 7.0 | 27.6 |
| 06/09/08 | Y | 2 | 2 | 1 | 1 | | 1 | | 1 | 1 | 1 | | **10** | 6.7 | 26.5 |
| 06/10/08 | Y | | | 1 | 1 | | | | | | 4 | | **6** | 5.9 | 21.4 |
| 06/11/08 | Y | 4 | 3 | | 2 | | 1 | | | 4 | 7 | | **21** | 4.9 | 23.5 |
| 06/12/08 | Y | 3 | | | | | | | 1 | 2 | 1 | | **7** | 5.7 | 24.5 |
| 06/13/08 | Y | | 1 | | | | | | | 2 | 3 | | **6** | 6.3 | 24.1 |
| 06/14/08 | Y | 2 | 3 | | | | 1 | | 1 | 1 | 2 | | **10** | 4.2 | 22.3 |
| 06/15/08 | Y | 1 | 2 | | | | | | | | | | **3** | 5.1 | 22.6 |
| 06/16/08 | Y | | | | | | 2 | | | 1 | | | **3** | 6.5 | 20.6 |
| 06/17/08 | Y | 1 | | | | | 1 | | | 1 | 1 | | **4** | 6.2 | 16.4 |
| 06/18/08 | Y | | | | | | | 1 | | | 2 | | **3** | 5.6 | 17.5 |
| 06/19/08 | Y | 2 | 2 | 1 | | | | | | 1 | 2 | | **8** | 4.0 | 18.2 |
| 06/20/08 | Y | 4 | 2 | | | | | | 1 | 1 | 1 | | **9** | 2.9 | 22.3 |
| 06/21/08 | Y | 2 | | | | | | | | | 3 | | **5** | 5.4 | 20.1 |
| 06/22/08 | Y | | 1 | | | 1 | | | | | | | **2** | 5.2 | 19.4 |
| 06/23/08 | Y | 1 | 1 | | | | | | 1 | 2 | | | **5** | 4.8 | 18.8 |
| 06/24/08 | Y | 1 | | | | | | | 1 | 3 | 3 | | **8** | 3.8 | 20.3 |
| 06/25/08 | Y | | 1 | | | | | | | | 3 | | **4** | 5.4 | 21.9 |
| 06/26/08 | Y | 2 | 3 | | | | | | | | 9 | | **14** | 5.7 | 24.2 |
| 06/27/08 | Y | | 1 | | | | | | | | 1 | | **2** | 4.8 | 23.6 |
| 06/28/08 | Y | 1 | | | | | | | | 2 | | | **3** | 6.5 | 22.4 |
| 06/29/08 | Y | | 1 | | | | 1 | | 1 | 1 | | 1 | **5** | 7.1 | 21.2 |
| 06/30/08 | Y | | | | | | | | | 1 | | | **1** | 4.9 | 16.7 |
| 07/01/08 | N | | | | | | | | | | | | | 3.8 | 19.4 |
| 07/02/08 | N | | | | | | | | | | | | | 8.1 | 22.6 |
| 07/03/08 | N | | | | | | | | | | | | | 6.3 | 19.7 |
| 07/04/08 | N | | | | | | | | | | | | | 4.6 | 17.7 |
| 07/05/08 | N | | | | | | | | | | | | | 4.8 | 20.6 |
| 07/06/08 | N | | | | | | | | | | | | | 3.8 | 23.1 |
| 07/07/08 | N | | | | | | | | | | | | | 4.3 | 24.5 |
| 07/08/08 | Y | 2 | 1 | | | | | | | | 2 | | **5** | 6.5 | 23.5 |
| 07/09/08 | Y | 4 | | | | | | | | 1 | 1 | 1 | **7** | 6.2 | 22.5 |
| 07/10/08 | Y | 1 | 3 | | | | | | | | 2 | | **6** | 3.7 | 21.9 |
| 07/11/08 | Y | 1 | | | | | | | 1 | 1 | | 1 | **4** | 5.5 | 24.3 |
| 07/12/08 | Y | | 1 | | | | | | | | 2 | | **3** | 6.8 | 23.4 |
| 07/13/08 | Y | 1 | 2 | | | | | | 1 | | 4 | | **8** | 6.3 | 21.9 |
| 07/14/08 | Y | 2 | 1 | | | | | | | | 2 | | **5** | 4.3 | 20.5 |
| 07/15/08 | Y | 4 | | | | | 1 | | 1 | 3 | 4 | 1 | **14** | 2.8 | 22.9 |
| 07/16/08 | Y | 8 | 2 | | | 1 | 1 | | 4 | 3 | 4 | | **23** | 3.8 | 24.9 |
| 07/17/08 | Y | 8 | 2 | | | | | | 2 | | 7 | | **19** | 3.7 | 25.7 |
| 07/18/08 | Y | 6 | | | | 1 | 1 | | 1 | 1 | 4 | | **14** | 5.1 | 25.8 |
| 07/19/08 | Y | 8 | 3 | | 1 | | 4 | | | 3 | 4 | 1 | **24** | 4.8 | 25.9 |
| 07/20/08 | Y | 4 | 1 | | 2 | 2 | 1 | | 2 | 4 | 5 | 2 | **23** | 6.8 | 25.3 |
| 07/21/08 | Y | 5 | 3 | | 1 | 1 | | | | 4 | 8 | 1 | **23** | 5.2 | 24.2 |
| 07/22/08 | Y | 5 | | | | | 2 | | 1 | 4 | 5 | 1 | **18** | 4.7 | 22.5 |
| 07/23/08 | Y | 1 | 2 | | | | | | | 3 | 1 | | **7** | 4.8 | 20.6 |
| 07/24/08 | Y | 1 | 1 | | | | 1 | | 1 | 1 | 3 | | **8** | 4.3 | 20.9 |
| 07/25/08 | Y | 4 | 1 | | | | | | 1 | 1 | 7 | 1 | **15** | 3.0 | 21.4 |
| 07/26/08 | Y | 4 | 1 | | | | 1 | | | 2 | 3 | | **11** | 4.7 | 22.9 |
| 07/27/08 | Y | 8 | 2 | | | | | | 2 | | 1 | | **13** | 4.0 | 21.1 |
| 07/28/08 | Y | 5 | 1 | | | | 2 | | | 3 | 3 | | **14** | 3.8 | 22.4 |
| 07/29/08 | Y | 7 | 3 | | | 1 | 2 | | 2 | 4 | 5 | 2 | **26** | 3.0 | 24.6 |
| 07/30/08 | Y | 9 | 2 | | | 1 | 1 | | | 2 | 2 | | **17** | 5.9 | 23.8 |
| 07/31/08 | Y | 5 | 1 | | 1 | 1 | | | 1 | 3 | 9 | 1 | **22** | 4.9 | 23.7 |
| 08/01/08 | Y | 6 | 2 | | | | 1 | | 2 | 5 | 5 | 2 | **23** | 5.1 | 24.3 |
| 08/02/08 | Y | 4 | | | | | | | 2 | | 3 | 2 | **11** | 4.9 | 23.4 |
| 08/03/08 | Y | 2 | 2 | | | 1 | 1 | | | 1 | 1 | 1 | **9** | 2.9 | 22.2 |
| 08/04/08 | Y | | | | | | | | 1 | 1 | | | **2** | 4.9 | 23.1 |
| 08/05/08 | Y | 7 | 3 | | | | 1 | | | 2 | 3 | 2 | **18** | 6.2 | 22.5 |
| 08/06/08 | Y | 2 | | | | | 1 | | 2 | 3 | 4 | | **12** | 4.7 | 23.8 |
| 08/07/08 | Y | 10 | 2 | | | | | | | 4 | 5 | | **21** | 5.5 | 20.9 |
| 08/08/08 | Y | 3 | | | | 1 | 1 | | | 1 | 2 | | **8** | 4.8 | 19.2 |
| 08/09/08 | Y | 4 | | | | | | | | | 4 | | **8** | 4.8 | 19.6 |
| 08/10/08 | Y | 3 | 3 | | | | 1 | | 1 | 6 | 6 | | **20** | 4.8 | 18.1 |
| 08/11/08 | Y | 3 | | | | | 2 | | | 1 | 1 | | **7** | 4.0 | 18.5 |
| 08/12/08 | Y | 6 | | | | | | | 2 | 2 | 3 | | **13** | 1.9 | 21.0 |
| 08/13/08 | Y | 2 | | | | | | | 1 | 5 | 2 | | **10** | 3.5 | 21.3 |
| 08/14/08 | Y | 1 | | | | | 1 | | 1 | 4 | 4 | | **11** | 3.9 | 19.5 |
| 08/15/08 | Y | 4 | 2 | | | | 2 | | 2 | 2 | 1 | | **13** | 4.5 | 20.1 |
| 08/16/08 | Y | 3 | | | | | | | 1 | 1 | 4 | | **9** | 3.8 | 20.5 |
| 08/17/08 | Y | 1 | 1 | | | | | | 1 | 3 | 3 | 1 | **10** | 4.5 | 20.4 |
| 08/18/08 | Y | 6 | 2 | | | 1 | 3 | 1 | 3 | 8 | | 1 | **25** | 4.5 | 21.4 |
| 08/19/08 | Y | 7 | 3 | | | | 3 | | 2 | 17 | 8 | 1 | **41** | 5.0 | 22.7 |
| 08/20/08 | Y | 4 | 4 | | | | 1 | | 4 | 6 | 5 | | **24** | 5.3 | 20.7 |
| 08/21/08 | Y | 4 | 4 | | | | 1 | | 5 | 5 | 3 | | **22** | 5.8 | 24.0 |
| 08/22/08 | Y | 2 | 5 | | | 1 | 1 | | 2 | 5 | 5 | | **21** | 5.7 | 25.6 |
| 08/23/08 | Y | 6 | 2 | | 1 | | | | | 5 | 2 | | **16** | 4.6 | 25.7 |
| 08/24/08 | Y | 9 | 3 | | | 1 | 5 | | 4 | 15 | 6 | 3 | **46** | 4.5 | 24.2 |
| 08/25/08 | Y | 13 | 3 | | | | 4 | | 1 | 4 | 8 | 1 | **34** | 8.2 | 20.0 |
| 08/26/08 | Y | 7 | 2 | | | | 4 | | 1 | 1 | 6 | 1 | **22** | 7.4 | 19.7 |
| 08/27/08 | Y | 3 | 4 | | | 1 | 1 | | 2 | 4 | 2 | | **17** | 5.4 | 19.3 |
| 08/28/08 | Y | 10 | 6 | | | | | | 1 | 3 | 10 | | **30** | 3.3 | 19.4 |
| 08/29/08 | Y | 5 | | | | | 2 | | 1 | 3 | 11 | 1 | **23** | 4.6 | 23.8 |
| 08/30/08 | Y | 8 | | | | | 4 | 1 | 1 | 2 | 2 | 2 | **20** | 5.1 | 23.2 |
| 08/31/08 | Y | 9 | 2 | | | | 4 | | 2 | 14 | 4 | | **35** | 5.9 | 22.8 |
| 09/01/08 | Y | 4 | | | | | | | | 2 | 5 | | **11** | 5.5 | 22.9 |
| 09/02/08 | Y | 9 | 3 | | | | | | | 3 | 3 | | **18** | 4.5 | 26.2 |
| 09/03/08 | Y | 8 | 4 | | | | 3 | | | 12 | 10 | | **37** | 3.4 | 27.2 |
| **By Species** | | **347** | **133** | **15** | **17** | **21** | **88** | **7** | **78** | **249** | **318** | **32** | **1305** | | |
| **By Guild** | | **495** | | | **17** | **21** | **173** | | | **599** | | | | | |
| | | **BBSH** | | | **HB** | **MYSP** | **RBTB** | | | **UNKN** | | | **Total** | | |

**Appendix A Table 3.** Summary of acoustic bat data and weather during each survey night at the North Tree detector – 2008

| | | BBSH | | | HB | MYSP | RBTP | | | UNKN | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Night of | Functional? | BBSH | Big brown | Silver-haired | Hoary | MYSP | Eastern red | Tri-colored | RBTB | HFUN | LFUN | UNKN | Total | Wind Speed (m/s) | Temperature (celsius) |
| 3/29/08 | Y | | | | | | | | | | | | **0** | | |
| 3/30/08 | Y | | | | | | | | | | | | **0** | | |
| 3/31/08 | Y | | | | | | | | | | | | **0** | | |
| 4/1/08 | Y | | | | | | | | | | | | **0** | 5.7 | 0.8 |
| 4/2/08 | Y | | | | | 1 | | | | | | | **1** | 7.3 | 2.4 |
| 4/3/08 | Y | | | | | | | | | | | | **0** | 8.0 | 8.6 |
| 4/4/08 | Y | | | | | 1 | | | | | | | **1** | 3.6 | 4.2 |
| 4/5/08 | Y | 2 | 3 | | | | | | | 2 | | | **7** | 7.4 | 6.8 |
| 4/6/08 | Y | 1 | 1 | | | | | | | 1 | 2 | | **5** | 5.5 | 12.5 |
| 4/7/08 | N | | | | | | | | | | | | **0** | 6.1 | 12.5 |
| 4/8/08 | N | | | | | | | | | | | | **0** | 8.8 | 17.4 |
| 4/9/08 | N | | | | | | | | | | | | **0** | 7.5 | 7.0 |
| 4/10/08 | N | | | | | | | | | | | | **0** | 8.9 | 14.8 |
| 4/11/08 | N | | | | | | | | | | | | **0** | 8.5 | 9.2 |
| 4/12/08 | N | | | | | | | | | | | | **0** | 6.9 | 2.6 |
| 4/13/08 | N | | | | | | | | | | | | **0** | 5.3 | 0.9 |
| 4/14/08 | N | | | | | | | | | | | | **0** | 4.6 | 2.6 |
| 4/15/08 | N | | | | | | | | | | | | **0** | 6.9 | 7.7 |
| 4/16/08 | N | | | | | | | | | | | | **0** | 8.5 | 11.6 |
| 4/17/08 | N | | | | | | | | | | | | **0** | 7.1 | 14.5 |
| 4/18/08 | N | | | | | | | | | | | | **0** | 5.4 | 16.3 |
| 4/19/08 | N | | | | | | | | | | | | **0** | 4.1 | 8.7 |
| 4/20/08 | N | | | | | | | | | | | | **0** | 3.4 | 10.9 |
| 4/21/08 | N | | | | | | | | | | | | **0** | 7.0 | 13.5 |
| 4/22/08 | N | | | | | | | | | | | | **0** | 5.7 | 17.4 |
| 4/23/08 | N | | | | | | | | | | | | **0** | 9.1 | 14.2 |
| 4/24/08 | N | | | | | | | | | | | | **0** | 5.9 | 18.8 |
| 4/25/08 | N | | | | | | | | | | | | **0** | 8.5 | 20.2 |
| 4/26/08 | N | | | | | | | | | | | | **0** | 3.9 | 10.0 |
| 4/27/08 | N | | | | | | | | | | | | **0** | 5.2 | 9.0 |
| 4/28/08 | N | | | | | | | | | | | | **0** | 5.1 | 3.1 |
| 4/29/08 | N | | | | | | | | | | | | **0** | 3.9 | 4.1 |
| 4/30/08 | N | | | | | | | | 1 | | 2 | | **3** | 6.7 | 11.3 |
| 5/1/08 | Y | 3 | 1 | | | | | | 1 | 1 | 1 | | **7** | 7.8 | 18.7 |
| 5/2/08 | Y | 1 | | | | | | | | | | | **1** | 9.5 | 16.4 |
| 5/3/08 | Y | | | | | 1 | | | 1 | 10 | 1 | | **13** | 7.4 | 7.8 |
| 5/4/08 | Y | 2 | 2 | | | 1 | | | | 2 | 2 | | **9** | 4.8 | 11.4 |
| 5/5/08 | Y | 56 | 18 | 8 | | 3 | | | 4 | 1 | 4 | | **94** | 4.8 | 14.0 |
| 5/6/08 | Y | 6 | 1 | 1 | | | | | | 1 | 1 | | **10** | 6.5 | 17.1 |
| 5/7/08 | Y | 1 | | | | | | | | | | | **1** | 6.2 | 15.2 |
| 5/8/08 | Y | | | | 1 | | | | | 4 | 5 | | **10** | 7.4 | 9.4 |
| 5/9/08 | Y | 2 | | | | 1 | | | | 2 | 2 | | **7** | 5.1 | 8.1 |
| 5/10/08 | Y | 7 | 2 | 1 | | | | | | | 4 | | **14** | 6.7 | 12.1 |
| 5/11/08 | Y | 16 | 5 | | | | | | | 6 | | | **27** | 8.2 | 9.8 |
| 5/12/08 | Y | 7 | 3 | | | | | | | 1 | 2 | | **13** | 4.6 | 8.2 |
| 5/13/08 | Y | 3 | | | | | | | 1 | | | | **4** | 6.4 | 13.9 |
| 5/14/08 | Y | 23 | 12 | | 1 | 1 | | | | 12 | 18 | | **67** | 5.4 | 12.1 |
| 5/15/08 | Y | 1 | | | 3 | | | | 1 | 1 | | | **6** | 8.6 | 9.0 |
| 5/16/08 | Y | 11 | 13 | 1 | | | | | | 1 | 8 | | **34** | 6.7 | 11.6 |
| 5/17/08 | Y | 46 | 21 | 1 | | | | | 1 | 1 | 19 | | **89** | 4.5 | 11.9 |
| 5/18/08 | Y | 3 | 2 | | 2 | | 1 | | | 2 | 1 | | **11** | 5.4 | 6.6 |
| 5/19/08 | Y | 6 | 6 | | 1 | | | | | | 2 | | **15** | 3.0 | 9.5 |
| 5/20/08 | Y | 4 | | | 17 | | 6 | | | | 1 | | **28** | 5.5 | 8.1 |
| 5/21/08 | Y | 4 | 4 | | 6 | | | | | 4 | 43 | | **61** | 5.8 | 8.6 |
| 5/22/08 | Y | 4 | 4 | | | | | | 2 | 3 | 2 | | **15** | 4.8 | 11.0 |
| 5/23/08 | Y | 14 | 13 | | | | | | 6 | | 23 | | **56** | 6.0 | 10.6 |
| 5/24/08 | Y | 37 | 23 | | | | 1 | | 2 | 3 | 29 | | **95** | 4.6 | 10.4 |
| 5/25/08 | Y | 2 | | | | | | | | | 1 | | **3** | 7.2 | 18.3 |
| 5/26/08 | Y | 37 | 6 | | 3 | | 10 | | 1 | 11 | 10 | | **78** | 6.3 | 19.2 |
| 5/27/08 | N | | | | | | | | | | | | **0** | 9.7 | 6.5 |
| 5/28/08 | N | | | | | | | | | | | | **0** | 6.4 | 9.9 |
| 5/29/08 | N | | | | | | | | | | | | **0** | 4.5 | 16.9 |
| 5/30/08 | N | | | | | | | | | | | | **0** | 9.2 | 20.9 |
| 5/31/08 | N | | | | | | | | | | | | **0** | 6.2 | 18.8 |
| 6/1/08 | N | | | | | | | | | | | | **0** | 5.8 | 17.5 |
| 6/2/08 | Y | 7 | | | | | | | | | 9 | | **16** | 3.9 | 21.3 |
| 6/3/08 | Y | 11 | 2 | | | | 6 | | | 9 | 1 | | **29** | 5.4 | 20.5 |
| 6/4/08 | Y | 10 | 2 | | | 4 | | | 1 | 5 | | | **22** | 5.1 | 20.5 |
| 6/5/08 | Y | 3 | | | | 1 | | | | 3 | | | **7** | 7.3 | 25.8 |
| 6/6/08 | Y | 5 | | | | | | | | 3 | 1 | | **9** | 8.0 | 27.4 |
| 6/7/08 | Y | | | | | | 3 | | | | | | **3** | 4.7 | 24.1 |
| 6/8/08 | Y | 5 | | | | | | | | 1 | | | **6** | 7.0 | 27.6 |
| 6/9/08 | Y | 87 | 4 | | 1 | 2 | 1 | | 1 | 13 | 23 | 1 | **133** | 6.7 | 26.5 |
| 6/10/08 | Y | 39 | 5 | | | | 1 | | | 4 | 14 | 2 | **65** | 5.9 | 21.4 |
| 6/11/08 | Y | 16 | | | | | | | | | 2 | 2 | **20** | 4.9 | 23.5 |
| 6/12/08 | Y | 4 | | | | | | | | | 1 | 3 | **8** | 5.7 | 24.5 |
| 6/13/08 | Y | 9 | 1 | | | 1 | 46 | | | 32 | 2 | 1 | **92** | 6.3 | 24.1 |
| 6/14/08 | Y | 147 | 14 | 1 | | 1 | | | | 35 | 10 | 10 | **218** | 4.2 | 22.3 |
| 6/15/08 | Y | 46 | 87 | | | 2 | | | | 1 | 5 | 13 | **154** | 5.1 | 22.6 |
| 6/16/08 | Y | 287 | 6 | | | | | | | 7 | 59 | 14 | **373** | 6.5 | 20.6 |
| 6/17/08 | Y | 37 | 10 | | | | | | | 8 | 2 | 6 | **63** | 6.2 | 16.4 |
| 6/18/08 | Y | 26 | | | | | | | | 3 | 8 | | **37** | 5.6 | 17.5 |
| 6/19/08 | Y | 57 | 11 | | | | | | | | 45 | 4 | **117** | 4.0 | 18.2 |
| 6/20/08 | Y | 11 | 1 | | | | | | 1 | 7 | 21 | 1 | **42** | 2.9 | 22.3 |
| 6/21/08 | Y | 6 | | | | | | | | | 4 | | **10** | 5.4 | 20.1 |
| 6/22/08 | Y | 4 | | | | | | | | 1 | 1 | | **6** | 5.2 | 19.4 |
| 6/23/08 | Y | 53 | 13 | | | | 1 | | | 1 | 15 | 2 | **85** | 4.8 | 18.8 |
| 6/24/08 | Y | 35 | 7 | | | | | | | 2 | 15 | 3 | **62** | 3.8 | 20.3 |
| 6/25/08 | Y | 173 | 84 | | | | | | | | 73 | 68 | **398** | 5.4 | 21.9 |
| 6/26/08 | Y | 1 | | | | | | | | | 3 | | **4** | 5.7 | 24.2 |
| 6/27/08 | Y | | | | | | | | | | 1 | | **1** | 4.8 | 23.6 |
| 6/28/08 | Y | | | | | | | | | | | | **0** | 6.5 | 22.4 |
| 6/29/08 | Y | | | | | | | | | | | | **0** | 7.1 | 21.2 |
| 6/30/08 | Y | | | | | | | | | | | | **0** | 4.9 | 16.7 |
| 7/1/08 | Y | 26 | | | | | | | | 2 | 1 | | **29** | 3.8 | 19.4 |
| 7/2/08 | Y | 9 | 5 | | | | | | | | 1 | | **15** | 8.1 | 22.6 |
| 7/3/08 | Y | 27 | 2 | | | | | | | 4 | 6 | 1 | **40** | 6.3 | 19.7 |
| 7/4/08 | Y | 37 | 2 | | | | | | 4 | 12 | 4 | | **59** | 4.6 | 17.7 |
| 7/5/08 | Y | 57 | 1 | | | 1 | | | 1 | 4 | 11 | | **75** | 4.8 | 20.6 |
| 7/6/08 | Y | 55 | 18 | | | 1 | | | | 1 | 2 | 1 | **78** | 3.8 | 23.1 |
| 7/7/08 | Y | 4 | | | | | | | | | 5 | | **9** | 4.3 | 24.5 |
| 7/8/08 | Y | 13 | 7 | | 1 | 2 | 4 | | | 38 | | 1 | **66** | 6.5 | 23.5 |
| 7/9/08 | Y | 103 | 2 | | | | | | | 3 | 11 | | **119** | 6.2 | 22.5 |
| 7/10/08 | Y | 10 | | | | | 4 | | | 6 | | | **20** | 3.7 | 21.9 |
| 7/11/08 | Y | 6 | | | | | 2 | | | | 1 | | **9** | 5.5 | 24.3 |
| 7/12/08 | Y | 86 | 29 | | 1 | 10 | 2 | | | 37 | 5 | 5 | **175** | 6.8 | 23.4 |
| 7/13/08 | Y | 240 | 26 | | | 3 | 3 | | 1 | 17 | 26 | | **316** | 6.3 | 21.9 |
| 7/14/08 | Y | 129 | 96 | | | | 1 | | 1 | 22 | 10 | | **259** | 4.3 | 20.5 |
| 7/15/08 | Y | 20 | 3 | | | 1 | | | | 4 | 2 | | **30** | 2.8 | 22.9 |
| 7/16/08 | Y | 19 | 2 | | | 9 | 4 | | | 8 | 2 | | **44** | 3.8 | 24.9 |
| 7/17/08 | Y | 14 | 3 | | | 1 | | | | | 2 | 1 | **21** | 3.7 | 25.7 |
| 7/18/08 | Y | 23 | 1 | | | 2 | | | 1 | 10 | 3 | | **40** | 5.1 | 25.8 |
| 7/19/08 | Y | 16 | 2 | | | 39 | 3 | | | 28 | 5 | | **93** | 4.8 | 25.9 |
| 7/20/08 | Y | 34 | 5 | | | 8 | 25 | | 6 | 63 | 5 | | **146** | 6.8 | 25.3 |
| 7/21/08 | Y | 367 | 28 | | | 24 | 9 | | 6 | 49 | 30 | 4 | **517** | 5.2 | 24.2 |
| 7/22/08 | N | | | | | | | | | | | | **0** | 4.7 | 22.5 |
| 7/23/08 | N | | | | | | | | | | | | **0** | 4.8 | 20.6 |
| 7/24/08 | N | | | | | | | | | | | | **0** | 4.3 | 20.9 |
| 7/25/08 | N | | | | | | | | | | | | **0** | 3.0 | 21.4 |
| 7/26/08 | N | | | | | | | | | | | | **0** | 4.7 | 22.9 |
| 7/27/08 | N | | | | | | | | | | | | **0** | 4.0 | 21.1 |
| 7/28/08 | N | | | | | | | | | | | | **0** | 3.8 | 22.4 |
| 7/29/08 | N | | | | | | | | | | | | **0** | 3.0 | 24.6 |
| 7/30/08 | Y | 90 | 8 | | | 15 | 4 | | 1 | 88 | 15 | 1 | **222** | 5.9 | 23.8 |
| 7/31/08 | Y | 176 | 9 | | | 15 | 1 | | 1 | 66 | 60 | 3 | **331** | 4.9 | 23.7 |
| 8/1/08 | Y | 105 | 8 | | 1 | 7 | 2 | | 1 | 61 | 24 | 2 | **211** | 5.1 | 24.3 |
| 8/2/08 | Y | 130 | 17 | | 2 | 17 | | | 8 | 60 | 9 | 1 | **244** | 4.9 | 23.4 |
| 8/3/08 | Y | 353 | 115 | | | 28 | 8 | | 5 | 65 | 30 | 10 | **614** | 2.9 | 22.2 |
| 8/4/08 | Y | 27 | 4 | | 4 | 6 | | | | 16 | 4 | 1 | **62** | 4.9 | 23.1 |
| 8/5/08 | Y | 216 | 18 | | | 185 | 31 | | 9 | 198 | 27 | 4 | **688** | 6.2 | 22.5 |
| 8/6/08 | Y | 69 | 13 | | | 31 | 4 | | 2 | 120 | 12 | 3 | **254** | 4.7 | 23.8 |
| 8/7/08 | N | | | | | | | | | | | | **0** | 5.5 | 20.9 |
| 8/8/08 | N | | | | | | | | | | | | **0** | 4.8 | 19.2 |
| 8/9/08 | N | | | | | | | | | | | | **0** | 4.8 | 19.6 |
| 8/10/08 | N | | | | | | | | | | | | **0** | 4.8 | 18.1 |
| 8/11/08 | N | | | | | | | | | | | | **0** | 4.0 | 18.5 |
| 8/12/08 | N | | | | | | | | | | | | **0** | 1.9 | 21.0 |
| 8/13/08 | N | | | | | | | | | | | | **0** | 3.5 | 21.3 |
| 8/14/08 | N | | | | | | | | | | | | **0** | 3.9 | 19.5 |
| 8/15/08 | N | | | | | | | | | | | | **0** | 4.5 | 20.1 |
| 8/16/08 | N | | | | | | | | | | | | **0** | 3.8 | 20.5 |
| 8/17/08 | N | | | | | | | | | | | | **0** | 4.5 | 20.4 |
| 8/18/08 | Y | 87 | 8 | | | | 23 | | 2 | 93 | 13 | 17 | **243** | 4.5 | 21.4 |
| 8/19/08 | Y | 19 | 6 | | | 1 | | | | 5 | 3 | | **34** | 5.0 | 22.7 |
| 8/20/08 | Y | 90 | 24 | | | 3 | 7 | | 3 | 30 | 7 | 6 | **170** | 5.3 | 20.7 |
| 8/21/08 | Y | 26 | 4 | | | 6 | 2 | | | 6 | 7 | | **51** | 5.8 | 24.0 |
| 8/22/08 | Y | 51 | 3 | | | 6 | 2 | | 1 | 13 | 8 | 1 | **85** | 5.7 | 25.6 |
| 8/23/08 | Y | 95 | 10 | | | 10 | 1 | | 2 | 19 | 15 | 3 | **155** | 4.6 | 25.7 |
| 8/24/08 | Y | 194 | 8 | | | 33 | 4 | | 12 | 61 | 22 | | **334** | 4.5 | 24.2 |
| 8/25/08 | Y | 34 | 4 | | | 13 | 2 | | 3 | 15 | 10 | | **81** | 8.2 | 20.0 |
| 8/26/08 | Y | 191 | 158 | | | 23 | | | 6 | 43 | 38 | | **459** | 7.4 | 19.7 |
| 8/27/08 | Y | 45 | 3 | | | 8 | | | 4 | 39 | 1 | | **100** | 5.4 | 19.3 |
| 8/28/08 | Y | | | | | | | | | | 12 | | **12** | 3.3 | 19.4 |
| 8/29/08 | Y | 187 | | | | 1 | | 1 | 2 | 12 | 23 | | **226** | 4.6 | 23.8 |
| 8/30/08 | Y | 246 | 8 | | | | | | | 5 | 88 | 1 | **348** | 5.1 | 23.2 |
| 8/31/08 | Y | 253 | 14 | | | | | | | 3 | 91 | 1 | **362** | 5.9 | 22.8 |
| 9/1/08 | Y | 385 | 2 | | | 1 | | | | 3 | 53 | | **444** | 5.5 | 22.9 |
| 9/2/08 | Y | 459 | 2 | | | 2 | | | | 23 | 86 | 3 | **575** | 4.5 | 26.2 |
| 9/3/08 | 14 | 608 | 4 | | | 14 | | | 2 | 30 | 24 | | **682** | 3.4 | 27.2 |
| **By Species** | | **6809** | **1069** | **13** | **44** | **546** | **224** | **1** | **108** | **1586** | **1312** | **200** | **11912** | | |
| **By Guild** | | **7891** | | | **44** | **546** | **333** | | | **3098** | | | | | |
| | | **BBSH** | | | **HB** | **MYSP** | **RBTB** | | | **UNKN** | | | **Total** | | |

**Appendix A Table 4**. Summary of acoustic bat data and weather during each survey night at the South High detector – 2008

| | | BBSH | | | HB | MYSP | RBTP | | | UNKN | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Night of | Functional? | BBSH | Big brown | Silver-haired | Hoary | MYSP | Eastern red | Tri-colored | RBTB | HFUN | LFUN | UNKN | Total | Wind Speed (m/s) | Temperature (celsius) |
| 3/29/08 | N | | | | | | | | | | | | | | |
| 3/30/08 | N | | | | | | | | | | | | | | |
| 3/31/08 | N | | | | | | | | | | | | | | |
| 4/1/08 | N | | | | | | | | | | | | | 5.7 | 0.8 |
| 4/2/08 | N | | | | | | | | | | | | | 7.3 | 2.4 |
| 4/3/08 | N | | | | | | | | | | | | | 8.0 | 8.6 |
| 4/4/08 | N | | | | | | | | | | | | | 3.6 | 4.2 |
| 4/5/08 | N | | | | | | | | | | | | | 7.4 | 6.8 |
| 4/6/08 | N | | | | | | | | | | | | | 5.5 | 12.5 |
| 4/7/08 | N | | | | | | | | | | | | | 6.1 | 12.5 |
| 4/8/08 | N | | | | | | | | | | | | | 8.8 | 17.4 |
| 4/9/08 | Y | | | | | | | | | | | | **0** | 7.5 | 7.0 |
| 4/10/08 | Y | | | | | | | | | | | | **0** | 8.9 | 14.8 |
| 4/11/08 | Y | | | | | | | | | | | | **0** | 8.5 | 9.2 |
| 4/12/08 | Y | | | | | | | | | | | | **0** | 6.9 | 2.6 |
| 4/13/08 | Y | | | | | | | | | | | | **0** | 5.3 | 0.9 |
| 4/14/08 | Y | | | | | | | | | | | | **0** | 4.6 | 2.6 |
| 4/15/08 | Y | | | | | | | | | | | | **0** | 6.9 | 7.7 |
| 4/16/08 | Y | | | | | | | | | | 1 | | **1** | 8.5 | 11.6 |
| 4/17/08 | Y | 1 | | | | | | | | | | | **1** | 7.1 | 14.5 |
| 4/18/08 | Y | | | | | | | | | | | | **0** | 5.4 | 16.3 |
| 4/19/08 | Y | | | | | | | | | | | | **0** | 4.1 | 8.7 |
| 4/20/08 | Y | | | | | | | | | | | | **0** | 3.4 | 10.9 |
| 4/21/08 | N | | | | | | | | | | | | | 7.0 | 13.5 |
| 4/22/08 | N | | | | | | | | | | | | | 5.7 | 17.4 |
| 4/23/08 | N | | | | | | | | | | | | | 9.1 | 14.2 |
| 4/24/08 | N | | | | | | | | | | | | | 5.9 | 18.8 |
| 4/25/08 | N | | | | | | | | | | | | | 8.5 | 20.2 |
| 4/26/08 | N | | | | | | | | | | | | | 3.9 | 10.0 |
| 4/27/08 | N | | | | | | | | | | | | | 5.2 | 9.0 |
| 4/28/08 | N | | | | | | | | | | | | | 5.1 | 3.1 |
| 4/29/08 | N | | | | | | | | | | | | | 3.9 | 4.1 |
| 4/30/08 | N | | | | | | | | | | | | | 6.7 | 11.3 |
| 5/1/08 | N | | | | | | | | | | | | | 7.8 | 18.7 |
| 5/2/08 | N | | | | | | | | | | | | | 9.5 | 16.4 |
| 5/3/08 | N | | | | | | | | | | | | | 7.4 | 7.8 |
| 5/4/08 | N | | | | | | | | | | | | | 4.8 | 11.4 |
| 5/5/08 | N | | | | | | | | | | | | | 4.8 | 14.0 |
| 5/6/08 | N | | | | | | | | | | | | | 6.5 | 17.1 |
| 5/7/08 | N | | | | | | | | | | | | | 6.2 | 15.2 |
| 5/8/08 | N | | | | | | | | | | | | | 7.4 | 9.4 |
| 5/9/08 | N | | | | | | | | | | | | | 5.1 | 8.1 |
| 5/10/08 | N | | | | | | | | | | | | | 6.7 | 12.1 |
| 5/11/08 | N | | | | | | | | | | | | | 8.2 | 9.8 |
| 5/12/08 | N | | | | | | | | | | | | | 4.6 | 8.2 |
| 5/13/08 | N | | | | | | | | | | | | | 6.4 | 13.9 |
| 5/14/08 | N | | | | | | | | | | | | | 5.4 | 12.1 |
| 5/15/08 | Y | | | | | | | | | | | | **0** | 8.6 | 9.0 |
| 5/16/08 | Y | | | | 1 | | | | | 1 | 1 | | **3** | 6.7 | 11.6 |
| 5/17/08 | Y | 1 | | | | | | | | | 1 | | **2** | 4.5 | 11.9 |
| 5/18/08 | Y | | | | | | | | | | | | **0** | 5.4 | 6.6 |
| 5/19/08 | Y | | | | | | | | | | 1 | | **1** | 3.0 | 9.5 |
| 5/20/08 | Y | | | | | | | | | | | | **0** | 5.5 | 8.1 |
| 5/21/08 | Y | | | | | | | | | | | | **0** | 5.8 | 8.6 |
| 5/22/08 | Y | | | | | | | | | | | | **0** | 4.8 | 11.0 |
| 5/23/08 | Y | | | | | | | | | | | | **0** | 6.0 | 10.6 |
| 5/24/08 | Y | | | | | | | | | | | | **0** | 4.6 | 10.4 |
| 5/25/08 | Y | | | | 1 | | 2 | | | | | | **3** | 7.2 | 18.3 |
| 5/26/08 | Y | 1 | 1 | | | | | | | | 3 | | **5** | 6.3 | 19.2 |
| 5/27/08 | Y | | | | | | | | | | | | **0** | 9.7 | 6.5 |
| 5/28/08 | Y | | | | | | | | | | | | **0** | 6.4 | 9.9 |
| 5/29/08 | Y | | | | | | 1 | | | | | | **1** | 4.5 | 16.9 |
| 5/30/08 | Y | | | | 2 | | | | | | 1 | | **3** | 9.2 | 20.9 |
| 5/31/08 | Y | 1 | | | | | 1 | | | | 3 | | **5** | 6.2 | 18.8 |
| 6/1/08 | Y | | | | 1 | | | | | | 3 | | **4** | 5.8 | 17.5 |
| 6/2/08 | Y | 1 | 2 | | | | | | | 1 | 2 | | **6** | 3.9 | 21.3 |
| 6/3/08 | N | | | | | | | | | | | | | 5.4 | 20.5 |
| 6/4/08 | N | | | | | | | | | | | | | 5.1 | 20.5 |
| 6/5/08 | N | | | | | | | | | | | | | 7.3 | 25.8 |
| 6/6/08 | N | | | | | | | | | | | | | 8.0 | 27.4 |
| 6/7/08 | N | | | | | | | | | | | | | 4.7 | 24.1 |
| 6/8/08 | N | | | | | | | | | | | | | 7.0 | 27.6 |
| 6/9/08 | N | | | | | | | | | | | | | 6.7 | 26.5 |
| 6/10/08 | N | | | | | | | | | | | | | 5.9 | 21.4 |
| 6/11/08 | N | | | | | | | | | | | | | 4.9 | 23.5 |
| 6/12/08 | N | | | | | | | | | | | | | 5.7 | 24.5 |
| 6/13/08 | N | | | | | | | | | | | | | 6.3 | 24.1 |
| 6/14/08 | N | | | | | | | | | | | | | 4.2 | 22.3 |
| 6/15/08 | N | | | | | | | | | | | | | 5.1 | 22.6 |
| 6/16/08 | Y | 2 | | | 1 | | | | | | 1 | | **4** | 6.5 | 20.6 |
| 6/17/08 | Y | | | | | | | | | 2 | | | **2** | 6.2 | 16.4 |
| 6/18/08 | Y | | | 1 | | | | | | 1 | | | **2** | 5.6 | 17.5 |
| 6/19/08 | Y | | | | | | | | | | 2 | | **2** | 4.0 | 18.2 |
| 6/20/08 | Y | 2 | 1 | | | | | | | 1 | 1 | | **5** | 2.9 | 22.3 |
| 6/21/08 | Y | | | | | | | | | | 1 | | **1** | 5.4 | 20.1 |
| 6/22/08 | Y | | | | | | | | | | 2 | | **2** | 5.2 | 19.4 |
| 6/23/08 | Y | | | | | | | | | | 1 | | **1** | 4.8 | 18.8 |
| 6/24/08 | Y | | 1 | | | | | | | 1 | | | **2** | 3.8 | 20.3 |
| 6/25/08 | Y | | | 2 | | | | | | | 3 | | **5** | 5.4 | 21.9 |
| 6/26/08 | Y | | | 2 | | | | | | 1 | | | **3** | 5.7 | 24.2 |
| 6/27/08 | Y | | | | | | | | | | 5 | | **5** | 4.8 | 23.6 |
| 6/28/08 | Y | | 2 | | | | | | | | 1 | | **3** | 6.5 | 22.4 |
| 6/29/08 | Y | | | | | | | | | 2 | 1 | | **3** | 7.1 | 21.2 |
| 6/30/08 | Y | | | | | | | | | | | | **0** | 4.9 | 16.7 |
| 7/1/08 | Y | | | | 2 | | | | | 1 | | | **3** | 3.8 | 19.4 |
| 7/2/08 | Y | 1 | | | | | | | | | | | **1** | 8.1 | 22.6 |
| 7/3/08 | Y | | | | | | | | | | | | **0** | 6.3 | 19.7 |
| 7/4/08 | Y | | 1 | | | | | | | | | | **1** | 4.6 | 17.7 |
| 7/5/08 | Y | | | | | | | | | | 2 | | **2** | 4.8 | 20.6 |
| 7/6/08 | Y | | 1 | | 1 | | | | | 1 | 2 | | **5** | 3.8 | 23.1 |
| 7/7/08 | Y | 1 | | | 1 | | | | | | 1 | | **3** | 4.3 | 24.5 |
| 7/8/08 | Y | 1 | | | 1 | | | | | | 1 | | **3** | 6.5 | 23.5 |
| 7/9/08 | Y | | | | 3 | | | | | | 2 | | **5** | 6.2 | 22.5 |
| 7/10/08 | Y | | | | | | | | | | 1 | | **1** | 3.7 | 21.9 |
| 7/11/08 | Y | | | | 1 | 1 | | | | | 4 | | **6** | 5.5 | 24.3 |
| 7/12/08 | Y | | | | | | | | | | | | **0** | 6.8 | 23.4 |
| 7/13/08 | Y | | | | | | | | | 1 | 2 | | **3** | 6.3 | 21.9 |
| 7/14/08 | Y | | | | | | | | | | | | **0** | 4.3 | 20.5 |
| 7/15/08 | Y | | 1 | | 2 | | | | | 2 | 2 | | **7** | 2.8 | 22.9 |
| 7/16/08 | Y | | | | | | 1 | | | | | | **1** | 3.8 | 24.9 |
| 7/17/08 | Y | | | | | | 1 | | | 1 | 2 | | **4** | 3.7 | 25.7 |
| 7/18/08 | Y | 1 | | | | 1 | 1 | | | 1 | 2 | | **6** | 5.1 | 25.8 |
| 7/19/08 | Y | | | | | | | | | | 1 | | **1** | 4.8 | 25.9 |
| 7/20/08 | Y | 3 | 3 | | 2 | | | | | 1 | 5 | | **14** | 6.8 | 25.3 |
| 7/21/08 | Y | 2 | | | 1 | | | | | | 1 | | **4** | 5.2 | 24.2 |
| 7/22/08 | Y | | | | 1 | | | | | | 1 | | **2** | 4.7 | 22.5 |
| 7/23/08 | Y | | | | | | | | | 1 | | | **1** | 4.8 | 20.6 |
| 7/24/08 | Y | | | | 1 | | | | | | | | **1** | 4.3 | 20.9 |
| 7/25/08 | Y | 2 | | | | | | | | | 4 | | **6** | 3.0 | 21.4 |
| 7/26/08 | Y | 1 | | | | | | | | | 3 | | **4** | 4.7 | 22.9 |
| 7/27/08 | Y | | | | 1 | | | | | | 4 | | **5** | 4.0 | 21.1 |
| 7/28/08 | Y | | 3 | | | | | | | | 3 | | **6** | 3.8 | 22.4 |
| 7/29/08 | Y | 2 | | | | | | | | 1 | 6 | | **9** | 3.0 | 24.6 |
| 7/30/08 | Y | | 2 | | | | | | | | 6 | | **8** | 5.9 | 23.8 |
| 7/31/08 | Y | 2 | 1 | | | | | | | | 3 | | **6** | 4.9 | 23.7 |
| 8/1/08 | Y | 1 | 2 | | | | | | | | 4 | | **7** | 5.1 | 24.3 |
| 8/2/08 | Y | 1 | 3 | | | | | | | | 2 | | **6** | 4.9 | 23.4 |
| 8/3/08 | Y | 2 | 1 | | | | | | | 1 | 1 | | **5** | 2.9 | 22.2 |
| 8/4/08 | Y | 2 | 1 | | | | | | | | 2 | | **5** | 4.9 | 23.1 |
| 8/5/08 | Y | 1 | | | | | | | | 1 | 3 | | **5** | 6.2 | 22.5 |
| 8/6/08 | Y | 1 | 2 | | | | | | | | 2 | | **5** | 4.7 | 23.8 |
| 8/7/08 | Y | | 1 | | | | 1 | | | | 4 | | **6** | 5.5 | 20.9 |
| 8/8/08 | Y | | | | | | | | | | | 1 | **1** | 4.8 | 19.2 |
| 8/9/08 | Y | 3 | 1 | | | | | | | 1 | 3 | | **8** | 4.8 | 19.6 |
| 8/10/08 | Y | | 2 | | | | | | | 1 | 3 | | **6** | 4.8 | 18.1 |
| 8/11/08 | Y | | | | | | | | | | | | **0** | 4.0 | 18.5 |
| 8/12/08 | Y | | | | | | | | | 1 | 4 | | **5** | 1.9 | 21.0 |
| 8/13/08 | Y | 1 | | | | | | | | | 1 | | **2** | 3.5 | 21.3 |
| 8/14/08 | Y | 1 | | | | | 1 | | | | 2 | | **4** | 3.9 | 19.5 |
| 8/15/08 | Y | 1 | | | 1 | | 1 | | | | | | **3** | 4.5 | 20.1 |
| 8/16/08 | Y | | 1 | | | | | | | | 1 | | **2** | 3.8 | 20.5 |
| 8/17/08 | Y | | 2 | | | 1 | | | | | | | **3** | 4.5 | 20.4 |
| 8/18/08 | Y | | 2 | | | | | | | 1 | 1 | | **4** | 4.5 | 21.4 |
| 8/19/08 | Y | | | | 1 | | 1 | | | | 3 | | **5** | 5.0 | 22.7 |
| 8/20/08 | Y | | 1 | | | | | | | 1 | 2 | | **4** | 5.3 | 20.7 |
| 8/21/08 | Y | 6 | 1 | 1 | | | | | | 1 | 5 | | **14** | 5.8 | 24.0 |
| 8/22/08 | Y | 2 | 2 | | | | 1 | | | 2 | 4 | | **11** | 5.7 | 25.6 |
| 8/23/08 | Y | | 1 | | | | | | | | | | **1** | 4.6 | 25.7 |
| 8/24/08 | Y | 2 | | | | | 3 | | 2 | 6 | 3 | | **16** | 4.5 | 24.2 |
| 8/25/08 | Y | 2 | | | | | 2 | | | | 1 | | **5** | 8.2 | 20.0 |
| 8/26/08 | Y | 2 | 1 | | 1 | | | | 1 | | 2 | | **7** | 7.4 | 19.7 |
| 8/27/08 | Y | 1 | 1 | | 2 | | | | | | 2 | | **6** | 5.4 | 19.3 |
| 8/28/08 | Y | | 4 | 1 | | | | | | 1 | 4 | | **10** | 3.3 | 19.4 |
| 8/29/08 | Y | 2 | 1 | 2 | | | 1 | | | 1 | 3 | | **10** | 4.6 | 23.8 |
| 8/30/08 | Y | | | | | | 1 | | | | | | **1** | 5.1 | 23.2 |
| 8/31/08 | Y | | | | | | | | | | | | **0** | 5.9 | 22.8 |
| 9/1/08 | Y | 1 | 1 | | 1 | | | | | | 2 | | **5** | 5.5 | 22.9 |
| 9/2/08 | Y | 3 | 1 | | | 1 | 1 | | | 3 | 2 | | **11** | 4.5 | 26.2 |
| 9/3/08 | Y | | | | | | 2 | | | 3 | 3 | | **8** | 3.4 | 27.2 |
| **By Species** | | **60** | **51** | **9** | **29** | **4** | **22** | **0** | **3** | **44** | **161** | **1** | **384** | | |
| **By Guild** | | **120** | | | **29** | **4** | **25** | | | **206** | | | | | |
| | | **BBSH** | | | **HB** | **MYSP** | **RBTB** | | | **UNKN** | | | **Total** | | |

**Appendix A Table 5**. Summary of acoustic bat data and weather during each survey night at the South Low detector – 2008

| | | BBSH | | | HB | MYSP | RBTP | | | UNKN | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Night of | Functional? | BBSH | Big brown | Silver-haired | Hoary | MYSP | Eastern red | Tri-colored | RBTB | HFUN | LFUN | UNKN | Total | Wind Speed (m/s) | Temperature (celsius) |
| 3/29/08 | Y | | | | | | | | | | | | 0 | | |
| 3/30/08 | Y | | | | | | | | | | | | 0 | | |
| 3/31/08 | Y | | | | | | | | | | | | 0 | | |
| 4/1/08 | Y | | | | | | | | | | | | 0 | 5.7 | 0.8 |
| 4/2/08 | Y | | | | | | | | | | | | 0 | 7.3 | 2.4 |
| 4/3/08 | Y | | | | | | | | | | | | 0 | 8.0 | 8.6 |
| 4/4/08 | Y | | | | | | | | | | | | 0 | 3.6 | 4.2 |
| 4/5/08 | Y | | | | | | | | | | | | 0 | 7.4 | 6.8 |
| 4/6/08 | Y | 1 | | | | | 1 | | | | 1 | | 3 | 5.5 | 12.5 |
| 4/7/08 | Y | | | | | | | | | | | | 0 | 6.1 | 12.5 |
| 4/8/08 | Y | | | | | | | | | | | | 0 | 8.8 | 17.4 |
| 4/9/08 | Y | | | | | | | | | | 1 | | 1 | 7.5 | 7.0 |
| 4/10/08 | Y | | | | | | | | | | | | 0 | 8.9 | 14.8 |
| 4/11/08 | Y | | | | | | | | | | | | 0 | 8.5 | 9.2 |
| 4/12/08 | Y | | | | | | | | | | | | 0 | 6.9 | 2.6 |
| 4/13/08 | Y | | | | | | | | | | | | 0 | 5.3 | 0.9 |
| 4/14/08 | Y | | | | | | | | | | | | 0 | 4.6 | 2.6 |
| 4/15/08 | Y | | | | | | | | | | | | 0 | 6.9 | 7.7 |
| 4/16/08 | Y | 1 | | | | | | | | | 1 | | 2 | 8.5 | 11.6 |
| 4/17/08 | Y | | | | | | 1 | | | 1 | 1 | | 3 | 7.1 | 14.5 |
| 4/18/08 | Y | 1 | 1 | | 1 | | 1 | | | 2 | | | 6 | 5.4 | 16.3 |
| 4/19/08 | Y | 1 | | | | | 1 | | | | | | 2 | 4.1 | 8.7 |
| 4/20/08 | Y | | | | | | | | | | 1 | | 1 | 3.4 | 10.9 |
| 4/21/08 | Y | | | 2 | | 1 | | | | 1 | 2 | | 6 | 7.0 | 13.5 |
| 4/22/08 | Y | 2 | 1 | | | | | | | | 2 | | 5 | 5.7 | 17.4 |
| 4/23/08 | Y | 3 | | | | | 1 | | | 1 | 2 | | 7 | 9.1 | 14.2 |
| 4/24/08 | Y | 4 | | | | | | | | | 4 | | 8 | 5.9 | 18.8 |
| 4/25/08 | Y | 2 | | | | | 1 | | | | | | 3 | 8.5 | 20.2 |
| 4/26/08 | Y | 2 | 1 | | | | | | 1 | | 1 | | 5 | 3.9 | 10.0 |
| 4/27/08 | Y | 2 | | | | | | | | | | | 2 | 5.2 | 9.0 |
| 4/28/08 | Y | | | | | | | | | | | | 0 | 5.1 | 3.1 |
| 4/29/08 | Y | | | | | | | | | | | | 0 | 3.9 | 4.1 |
| 4/30/08 | Y | 2 | | | | | 1 | | 2 | 3 | 1 | | 9 | 6.7 | 11.3 |
| 5/1/08 | Y | 2 | 1 | | | | | | | | 3 | 1 | 7 | 7.8 | 18.7 |
| 5/2/08 | Y | | | | | | 1 | | | | | | 1 | 9.5 | 16.4 |
| 5/3/08 | Y | 1 | | | | | 1 | | | | | | 2 | 7.4 | 7.8 |
| 5/4/08 | Y | 2 | | | | | | | | 2 | 1 | | 5 | 4.8 | 11.4 |
| 5/5/08 | Y | 2 | | 1 | | | | | | 2 | 1 | | 6 | 4.8 | 14.0 |
| 5/6/08 | Y | | 1 | | | | | | | | 2 | | 3 | 6.5 | 17.1 |
| 5/7/08 | Y | | | | | | | | | | | | 0 | 6.2 | 15.2 |
| 5/8/08 | Y | 1 | | 1 | | | | | | | | | 2 | 7.4 | 9.4 |
| 5/9/08 | Y | 1 | | | | | | | | | | | 1 | 5.1 | 8.1 |
| 5/10/08 | Y | 5 | 1 | | | | | | | 1 | 1 | | 8 | 6.7 | 12.1 |
| 5/11/08 | Y | 1 | | | | | | | | | 1 | | 2 | 8.2 | 9.8 |
| 5/12/08 | Y | 1 | | | | | | | | | | | 1 | 4.6 | 8.2 |
| 5/13/08 | Y | 2 | | | | | | | | 2 | 1 | | 5 | 6.4 | 13.9 |
| 5/14/08 | Y | 1 | | | | | | | | 1 | | | 2 | 5.4 | 12.1 |
| 5/15/08 | Y | | | | | | | | | | | | 0 | 8.6 | 9.0 |
| 5/16/08 | Y | | | | | | | | | | 1 | | 1 | 6.7 | 11.6 |
| 5/17/08 | Y | 2 | | 1 | | | 1 | | | 1 | 4 | | 9 | 4.5 | 11.9 |
| 5/18/08 | Y | | | | | | | | | 1 | | | 1 | 5.4 | 6.6 |
| 5/19/08 | Y | 1 | | | | | | | | 1 | | | 2 | 3.0 | 9.5 |
| 5/20/08 | Y | | | | | | | | | | | | 0 | 5.5 | 8.1 |
| 5/21/08 | Y | | | | | | | | | | | | 0 | 5.8 | 8.6 |
| 5/22/08 | Y | | | | | | | | | | | | 0 | 4.8 | 11.0 |
| 5/23/08 | Y | | | | | | | | | | | | 0 | 6.0 | 10.6 |
| 5/24/08 | Y | 1 | | | | | | | | | 2 | | 3 | 4.6 | 10.4 |
| 5/25/08 | Y | 1 | | | | | 1 | | | 1 | 4 | | 7 | 7.2 | 18.3 |
| 5/26/08 | Y | | 1 | | 1 | 1 | | | | | | | 3 | 6.3 | 19.2 |
| 5/27/08 | Y | | | | | | | | | | | | 0 | 9.7 | 6.5 |
| 5/28/08 | Y | | | | | | | | | 1 | | | 1 | 6.4 | 9.9 |
| 5/29/08 | Y | | | | 1 | | | | | 2 | 2 | | 5 | 4.5 | 16.9 |
| 5/30/08 | Y | | | | 2 | | | | | | 1 | | 3 | 9.2 | 20.9 |
| 5/31/08 | Y | | | | | | | | | 1 | 3 | | 4 | 6.2 | 18.8 |
| 6/1/08 | Y | | | | | | 1 | | | | 3 | | 4 | 5.8 | 17.5 |
| 6/2/08 | Y | 2 | | | | | 1 | | | | 2 | | 5 | 3.9 | 21.3 |
| 6/3/08 | Y | 1 | 2 | | 1 | | 1 | | | 1 | 1 | | 7 | 5.4 | 20.5 |
| 6/4/08 | Y | | | | | | | | | | 4 | | 4 | 5.1 | 20.5 |
| 6/5/08 | Y | | 1 | | | | | | | 1 | 1 | | 3 | 7.3 | 25.8 |
| 6/6/08 | Y | | 1 | | | | | | | | 2 | | 3 | 8.0 | 27.4 |
| 6/7/08 | Y | 1 | 3 | | | | | | | 1 | 1 | | 6 | 4.7 | 24.1 |
| 6/8/08 | Y | | | | | | | | | | 1 | | 1 | 7.0 | 27.6 |
| 6/9/08 | Y | 2 | 1 | | | | 1 | | | 1 | 2 | | 7 | 6.7 | 26.5 |
| 6/10/08 | Y | | 1 | | | | 1 | | | | 1 | | 3 | 5.9 | 21.4 |
| 6/11/08 | Y | 1 | | | | | | | | 1 | 3 | | 5 | 4.9 | 23.5 |
| 6/12/08 | Y | | | | | | | | | | 6 | | 6 | 5.7 | 24.5 |
| 6/13/08 | Y | | | | | | | | | | 3 | | 3 | 6.3 | 24.1 |
| 6/14/08 | Y | 2 | | 1 | | | 1 | | | | | | 4 | 4.2 | 22.3 |
| 6/15/08 | Y | | 1 | | | | | | | | 2 | | 3 | 5.1 | 22.6 |
| 6/16/08 | Y | 1 | | | | | | | | | 4 | | 5 | 6.5 | 20.6 |
| 6/17/08 | Y | | | | | | | | | | 2 | | 2 | 6.2 | 16.4 |
| 6/18/08 | Y | | | | | | | | | | 1 | | 1 | 5.6 | 17.5 |
| 6/19/08 | Y | | | | 2 | | | | | 1 | 2 | | 5 | 4.0 | 18.2 |
| 6/20/08 | Y | 4 | | | | | | | | | 1 | | 5 | 2.9 | 22.3 |
| 6/21/08 | Y | 3 | 1 | | | | | | | | 1 | | 5 | 5.4 | 20.1 |
| 6/22/08 | Y | | | | | | | | | | 1 | | 1 | 5.2 | 19.4 |
| 6/23/08 | Y | | | | | | | | | 1 | 2 | | 3 | 4.8 | 18.8 |
| 6/24/08 | Y | 2 | | | | | | | | | 4 | | 6 | 3.8 | 20.3 |
| 6/25/08 | Y | 1 | | | | | | | | | | | 1 | 5.4 | 21.9 |
| 6/26/08 | Y | | | | | | | | | | 2 | | 2 | 5.7 | 24.2 |
| 6/27/08 | Y | | | | | | | | | 1 | 3 | | 4 | 4.8 | 23.6 |
| 6/28/08 | Y | 2 | 1 | | | | | | | | 2 | | 5 | 6.5 | 22.4 |
| 6/29/08 | Y | | | | | | | | | | | | 0 | 7.1 | 21.2 |
| 6/30/08 | Y | | | | | | | | | | | | 0 | 4.9 | 16.7 |
| 7/1/08 | Y | | | | | | | | | | | | 0 | 3.8 | 19.4 |
| 7/2/08 | Y | | | | | | | | | | 1 | | 1 | 8.1 | 22.6 |
| 7/3/08 | Y | | | | | | | | | 1 | | | 1 | 6.3 | 19.7 |
| 7/4/08 | Y | | | | | | | | | 1 | | | 1 | 4.6 | 17.7 |
| 7/5/08 | Y | | | | | | | | | | 1 | | 1 | 4.8 | 20.6 |
| 7/6/08 | Y | 1 | | | | | | | | | | | 1 | 3.8 | 23.1 |
| 7/7/08 | Y | | | 1 | | | | | | 1 | | | 2 | 4.3 | 24.5 |
| 7/8/08 | Y | 1 | | | | | | | | 1 | 2 | | 4 | 6.5 | 23.5 |
| 7/9/08 | Y | 2 | 1 | | | | | | | | | | 3 | 6.2 | 22.5 |
| 7/10/08 | Y | 1 | 2 | | | | | | | | 1 | | 4 | 3.7 | 21.9 |
| 7/11/08 | Y | | 1 | | 1 | | | | | 1 | 2 | | 5 | 5.5 | 24.3 |
| 7/12/08 | Y | 1 | | | | | | | | | | | 1 | 6.8 | 23.4 |
| 7/13/08 | Y | 1 | | | | | | | | | | | 1 | 6.3 | 21.9 |
| 7/14/08 | Y | | | | | | | | | | | | 0 | 4.3 | 20.5 |
| 7/15/08 | Y | 2 | | | | | 1 | | | | 4 | | 7 | 2.8 | 22.9 |
| 7/16/08 | Y | 1 | | | | | 1 | | | | 3 | | 5 | 3.8 | 24.9 |
| 7/17/08 | Y | 1 | | | | | | | | | 1 | | 2 | 3.7 | 25.7 |
| 7/18/08 | Y | 2 | | | 3 | | 1 | | | 4 | 1 | | 11 | 5.1 | 25.8 |
| 7/19/08 | Y | 1 | | | 1 | | | | 1 | 2 | 2 | | 7 | 4.8 | 25.9 |
| 7/20/08 | Y | 2 | 3 | | 2 | | | | | 1 | 4 | | 12 | 6.8 | 25.3 |
| 7/21/08 | Y | 2 | | | | | | | | 1 | 4 | | 7 | 5.2 | 24.2 |
| 7/22/08 | Y | 1 | | 1 | | | | | | 1 | 6 | | 9 | 4.7 | 22.5 |
| 7/23/08 | Y | | | | | | | | | | | | 0 | 4.8 | 20.6 |
| 7/24/08 | Y | | | | 1 | | | | | | | | 1 | 4.3 | 20.9 |
| 7/25/08 | Y | 1 | 3 | | | | 1 | | | 1 | 2 | | 8 | 3.0 | 21.4 |
| 7/26/08 | Y | 3 | | | 1 | | 1 | | | | 6 | | 11 | 4.7 | 22.9 |
| 7/27/08 | Y | 4 | 1 | | | | | | | | 2 | | 7 | 4.0 | 21.1 |
| 7/28/08 | Y | | 3 | | | | | | | 1 | 2 | | 6 | 3.8 | 22.4 |
| 7/29/08 | Y | 3 | 1 | 1 | | | 1 | | | | 6 | | 12 | 3.0 | 24.6 |
| 7/30/08 | Y | 3 | 4 | | | | 1 | | | | 7 | | 15 | 5.9 | 23.8 |
| 7/31/08 | Y | 8 | | | 1 | | 1 | | | 3 | 5 | | 18 | 4.9 | 23.7 |
| 8/1/08 | Y | 6 | 5 | | | | | | | 1 | 10 | | 22 | 5.1 | 24.3 |
| 8/2/08 | Y | 8 | | | | | 1 | | | | 4 | | 13 | 4.9 | 23.4 |
| 8/3/08 | Y | 1 | 1 | | | | | | | | 3 | | 5 | 2.9 | 22.2 |
| 8/4/08 | Y | 2 | 1 | | 1 | | 1 | | | 4 | 3 | | 12 | 4.9 | 23.1 |
| 8/5/08 | Y | 13 | 1 | | | | | | | 2 | 6 | | 22 | 6.2 | 22.5 |
| 8/6/08 | Y | 6 | 4 | | | | 2 | | | | 7 | | 19 | 4.7 | 23.8 |
| 8/7/08 | Y | 3 | 1 | | 1 | | | | | 1 | 10 | | 16 | 5.5 | 20.9 |
| 8/8/08 | Y | 1 | | | | | 1 | | | | | | 2 | 4.8 | 19.2 |
| 8/9/08 | Y | 6 | 4 | | | | | | | | 4 | | 14 | 4.8 | 19.6 |
| 8/10/08 | Y | 2 | 2 | | | 1 | 1 | | | 1 | 3 | | 10 | 4.8 | 18.1 |
| 8/11/08 | Y | | | | | | | | | | 1 | | 1 | 4.0 | 18.5 |
| 8/12/08 | Y | | 3 | | | | | | | | 1 | | 4 | 1.9 | 21.0 |
| 8/13/08 | Y | 1 | 3 | 1 | | | 1 | | | | 4 | | 10 | 3.5 | 21.3 |
| 8/14/08 | Y | 3 | 2 | | | | 2 | | | | 2 | | 9 | 3.9 | 19.5 |
| 8/15/08 | Y | 2 | 1 | | 1 | | 1 | | | | 2 | | 7 | 4.5 | 20.1 |
| 8/16/08 | Y | 4 | 2 | | | | 1 | | | | 5 | | 12 | 3.8 | 20.5 |
| 8/17/08 | Y | 2 | | | | | 2 | | 1 | | 1 | | 6 | 4.5 | 20.4 |
| 8/18/08 | Y | 2 | 3 | | | | 4 | | | 3 | | | 12 | 4.5 | 21.4 |
| 8/19/08 | Y | 5 | 3 | | | | 2 | | | 1 | 6 | | 17 | 5.0 | 22.7 |
| 8/20/08 | Y | 6 | 3 | 1 | 1 | | 1 | | | 4 | 3 | | 19 | 5.3 | 20.7 |
| 8/21/08 | Y | 12 | 5 | | 1 | | 5 | | | 2 | 8 | | 33 | 5.8 | 24.0 |
| 8/22/08 | Y | 9 | 4 | | 1 | 1 | 2 | | | 5 | 4 | | 26 | 5.7 | 25.6 |
| 8/23/08 | Y | 2 | 3 | | | | 1 | | | 1 | 1 | | 8 | 4.6 | 25.7 |
| 8/24/08 | Y | 7 | 2 | 1 | | | 5 | | | 10 | 6 | | 31 | 4.5 | 24.2 |
| 8/25/08 | Y | 6 | 1 | | | | | | | 1 | 8 | 1 | 17 | 8.2 | 20.0 |
| 8/26/08 | Y | 3 | | | | | 2 | | | 1 | 11 | 1 | 18 | 7.4 | 19.7 |
| 8/27/08 | Y | 1 | | | | | 1 | | | 1 | 2 | | 5 | 5.4 | 19.3 |
| 8/28/08 | Y | 4 | 1 | | | | | | | 4 | 2 | | 11 | 3.3 | 19.4 |
| 8/29/08 | Y | 2 | | | | | | | 1 | 1 | 8 | | 12 | 4.6 | 23.8 |
| 8/30/08 | Y | | | | | | | | | | 4 | | 4 | 5.1 | 23.2 |
| 8/31/08 | Y | 1 | | | | | 1 | | | 1 | 1 | | 4 | 5.9 | 22.8 |
| 9/1/08 | Y | 4 | | | | | 1 | | | 2 | 3 | | 10 | 5.5 | 22.9 |
| 9/2/08 | Y | 4 | 2 | | | | 1 | | | 1 | 3 | | 11 | 4.5 | 26.2 |
| 9/3/08 | Y | | | | | | | | | 4 | 5 | | 9 | 3.4 | 27.2 |
| **By Species** | | **236** | **95** | **12** | **24** | **4** | **64** | **0** | **6** | **102** | **304** | **3** | **850** | | |
| **By Guild** | | **343** | | | **24** | **4** | **70** | | | **409** | | | | | |
| | | **BBSH** | | | **HB** | **MYSP** | **RBTB** | | | **UNKN** | | | **Total** | | |

**Appendix A Table 6**. Summary of acoustic bat data and weather during each survey night at the South Tree detector – 2008

| | | BBSH | | | HB | MYSP | RBTP | | | UNKN | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Night of** | **Functional?** | **BBSH** | **Big brown** | **Silver-haired** | **Hoary** | **MYSP** | **Eastern red** | **Tri-colored** | **RBTB** | **HFUN** | **LFUN** | **UNKN** | **Total** | **Wind Speed (m/s)** | **Temperature (celsius)** |
| 03/29/08 | N | | | | | | | | | | | | **0** | | |
| 03/30/08 | Y | | | | | | | | | | | | **0** | | |
| 03/31/08 | Y | | | | | | | | | | | | **0** | | |
| 04/01/08 | Y | | | | | | | | | | | | **0** | 5.7 | 0.8 |
| 04/02/08 | Y | | | | | | | | | | | | **0** | 7.3 | 2.4 |
| 04/03/08 | Y | | | | | | | | | | | | **0** | 8.0 | 8.6 |
| 04/04/08 | Y | | | | | | | | | | | | **0** | 3.6 | 4.2 |
| 04/05/08 | Y | | | | | | | | | | | | **0** | 7.4 | 6.8 |
| 04/06/08 | Y | 1 | | | | | | | | | 6 | | **7** | 5.5 | 12.5 |
| 04/07/08 | Y | 1 | | | | | | | | 1 | | | **2** | 6.1 | 12.5 |
| 04/08/08 | Y | | | | | | | | | | 1 | | **1** | 8.8 | 17.4 |
| 04/09/08 | Y | 2 | | | | | | | | | 3 | | **5** | 7.5 | 7.0 |
| 04/10/08 | Y | | | | | | | | | 4 | | | **4** | 8.9 | 14.8 |
| 04/11/08 | Y | | | | | | | | | 1 | | | **1** | 8.5 | 9.2 |
| 04/12/08 | Y | | | | | | | | | | | | **0** | 6.9 | 2.6 |
| 04/13/08 | Y | | | | | | | | | | | | **0** | 5.3 | 0.9 |
| 04/14/08 | Y | | | | | | | | | | | | **0** | 4.6 | 2.6 |
| 04/15/08 | Y | | | | | | | | | | | | **0** | 6.9 | 7.7 |
| 04/16/08 | Y | | | | | | | | | | | | **0** | 8.5 | 11.6 |
| 04/17/08 | Y | 1 | | | | 1 | | | | | | | **2** | 7.1 | 14.5 |
| 04/18/08 | Y | 3 | | | | | | | | | 8 | | **11** | 5.4 | 16.3 |
| 04/19/08 | Y | 1 | | 1 | | | | | | 1 | 2 | 1 | **6** | 4.1 | 8.7 |
| 04/20/08 | Y | 1 | | 2 | | | | | | 3 | 4 | | **10** | 3.4 | 10.9 |
| 04/21/08 | Y | 10 | 2 | 2 | | | | | | 1 | 15 | | **30** | 7.0 | 13.5 |
| 04/22/08 | Y | 2 | 1 | | | 1 | | | | 1 | 5 | | **10** | 5.7 | 17.4 |
| 04/23/08 | Y | 57 | 18 | 1 | | | 1 | | | 9 | 20 | | **106** | 9.1 | 14.2 |
| 04/24/08 | Y | 7 | | | | | | | | 2 | 6 | | **15** | 5.9 | 18.8 |
| 04/25/08 | Y | 2 | | | | | | | | 1 | 5 | | **8** | 8.5 | 20.2 |
| 04/26/08 | Y | 31 | 10 | 1 | | | | | | 3 | 6 | | **51** | 3.9 | 10.0 |
| 04/27/08 | Y | 31 | 3 | | | | | | 1 | 3 | 7 | 1 | **46** | 5.2 | 9.0 |
| 04/28/08 | Y | 1 | | | | | | | | | | | **1** | 5.1 | 3.1 |
| 04/29/08 | Y | | | | | | 4 | | | 5 | | | **9** | 3.9 | 4.1 |
| 04/30/08 | Y | 8 | 3 | | | 1 | | | | 2 | 11 | 4 | **29** | 6.7 | 11.3 |
| 05/01/08 | Y | 17 | | | | | | | | 1 | 6 | 1 | **25** | 7.8 | 18.7 |
| 05/02/08 | Y | 1 | | | | | | | | | 2 | | **3** | 9.5 | 16.4 |
| 05/03/08 | Y | | | | | | | | | 1 | | | **1** | 7.4 | 7.8 |
| 05/04/08 | Y | 8 | 1 | | | | | | | | 5 | | **14** | 4.8 | 11.4 |
| 05/05/08 | Y | 120 | 17 | 37 | | | | | | 3 | 26 | 1 | **204** | 4.8 | 14.0 |
| 05/06/08 | Y | 17 | | | | | | | | 4 | 6 | 1 | **28** | 6.5 | 17.1 |
| 05/07/08 | Y | 1 | | | | | | | | | | | **1** | 6.2 | 15.2 |
| 05/08/08 | Y | 11 | | | | 1 | | | | 3 | | | **15** | 7.4 | 9.4 |
| 05/09/08 | Y | | 1 | | | | | | | 8 | | | **9** | 5.1 | 8.1 |
| 05/10/08 | Y | 39 | 3 | | | | | | | | 10 | | **52** | 6.7 | 12.1 |
| 05/11/08 | Y | 20 | 6 | | | | 3 | | | 18 | 1 | | **48** | 8.2 | 9.8 |
| 05/12/08 | Y | 34 | 15 | | | | | | | | 14 | 3 | **66** | 4.6 | 8.2 |
| 05/13/08 | Y | 16 | | | | | | | | 1 | 14 | | **31** | 6.4 | 13.9 |
| 05/14/08 | Y | 60 | 22 | | | | 2 | | | 1 | 16 | 3 | **104** | 5.4 | 12.1 |
| 05/15/08 | Y | 1 | | | | | | | | 1 | | | **2** | 8.6 | 9.0 |
| 05/16/08 | Y | 131 | 72 | | | | 1 | | | 2 | 29 | 1 | **236** | 6.7 | 11.6 |
| 05/17/08 | Y | 117 | 33 | | | | 2 | | | 2 | 40 | 1 | **195** | 4.5 | 11.9 |
| 05/18/08 | Y | 10 | 13 | | | | | | | | | | **23** | 5.4 | 6.6 |
| 05/19/08 | Y | 3 | 1 | | | | | | | | | | **4** | 3.0 | 9.5 |
| 05/20/08 | Y | 7 | 9 | | | | | | | | 3 | | **19** | 5.5 | 8.1 |
| 05/21/08 | Y | 38 | 36 | | | | | | | | 12 | | **86** | 5.8 | 8.6 |
| 05/22/08 | Y | 43 | 35 | | | | 8 | | | 10 | 36 | 1 | **133** | 4.8 | 11.0 |
| 05/23/08 | Y | 50 | 5 | | | | | | 2 | 7 | 21 | | **85** | 6.0 | 10.6 |
| 05/24/08 | Y | 79 | 61 | 1 | | | 4 | | 1 | 9 | 37 | 7 | **199** | 4.6 | 10.4 |
| 05/25/08 | Y | 15 | 6 | | | | | | | 1 | 24 | | **46** | 7.2 | 18.3 |
| 05/26/08 | Y | 73 | 32 | | | 1 | 8 | | | 9 | 51 | 1 | **175** | 6.3 | 19.2 |
| 05/27/08 | Y | 1 | | | | | | | | 1 | 1 | | **3** | 9.7 | 6.5 |
| 05/28/08 | Y | 19 | 11 | | 2 | | 4 | | | 20 | 6 | 1 | **63** | 6.4 | 9.9 |
| 05/29/08 | Y | 33 | 13 | | | 1 | 5 | | | 1 | 18 | 3 | **74** | 4.5 | 16.9 |
| 05/30/08 | Y | 6 | 1 | | 4 | | 1 | | | 4 | 6 | | **22** | 9.2 | 20.9 |
| 05/31/08 | Y | 253 | 51 | | 4 | | 22 | | | 24 | 123 | 3 | **480** | 6.2 | 18.8 |
| 06/01/08 | Y | 73 | 32 | | 15 | | 1 | | 2 | 8 | 45 | 6 | **182** | 5.8 | 17.5 |
| 06/02/08 | Y | | | | | | | | | 1 | | | **1** | 3.9 | 21.3 |
| 06/03/08 | Y | | | | | | | | | | | | **0** | 5.4 | 20.5 |
| 06/04/08 | Y | | | | | | | | | | 4 | | **4** | 5.1 | 20.5 |
| 06/05/08 | Y | | | | | | | | | | | | **0** | 7.3 | 25.8 |
| 06/06/08 | Y | | | | | | | | | | | | **0** | 8.0 | 27.4 |
| 06/07/08 | Y | 1 | | | | | | | | | | | **1** | 4.7 | 24.1 |
| 06/08/08 | Y | | | | | | | | | | | | **0** | 7.0 | 27.6 |
| 06/09/08 | Y | 5 | | | | | | | | 1 | 20 | 1 | **27** | 6.7 | 26.5 |
| 06/10/08 | Y | | | | | | | | | | 2 | | **2** | 5.9 | 21.4 |
| 06/11/08 | Y | 1 | | | | | | | | 5 | | | **6** | 4.9 | 23.5 |
| 06/12/08 | Y | | | | | | | | | 1 | | | **1** | 5.7 | 24.5 |
| 06/13/08 | Y | | | | | | | | | | 5 | | **5** | 6.3 | 24.1 |
| 06/14/08 | Y | 1 | | | | | | | | 1 | 8 | | **10** | 4.2 | 22.3 |
| 06/15/08 | Y | 2 | | | | 1 | | | | | 5 | 1 | **9** | 5.1 | 22.6 |
| 06/16/08 | Y | 2 | 1 | | | | | | | | 6 | | **9** | 6.5 | 20.6 |
| 06/17/08 | Y | 4 | | | | | | | | | 3 | | **7** | 6.2 | 16.4 |
| 06/18/08 | Y | | 1 | | | | | | | | 2 | | **3** | 5.6 | 17.5 |
| 06/19/08 | Y | 2 | 2 | | | | | | | 1 | 4 | | **9** | 4.0 | 18.2 |
| 06/20/08 | Y | | | | | 1 | | | | 1 | | | **2** | 2.9 | 22.3 |
| 06/21/08 | Y | 2 | | | | | | | | | 4 | | **6** | 5.4 | 20.1 |
| 06/22/08 | Y | | | | | | | | | 1 | | | **1** | 5.2 | 19.4 |
| 06/23/08 | Y | 4 | 3 | | | | | | | | 11 | | **18** | 4.8 | 18.8 |
| 06/24/08 | Y | | | | | | | | | | 5 | 1 | **6** | 3.8 | 20.3 |
| 06/25/08 | Y | 8 | 1 | | | | | | | | 10 | | **19** | 5.4 | 21.9 |
| 06/26/08 | Y | | | | | | | | | 1 | 1 | | **2** | 5.7 | 24.2 |
| 06/27/08 | Y | | | | | | | | | | | | **0** | 4.8 | 23.6 |
| 06/28/08 | Y | | | | | | | | | | 4 | | **4** | 6.5 | 22.4 |
| 06/29/08 | Y | | | | | | | | | | 1 | 1 | **2** | 7.1 | 21.2 |
| 06/30/08 | Y | | | | | | | | | | | 1 | **1** | 4.9 | 16.7 |
| 07/01/08 | Y | | | | | | | | | | 2 | | **2** | 3.8 | 19.4 |
| 07/02/08 | Y | | | | | | | | | | | | **0** | 8.1 | 22.6 |
| 07/03/08 | Y | | | | | | | | | | 1 | 1 | **2** | 6.3 | 19.7 |
| 07/04/08 | Y | 1 | | | | 1 | | | | 1 | 1 | 1 | **5** | 4.6 | 17.7 |
| 07/05/08 | Y | | 2 | | | | | | | 4 | 2 | 1 | **9** | 4.8 | 20.6 |
| 07/06/08 | Y | | | | | | | | | | | 1 | **1** | 3.8 | 23.1 |
| 07/07/08 | Y | | | | | | | | | | | | **0** | 4.3 | 24.5 |
| 07/08/08 | N | | | | | | | | | | | | **0** | 6.5 | 23.5 |
| 07/09/08 | N | | | | | | | | | | | | **0** | 6.2 | 22.5 |
| 07/10/08 | N | | | | | | | | | | | | **0** | 3.7 | 21.9 |
| 07/11/08 | N | | | | | | | | | | | | **0** | 5.5 | 24.3 |
| 07/12/08 | N | | | | | | | | | | | | **0** | 6.8 | 23.4 |
| 07/13/08 | N | | | | | | | | | | | | **0** | 6.3 | 21.9 |
| 07/14/08 | N | | | | | | | | | | | | **0** | 4.3 | 20.5 |
| 07/15/08 | Y | | | | | | | | | | 2 | | **2** | 2.8 | 22.9 |
| 07/16/08 | Y | | | | | | | | | 2 | | | **2** | 3.8 | 24.9 |
| 07/17/08 | Y | | | | | | | | | | 1 | | **1** | 3.7 | 25.7 |
| 07/18/08 | Y | 1 | | | | | | | | 3 | 4 | | **8** | 5.1 | 25.8 |
| 07/19/08 | Y | | | | | | | | | 1 | | | **1** | 4.8 | 25.9 |
| 07/20/08 | Y | 4 | | | | | | | | 3 | 5 | | **12** | 6.8 | 25.3 |
| 07/21/08 | Y | 17 | 1 | | | | | | | 2 | 29 | 2 | **51** | 5.2 | 24.2 |
| 07/22/08 | Y | 12 | | | | 1 | | | | 7 | 9 | | **29** | 4.7 | 22.5 |
| 07/23/08 | Y | 28 | 12 | | | 1 | 1 | | | 11 | 21 | 2 | **76** | 4.8 | 20.6 |
| 07/24/08 | Y | 52 | 18 | | | | 1 | | | 17 | 24 | 1 | **113** | 4.3 | 20.9 |
| 07/25/08 | Y | 2 | 2 | | | | 1 | | | 4 | 5 | | **14** | 3.0 | 21.4 |
| 07/26/08 | Y | 4 | | | | 2 | 11 | | | 26 | 24 | 2 | **69** | 4.7 | 22.9 |
| 07/27/08 | Y | 18 | 1 | | | 1 | 1 | | | 10 | 12 | 2 | **45** | 4.0 | 21.1 |
| 07/28/08 | Y | 3 | 1 | | | | 1 | | 4 | 14 | 1 | | **24** | 3.8 | 22.4 |
| 07/29/08 | Y | 3 | | | | | 1 | | | 9 | 2 | 2 | **17** | 3.0 | 24.6 |
| 07/30/08 | Y | | | | | | | | | | 1 | | **1** | 5.9 | 23.8 |
| 07/31/08 | Y | 2 | | | | 2 | | | | 5 | 5 | 1 | **15** | 4.9 | 23.7 |
| 08/01/08 | Y | | | | | | | | | 1 | 1 | 1 | **3** | 5.1 | 24.3 |
| 08/02/08 | Y | 1 | | | | | | | | 5 | 1 | 2 | **9** | 4.9 | 23.4 |
| 08/03/08 | Y | 1 | | | | | | | | 6 | 1 | 2 | **10** | 2.9 | 22.2 |
| 08/04/08 | Y | | | | | | | | | | 1 | | **1** | 4.9 | 23.1 |
| 08/05/08 | Y | 1 | 1 | | | | | | | 1 | 6 | 1 | **10** | 6.2 | 22.5 |
| 08/06/08 | Y | | | | | 1 | | | | 1 | | | **2** | 4.7 | 23.8 |
| 08/07/08 | Y | 1 | | | | 1 | | | 1 | 4 | 2 | | **9** | 5.5 | 20.9 |
| 08/08/08 | Y | 1 | | | | | | | | 3 | 3 | 2 | **9** | 4.8 | 19.2 |
| 08/09/08 | Y | | | | | | | | | 2 | 1 | | **3** | 4.8 | 19.6 |
| 08/10/08 | Y | | | | | | | | | 3 | 11 | | **14** | 4.8 | 18.1 |
| 08/11/08 | Y | 1 | | | | | | | | 3 | 7 | 2 | **13** | 4.0 | 18.5 |
| 08/12/08 | Y | | 1 | | | | | | | 7 | 3 | | **11** | 1.9 | 21.0 |
| 08/13/08 | Y | | | | | | | | | 2 | | | **2** | 3.5 | 21.3 |
| 08/14/08 | Y | 1 | | | | 1 | | | | 1 | 1 | | **4** | 3.9 | 19.5 |
| 08/15/08 | Y | | | | | | | | | 6 | 1 | 1 | **8** | 4.5 | 20.1 |
| 08/16/08 | Y | | 1 | | | | | | | 1 | 4 | | **6** | 3.8 | 20.5 |
| 08/17/08 | Y | | 2 | | | | | | | 7 | 18 | 5 | **32** | 4.5 | 20.4 |
| 08/18/08 | Y | | | | | | | | | | | | **0** | 4.5 | 21.4 |
| 08/19/08 | Y | | | | | | | | | | | | **0** | 5.0 | 22.7 |
| 08/20/08 | Y | | | | | | | | | | | | **0** | 5.3 | 20.7 |
| 08/21/08 | Y | | | | | | | | | | | | **0** | 5.8 | 24.0 |
| 08/22/08 | Y | | | | | | | | | | | | **0** | 5.7 | 25.6 |
| 08/23/08 | Y | | | | | | | | | | | | **0** | 4.6 | 25.7 |
| 08/24/08 | Y | | | | | | | | | | | | **0** | 4.5 | 24.2 |
| 08/25/08 | Y | | | | | 2 | | | | 3 | | 1 | **6** | 8.2 | 20.0 |
| 08/26/08 | Y | | 1 | | | 1 | | | | 5 | 3 | 2 | **12** | 7.4 | 19.7 |
| 08/27/08 | Y | 1 | | | | 1 | | | | 6 | 8 | | **16** | 5.4 | 19.3 |
| 08/28/08 | Y | | 1 | | | | | | | 4 | 2 | | **7** | 3.3 | 19.4 |
| 08/29/08 | Y | 2 | | | | | | | 1 | 7 | 1 | | **11** | 4.6 | 23.8 |
| 08/30/08 | Y | 5 | 2 | | | | | | | 6 | 10 | | **23** | 5.1 | 23.2 |
| 08/31/08 | Y | 24 | 4 | | | | | | 1 | 12 | 53 | 1 | **95** | 5.9 | 22.8 |
| 09/01/08 | Y | 4 | 3 | | | 1 | | | | 8 | 8 | | **24** | 5.5 | 22.9 |
| 09/02/08 | Y | | | | | | | | | 4 | 2 | | **6** | 4.5 | 26.2 |
| 09/03/08 | Y | 2 | | | | | | | | 7 | 1 | | **10** | 3.4 | 27.2 |
| **By Species** | | **1679** | **574** | **45** | **25** | **24** | **83** | **0** | **13** | **423** | **1046** | **80** | **3992** | | |
| **By Guild** | | **2298** | | | **25** | **24** | **96** | | | **1549** | | | | | |
| | | **BBSH** | | | **HB** | **MYSP** | **RBTB** | | | **UNKN** | | | **Total** | | |

# Appendix B

Raptor survey results

**Appendix B Table 1a.** Summary of species observed on each day of raptor surveys in spring 2008

| | Date | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **3/3** | **3/5** | **3/6** | **3/13** | **3/17** | **3/20** | **3/21** | **4/2** | **4/3** | **4/5** | **4/8** | **4/9** | **4/12** | **4/15** | **4/16** | **4/17** | **4/18** | **4/21** | **4/22** | **4/24** | **4/25** | **4/29** | **4/30** | **5/1** | **5/5** | **5/6** | **5/7** | **5/9** | **5/12** | **5/13** | **5/15** | **5/16** | **Total** |
| American kestrel | | | | | | | | 1 | 1 | 1 | | | | | 1 | | | | | | | | | 2 | 1 | | | | | | | | 7 |
| bald eagle | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| broad-winged hawk | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Cooper's hawk | | | | | | | 1 | | | | | | | | 1 | | | | | | | 1 | | | | 1 | | | | | | | 4 |
| golden eagle | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | 1 |
| merlin | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | 2 |
| northern harrier | | | | | 1 | | | | | | | | 1 | | | | | | | | 1 | | | | 1 | 1 | | | | | | | 5 |
| peregrine falcon | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | 1 |
| red-shouldered hawk | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | 1 |
| red-tailed hawk | 1 | 2 | 2 | 4 | 5 | 5 | 4 | | 5 | 3 | 2 | 3 | | 6 | 3 | 5 | 2 | 3 | 4 | 1 | 3 | 1 | 5 | 2 | 5 | 3 | 1 | 2 | 4 | 6 | 4 | 2 | 98 |
| sandhill crane | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 4 |
| sharp-shinned hawk | | | | 1 | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | 2 |
| turkey vulture | 4 | | 11 | 20 | 42 | 52 | 47 | 30 | 32 | 50 | 55 | 74 | 24 | 22 | 71 | 27 | 30 | 42 | 18 | 44 | 82 | 23 | 65 | 48 | 67 | 89 | 30 | 33 | 49 | 60 | 79 | 27 | 1347 |
| unknown accipiter | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | | | | | | 2 |
| unknown buteo | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| unknown falcon | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | 1 |
| unknown raptor | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | 1 | | | | 2 |
| **Total** | 5 | 2 | 17 | 26 | 49 | 57 | 52 | 32 | 39 | 54 | 57 | 77 | 25 | 30 | 77 | 32 | 33 | 45 | 23 | 45 | 88 | 25 | 71 | 52 | 74 | 94 | 32 | 35 | 54 | 66 | 83 | 29 | 1480 |

**Appendix B Table 1b.** Summary of species observed on each day of raptor surveys in fall 2008

| | Date | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **9/1** | **9/2** | **9/3** | **9/11** | **9/18** | **9/23** | **9/25** | **9/26** | **10/10** | **10/12** | **10/13** | **10/14** | **10/21** | **10/22** | **10/23** | **10/27** | **10/29** | **10/30** | **11/2** | **11/3** | **11/4** | **11/11** | **11/12** | **11/13** | **Total** |
| American kestrel | | | | | | | | | | 1 | 2 | 2 | | | 1 | | | | | | 1 | | 1 | | 8 |
| bald eagle | | | | | 1 | | | | | | | | | | | | | | | | | | | | 1 |
| Cooper's hawk | 3 | | | | | | | 1 | | | | | | | | | | | 1 | 1 | | | 1 | | 7 |
| northern goshawk | | 1 | | | | | | | | | | | | | | | | | | | | | | | 1 |
| northern harrier | | | | | | | | | | | | | | | | 1 | | | | | 2 | 1 | | | 4 |
| red-tailed hawk | 6 | 1 | 2 | | 1 | 1 | | | 1 | | 1 | 1 | 1 | 4 | 1 | 2 | 3 | 2 | 2 | 2 | | | | 1 | 32 |
| turkey vulture | 23 | 23 | 32 | 21 | 14 | 23 | 15 | 20 | 31 | 18 | 20 | 18 | 54 | 77 | 38 | 14 | 23 | 37 | 6 | 7 | 6 | 2 | 3 | 2 | 527 |
| unknown buteo | | | | | | | | | | | | | | | | | | | 1 | | | | | | 1 |
| **Total** | 32 | 25 | 34 | 21 | 16 | 24 | 15 | 21 | 32 | 19 | 23 | 21 | 55 | 81 | 40 | 17 | 26 | 39 | 10 | 10 | 9 | 3 | 5 | 3 | 581 |

**Appendix B Table 1c.** Summary of species observed on each day of sandhill crane surveys in fall 2008

| | Date | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **11/17** | **11/18** | **11/19** | **11/23** | **11/24** | **11/25** | **12/4** | **12/5** | **12/6** | **12/7** | **12/8** | **12/9** | **Total** |
| American kestrel | | | | 1 | | | | | | | | 1 | 2 |
| Cooper's hawk | | | | 1 | | | | | | | | | 1 |
| golden eagle | | | | 1 | | | | | | | | | 1 |
| northern harrier | | | 2 | 1 | | | | | | | | | 3 |
| red-tailed hawk | | 1 | 1 | 2 | 1 | 1 | | 1 | 1 | 1 | 1 | | 10 |
| turkey vulture | 1 | 3 | | | | | 4 | 1 | | 1 | | | 10 |
| **Total** | 1 | 4 | 3 | 6 | 1 | 1 | 4 | 2 | 1 | 2 | 1 | 1 | 27 |

**Appendix B Table 2a.** Observation totals of raptors and sandhill cranes by hour; spring 2008

| Species | 9:00-10:00 | 10:00-11:00 | 11:00-12:00 | 12:00-1:00 | 1:00-2:00 | 2:00-3:00 | 3:00-4:00 | 4:00-5:00 | Grand Total |
|---|---|---|---|---|---|---|---|---|---|
| American kestrel | 1 | | 1 | | 2 | 1 | 2 | | 7 |
| bald eagle | | | | | | | 1 | | 1 |
| broad-winged hawk | | | | | | 1 | | | 1 |
| Cooper's hawk | | 1 | 1 | | | 1 | 1 | | 4 |
| golden eagle | | 1 | | | | | | | 1 |
| merlin | | | | | 1 | 1 | | | 2 |
| northern harrier | | 1 | 2 | | | | 2 | | 5 |
| peregrine flacon | | 1 | | | | | | | 1 |
| red-shouldered hawk | | | | 1 | | | | | 1 |
| red-tailed hawk | 5 | 22 | 22 | 14 | 8 | 12 | 13 | 2 | 98 |
| sharp-shinned hawk | | | | | 2 | | | | 2 |
| turkey vulture | 89 | 240 | 155 | 203 | 188 | 221 | 237 | 14 | 1347 |
| unknown accipiter | | 2 | | | | | | | 2 |
| unknown buteo | | | | | 1 | | | | 1 |
| unknown falcon | | 1 | | | | | | | 1 |
| unknown raptor | | 2 | | | | | | | 2 |
| sandhill crane | | | | | | 2 | 2 | | 4 |
| **Hourly totals:** | 95 | 271 | 181 | 218 | 202 | 239 | 258 | 16 | 1480 |

**Appendix B Table 2b.** Observation totals of raptors by hour; fall 2008

| Species | 9:00-10:00 | 10:00-11:00 | 11:00-12:00 | 12:00-1:00 | 1:00-2:00 | 2:00-3:00 | 3:00-4:00 | Grand Total |
|---|---|---|---|---|---|---|---|---|
| American kestrel | 4 | 1 | 1 | | 1 | 1 | | 8 |
| bald eagle | 1 | | | | | | | 1 |
| Cooper's hawk | | 1 | 3 | 2 | | 1 | | 7 |
| golden eagle | | | | | | | | 0 |
| northern goshawk | | | | | 1 | | | 1 |
| northern harrier | 1 | | | | 2 | | 1 | 4 |
| red-tailed hawk | 4 | | 10 | 7 | 4 | 3 | 4 | 32 |
| turkey vulture | 20 | 124 | 114 | 83 | 69 | 74 | 43 | 527 |
| unknown buteo | | | | 1 | | | | 1 |
| **Hourly totals:** | 30 | 126 | 128 | 93 | 77 | 79 | 48 | 581 |

**Appendix B Table 3a.** Raptor flight altitudes by species; spring 2008

| Species | Less than 150 m | 150 m or greater |
|---|---|---|
| American kestrel | 7 | |
| bald eagle | | 1 |
| broad-winged hawk | 1 | |
| Cooper's hawk | 3 | 1 |
| golden eagle | 1 | |
| merlin | 2 | |
| northern harrier | 5 | |
| peregrine falcon | 1 | |
| red-shouldered hawk | 1 | |
| sharp-shinned hawk | 2 | |
| unknown accipiter | 2 | |
| unknown buteo | 1 | |
| unknown falcon | 1 | |
| unknown raptor | 2 | |
| red-tailed hawk | 97 | 1 |
| turkey vulture | 1278 | 69 |
| **Totals:** | 1404 | 72 |

**Appendix B Table 3b**. Raptor flight altitudes by species; fall 2008

| Species | Less than 150 m | 150 m or greater |
|---|---|---|
| American kestrel | 8 | |
| bald eagle | 1 | |
| Cooper's hawk | 6 | 1 |
| northern goshawk | 1 | |
| northern harrier | 4 | |
| unknown buteo | 1 | |
| red-tailed hawk | 32 | |
| turkey vulture | 488 | 39 |
| **Totals:** | 541 | 40 |

**Appendix B Table 4.** Summary of regional 2008 (February - December) migration surveys*to text

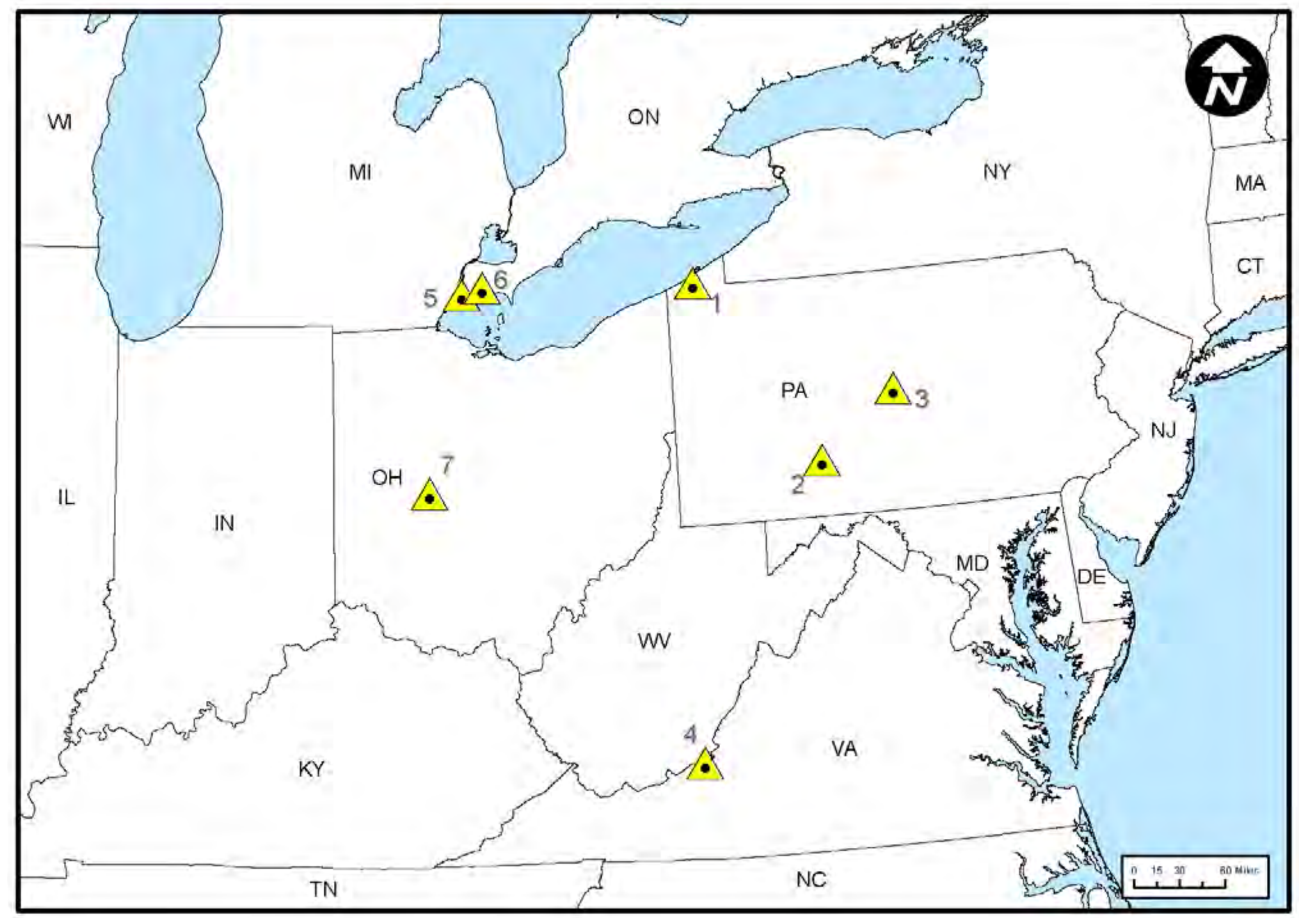
| Site Number** | Season | Location | Site Characteristics | Observation Hours | BV | TV | OS | BE | NH | SS | CH | NG | RS | BW | RT | RL | GE | AK | ML | PG | UR | UB | UA | UF | UE | TOTAL | BIRDS/ HOUR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Spring | Presque Isle; Erie, PA | Bluff along south shore Lake Erie | 35 | 0 | 1478 | 51 | 5 | 31 | 307 | 24 | 0 | 11 | 1661 | 205 | 8 | 0 | 139 | 7 | 1 | 4 | 3 | 1 | 0 | 0 | 3937 | 113 |
| 2 | Spring and Fall | Allegheny Front; Central City,PA | High elevation forested ridge | 1195 | 27 | 757 | 296 | 104 | 81 | 1171 | 250 | 16 | 166 | 4320 | 1762 | 5 | 248 | 81 | 33 | 19 | 51 | 79 | 8 | 5 | 167 | 9646 | 8 |
| 3 | Spring | Tussey Mountain; State College, PA | Forested ridge | 248 | 12 | 144 | 33 | 51 | 29 | 80 | 26 | 0 | 50 | 193 | 366 | 9 | 225 | 25 | 2 | 0 | 1 | 7 | 1 | 1 | 28 | 1283 | 5 |
| 4 | Fall | Hanging Rock Tower; Waiteville, WV | Forested ridge | 219 | 248 | 42 | 169 | 69 | 66 | 225 | 111 | 26 | 4 | 2268 | 286 | 366 | 14 | 279 | 25 | 6 | 2 | 15 | 9 | 2 | 3 | 2760 | 13 |
| 5 | Fall | Detroit River Hawkwatch - Pointe Mouillee; Grosse Ile, MI | Peninsula on S side L. Erie | 105 | 0 | 34503 | 11 | 54 | 143 | 1135 | 164 | 2 | 143 | 285546 | 1496 | 12 | 59 | 391 | 9 | 14 | 0 | 0 | 0 | 0 | 0 | 323691 | 3083 |
| 6 | Fall | Holiday Beach; Amherstburg, ON | North side Lake Erie | 424 | 0 | 21182 | 48 | 99 | 266 | 3533 | 219 | 7 | 298 | 8953 | 2282 | 23 | 133 | 597 | 36 | 30 | 1 | 11 | 0 | 0 | 1 | 37719 | 89 |
| 7 | Spring and Fall | *Buckeye Mountain; Mingo, OH* | Agricultural plateau | 467 | 0 | 1884 | 0 | 2 | 12 | 2 | 12 | 1 | 1 | 1 | 140 | 0 | 2 | 17 | 2 | 1 | 2 | 2 | 2 | 1 | 0 | 2084 | 4 |

* Data obtained from HMANA website (HMANA collects hawk count data from almost two hundred affiliated raptor monitoring sites throughout the United States, Canada, and Mexico). The HMANA count data used to construct this table included unusual species, such as Swainson's hawks and gyrfalcons. These numbers were not incorporated here.

** See map to right for site location.

**Abbreviation Key:**

BV - Black vulture
TV - Turkey vulture
OS - Osprey
BE - Bald eagle
NH - Northern harrier
SS - Sharp-shinned hawk
CH - Cooper's hawk
NG - Northern goshawk
RS - Red-shouldered hawk
BW - Broad-winged hawk
RT - Red-tailed hawk
RL - Rough-legged hawk
GE - Golden eagle
AK - American kestrel
ML - Merlin
PG – Peregrine falcon
UA – Unidentified accipiter
UB – Unidentified buteo
UF – Unidentified falcon
UE – Unidentified eagle
UR – Unidentified raptor



**Appendix B Table 5.** Summary of publicly available raptor survey results for wind projects

| Year | Season | Project Site | State | Landscape | Survey Period | # Survey Days | # Survey Hours | # Birds Observed | # Species Observed | Passage Rate (b/hr) | % Below Turbine Height | Citation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1996 | Fall | Searsburg, Bennington County | VT | Forested ridge | 9/11-11/13 | 20 | 80 | 430 | 12 | 5.4 | n/a | Kerlinger 1996 |
| 1998 | Fall | Harrisburg, Lewis County | NY | Great Lakes plain | 9/2-10/1 | 13 | 68 | 554 | 12 | 8.1 | n/a (47 m mean flight height) | Cooper & Mabee 2000 |
| 1998 | Fall | Wethersfield, Wyoming County | NY | Agricultural plateau | 9/2-10/1 | 24 | 107 | 256 | 12 | 2.4 | n/a (48 m mean flight height) | Cooper & Mabee 2000 |
| 2004 | Fall | Prattsburgh, Steuben County | NY | Agricultural plateau | 9/2-10/28 | 13 | 73 | 220 | 10 | 3.0 | (125 m) 62% | Woodlot 2005b |
| 2004 | Fall | Cohocton, Steuben County | NY | Agricultural plateau | 9/2-10/28 | 8 | 41 | 128 | 8 | 3.1 | (125 m) 80% | ED&R 2006b |
| 2004 | Fall | Deerfield, Bennington County | VT | Forested ridge | 9/2-10/31 | 10 | 60 | 147 | 11 for sites combined | 2.5 | (100 m) 9% for sites combined | Woodlot 2005c |
| 2004 | Fall | Deerfield, Bennington County | VT | Forested ridge | 9/2-10/31 | 10 | 57 | 725 | 11 for sites combined | 12.7 | (100 m) 9% for sites combined | Woodlot 2005c |
| 2004 | Fall | Sheffield, Caledonia County | VT | Forested ridge | 9/11-10/14 | 10 | 60 | 193 | 10 | 3.2 | (125 m) 31% | Woodlot 2006a |
| 2005 | Fall | Cohocton, Steuben County | NY | Agricultural plateau | 9/7-10/1 | 7 | 40 | 131 | 10 | 3.3 | (125) 63% | ED&R 2006b |
| 2005 | Fall | Churubusco, Clinton County | NY | Great Lakes plain | 10/6-10/22 | 10 | 60 | 217 | 15 | 3.6 | (120 m) 69% | Woodlot 2005l |
| 2005 | Fall | Dairy Hills, Clinton County | NY | Great Lakes Shore | 9/11-10/10 | 4 | 16 | 48 | 7 | 3.0 | n/a | Young et al. 2006 |
| 2005 | Fall | Howard, Steuben County | NY | Agricultural plateau | 9/1-10/28 | 10 | 57 | 206 | 12 | 3.6 | (91 m) 65% | Woodlot 2005o |
| 2005 | Fall | Munnsville, Madison County | NY | Agricultural plateau | 9/6-10/31 | 11 | 65 | 369 | 14 | 5.7 | (118 m) 51% | Woodlot 2005r |
| 2005 | Fall | Mars Hill, Aroostook County | ME | Forested ridge | 9/9-10/13 | 8 | 43 | 115 | 13 | 1.5 | (120 m) 42% | Woodlot 2005t |
| 2005 | Fall | Lempster, Sullivan County | NH | Forested ridge | Fall | 10 | 80 | 264 | 10 | 3.3 | (125 m) 40% | Woodlot 2007c |
| 2005 | Fall | Clayton, Jefferson County | NY | Agricultural plateau | 9/9-10/16 | 11 | 64 | 575 | 13 | 9.1 | (150 m) 89% | Woodlot 2005m |
| 2006 | Fall | Stetson, Penobscot County | ME | Forested ridge | 9/14-10/26 | 7 | 42 | 86 | 11 | 2.1 | (125 m) 63% | Woodlot 2007b |
| 2007 | Fall | Buckeye, Champaign and Logan Counties | OH | Agricultural plateau | 8/30-10/11 | 11 | 66 | 421 | 8 | 6.4 | (125) 78%; (150) 84% | *Not publicly available* |
| 2008 | Fall | Buckeye, Champaign and Logan Counties | OH | Agricultural plateau | 9/1-12/15 | 24 | 167 | 581 | 7 | 3.5 | (150 m) 93% | *this report* |
| 1999 | Spring | Wethersfield, Wyoming County | NY | Agricultural plateau | 4/20-5/24 | 24 | 97 | 348 | 12 | 3.6 | n/a (23 m mean flight height) | Cooper and Mabee 2000 |
| 2003 | Spring | Westfield, Chautaugua | NY | Great Lakes shore | 4/16-5/15 | 50 | 101 | 2578 | 17 | 25.6 | n/a (278 m mean flight height) | Cooper et al.2004c |
| 2005 | Spring | Churubusco, Clinton County | NY | Great Lakes plain | Spring | 10 | 60 | 170 | 11 | 2.8 | (120 m) 69% | Woodlot 2005a |
| 2005 | Spring | Dairy Hills, Clinton County | NY | Great Lakes Shore | 4/15-4/26 | 5 | 20 | 50 | 7 | 3.0 | n/a | ED&R 2006b |
| 2005 | Spring | Clayton, Jefferson County | NY | Agricultural plateau | 3/30-5/7 | 10 | 58 | 700 | 14 | 12.1 | (150 m) 61% | Woodlot 2005b |
| 2005 | Spring | Prattsburgh, Steuben County | NY | Agricultural plateau | Spring | 10 | 60 | 314 | 15 | 5.2 | (125 m) 83% | Woodlot 2005u |
| 2005 | Spring | Cohocton, Steuben County | NY | Agricultural plateau | Spring | 10 | 60 | 164 | 11 | 2.7 | (125 m) 77% | ED&R 2006b |
| 2005 | Spring | Munnsville, Madison County | NY | Agricultural plateau | 4/5-5/16 | 10 | 60 | 375 | 12 | 6.3 | (118 m) 78% | Woodlot 2005d |
| 2005 | Spring | Sheffield, Caledonia County | VT | Forested ridge | April - May | 10 | 60 | 98 | 10 | 1.6 | (125 m) 69% | Woodlot 2006b |
| 2005 | Spring | Deerfield, Bennington County | VT | Forested ridge | 4/9-4/29 | 7 | 42 | 44 | 11 (for both sites combined) | 1.1 | (125 m) 83% (at both sites combined) | Woodlot 2005g |
| 2005 | Spring | Deerfield, Bennington County | VT | Forested ridge | 4/9-4/29 | 7 | 42 | 38 | 11 (for both sites combined) | 0.9 | (125 m) 83% (at both sites combined) | Woodlot 2005g |
| 2006 | Spring | Lempster, Sullivan County | NH | Forested ridge | Spring | 10 | 78 | 102 | n/a | 1.3 | 125 m (18%) | Woodlot 2007c |
| 2006 | Spring | Howard, Steuben County | NY | Agricultural plateau | 4/3-5/19 | 9 | 53 | 260 | 11 | 5.0 | (125 m) 64% | Woodlot 2006d |
| 2006 | Spring | Mars Hill, Aroostook County | ME | Forested ridge | 4/12-5/18 | 10 | 60 | 64 | 9 | 1.1 | (120 m) 48% | Woodlot 2006g |
| 2008 | Spring | Buckeye, Champaign and Logan Counties | OH | Agricultural plateau | 3/1-5/15 | 32 | 216 | 1476 | 12 | 6.8 | (150 m) 95% | *this report* |

# Appendix C

Breeding bird survey results

**Appendix C Table 1.** Total number of species and individuals detected, and distance from observer at 90 point count locations during four survey periods - spring 2008*

| Common name | Scientific name | 0-50 m | 50-100 m | > 100 m | Flyovers | Unknown | Grand Total |
|---|---|---|---|---|---|---|---|
| Acadian flycatcher | *Empidonax virescens* | 1 | | | | | 1 |
| American crow | *Corvus brachyrhynchos* | 18 | 5 | 171 | 52 | | 246 |
| American goldfinch | *Carduelis tristis* | 38 | 45 | 29 | 75 | 4 | 191 |
| American kestrel | *Falco sparverius* | | | | 1 | | 1 |
| American redstart | *Setophaga ruticilla* | 3 | 1 | | | | 4 |
| American robin | *Turdus migratorius* | 71 | 90 | 114 | 29 | | 304 |
| Baltimore oriole | *Icterus galbula* | 15 | 16 | 12 | | | 43 |
| Barn swallow | *Hirundo rustica* | 6 | 34 | 38 | 117 | | 195 |
| Black-and-white warbler | *Mniotilta varia* | | 2 | | | | 2 |
| Black-throated green warbler | *Dendroica virens* | | 1 | | | | 1 |
| Blackburnian warbler | *Dendroica fusca* | 4 | | | | | 4 |
| Blue-gray gnatcatcher | *Polioptila caerulea* | 12 | 6 | | | | 18 |
| Blue-winged warbler | *Vermivora pinus* | 2 | 1 | | | | 3 |
| Blue jay | *Cyanocitta cristata* | 31 | 37 | 105 | 18 | | 191 |
| Bobolink | *Dolichonyx oryzivorus* | 3 | 3 | 10 | | | 16 |
| Brown-headed cowbird | *Molothrus ater* | 61 | 45 | 27 | 27 | | 160 |
| Brown thrasher | *Toxostoma rufum* | 7 | 13 | 13 | | | 33 |
| Carolina chickadee | *Poecile carolinensis* | 23 | 14 | 3 | | | 40 |
| Carolina wren | *Thryothorus ludovicianus* | 2 | 7 | 3 | | | 12 |
| Canada goose | *Branta canadensis* | 2 | | 6 | 82 | | 90 |
| Cedar waxwing | *Bombycilla cedrorum* | 2 | | 3 | 23 | | 28 |
| Chestnut-sided warbler | *Dendroica pensylvanica* | 3 | | | | | 3 |
| Chimney swift | *Chaetura pelagica* | | 3 | 3 | 10 | | 16 |
| Chipping sparrow | *Spizella passerina* | 6 | 10 | 29 | | | 45 |
| Common grackle | *Quiscalus quiscula* | 10 | 30 | 17 | 98 | | 155 |
| Common yellowthroat | *Geothlypis trichas* | 18 | 26 | 34 | 1 | 1 | 80 |
| Cooper's hawk | *Accipiter gentilis* | | 2 | | 1 | | 3 |
| Downy woodpecker | *Picoides pubescens* | 9 | 10 | 8 | 1 | | 28 |
| Eastern bluebird | *Sialia sialis* | | 1 | | 1 | | 2 |
| Eastern kingbird | *Tyrannus tyrannus* | 5 | 6 | 2 | 1 | | 14 |
| Eastern meadowlark | *Sturnella magna* | 2 | 10 | 22 | 6 | | 40 |
| Eastern towhee | *Pipilo erythrophthalmus* | 8 | 10 | 6 | | | 24 |
| Eastern wood-pewee | *Contopus virens* | 5 | 21 | 10 | | | 36 |
| European starling | *Sturnus vulgaris* | 45 | 24 | 106 | 31 | | 206 |
| Field sparrow | *Spizella pusilla* | 7 | 50 | 104 | 1 | | 162 |
| Flycatcher sp. | *n/a* | | 1 | | | | 1 |
| Grasshopper sparrow | *Ammodramus savannarum* | 6 | 3 | 1 | | | 10 |
| Gray catbird | *Dumetella carolinensis* | 44 | 20 | 7 | | | 71 |
| Great blue heron | *Ardea herodias* | | | | 5 | | 5 |
| Great crested flycatcher | *Myiarchus crinitus* | 7 | 15 | 16 | | | 38 |
| Horned lark | *Eremophilia alpestris* | 113 | 143 | 79 | 92 | | 427 |
| House finch | *Carpodacus mexicanus* | 1 | | | | | 1 |
| House sparrow | *Passer domesticus* | 1 | 17 | 6 | | | 24 |
| House wren | *Troglodytes aedon* | 40 | 46 | 40 | | | 126 |
| Indigo bunting | *Passerina cyanea* | 59 | 62 | 60 | 5 | | 186 |
| Killdeer | *Charadrius vociferus* | 20 | 18 | 88 | 20 | | 146 |
| Least flycatcher | *Empidonax minimus* | 1 | | | | | 1 |
| Louisiana waterthrush | *Seiurus motacilla* | 1 | | | | | 1 |
| Magnolia warbler | *Dendroica magnolia* | 4 | | | | | 4 |
| Mallard duck | *Anas platyrhynchos* | | | 2 | 5 | | 7 |
| Merlin | *Falco columbarius* | | | | 1 | | 1 |
| Mourning dove | *Zenaida macroura* | 13 | 27 | 62 | 56 | | 158 |
| Nashville warbler | *Vermivora ruficapilla* | | 2 | | | | 2 |
| Northern bobwhite | *Colinus virginianus* | | | 2 | | | 2 |
| Northern cardinal | *Cardinalis cardinalis* | 38 | 60 | 58 | | | 156 |
| Northern flicker | *Colaptes auratus* | 2 | 3 | 11 | 1 | | 17 |
| Northern harrier | *Circus cyaneus* | | | | 1 | | 1 |
| Northern lapwing | *Vanellus vanellus* | 1 | | | | | 1 |
| Northern mockingbird | *Mimus polyglottos* | 1 | | | 1 | | 2 |
| Northern parula | *Parula americana* | | 1 | 1 | | | 2 |
| Northern rough-winged swallow | *Stelgidopteryx serripennis* | | | | 2 | | 2 |
| Orchard oriole | *Icterus spurius* | 7 | 2 | 1 | | | 10 |
| Ovenbird | *Seiurus aurocapillus* | | | 1 | | | 1 |
| Palm warbler | *Dendroica palmarum* | 2 | 1 | | | | 3 |
| Prairie warbler | *Dendroica discolor* | 1 | | | | | 1 |
| Red-bellied woodpecker | *Melanerpes carolinus* | 14 | 20 | 20 | | | 54 |
| Red-eyed vireo | *Vireo olivaceus* | 14 | 17 | 3 | | | 34 |
| Red-headed woodpecker | *Melanerpes erythrocephalus* | 4 | 1 | 4 | | | 9 |
| Red-tailed hawk | *Buteo jamaicensis* | 1 | | 11 | 3 | | 15 |
| Red-winged blackbird | *Agelaius phoeniceus* | 275 | 442 | 435 | 172 | | 1324 |
| Ring-necked pheasant | *Phasianus colchicus* | | | 8 | | | 8 |
| Rose-breasted grosbeak | *Pheucticus ludovicianus* | 1 | 3 | 4 | | | 8 |
| Rock pigeon | *Columba livia* | 1 | | 5 | 5 | | 11 |
| Ruby-throated hummingbird | *Archilochus colubris* | | | 1 | 2 | | 3 |
| Savannah sparrow | *Passerculus sandwichensis* | 8 | 17 | 7 | | | 32 |
| Scarlet tanager | *Piranga olivacea* | 4 | 3 | 1 | | | 8 |
| Song sparrow | *Melospiza melodia* | 89 | 116 | 90 | 2 | | 297 |
| Swamp sparrow | *Melospiza georgiana* | | | | | 1 | 1 |
| Tennessee warbler | *Vermivora peregrina* | 3 | 1 | | | | 4 |
| Tree swallow | *Tachycineta bicolor* | | 2 | 1 | 21 | | 24 |
| Tufted titmouse | *Baeolophus bicolor* | 11 | 24 | 25 | | | 60 |
| Turkey vulture | *Cathartes aura* | 1 | | 14 | 31 | | 46 |
| Unidentified sp. | *n/a* | 3 | 3 | | | | 6 |
| Vesper sparrow | *Pooecetes gramineus* | 21 | 22 | 6 | | | 49 |
| Warbling vireo | *Vireo gilvus* | 4 | 2 | | | | 6 |
| White-breasted nuthatch | *Sitta carolinensis* | 10 | 9 | 2 | | | 21 |
| White-eyed vireo | *Vireo griseus* | 3 | 1 | | | | 4 |
| White-throated sparrow | *Zonotrichia albicollis* | 1 | | | | | 1 |
| Willow flycatcher | *Empidonax traillii* | 13 | 9 | 5 | | | 27 |
| Wild turkey | *Meleagris gallopavo* | | | 4 | | | 4 |
| Wood duck | *Aix sponsa* | | 2 | | 3 | | 5 |
| Wood thrush | *Hylocichla mustelina* | 4 | 9 | 26 | | | 39 |
| Woodpecker sp. | *n/a* | 1 | | 3 | | | 4 |
| Yellow-billed cuckoo | *Coccyzus americanus* | 2 | 8 | 5 | | | 15 |
| Yellow-breasted chat | *Ictera virens* | | | 1 | | | 1 |
| Yellow-rumped warbler | *Dendroica coronata* | 5 | 3 | | | | 8 |
| Yellow warbler | *Dendroica petechia* | 5 | 5 | 5 | | | 15 |
| Grand Total | | 1279 | 1663 | 1996 | 1003 | 6 | 5947 |

*Numbers largely represent singing males but also include male and some female individuals that were visually detected.

**Appendix C Table 2.** Total number of observations, relative abundance, and frequency of species at point count locations in the control plot during three survey periods; spring 2008

| | Agricultural habitat (20 points) | | | Forest habitat (10 points) | | |
|---|---|---|---|---|---|---|
| **Species** | **Total[a]** | **Relative abundance[b]** | **Frequency[c]** | **Total[a]** | **Relative abundance[b]** | **Frequency[c]** |
| American crow | 1 | 0.02 | 5% | | 0.00 | 0% |
| American goldfinch | 8 | 0.13 | 30% | 10 | 0.33 | 40% |
| American robin | 15 | 0.25 | 45% | 19 | 0.63 | 90% |
| Baltimore oriole | | 0.00 | 0% | 3 | 0.10 | 30% |
| Barn swallow | 1 | 0.02 | 5% | | 0.00 | 0% |
| Blue-gray gnatcatcher | | 0.00 | 0% | 3 | 0.10 | 20% |
| Blue jay | 3 | 0.05 | 10% | 15 | 0.50 | 70% |
| Brown-headed cowbird | 7 | 0.12 | 25% | 8 | 0.27 | 50% |
| Brown thrasher | 2 | 0.03 | 10% | 1 | 0.03 | 10% |
| Carolina chickadee | | 0.00 | 0% | 12 | 0.40 | 50% |
| Carolina wren | 2 | 0.03 | 10% | | 0.00 | 0% |
| Cedar waxwing | 2 | 0.03 | 10% | | 0.00 | 0% |
| Chipping sparrow | 4 | 0.07 | 15% | | 0.00 | 0% |
| Common grackle | 6 | 0.10 | 10% | 3 | 0.10 | 10% |
| Common yellowthroat | 4 | 0.07 | 15% | 7 | 0.23 | 40% |
| Downy woodpecker | | 0.00 | 0% | 7 | 0.23 | 70% |
| Eastern kingbird | 1 | 0.02 | 5% | 3 | 0.10 | 20% |
| Eastern meadowlark | | 0.00 | 0% | 1 | 0.03 | 10% |
| Eastern towhee | | 0.00 | 0% | 4 | 0.13 | 40% |
| Eastern wood-pewee | | 0.00 | 0% | 4 | 0.13 | 20% |
| European starling | 2 | 0.03 | 5% | 3 | 0.10 | 10% |
| Field sparrow | 4 | 0.07 | 15% | 4 | 0.13 | 40% |
| Gray catbird | 2 | 0.03 | 10% | 11 | 0.37 | 60% |
| Great crested flycatcher | | 0.00 | 0% | 1 | 0.03 | 10% |
| Horned lark | 69 | 1.15 | 80% | 1 | 0.03 | 10% |
| House sparrow | 5 | 0.08 | 5% | | 0.00 | 0% |
| House wren | 6 | 0.10 | 15% | 9 | 0.30 | 50% |
| Indigo bunting | 11 | 0.18 | 30% | 27 | 0.90 | 100% |
| Killdeer | 9 | 0.15 | 30% | 1 | 0.03 | 10% |
| Mourning dove | 1 | 0.02 | 5% | 4 | 0.13 | 40% |
| Northern cardinal | 1 | 0.02 | 5% | 8 | 0.27 | 50% |
| Northern flicker | | 0.00 | 0% | 1 | 0.03 | 10% |
| Orchard oriole | | 0.00 | 0% | 2 | 0.07 | 20% |
| Red-eyed vireo | | 0.00 | 0% | 7 | 0.23 | 50% |
| Red-tailed hawk | | 0.00 | 0% | 1 | 0.03 | 10% |
| Red-winged blackbird | 130 | 2.17 | 90% | 8 | 0.27 | 50% |
| Scarlet tanager | | 0.00 | 0% | 2 | 0.07 | 20% |
| Song sparrow | 30 | 0.50 | 70% | 18 | 0.60 | 70% |
| Tufted titmouse | | 0.00 | 0% | 9 | 0.30 | 60% |
| Vesper sparrow | 27 | 0.45 | 50% | 3 | 0.10 | 20% |
| White-breasted nuthatch | | 0.00 | 0% | 2 | 0.07 | 10% |
| Willow flycatcher | | 0.00 | 0% | 1 | 0.03 | 10% |
| Woodpecker sp. | | 0.00 | 0% | 1 | 0.03 | 10% |
| Wood thrush | | 0.00 | 0% | 1 | 0.03 | 10% |
| Yellow-billed cuckoo | 1 | 0.02 | 5% | 5 | 0.17 | 30% |
| **Grand Total** | **354** | **5.90** | | **230** | **7.67** | |
| **Species Richness** | **27** | | | **39** | | |

a Total number of individuals detected (mainly singing males, also males and females that were visually observed).

b Mean number of birds observed.

c Percentage of survey points at which the species was observed.

**Appendix C Table 3.** Total number of observations, relative abundance, and frequency of species at point count locations in 2 treatment plots during three survey periods; spring 2008

| | Agricultural habitat (37 points) | | | Forest habitat (23 points) | | |
|---|---|---|---|---|---|---|
| **Species** | **Total[a]** | **Relative abundance[b]** | **Frequency[c]** | **Total[a]** | **Relative abundance[b]** | **Frequency[c]** |
| American crow | 4 | 0.04 | 8% | 17 | 0.25 | 17% |
| American goldfinch | 20 | 0.18 | 32% | 16 | 0.23 | 43% |
| American robin | 39 | 0.35 | 46% | 50 | 0.72 | 100% |
| Baltimore oriole | 1 | 0.01 | 3% | 6 | 0.09 | 22% |
| Barn swallow | 32 | 0.29 | 8% | | 0.00 | 0% |
| Blue-gray gnatcatcher | | 0.00 | 0% | 3 | 0.04 | 9% |
| Blue jay | 5 | 0.05 | 8% | 23 | 0.33 | 43% |
| Bobolink | 1 | 0.01 | 3% | | 0.00 | 0% |
| Brown-headed cowbird | 23 | 0.21 | 24% | 15 | 0.22 | 39% |
| Brown thrasher | 8 | 0.07 | 19% | 6 | 0.09 | 17% |
| Carolina chickadee | | 0.00 | 0% | 16 | 0.23 | 39% |
| Carolina wren | 1 | 0.01 | 3% | 6 | 0.09 | 26% |
| Chimney swift | 3 | 0.03 | 3% | | 0.00 | 0% |
| Chipping sparrow | 6 | 0.05 | 14% | 1 | 0.01 | 4% |
| Common grackle | 25 | 0.23 | 19% | 1 | 0.01 | 4% |
| Common yellowthroat | 15 | 0.14 | 30% | 5 | 0.07 | 13% |
| Downy woodpecker | 4 | 0.04 | 11% | 4 | 0.06 | 13% |
| Eastern kingbird | 4 | 0.04 | 5% | 2 | 0.03 | 4% |
| Eastern meadowlark | 6 | 0.05 | 16% | | 0.00 | 0% |
| Eastern towhee | 2 | 0.02 | 5% | 6 | 0.09 | 17% |
| Eastern wood-pewee | | 0.00 | 0% | 19 | 0.28 | 52% |
| Eurpoean starling | 9 | 0.08 | 8% | 26 | 0.38 | 9% |
| Field sparrow | 17 | 0.15 | 32% | 12 | 0.17 | 30% |
| Flycatcher sp. | | 0.00 | 0% | 1 | 0.01 | 4% |
| Grasshopper sparrow | 7 | 0.06 | 14% | | 0.00 | 0% |
| Gray catbird | 8 | 0.07 | 16% | 23 | 0.33 | 57% |
| Great crested flycatcher | 2 | 0.02 | 5% | 15 | 0.22 | 43% |
| Horned lark | 97 | 0.87 | 65% | 1 | 0.01 | 4% |
| House finch | 1 | 0.01 | 3% | | 0.00 | 0% |
| House sparrow | 10 | 0.09 | 8% | 1 | 0.01 | 4% |
| House wren | 21 | 0.19 | 22% | 27 | 0.39 | 70% |
| Indigo bunting | 21 | 0.19 | 35% | 25 | 0.36 | 65% |
| Killdeer | 20 | 0.18 | 35% | | 0.00 | 0% |
| Mourning dove | 15 | 0.14 | 16% | 12 | 0.17 | 26% |
| Northern cardinal | 18 | 0.16 | 30% | 54 | 0.78 | 96% |
| Northern flicker | 1 | 0.01 | 3% | | 0.00 | 0% |
| Northern lapwing | | 0.00 | 0% | 1 | 0.01 | 4% |
| Northern parula | | 0.00 | 0% | 1 | 0.01 | 4% |
| Orchard oriole | 1 | 0.01 | 3% | | 0.00 | 0% |
| Red-bellied woodpecker | 3 | 0.03 | 8% | 17 | 0.25 | 48% |
| Red-eyed vireo | | 0.00 | 0% | 15 | 0.22 | 30% |
| Red-headed woodpecker | | 0.00 | 0% | 1 | 0.01 | 4% |
| Red-winged blackbird | 438 | 3.95 | 70% | 17 | 0.25 | 22% |
| Rock pigeon | 1 | 0.01 | 3% | | 0.00 | 0% |
| Rose-breasted grosbeak | | 0.00 | 0% | 4 | 0.06 | 13% |
| Savannah sparrow | 21 | 0.19 | 24% | | 0.00 | 0% |
| Scarlet tanager | | 0.00 | 0% | 2 | 0.03 | 9% |
| Song sparrow | 78 | 0.70 | 81% | 23 | 0.33 | 52% |
| Swamp sparrow | | 0.00 | 0% | 1 | 0.01 | 4% |
| Tree swallow | 2 | 0.02 | 3% | | 0.00 | 0% |
| Tufted titmouse | 2 | 0.02 | 5% | 16 | 0.23 | 43% |
| Turkey vulture | 1 | 0.01 | 3% | | 0.00 | 0% |
| Unidentified sp. | | 0.00 | 0% | 6 | 0.09 | 9% |
| Vesper sparrow | 4 | 0.04 | 8% | 3 | 0.04 | 9% |
| Warbling vireo | 1 | 0.01 | 3% | | 0.00 | 0% |
| White-breasted nuthatch | 2 | 0.02 | 5% | 6 | 0.09 | 26% |
| White-eyed vireo | | 0.00 | 0% | 3 | 0.04 | 9% |
| Willow flycatcher | 20 | 0.18 | 24% | | 0.00 | 0% |
| Wood thrush | | 0.00 | 0% | 5 | 0.07 | 17% |
| Yellow-billed cuckoo | 1 | 0.01 | 3% | 2 | 0.03 | 9% |
| Yellow warbler | 2 | 0.02 | 5% | | 0.00 | 0% |
| **Grand Total** | **1023** | **9.22** | | **516** | **7.48** | |
| **Species Richness** | **47** | | | **45** | | |

a Total number of individuals detected (mainly singing males, also males and females that were visually observed).

b Mean number of birds observed.

c Percentage of survey points at which the species was observed.

*Appendix H*
*Visual Impact Assessment for the Buckeye Wind Project*

# Visual Impact Assessment

## Buckeye Wind Project
**Champaign County, Ohio**

Prepared for:

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**March 2009**

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## FIGURES



## TABLES



## APPENDICES

## *1.0 Introduction*

Environmental Design & Research, Landscape Architecture, Planning, Environmental Services, Engineering and Surveying, P.C. (EDR) was retained by Buckeye Wind LLC, a wholly owned subsidy of EverPower Wind Holdings, Inc., ("Project Sponsor") to prepare a Visual Impact Assessment (VIA) for the proposed Buckeye Wind Project (the Project) located in Champaign and Logan County, Ohio. The purpose of this VIA is to:

- Describe the appearance of the visible components of the proposed Project.
- Define the visual character of the Project study area.
- Inventory and evaluate existing visual resources and viewer groups.
- Evaluate potential Project visibility within the study area.
- Identify key views for visual assessment.
- Assess the visual impacts associated with the proposed action.

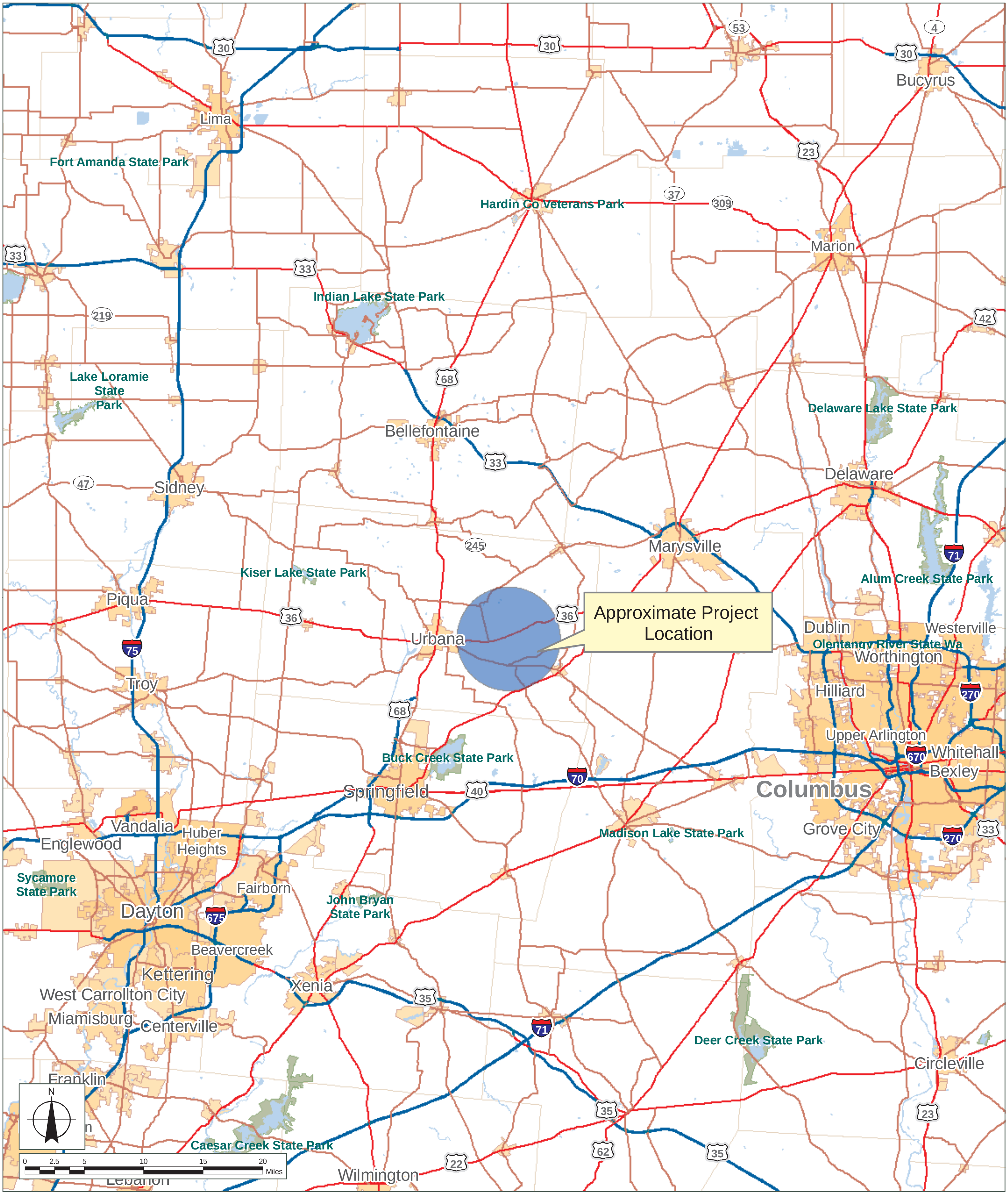
This VIA was prepared under the direct guidance of a registered landscape architect experienced in the preparation of visual impact assessments. It is also consistent with the policies, procedures, and guidelines contained in established visual impact assessment methodologies (see Literature Cited/References section).

## *2.0 Project Description*

### 2.1 Project Site

The Project site includes approximately 9,000 acres of leased private land in the Towns of Salem, Wayne, Rush, Goshen, Urbana, and Union in Champaign County, Ohio (Figure 1). The site is roughly bounded by State Route 245 to the north, State Route 559 to the east, State Route 4 to the south, and State Route 54 and U.S. Route 68 to the west. The site is located approximately 0.5 mile east of the City of Urbana, 0.5 mile northwest of the Village of Mechanicsburg, 4 miles southwest of the Village of North Lewisburg, 6 miles northeast of the City of Springfield, and 6 miles southeast of the Village of West Liberty. It is approximately 21 miles west of Columbus, and 20 miles northeast of Dayton (as measured to the nearest turbine).

The Project site is located on an elevated plateau that is characterized by level to gently-rolling topography with elevation ranging from approximately 1,080 feet above mean sea level (amsl) in the eastern, southern and western portions of the Project site to 1,335 feet amsl at the central portion of the Project site. Land use within the Project site is dominated by active agriculture, with farms and single-family rural residences generally occurring along the road frontage (see representative photos in Appendix C).




## Buckeye Wind Project

Champaign County, Ohio

Figure 1: Regional Project Location

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**Notes:**
Base Map: ESRI StreetMap North America, Year 2008.

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## 2.2 Proposed Project

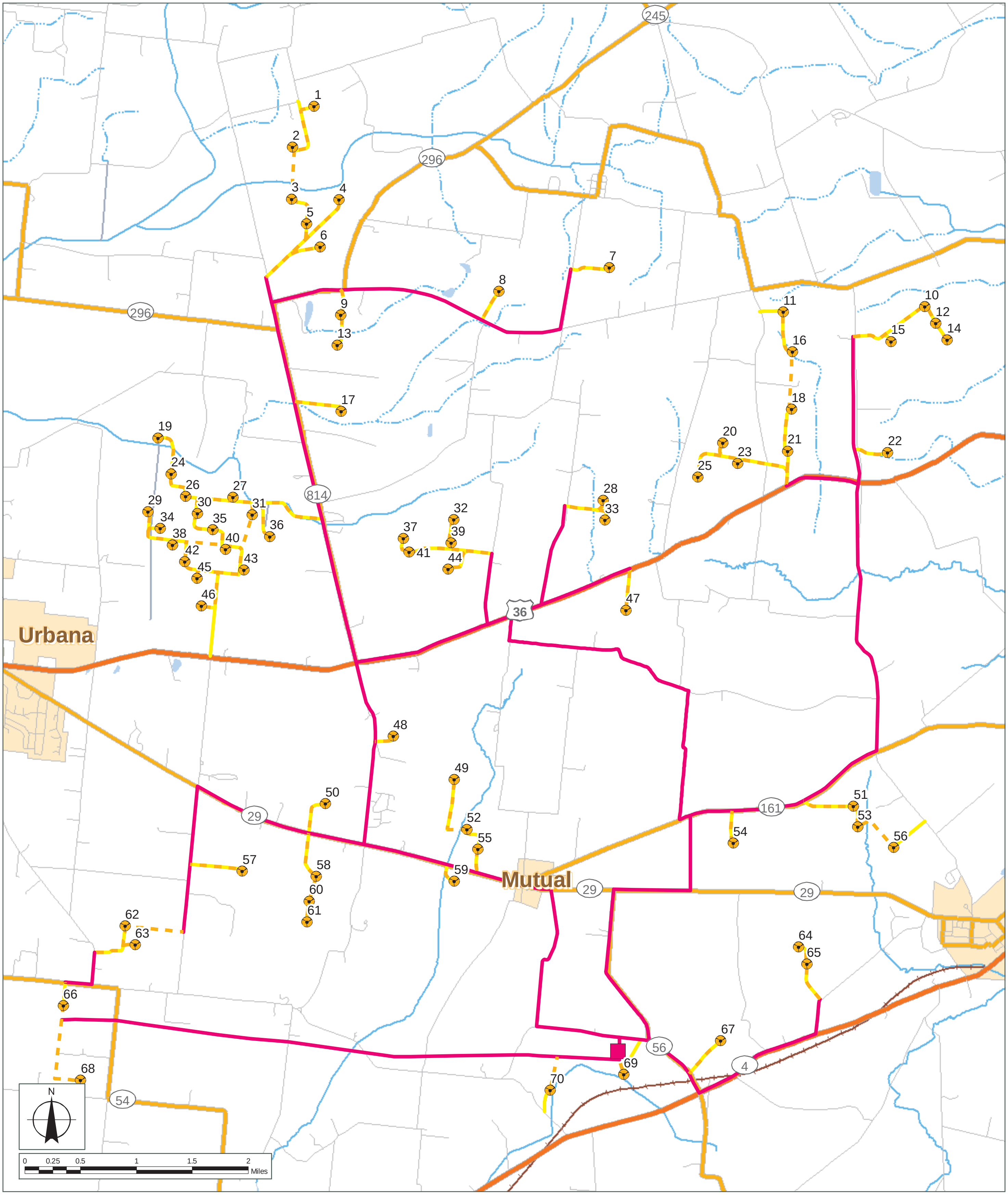
The proposed Project evaluated in this VIA is a wind-powered electric generating facility, consisting of 70 wind turbines and associated support facilities (roads, overhead/buried electrical interconnect cable, meteorological towers, substation, and operations and maintenance building). Project configuration/layout is illustrated in Figure 2. The major components of the proposed Project are described below:

### 2.2.1 Wind Turbines

The wind turbines proposed for this Project will be in the 1.8-2.5 MW range, (total project size approximately 126-175 MW). Although several turbine models are being considered, for the purpose of the VIA, it was assumed that the Nordex N100 turbine will be utilized on the Project. This turbine is larger than others being considered (e.g., Repower MM92) and therefore presents a worst case assessment of Project visibility. Each wind turbine consists of three major components; the tower, the nacelle, and the rotor, all of which will be white in color. The height of the tower, or “hub height” (height from foundation to top of tower) will be approximately 328 feet (100 m). The nacelle sits atop the tower, and the rotor hub is mounted to the nacelle. Assuming a 100 m rotor diameter, the total turbine height (i.e., height at the highest blade tip position) will be approximately 492 feet (150 m). A computer model illustrating the appearance of the proposed turbine is shown in Figure 3. Descriptions of each of the turbine components are provided below.

> *Tower*: The towers used for this Project are conical steel structures manufactured in multiple sections. The towers have a base diameter of approximately 13 feet and a top diameter of approximately 9.5 feet. Each tower will have an access door and an internal safety ladder to access the nacelle.
>
> *Nacelle*: The main mechanical components of the wind turbine are housed in the nacelle. These components include the drive train, gearbox, and generator. The nacelle is approximately 35 feet long, 13 feet tall, and 11.5 feet wide. Attached to the top of up to approximately half of the nacelles, per specifications of the Federal Aviation Administration (FAA), will be a single aviation warning light. These will be medium intensity flashing red lights (L864) and operated only at night. For the purposes of this study, it is assumed that the nacelle will include no obvious lettering, logo, or other exterior marking.

*Rotor*: A rotor assembly is mounted to the nacelle to operate upwind of the tower. Each rotor consists of three composite blades, each approximately 164 feet (50 m) in length (total rotor diameter = 328 feet or 100 m). The rotor blades are rotated along their axis or “pitched” to enable them to operate efficiently at varying speeds. Also, the rotor can spin at varying speeds (between 9.6 and 14.9 revolutions per minute) to operate more efficiently at lower wind speeds.




## Buckeye Wind Project

Champaign County, Ohio

Figure 2: Proposed Project Layout

- Substation
- Turbines
- Buried Interconnect
- Overhead Interconnect
- Access Roads

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**Notes:**
Base Map: ESRI StreetMap USA, Year 2006.

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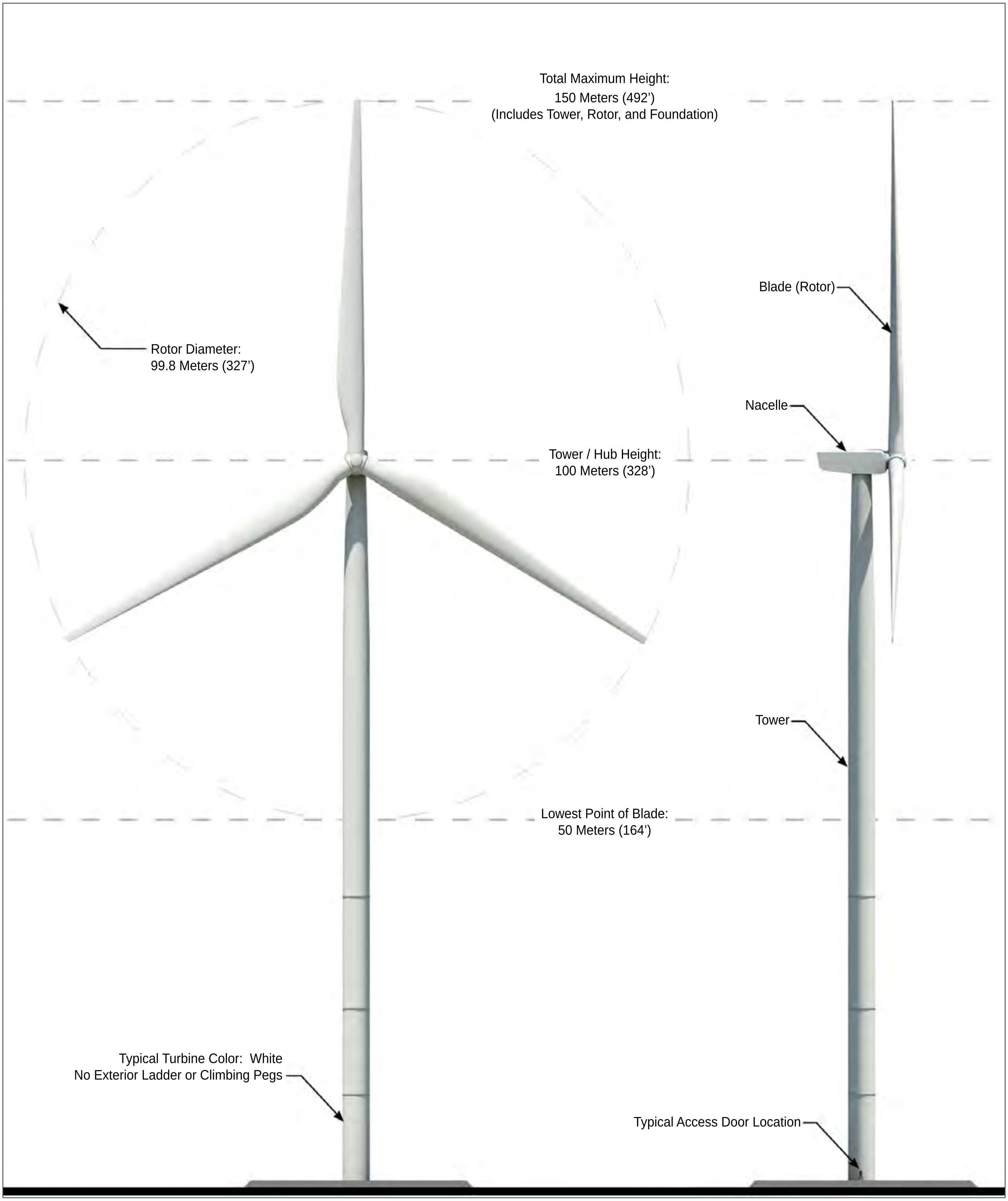


## Buckeye Wind Project

Champaign and Logan Counties, Ohio

Figure 3: Computer Model of Proposed Turbine

**Notes: Nordex N100**

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2.2.2 Electrical System

The proposed Project will have an electrical system that consists of 1) a system of buried and above-ground 34.5 kilovolt (kV) cables that will collect power from each wind turbine, and 2) a substation that transfers the power from the 34.5 kV cables to the existing Urbana-Mechanicsburg-Darby 138 kV transmission line and regional power grid. Each of these components is described below.

*Collection System:* A transformer located in the nacelle or adjacent to the base of each turbine raises the voltage of electricity produced by the turbine generator up from roughly 690 volts to the 34.5 kV voltage level of the collection system. From each turbine transformer, the electricity will flow into the collector circuit, which along with the turbine communication cables will run between the turbines and overhead to the substation. A total of approximately 65.4 miles of cable will be installed (39.8 miles overhead and 25.6 miles underground). Of the 25.6 miles of buried cable, 21.4 miles (84%) is collinear with Project access roads, and the location of these lines is indicated in Figure 2. The overhead collection lines are anticipated to run along public roads within the study area to the proposed substation site. The Applicant has signed a Letter of Intent with Dayton Power and Light (DPL), and is currently working to finalize the engineering and design of the overhead portions of the collection system. However, the exact location and appearance of the overhead lines have yet to be determined. Compared to the wind turbine, these lines are a very minor visual component of the Project. In addition, 34.5 kV lines often run along rural roadways and will generally not appear out of place in this setting (see examples of typical 34.5 kV lines in Appendix E). Consequently, this component of the Project is not the subject of further evaluation in this study.

*Substation*: The substation will be located on private land near the intersection of Pisgah Road and Route 56 in the Town of Union, adjacent to the Givens to Mechanicsburg section of the Urbana-Mechanicsburg-Darby 138 kV transmission line. The station terminates the 34.5 kV collection cables and steps the voltage up to 138 kV prior to connection with the transmission system. The substation will encompass up to 1.6 acres and will be enclosed by a chain link fence and accessed by a new gravel access road. The substation control building will require utility service (phone and electrical) that will be run from the nearest existing local utility lines. Design of the proposed substation has not yet been finalized, but examples from other wind power projects showing the typical appearance of such facilities are included in Appendix E. As these examples illustrate, although they present contrast with the existing landscape in line, color, texture and form, substation components are relatively low in height and have limited solid mass. Consequently, they are generally only visible from foreground locations (i.e., within 0.5 mile) where natural screening is lacking. Their visual impact is thus limited, and is not the subject of further evaluation in this report.

#### 2.2.3 Access Roads

The Project site includes an extensive network of existing state, county and local roads. Therefore, existing roads will be used to access the proposed Project in a way that minimizes the number of public roads used and the amount of Project related traffic. However, it is possible that some existing public roads will need to be improved to facilitate Project construction. Although the location and extent of these public road improvements is currently unknown, they are not anticipated to significantly change the character of the roads, and therefore are not evaluated in this study.

In addition to using the existing public roads, the Project will require the construction of new or improved private roads to access individual turbine sites. The proposed location of Project access roads is shown in Figure 2. The total length of access roads required to service all proposed wind turbine locations is approximately 23.3 miles, the majority of which will be upgrades to existing farm lanes. The roads will be gravel-surfaced and typically 36 to 40 feet in width including side slopes. Each road will be individually designed for site-specific engineering and environmental constraints, therefore as-built road widths may vary. Following construction, Project access roads will be reduced in width to 16-20 feet, and will receive very limited use. Although included in any simulations where they may be visible, these access roads take on the appearance of farm lanes, and generally do not have a significant long-term visual impact. Consequently, the visibility and visual impact of Project access roads, on their own, are not evaluated in this study.

#### 2.2.4 Meteorological Towers

One or more 328-foot (100 m) tall meteorological towers will be installed to collect wind data and support performance testing of the turbines. The Project Sponsor anticipates that these towers will be galvanized steel structures, with wind monitoring instruments suspended at the end of booms attached perpendicular to the tower. It is assumed that red aviation warning lights will be mounted at the top of the meteorological towers. The towers will be sited upwind of the prevailing wind direction within the larger Project area, but the final design and location of these towers have yet to be determined. In addition, meteorological towers typically have limited visibility and visual impact relative to the adjacent turbines. Consequently, this component of the Project is not addressed in this study.

### 2.2.5 Operations and Maintenance Facility

An operations and maintenance (O&M) building will house the command center of the Project's supervisory control and data acquisition (SCADA) system. A storage yard adjacent to the O&M building will house equipment and materials necessary to service the Project. At this time, it is anticipated that an existing structure in the vicinity of the proposed Project will be purchased and refurbished for use as the O&M facility. However, if a new building is needed, it is not expected to exceed 6,000 square feet in size. The O&M building and storage yard will utilize up to 2 acres of land. The Project Sponsor will incorporate motifs and design elements into the construction of the O&M building to ensure that it blends with the area's agricultural landscape. Likewise, if necessary, the Project Sponsor will provide visual screening (e.g. vegetation, berms, etc.) to reduce the visual impact of the associated storage yard. Consequently, the O&M facility should be compatible with the existing landscape, and is not evaluated as part of this study.

## *3.0 Existing Visual Character*

Based on established visual assessment methodology the visual study area for the Project was defined as the area within a 5-mile radius of each of the proposed turbines, and includes approximately 268 square miles in Champaign County. This area includes all or portions of the City of Urbana, the Villages of North Lewisburg, Woodstock, Mechanicsburg, Mutual and Catawba, and the hamlets of Middletown, Fountain Park, Kennard, Cable, and Mingo. The location of the visual study area is illustrated in Figure 4.


## Buckeye Wind Project

Champaign County, Ohio

Figure 4: Visual Study Area

● Turbines

5 Mile Study Area

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Notes:
USGS 1:100000 Bellefontaine and Springfield Quadrangles.

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## 3.1 Physiographic/Visual Setting

### 3.1.1 Landform and Vegetation

The visual study area is in the Bellefontaine Uplands physiographic sub-region of the Central Ohio Till Plains. This area is distinguished by gently rolling hills and moderate slopes formed as a result of glacial processes. Elevations within the study area range from approximately 950 to 1,400 feet amsl. Higher elevation land occurs along a dissected plateau that is oriented in a north-south direction through the central portion of the study area. Level, lower elevation plains occur to the east and west, and broad valleys associated with the Mad River and Buck Creek occur to the southwest and south, respectively.

Vegetation in the study area is dominated by active agricultural land (pasture and active crop fields) with scattered areas of upland and riparian forest and some successional shrub land. Open fields are often interspersed with and bordered by hedgerows and small woodlots. Significant blocks of forest (upland and riparian) occur primarily on steeper slopes and in stream valleys in the central and eastern portion of the study area. Forest vegetation is primarily deciduous (oak-hickory and northern hardwoods).

### 3.1.2 Land Use

Land use within the 5 mile-radius visual study area is dominated by agricultural land, farms, and rural and suburban style residences. Farms in the area are typically large (average size over 200 acres), with soybeans, corn wheat and hay being the primary agricultural crops grown in the area. Higher density residential and commercial development is concentrated in the City of Urbana, the Villages of North Lewisburg, Woodstock, Mechanicsburg, Catawba, and Mutual, and several small settlements including the hamlets of Mingo, Kennard, Fountain Park, Cable, and Middletown. The study area also includes a portion of Northridge, which is a suburb located immediately north of the City of Springfield. The city and villages are generally characterized by a main street business district, surrounded by traditional residential neighborhoods, with some commercial frontage development along the outskirts. Hamlets within the study area are relatively small pockets of development within a primarily rural/agricultural landscape. Suburban residential and commercial development occurs outside the cities and villages, primarily in the southwestern portion of the study area. Outside the areas of concentrated human settlement, commercial/industrial uses within the study area occur along certain portions of state and county highways in the area. These include automobile dealerships, retail/convenience stores, farm suppliers, and equipment yards.

#### 3.1.3 Water Features

Water features within a 5-mile radius of the Project site are primarily the headwaters and tributaries of Big Darby Creek, Mad River, and Deer Creek. The study area also includes Muzzy's Lake, located just west of the City of Urbana, as well as the C.J. Brown Reservoir within Buck Creek State Park, in the southern portion of the visual study area. The majority of the water features within the study area are small streams and ponds that occur on private land, and therefore receive very limited recreational use. However, public access to the C.J. Brown Reservoir is available, and this water body receives considerable recreational use, including boating, swimming, and fishing. Most of the streams within the study area are not major visual components of the landscape, and typically can only be seen at, or in proximity to public road crossings.

### 3.2 Landscape Similarity Zones

Within the 5-mile radius visual study area, four major landscape similarity zones (LSZ) were defined. The USGS Land Cover Data used to help define the location of these zones is illustrated in Figure 5 (Sheet 1), along with representative photos of each (Sheets 2 and 3). The general landscape character, use, and potential views to the proposed Project within each of the LSZs that occur within the study area are described below.

#### 3.2.1 Zone 1: Rural Residential/ Agricultural Zone

The Rural Residential/ Agricultural landscape similarity zone (LSZ) is the dominant landscape type, and occurs throughout the study area. The landscape is characterized by level to gently rolling topography with a mix of farms and rural residences, open fields, hedgerows, and small woodlots. Open fields tend to occur on the more level ground, while woodlots and bands of forest vegetation occur more commonly on steeper slopes and poorly drained areas. Dominant agricultural uses include crop farming (primarily soybeans, corn, wheat and hay) along with pasture. Due to the presence of open fields, views within this LSZ are more open and long distance than those available in other zones within the study area. These views typically include a level to gently sloping foreground landscape, with woodland vegetation in the background, and, in places, crossing or framing the view. Views in the Rural Residential/Agricultural LSZ include widely scattered homes, barns and silos, with working farm equipment occasionally seen in the fields. Due to the location of the turbines on an elevated plateau, the abundance of open fields, and the proposed location of turbines exclusively within this zone, foreground (0-0.5 mile), midground (0.5-3.5 miles), and background (>3.5 miles) views of the proposed Project will be available from many areas within the Rural Residential/Agricultural LSZ.

### 3.2.2 Zone 2. City/Village Zone

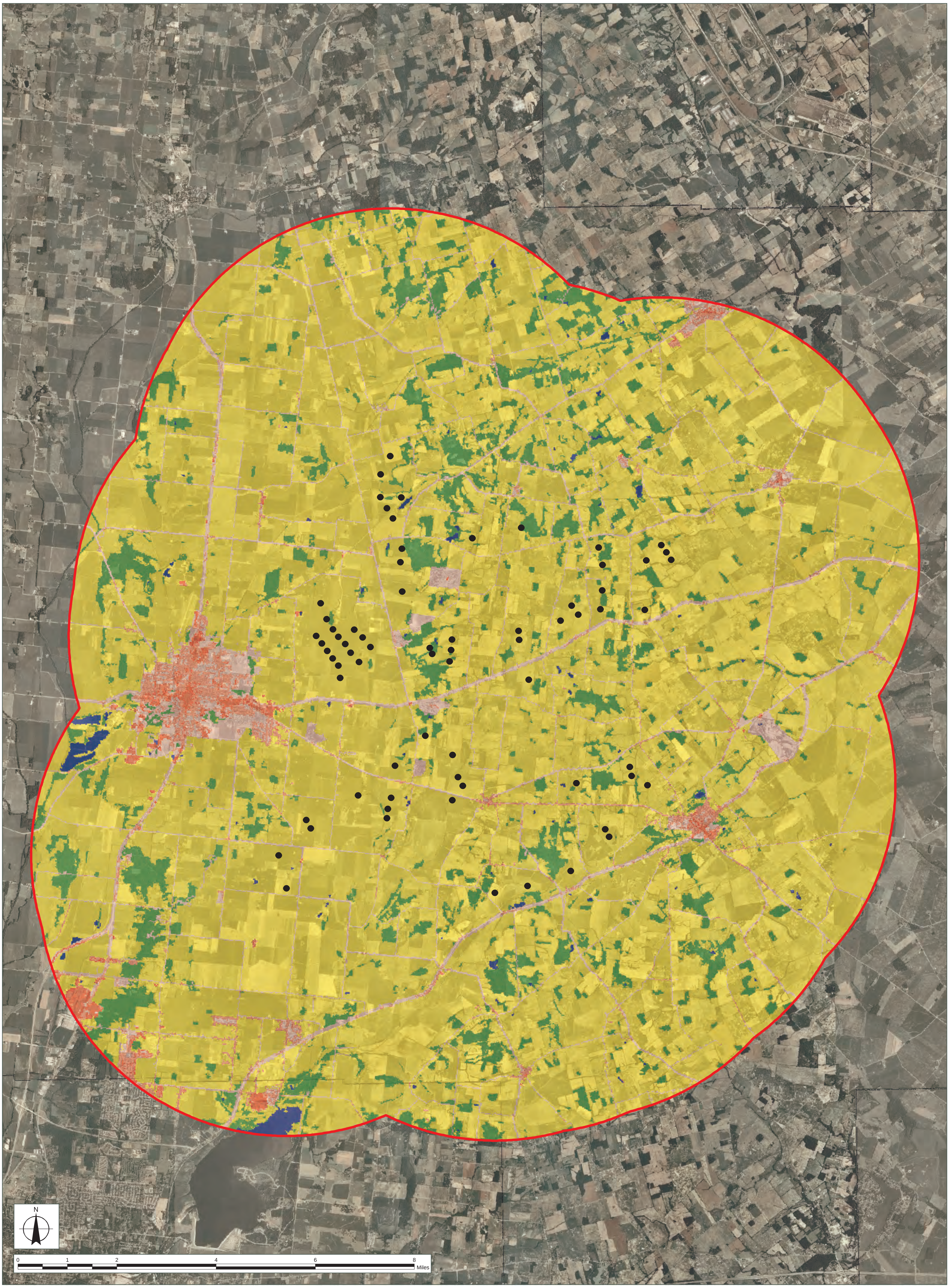
This LSZ includes the City of Urbana and the various villages within the visual study area. This zone is characterized by high to moderate-density residential and commercial development. Vegetation and landform contribute to visual character in the city and village areas, but within the majority of this zone, buildings (typically 2-3 stories tall) and other man-made features dominate the landscape. These features are highly variable in their size, architectural style, and arrangement. Activities within this zone are primarily associated with business and residential uses, as well as local travel. Views within this zone are typically focused on the roadways and adjacent structures, although outward views across yards and adjacent fields are also available at the outskirts of these areas. Views are most likely from open road corridors and the edges of the city/village zone, where structures and vegetation density decrease and therefore screening is reduced.

### 3.2.3 Zone 3. Suburban Residential Zone

This zone is dominated by low to medium-density residential neighborhood development that typically occurs along the main road frontage or in cul-de-sacs spurring off the main roads. Buildings tend to be relatively new construction, 1-2 stories in height, and more spread out than in a village setting. Consequently, open views to the surrounding landscape are generally more restricted than in open agricultural areas, but more available than in areas of more concentrated human settlement. The effect of vegetation on visibility is highly variable in this LSZ, with adjacent agricultural fields offering open views in some areas, and hedgerows, woodlots and yard trees significantly blocking views in others. Land use in this zone is almost exclusively residential, suggesting a relatively high sensitivity to visual quality and visual change. Examples of this zone can be found on the outskirts of the City of Urbana and in Northridge.

#### 3.2.4 Zone 4. Hamlet Zone

This zone includes the hamlets of Middletown, Fountain Park, Kennard, Cable and Mingo. The hamlets generally consist of a cluster of residential and municipal structures, often at the intersection of two or more highways. Houses are a mix of traditional and more modern architectural styles, with spacing similar to that in a village setting. However, they also tend to have larger backyards and may border on active or inactive agricultural land and/or woodlots. Occasional commercial establishments, churches, and historic structures are found in some of these areas. Activities are primarily associated with residential use and local travel, although some small scale commercial businesses and limited agricultural activity also occur in some areas. Views within this zone are typically focused on the highway and adjacent structures, although outward views across yards and adjacent fields are also available. Views are most likely from the edges of the hamlet zone, where housing and vegetation density decrease and therefore screening is reduced. Potential project visibility will vary based on distance between the hamlets and the proposed project.




## Buckeye Wind Project

Champaign County, Ohio

### Figure 5: Landscape Similarity Zones

Sheet 1 of 3 - Land Cover Mapping

- Turbines
- 5 Mile Study Area
- Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Open/Agriculture
- Forest

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**Notes:**
Base Map: NAIP Orthoimagery, 1 meter resolution, Year 2004.
Source: USGS National Land Cover Data Set, Year 2001.

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**Photo 1.**

Rural Residential / Agriculture Zone

**Photo 2.**


City / Village Zone

## Buckeye Wind Project

Champaign County, Ohio

Figure 5: Landscape Similarity Zones

Sheet 2 of 3 - Representative Photos

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**Photo 3.**

Suburban Residential Zone

**Photo 4.**


Hamlet Zone

**Buckeye Wind Project**
Champaign County, Ohio

Figure 5: Landscape Similarity Zones
Sheet 3 of 3 - Representative Photos

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## 3.3 Viewer/User Groups

Three categories of viewer/user groups were identified within the visual study area. These include the following:

### 3.3.1 Local Residents

Local residents include those who live and work within the visual study area. They generally view the landscape from their yards, homes, local roads and places of employment. Residents are concentrated in and around the City of Urbana, and the various villages and hamlets, but occur throughout the visual study area. Except when involved in local travel, residents are likely to be stationary, and have frequent or prolonged views of the landscape. Local residents may view the landscape from ground level or elevated viewpoints (typically upper floors/stories of homes). Residents' sensitivity to visual quality is variable, however, it is assumed that some residents may be very sensitive to changes in particular views that are important to them.

### 3.3.2 Through Travelers/Commuters

Commuters and travelers passing through the area view the landscape from motor vehicles on their way to work or other destinations. Commuters and through travelers are typically moving, have a relatively narrow field of view, and are destination oriented. Drivers on major roads in the area (e.g., U.S. Routes 36 and 68, and State Routes 559, 507, 245, 296, 814, 187, 161, 29, 56, 54, 55, and 4) will generally be focused on the road and traffic conditions, but do have the opportunity to observe roadside scenery. Passengers in moving vehicles will have greater opportunities for prolonged off-road views than will drivers, and accordingly, may have greater perception of changes in the visual environment.

### 3.3.3 Tourists/Recreational Users

Recreational users and tourists include local residents and out-of-town visitors involved in cultural and recreational activities at parks, recreational facilities, and historic sites, as well as in undeveloped natural settings such as forests and fields. These viewers are concentrated in the recreational facilities/cultural sites located within and adjacent to the visual study area, including the Ohio Caverns, Buck Creek State Park, C.J. Brown Reservoir, various local parks and golf courses, as well as historic sites in Urbana and Mechanicsburg. Members of this group may view the landscape from area highways while on their way to these destinations, or from the sites themselves. This group includes, bicyclists, hikers, recreational boaters, hunters, fishermen and those involved in more passive recreational activities (e.g., picnicking, sight seeing, or walking). Visual quality may or may not be an important part of the recreational experience for these viewers. However, for some, scenery will be a very important part of their experience, and in almost all cases enhances the quality of recreational experiences. Recreational users and tourists will often have continuous views of landscape features over relatively long periods of time. However, there is not a significant concentration of recreational areas in the visual study area, and most recreational viewers and tourists will only view the surrounding landscape from ground-level vantage points.

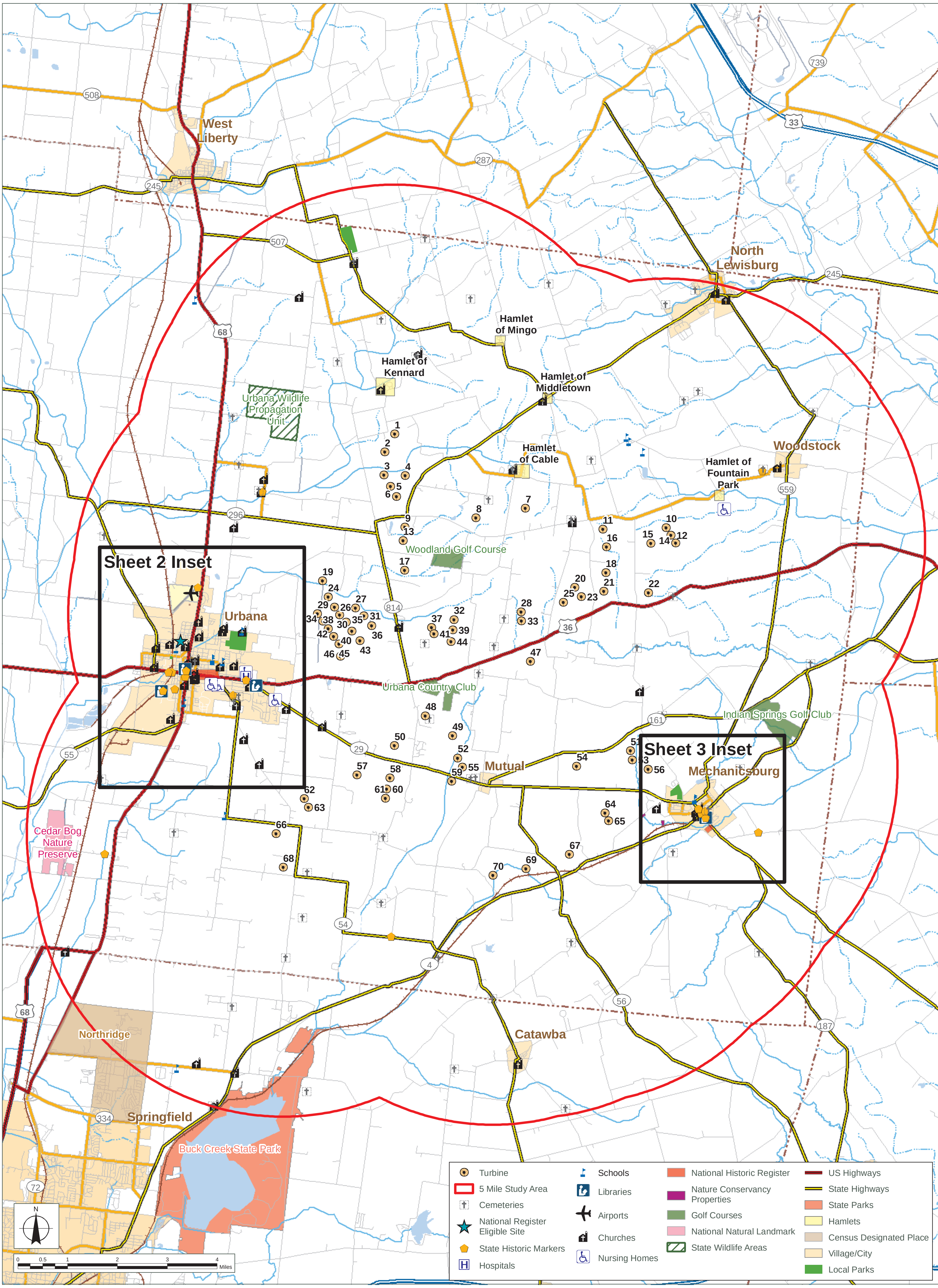
## 3.4 Visually Sensitive Resources

The 5-mile radius visual study area includes several sites that could be considered scenic resources of statewide significance. These include 31 sites/districts listed on the National Register of Historic Places (including 21 in Mechanicsburg and eight in Urbana), plus one additional site in Urbana that has been determined eligible for listing. Within the study area, there are also 19 state historic markers, one State Park (Buck Creek State Park), one State Wildlife Management Area (Urbana Wildlife Propagation Unit), one State Nature Preserve (Prairie Road Fen), one parcel of Nature Conservancy land (Darby Wetlands Reserve), and one National Natural Landmark (Cedar Bog Nature Preserve). There are no State Forests, National Wildlife Refuges, National Park Service Lands, designated State or Federal trails, or designated scenic roads or overlooks.

There are also no state or federally designated wild, scenic, or recreational rivers within the visual study area. However, outside of the 5-mile radius study area, portions of both Big and Little Darby Creek are designated as state and national scenic rivers. The Little Darby Creek designation starts at the Lafayette-Plain City Road Bridge (approximately 9.3 miles from the nearest proposed turbine), while the Big Darby Creek designation starts at the Champaign-Union County line (approximately 6 miles from the nearest proposed turbine). However, the National Park Service also maintains the National Rivers Inventory (NRI), a national listing of "potentially eligible river segments," as required by the Wild and Scenic Rivers Act of 1968. A river segment may be listed on the NRI if it is free-flowing and has one or more "outstandingly remarkable values" (ORVs). The kinds of ORVs that can qualify a river for listing include: exceptional scenery, fishing or boating, unusual geological formations, rare plant and animal life, and cultural or historical artifacts that are judged to be of more than local or regional significance. The NRI website for Ohio (http://www.nps.gov/ncrc/programs/rtca/nri/states/oh.html) indicates that Big Darby Creek is listed as potentially eligible from its source, with ORVs for recreation, fish, and wildlife. This segment of Big Darby Creek is approximately 9.5 miles north of the nearest proposed turbine. The next closest potentially eligible river segment is the Mad River in Clark County (only listed up to Tremont City), approximately 6.5 miles from the nearest turbine.

Beyond these scenic resources of statewide significance, the 5-mile radius study area also includes areas that are regionally or locally significant/sensitive, due to the type of land use they receive. These include Ohio Caverns, the C.J. Brown Reservoir, and various golf courses, local parks, schools, waterbodies, churches, cemeteries, areas of concentrated human settlement (City of Urbana and various villages and hamlets), and heavily traveled highways.

All inventoried scenic/sensitive resources are listed in Table B1 in Appendix B. The location of mapped visually sensitive resources within the visual study area is illustrated in Figure 6, and on the large-scale viewshed maps included in Appendix B.




## Buckeye Wind Project

Champaign County, Ohio

## Figure 6: Visually Sensitive Resources

Sheet 1 of 3

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**Notes:**
Base Map: ESRI Street Map USA, Year 2006.

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# Buckeye Wind Project

Champaign County, Ohio

## Figure 6: Visually Sensitive Resources

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**Notes:**
Base Map: ESRI Street Map USA, Year 2006.

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## Buckeye Wind Project

Champaign County, Ohio

## Figure 6: Visually Sensitive Resources

Sheet 3 of 3

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**Notes:**
Base Map: ESRI Street Map USA, Year 2006.

EDR

# *4.0 Visual Impact Assessment Methodology*

The Visual Impact Assessment (VIA) procedures used for this study are consistent with methodologies developed by the U.S. Department of the Interior, Bureau of Land Management (1980), U.S. Department of Agriculture, National Forest Service (1974), the U.S. Department of Transportation, Federal Highway Administration (1981), and the NYS Department of Environmental Conservation (not dated). The specific techniques used to assess potential Project visibility and visual impacts are described in the following section.

## 4.1 Project Visibility

An analysis of Project visibility was undertaken to identify those locations within the visual study area where there is potential for the proposed wind turbines to be seen from ground-level vantage points. This analysis included identifying potentially visible areas on viewshed maps, preparing technical cross sections, and verifying visibility in the field. The methodology employed for each of these assessment techniques is described below.

### 4.1.1 Viewshed Analysis

Topographic viewshed maps for the Project were prepared using USGS digital elevation model (DEM) data (7.5-minute series), the location and height of all proposed turbines (see Figure 2), and ESRI ArcView® software with the Spatial Analyst extension. Two 5-mile radius topographic viewsheds were mapped, one to illustrate “worst case” daytime visibility (based on a maximum blade tip height of 492 feet above existing grade) and the other to illustrate potential visibility of turbine lights (based on a nacelle height of 328 feet above existing grade).

The ArcView program defines the viewshed (using topography only) by reading every cell of the DEM data and assigning a value based upon visibility from observation points throughout the 5-mile study area. The resulting topographic viewshed maps define the maximum area from which any turbine within the completed Project could potentially be seen within the study area during both daytime and nighttime hours (ignoring the screening effects of existing vegetation and structures). Because the screening provided by vegetation and structures is not considered in this analysis, the topographic viewsheds represent a "worst case" assessment of potential Project visibility.

A turbine count analysis was performed to determine how many wind turbines are potentially visible from various locations within the viewshed. This analysis was based on blade tip height and utilizes the same topographic viewshed methodology described above. The results of this analysis are then grouped by number of turbines potentially visible. Three turbine count groups were defined to create an even distribution of turbines within each group, and to allow easy interpretation of the final map.

In addition, a vegetation viewshed analysis was also prepared to better illustrate the potential screening effect of forest vegetation. The vegetation viewshed utilized a base vegetation layer created with USGS National Land Cover Data (forests) with an assumed elevation of 40 feet. This layer was added to the digital elevation model to produce a base layer for the viewshed analysis, as described above (using the blade tip and nacelle heights as input data). Once the viewshed analysis was completed, the areas covered by the forest vegetation layer were designated as "not visible" on the resulting data layer to reflect the fact that views from within forested areas will be screened.

It is worth noting that because characteristics of the proposed turbines that influence visibility (color, narrow profile, distance from viewer, etc.) are not into taken consideration in the viewshed analyses, being within the viewshed does not necessarily equate to actual Project visibility.

#### 4.1.2 Cross Section Analysis

To further illustrate the screening effect of vegetation and structures within the study area, four representative line-of-sight cross sections (ranging from 6.1 to 9.8 miles long) were cut through the study area. Cross section locations were chosen so as to include visually sensitive areas (e.g., villages, water bodies, and major roads) and cover the various landscape similarity zones occurring within the 5-mile radius study area. The cross sections are based on forest vegetation and topography as indicated on the 7.5-minute USGS quadrangle maps and digital aerial photographs. For the purposes of this analysis, a uniform 40-foot tree height was assumed. A 10 fold vertical exaggeration was used to increase the accuracy of the analysis and facilitate reader interpretation.

#### 4.1.3 Field Verification

Visibility of the proposed Project was also evaluated in the field on January 24-25, 2008. The purpose of this exercise was to verify potential turbine visibility as indicated by viewshed analysis and to obtain photographs for subsequent use in the development of visual simulations. A mix of clear skies and high clouds resulted in good visibility and a representative variety of sky/lighting conditions.

During the field verification, an EDR field crew drove public roads and visited public vantage points within the 5-mile radius study area to document points from which the turbines would likely be visible, partially screened, or fully screened. This determination was made based on the visibility of existing structures located in proximity to the proposed turbine sites (communication towers, silos, houses, roads, etc.), which served as locational and scale references. Photos were taken from 116 representative viewpoints within the study area. All photos were obtained using Nikon D200 digital SLR camera with a focal length between 28 and 35 mm (equivalent to between 45 and 55 mm on a standard 35 mm film camera). This focal length most closely approximates normal human eyesight relative to scale. Viewpoint locations were determined using hand-held global positioning system (GPS) units and high resolution aerial photographs (digital ortho quarter quadrangles). The time and location of each photo were documented on all electronic equipment (camera, GPS unit, etc.) and noted on field maps and data sheets (see Appendix C). Viewpoints photographed during field review generally represented the most open, unobstructed available views toward the Project.

## 4.2 Project Visual Impact

Beyond evaluating potential Project visibility, the VIA also examined the visual impact of the proposed wind turbines on the aesthetic resources and viewers within the Project study area. This assessment involved creating computer models of the proposed Project turbines and layout, selecting representative viewpoints within the study area, and preparing computer-assisted visual simulations of the proposed Project. These simulations were then used to characterize the type and extent of visual impact resulting from Project construction. Details of the visual impact assessment procedures are described below.

### 4.2.1 Viewpoint Selection

From the photo documentation conducted during field verification, EDR selected a total of 13 viewpoints for development of visual simulations. These viewpoints were selected based upon the following criteria:

1. They provide clear, unobstructed views of the Project (as determined through field verification).
2. They illustrate Project visibility from sensitive sites/resources with the visual study area.
3. They illustrate typical views from landscape similarity zones where views of the Project will be available.
4. They illustrate typical views of the proposed Project that will be available to representative viewer/user groups within the visual study area.
5. They illustrate typical views of different numbers of turbines, from a variety of viewer distances, and under different lighting conditions, to illustrate the range of visual change that will occur with the Project in place.

Location of the selected viewpoints is indicated in Figure 9. Locational details and the criteria for selection of each simulation viewpoint are summarized in Table 1, below:

**Table 1. Viewpoints Selected for Simulations and Evaluation**

| Viewpoint Number | Visually Sensitive Resource | LSZ Represented | Viewer Group Represented | Viewing Distance | View Orientation[1] |
|---|---|---|---|---|---|
| 14 | State Route 20 | Rural Residential/Agricultural | Travelers & Residents | 0.5 mile | NNE |
| 29 | State Route 296 | Rural Residential/Agricultural | Residents | 0.5 mile | ESE |
| 41 | U.S. Route 36 | Rural Residential/Agricultural | Travelers & Residents | 1.0 mile | NE |
| 45 | | Rural Residential/Agricultural | Residents | 1.0 mile | NW |
| 48 | | Rural & Suburban | Residents | 1.8 mile | NNE |
| 52 | U.S. Route 26 | Rural & Suburban | Travelers & Residents | 1.6 mile | WSW |
| 54 | Union Cemetery | Rural Residential/Agricultural | Residents | 0.9 mile | W |
| 61 | State Route 814 | Rural Residential/Agricultural | Residents | 0.9 mile | NNE |
| 95 | | Rural Residential/Agricultural | Residents | 4.7 mile | SSE |
| 119 | State Route 54 | Rural Residential/Agricultural | Residents | 0.6 mile | NE |
| 123 | State Route 4 & 56 | Rural Residential/Agricultural | Travelers & Residents | 0.5 mile | NNE |
| 128 | Darby Wetlands | Rural Residential/Agricultural | Residents | 0.7 mile | WSW |
| 131 | State Route 559 | Rural Residential/Agricultural | Residents | 3.5 mile | WSW |

[1]N = North, S = South, E = East, W = West

### 4.2.2 Visual Simulations

To show anticipated visual changes associated with the proposed Project, high-resolution computer-enhanced image processing was used to create realistic photographic simulations of the completed turbines from each of the 13 selected viewpoints. The photographic simulations were developed by constructing a three-dimensional computer model of the proposed turbine and turbine layout based on turbine specifications and survey coordinates provided by the Project developer. For the purposes of this analysis, it was assumed that all new turbines would be Nordex N100 machines. Simulation methodology and accuracy is outlined in Appendix A, and the computer model used in this VIA is shown in Figure 3.

The next step in this process involved utilizing aerial photographs and GPS data collected in the field to create an AutoCAD 2004® drawing. The two dimensional AutoCAD data was then imported into AutoDesk 3ds MAX 9.0® and three-dimensional components (cameras, modeled turbines, etc.) were added. These data were superimposed over photographs from each of the viewpoints, and minor camera changes (height, roll, precise lens setting) made to align all known reference points within the view. This process ensures that Project elements are shown in proportion, perspective, and proper relation to the existing landscape elements in the view. Consequently, the alignment, elevations, dimensions and locations of the proposed structures will be accurate and true in their relationship to other landscape features in the photo (see Appendix A).

At this point, a "wire frame" model of the facility and known reference points is shown on each of the photographs. The proposed exterior color/finish of the turbines is then added to the model and the appropriate sun angle is simulated based on the specific date, time and location (latitude and longitude) at which each photo was taken. This information allows the computer to accurately illustrate highlights, shading and shadows for each individual turbine shown in the view. All simulations show the turbines with rotors oriented toward the southwest, which is generally the prevailing wind direction in the area. To illustrate the full expanse of the Project that may be perceived from certain viewpoints, panoramic simulations were created at Viewpoints 41 and 95. This image was created by stitching together two 50 mm photos to illustrate an approximately 60-degree field of view. To illustrate the motion of the turning rotor, animation was added to the simulations from Viewpoints 48 and 61 (see digital images in Appendix D).

4.2.3 Visual Impact Evaluation

To evaluate anticipated visual changes associated with the proposed Project, the photographic simulations of the completed Project (as described above) were compared to photos of existing conditions. These “before” and “after” photographs, identical in every respect except for the Project components shown in the simulated views, were printed on 11 x 17 inch format for every viewpoint selected in the previously described process. A licensed EDR landscape architect was then asked to determine the effect of the proposed Project on the existing visual conditions in terms of its contrast with existing components of the landscape.

# *5.0 Visual Impact Assessment Results*

## 5.1 Project Visibility

Potential turbine visibility, as indicated by the viewshed analyses, is illustrated in Figure 7 and summarized in Table 3. As indicated by the topographic blade tip analysis, the proposed Project could potentially be visible in approximately 95.5% of the 5-mile study area. This "worst case" assessment of potential visibility indicates the area where any portion of any turbine could possibly be seen without considering the screening effect of existing vegetation and structures. Areas where there is no possibility of seeing the Project are generally limited to the backside of hills and some stream valleys, primarily in the vicinity of Mingo and Catawba, and one some slopes along the far western edge of the study area. Based on blade tip height and the screening effect of topography alone, the vast majority of the visually sensitive sites within the 5-mile study area are indicated as having potential views of the Project (see Table B-2 in Appendix B). As indicated by the turbine count analysis in Table 3, in most areas where potential blade tip visibility is indicated by the topographic viewshed analysis, views to the majority (37-70) of the proposed turbines could be available. Only about 15% of the 5-mile radius study area has the potential for views that include fewer than 19 turbines (if screening by trees is not considered).

Areas of potential nighttime visibility based on the topographic viewshed analysis (Figure 7, Sheet 2) cover approximately 92.7% of the 5-mile radius study area, and are indicated in roughly the same locations shown by the blade tip analysis. However, areas where over 55 turbines could potentially be visible are reduced from 59% to 34% of the study area, and areas where fewer than 19 turbines could be visible are increased from 15% to 22% of the study area.

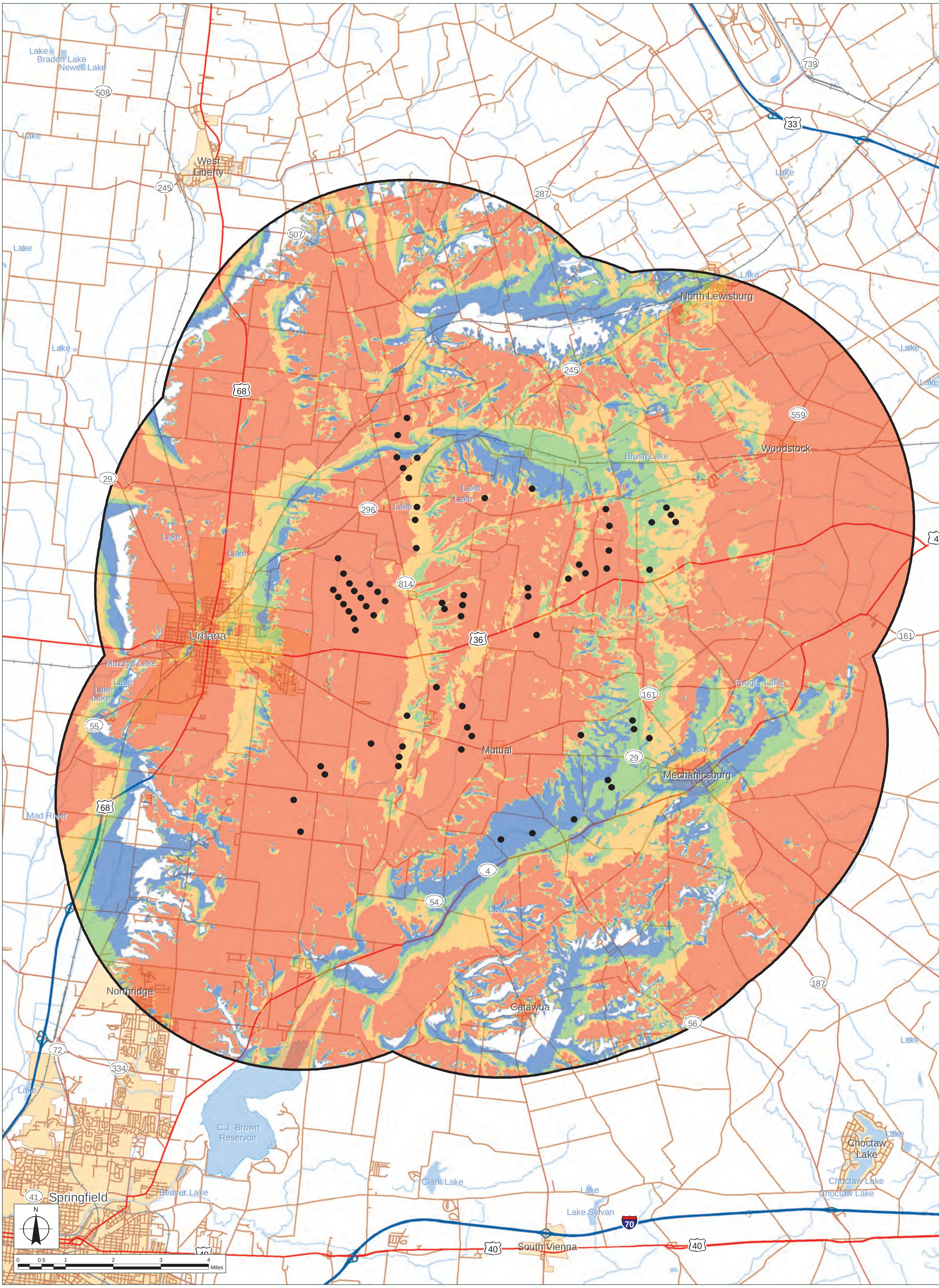
Factoring vegetation into the viewshed analysis reduces potential Project visibility, and is a more accurate reflection of what the actual extent of Project visibility is likely to be (Figure 7, Sheet 3 and 4). Within a 5-mile radius, the vegetative viewshed analysis indicates that approximately 84.6% of the area will have potential views of some portion of the Project. Visibility will be eliminated in small areas throughout the study area where blocks of forest vegetation occur. These areas occur most commonly in a north-south band that runs through the central portion of the study area. Compared to the topographic blade tip viewshed, areas where fewer than 19 turbines could potentially be visible increases from 15% to 31% of the study area simply by factoring in the screening effect of vegetation. Roughly the same doubling of screening is true when comparing the vegetation and topographic viewshed analysis of the nacelle height (see Table 2). As indicated in Table B-2, considering the screening effect of vegetation in the viewshed analysis reduces potential Project visibility from sensitive sites, but the majority of these sites are still indicated as having the potential for at least partial visibility of the Project.

As mentioned previously, areas of actual visibility are anticipated to be much more limited than indicated by the viewshed analysis, due to the slender profile of the turbines (especially the blade, which make up the top 160 feet of the turbine), the effects of distance, and screening from hedgerows, street trees and structures, which are not considered in the viewshed analysis.

**Table 2. Viewshed Results Summary**

| | 5-mile Radius Study Area | | |
|---|---|---|---|
| **Type of Viewshed** | **Total Acres** | **Visible Acres[1]** | **%** |
| Blade Tip - Topo Only | 171,270 | 163, 519 | 95.5 |
| 0 Visible | 171,270 | 7,788 | 4.5 |
| 1-18 Turbines Visible | 171,270 | 17,505 | 10.2 |
| 19-36 Turbines Visible | 171,270 | 18,807 | 11.0 |
| 37-54 Turbines Visible | 171,270 | 26,140 | 15.3 |
| 55-70 Turbines Visible | 171,270 | 101,025 | 59.0 |
| Nacelle/Lighting - Topo Only | 171,270 | 158,815 | 92.7 |
| 0 Visible | 171,270 | 12,500 | 7.3 |
| 1-18 Turbines Visible | 171,270 | 25,144 | 14.7 |
| 19-36 Turbines Visible | 171,270 | 29,649 | 17.3 |
| 37-54 Turbines Visible | 171,270 | 45,388 | 26.5 |
| 55-70 Turbines Visible | 171,270 | 58,587 | 34.2 |
| Blade Tip - Topo & Vegetation | 171,270 | 144,853 | 84.6 |
| 0 Visible | 171,270 | 26,940 | 15.7 |
| 1-18 Turbines Visible | 171,270 | 26,292 | 15.4 |
| 19-36 Turbines Visible | 171,270 | 26,105 | 15.2 |
| 37-54 Turbines Visible | 171,270 | 33,451 | 19.5 |
| 55-70 Turbines Visible | 171,270 | 58,377 | 34.1 |
| Nacelle/Lighting - Topo & Vegetation | 171,270 | 139,028 | 81.2 |
| 0 Visible | 171,270 | 32,782 | 19.1 |
| 1-18 Turbines Visible | 171,270 | 36,819 | 21.5 |
| 19-36 Turbines Visible | 171,270 | 39,596 | 23.1 |
| 37-54 Turbines Visible | 171,270 | 38,966 | 22.8 |
| 55-70 Turbines Visible | 171,270 | 23,003 | 13.4 |

[1]Acreage for turbine count analysis may not be equal to study area acreage due to rounding and/or raster-to-vector conversion




## Buckeye Windpower Project

Champaign County, Ohio

Figure 7: Viewshed Analysis - Topographic Blade Tip (492 ft.) Visibility

Sheet 1 of 4

March 2009

● Turbines

5 Mile Study Area

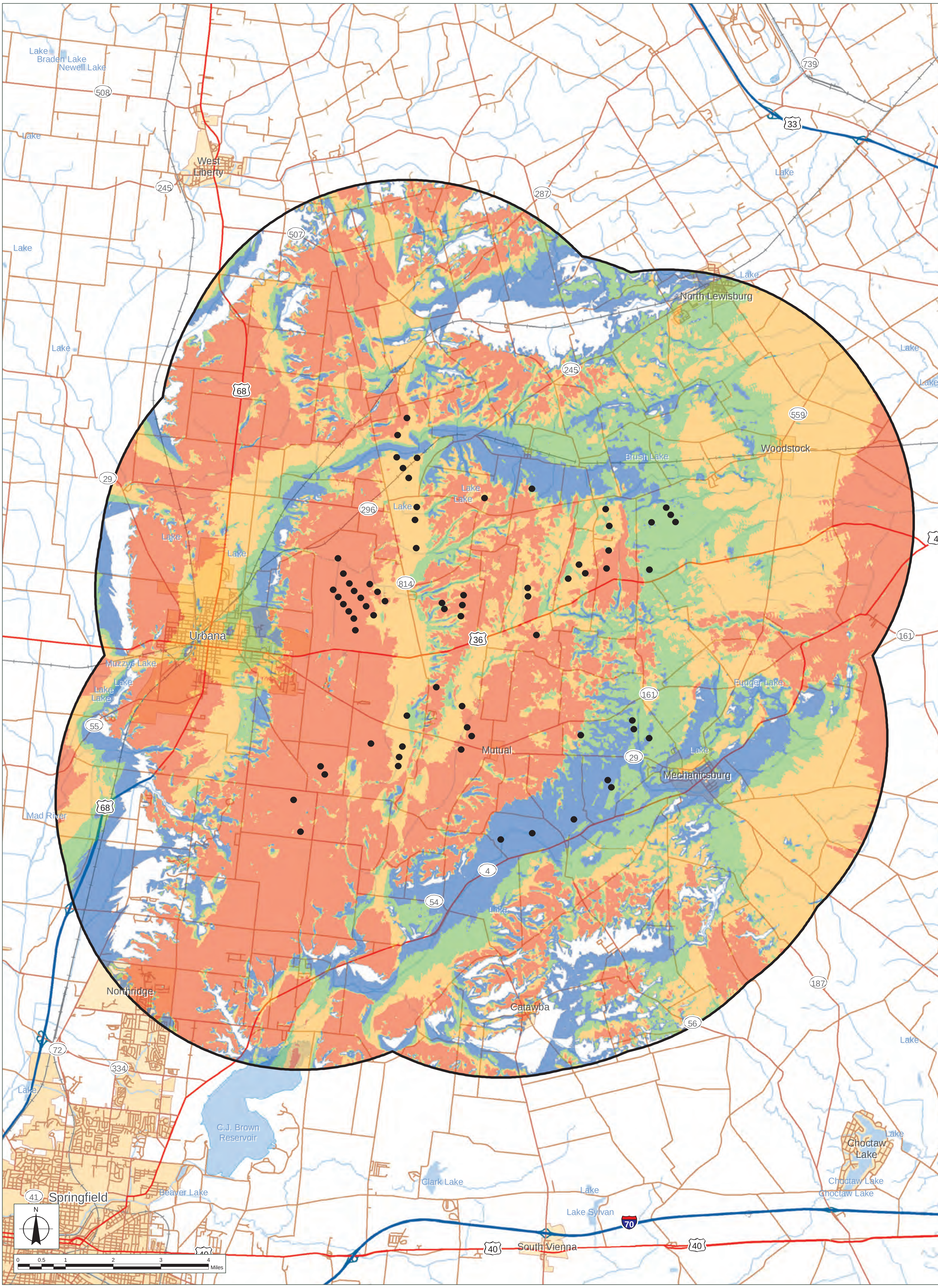
Turbine Count Visibility Analysis

Number Visible (Blade Tip)

- 0
- 1 - 18
- 19 - 36
- 37 - 54
- 55 - 70

**Notes:**
Base Map: ESRI StreetMap North America 2008.

EDR




# Buckeye Windpower Project

Champaign County, Ohio

## Figure 7: Viewshed Analysis - Topographic Nacelle (328 ft.) Visibility

Sheet 2 of 4

March 2009

- Turbines
- 5 Mile Study Area

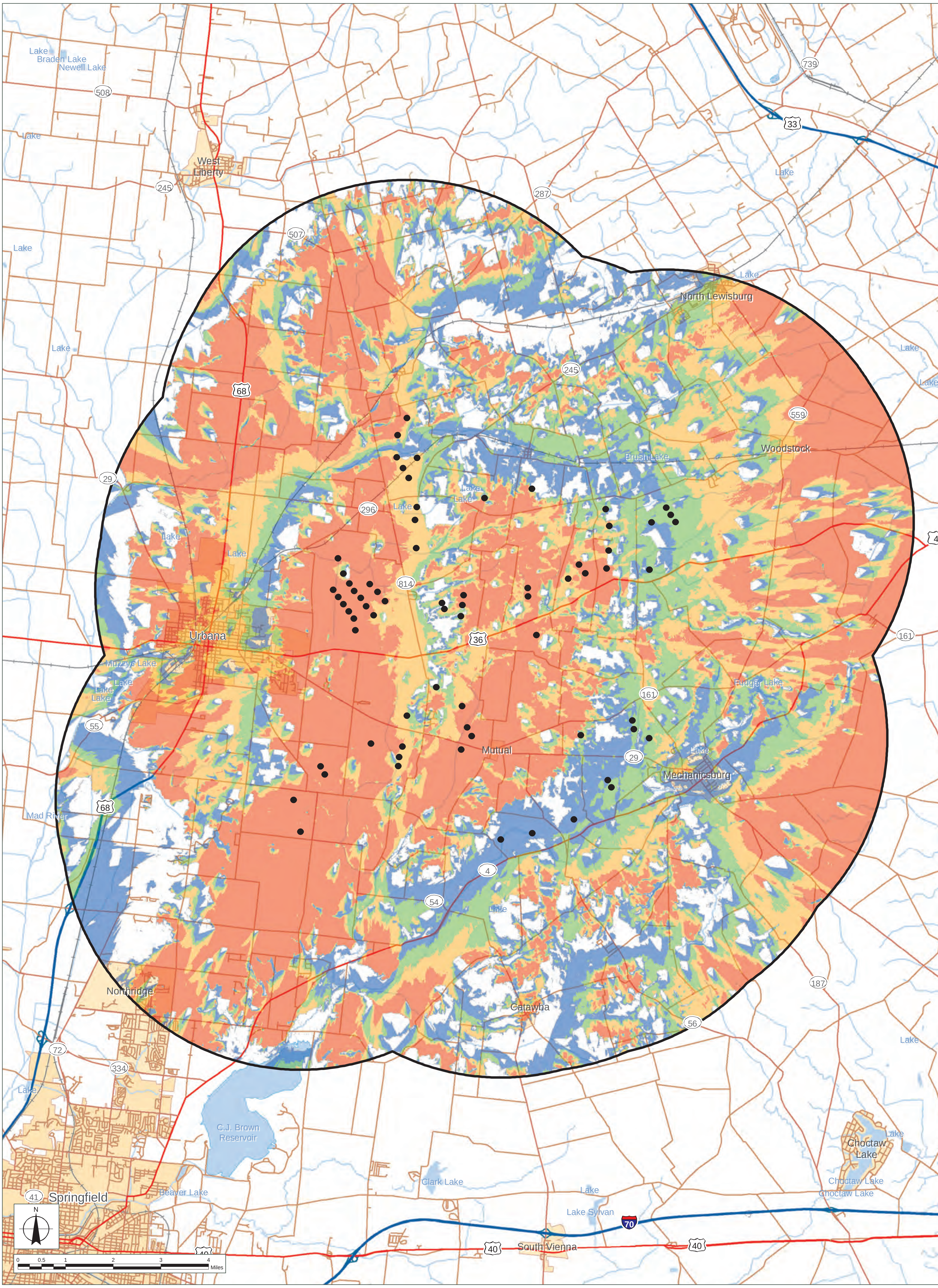
Turbine Count Visibility Analysis

Number Visible (Nacelle)

- 0
- 1 - 18
- 19 - 36
- 37 - 54
- 55 - 70

**Notes:**
Base Map: ESRI StreetMap North America 2008.

EDR




## Buckeye Windpower Project

Champaign County, Ohio

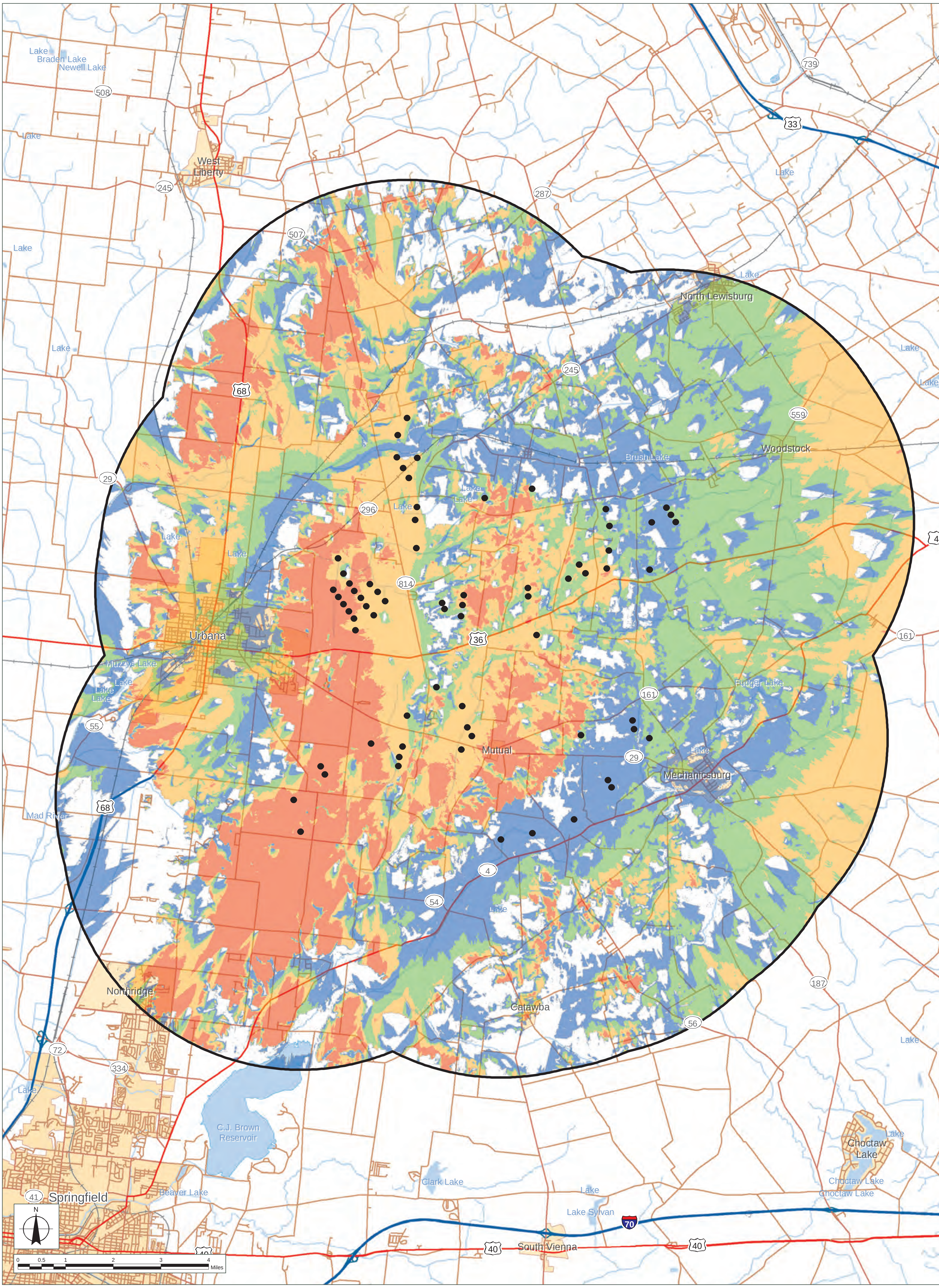
Figure 7: Viewshed Analysis - Vegetation Blade Tip (492 ft.) Visibility

Sheet 3 of 4

March 2009

Notes:
Base Map: ESRI StreetMap North America 2008.

EDR




# Buckeye Windpower Project

Champaign County, Ohio

## Figure 7: Viewshed Analysis - Vegetation Nacelle (328 ft.) Visibility

Sheet 4 of 4

March 2009

● Turbines

5 Mile Study Area

Turbine Count Visibility Analysis

Number Visible (Nacelle)

- 0
- 1 - 18
- 19 - 36
- 37 - 54
- 55 - 70

**Notes:**
Base Map: ESRI StreetMap North America 2008.

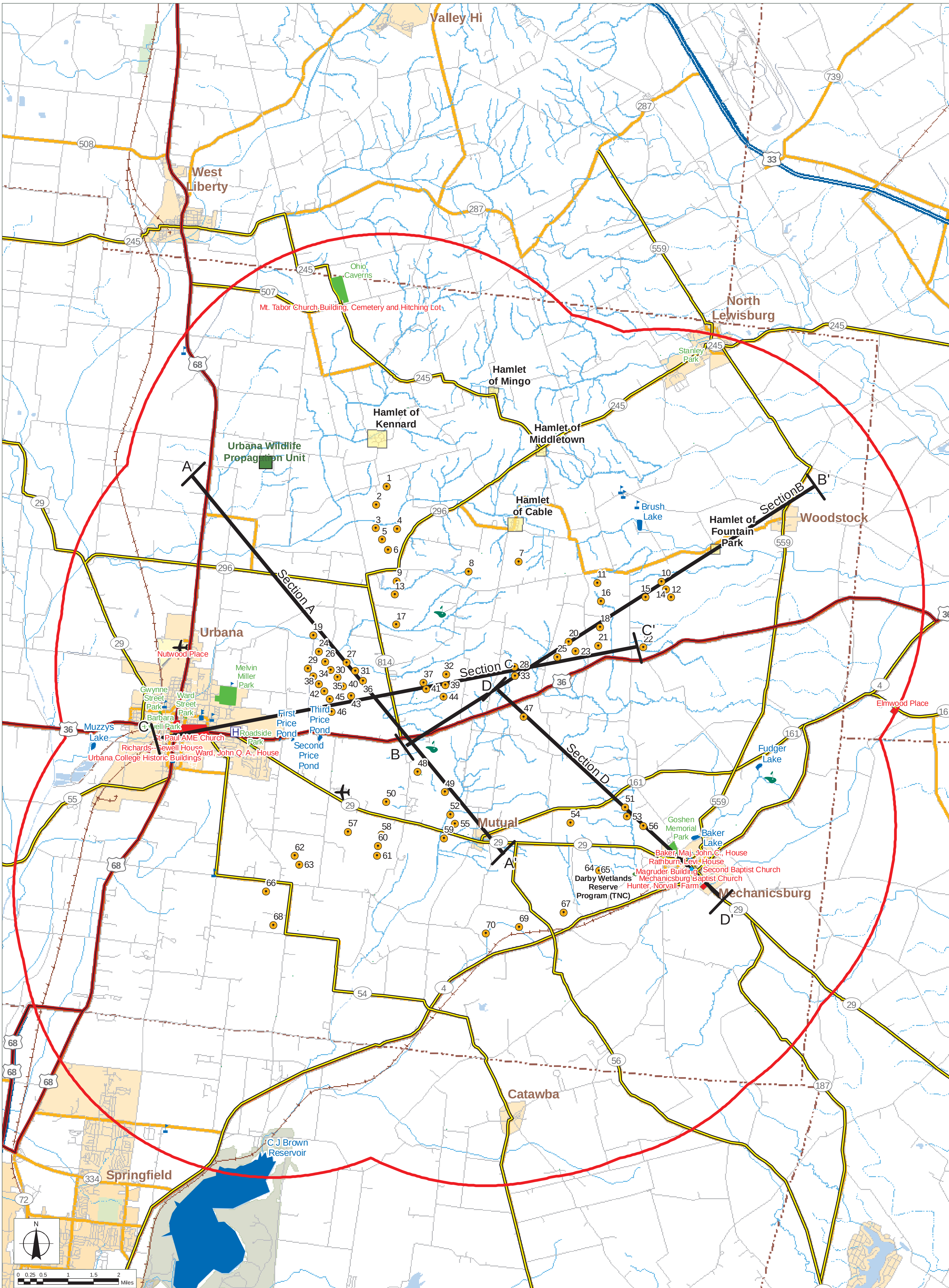
EDR

Cross section analysis (Figure 8) indicates that the Project will be visible from between 55% and 66% of the area along the selected lines of sight. Although this conclusion only applies to the specific lines of sight evaluated, analysis suggests that views of the Project from many of the visually sensitive sites within the study area are likely to be at least partially screened by buildings and trees. The cross sections indicate that views of turbines along the selected site lines will either not be available or will be partially screened from the Villages of Mutual and Woodstock, the City of Urbana, and most historic sites within that occur within the study area. It should be noted that views of other turbines, not located along the selected cross sections may be available from some of the sensitive receptors that are indicated as being screened along the selected section lines. The results of the cross section analysis are summarized in Table 3.

**Table 3. Line-of-Sight (LOS) Summary**

| **Line-of-Sight A-A'** | 55% Potential Project Visibility along 9.78-miles LOS | |
|---|---|---|
| *Visually Sensitive Resources in LOS* | *Location* | *Potential Visibility** |
| U.S. Route 68 | Town of Salem, Champaign County | Visible |
| Kings Creek | Town of Salem, Champaign County | No |
| State Route 290 | Town of Salem, Champaign County | No |
| Dugan Run | Town of Salem, Champaign County | Visible |
| U.S. Route 36 | Town of Union, Champaign County | Visible |
| Buck Creek | Town of Union, Champaign County | No |
| State Route 161 | Town of Union, Champaign County | No |
| State Route 29 | Town of Union, Champaign County | No |
| Village of Mutual | Village of Mutual, Champaign County | No |
| **Line-of-Sight B-B'** | 56% Potential Project Visibility along 9.59-miles LOS | |
| *Visually Sensitive Resources in LOS* | *Location* | *Potential Visibility* |
| Urbana Country Club | Town of Union, Champaign County | No |
| U.S. Route 36 | Town of Union, Champaign County | No |
| Treacle Creek | Town of Union, Champaign County | Partial |
| Fountain Park | Town of Rush, Champaign County | Partial |
| Village of Woodstock | Village of Woodstock, Champaign County | Partial |
| Woodstock Cemetery | Village of Woodstock, Champaign County | No |
| **Line-of-Sight C-C'** | 66% Potential Project Visibility along 9.71-miles LOS | |
| *Visually Sensitive Resources in LOS* | *Location* | *Potential Visibility* |
| Scioto Street Historic District | City of Urbana, Champaign County | No |
| City of Urbana | City of Urbana, Champaign County | Partial |

| | | |
|---|---|---|
| Township Highway 101 | Town of Urbana, Champaign County | Visible |
| State Route 814 | Town of Urbana, Champaign County | Visible |
| **Line-of-Sight D-D'** | 63% Potential Project Visibility along 6.11-miles LOS | |
| *Visually Sensitive Resources in LOS* | *Location* | *Potential Visibility* |
| U.S. Route 36 | Town of Union, Champaign County | Visible |
| State Route 161 | Town of Goshen, Champaign County | Visible |
| Memorial Park | Village of Mechanicsburg, Champaign County | Partial |
| State Route 29 | Village of Mechanicsburg, Champaign County | Partial |
| Hunter, Norvall Farm NRL Historic Site | Village of Mechanicsburg, Champaign County | Partial |
| St. Michael Catholic Church NRL Historic Site | Village of Mechanicsburg, Champaign County | Not Visible |




## Buckeye Wind Project

Champaign and Logan Counties, Ohio

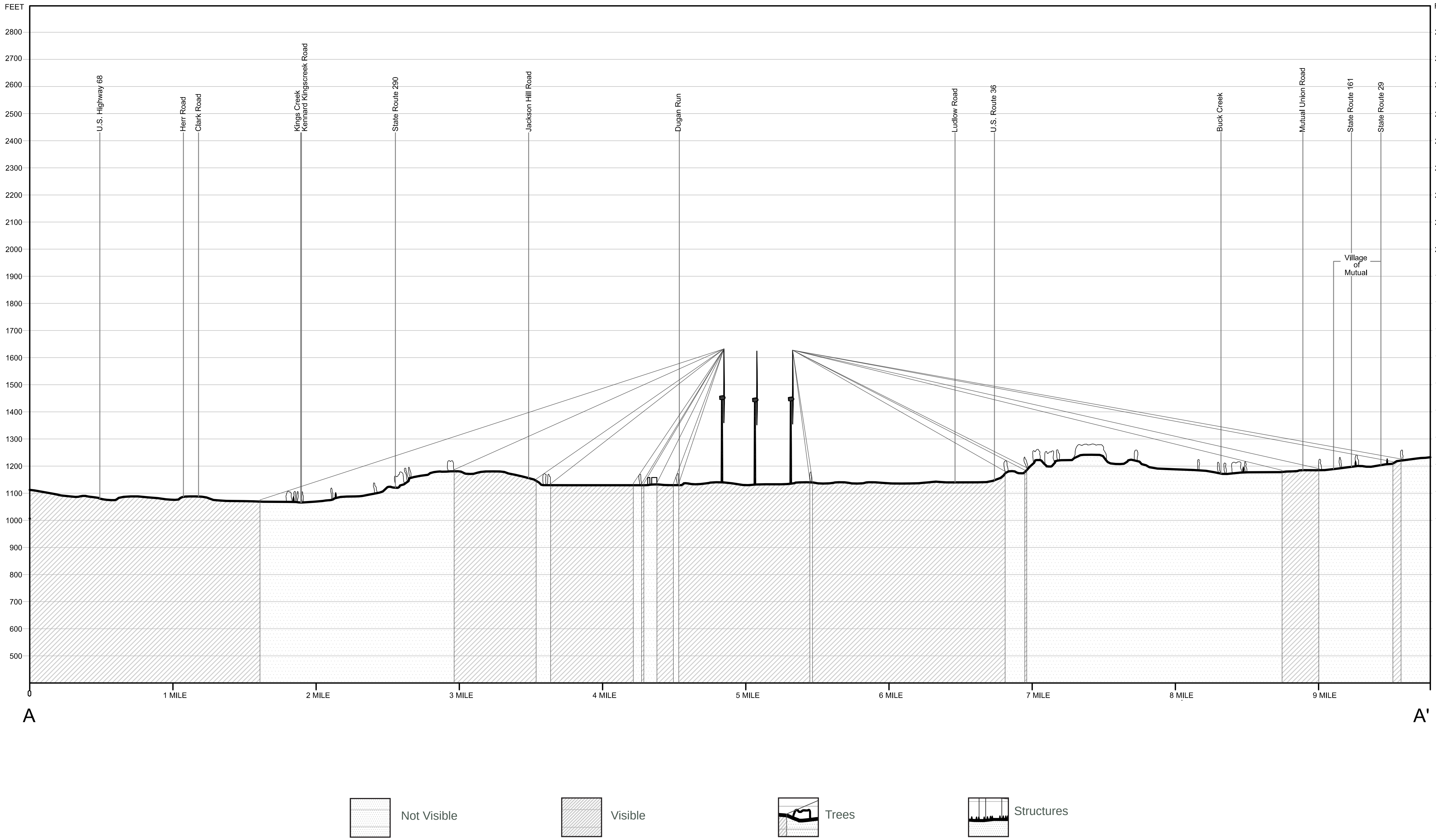
Figure 8: Line-of-Sight Cross Sections
Section Map

March 2009

- Turbines
- Line of Sight Cross Sections
- Village/City
- Hamlets
- Cemeteries
- 5 Mile Study Area
- Nature Conservancy Properties
- Local Parks
- National Register
- Lakes & Ponds
- Hospitals
- Airports
- Golf Courses
- US Highways
- State Highways
- Wildlife Areas

**Notes:**
Base Map: ESRI Street Map USA, Year 2006.

EDR




# Buckeye Wind Project

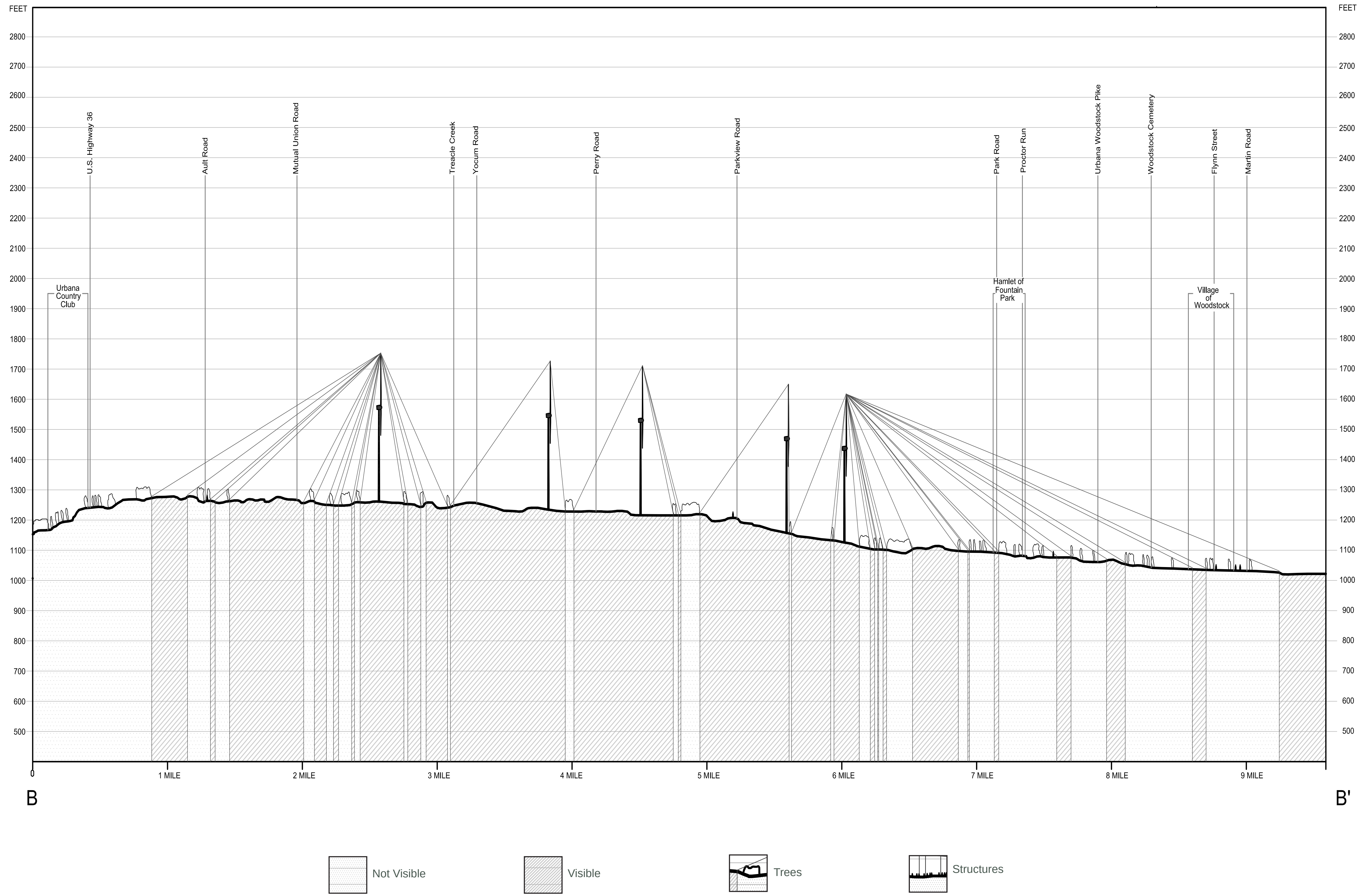
Champaign and Logan Counties, Ohio

Figure 8: Line-of-Sight Cross Sections Section A-A'

Sheet 1 of 4

March 2009

EDR




# Buckeye Wind Project

Champaign and Logan Counties, Ohio

Figure 8: Line-of-Sight Cross Sections Section B-B'

Sheet 2 of 4

March 2009

EDR

# Buckeye Wind Project

Champaign and Logan Counties, Ohio

Figure 8: Line-of-Sight Cross Sections Section C-C'

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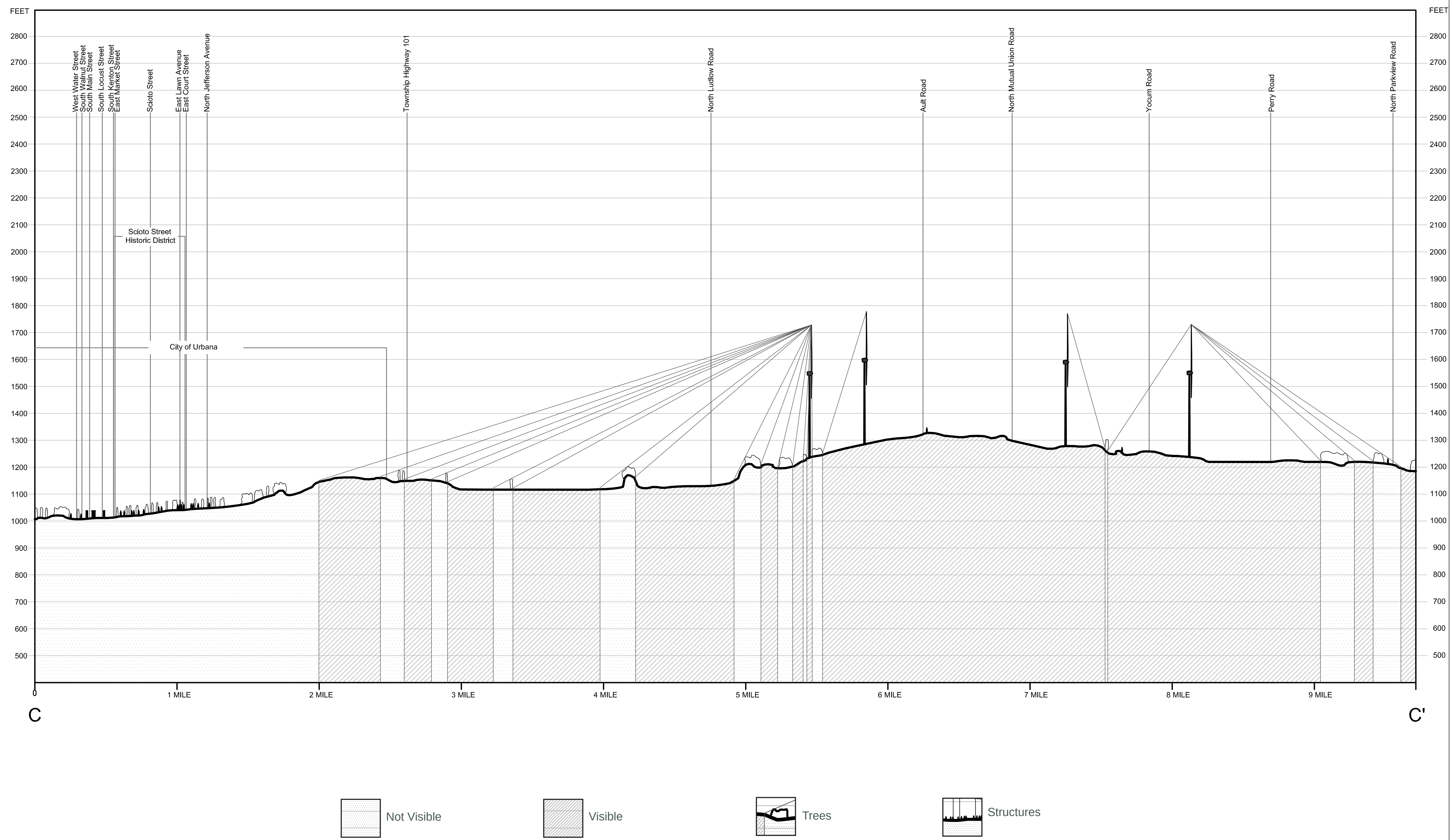
March 2009

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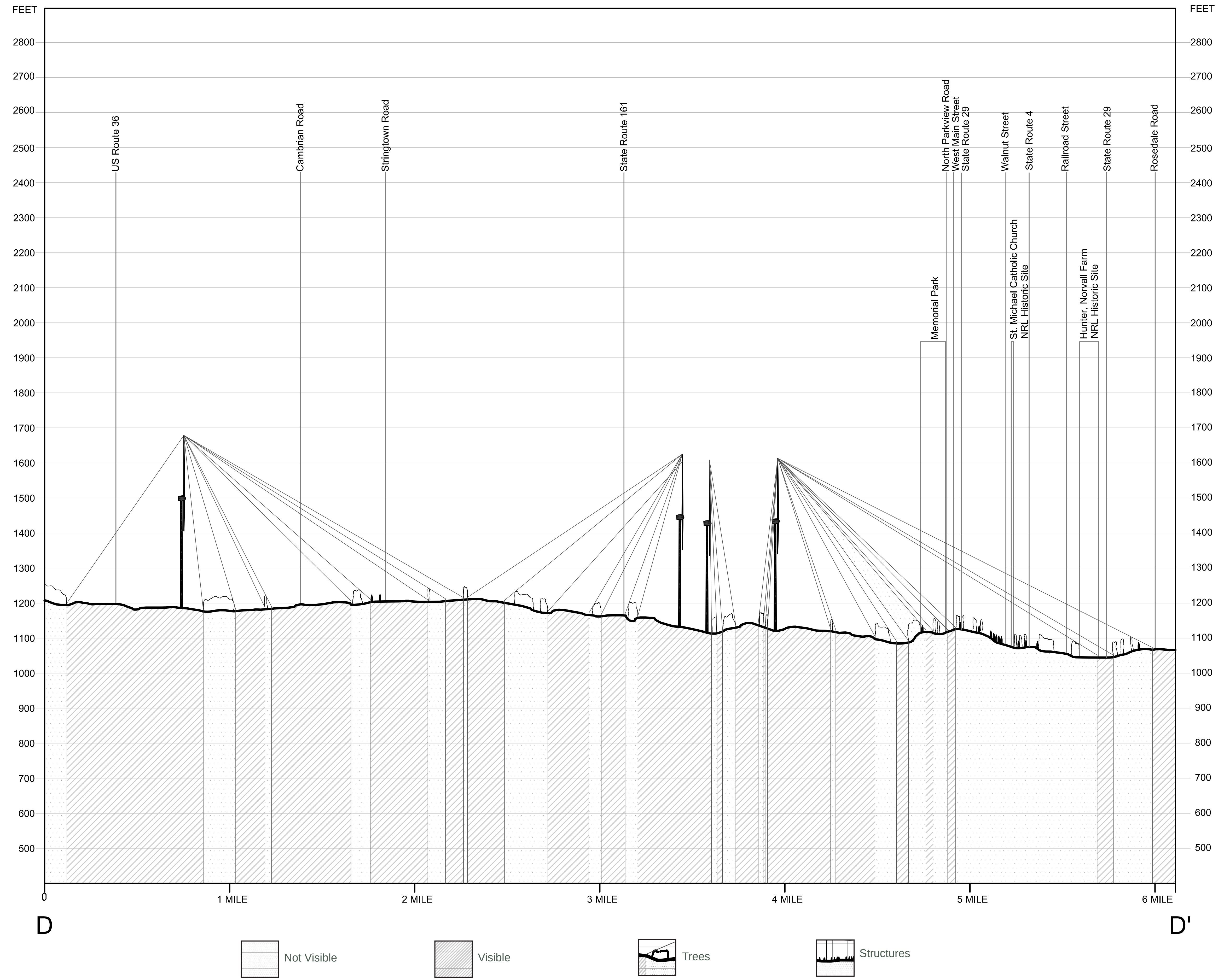



# Buckeye Wind Project

Champaign and Logan Counties, Ohio

Figure 8: Line-of-Sight Cross Sections Section D-D'

Sheet 4 of 4

March 2009

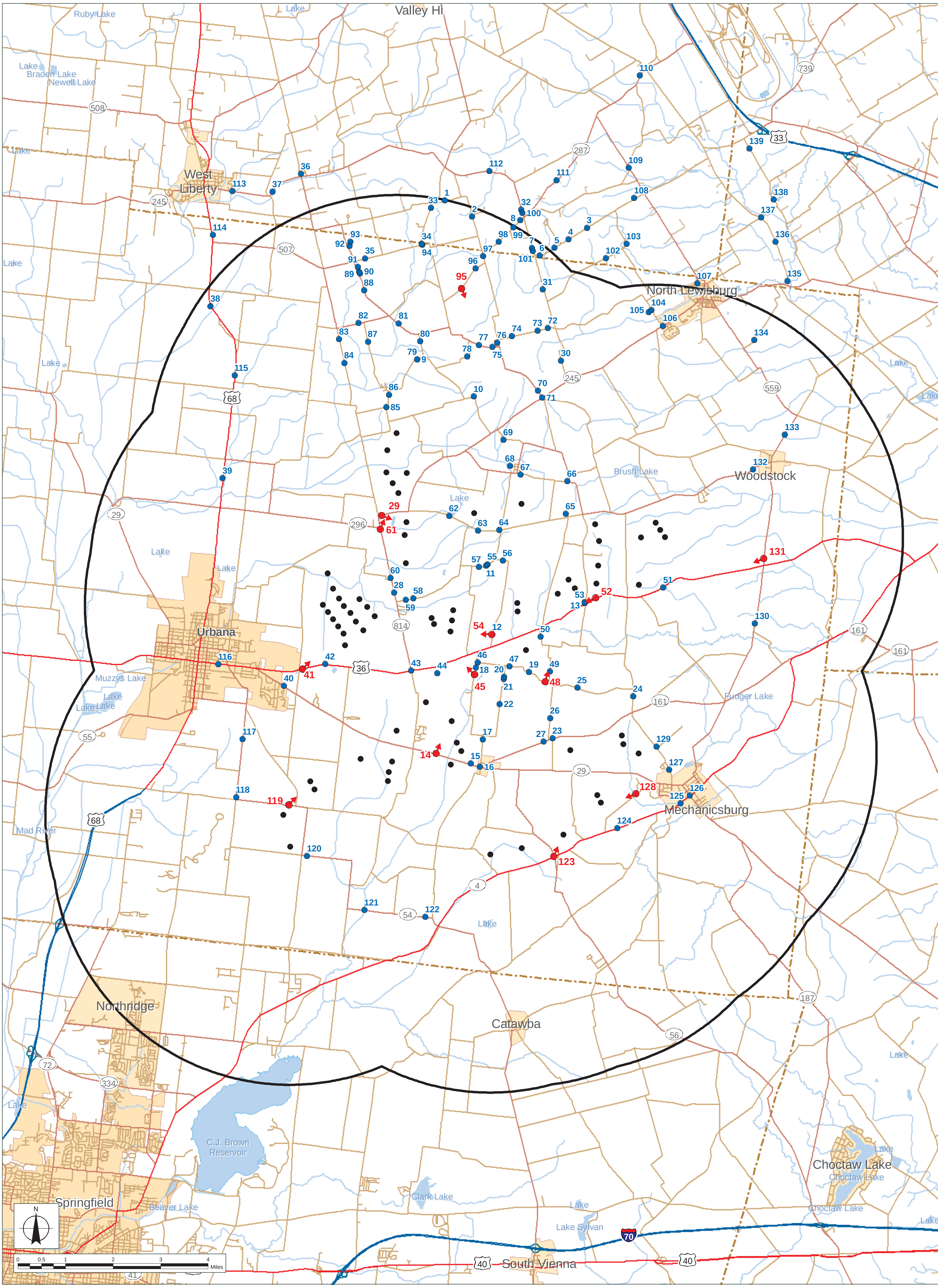
EDR

Field review also suggested that actual Project visibility is likely to be more limited than suggested by viewshed mapping. This is due to the fact that screening provided by buildings and trees within the study area is more extensive and effective than assumed in these analyses (e.g., vegetation is more extensive than indicated on the USGS maps, and often taller than 40 feet in height). The result is that certain sites/areas where "potential" visibility was indicated by viewshed mapping were actually well screened from views of the proposed Project. Field review confirmed a lack of visibility from areas that were screened by structures and trees, particularly developed areas such as the City Urbana and the various villages within the study area. Consequently, views of the Project from the majority of residences and historic sites within these areas are anticipated to be fully or partially screened. In general, only on the outskirts of these developed areas, where open fields adjoined residential areas, were open views available in the direction of the Project site. Even in the more rural/agricultural portions of the study area, hedgerows and trees not indicated on the USGS maps often blocked/interrupted views toward the Project site in many areas. However, open views that include at least some of the proposed turbines will be available from a broad range of distances/locations within the Rural Residential/Agricultural LSZ.

A comprehensive summary of potential Project visibility from sensitive sites is presented in the Table B-2 in Appendix B.

## 5.2 Analysis of Existing and Proposed Views

To illustrate anticipated visual changes associated with the proposed Project, photographic simulations of the completed Project from each of the 13 viewpoints indicated in Figure 9 were used to evaluate Project visibility and appearance. Review of these images, along with photos of the existing view, allowed for comparison of the aesthetic character of each view with and without the proposed Project in place. Results of this evaluation are presented below.




## Buckeye Wind Project

Champaign County, Ohio

Figure 9: Viewpoint Locations

March 2009

- Turbines
- Viewpoint
- Selected Viewpoint Direction of View
- 5 Mile Study Area

Notes:
Base Map: ESRI StreetMap North America, Year 2008.

Viewpoint 14 (Figure 10)

*Existing View*

This view from State Route 29 in the Town of Mutual features an agricultural landscape. It faces north-northeast and is approximately 0.5 from the nearest turbine that would be visible in this view. The foreground is extremely flat, with an intermittent line of structures, forest patches and low hills along the horizon. The roadway cuts diagonally across the immediate foreground, and on the opposite side, a cut cornfield dusted with snow stretches far back into the view. A line of wooden utility poles, of which four are visible, cross the view in the mid-ground. Light colored houses can be picked out in the distance, contrasting with the soft gray masses of vegetation behind them. The sky is mostly cloudy, with some blue faintly visible. Overall, this view appears very neutral in tone, open and horizontal.

*Proposed Project*

With the Project in place, two foreground turbines can be seen on either side of the view's center, and a third, more distant, turbine can be seen rising above the background ridge on the right hand side of the view. Details of the foreground turbines can be seen clearly, and their scale is in marked contrast to other built features in this view (e.g., houses, barns, utility poles). However, the turbines' scale contrast does not appear overwhelming due to the openness of the existing view. Their whiteness is consonant with the color of the snow, clouds, and houses and therefore compatible with the palette of the winter view. During the growing season, the color of the turbines will likely be favorably offset by the green or the foliage and corn, as well as the blue sky, giving a crisp freshness to the summer view. The turbines' vertical line contrasts with the horizontality of this view, yet they do not alter its clear agricultural character. For this particular viewpoint, the turbines complete the compositional balance of the landscape, adding focal elements and tension to the view. However, while the turbines appear appropriate, the overall contrast they create is appreciable.

**Buckeye Wind Project**
Champaign County, Ohio

Figure 10: Viewpoint 14

Sheet 1 of 2 - Existing View from OH-29 - Town of Mutual, Champaign County, OH
Facing North-Northeast, 0.5 Miles from Nearest Visible Turbine

March 2009

**Buckeye Wind Project**
Champaign County, Ohio

Figure 10: Viewpoint 14

Sheet 2 of 2 - Simulated View from OH-29 - Town of Mutual, Champaign County, OH
Facing North-Northeast, 0.5 Miles from Nearest Visible Turbine

March 2009

Viewpoint 29 (Figure 11)

*Existing View*

This view from State Route 296 in the Town of Salem faces east-southeast and is approximately 0.5 mile from the nearest turbine that would be visible in this view. This rural agricultural view is spatially well defined, with a clear delineation of foreground, mid-ground, and background. The coarse texture of the cut cornfield is evident in the foreground, its detail accentuated by the contrasting snow cover. A farm compound and a hedgerow partially screen the less distinct brown and white field in the mid-ground. The trees along the edge of the yard are large, and their coarse, bare branches stand out clearly against the sky. The background consists of a band of forest vegetation, whose upper branches appear soft and transparent. Large clouds provide some texture to an otherwise bright blue sky. The landform in this view is subtly undulating, and the late afternoon sun illuminates the mid-ground and casts the shadows of the trees onto the white farm structures.

*Proposed Project*

With the Project in place, two turbines of similar apparent size can be seen in this view. One is partially screened by structures and trees, while the other is more isolated and distinct on the opposite side of the view. The low sun angle results in a strong contrast of illuminated and shaded surfaces on both of the turbines, which makes them stand out against the sky. The turbine on the left of the view is compatible in color and scale with the composition of the house, outbuildings, and large trees that make up the farm compound. It is easy to imagine the greater screening effect the trees in the yard will have during the leaf-out season. The turbine on the right of the view is screened for about a third of its height by forest, with the rest of its tower, nacelle and blades distinct against the partially clouded sky. The proximety of these turbines to the viewer, and the measurable comparison between the turbine on the right and the background trees accentuates their scale contrast. However, the overall visual contrast is moderated by the existing man-made elements in this view.

**Buckeye Wind Project**
Champaign County, Ohio

Figure 11: Viewpoint 29

Sheet 1 of 2 - Existing View from OH-296 - Town of Salem, Champaign County, OH
Facing East-Southeast, 0.5 Miles from Nearest Visible Turbine

March 2009

**Buckeye Wind Project**
Champaign County, Ohio

Figure 11: Viewpoint 29

Sheet 2 of 2 - Simulated View from OH-296 - Town of Salem, Champaign County, OH
Facing East-Southeast, 0.5 Miles from Nearest Visible Turbine

March 2009

Viewpoint 41-Panoramic (Figure 12)

*Existing View*

This view from US Route 36 in the Town of Urbana (just beyond the Urbana City limits) faces northeast and is approximately 1.0 mile from the nearest turbine that would be visible in this view. A rural roadway occupies the near foreground, crossing diagonally to exit the view on the right. A post and wire fence, and a sign run along the road's shoulder in the foreground. A line of wooden utility poles, whose receding size gives this view a strong sense of perspective depth, accentuates the strong converging lines of the road. The rest of the view shows agricultural fields dusted with snow, separated by hedgerows of filigreed trees screening isolated rural structures. The distant horizon in this panoramic view is a low, even ridge that stretches across the entire view. The ridge is mostly in shadow, backlit by the pink light of the morning sun. The ridge, lines of mid-ground hedgerows, and flatness of the fields create strong horizontal lines in this view. The upper half of the view is open sky, interrupted only by the utility poles and the crowns of the bare trees.

*Proposed Project*

With the proposed Project in place, over 30 turbines can be counted in this view. Due to the low sun angle, they are back-lit, their forms appearing dark gray against the pink sky. The turbines are compatible with the existing agricultural land use, though they are clearly taller than the existing vegetation. However, at this distance their form appears both smaller and more delicate than the existing utility poles in the foreground. The number of turbines and the random, at times overlapping, orientation of their blades creates a certain degree of visual clutter, and they become the dominant feature of the view. Their principal source of contrast with the existing landscape lies in their unique form and the kinetic quality they lend to this otherwise static and placid view. Distance is the greatest moderator of contrast in this view.

Existing View

Simulated View

**Buckeye Wind Project**
Champaign County, Ohio

# Figure 12: Viewpoint 41

View from US Route 36 - Town of Urbana, Champaign County, OH
Facing Northeast, 1.0 Miles from Nearest Visible Turbine

March 2009

Viewpoint 45 (Figure 13)

*Existing View*

This view from Mutual Union Road South in the Town of Union faces northwest and is approximately 1.0 mile from the nearest turbine that would be visible in this view. Hedgerows that follow the rises and dips accentuate the gentle undulations of the landform in this view. The low sun casts a patchwork of light and shadow across the landscape, and its orange glow contrasts with the clear blue sky. Except for a few evergreens, the vegetation appears russet in its bare-branched condition. A light layer of snow covers the ground of the cropped field. Two groupings of white rural structures are bright with reflected light, nestled among trees at the back of this view. The landscape appears to fall away in the background, making this view seem very broad and not as deep.

*Proposed Project*

With the Project in place, four turbines are visible beyond the ground and trees that form the horizon line in this view. All of the turbines are partially screened by vegetation and landform, although the two on the right appear closer and extend higher into the sky. The turbines are clearly grander in scale than the trees and structures in the view. However, the open character and broad scale of the view dilutes their number and apparent size. Moreover, the turbines appear compatible with the agricultural land use that characterizes this view. Their contrast with the horizontal lines of the landscape is also mitigated to some degree by the jagged line of vertical elements (trees and buildings) that straddle the horizon. Overall, their presence seems to be absorbed in this landscape, from this viewer position.

**Buckeye Wind Project**
Champaign County, Ohio

Figure 13: Viewpoint 45

Sheet 1 of 2 - Existing View from Mutual Union Road - Town of Union, Champaign County, OH
Facing Northwest, 1.0 Miles from Nearest Visible Turbine

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■ **Buckeye Wind Project**
Champaign County, Ohio

## Figure 13: Viewpoint 45

Sheet 2 of 2 - Simulated View from Mutual Union Road - Town of Union, Champaign County, OH
Facing Northwest, 1.0 Miles from Nearest Visible Turbine

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Viewpoint 48 (Figure 14)

*Existing View*

This view from Stringtown Road in the Town of Union faces north-northeast and is approximately 1.8 miles from the nearest turbine that would be visible in this view. This semi-rural landscape includes farm structures as well as new suburban residences along the road frontage and in small subdivisions. Background vegetation is abundant, stretching across the view and opening in some spots to reveal both residential and agricultural structures well into the distance. The mown field in the foreground has a light dusting of snow, giving a neutral brown and white texture to the ground plane. The emptiness in the center of the view appears transient, as if future residential development could be expected. Generally, the landscape looks more structured in the background than in the foreground. A broad, blue sky, and the apparent scale of the existing structures make this view seem expansive.

*Proposed Project*

Eight turbines can be seen in this view with the proposed Project in place. Two of them appear to overlap, while the rest are well distributed across the view. The turbines appear fairly compatible with the density of structures in this view, although the presence of the homes accentuates their contrast in terms of scale and land use. Low sun angle creates high contrast between portions of the turbines that are in sun and shadow. This in turn, heightens the contrast of their profile against the sky. The many scale references in this view allow the viewer to assess the turbines' height despite their distance. However, the scale of the landscape is able to absorb their size. If not for their vicinity to residential structures, the turbines would present only a moderate level of contrast in this landscape. The animation of this simulation showing the blades in motion (see Appendix D) did not change this evaluation. The relatively slow rate of revolution, and the perception that the turbines were operational (i.e., doing what they are supposed to do) actually helps the turbines appear compatible with their surroundings.

**Buckeye Wind Project**

Champaign County, Ohio

Figure 14: Viewpoint 48

Sheet 1 of 2 - Existing View from Stringtown Road - Town of Union, Champaign County, OH
Facing North-Northeast, 1.8 Miles from Nearest Visible Turbine

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**Buckeye Wind Project**
Champaign County, Ohio

Figure 14: Viewpoint 48

Sheet 2 of 2 - Simulated View from Stringtown Road - Town of Union, Champaign County, OH
Facing North-Northeast, 1.8 Miles from Nearest Visible Turbine

March 2009

<u>Viewpoint 52 (Figure 15)</u>

*Existing View*

This view is from US route 36 in the Town of Wayne. It is oriented to the west-southwest and is approximately 1.6 miles from the nearest turbine that would be visible in this view. Like the previous viewpoint, it presents a landscape that is in transition from a rural/agricultural character to a more suburban character. A roadway is located to the left of the viewer, leading to the center of the horizon line in the back of the view. A roadside drainage swale travels down the center of the view, and a row of wooden utility poles alongside it (above the viewer position) focus the viewer’s attention along the orientation of the road. There are cropped, snow-dusted fields on both sides of the road, which allow a clear view across foreground and mid-ground. Residences line the background along most of the horizon, backdropped by soft gray masses of winter forest vegetation. The wooden poles against the blue sky are the strongest vertical element in an otherwise horizontal view.

*Proposed Project*

With the proposed Project in place, a group of seven turbines can be seen in the background on the right side of the view, while a single background turbine appears at the far left. Three of these turbines appear closer than the others, but their apparent height is still less than that of the existing utility poles. The remaining turbines are much less distinct. With the exception of the turbine on the far left, the turbines seem mostly segregated from the residences, which mitigates their contrast with that land use. They are generally compatible with the agricultural setting that dominates the part of the view they occupy. Their size relative to the houses and background vegetation is easy to assess, which accentuates their scale contrast. However, the turbines’ scale contract is significantly mitigated by their distance from the viewer, and their contrast in line and form are reduced due to the presence of the overhead line. Their off-set from the central focal point created by the road and roadside swale also reduces their dominance in this view. From this viewpoint the turbines’ overall contrast is minimal to moderate.

**Buckeye Wind Project**
Champaign County, Ohio

## Figure 15: Viewpoint 52

Sheet 1 of 2 - Existing View from US Route 36 - Town of Wayne, Champaign County, OH
Facing West-Southwest, 1.6 Miles from Nearest Visible Turbine

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Buckeye Wind Project
Champaign County, Ohio

Figure 15: Viewpoint 52

Sheet 2 of 2 - Simulated View from US Route 36 - Town of Wayne, Champaign County, OH
Facing West-Southwest, 1.6 Miles from Nearest Visible Turbine

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Viewpoint 54 (Figure 16)

*Existing View*

This view is from a small, rural cemetery on North Mutual Union Road (CR 167) in the Town of Union. It is oriented to the west, approximately 0.9 mile from the nearest turbine that would be visible in this view. The cemetery is enclosed across the frame of view by a small, rusted wire fence. Beyond that, still in the foreground, the tight parallel lines of a harvested corn field dusted with snow rise on the waves of the landform to a low mid-ground ridge running across the line of sight. Farm buildings, including a silo, saddle the ridge on the right, and a hedgerow climbs the sloping field along the left, so that the upper portions of the trees are seen against the sky. In the distance, other linear patches of forest vegetation run along the horizon, and dip in and out of the view with the undulating landform.

*Proposed Project*

With the proposed Project in place, portions of 17 turbines appear in the view. Four more nearby turbines appear on the right hand side of the view, beyond the farm complex, while the others are more distant and run along the horizon in the center and right side of the view. The nearer turbines appear relatively close to the barns and silos, and have more visual association with the farm than the cemetery. The turbines along the horizon are fairly uniform in height and spacing, and therefore look orderly and appropriate in this working agricultural landscape. Their vertical line is consistent with the line of the trees and farm structures, and their white color and man-made form is consistent with the structures in the farm complex. The turbines' scale contrast with the forest is softened by the indistinct detail in the background vegetation, which appears as a mass. In addition, the unoccupied space between the cemetery and the turbines/farm structures acts as a visual buffer between the disparate land uses, mitigating the otherwise moderate land use contrast in this view.


**Buckeye Wind Project**

Champaign County, Ohio

# Figure 16: Viewpoint 54

Sheet 1 of 2 - Existing View from Mutual Union Road - Town of Union, Champaign County

Facing West, 0.9 Miles from Nearest Visible Turbine

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Buckeye Wind Project
Champaign County, Ohio

Figure 16: Viewpoint 54

Sheet 2 of 2 - Simulated View from Mutual Union Road - Town of Union, Champaign County
Facing West, 0.9 Miles from Nearest Visible Turbine

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Viewpoint 61 (Figure 17)

*Existing View*

This rural view from State Route 814/County Route 223 (North Ludlow Road) in the Town of Salem faces north-northeast and is approximately 0.9 mile from the nearest turbine that would be visible in this view. This view is dominated by the light brown texture of cropped winter fields. A light dusting of snow covers the ground between the dried plants. The focal point of the view is a farmstead in the mid-ground, just to the right of the center, with a substantial residence and several outbuildings nestled among trees. A fairly continuous line of distant trees and widely-spaced utility poles cross the background of the view, all a monochrome gray against the bright blue sky.

*Proposed Project*

With the proposed Project in place, six turbines are present in the mid-ground and background of the view. Due to their proximity and lack of foreground screening, the turbines replace the farmstead as the dominant focal point within this view. Three of the turbines form a triangle behind the farmstead, their appreciable disparity of scale made apparent by comparison to the structures and trees. However, the turbines present no significant contrast with the agricultural land use that characterizes this view, and the location of these three turbines relative to the existing massing of landscape features reduces contrast with the overall pattern of the landscape. The more distant turbines appear to balance the former, and the profile of the turbines against the sky does not create more than a moderate contrast due to distance and number. The more significant contrast lies in the perceived vicinity of the nearer turbines to the residence in this view. Review of an animation of this simulation showing the blades in motion (see Appendix D) was considered to have the same generally positive effect as described previously for the simulation from Viewpoint 48.

■ **Buckeye Wind Project**
Champaign County, Ohio

Figure 17: Viewpoint 61

Sheet 1 of 2 - Existing View from OH-814 / CR-223 (N. Ludlow Rd.) - Town of Salem, Champaign County, OH
Facing North-Northeast, 0.9 Miles from Nearest Visible Turbine

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**Buckeye Wind Project**
Champaign County, Ohio

Figure 17: Viewpoint 61

Sheet 2 of 2 - Simulated View from OH-814 / CR-223 (N. Ludlow Rd.) - Town of Salem, Champaign County, OH
Facing North-Northeast, 0.9 Miles from Nearest Visible Turbine

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Viewpoint 95-Panoramic  (Figure 18)

*Existing View*

This panoramic view from Bump Road in the Town of Wayne faces south-southeast and is approximately 4.7 miles from the nearest turbine that would be visible in this view.  The view looks across a gentle valley where agricultural fields alternate with hedgerows and patches of trees.  The descending foreground field is textured by dried remnants of crops, brown against the snow.  A group of farm buildings to the left is the focal point, which is balanced by a hedgerow crossing the view on the right.  Together, these two features separate the foreground from the mid-ground where the low point of the valley occurs.  The slope in the background includes divided fields in the center, and substantial patches of forest on the right and left.  The background fields appear white in contrast with the dark gray of the adjacent forest cover. Small farm structures can be seen at the base and along the lower portion of the slope. The mostly blue sky is streaked with diffuse, horizontal clouds, and two telecommunications towers can be seen against it on both sides of the view.

*Proposed Project*

Part or all of over 10 turbines are visible above the background ridge in this view with the proposed Project in place.  All of the turbines appear relatively small and delicate due to their distance from the viewer.  Only the blade tips of a number of the turbines can be picked out, though they are barely distinguishable from the irregular edge of the bare-branched tree masses.  Others are plainly visible above the treetops, though most have the advantage of partial screening, and all appear smaller than the two telecommunication towers in the view.  These turbines appear in small groups, which has the effect of breaking up the sense of Project size across this panorama.  Though gray against the light sky, their color is not in contrast with the vegetation from which they seem to emerge. Within the general pattern of the landscape, the turbines mimic the irregularly linear arrangement of the vegetation as seen from this position, and present only minor visual contrast.

Existing View

Simulated View

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Champaign County, Ohio

# Figure 18: Viewpoint 95

View from Bump Road - Town of Wayne, Champaign County, OH
Facing South-Southeast, 4.7 Miles from Nearest Visible Turbine

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Viewpoint 119 (Figure 19)

*Existing View*

This rural agricultural view from State Route 54 in the Town of Urbana faces northeast and is approximately 0.6 mile from the nearest turbine that would be visible in this view. The predominant feature in the landscape is a broad, flat, cropped field extending from the foreground through the mid-ground. The focal point is a large farmhouse and its compound, viewed through bare-branched trees. Another smaller farm complex to the left of the first establishes a secondary focal point. Most of the trees are large and close to the structures, and would screen much of the houses and barns during the growing season. Additional trees/hedgerow further to the left completes the horizontal line of mid-ground vegetation, and provides additional massing against the broad, blue sky above. A low forested ridge, uniformly dark gray in color, can be seen in the background from the center to the left hand side of the view. Vertical elements are somewhat distant from the viewer, and do not affect the overall sense of flatness that characterizes this view.

*Proposed Project*

With the proposed project in place, two turbines appear just behind the structures and trees, and their contrast in scale with these landscape features is evident. Other turbines visible in the view are more distant, less distinct, and appear similar in height to the mid-ground trees in the view. The turbines are generally compatible with the land use and palette of this working agricultural landscape, and the openness of the landscape is able to absorb the number of visible turbines. However, the two nearest turbines now become the dominant focal points in the view due to their large size. Their perceived scale contrast results from viewer proximity and the presence features of known height in the view.

**Buckeye Wind Project**
Champaign County, Ohio

Figure 19: Viewpoint 119
Sheet 1 of 2 - Existing View from OH-54 - Town of Urbana, Champaign County, OH
Facing Northeast, 0.6 Miles from Nearest Visible Turbine

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**Buckeye Wind Project**
Champaign County, Ohio

Figure 19: Viewpoint 119

Sheet 2 of 2 - Simulated View from OH-54 - Town of Urbana, Champaign County, OH
Facing Northeast, 0.6 Miles from Nearest Visible Turbine

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Viewpoint 123 (Figure 20)

*Existing View*

This view is from the intersection of State Routes 4 and 56 in the Town of Union, facing north-northeast. It is approximately 0.5 mile from the nearest turbine that would be visible in the view. This shallow view shows little beyond the foreground, due to an embankment that crosses the view at eye level on the opposite side of the road. The road, two signs, and several utility structures are the only built features in the view. A hedgerow of medium to large deciduous trees sits on the higher ground beyond the crest of the embankment, the bare branches of the trees providing a coarsely textured screen against the blue sky. The tops of a more distant band of forest vegetation can be seen through the trees, just above the crest of the foreground embankment. The foreground is dominated by mowed grass that is brown, with a dusting of snow in the low and bare spots.

*Proposed Project*

Seven turbines are visible from this viewpoint with the proposed Project in place. The closest of these appears to be just behind the hedgerow, and presents notable scale contrast with the mature trees, which appear to be about one third of its total height. This turbine's white color also presents noticeable contrast with the sky, although it is less imposing than the existing galvanized utility pole in the immediate foreground of this view. The other turbines in the view are visually in scale with the trees and with the trees leafed out, would be largely screened from view. The turbines do not present any significant land use contrast in this view, and are compatible with the existing landscape elements in this view.


**Buckeye Wind Project**
Champaign County, Ohio

Figure 20: Viewpoint 123

Sheet 1 of 2 - Existing View from Intersection of OH-4 and OH-56 - Town of Union, Champaign County, OH
Facing North-Northeast, 0.5 Miles from Nearest Visible Turbine

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**Buckeye Wind Project**

Champaign County, Ohio

Figure 20: Viewpoint 123

Sheet 2 of 2 - Simulated View from Intersection of OH-4 and OH-56 - Town of Union, Champaign County, OH

Facing North-Northeast, 0.5 Miles from Nearest Visible Turbine

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Viewpoint 128 (Figure 21)

*Existing View*

This view, overlooking successional fields and pasture/inactive cropland, is from Allison Road in the Town of Goshen, just outside the Village of Mechanicsburg. It faces west-southwest at about 0.7 mile from the nearest turbine that would be visible in the view. This view features a patchwork of brown, snow dusted fields delineated by an orthogonal network of hedgerows. The foreground includes a sloping mowed lawn with a couple of small evergreens (suggesting the presence of a nearby home). The viewer’s position is superior, and because the view faces toward the sun, foreground and mid-ground trees are back-lit. A distinct hedgerow forms a dark, textured wall on the left of the view, and this line of trees continues well into the center mid-ground of the view. Other fields in the mid-ground and background of the view are defined by successive layers of hedgerows, along both their length and width. The background ends at a dark gray wooded ridge that is indistinct against a blue sky streaked with white, diffuse clouds

*Proposed Project*

The proposed Project would locate two turbines, one to the right and one to the left of the view’s center, at similar distances from the viewer position. This provides symmetry to the view, and the foreground hedgerow seems to travel into the space between the turbines. Though they both appear substantial in size, one of the turbines is significantly screened by trees, an effect that would be even greater during the growing season. The turbines’ form and color contrast with the dark, irregular branching patterns of the foreground hedgerow trees. However, their line contrast is somewhat softened by the presence of vertical tree trunks in the hedgerows and the height of the vegetated landform behind them, which reduces their perceived height against the sky. Although distance and superior viewer position moderates the visual contrast of the turbines, their large scale relative to adjacent trees and their back-lit form against the bright sky results in a moderate level of contrast.

**Buckeye Wind Project**
Champaign County, Ohio

## Figure 21: Viewpoint 128

Sheet 1 of 2 - Existing View from Allison Road - Town of Goshen, Champaign County, OH
Facing West-Southwest, 0.7 Miles from Nearest Visible Turbine

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**Buckeye Wind Project**
Champaign County, Ohio

Figure 21: Viewpoint 128

Sheet 2 of 2 - Simulated View from Allison Road - Town of Goshen, Champaign County, OH
Facing West-Southwest, 0.7 Miles from Nearest Visible Turbine

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Viewpoint 131(Figure 22)

*Existing View*

This broad, deep view is from State Route 559 in the Town of Rush. It faces west-southwest and is approximately 3.5 miles from the nearest turbine that would be visible in the view. The majority of this agricultural view is occupied by a furrowed field laced with snow that stretches, almost completely flat, from the foreground to the background of the view. The horizon line is garnished by bands of both forest and hedgerow vegetation. The only structures visible in the view are a cluster of galvanized grain bins, a distant silo, and a couple of low barns. These all occur in the background and are not significant features in the view. The bright blue sky has a broad band of diffuse cloud cover just above the horizon. The view imparts a feeling of openness and emptiness.

*Proposed Project*

With the proposed Project in place, just over a dozen turbines are visible in the view. None of them can be seen in their entirety, as their towers are partially screened by the vegetation in the background of the view. Their contrast in height with the forest is evident, and back-lighting makes them appear dark gray against the white clouds nestled along the horizon. However, distance reduces the perceived scale of the turbines and their vertical line contrast with the level landscape. Although adding some degree of visual clutter to the generally open sky, they appear compatible with the agricultural land use that characterizes this view.

■ **Buckeye Wind Project**
Champaign County, Ohio

Figure 22: Viewpoint 131

Sheet 1 of 2 - Existing View from OH-559 - Town of Rush, Champaign County, OH
Facing West-Southwest, 3.5 Miles from Nearest Visible Turbine

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**Buckeye Wind Project**
Champaign County, Ohio

Figure 22: Viewpoint 131

Sheet 2 of 2 - Simulated View from OH-559 - Town of Rush, Champaign County, OH
Facing West-Southwest, 3.5 Miles from Nearest Visible Turbine

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As a group, the simulations indicate that the Project will result in a moderate to appreciable visual contrast from open viewpoints within 1.0 mile of the nearest turbine. At greater distances and with more screening, the contrast/impact of the Project should be significantly reduced. However, in EDR's experience, the contrast and visual impact of the wind turbines will be highly variable based on the number of turbines visible, viewer sensitivity/acceptance, and/or existing land use characteristics. The greatest impact typically occurs when numerous turbines are visible and/or where the turbines are close to the viewer (i.e., less than 1.0 mile). These conditions tend to heighten the Project's contrast with existing elements of the landscape in terms of, line, form, and especially scale. Visual impact can also be significant where the turbines appear incongruous or out of place in a certain landscape setting, or where aesthetic quality and/or viewer sensitivity are high.

However, it is worth noting that the lack of topographic and vegetative variability in the Rural Residential/Agricultural LSZ, which dominates the study area, generally results in only average aesthetic quality in much of the area surrounding the proposed Project. In such settings, the proposed Project, although at times offering appreciable contrast with the landscape, will not necessarily be perceived by most viewers as having an adverse visual impact. EDR's experience is that recently built wind power projects in New York State have generally received a positive public reaction following their construction. In fact, a survey conducted in Lewis County, New York (location of the 195-turbine Maple Ridge Wind Power Project in operation since 2006) revealed strong community support for wind power. The primary goal of this survey (the Second Annual Lewis County Survey of the Community, conducted in 2008 by The Center for Community Studies at Jefferson Community College) was to collect data regarding quality of life issues of importance to the local citizens. The survey consisted of 393 telephone interviews of Lewis County residents who were asked a series of 80 questions, 5 of which were related to wind power. A majority of residents surveyed indicated that wind farms have had a positive impact on Lewis County (70.7% of participants) and indicated that wind farms should be expanded in Lewis County (79.2% of participants). Of the individuals participating in the survey, only 9.2% have turbines on land owned by themselves or a family member, and 37.4% reported that they were able to see and/or hear wind turbines from their home. The survey further characterizes the individuals that were able to see and/or hear turbines from their homes to reveal that 77.1% of these individuals indicated that the wind farms have had a positive impact on Lewis County. Additionally, only 7.5% of participants who live within 1 mile of the nearest wind turbine felt that wind farms have had a negative impact (Jefferson Community College, 2008). In addition, typical are the following published observations:

> *"Given the broad sweep of the Fenner* [New York] *landscape…the completed turbines look anything but out of place. Their colossal dimensions notwithstanding…from a distance, they take on a spindly, almost delicate look." Syracuse New Times, August 21, 2002.*
>
> *"The nonlinear arrangement of the Fenner turbines situated them comfortably among the traditional farmhouses, paths, and roads, while at Madison* [New York]*, a grassy hillside site, the windmills were more prominent but still unaggressive. Unlike a ski run, say, or a power line cutting through the countryside, the windmills didn't seem like a violation of the landscape. The turning vanes called to mind a natural force – the wind – in a way that a cell phone or microwave tower, for example, most certainly does not." Orion, September-October 2006.*

These observations, and the Jefferson Community College 2008 survey, are consistent with the results of a recent study of public perception of wind power in Scotland and Ireland (Warren, et. al., 2005). The conclusion of this study states the following:

> *"A remarkably consistent picture is emerging from surveys of public attitudes to wind power, and the case studies provide further evidence that this picture is a representative one. Large majorities of people are strongly in favour of their local windfarm, their personal experience having engendered positive attitudes. Moreover, although some of those living near proposed windfarm sites are less convinced of their merits, large majorities nevertheless favour their construction. This stands in marked contrast with the impression conveyed in much media coverage, which typically portrays massive grassroots opposition to windfarms."*

Nighttime photos from the Fenner (New York) Wind Power Project (Figure 23), illustrate the type of nighttime visual impact that could occur from certain viewpoints within the Buckeye Project study area due to the turbines' FAA aviation warning lights. Although daytime lighting, and night time lighting of every turbine, (as was the case in Fenner) will not be required on this project, as shown in this photo, the contrast of the aviation warning lights with the night sky can be strong in dark, rural settings, and their presence suggests a more commercial/industrial land use. Viewer attention is drawn by the flashing of the lights, and any positive reaction that wind turbines engender (due to their graceful form, association with clean energy, etc.) is lost at night. While not disturbing (or even strongly perceptible) from roads and other public viewpoints, turbine lighting may be perceived negatively by area residents who may be able to view these lights from their homes and yards.

**Existing Fenner Wind Power Project   Fenner, NY**

## Buckeye Wind Project

Champaign County, Ohio

Figure 23: Representative Evening/Nightime Photos

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## *6.0 Conclusions*

The VIA for the Buckeye Wind Power Project allows the following conclusions to be drawn:

1. Viewshed mapping, cross section analysis, and field verification indicate that the Project has the potential to be visible from the majority of the 5-mile radius study area. In most locations where turbines will be visible, significant portions of the overall Project are also likely to be visible. However, in many areas a significant number of the turbines will be at least partially screened by trees and structures. In addition, significant visual effects of wind power projects are generally concentrated within 3.5 miles (6 kilometers) of the Project site (Eyre, 1995). EDR's observations on existing wind power projects in New York State indicate that under favorable conditions, views of the wind turbines will likely be available from certain viewpoints well over 10 miles from the Project site. However, visual impact at these distances is typically minimal.

2. Viewshed analysis indicates that views of the Project are likely to be available from the majority of the visually sensitive resources and areas of intensive land use that occur within the 5-mile radius study area. However, for many sensitive sites within the study area, including National Register-listed historic sties and others that occur in the City of Urbana and the various villages, cross section analysis and field review suggest that the Project will either not be visible or will be significantly screened by foreground vegetation and structures.

3. Simulations of the proposed Project, indicate that the visibility and visual impact of the wind turbines will be highly variable, based on landscape setting, the extent of natural screening, the presence of other man-made features in the view, and distance of the viewer from the Project.

4. Evaluation by a licensed EDR landscape architect indicates that the Project's overall contrast with the visual/aesthetic character of the area will generally be moderate. Minimal contrast was noted for viewpoints over 3.5 miles from the Project, while more appreciable contrast was noted where foreground and near mid-ground views of turbines (i.e., under 1.0 mile) are available, where substantial numbers of turbines span the field of view, and/or where the turbines appear out of context/character with the landscape (i.e., in more suburban residential areas). However, in most cases the reviewing landscape architect felt the Project was compatible with the working agricultural landscape that makes up the majority of the visual study area. Based on experience with currently operating wind power projects elsewhere, public reaction to the Project is likely to be generally positive, but highly variable based on proximity to the turbines, the affected

landscape, and personal attitude of the viewer regarding wind power. As Stanton (1996) notes, although a wind power project is a man-made facility, what it represents "may be seen as a positive addition" to the landscape.

5. Based upon the nighttime photos/observations of existing wind power projects, the red flashing lights on the turbines could result in a nighttime visual impact on certain viewers. The actual significance of this impact from a given viewpoint will depend on how many lighted turbines are visible, what other sources of lighting are present in the view, the extent of screening provided by structures and trees, and nighttime viewer activity/sensitivity. However, night lighting could be somewhat distracting and have an adverse effect on rural residents that currently experience dark nighttime skies. It should be noted that nighttime visibility/visual impact will be reduced on this Project due to 1) FAA lighting guidelines which typically result in aviation warning lights on only about one third to one half the turbines, 2) the presence of yard trees and hedgerows that screen portions of the Project from many locations, and 3) the concentration of residences in villages, hamlets, and along highways where existing lights already compromise dark skies and compete for viewer attention.

6. Mitigation options are limited, given the nature of the Project and its siting criteria (tall structures typically located in open fields). However, various mitigation measures were considered. These included the following:

   A. Screening. Due do the height of individual turbines and the geographic extent of the proposed Project, screening of individual turbines with earthen berms, fences, or planted vegetation will generally not be effective in reducing Project visibility or visual impact. However, if adequate natural screening is lacking at the proposed substation site, a planting plan should be developed and implemented to minimize the visibility of this facility. In addition, selective off-site plantings could be effective in screening views of the turbines from some cemeteries, local parks, or historic resources in the area (see Viewpoint 54 as an example).

   B. Relocation. Again, because of the extent of the Project, the number of individual turbines, and the variety of viewpoints from which the Project can be seen, turbine relocation will generally not significantly alter visual impact. Where visible from sensitive resources within the study area, (e.g., local parks. cemeteries, and heavily used roadways) numerous turbines are likely to be visible, and relocation of individual machines would have little effect on overall visual impact. Throughout the study area, views of the Project are highly variable and include different turbines at different vantage points. Therefore, turbine relocation would generally not be effective in mitigating visual impacts.

C. Camouflage. The white color of wind turbines (as mandated by the FAA to eliminate the need for day time lighting) minimizes contrast with the sky under most conditions, especially when viewed at distance against the horizon. Consequently it is recommended that this color be utilized on the Buckeye Project. The size and movement of the turbines prevents more extensive camouflage from being a viable mitigation alternative (i.e., they cannot be made to look like anything else). Neilson (1996) notes that efforts to camouflage or hide wind farms generally fail, while Stanton (1996) feels that such efforts are inappropriate. She believes that wind turbine siting "is about honestly portraying a form in direct relation to its function and our culture; by compromising this relationship, a negative image of attempted camouflage can occur."

D. Low Profile. A significant reduction in turbine height is not possible without significantly decreasing power generation. To off-set this decrease, additional turbines would be necessary. There is not adequate land under lease to accommodate a significant number of additional turbines, and a higher number of shorter turbines would not necessarily decrease Project visual impact. In fact, several studies have concluded that people tend to prefer fewer larger turbines to a greater number of smaller ones (Thayer and Freeman, 1987; van de Wardt and Staats, 1988). EDR has evaluated this alternative on several proposed wind power projects in New York, and we have typically found that visual impact is not significantly altered by using a larger number of smaller turbines. The visual impact of the electrical collection system is being minimized by installing significant portions of the lines underground.

E. Downsizing. Reducing the number of turbines could reduce visual impact from certain viewpoints, but from most locations within the study area where numerous turbines are visible, unless this reduction were drastic, the visual impact of the Project would change only marginally. A dramatic reduction in turbine number (e.g., reduction by 50%) would impact the Project's economic viability.

F. Alternate Technologies. Alternate technologies for power generation (fossil fuel, nuclear, solar, etc.) would have different, and perhaps more significant, visual impacts than wind power. In addition, because the Project Sponsor is a wind power developer, alternative types of power generation are not realistic alternatives. Alternative utility-scale wind power technologies (e.g., vertical axis turbines), that could reduce visual impacts, do not currently exist.

G. Nonspecular Materials. Where possible, non-reflective paints and finishes will be used on the wind turbines to minimize reflected glare. Where this is not feasible, natural weathering/dulling of any glossy surfaces (on turbine or substation components) will typically occur within one year following installation.

H. Lighting. Turbine lighting will be kept to the minimum allowable by the FAA. Medium intensity red strobes will be used at night, rather than white strobes or steady burning red lights. Lighting at the proposed substation should be kept to a minimum, and turned on only as needed by switch or motion detector.

I. Maintenance. The turbines and turbine sites will be maintained to ensure that they are clean, attractive, and operating efficiently. Research and anecdotal reports indicate that viewers find wind turbines more appealing when the rotors are turning (Stanton, 1996). In addition, the Project operator will establish a decommissioning fund to ensure that if the Project goes out of service and is not repowered/redeveloped, all visible above-ground components will be removed.

J. Offsets. Correction of an existing aesthetic problem within the viewshed is a viable mitigation strategy for wind power projects that result in significant adverse visual impact. However, because the analysis presented herein does not indicate a significant adverse impact, offset mitigation is not proposed at this time.

In addition to the mitigation measures described above, other measures that will reduce or mitigate visual impact have been incorporated into the Project design. These include the following:

- All turbines will have uniform design, speed, color, height and rotor diameter.

- Towers will include no exterior ladders or catwalks.

- The Project operations and maintenance building (although not yet designed) will reflect the vernacular architecture of the area (i.e., resemble an agricultural structure).

- New road construction will be minimized by utilizing existing farm lanes whenever possible.

- The placement of any advertising devices on the turbines will be prohibited.

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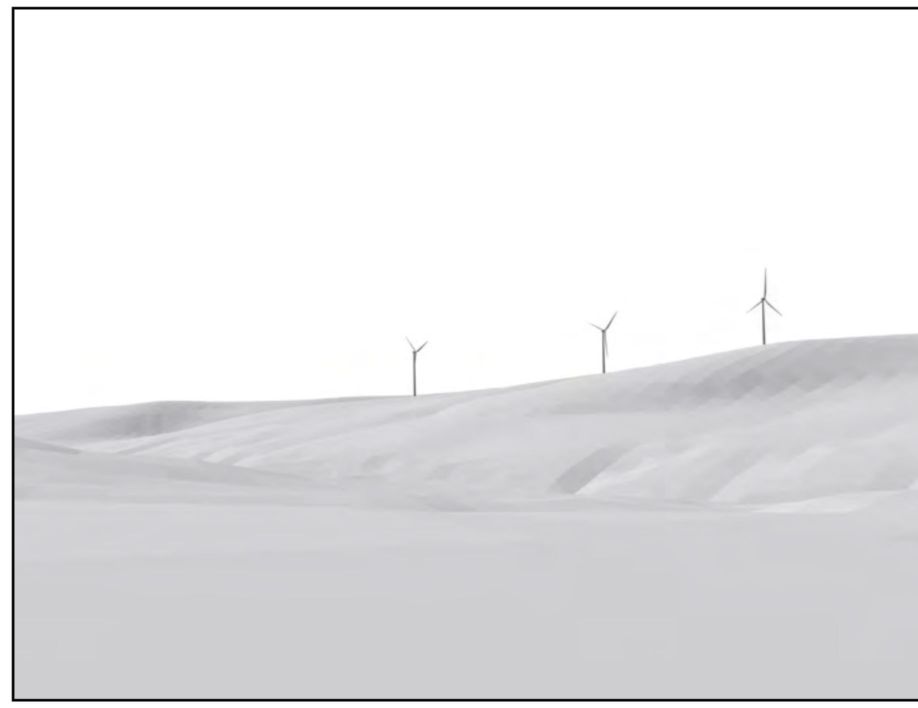
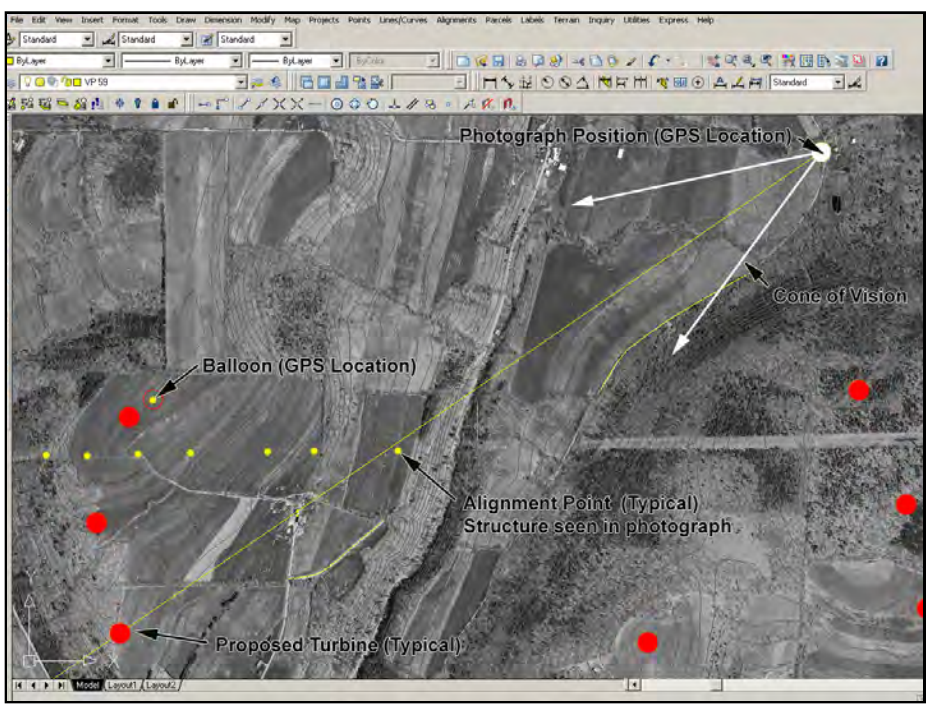
# Appendix A

Visual Simulation Process

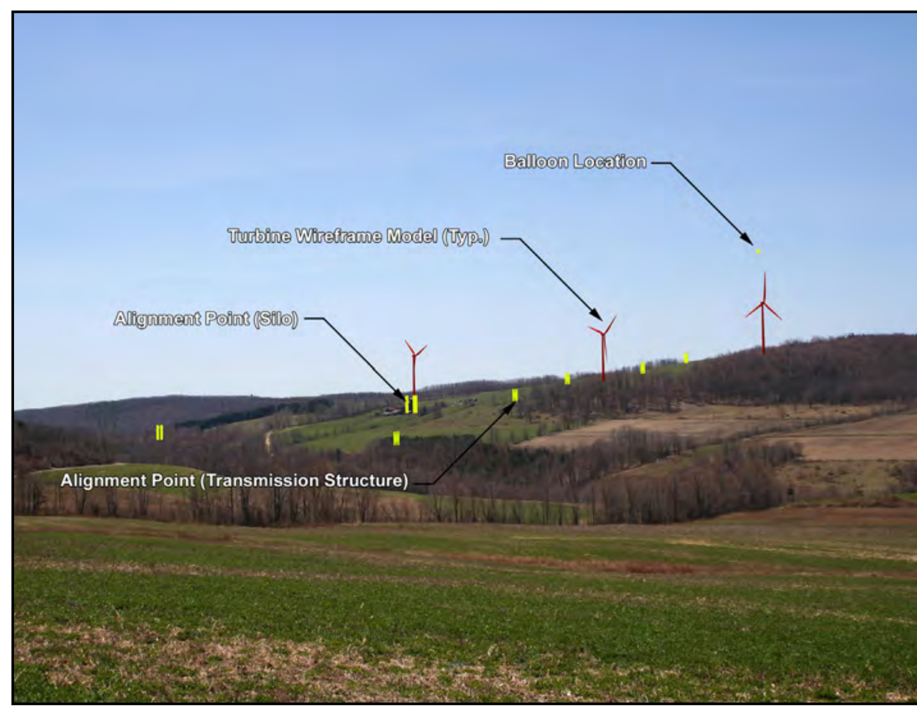
Photos are selected to illustrate typical views of the proposed project that will be available to representative viewer/user groups from the major landscape similarity zones and sensitive sites within the study area.



A three-dimensional computer model of the project is built based on proposed turbine specifications and tower site coordinates.




Aerial photographs and GPS data collected in the field are used to create an AutoCAD 2005® drawing.




These data are superimposed over photographs from each of the viewpoints, and minor camera changes are made to align all known reference points within the view.

A digital terrain model representing the existing topography is also overlayed on the existing photograph to refine camera alignment, and target elevation.

The proposed exterior color/finish of the turbines was then added to the model and the appropriate sun angle is simulated based on the specific date, time and location (latitude and longitude) at which each photo was taken.

# Appendix B

Large Scale Viewshed Maps and Visually Sensitive Site Tables

## Table B1. Inventory of Visually Sensitive Resources

| Visually Sensitive Resource[1] | Location | Nearest Distance (miles) to Proposed Wind Turbine[2] |
|---|---|---|
| ***STATEWIDE RESOURCES*** | | |
| **National Register of Historic Places** | | |
| Baker, Maj. John C., House | 202 W. Main St., Village of Mechanicsburg, Champaign County | 1.1 |
| Barr House | Locust & Sandusky Sts., Village of Mechanicsburg, Champaign County | 1.5 |
| Burnham, Henry, House | N. Main St. & Rt. 559, Village of Mechanicsburg, Champaign County | 1.1 |
| Church Of Our Savior | 56 S. Main St., Village of Mechanicsburg, Champaign County | 1.5 |
| Clark, Dr., House | 21 N. Main St., Village of Mechanicsburg, Champaign County | 1.3 |
| Culbertson, William, House | 103 Race St., Village of Mechanicsburg, Champaign County | 1.3 |
| Demand-Gest House | 37 N. Main St., Village of Mechanicsburg, Champaign County | 1.3 |
| Elmwood Place | SW of Irwin on OH 161, Irwin, Union County | 4.9 |
| Hamer's General Store | 88 S. Main St., Village of Mechanicsburg, Champaign County | 1.6 |
| Hunter, Norvall, Farm | S. Main St., Village of Mechanicsburg, Champaign County | 1.6 |
| Kimball House | 115 N. Main St., Village of Mechanicsburg, Champaign County | 1.2 |
| Lowler's Tavern | N. Main St., Village of Mechanicsburg, Champaign County | 1.3 |
| Magruder Building | 16 N. Main St., Village of Mechanicsburg, Champaign County | 1.4 |
| Masonic Temple | N. Main St., Village of Mechanicsburg, Champaign County | 1.3 |
| Mechanicsburg Baptist Church | Walnut & Sandusky Sts., Village of Mechanicsburg, Champaign County | 1.3 |
| Mechanicsburg Commercial Historic District | 1-11 S. Main St., Village of Mechanicsburg, Champaign County | 1.4 |
| Mosgrove, Dr. Adam, House | 127 Miami St., City of Urbana, Champaign County | 2.9 |
| Mt. Tabor Church Building, Cemetery and Hitching Lot | OH 245, 300 meters S of jct. with Mt. Tabor Rd., Salem Township, Champaign County | 3.5 |
| Ninchelser, Dr., House | 28 N. Main St., Village of Mechanicsburg, Champaign County | 1.3 |
| Nutwood Place | 1428 Nutwood Place, City of Urbana, Champaign County | 2.6 |
| Rathburn, Levi, House | Locust & Sandusky Sts., Village of Mechanicsburg, Champaign County | 1.4 |
| Richards--Sewell House | 222 College St., City of Urbana, Champaign County | 3.2 |
| Scioto Street Historic District | Scioto St. from Locust to E. Lawn Ave., City of Urbana, Champaign County | 2.3 |
| Second Baptist Church | Sandusky St., Village of Mechanicsburg, Champaign County | 1.4 |
| St. Michael Catholic Church | 40 Walnut St, Village of Mechanicsburg, Champaign County | 1.3 |
| St. Paul AME Church | 316 E. Market St., City of Urbana, Champaign County | 2.8 |
| United Methodist Church | N. Main & Race Sts., Village of Mechanicsburg, Champaign County | 1.3 |
| Urbana College Historic Buildings | College Way, City of Urbana, Champaign County | 3.4 |
| Urbana Monument Square Historic District | Roughly bounded by Market, Walnut, Church, and Locust Sts., City of Urbana, Champaign County | 2.7 |
| Village Hobby Shop | N. Main St., Village of Mechanicsburg, Champaign County | 1.4 |
| Ward, John Q. A., House | 335 College St., City of Urbana, Champaign County | 2.2 |
| **National Register of Historic Places Determination of Eligibility (NRHP DOE)** | | |
| Urbana | 318 W. Light St., City of Urbana, Champaign County | 2.8 |

| Visually Sensitive Resource[1] | Location | Nearest Distance (miles) to Proposed Wind Turbine[2] |
|---|---|---|
| **State Historic Markers** | | |
| 1950 National and Ohio Plowing Matches (#08-11) | Intersection of Benson Road and State Route 54, Town of Union, Champaign County | 2.4 |
| Addison White (#16-11) | 1 South Main Street, Village of Mechanicsburg, Champaign County | 1.4 |
| Bailey and Barclay Halls/Johnny Appleseed (#05-11) | 579 College Way, City of Urbana, Champaign County | 3.5 |
| Cedar Bog Nature Preserve (#06-11) | 980 Woodburn Road, Town of Urbana, Champaign County | 3.5 |
| Dayton, Springfield, and Urbana Electric Railway (#15-11) | 122 South Main Street, City of Urbana, Champaign County | 2.9 |
| General Robert Lawrence Eichelberger (#14-11) | 907 Scioto Street, City of Urbana, Champaign County | 1.9 |
| Harmony Lodge No. 8 Free and Accepted Masons (#01-11) | 222 N. Main Street, City of Urbana, Champaign County | 2.9 |
| In Memory of Simon Kenton (#03-11) | Intersection of Jefferson St. and State Route 54, Oakdale Cemetery, City of Urbana, Champaign County | 2.3 |
| James Roy Hopkins (#23-11) | 60 South Main Street, Village of Mechanicsburg, Champaign County | 1.5 |
| John Anderson Ward Farmstead/John Quincy Adams Ward 1830-1910/Edgar Melville Ward 1839-1915 (#13-11) | 335 College Street, City of Urbana, Champaign County | 3.2 |
| Joseph E. Wing (#09-11) | Intersection of Wing Road and Rosedale Road, Town of Goshen, Champaign County | 2.5 |
| Kings Creek Baptist Church (#12-11) | 1250 Kennard-Kings Creek Road, Town of Urbana, Champaign County | 2.2 |
| Lincoln Funeral Train (#24-11) | Urbana-Woodstock Pike/West Bennett, Woodstock Cemetery, Town of Rush, Champaign County | 2.2 |
| Mad River and Lake Erie Railroad (#26-11) | WESTCO Bridge over Miami Street, City of Urbana, Champaign County | 3.1 |
| Mad River and Lake Erie Railroad (#27-11) | WESTCO Bridge over Miami Street, City of Urbana, Champaign County | 3.1 |
| Mechanicsburg United Methodist Church (#25-11) | 42 North Main Street, Village of Mechanicsburg, Champaign County | 1.3 |
| Second Baptist Church (#19-11) | 43 East Sandusky Street, Village of Mechanicsburg, Champaign County | 1.4 |
| The Johnson Manufacturing Company (#21-11) | 605 Miami Street, City of Urbana, Champaign County | 3.2 |
| Warren G. Grimes/Grimes Field (#11-11) | 1636 North Main Street, City of Urbana, Champaign County | 2.5 |
| **State Parks** | | |
| Buck Creek State Park | Town of Monroe, Clark County | 3.2 |
| **State Forest** | | |
| None | - | - |
| **State Nature Preserve** | | |
| Prairie Road Fen Nature Preserve | Town of Moorefield, Clark County | 3.7 |
| **State Wildlife Management Areas** | | |
| Urbana Wildlife Propagation Unit | Town of Salem, Champaign County | 1.8 |
| **National Wildlife Refuges** | | |
| None | - | - |
| **National Natural Landmarks** | | |
| Cedar Bog Nature Preserve | Town of Urbana, Champaign County | 4.0 |
| **National Park Service Lands** | | |
| None | - | - |
| **National or State Wild, Scenic, or Recreational Rivers** | | |
| None | - | - |
| **National or State Scenic Byway** | | |
| None | - | - |

| Visually Sensitive Resource[1] | Location | Nearest Distance (miles) to Proposed Wind Turbine[2] |
|---|---|---|
| **State or Federal Designated Trails** | | |
| None | - | - |
| **Nature Preserve Areas** | | |
| Darby Wetlands Reserve Program (TNC) | Town of Goshen, Champaign County | 0.6 |
| | | |
| ***LOCAL RESOURCES*** | | |
| **Areas of Intensive Land Use (City, Village, Hamlet)** | | |
| CDP of Northridge | Town of Moorefield, Clark County | 3.9 |
| City of Urbana | Towns of Urbana and Salem, Champaign County | 0.9 |
| Hamlet of Cable | Town of Wayne, Champaign County | 0.6 |
| Hamlet of Fountain Park | Town of Rush, Champaign County | 1.1 |
| Hamlet of Kennard | Town of Salem, Champaign County | 0.8 |
| Hamlet of Middletown | Town of Wayne, Champaign County | 2.1 |
| Hamlet of Mingo | Town of Wayne, Champaign County | 2.7 |
| Village of Catawba | Town of Pleasant, Clark County | 3.4 |
| Village of Mechanicsburg | Town of Goshen, Champaign County | 0.5 |
| Village of Mutual | Town of Union, Champaign County | 0.4 |
| Village of North Lewisburg | Town of Rush, Champaign County | 3.8 |
| Village of Woodstock | Town of Rush, Champaign County | 2.4 |
| **Locally Important Resources (Schools, Libraries, Hospitals, Nursing Homes, Churches, Airports)** | | |
| Bethesda Apostolic Church | 301 East Market Street, City of Urbana, Champaign County | 2.8 |
| Bowlusville United Methodist Church | 445 West County Line Road, Town of Moorefield, Clark County | 4.7 |
| Cable United Methodist Church | 5779 Fillmore Street, Hamlet of Cable, Champaign County | 0.8 |
| Catawba Freewill Baptist Church | 58 South Persimmon Street, Hamlet of Catawba, Clark County | 3.8 |
| Champaign County Law Library | 200 North Main Street #2, City of Urbana, Champaign County | 2.9 |
| Champaign County Library | 1060 Scioto Street, City of Urbana, Champaign County | 1.8 |
| Chapel Hill Church of God | 1155 North Ludlow Road, Town of Urbana, Champaign County | 0.5 |
| Church of Our Saviour Episcopal Church | 56 South Main Street, Village of Mechanicsburg, Champaign County | 1.5 |
| Community Hearth and Home | 1579 East State Route 29, City of Urbana, Champaign County | 1.6 |
| Dohron Wilson Elementary School | Village of Mechanicsburg, Champaign County | 1.1 |
| East Elementary School | City of Urbana, Champaign County | 2.1 |
| El Shaddi Community Church | 2815 Clark Road, City of Urbana, Champaign County | 2.1 |
| Enterprise Church | 1929 South Parkview Road, Town of Goshen, Champaign County | 1.2 |
| Episcopal Church of Epiphany | 230 Scioto Street, City of Urbana, Champaign County | 2.7 |
| Eternal Life Ministries | 4287 Mechanicsburg Road, Town of Moorefield, Clark County | 5.0 |
| Fellowship Baptist Church | 27 North Sycamore Street, Village of North Lewisburg, Champaign County | 4.8 |
| First Baptist Church | 401 North Main, City of Urbana, Champaign County | 2.8 |
| First Christian Church | 113 Orange Street, City of Urbana, Champaign County | 2.7 |
| First Presbyterian Church | 116 West Court Street, City of Urbana, Champaign County | 2.9 |
| Free Will Baptist Church | 332 West Bennett, Village of Woodstock, Champaign County | 2.5 |
| Grace Baptist Academy | Town of Urbana, Champaign County | 1.6 |
| Grace Baptist Church | 960 Childrens Home Road, City of Urbana, Champaign County | 1.5 |
| Grimes Field | City of Urbana, Champaign County | 2.6 |
| Heartland of Urbana | 741 East Water Street, City of Urbana, Champaign County | 2.5 |

| Visually Sensitive Resource[1] | Location | Nearest Distance (miles) to Proposed Wind Turbine[2] |
|---|---|---|
| Jerusalem Second Baptist Church | 1036 South High Street, City of Urbana, Champaign County | 3.1 |
| Kennard Church of the Nazarene | 3134 Reed Street, Hamlet of Kennard, Champaign County | 0.9 |
| Kingdom Hall-Jehovah's Witness | 700 State Route 54, City of Urbana, Champaign County | 2.3 |
| Kings Creek United Methodist Church | 1362 Kennard-Kings Creek Road, Town of Urbana, Champaign County | 2.4 |
| Kings Creek Baptist Church | 1250 Kennard-Kings Creek Road, Town of Urbana, Champaign County | 2.2 |
| Living Faith Baptist Church | 2730 East State Route 29, City of Urbana, Champaign County | 1.2 |
| Mechanicsburg Baptist Church | 112 West Sandusky Street, Village of Mechanicsburg, Champaign County | 1.4 |
| Mechanicsburg Christian Church | 4401 Allison Road, Village of Mechanicsburg, Champaign County | 0.8 |
| Mechanicsburg Public Library | 60 South Main Street, Village of Mechanicsburg, Champaign County | 1.5 |
| Mechanicsburg Secondary School | Village of Mechanicsburg, Champaign County | 1.1 |
| Mercy McAuley Center Nursing Home | 906 Scioto Street, City of Urbana, Champaign County | 2.0 |
| Mercy Memorial Hospital | City of Urbana, Champaign County | 1.9 |
| Messiah Lutheran Church | 1013 East Lawn, City of Urbana, Champaign County | 1.9 |
| Middletown Church of God | 6205 State Route 296, Hamlet of Middletown, Champaign County | 2.2 |
| Mt. Carmel Friends Church | 3470 Kennard-Kings Creek Road, Town of Wayne, Champaign County | 1.7 |
| Mt. Tabor Church | Route 245, Town of Salem, Champaign County | 3.5 |
| New Beginning Fellowship | 630 East Ward Street, City of Urbana, Champaign County | 2.2 |
| New Hope Church of Urbana | 531 Hagenbuch Street, City of Urbana, Champaign County | 3.0 |
| New Life Christian Church | 7016 Urbana Woodstock Road, Town of Wayne, Champaign County | 0.6 |
| New Moorefield United Methodist Church | 5065 Mechanicsburg Road, Town of Moorefield, Clark County | 4.2 |
| North Elementary School | City of Urbana, Champaign County | 2.9 |
| North Hills Church of God | 2950 Moorefield Road, Town of Moorefield, Clark County | 4.3 |
| Northside Church of God | 985 East Lawn Avenue, City of Urbana, Champaign County | 1.9 |
| Oak Grove Mennonite Church | 1525 Mennonite Church Road, Town of Salem, Champaign County | 3.4 |
| Pleasant Hill Primitive Baptist Church | 615 North Oakland Street, City of Urbana, Champaign County | 3.3 |
| River of Life Christian Center | 775 Washington Avenue, City of Urbana, Champaign County | 2.0 |
| Rolling Hills Elementary School | Town of Moorefield, Clark County | 4.6 |
| Saint Mary Catholic Church | 231 Washington Avenue, City of Urbana, Champaign County | 2.6 |
| Saint Michael's Church | 40 Walnut Street, Village of Mechanicsburg, Champaign County | 1.3 |
| Saint Paul AME Church | 316 East Market Street, City of Urbana, Champaign County | 2.8 |
| Sisters of Mercy | 911 Bon Air Drive, City of Urbana, Champaign County | 1.9 |
| South Elementary School | City of Urbana, Champaign County | 3.1 |
| Spring Meadows Care Center | 1649 Park Road, Town of Rush, Champaign County | 1.3 |
| Sterling House of Urbana | 609 East Water Street, City of Urbana, Champaign County | 2.6 |
| Swedenborg Memorial Library | 579 College Way, City of Urbana, Champaign County | 3.5 |
| Triad Elementary School | Town of Wayne, Champaign County | 1.8 |
| Triad High School | Town of Rush, Champaign County | 1.7 |
| Triad Middle School | Town of Wayne, Champaign County | 1.9 |

| Visually Sensitive Resource[1] | Location | Nearest Distance (miles) to Proposed Wind Turbine[2] |
|---|---|---|
| United Methodist Church | 42 North Main Street, Village of Mechanicsburg, Champaign County | 1.3 |
| Urbana Church of Christ | 1400 Short Cut Road, City of Urbana, Champaign County | 1.7 |
| Urbana Church of Christ in Christian Union | 1115 North Main Street, City of Urbana, Champaign County | 2.4 |
| Urbana Church of the Nazarene | 1999 East State Route 29, City of Urbana, Champaign County | 1.5 |
| Urbana Faith Fellowship Church | 236 Bloomfield Avenue, City of Urbana, Champaign County | 2.4 |
| Urbana Fellowship Church | 129 North Oakland Street, City of Urbana, Champaign County | 3.4 |
| Urbana High School | City of Urbana, Champaign County | 2.3 |
| Urbana Junior High School | City of Urbana, Champaign County | 2.3 |
| Urbana Local Intermediate School | Town of Urbana, Champaign County | 1.1 |
| Urbana Swedenborgian Church & Wedding Chapel | 330 South Main Street, City of Urbana, Champaign County | 3.0 |
| Urbana United Methodist Church | 238 North Main Street, City of Urbana, Champaign County | 2.8 |
| Urbana University | City of Urbana, Champaign County | 3.2 |
| Victory Chapel Church of Christ in Christian Union | 239 East Townsend Street, Village of North Lewisburg, Champaign County | 4.7 |
| Weller Airport | Town of Urbana, Champaign County | 0.8 |
| Wesley Chapel Baptist Church | 1809 Short Cut Road, City of Urbana, Champaign County | 1.3 |
| West Liberty-Salem High School | Town of Salem, Champaign County | 4.8 |
| **Recreation Resources (Local Parks, Lakes, Ponds, Golf Courses, Ski Resorts, Rivers, Streams)** | | |
| Baker Lake | Town of Goshen, Champaign County | 1.0 |
| Barbara Howell Park | City of Urbana, Champaign County | 2.8 |
| Bogles Run | Towns of Mad River and Urbana, Champaign County | 1.8 |
| Brush Lake | Town of Rush, Champaign County | 1.1 |
| Buck Creek | Town of Union, Champaign County and Town of Moorefield, Clark County | 0.1 |
| C J Brown Reservoir | Town of Moorefield, Clark County | 4.5 |
| Cedar Run | Towns of Mad River and Urbana, Champaign County | 4.2 |
| Clover Run | Town of Goshen, Champaign County | 1.2 |
| Dugan Ditch | Towns of Union and Urbana, Champaign County | 0.0 |
| Dugan Run | Towns of Urbana, Salem, and Wayne and City of Urbana, Champaign County | 0.1 |
| East Fork Buck Creek | Town of Union, Champaign County and Town of Moorefield, Clark County | 0.0 |
| First Price Pond | Town of Urbana, Champaign County | 1.1 |
| Fudger Lake | Town of Goshen, Champaign County | 2.5 |
| Georges Fork | Town of Pleasant, Clark County | 4.9 |
| Goshen Memorial Park | Village of Mechanicsburg and Town of Goshen, Champaign County | 0.6 |
| Gwynne Street Park | City of Urbana, Champaign County | 3.0 |
| Howard Run | Town of Rush, Champaign County and Town of Union, Union County | 1.8 |
| Indian Springs Golf Club | Town of Goshen, Champaign County | 2.2 |
| Jumping Run | Town of Goshen, Champaign County | 1.2 |
| Kings Creek | Towns of Salem and Wayne, Champaign County | 0.1 |
| Lake Run | Town of Goshen, Champaign County | 1.2 |
| Little Darby Creek | Town of Goshen, Champaign County, Town of Pike, Madison County, and Town of Union, Union County | 0.1 |
| Mac-O-Chee Creek | Towns of Salem and Concord, Champaign County | 4.7 |
| Mad River | Towns of Salem, Concord, Mad River, and Urbana, Champaign County | 4.7 |

| Visually Sensitive Resource[1] | Location | Nearest Distance (miles) to Proposed Wind Turbine[2] |
|---|---|---|
| Melvin Miller Park | City of Urbana, Champaign County | 1.5 |
| Moore Run | Town of Urbana, Champaign County and Town of Moorefield, Clark County | 1.9 |
| Muzzys Lake | Town of Urbana, Champaign County | 4.4 |
| North Fork Deer Creek | Town of Pleasant, Clark County | 4.4 |
| Ohio Caverns | Town of Salem, Champaign County | 3.7 |
| Pleasant Run | Towns of Wayne and Rush, Champaign County | 1.9 |
| Proctor Run | Town of Rush, Champaign County and Town of Union, Union County | 0.6 |
| Roadside Park | City of Urbana, Champaign County | 1.7 |
| Second Price Pond | Town of Urbana, Champaign County | 0.9 |
| Spain Creek | Towns of Wayne and Rush and Village of North Lewisburg, Champaign County | 3.5 |
| Spring Fork | Town of Goshen, Champaign County and Town of Pike, Madison County | 3.1 |
| Stanley Park | Village of North Lewisburg, Champaign County | 4.7 |
| Third Price Pond | Town of Urbana, Champaign County | 0.5 |
| Treacle Creek | Towns of Wayne, Union, and Goshen, Champaign County and Town of Union, Union County | 0.2 |
| Urbana Country Club | Town of Union, Champaign County | 0.4 |
| Ward Street Park | City of Urbana, Champaign County | 2.6 |
| Woodland Golf Course | Town of Union, Champaign County | 0.5 |
| **Cemeteries** | | |
| Baptist Cemetery | Town of Urbana, Champaign County | 2.0 |
| Beltz Cemetery | Town of Wayne, Champaign County | 4.3 |
| Black Cemetery | Town of Rush, Champaign County | 2.8 |
| Britton Cemetery | Town of Goshen, Champaign County | 1.8 |
| Buck Creek Cemetery | Town of Union, Champaign County | 2.1 |
| Butcher Cemetery | Village of North Lewisburg, Champaign County | 4.8 |
| Cable Cemetery | Town of Wayne, Champaign County | 0.8 |
| Comstock-Niles Cemetery | Town of Urbana, Champaign County | 1.4 |
| Corbet Cemetery | Town of Wayne, Champaign County | 4.5 |
| Fairview Cemetery | Town of Union, Champaign County | 0.3 |
| Foley Cemetery | Town of Moorefield, Clark County | 2.3 |
| French Cemetery | Town of Union, Champaign County | 3.5 |
| Georges Chapel-Methodist Episcopal Cemetery | Town of Urbana, Champaign County | 1.7 |
| Grace Cemetery | Town of Union, Champaign County | 0.7 |
| Grandview Cemetery | Town of Urbana, Champaign County | 3.1 |
| Haines Cemetery | Town of Rush, Champaign County | 2.2 |
| Hazel Cemetery | Town of Salem, Champaign County | 2.9 |
| Hopewell #2 Cemetery | Town of Union, Champaign County | 1.4 |
| Hopewell Cemetery | Town of Union, Champaign County | 4.5 |
| Jenkins Chapel Cemetery | Town of Wayne, Champaign County | 3.8 |
| Johnson Cemetery | Town of Wayne, Champaign County | 4.9 |
| Kings Creek Baptist Cemetery | Town of Salem, Champaign County | 2.6 |
| Kings Creek Cemetery | Town of Salem, Champaign County | 3.0 |
| Latham Cemetery | Town of Salem, Champaign County | 1.6 |
| Maple Grove Cemetery | Town of Goshen, Champaign County | 3.5 |
| Maple Grove Cemetery | Town of Rush, Champaign County | 1.8 |
| Martin Cemetery | Town of Rush, Champaign County | 2.2 |
| McConkey Cemetery | Town of Pleasant, Clark County | 0.8 |
| Mead Cemetery | Town of Wayne, Champaign County | 5.0 |
| Mitchell Cemetery | Town of Goshen, Champaign County | 0.8 |

| Visually Sensitive Resource[1] | Location | Nearest Distance (miles) to Proposed Wind Turbine[2] |
|---|---|---|
| Moorefield Chapel Cemetery | Town of Moorefield, Clark County | 4.5 |
| Mount Carmel Cemetery | Town of Wayne, Champaign County | 0.5 |
| Mount Tabor Cemetery | Town of Salem, Champaign County | 1.1 |
| Oak Grove Cemetery | Town of Salem, Champaign County | 0.8 |
| Oakdale Cemetery | City of Urbana, Champaign County | 4.0 |
| Old Friends Cemetery | Town of Salem, Champaign County | 1.8 |
| Old Graveyard Cemetery | City of Urbana, Champaign County | 2.3 |
| Pence Cemetery | Town of Urbana, Champaign County | 4.0 |
| Pisgah Cemetery | Town of Union, Champaign County | 3.1 |
| Pleasant Hill Cemetery | Town of Moorefield, Clark County | 2.3 |
| Sharon Cemetery | Town of Union, Champaign County | 0.3 |
| Snowhill Cemetery | Town of Salem, Champaign County | 2.0 |
| Sodom Cemetery | Town of Rush, Champaign County | 2.5 |
| Thomas Cemetery | Town of Salem, Champaign County | 0.4 |
| Townsend Cemetery | Town of Wayne, Champaign County | 0.1 |
| Treacles Creek Cemetery | Town of Goshen, Champaign County | 0.3 |
| Union Chapel Cemetery | Town of Union, Champaign County | 0.5 |
| Unnamed #1 Cemetery | Town of Goshen, Champaign County | 4.0 |
| Unnamed #2 Cemetery | Town of Goshen, Champaign County | 1.5 |
| Unnamed Cemetery | Town of Union, Champaign County | 1.0 |
| Vernon Cemetery | Town of Pleasant, Clark County | 1.2 |
| White Cemetery | Town of Union, Champaign County | 2.6 |
| Winn Cemetery | Town of Urbana, Champaign County | 3.7 |
| Wolfe Cemetery | Town of Union, Champaign County | 0.4 |
| Wolfe Cemetery | Town of Urbana, Champaign County | 1.1 |
| Woodstock Cemetery | Town of Rush, Champaign County | 2.6 |
| **Transportation Corridors** | | |
| State Highway 4 | Town of Moorefield, Clark Cty, Towns of Union and Goshen, Champaign Cty, Town of Union, Union Cty | 0.3 |
| State Highway 29 | Towns of Salem, Urbana, Union, and Goshen, City of Urbana, Village of Mechanicsburg, Champaign Cty | 0.1 |
| State Highway 54 | Towns of Urbana and Union, Champaign County and Town of Pleasant, Clark County | 0.2 |
| State Highway 55 | Towns of Urbana and Mad River and City of Urbana, Champaign County | 2.9 |
| State Highway 56 | Towns of Union and Goshen, Champaign County | 0.4 |
| State Highway 161 | Towns of Union and Goshen, Champaign County and Town of Union, Union County | 0.3 |
| State Highway 187 | Town of Goshen, Champaign County | 2.8 |
| State Highway 245 | Towns of Salem, Wayne, and Rush and Village of N. Lewisburg, Champaign Cty | 2.1 |
| State Highway 296 | Towns of Salem and Wayne, Champaign County | 0.2 |
| State Highway 507 | Town of Salem, Champaign County | 3.7 |
| State Highway 559 | Towns of Rush and Goshen and Villages of North Lewisburg and Woodstock, Champaign County | 1.1 |
| State Highway 814 | Towns of Salem and Union, Champaign County | 0.4 |
| US Highway 36 | Towns of Urbana, Union, Wayne, and Rush, and City of Urbana, Champaign Cty, Town of Union, Union Cty | 0.2 |
| US Highway 68 | Towns of Salem and Urbana and City of Urbana, Champaign County, and Town of Moorefield, Clark County | 2.4 |

[1]Resource located within 5 miles of a proposed turbine.

[2]For large areas and linear sites, approximate distance was measured from the nearest turbine to the respective area's closest point.

## Table B2. Visibility from Visually Sensitive Resources

| Visually Sensitive Resource[1] | Location | VP Number[2] | Project Visibility[3] | | |
|---|---|---|---|---|---|
| | | | Viewshed[4] | | Cross Section[5] |
| | | | Topography | Vegetation | |
| **National Register of Historic Places** | | | | | |
| Baker, Maj. John C., House | 202 W. Main St., Village of Mechanicsburg, Champaign County | - | V | V | - |
| Barr House | Locust & Sandusky Sts., Village of Mechanicsburg, Champaign County | - | V | V | - |
| Burnham, Henry, House | N. Main St. & Rt. 559, Village of Mechanicsburg, Champaign County | - | V | V | - |
| Church Of Our Savior | 56 S. Main St., Village of Mechanicsburg, Champaign County | - | V | V | - |
| Clark, Dr., House | 21 N. Main St., Village of Mechanicsburg, Champaign County | - | V | V | - |
| Culbertson, William, House | 103 Race St., Village of Mechanicsburg, Champaign County | - | V | V | - |
| Demand-Gest House | 37 N. Main St., Village of Mechanicsburg, Champaign County | - | V | V | - |
| Elmwood Place | SW of Irwin on OH 161, Irwin, Union County | - | V | V | - |
| Hamer's General Store | 88 S. Main St., Village of Mechanicsburg, Champaign County | - | V | V | - |
| Hunter, Norvall, Farm | S. Main St., Village of Mechanicsburg, Champaign County | - | V | PV | PV |
| Kimball House | 115 N. Main St., Village of Mechanicsburg, Champaign County | - | V | V | - |
| Lowler's Tavern | N. Main St., Village of Mechanicsburg, Champaign County | - | V | V | - |
| Magruder Building | 16 N. Main St., Village of Mechanicsburg, Champaign County | - | V | V | - |
| Masonic Temple | N. Main St., Village of Mechanicsburg, Champaign County | - | V | V | - |
| Mechanicsburg Baptist Church | Walnut & Sandusky Sts., Village of Mechanicsburg, Champaign County | - | V | V | - |
| Mechanicsburg Commercial Historic District | 1-11 S. Main St., Village of Mechanicsburg, Champaign County | 126 | V | V | - |
| Mosgrove, Dr. Adam, House | 127 Miami St., City of Urbana, Champaign County | - | V | V | - |
| Mt. Tabor Church Building, Cemetery and Hitching Lot | OH 245, 300 meters S of jct. with Mt. Tabor Rd., Salem Township, Champaign County | - | V | V | - |
| Ninchelser, Dr., House | 28 N. Main St., Village of Mechanicsburg, Champaign County | - | V | V | - |
| Nutwood Place | 1428 Nutwood Place, City of Urbana, Champaign County | - | V | V | - |
| Rathburn, Levi, House | Locust & Sandusky Sts., Village of Mechanicsburg, Champaign County | - | V | V | - |
| Richards--Sewell House | 222 College St., City of Urbana, Champaign County | - | V | V | - |
| Scioto Street Historic District | Scioto St. from Locust to E. Lawn Ave., City of Urbana, Champaign County | 116 | V | V | NV |
| Second Baptist Church | Sandusky St., Village of Mechanicsburg, Champaign County | - | V | V | - |
| St. Michael Catholic Church | 40 Walnut St, Village of Mechanicsburg, Champaign County | - | V | V | NV |
| St. Paul AME Church | 316 E. Market St., City of Urbana, Champaign County | - | V | V | - |
| United Methodist Church | N. Main & Race Sts., Village of Mechanicsburg, Champaign County | - | V | V | - |
| Urbana College Historic Buildings | College Way, City of Urbana, Champaign County | - | V | PV | - |
| Urbana Monument Square Historic District | Roughly bounded by Market, Walnut, Church, and Locust Sts., City of Urbana, Champaign County | - | V | V | - |
| Village Hobby Shop | N. Main St., Village of Mechanicsburg, Champaign County | 126 | V | V | - |
| Ward, John Q. A., House | 335 College St., City of Urbana, Champaign County | - | V | V | - |
| **National Register of Historic Places Determination of Eligibility (NRHP DOE)** | | | | | |
| Urbana | 318 W. Light St., City of Urbana, Champaign County | - | V | V | - |

| Visually Sensitive Resource[1] | Location | VP Number[2] | Project Visibility[3] | | |
|---|---|---|---|---|---|
| | | | Viewshed[4] | | Cross Section[5] |
| | | | Topography | Vegetation | |
| **State Historic Markers** | | | | | |
| 1950 National and Ohio Plowing Matches (#08-11) | Intersection of Benson Road and State Route 54, Town of Union, Champaign County | - | V | V | - |
| Addison White (#16-11) | 1 South Main Street, Village of Mechanicsburg, Champaign County | 126 | V | V | - |
| Bailey and Barclay Halls/Johnny Appleseed (#05-11) | 579 College Way, City of Urbana, Champaign County | - | V | V | - |
| Cedar Bog Nature Preserve (#06-11) | 980 Woodburn Road, Town of Urbana, Champaign County | - | NV | NV | - |
| Dayton, Springfield, and Urbana Electric Railway (#15-11) | 122 South Main Street, City of Urbana, Champaign County | - | V | V | - |
| General Robert Lawrence Eichelberger (#14-11) | 907 Scioto Street, City of Urbana, Champaign County | - | V | V | - |
| Harmony Lodge No. 8 Free and Accepted Masons (#01-11) | 222 N. Main Street, City of Urbana, Champaign County | - | V | V | - |
| In Memory of Simon Kenton (#03-11) | Intersection of Jefferson St. and State Route 54, Oakdale Cemetery, City of Urbana, Champaign County | - | V | V | - |
| James Roy Hopkins (#23-11) | 60 South Main Street, Village of Mechanicsburg, Champaign County | - | V | V | - |
| John Anderson Ward Farmstead/John Quincy Adams Ward 1830-1910/Edgar Melville Ward 1839-1915 (#13-11) | 335 College Street, City of Urbana, Champaign County | - | V | V | - |
| Joseph E. Wing (#09-11) | Intersection of Wing Road and Rosedale Road, Town of Goshen, Champaign County | - | V | V | - |
| Kings Creek Baptist Church (#12-11) | 1250 Kennard-Kings Creek Road, Town of Urbana, Champaign County | - | V | V | - |
| Lincoln Funeral Train (#24-11) | Urbana-Woodstock Pike/West Bennett, Woodstock Cemetery, Town of Rush, Champaign County | - | V | V | - |
| Mad River and Lake Erie Railroad (#26-11) | WESTCO Bridge over Miami Street, City of Urbana, Champaign County | - | V | V | - |
| Mad River and Lake Erie Railroad (#27-11) | WESTCO Bridge over Miami Street, City of Urbana, Champaign County | - | V | V | - |
| Mechanicsburg United Methodist Church (#25-11) | 42 North Main Street, Village of Mechanicsburg, Champaign County | - | V | V | - |
| Second Baptist Church (#19-11) | 43 East Sandusky Street, Village of Mechanicsburg, Champaign County | - | V | V | - |
| The Johnson Manufacturing Company (#21-11) | 605 Miami Street, City of Urbana, Champaign County | - | V | V | - |
| Warren G. Grimes/Grimes Field (#11-11) | 1636 North Main Street, City of Urbana, Champaign County | - | V | V | - |
| **State Parks** | | | | | |
| Buck Creek State Park | Town of Monroe, Clark County | - | PV | PV | - |
| **State Forest** | | | | | |
| None | - | - | - | - | - |
| **State Nature Preserve** | | | | | |
| Prairie Road Fen Nature Preserve | Town of Moorefield, Clark County | - | V | PV | - |
| **State Wildlife Management Areas** | | | | | |
| Urbana Wildlife Propagation Unit | Town of Salem, Champaign County | - | PV | PV | - |

| Visually Sensitive Resource[1] | Location | VP Number[2] | Project Visibility[3] | | |
|---|---|---|---|---|---|
| | | | Viewshed[4] | | Cross Section[5] |
| | | | Topography | Vegetation | |
| **National Wildlife Refuges** | | | | | |
| None | - | - | - | - | - |
| **National Natural Landmarks** | | | | | |
| Cedar Bog Nature Preserve | Town of Urbana, Champaign County | - | V | PV | - |
| **National Park Service Lands** | | | | | |
| None | - | - | - | - | - |
| **National or State Wild, Scenic, or Recreational Rivers** | | | | | |
| None | - | - | - | - | - |
| **National or State Scenic Byway** | | | | | |
| None | - | - | - | - | - |
| **State or Federal Designated Trails** | | | | | |
| None | - | - | - | - | - |
| **Nature Preserve Areas** | | | | | |
| Darby Wetlands Reserve Program (TNC) | Town of Goshen, Champaign County | - | V | PV | - |
| | | | | | |
| ***LOCAL RESOURCES*** | | | | | |
| **Areas of Intensive Land Use (City, Village, Hamlet)** | | | | | |
| CDP of Northridge | Town of Moorefield, Clark County | - | PV | PV | - |
| City of Urbana | Towns of Urbana and Salem, Champaign County | 40, 116 | PV | PV | PV |
| Hamlet of Cable | Town of Wayne, Champaign County | 67, 68 | V | PV | - |
| Hamlet of Fountain Park | Town of Rush, Champaign County | - | V | PV | PV |
| Hamlet of Kennard | Town of Salem, Champaign County | 86 | V | V | - |
| Hamlet of Middletown | Town of Wayne, Champaign County | 71 | V | PV | - |
| Hamlet of Mingo | Town of Wayne, Champaign County | 75, 76 | NV | NV | - |
| Village of Catawba | Town of Pleasant, Clark County | - | PV | PV | - |
| Village of Mechanicsburg | Town of Goshen, Champaign County | 125, 126, 127 | PV | PV | - |
| Village of Mutual | Town of Union, Champaign County | 16 | V | V | NV |
| Village of North Lewisburg | Town of Rush, Champaign County | 106 | PV | PV | - |
| Village of Woodstock | Town of Rush, Champaign County | - | V | V | PV |
| **Locally Important Resources (Schools, Libraries, Hospitals, Nursing Homes, Churches, Airports)** | | | | | |
| Bethesda Apostolic Church | 301 East Market Street, City of Urbana, Champaign County | - | V | V | - |
| Bowlusville United Methodist Church | 445 West County Line Road, Town of Moorefield, Clark County | - | V | V | - |
| Cable United Methodist Church | 5779 Fillmore Street, Hamlet of Cable, Champaign County | 68 | V | V | - |
| Catawba Freewill Baptist Church | 58 South Persimmon Street, Hamlet of Catawba, Clark County | - | V | V | - |
| Champaign County Law Library | 200 North Main Street #2, City of Urbana, Champaign County | - | V | V | - |
| Champaign County Library | 1060 Scioto Street, City of Urbana, Champaign County | - | V | V | - |
| Chapel Hill Church of God | 1155 North Ludlow Road, Town of Urbana, Champaign County | - | V | V | - |

| Visually Sensitive Resource[1] | Location | VP Number[2] | Project Visibility[3] | | |
|---|---|---|---|---|---|
| | | | Viewshed[4] | | Cross Section[5] |
| | | | Topography | Vegetation | |
| Church of Our Saviour Episcopal Church | 56 South Main Street, Village of Mechanicsburg, Champaign County | - | V | V | - |
| Community Hearth and Home | 1579 East State Route 29, City of Urbana, Champaign County | - | V | V | - |
| Dohron Wilson Elementary School | Village of Mechanicsburg, Champaign County | - | V | V | - |
| East Elementary School | City of Urbana, Champaign County | - | V | V | - |
| El Shaddi Community Church | 2815 Clark Road, City of Urbana, Champaign County | - | V | V | - |
| Enterprise Church | 1929 South Parkview Road, Town of Goshen, Champaign County | - | V | V | - |
| Episcopal Church of Epiphany | 230 Scioto Street, City of Urbana, Champaign County | - | V | V | - |
| Eternal Life Ministries | 4287 Mechanicsburg Road, Town of Moorefield, Clark County | - | V | V | - |
| Fellowship Baptist Church | 27 North Sycamore Street, Village of North Lewisburg, Champaign County | - | V | V | - |
| First Baptist Church | 401 North Main, City of Urbana, Champaign County | - | V | V | - |
| First Christian Church | 113 Orange Street, City of Urbana, Champaign County | - | V | V | - |
| First Presbyterian Church | 116 West Court Street, City of Urbana, Champaign County | - | V | V | - |
| Free Will Baptist Church | 332 West Bennett, Village of Woodstock, Champaign County | - | V | V | - |
| Grace Baptist Academy | Town of Urbana, Champaign County | - | V | V | - |
| Grace Baptist Church | 960 Childrens Home Road, City of Urbana, Champaign County | - | V | V | - |
| Grimes Field | City of Urbana, Champaign County | - | V | V | - |
| Heartland of Urbana | 741 East Water Street, City of Urbana, Champaign County | - | V | V | - |
| Jerusalem Second Baptist Church | 1036 South High Street, City of Urbana, Champaign County | - | V | V | - |
| Kennard Church of the Nazarene | 3134 Reed Street, Hamlet of Kennard, Champaign County | - | V | V | - |
| Kingdom Hall-Jehovah's Witness | 700 State Route 54, City of Urbana, Champaign County | - | V | V | - |
| Kings Creek United Methodist Church | 1362 Kennard-Kings Creek Road, Town of Urbana, Champaign County | - | V | V | - |
| Kings Creek Baptist Church | 1250 Kennard-Kings Creek Road, Town of Urbana, Champaign County | - | V | V | - |
| Living Faith Baptist Church | 2730 East State Route 29, City of Urbana, Champaign County | - | V | V | - |
| Mechanicsburg Baptist Church | 112 West Sandusky Street, Village of Mechanicsburg, Champaign County | - | V | V | - |
| Mechanicsburg Christian Church | 4401 Allison Road, Village of Mechanicsburg, Champaign County | - | V | V | - |
| Mechanicsburg Public Library | 60 South Main Street, Village of Mechanicsburg, Champaign County | - | V | V | - |
| Mechanicsburg Secondary School | Village of Mechanicsburg, Champaign County | - | V | V | - |
| Mercy McAuley Center Nursing Home | 906 Scioto Street, City of Urbana, Champaign County | - | V | V | - |
| Mercy Memorial Hospital | City of Urbana, Champaign County | - | V | V | - |
| Messiah Lutheran Church | 1013 East Lawn, City of Urbana, Champaign County | - | V | V | - |
| Middletown Church of God | 6205 State Route 296, Hamlet of Middletown, Champaign County | - | V | V | - |
| Mt. Carmel Friends Church | 3470 Kennard-Kings Creek Road, Town of Wayne, Champaign County | - | NV | NV | - |
| Mt. Tabor Church | Route 245, Town of Salem, Champaign County | - | V | V | - |
| New Beginning Fellowship | 630 East Ward Street, City of Urbana, Champaign County | - | V | V | - |
| New Hope Church of Urbana | 531 Hagenbuch Street, City of Urbana, Champaign County | - | V | V | - |
| New Life Christian Church | 7016 Urbana Woodstock Road, Town of Wayne, Champaign County | - | V | V | - |
| New Moorefield United Methodist Church | 5065 Mechanicsburg Road, Town of Moorefield, Clark County | - | V | V | - |
| North Elementary School | City of Urbana, Champaign County | - | V | V | - |
| North Hills Church of God | 2950 Moorefield Road, Town of Moorefield, Clark County | - | V | V | - |
| Northside Church of God | 985 East Lawn Avenue, City of Urbana, Champaign County | - | V | V | - |

| Visually Sensitive Resource[1] | Location | VP Number[2] | Project Visibility[3] | | |
|---|---|---|---|---|---|
| | | | Viewshed[4] | | Cross Section[5] |
| | | | Topography | Vegetation | |
| Oak Grove Mennonite Church | 1525 Mennonite Church Road, Town of Salem, Champaign County | - | V | V | - |
| Pleasant Hill Primitive Baptist Church | 615 North Oakland Street, City of Urbana, Champaign County | - | V | V | - |
| River of Life Christian Center | 775 Washington Avenue, City of Urbana, Champaign County | - | V | V | - |
| Rolling Hills Elementary School | Town of Moorefield, Clark County | - | V | V | - |
| Saint Mary Catholic Church | 231 Washington Avenue, City of Urbana, Champaign County | - | V | V | - |
| Saint Michael's Church | 40 Walnut Street, Village of Mechanicsburg, Champaign County | - | V | V | - |
| Saint Paul AME Church | 316 East Market Street, City of Urbana, Champaign County | - | V | V | - |
| Sisters of Mercy | 911 Bon Air Drive, City of Urbana, Champaign County | - | V | V | - |
| South Elementary School | City of Urbana, Champaign County | - | V | V | - |
| Spring Meadows Care Center | 1649 Park Road, Town of Rush, Champaign County | - | V | V | - |
| Sterling House of Urbana | 609 East Water Street, City of Urbana, Champaign County | - | V | V | - |
| Swedenborg Memorial Library | 579 College Way, City of Urbana, Champaign County | - | V | V | - |
| Triad Elementary School | Town of Wayne, Champaign County | - | V | V | - |
| Triad High School | Town of Rush, Champaign County | - | V | V | - |
| Triad Middle School | Town of Wayne, Champaign County | - | V | V | - |
| United Methodist Church | 42 North Main Street, Village of Mechanicsburg, Champaign County | - | V | V | - |
| Urbana Church of Christ | 1400 Short Cut Road, City of Urbana, Champaign County | - | V | V | - |
| Urbana Church of Christ in Christian Union | 1115 North Main Street, City of Urbana, Champaign County | - | V | V | - |
| Urbana Church of the Nazarene | 1999 East State Route 29, City of Urbana, Champaign County | - | V | V | - |
| Urbana Faith Fellowship Church | 236 Bloomfield Avenue, City of Urbana, Champaign County | - | V | V | - |
| Urbana Fellowship Church | 129 North Oakland Street, City of Urbana, Champaign County | - | V | V | - |
| Urbana High School | City of Urbana, Champaign County | - | V | V | - |
| Urbana Junior High School | City of Urbana, Champaign County | - | V | V | - |
| Urbana Local Intermediate School | Town of Urbana, Champaign County | - | V | V | - |
| Urbana Swedenborgian Church & Wedding Chapel | 330 South Main Street, City of Urbana, Champaign County | - | V | V | - |
| Urbana United Methodist Church | 238 North Main Street, City of Urbana, Champaign County | - | V | V | - |
| Urbana University | City of Urbana, Champaign County | - | V | PV | - |
| Victory Chapel Church of Christ in Christian Union | 239 East Townsend Street, Village of North Lewisburg, Champaign County | - | V | V | - |
| Weller Airport | Town of Urbana, Champaign County | - | V | V | - |
| Wesley Chapel Baptist Church | 1809 Short Cut Road, City of Urbana, Champaign County | - | V | V | - |
| West Liberty-Salem High School | Town of Salem, Champaign County | - | V | V | - |
| **Recreation Resources (Local Parks, Lakes, Ponds, Golf Courses, Ski Resorts, Rivers, Streams)** | | | | | |
| Baker Lake | Town of Goshen, Champaign County | - | V | PV | - |
| Barbara Howell Park | City of Urbana, Champaign County | - | V | V | - |
| Bogles Run | Towns of Mad River and Urbana, Champaign County | - | V | PV | - |
| Brush Lake | Town of Rush, Champaign County | - | V | PV | - |

| Visually Sensitive Resource[1] | Location | VP Number[2] | Project Visibility[3] | | |
|---|---|---|---|---|---|
| | | | Viewshed[4] | | Cross Section[5] |
| | | | Topography | Vegetation | |
| Buck Creek | Town of Union, Champaign County and Town of Moorefield, Clark County | - | V | PV | NV |
| C J Brown Reservoir | Town of Moorefield, Clark County | - | V | PV | - |
| Cedar Run | Towns of Mad River and Urbana, Champaign County | - | V | PV | - |
| Clover Run | Town of Goshen, Champaign County | - | PV | PV | - |
| Dugan Ditch | Towns of Union and Urbana, Champaign County | - | V | PV | - |
| Dugan Run | Towns of Urbana, Salem, and Wayne and City of Urbana, Champaign County | - | V | PV | V |
| East Fork Buck Creek | Town of Union, Champaign County and Town of Moorefield, Clark County | - | V | PV | - |
| First Price Pond | Town of Urbana, Champaign County | - | V | V | - |
| Fudger Lake | Town of Goshen, Champaign County | - | PV | PV | - |
| Georges Fork | Town of Pleasant, Clark County | - | V | V | - |
| Goshen Memorial Park | Village of Mechanicsburg and Town of Goshen, Champaign County | 127 | V | PV | - |
| Gwynne Street Park | City of Urbana, Champaign County | - | V | V | - |
| Howard Run | Town of Rush, Champaign County and Town of Union, Union County | - | V | V | - |
| Indian Springs Golf Club | Town of Goshen, Champaign County | - | PV | PV | - |
| Jumping Run | Town of Goshen, Champaign County | - | V | PV | - |
| Kings Creek | Towns of Salem and Wayne, Champaign County | - | V | PV | NV |
| Lake Run | Town of Goshen, Champaign County | - | PV | PV | - |
| Little Darby Creek | Town of Goshen, Champaign County, Town of Pike, Madison County, and Town of Union, Union County | - | PV | PV | - |
| Mac-O-Chee Creek | Towns of Salem and Concord, Champaign County | - | PV | PV | - |
| Mad River | Towns of Salem, Concord, Mad River, and Urbana, Champaign County | - | V | PV | - |
| Melvin Miller Park | City of Urbana, Champaign County | - | PV | PV | - |
| Moore Run | Town of Urbana, Champaign County and Town of Moorefield, Clark County | - | PV | PV | - |
| Muzzys Lake | Town of Urbana, Champaign County | - | V | V | - |
| North Fork Deer Creek | Town of Pleasant, Clark County | - | V | V | - |
| Ohio Caverns | Town of Salem, Champaign County | 92, 93 | PV | PV | - |
| Pleasant Run | Towns of Wayne and Rush, Champaign County | - | V | PV | - |
| Proctor Run | Town of Rush, Champaign County and Town of Union, Union County | - | V | PV | - |
| Roadside Park | City of Urbana, Champaign County | - | V | V | - |
| Second Price Pond | Town of Urbana, Champaign County | - | V | V | - |
| Spain Creek | Towns of Wayne and Rush and Village of North Lewisburg, Champaign County | - | PV | PV | - |
| Spring Fork | Town of Goshen, Champaign County and Town of Pike, Madison County | - | PV | PV | - |
| Stanley Park | Village of North Lewisburg, Champaign County | - | V | V | - |
| Third Price Pond | Town of Urbana, Champaign County | - | V | V | - |
| Treacle Creek | Towns of Wayne, Union, and Goshen, Champaign County and Town of Union, Union County | - | V | PV | V |
| Urbana Country Club | Town of Union, Champaign County | 44 | V | PV | NV |
| Ward Street Park | City of Urbana, Champaign County | - | V | V | - |

| Visually Sensitive Resource[1] | Location | VP Number[2] | Project Visibility[3] | | |
|---|---|---|---|---|---|
| | | | Viewshed[4] | | Cross Section[5] |
| | | | Topography | Vegetation | |
| Woodland Golf Course | Town of Union, Champaign County | - | V | PV | - |
| **Cemeteries** | | | | | |
| Baptist Cemetery | Town of Urbana, Champaign County | - | V | V | - |
| Beltz Cemetery | Town of Wayne, Champaign County | - | V | V | - |
| Black Cemetery | Town of Rush, Champaign County | - | V | V | - |
| Britton Cemetery | Town of Goshen, Champaign County | - | V | V | - |
| Buck Creek Cemetery | Town of Union, Champaign County | - | V | V | - |
| Butcher Cemetery | Village of North Lewisburg, Champaign County | - | NV | NV | - |
| Cable Cemetery | Town of Wayne, Champaign County | - | V | V | - |
| Comstock-Niles Cemetery | Town of Urbana, Champaign County | - | V | V | - |
| Corbet Cemetery | Town of Wayne, Champaign County | - | V | V | - |
| Fairview Cemetery | Town of Union, Champaign County | - | V | V | - |
| Foley Cemetery | Town of Moorefield, Clark County | - | V | V | - |
| French Cemetery | Town of Union, Champaign County | - | V | V | - |
| Georges Chapel-Methodist Episcopal Cemetery | Town of Urbana, Champaign County | - | V | V | - |
| Grace Cemetery | Town of Union, Champaign County | - | V | V | - |
| Grandview Cemetery | Town of Urbana, Champaign County | - | V | V | - |
| Haines Cemetery | Town of Rush, Champaign County | - | V | V | - |
| Hazel Cemetery | Town of Salem, Champaign County | - | V | V | - |
| Hopewell #2 Cemetery | Town of Union, Champaign County | - | V | V | - |
| Hopewell Cemetery | Town of Union, Champaign County | - | V | V | - |
| Jenkins Chapel Cemetery | Town of Wayne, Champaign County | - | V | V | - |
| Johnson Cemetery | Town of Wayne, Champaign County | - | V | V | - |
| Kings Creek Baptist Cemetery | Town of Salem, Champaign County | - | V | V | - |
| Kings Creek Cemetery | Town of Salem, Champaign County | - | V | V | - |
| Latham Cemetery | Town of Salem, Champaign County | 9, 79 | V | NV | - |
| Maple Grove Cemetery | Town of Goshen, Champaign County | - | V | V | - |
| Maple Grove Cemetery | Town of Rush, Champaign County | - | V | V | - |
| Martin Cemetery | Town of Rush, Champaign County | - | V | V | - |
| McConkey Cemetery | Town of Pleasant, Clark County | - | V | V | - |
| Mead Cemetery | Town of Wayne, Champaign County | - | V | V | - |
| Mitchell Cemetery | Town of Goshen, Champaign County | 46 | V | V | - |
| Moorefield Chapel Cemetery | Town of Moorefield, Clark County | - | NV | NV | - |
| Mount Carmel Cemetery | Town of Wayne, Champaign County | 51 | V | V | - |
| Mount Tabor Cemetery | Town of Salem, Champaign County | - | V | V | - |

| Visually Sensitive Resource[1] | Location | VP Number[2] | Project Visibility[3] | | |
|---|---|---|---|---|---|
| | | | Viewshed[4] | | Cross Section[5] |
| | | | Topography | Vegetation | |
| Oak Grove Cemetery | Town of Salem, Champaign County | - | V | V | - |
| Oakdale Cemetery | City of Urbana, Champaign County | - | V | V | - |
| Old Friends Cemetery | Town of Salem, Champaign County | - | V | V | - |
| Old Graveyard Cemetery | City of Urbana, Champaign County | - | V | V | - |
| Pence Cemetery | Town of Urbana, Champaign County | - | V | V | - |
| Pisgah Cemetery | Town of Union, Champaign County | - | V | V | - |
| Pleasant Hill Cemetery | Town of Moorefield, Clark County | - | V | V | - |
| Sharon Cemetery | Town of Union, Champaign County | - | V | V | - |
| Snowhill Cemetery | Town of Salem, Champaign County | - | V | V | - |
| Sodom Cemetery | Town of Rush, Champaign County | - | V | V | - |
| Thomas Cemetery | Town of Salem, Champaign County | - | V | V | - |
| Townsend Cemetery | Town of Wayne, Champaign County | - | V | V | - |
| Treacles Creek Cemetery | Town of Goshen, Champaign County | - | V | V | - |
| Union Chapel Cemetery | Town of Union, Champaign County | - | V | V | - |
| Unnamed #1 Cemetery | Town of Goshen, Champaign County | - | V | V | - |
| Unnamed #2 Cemetery | Town of Goshen, Champaign County | - | V | V | - |
| Unnamed Cemetery | Town of Union, Champaign County | - | V | V | - |
| Vernon Cemetery | Town of Pleasant, Clark County | - | V | V | - |
| White Cemetery | Town of Union, Champaign County | - | V | V | - |
| Winn Cemetery | Town of Urbana, Champaign County | - | V | NV | - |
| Wolfe Cemetery | Town of Union, Champaign County | - | V | V | - |
| Wolfe Cemetery | Town of Urbana, Champaign County | - | V | V | - |
| Woodstock Cemetery | Town of Rush, Champaign County | - | V | V | NV |
| **Transportation Corridors** | | | | | |
| State Highway 4 | Town of Moorefield, Clark Cty, Towns of Union and Goshen, Champaign Cty, Town of Union, Union Cty | 123, 124, 125, 126 | PV | PV | NV |
| State Highway 29 | Towns of Salem, Urbana, Union, and Goshen, City of Urbana, Village of Mechanicsburg, Champaign Cty | 14, 15, 16, 40, 116, 126 | PV | PV | PV |
| State Highway 54 | Towns of Urbana and Union, Champaign County and Town of Pleasant, Clark County | 117, 118, 119, 120, 121, 122 | PV | PV | - |
| State Highway 55 | Towns of Urbana and Mad River and City of Urbana, Champaign County | - | PV | PV | - |
| State Highway 56 | Towns of Union and Goshen, Champaign County | 123 | PV | PV | - |
| State Highway 161 | Towns of Union and Goshen, Champaign County and Town of Union, Union County | 23, 27 | V | V | PV |
| State Highway 187 | Town of Goshen, Champaign County | - | V | V | - |
| State Highway 245 | Towns of Salem, Wayne, and Rush and Village of N. Lewisburg, Champaign Cty | 70, 75, 77, 81, 88, 106 | PV | PV | - |
| State Highway 296 | Towns of Salem and Wayne, Champaign County | 29, 71 | V | PV | - |

| Visually Sensitive Resource[1] | Location | VP Number[2] | Project Visibility[3] | | |
|---|---|---|---|---|---|
| | | | Viewshed[4] | | Cross Section[5] |
| | | | Topography | Vegetation | |
| State Highway 507 | Town of Salem, Champaign County | - | PV | PV | - |
| State Highway 559 | Towns of Rush and Goshen and Villages of North Lewisburg and Woodstock, Champaign County | 130, 131, 133 | PV | PV | - |
| State Highway 814 | Towns of Salem and Union, Champaign County | 28, 43, 60, 61 | V | V | - |
| US Highway 36 | Towns of Urbana, Union, Wayne, and Rush, and City of Urbana, Champaign Cty, Town of Union, Union Cty | 41, 42, 43, 52, 116 | PV | PV | V |
| US Highway 68 | Towns of Salem and Urbana and City of Urbana, Champaign County, and Town of Moorefield, Clark County | 38, 39, 115 | PV | PV | V |

[1]Resource located within 5 miles of a proposed turbine.
[2]Viewpoint occurs within 100 feet of identified sensitive site. If no viewpoint (VP) number is indicated, no photo was obtained during fieldwork.
[3]Project visibility is indicated as follows: V=Visible, PV=Partly Visible, NV=Not Visible, U=Undetermined.
[4]Does not take into account screening provided by structures and street trees.
[5]Cross section visibility only applies to views along the selective lines of site illustrated in Figure 8.

# Appendix C

Photo Log and Field Notes

(See Enclosed CD)

Viewpoint 1

Viewpoint 2

Viewpoint 3

Viewpoint 4

Viewpoint 5

Viewpoint 6

Viewpoint 7

Viewpoint 8

**Buckeye Wind Project**

Champaign County, Ohio

Appendix C: Photo Log

*Denotes Image Used In Visual Simulation

Sheet 1 of 18

March 2009

EDR


Viewpoint 9


Viewpoint 10


Viewpoint 11


Viewpoint 12


Viewpoint 13


Viewpoint 14 *


Viewpoint 15


Viewpoint 16

## Buckeye Wind Project
Champaign County, Ohio

Appendix C: Photo Log

*Denotes Image Used In Visual Simulation

Sheet 2 of 18

March 2009

EDR


Viewpoint 17


Viewpoint 18


Viewpoint 19


Viewpoint 20


Viewpoint 21


Viewpoint 22


Viewpoint 23


Viewpoint 24

**Buckeye Wind Project**
Champaign County, Ohio

Appendix C: Photo Log
*Denotes Image Used In Visual Simulation
Sheet 3 of 18

March 2009

EDR

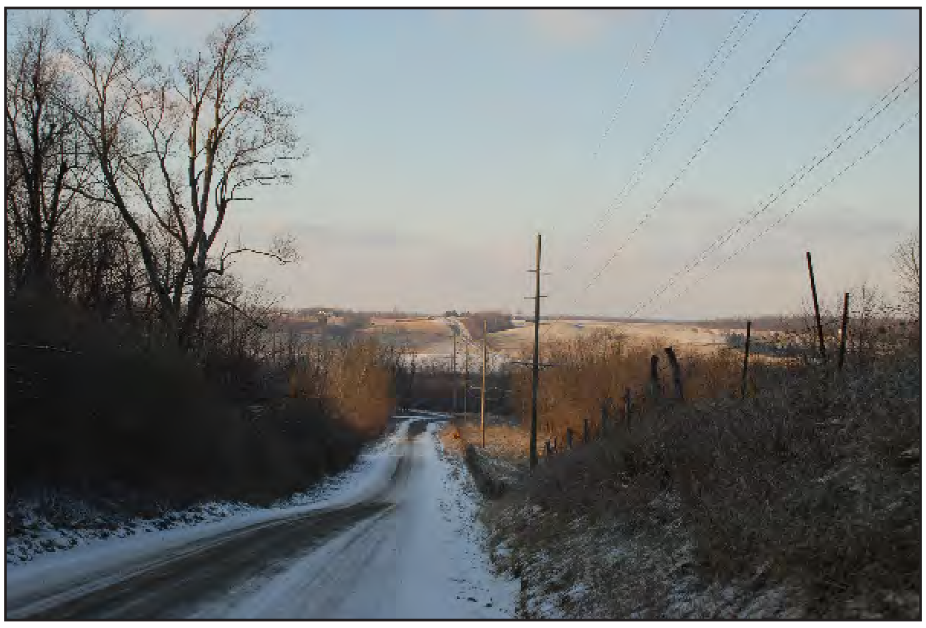
Viewpoint 25

Viewpoint 26

Viewpoint 27

Viewpoint 28

Viewpoint 29 *



Viewpoint 30

Viewpoint 31

Viewpoint 32

**Buckeye Wind Project**
Champaign County, Ohio

Appendix C: Photo Log

*Denotes Image Used In Visual Simulation

Sheet 4 of 18

March 2009

EDR

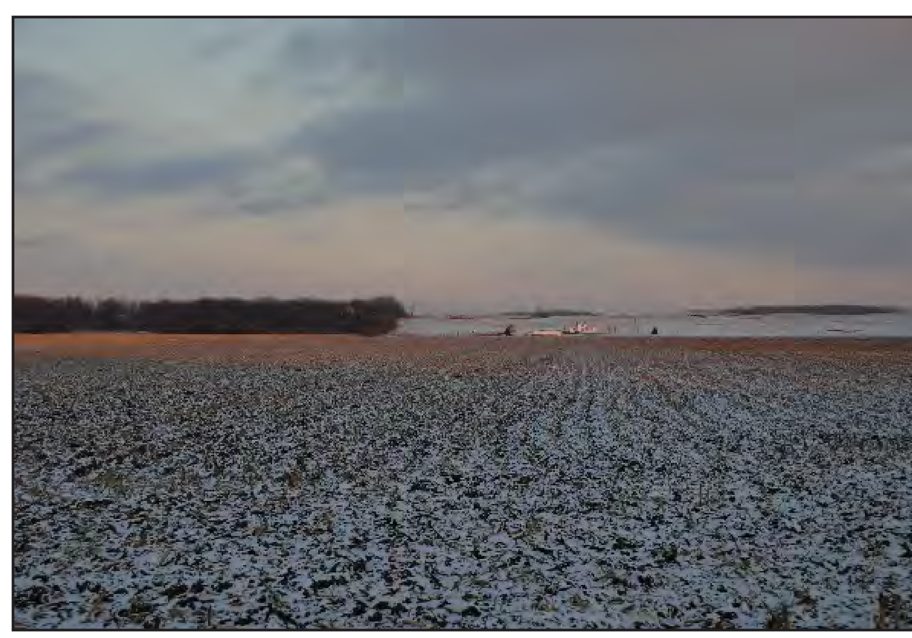
Viewpoint 33

Viewpoint 34

Viewpoint 35

Viewpoint 36

Viewpoint 37



Viewpoint 38

Viewpoint 39

Viewpoint 40

**Buckeye Wind Project**
Champaign County, Ohio

Appendix C: Photo Log

*Denotes Image Used In Visual Simulation

Sheet 5 of 18

March 2009

EDR

Viewpoint 41 *

Viewpoint 42

Viewpoint 43

Viewpoint 44

Viewpoint 45 *

Viewpoint 46

Viewpoint 47

Viewpoint 48 *

**Buckeye Wind Project**
Champaign County, Ohio

Appendix C: Photo Log
*Denotes Image Used In Visual Simulation
Sheet 6 of 18

March 2009

EDR

Viewpoint 49

Viewpoint 50

Viewpoint 51

Viewpoint 52 *

Viewpoint 53

Viewpoint 54 *

Viewpoint 55

Viewpoint 56

**Buckeye Wind Project**
Champaign County, Ohio

Appendix C: Photo Log

*Denotes Image Used In Visual Simulation

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March 2009

EDR

Viewpoint 57

Viewpoint 58

Viewpoint 59

Viewpoint 60

Viewpoint 61 *

Viewpoint 62

Viewpoint 63

Viewpoint 64

## Buckeye Wind Project

Champaign County, Ohio

Appendix C: Photo Log

*Denotes Image Used In Visual Simulation

Sheet 8 of 18

March 2009

EDR


Viewpoint 65


Viewpoint 66


Viewpoint 67


Viewpoint 68


Viewpoint 69


Viewpoint 70


Viewpoint 71


Viewpoint 72

**Buckeye Wind Project**
Champaign County, Ohio

Appendix C: Photo Log
*Denotes Image Used In Visual Simulation
Sheet 9 of 18

March 2009

EDR


Viewpoint 73


Viewpoint 74


Viewpoint 75

Viewpoint 76


Viewpoint 77


Viewpoint 78


Viewpoint 79


Viewpoint 80

## Buckeye Wind Project
Champaign County, Ohio

Appendix C: Photo Log

*Denotes Image Used In Visual Simulation

Sheet 10 of 18

March 2009

Viewpoint 81

Viewpoint 82

Viewpoint 83

Viewpoint 84

Viewpoint 85

Viewpoint 86

Viewpoint 87

Viewpoint 88


Viewpoint 89


Viewpoint 90


Viewpoint 91


Viewpoint 92


Viewpoint 93


Viewpoint 94


Viewpoint 95 *


Viewpoint 96

**Buckeye Wind Project**
Champaign County, Ohio

Appendix C: Photo Log
*Denotes Image Used In Visual Simulation
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March 2009

EDR


Viewpoint 97


Viewpoint 98


Viewpoint 99


Viewpoint 100


Viewpoint 101


Viewpoint 102


Viewpoint 103


Viewpoint 104

**Buckeye Wind Project**
Champaign County, Ohio

Appendix C: Photo Log
*Denotes Image Used In Visual Simulation
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March 2009

Viewpoint 105

Viewpoint 106

Viewpoint 107

Viewpoint 108

Viewpoint 109


Viewpoint 110

Viewpoint 111

Viewpoint 112

**Buckeye Wind Project**

Champaign County, Ohio

Appendix C: Photo Log

*Denotes Image Used In Visual Simulation

Sheet 14 of 18

March 2009

Viewpoint 113

Viewpoint 114

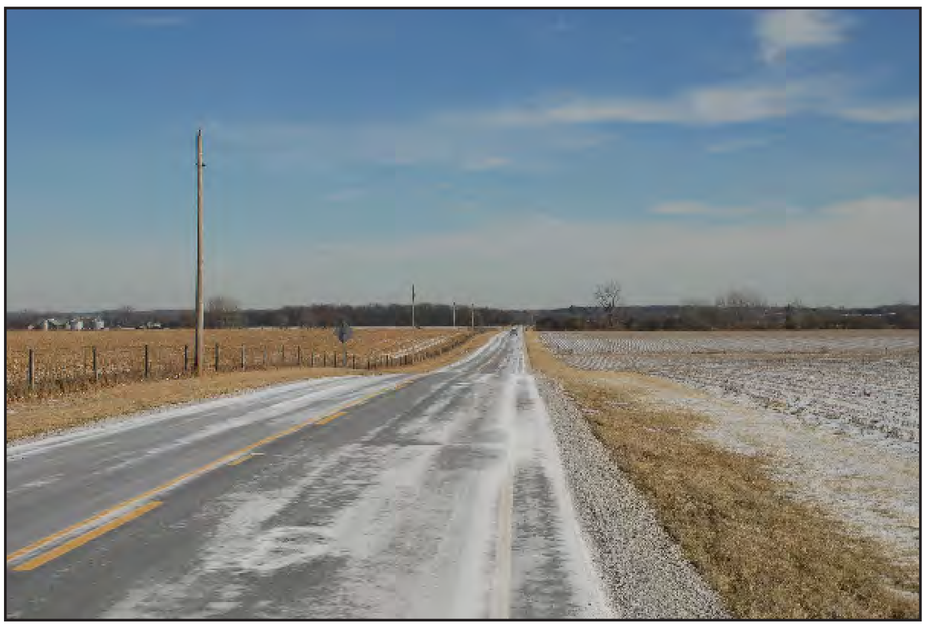
Viewpoint 115

Viewpoint 116

Viewpoint 117

Viewpoint 118

Viewpoint 119 *



Viewpoint 120

**Buckeye Wind Project**
Champaign County, Ohio

Appendix C: Photo Log

*Denotes Image Used In Visual Simulation

Sheet 15 of 18

March 2009

EDR

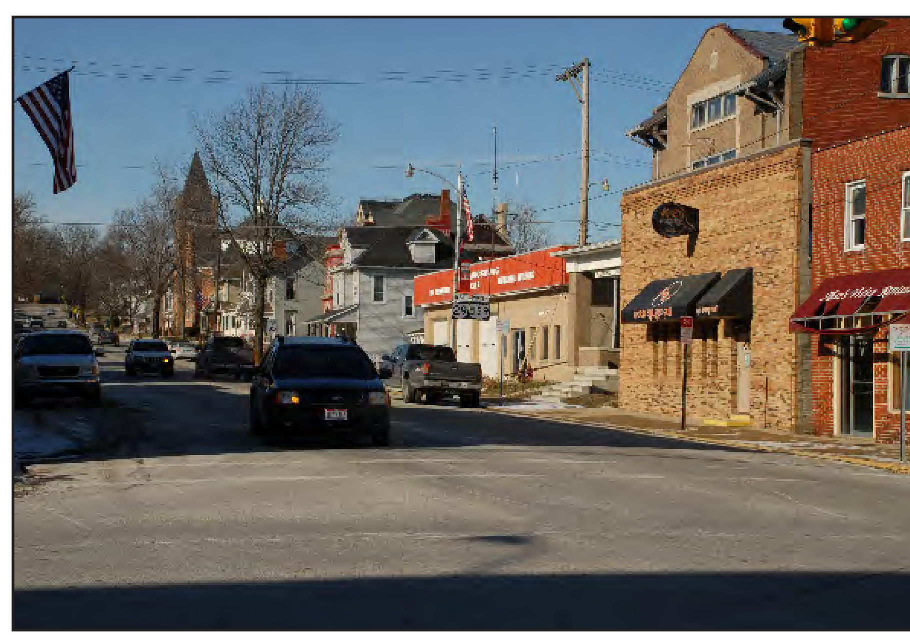

Viewpoint 121


Viewpoint 122


Viewpoint 123 *


Viewpoint 124


Viewpoint 125


Viewpoint 126


Viewpoint 127


Viewpoint 128 *

## Buckeye Wind Project
Champaign County, Ohio

Appendix C: Photo Log

*Denotes Image Used In Visual Simulation

Sheet 16 of 18

March 2009

EDR


Viewpoint 129


Viewpoint 130


Viewpoint 131 *


Viewpoint 132


Viewpoint 133


Viewpoint 134


Viewpoint 135


Viewpoint 136

**Buckeye Wind Project**
Champaign County, Ohio

Appendix C: Photo Log
*Denotes Image Used In Visual Simulation
Sheet 17 of 18

March 2009

EDR


Viewpoint 137


Viewpoint 138


Viewpoint 139

## 07079 Buckeye Windpower Project

Date: 1/24/08 Weather: OVERCAST / SUNNY Winds: Sheet: 1 of 6 Car #: GP/WH

| VP # | GPS # | Photo Reference | TIME | Location/ Similarity Zone/ Comments/Road Name |
|---|---|---|---|---|
| 1 | 001 | 001 - 004 | 9:42 | South/South W 210° — |
| 2 | 002 | 005 - 010 | 9:49 | WEST → 001 MET TOWER / CR-28 |
| 3 | 003 | 011 - 021 | 10:22 | NORTH-NORTH WEST — Ag FIELDS — N12, N8, N4, N5, N2 — LOGAN 44 |
| 4 | 004 | 022 - 031 | 10:26 | NORTH-NORTH WEST — Ag FIELDS — LOGAN 44 |
| 5 | 005 | 032 - 038 | 10:33 | NORTH WEST — Ag FIELDS — LOGAN 44 |
| 6 | 006 | 039 - 048 | 10:39 | NORTH WEST — Ag FIELDS — LOGAN 44 |
| 7 | 007 | 049 - 056 | 10:49 | EAST — Ag LANDS — |
| * 8 | 008 | 057 - 070 | 10:52 | 360° — UNION CHAPEL — |
| RS * 9 | 009 | 071 - 078 | 11:54 | CARMEL CEMETERY — North Northwest |
| 10 | 010 | 079 - 087 | 12:13 | North — FLATFOOT Rd |
| RS * 11 | 011 | 088 - 096 | 12:59 | |
| RS 12 | 012 | 097 - 099 | 1:23 | WEST — UNION CEM. |
| RS 13 | 013 | 100 - 111 | 1:36 | McADAMS & Perry — Field Ag |
| 14 | 014 | 112 - 130 | 3:11 | Tower [illegible] 4 — RT 29 — Ag LAND |
| 15 | 015 | 131 - 139 | 3:15 | FAIR VIEW CEM. — RT 29 |
| 16 | 016 | 140 - 142 | 3:18 | Rt 29 & Mutual Union — (Hamlet) |
| 17 | 017 | 143 - 164 | 3:21 | Mutual Union Rd — Ag Land |
| 18 | 018 | 165 - 170 | 3:32 | Mutual Union Rd — Ag Land |
| 19 | 019 | 171 - 180 | 3:41 | Springtown — Ag LAND — CELL TOWER |
| 20 | 020 | 181 - 192 | 3:46 | Madden Rd — Ag LAND — |
| 21 | 021 | 193 - 212 | 3:49 | Madden Rd — Ag LAND — |
| 22 | 022 | 213 - 226 | 3:51 | Madden Rd — Ag LAND — |
| 23 | 023 | 227 - 238 | 3:58 | Yankeetown Rd — Ag LAND — |
| 24 | 024 | 239 - 246 | 4:02 | S. Parkview — Ag LAND — |

**07079 Buckeye Windpower Project**

Date: 1-24-08 1-25-08 Weather: Winds: Sheet: 2 of 6 Car #:

| VP # | GPS # | Photo Reference | TIME | Location/ Similarity Zone/ Comments/Road Name |
|---|---|---|---|---|
| 25 | 025 | 247 - 250 | 4:09 | AG-LAND / STRINGTOWN Rd / |
| 26 | 026 | 251 - 268 | 4:12 | AG-LAND / TALBOTT Rd / |
| 27 | 027 | 269 - 286 | 4:18 | AG-LAND / RT 161 / |
| 28 | 028 | 287 - 300 | 4:30 | AG-LAND / TOWER 2 / LUDLOW Rd |
| 29 | 029 | 301 - 313 | 4:34 | AG-LAND / 3 TOWERS IN VIEW / LUDLOW Rd |
| 30 | 030 | 314 - 316 | 4:43 | AG LAND / |
| 31 | 031 | 317 - 335 | 4:47 | AG LAND / Johnson Rd |
| 32 | 032 | 336 - 346 | 4:55 | AG LAND / |
| 33 | 033 | 347-365 | 5:04 | AG LAND / RT 169 |
| 34 | 034 | 366 - 374 | 5:07 | AG LAND / RT 169 |
| 35 | 035 | 0375 - 384 | 5:10 | AG LAND / MOUNT TABOR RD |
| 36 | 036 | 0385 - 389 | 5:19 | MAC-O-CHEEK CASTLE / R287 & 245 |
| 37 | 037 | 0390 - 392 | 5:23 | MAC-OCHEEK CASTLE / RT 245 |
| 38 | 038 | 393 - 404 | 5:30 | WEST LIBERTY SCHOOL / RT 68 |
| 39 | 039 | 0405 - 424 | 5:37 | RT 68 |
| 40 | 040 | 0425 427 | 7:44 AM | |
| 41 | 041 | 0428 - 434 | 7:50 | RT 36 - TOWERS |
| 42 | 042 | 0435 - 450 | 7:52 | RT 36 - TOWERS |
| 43 | 043 | 0451 - 456 | 8:00 | RT 36 - |
| 44 | 044 | 0457 - 0467 | 8:03 | URBANA Country Club |
| 45 | 045 | 0468 0479 | 8:10 | |
| 46 | 046 | 0480 - 493 | 8:13 | SHARON CEMETERY - Stringtown Rd |
| 47 | 047 | 0494 - 516 | 8:15 | Structure (1/31311) - STRINGTOWN Rd |
| 48 | 048 | 517 - 532 | 8:18 | - Stringtown Rd |

# 07079 Buckeye Windpower Project

Date: 1-25-08 Weather: CLEAR Winds: Sheet: 3 of 6 Car #: GP/WTT

| VP # | GPS # | Photo Reference | TIME | Location/ Similarity Zone/ Comments/Road Name |
|---|---|---|---|---|
| 49 | 049 | 533 - 538 | 8:21 | CAMBRIAN Rd. / RES. HOMES |
| 50 | 050 | 539 - 545 | 8:23 | CAMBRIAN Rd. / RES. HOMES |
| 51 | 051 | 546 - 557 | 8:29 | SODUM-CLARK CEMETERY / RT 36 |
| 52 | 052 | 0558 - 583 | 8:32 | RT 36 / |
| 53 | 053 | 0584 - 0598 | 8:35 | (RS) PERRY Rd RS of 013 |
| 54 D | 54 | 0599 - 624 | 8:40 | UNION CEMETERY RS of 012 / |
| 55 | 055 | 0625 - 0640 | 8:46 | RS OF 011 |
| 56 | 056 | 0641 - 0657 | 8:49 | EVANS RD |
| 57 | 057 | 0658 - 0670 | 8:51 | EVANS RD |
| 58 | 058 | 0671 - 0674 | 8:55 | SWISHER Rd |
| 59 | 059 | 0675 - 0690 | 8:56 | SWISHER Rd |
| 60 | 060 | 0691 - 703 | 8:59 | RT 814 / |
| 61 | 061 | 0704 - 716 | 9:02 | → RT 814 & 296 |
| 62 | 062 | 0717 - 736 | 9:06 | RT 296 (URBANA WOODSTOCK Rd) |
| 63 | 063 | 0737 - 761 | 9:08 | RT 296 (URBANA WOODSTOCK Rd) |
| 64 | 064 | 0762 - 0788 | 9:12 | URBANA WOODSTOCK RD (296) |
| 65 | 065 | 0789 - 0802 | 9:15 | JENKINS CHAPEL CEMETERY - URBANA WOODSTOCK RD |
| 66 | 066 | 0803 - 816 | 9:31 | BLACK Rd - |
| 67 | 067 | 0817 - 822 | 9:34 | CABLE Rd (CABLE HAMLET) |
| 68 | 068 | 0823 - 835 | 9:37 | CABLE CEMETERY (CABLE UNITED METH) |
| 69 | 069 | 0836 - 0839 | 9:46 | BLACK Rd |
| 70 | 070 | 0840 - 0851 | 9:52 | MIDDLETOWN (HAMLET) |
| 71 | 071 | 0852 - 0857 | 9:57 | MIDDLETOWN Intersections |
| 72 | 072 | 0858 - 0869 | 10:01 | SUBSTATION / MINGO LEWISBURG RD |

## 07079 Buckeye Windpower Project

Date: 1-25-08 Weather: Winds: Sheet: 5 of 6 Car #:

| VP # | GPS # | Photo Reference | TIME | Location/ Similarity Zone/ Comments/Road Name |
|---|---|---|---|---|
| 97 | 097 | 1274 - 1289 | 11:40 | LOGAN 41 |
| 98 | 098 | 1290 - 1309 | 11:43 | LOGAN 41 |
| 99 | 099 | 1310 - 1335 | 11:46 | LOGAN 41 |
| 100 | 100 | 1336 - 1369 | 11:48 | ~~RT 287~~ (RS OF 008 RS) UNION CHAPEL CHURCH |
| 101 | 101 | 1370 - 1397 | 11:53 | Johnson Rd |
| 102 | 102 | 1398 - 1403 | 12:00 | GRAHAM CEMETERY - JOHNSON ROAD |
| 103 | 103 | 1404 - 1412 | 12:05 | SHEEKE Rd |
| 104 | 104 | 1413 - 1427 | 12:09 | GILBERT Rd / MAPLE GROVE CEM.) WRONG DIRECTION |
| 105 | 105 | 1428 - 1437 | 12:13 | Rt 245 |
| 106 | 106 | 1438 - 1442 | 12:15 | Rt 245 |
| 107 | 107 | 1443 - 1445 | 12:22 | ELM & WINDER ST. |
| 108 | 108 | 1446 - 1451 | 12:27 | LOGAN 44 |
| 109 | 109 | 1452 - 1456 | 12:31 | MT. MORIAH CEMETERY |
| 110 | 110 | 1457 - 1461 | 12:37 | MIDDLEBURG / RT 287 |
| 111 | 111 | 1462 - 1474 | 12:52 | RT 287 |
| 112 | 112 | 1475 - 1478 | 12:56 | RT 287 |
| 113 | 113 | 1479 - 1486 | 1:04 | RT 245 / WEST LIBERTY |
| 114 | 114 | 1487 - 1497 | 1:29 | RT 68 / Looking EAST |
| 115 | 115 | 1498 - 1512 | 1:35 | RT 68 / Looking EAST |
| 116 | 116 | 1513 - 1516 | 1:48 | Rt 29 |
| 117 | 117 | 1517 - 1528 | 1:53 | Rt 54 EAST |
| 118 | 118 | 1529 - 1535 | 1:55 | URBANA LOCAL Intermediate School / Rt 54 / EAST |
| 119 | 119 | 1536 - 1553 | 1:58 | Rt 54 - EAST |
| 120 | 120 | 1554 - 1566 | 2:03 | Rt 54 NEAST |

# 07079 Buckeye Windpower Project

Date: 1-25-08 Weather: CLEAR Winds: Sheet: 6 of 6 Car #:

| VP # | GPS # | Photo Reference | TIME | Location/ Similarity Zone/ Comments/Road Name |
|---|---|---|---|---|
| 121 | 121 | 1567 - 1568 | 2:09 | Buck Creek / RT 54 North |
| 122 | 122 | 1569 - 1573 | 2:15 | RT 54 / NORTH |
| 123 | 123 | 1574 - 1586 | 2:21 | RT 54 & 56 INTERSECTION / NORTH |
| 124 | 124 | 1587 - 1605 | 2:25 | RT 4 |
| 125 | 125 | 1606 - 1611 | 2:29 | RT 4 Mechanicsburg Edge |
| 126 | 126 | 1612 - 1623 | 2:30 | RT 4 & RT 29 (Intersection of Mechanicsburg) |
| 127 | 127 | 1624 - 1626 | 2:34 | Parkview Rd (GOSHEN MEMORIAL PARK) |
| 128 | 128 | 1627 - 1647 | 2:40 | Nature Conservancy |
| 129 | 129 | 1648 - 1661 | 2:44 | Parkview / WEST |
| 130 | 130 | 1662 - 1674 | 2:52 | RT 559 / WEST |
| 131 | 131 | 1675 - 1681 | 2:55 | RT 559 / WEST |
| 132 | 132 | 1682 - 1685 | 2:57 | Woodstock Cemetery — BENNETT STR. |
| 133 | 133 | 1686 - 1695 | 3:02 | RT 559 |
| 134 | 134 | 1696 - 1706 | 3:09 | McColly Rd |
| 135 | 135 | 1707 - 1725 | 3:14 | Covered Bridge (Big Darby Scenic Byway) |
| 136 | 136 | 1726 - 1737 | 3:22 | COVERED BRIDGE ( " " ) |
| 137 | 137 | 1738 - 1750 | 3:24 | " " |
| 138 | 138 | 1751 - 1759 | 3:26 | (BIG DARBY SCENIC BYWAY) |
| 139 | 139 | 1760 - 1770 | 3:29 | ( " " ) |

COMPLETE AT 3:34 1-25-08

**07079 Buckeye Windpower Project**

Date: 1.25.08 Weather: CLEAR Winds: Sheet: 4 of 6 Car #:

| VP # | GPS # | Photo Reference | TIME | Location/ Similarity Zone/ Comments/Road Name |
|---|---|---|---|---|
| 73 | 073 | 0870 - 0889 | 10:03 | MINGO LEWISBURG Rd / TOWER 3 / |
| 74 | 074 | 0890 - 905 | 10:05 | MINGO LEWISBURG RD / TW 2 / |
| 75 | 075 | 0906 - 922 | 10:08 | MINGO HAMLET / URBANA RD |
| 76 | 076 | 0923 - 932 | 10:11 | MINGO CHURCH |
| ★ 77 | 077 | 0933 - 0946 | 10:14 | RT 245 |
| 78 | 078 | 0947 - 0981 | 10:16 | HAMMOND Rd / |
| 79 | 079 | 0982 - 0999 | 10:21 | MT CARMEL CEMETERY |
| 80 | 080 | 1000 - 1025 | 10:27 | KENNARD KINGSCREEK Rd |
| 81 | 081 | 1026 - 1042 | 10:31 | GEN. LOC. THOMAS CEM. — RT 245 |
| 82 | 082 | 1043 - 1067 | 10:34 | KANAGY Rd |
| 83 | 083 | 1068 - 1081 | 10:37 | LUDLOW Rd |
| 84 | 084 | 1082 - 1099 | 10:39 | OAK GROVE CEMETERY / LUDLOW RD |
| 85 | 085 | 1100 - 1108 | 10:44 | KENNARD KINGSCREEK Rd |
| 86 | 086 | 1109 - 1123 | 10:46 | KENNARD KINGSCREEK (KENNARD Hamlet) |
| 87 | 087 | 1124 - 1140 | 10:51 | W. KENNARD |
| 88 | 088 | 1141 - 1152 | 10:56 | Rt 245 |
| ★ 89 | 089 | 1153 - 1181 | 11:04 | MOUNT TABER CEMETERY \| NPS \| RT 245 |
| ★ 90 | 090 | 1182 - 1200 | 11:05 | MOUNT TABER CEMETERY \| NPS \| RT 245 |
| ★ 91 | 091 | 1201 - 1214 | 11:11 | MOUNT TABER CEMETERY \| NPS \| RT 245 |
| 92 | 092 | 1215 - 1223 | 11:15 | OHIO CAVERNS |
| 93 | 093 | 1224 - 1237 | 11:19 | OHIO CAVERNS |
| 94 | 094 | 1238 - 1243 | 11:26 | Mount TABOR Rd |
| 95 | 095 | 1244 - 1264 | 11:31 | BUMP Rd. } EAST |
| ★ 96 | 096 | 1265 - 1273 | 11:33 | BUMP Rd } NORTH |

# Appendix D

Digital Simulations

(See Enclosed CD)

# Appendix E

Typical Overhead Line/Substation Photos and Details

1.


2.


## Buckeye Wind Project
Champaign County, Ohio

Appendix E: Typical Overhead Line/Substation Photos and Details

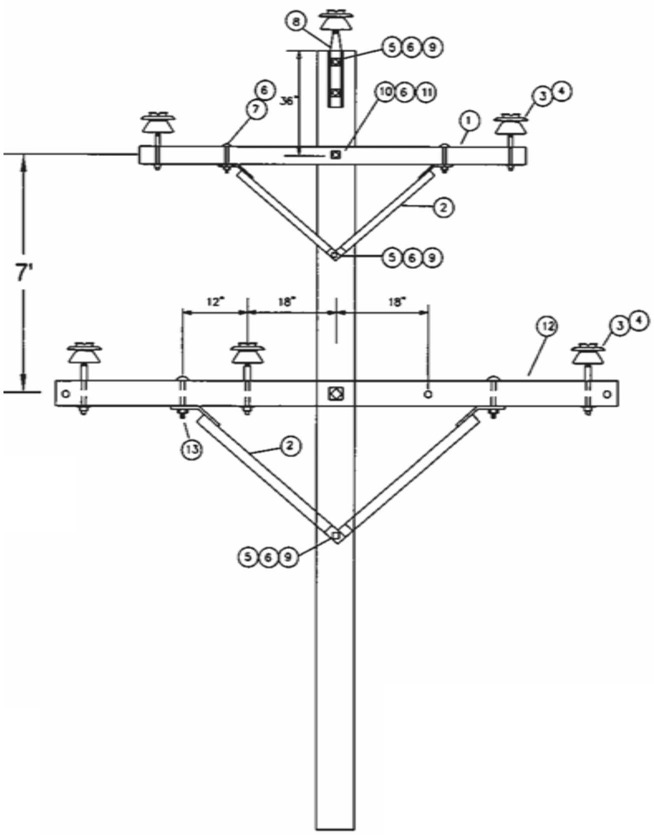
Sheet 1 of 5: Highland Wind Project, Cambria County, Pennsylvania

March 2009

EDR

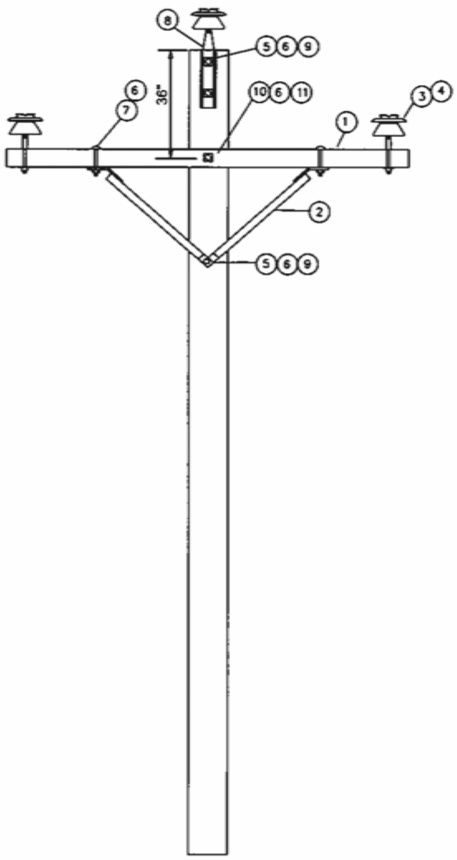
3.

4.




| ITEM | SYMBOL | QTY | DESCRIPTION |
|---|---|---|---|
| 1 | 014-104.000 | 1 | CROSSARM 4"x5"x9' |
| 2 | 011-077.000 | 2 | 60"/30" BRACE |
| 3 | 015-295.000 | 6 | 34.5kv PIN INSULATOR |
| 4 | 011-432.300 | 5 | STEEL INSULATOR PIN |
| 5 | 059 SERIES | 5 | 5/8" MACHINE BOLT TO SUIT |
| 6 | 059-984.000 | 10 | 2-1/4" SQUARE WASHER |
| 7 | 059-416.000 | 2 | 1/2" x6" BOLT |
| 8 | 2770-A24-130 | 1 | POLE TOP PIN (HUGHES BROTHERS) |
| 9 | 011-380.100 | 5 | 5/8" MF LOCKNUT |
| 10 | 059 SERIES | 2 | 3/4" BOLT TO SUIT |
| 11 | 011-380.200 | 2 | 3/4" MF LOCKNUT |
| 12 | 014-115.000 | 1 | 3-3/4"x4-3/4"x12' CROSSARM |
| 13 | 059-108.000 | 2 | CARRIAGE BOLT 1/2"x5" |

* CROSSARM(S) MAY BE DOUBLED - SEE CONSTRUCTION DRAWINGS




| ITEM | SYMBOL | QTY | DESCRIPTION |
|---|---|---|---|
| 1 | 014-104.000 | 1 | CROSSARM 4"x5"x9' |
| 2 | 011-077.000 | 1 | 60"/30" BRACE |
| 3 | 015-295.000 | 3 | 34.5kv PIN INSULATOR |
| 4 | 011-432.300 | 2 | STEEL INSULATOR PIN |
| 5 | 059 SERIES | 4 | ⅝" MACHINE BOLT TO SUIT |
| 6 | 059-984.000 | 7 | 2-1/4" SQUARE WASHER |
| 7 | 059-416.000 | 2 | ½"x6" BOLT |
| 8 | 2770-A24-130 | 1 | POLE TOP PIN (HUGHES BROTHERS) |
| 9 | 011-380.100 | 4 | ⅝" MF LOCKNUT |
| 10 | 059 SERIES | 1 | ¾" BOLT TO SUIT |
| 11 | 011-380.200 | 1 | ¾" MF LOCKNUT |

*CROSSARM MAY BE DOUBLED - SEE CONSTRUCTION DRAWINGS

7.

*Appendix I*
*Buckeye Facility Socioeconomic Report for the Buckeye Wind Project*

# BUCKEYE WIND PROJECT

## EVERPOWER WIND HOLDINGS, INC.
## BUCKEYE WIND LLC

April 2009

Landscape Architects, Architects,
Engineers and Planners, P.C.

## Buckeye Facility Socioeconomic Report

Table of Contents

Introduction

## Introduction

Central Ohio is an ideal place for harvesting wind due to the two glacial ridges that stretch across the region, capturing winds at high speeds. The magnitude of potential energy currently available is significant as "central Ohio could potentially power up to 165,000 Ohio homes within the next decade".[1] The glacial ridge pertinent to the proposed Buckeye Wind Project starts in Champaign County and runs north to Logan County and onward to Hardin County.

To capitalize on this valuable resource, Buckeye Wind LLC, a wholly owned subsidy of EverPower Wind Holdings, Inc. (hereafter referred to as "Buckeye Wind") proposes to construct a wind-powered electrical generating facility in Champaign County, Ohio. The Buckeye Wind Project includes all turbines, collection lines, associated substations and all other associated equipment (hereafter referred to as "Facility"). The "Project Area" means the Facility plus a setback of 1000 feet from the wind turbines. The proposed Facility will be located in the Townships of Goshen, Rush, Salem, Union, Urbana, and Wayne in Champaign County. An additional eleven (11) townships, one (1) city, five (5) villages, one (1) Census- designated place and four (4) counties, in addition to Champaign County, lie in the vicinity and within a five-mile radius of the Facility. These include the townships of Concord and Mad River, the City of Urbana as well as the villages of Mutual, Mechanicsburg, North Lewisburg and Woodstock in Champaign County; the townships of Moorefield, and Pleasant, Northridge, and the Village of Catawba in Clark County; the townships of Monroe and Zane in Logan County; the townships of Pike and Somerford in Madison County; and the townships of Allen and Union in Union County.

A principal impetus for clean renewable energy in Ohio comes from the Alternative Energy Portfolio Standard (AEPS), signed into law by Governor Strickland on May 1, 2008 (substitute Senate Bill 221). The law mandates that by 2025, at least 25 percent of all electricity sold in the state come from alternative energy resources. At least half of that standard, or 12.5 percent of electricity sold, must be generated by renewable resources, and at least half of this renewable energy must be generated in-state. In addition to renewables, the additional 12.5 percent of the overall 25 percent standard can also be met through alternative energy resources like third-generation nuclear power plants, fuel cells, energy efficiency programs, and clean coal technology that can control or prevent carbon dioxide emissions (www.pewclimate.or/node/5922). This goal is feasible, as Ohio could potentially generate 76,000 megawatts (MW) of renewable energy that would power 22 million homes (151% of Ohio's annual electricity sales).[2] A wind farm of the proposed scale is a positive step towards achieving this goal.

Further, Federal policy has recognized the need for increased supply of energy to the U.S., and for new renewable energy resources. The Project fulfills a need for the production and transmission of renewable energy, which would serve the public interest. The Project is consistent with Executive Order 13212 (dated May 18, 2001), which states:

[1] Gomberg, Amy, *"Ohio's Wind Energy Future,"* Environment Ohio and Environment Ohio Research and Policy Center, November 2006, Page 7.
[2] Gomberg, Amy, *"Ohio's Wind Energy Future,"* Environment Ohio and Environment Ohio Research and Policy Center, November 2006, Page 9.

> "The increased production and transmission of energy in a safe and environmentally sound manner is essential to the well being of the American people. In general, it is the policy of this Administration that executive departments and agencies shall take appropriate actions, to the extent consistent with applicable law, to expedite projects that will increase the production, transmission, or conservation of energy."

In addition, it is anticipated that the Obama-Biden administration will enhance the previous administration's policy. According to www.whitehouse.gov:

> "The energy challenges our country faces are severe and have gone unaddressed for far too long. Our addiction to foreign oil doesn't just undermine our national security and wreak havoc on our environment – it cripples our economy and strains the budgets of working families all across America. President Obama and Vice President Biden have a comprehensive plan to invest in alternative and renewable energy, end our addiction to foreign oil, address the global climate crisis and create millions of new jobs."

The Obama-Biden comprehensive New Energy for America plan has a number of objectives, which include creating five million new jobs over the next ten years, and ensuring that 10 percent of our electricity comes from renewable sources by 2012, and 25 percent by 2025 (www.whitehouse.gov/agenda/energy_and_environment/).

To ensure a comprehensive explanation of the action, Saratoga Associates was tasked with preparing a socioeconomic report for the proposed Facility. The following socioeconomic report satisfies the relevant requirements of Section 4906-13-07 of the Ohio Administrative Code to Implement Certification Requirements for Electric Generating Wind Facilities. The socioeconomic report specifically examines the regional demographics and economics; the existing industries and sources of employment; the existing tax base and tax revenues; the current county, township, city and school district budgets; the current tax contributions to the counties, townships, city and school districts; the community character and land use trends; the economic impacts of the wind farm; the benefits to the community; the potential regional impacts; and mitigation measures, assuming a Facility with rated capacity in the range of 131 MW to 182.5 MW is constructed.

# 1.0 Demographic and Economic Analysis

The study area for the proposed Facility and for this socioeconomic report includes the townships of Goshen, Rush, Salem, Union, Urbana and Wayne in Champaign County (hereafter referred to as "townships that will host the Facility"). However, it was also necessary to examine those geographic areas that are in the vicinity and are either completely or partially located within a five-mile radius from the outermost turbine. These geographic areas comprise the townships of Concord and Mad River, the City of Urbana as well as the villages of Mutual, Mechanicsburg, North Lewisburg and Woodstock in Champaign County; the townships of Moorefield and Pleasant, Northridge, and the Village of Catawba in Clark County; the townships of Monroe and Zane in Logan County; the townships of Pike and Somerford, in Madison County; and the townships of Allen and Union in Union County (hereafter referred to as "townships and communities within five-miles of the Facility").

Demographic, economic, and housing data were examined at five levels to provide the context used to benchmark characteristics and trends in this region of Ohio. These levels include townships that contain the Facility; townships and communities within five-miles of the Facility; Champaign County, (where the Facility is located); and Clark, Logan, Madison and Union counties (counties that are partially located within five-miles of the Facility); and the State of Ohio.

## 1.1 Population Trends

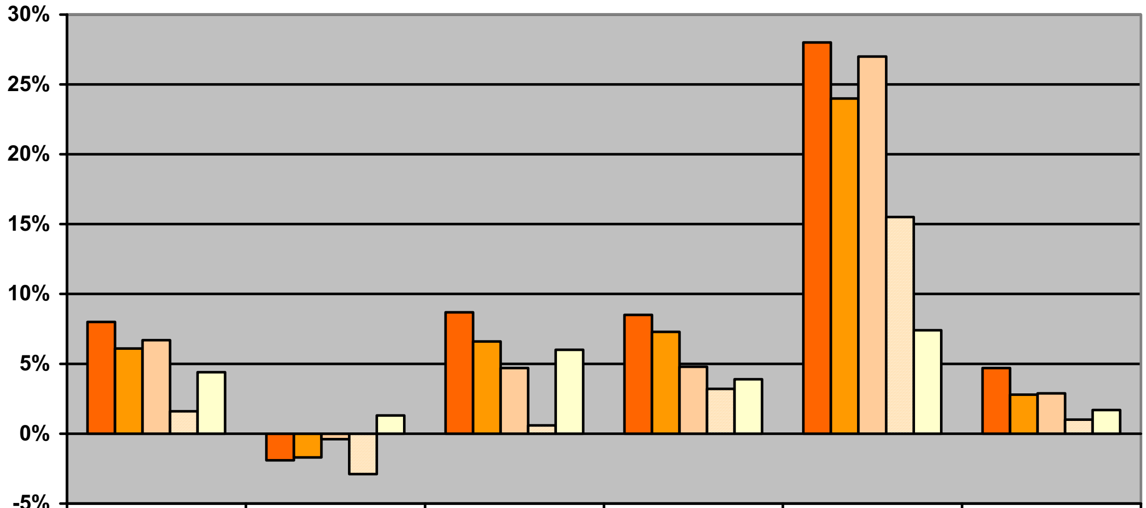
The townships that will host the Facility collectively comprised roughly 25,308 residents in 1990, and 27,017 in 2000. Based on estimates provided by the Ohio Office of Strategic Research, it is estimated that in 2007, approximately 27,256 persons resided within the townships of Goshen, Rush, Salem, Union, Urbana and Wayne in Champaign County. Much of this past growth can be attributed to unusually high population growth rates in the townships of Rush, Salem, Union and Wayne in Champaign County, which have all experienced double-digit growth from 1990 to 2000, ranging from 12.8% in Salem to 17.2% in Rush. Collectively, townships that will host the Facility experienced a population increase of 6.8% from 1990 to 2000. The robust population growth in the 1990s could be attributed to job growth in nearby employment centers, such as the Honda Plant in Marysville and Bellefontaine, as well as associated suppliers and manufacturers during the past decade. Other industries, such as health care, construction, and warehousing also contributed to this expansion, giving rise to "bedroom communities" throughout Champaign and its surrounding counties.

While population is projected to grow throughout the rest of Champaign County, data from the Ohio Office of Policy, Research and Strategic Planning indicate more modest population projections for the townships that will host the Facility, with population growth projected at less than 1%. The negative growth projected in the Township of Urbana, the biggest township that will host the Facility, has affected projections collectively. Townships and communities within five miles of the Facility experienced substantial growth of 13.4% from 1990 to 2000 and a more tempered growth estimated at 3.5% growth from 2000 to 2007, based on data from the Ohio Office of Strategic Research. The more modest population estimates from 2000 to 2007 indicate stabilization in population, as well as a slowdown in job growth within the region. Population estimates beyond 2007 have not been projected by the state agency for smaller geographic divisions lower than the county level.

Champaign County, where the Facility is located, experienced high population growth of 8% from 1990 to 2000. The county is estimated to experience a 6.1% growth from 2000 to 2010 and a 6.7% population increase from 2010 to 2020, based on projections from the Office of Strategic Research of the Ohio Department of Development.
Similar growth patterns have occurred over the 1990s for all counties within five miles of the Facility. The five counties within 5 miles of the Facility have collectively experienced a 5.4% growth from 1990 to 2000 and are projected a 5.1% growth from 2000 to 2010 and a 6.2% population growth from 2010 to 2020.

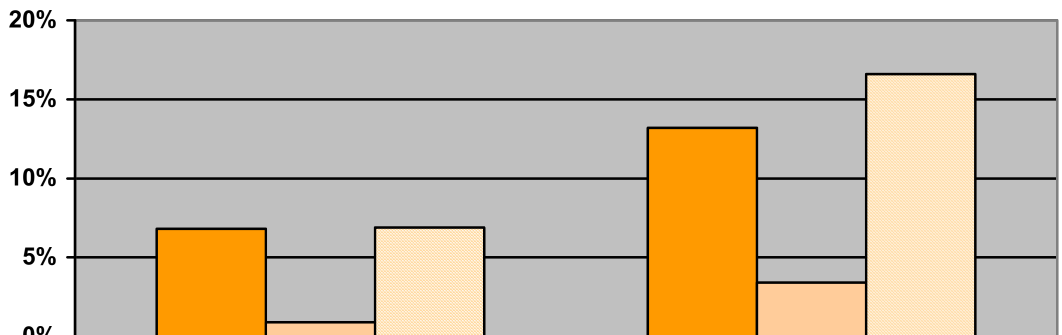
While the vicinity around the Facility has experienced population growth in the past, each geographic area has maintained its rural character and agricultural landscape, with an estimated population density of only 93.4 persons per square mile in Champaign County. In contrast, the State of Ohio's population density is 280.5 persons per square mile. This rural landscape is an ideal location for such large-scale wind development. The following graphs and tables illustrate Population Trends for counties within the Facility Boundary and within five miles of the project, as well as municipalities within and around the Facility. The succeeding table provides details regarding population trends, estimates, and projections for counties that host the Facility as well as within five miles of the Facility, as well as population trends and 2007 population estimates for municipalities within and around the Facility.

**Population Trends for Counties Within and Around the Buckeye Wind Farm**




| | Champaign County | Clark County | Logan County | Madison County | Union County | Ohio |
|---|---|---|---|---|---|---|
| 1990 - 2000 | 8.0% | -1.9% | 8.7% | 8.5% | 28.0% | 4.7% |
| 2000 - 2010 | 6.1% | -1.7% | 6.6% | 7.3% | 24.0% | 2.8% |
| 2010 - 2020 | 6.7% | -0.4% | 4.7% | 4.8% | 27.0% | 2.9% |
| 2000 - 2007 | 1.6% | -2.9% | 0.6% | 3.2% | 15.5% | 1.0% |
| 2007 - 2010 | 4.4% | 1.3% | 6.0% | 3.9% | 7.4% | 1.7% |

**Population Trends for Townships that will Host the Wind Farm and Within Five-Miles**




| | Townships that Host the Wind Farm | Townships & Communities Within Five Miles |
|---|---|---|
| 1990 - 2000 | 6.8% | 13.2% |
| 2000 - 2007 | 0.9% | 3.4% |
| 1990 - 2007 | 6.9% | 16.6% |

**Population Trends, Estimates & Projections**
(Sources: U.S. Census 1990 & 2000; Ohio State Office of Strategic Research; EasidDemographics)[3]

| | Census | | Estimates | Projections[4] | | |
|---|---|---|---|---|---|---|
| | **1990** | **2000** | **2007** | **2010** | **2015** | **2020** |
| **State of Ohio** | **10,847,115** | **11,353,140** | **11,466,917** | **11,666,850** | **11,816,170** | **12,005,730** |
| Change 1990 - 2000 | **4.7%** | | | | | |
| Change 2000 - 2007 | | **1.0%** | | | | |
| Change 2007 - 2010 | | | **1.7%** | | | |
| Change 2010 - 2015 | | | | **1.3%** | | |
| Change 2000 – 2010 | | **2.8%** | | | | |
| Change 2010 - 2020 | | | | **2.9%** | | |
| **COMMUNITIES THAT WILL HOST THE FACILITY** | | | | | | |
| **County** | | | | | | |
| Champaign County | **36,019** | **38,890** | **39,522** | **41,270** | **42,440** | **44,050** |
| Change 1990 - 2000 | **8.0%** | | | | | |
| Change 2000 - 2007 | | **1.6%** | | | | |
| Change 2007 - 2010 | | | **4.4%** | | | |
| Change 2010 - 2015 | | | | **2.8%** | | |
| Change 2000 - 2010 | | **6.1%** | | | | |
| Change 2010 - 2020 | | | | **6.7%** | | |
| **Townships** | | | | | | |
| **Within Champaign County** | | | | | | |
| Goshen Township | 3,172 | 3,383 | 3,434 | N/A | N/A | N/A |
| Rush Township | 2,248 | 2,779 | 2,811 | N/A | N/A | N/A |
| Salem Township | 2,045 | 2,307 | 2,431 | N/A | N/A | N/A |
| Union Township | 1,651 | 1,920 | 2,014 | N/A | N/A | N/A |
| Urbana Township | 14,770 | 14,968 | 14,824 | N/A | N/A | N/A |
| Wayne Township | 1,416 | 1,660 | 1,742 | N/A | N/A | N/A |
| | | | | | | |
| **Total Townships that Host the Facility** | **25,428** | **27,149** | **27,385** | **N/A** | **N/A** | **N/A** |
| Change 1990 - 2000 | **6.8%** | | | | | |
| Change 2000 - 2007 | | **0.9%** | | | | |
| **WITHIN 5 MILES OF FACILITY** | | | | | | |
| **Counties** | | | | | | |
| Champaign County | 36,019 | 38,890 | 39,522 | 41,270 | 42,440 | 44,050 |
| Clark County | 147,548 | 144,742 | 140,477 | 142,300 | 141,950 | 141,660 |
| Logan County | 42,310 | 46,005 | 46,279 | 49,040 | 50,420 | 51,340 |
| Madison County | 37,068 | 40,213 | 41,499 | 43,130 | 44,290 | 45,190 |
| Union County | 31,969 | 40,909 | 47,234 | 50,740 | 56,590 | 64,570 |
| **Total Counties Within 5 Miles** | **294,914** | **310,759** | **315,011** | **326,480** | **335,690** | **346,810** |
| Change 1990 - 2000 | **5.4%** | | | | | |
| Change 2000 - 2007 | | **1.4%** | | | | |
| Change 2007 - 2010 | | | **3.6%** | | | |
| Change 2010 - 2015 | | | | **2.8%** | | |
| Change 2000 – 2010 | | **5.1%** | | | | |
| Change 2010 - 2020 | | | | **6.2%** | | |
| **Townships and Communities** | | | | | | |

[3] EasiDemographics, a commercial data provider, was used as source for 2007 estimates for the Census-designated place of Northridge in Clark County. Data was not available with the Ohio Office of Strategic Research.
[4] Population projections are available only for State and County level.

**Population Trends, Estimates & Projections**
(Sources: U.S. Census 1990 & 2000; Ohio State Office of Strategic Research; EasidDemographics)[3]

| | Census | | Estimates | Projections[4] | | |
|---|---|---|---|---|---|---|
| | **1990** | **2000** | **2007** | **2010** | **2015** | **2020** |
| **Within Champaign County** | | | | | | |
| Concord Township | 1,122 | 1,408 | 1,484 | N/A | N/A | N/A |
| Mad River Township | 2,353 | 2,650 | 2,738 | N/A | N/A | N/A |
| City of Urbana | 11,353 | 11,613 | 11,408 | N/A | N/A | N/A |
| V. Mutual | 126 | 132 | 129 | N/A | N/A | N/A |
| V. Woodstock | 296 | 317 | 309 | N/A | N/A | N/A |
| V. North Lewisburg | 1,160 | 1,588 | 1,575 | N/A | N/A | N/A |
| V. Mechanicsburg | 1,803 | 1,744 | 1,698 | N/A | N/A | N/A |
| **Sub-Total** | **18,213** | **19,452** | **19,341** | **N/A** | **N/A** | **N/A** |
| **Within Clark County** | | | | | | |
| Moorefield Township | 9,621 | 11,402 | 11,193 | N/A | N/A | N/A |
| Pleasant Township | 2,700 | 3,134 | 3,282 | N/A | N/A | N/A |
| V. Catawba | 268 | 312 | 316 | N/A | N/A | N/A |
| Northridge | 5,939 | 6,853 | 7,769 | N/A | N/A | N/A |
| **Sub-Total** | **18,528** | **21,701** | **22,560** | **N/A** | **N/A** | **N/A** |
| **Within Logan County** | | | | | | |
| Monroe Township | 1,274 | 1,503 | 1,595 | N/A | N/A | N/A |
| Zane Township | 704 | 968 | 1,026 | N/A | N/A | N/A |
| **Sub-Total** | **1,978** | **2,471** | **2,621** | **N/A** | **N/A** | **N/A** |
| **Within Madison County** | | | | | | |
| Pike Township | 506 | 531 | 543 | N/A | N/A | N/A |
| Somerford Township | 2,544 | 2,939 | 2,993 | N/A | N/A | N/A |
| **Sub-Total** | **3,050** | **3,470** | **3,536** | **N/A** | **N/A** | **N/A** |
| **Within Union County** | | | | | | |
| Allen Township | 901 | 1,518 | 1,912 | N/A | N/A | N/A |
| Union Township | 1,658 | 1,565 | 1,920 | N/A | N/A | N/A |
| **Sub-Total** | **2,559** | **3,083** | **3,832** | **N/A** | **N/A** | **N/A** |
| **Total Municipalities Within 5 Miles of Project Boundary** | **44,328** | **50,177** | **51,890** | **N/A** | **N/A** | **N/A** |
| Change 1990 - 2000 | **13.2%** | | | | | |
| Change 2000 - 2007 | | **3.4%** | | | | |

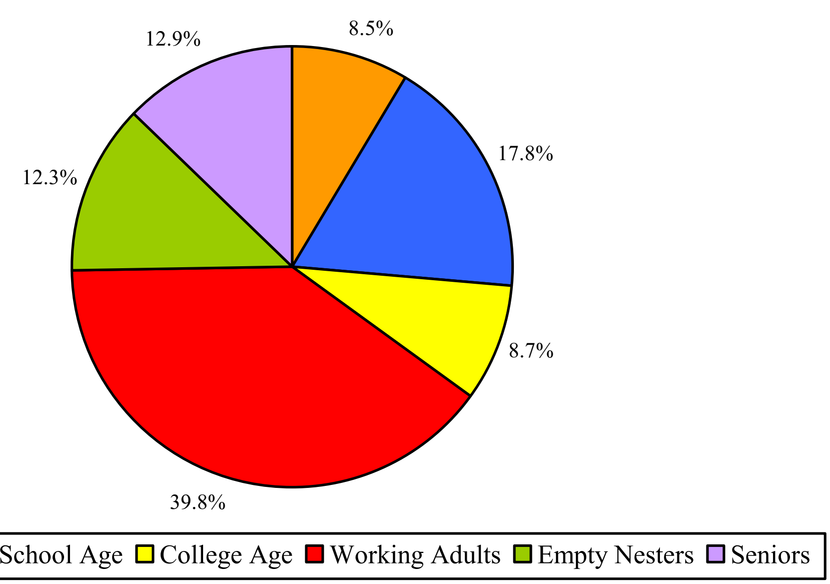
## 1.2 Age Cohort Profile

The population can be broken down into cohorts or groups, by age. An analysis of these age cohorts is an important component in determining the demographic profile of the geographic divisions under study. Following typical age cohort profiles, Baby Boomers are those born from 1946 to 1964. Those that belong to Generation X were born from 1965 to 1976, while the Generation Y or Echo Boomers were born from 1977 to 1994. As the decade moves on, these age cohorts mature and take on the characteristics of older generations, therefore changing the population trends and needs over time. As a result of these population adjustments, age cohorts help determine the types of development that a community might demand to adapt to future change.

For purposes of this study, age cohort profiles will be examined based on the following classifications:

- Pre-School: less than 6 years old
- School Age: 6 to 17 years old
- College Age: 18 to 24 years old
- Working Adults: 25 to 54 years old
- Empty Nesters: 55 to 64 years old
- Seniors: 65+ years old

**Age Cohort Profile, Townships that will Host the Wind Farm, 2007**
(Source: EasiDemographics)



An age cohort analysis indicates that the townships that will host the Facility have a considerable pre-school and school age population. Children under 18 years of age comprise 26.3% of the population in townships that will host the Facility compared to 23.7% for townships and communities within five miles of the Facility. Children under 18 years of age comprise 26.5% of Champaign County's population. This indicates the likelihood of younger families moving in to the region, due to possible affordability issues, school district performance[5], or the overall quality of life, and proximity to employment opportunities. The townships that will host the Facility are also within commuting distance to employment centers in the region that include Marysville and Bellefontaine, as well as bigger employment centers such as Columbus and Dayton.

The population found in the townships that will host the Facility is slightly younger than that of neighboring communities, as well as the five counties of Champaign, Clark, Logan, Madison and Union counties when viewed collectively, and the State of Ohio. In large part, this is attributed to the relatively young population residing within Rush Township in Champaign County (with a median age of 31.7 years), and the relatively older population residing within Moorefield Township in Clark County and Mad River Township in Champaign County (median age of 43.8 and 40.4 years, respectively).

**Age Cohort Profile: 2007**
(Source: EasiDemographics)

| | Townships that will Host the Facility | Townships and Communities within 5 miles of the Facility | Host County: Champaign County | All Counties within 5 miles: Champaign, Clark, Logan, Madison and Union counties | State of Ohio |
|---|---|---|---|---|---|
| Pre-School | 8.5% | 7.3% | 8.3% | 9.7% | 8.4% |
| School Age | 17.8% | 16.4% | 18.2% | 20.1% | 17.3% |
| College Age | 8.7% | 8.2% | 8.3% | 10.3% | 9.8% |
| Working Adults | 39.8% | 42.8% | 40.0% | 46.7% | 41.3% |
| Empty Nesters | 12.3% | 12.8% | 12.3% | 13.0% | 10.5% |
| Seniors | 12.9% | 12.5% | 12.2% | 14.7% | 12.7% |
| Median Age | 36.3 years | 37.0 years | 37.3 years | 37.2 years | 36.4 years |

## 1.3 HOUSEHOLD CHARACTERISTICS

Reflective of the population increase, the number of households has increased by 11.8% among the townships that will host the Facility from 1990 and 2000. It is estimated that the area has experienced an

[5] School district performance may be enhanced with the substantial increase in revenues for School Districts that host the Facility.

additional 3.6% growth in the number of households between 2000 and 2007. As evidenced by population trends, much of this growth occurred, and is projected to continue within the townships of Rush and Wayne in Champaign County.

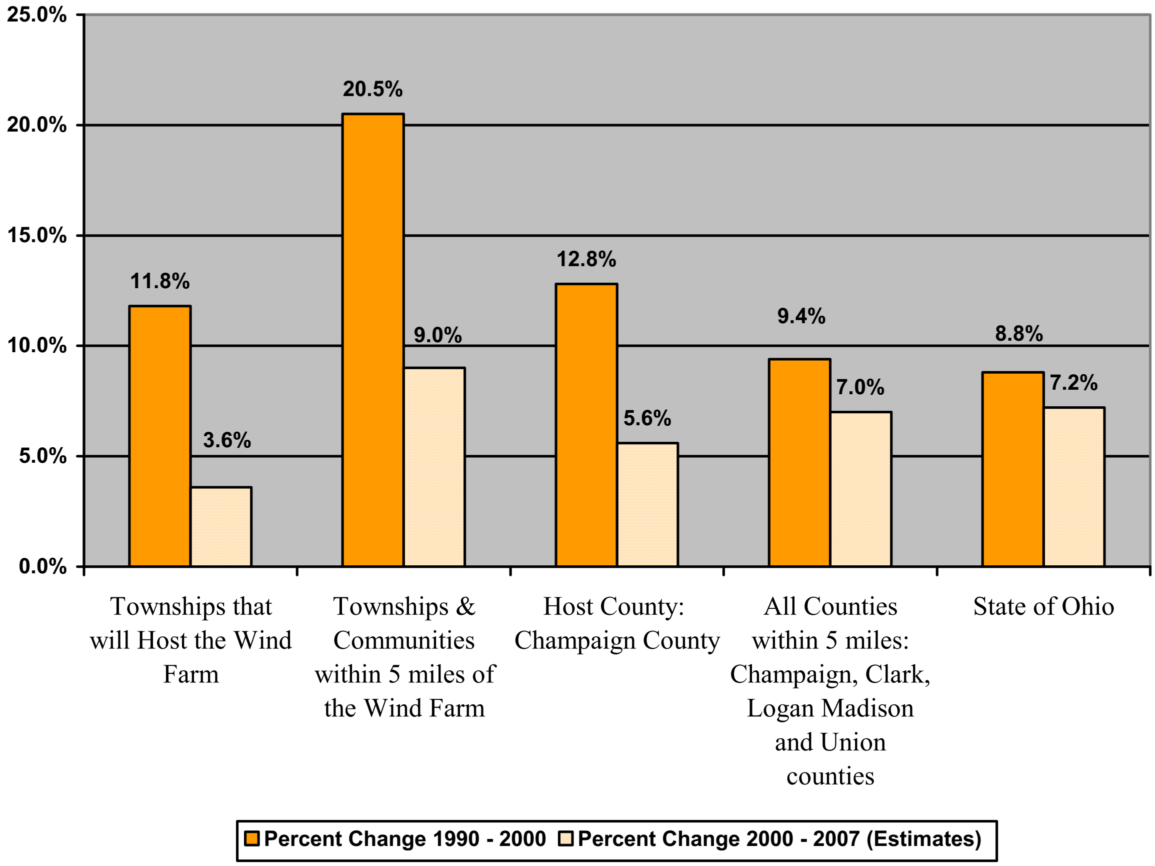
The townships and communities within five-miles of the Facility, in addition to all involved counties and the State of Ohio have also witnessed substantial growth in the number of households between 1990 and 2000. Household growth in the 1990's could be linked to the job growth with area employers. Household growth from 2000 to 2007 is more modest. The housing boom that peaked in 2005, could also have contributed to this household growth. The housing market began its decline in 2006, contributing to more tempered growth in the region.

While households grew at a faster pace during the last decade, household growth is anticipated to continue at a slower pace for townships that will host the Facility, as well as townships and communities within five miles of the Facility. Within the townships that will host the Facility, Wayne Township experienced a 23.6% growth in the 1990s and 17.6% growth from 2000 to 2007. Much of the growth in townships and communities within five miles of the Facility is anticipated to occur in the townships of Allen in Union County and the township of Somerford in Madison County. The number of households increased at a faster rate than the population in each geographic area under study, indicating a shift toward smaller household sizes throughout the region.

**Household Trends: 1990 – 2007**
(Source: U.S. Census Bureau; EasiDemographics)

| | **Townships that will Host the Facility** | **Townships and Communities within 5 miles of the Facility** | **Host County: Champaign County** | **All Counties within 5 miles: Champaign, Clark, Logan, Madison and Union counties** | **State of Ohio** |
|---|---|---|---|---|---|
| 1990 | 9,417 | 16,325 | 13,253 | 107,430 | 4,087,546 |
| 2000 | 10,530 | 19,669 | 14,952 | 117,574 | 4,445,773 |
| 2007 (Estimate) | 10,910 | 21,433 | 15,794 | 125,771 | 4,648,250 |
| Percent Change 1990 – 2000 | 11.8% | 20.5% | 12.8% | 9.4% | 8.8% |
| Percent Change (Estimates) 2000 – 2007 | 3.6% | 9.0% | 5.6% | 7.0% | 7.2% |

**Household Trends, 1990 - 2007**
(Sources: US Census Bureau, EasiDemographics)




## 1.4 Labor Force Characteristics

Labor force participation rates are a reflection of the current economic state of a community. The townships that will host the Facility have a slightly smaller percentage of their total population that are of working age when compared to the other geographic areas under study. This can largely be attributed to the relatively younger population, as seen in *Section 1.2: Age Cohort Profile*. However, the percentage of the working age population residing within townships that will host Facility that is in the labor force exceeds the averages of every geographic area under study.

The Honda Plant in Marysville has been a major source of employment in the area since 1982. While employment has been stable in the past, the economic crisis has caused automakers to slowdown production. The production of renewable energy and the manufacturing of its components in the State of Ohio could provide potential replacement jobs for the workforce that may be displaced by the economic downturn.

| Labor Force Characteristics: 2000 – 2007 (Source: U.S. Census Bureau; EasiDemographics) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Townships that will Host the Facility | | Townships and Communities within 5 miles of the Facility | | Host County: Champaign County | | All Counties within 5 miles: Champaign, Clark, Logan, Madison and Union counties | | State of Ohio | |
| | 2000 | 2007 | 2000 | 2007 | 2000 | 2007 | 2000 | 2007 | 2000 | 2007 |
| Working Age Population as Percentage of Total Population | 76.9% | 76.9% | 85.8% | 85.2% | 76.9% | 77.6% | 77.2% | 77.4% | 77.2% | 77.4% |
| Population in Labor Force as Percentage of Working Age Population | 65.9% | 64.1% | 61.4% | 60.5% | 67.4% | 65.7% | 64.8% | 62.9% | 64.8% | 62.9% |

## 1.5 Educational Attainment

Educational attainment refers to the highest level of education that a person has achieved, whether it is the highest grade completed or the highest degree received. Educational attainment levels have improved in each geographic area under study since 2000, with a lower percentage of persons having less than a high school degree, and higher percentages of persons obtaining a college degree, whether it is an Associate, a Bachelor or a Graduate or Professional Degree. However, only 16.3% of the population aged 25 and older residing within townships that will host the Facility has obtained such a degree in 2007. These educational attainment levels are likely indicative of the large number of employees that once were and/or remain within the manufacturing sector.

Investment in the wind power industry can create numerous jobs at each level of educational attainment. A recent survey conducted among existing Renewable Energy and Energy Efficiency companies in Ohio revealed that occupations in this industry demand a variety of skills, education, training and experience. While there are indeed jobs within this industry that require an advanced degree, many occupations within the industry require associates degrees, long-term on-the-job training, or trade certifications.[6]

[6] Bezdek, Roger, *"Renewable Energy and Energy Efficiency: Economic Drivers for the 21st Century,"* Management Information Services, Inc., for the American Solar Energy Society, 2007.

**Educational Attainment, Population 25 years and older: 2000 – 2007**
(Source: U.S. Census Bureau; EasiDemographics)

| | Townships that will Host the Facility | | Townships and Communities within 5 miles of the Facility | | Host County: Champaign County | | All Counties within 5 miles: Champaign, Clark, Logan, Madison and Union counties | | State of Ohio | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2000 | 2007 | 2000 | 2007 | 2000 | 2007 | 2000 | 2007 | 2000 | 2007 |
| Less than High School | 18.8% | 16.7% | 14.6% | 12.0% | 17.7% | 15.6% | 17.9% | 15.5% | 17.0% | 14.6% |
| High School | 47.4% | 47.2% | 45.5% | 45.0% | 48.1% | 47.6% | 43.3% | 42.6% | 36.1% | 35.0% |
| Some College | 18.3% | 19.8% | 20.0% | 21.2% | 18.4% | 19.8% | 19.3% | 20.8% | 19.9% | 21.2% |
| Associate Degree | 4.9% | 5.0% | 5.7% | 5.9% | 5.3% | 5.5% | 5.7% | 5.9% | 5.9% | 6.1% |
| Bachelor Degree | 7.0% | 7.6% | 9.4% | 10.5% | 7.1% | 7.7% | 9.1% | 10.1% | 13.7% | 15.1% |
| Graduate or Professional Degree | 3.3% | 3.7% | 4.8% | 5.4% | 3.5% | 3.9% | 4.6% | 5.1% | 7.4% | 8.0% |

## 1.6 Housing Characteristics

The number of housing units in the townships that will host the Facility as well as those within five-miles of the Facility have remained relatively unchanged between 2000 and 2007. However, the number of housing units within Champaign and Logan counties, and to a greater extent the units within Clark, Madison and Union counties experienced considerable growth between 2000 and 2007.

The occupancy rate has increased within each geographic area between 2000 and 2007. As a result, the vacancy rate has subsequently decreased at the same rate. The percentage of homeowners has increased between 2000 and 2007, throughout each geographic area under study. This has given way to slightly fewer rental properties available for residents in each geographic area. Homeownership is the major type of tenure in each geographic area under study. Within townships that will host the Facility, as well as those within 5 miles of the Facility, a substantially greater portion of the population own, rather than rent their homes.

| Housing Characteristics: 2000 – 2007 (Source: U.S. Census Bureau; Ohio Office of Strategic Research; EasiDemographics) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Townships that will Host the Facility | | Townships and Communities within 5 miles of the Facility | | Host County: Champaign County | | All Counties within 5 miles: Champaign, Clark, Logan, Madison and Union counties | | State of Ohio | |
| | 2000 | 2007 | 2000 | 2007 | 2000 | 2007 | 2000 | 2007 | 2000 | 2007 |
| Total Housing Units | 11,283 | 11,589 | 21,276 | 23,904 | 15,890 | 16,845 | 128,132 | 136,209 | 4,783,051 | 5,063,879 |
| Occupied | 93.3% | 94.1% | 95.2% | 95.9% | 94.1% | 94.8% | 91.8% | 92.3% | 92.9% | 93.9% |
| Homeowner | 72.8% | 74.6% | 78.5% | 81.6% | 75.9% | 77.4% | 73.5% | 75.0% | 69.1% | 70.8% |
| Renter | 27.2% | 25.4% | 21.5% | 18.4% | 24.1% | 22.6% | 26.5% | 25.0% | 30.9% | 29.2% |
| Vacant | 6.7% | 5.9% | 4.8% | 4.1% | 5.9% | 5.2% | 8.2% | 7.5% | 7.1% | 6.1% |

Housing values in the townships that will host the Facility are on par with housing values within the five counties, with the median value of homes in the townships that will host the Facility estimated at $161,064 in 2007 and median value of homes within the five counties estimated at $160,953. Median housing values for the State of Ohio are slightly higher at $166,784. The median value of homes in townships and communities within five miles of the Facility is relatively higher at $185,447 than the rest of the geographic areas under study. This can be attributed to the higher median housing values in the Township of Somerford (in Madison County) and the Township of Allen in Union County ($251,222 and $277,162, respectively).

Rental rates among the townships that will host the Facility are also relatively on par with the surrounding communities and counties. However, the rental values are significantly lower than those found throughout the State of Ohio. This is likely attributed to the higher percentages of rental units throughout the state, especially in the metropolitan areas including Cincinnati, Cleveland, Columbus and Dayton. These relatively higher housing and rental values throughout the townships that will host the Facility indicates a major strength to future development and investment in the region.

| Housing Values and Median Monthly Rents: 2007 (Source: EasiDemographics) | | | | | |
|---|---|---|---|---|---|
| | **Townships that will Host the Facility** | **Townships and Communities within 5 miles of the Facility** | **Host County: Champaign County** | **All Counties within 5 miles: Champaign, Clark, Logan, Madison and Union counties** | **State of Ohio** |
| **VALUE OF HOUSING** | | | | | |
| < $60,000 | 4.6% | 2.2% | 4.0% | 4.9% | 4.0% |
| $60,000 - $99,999 | 8.4% | 3.8% | 7.3% | 12.7% | 12.4% |
| $100,000 - $124,999 | 20.5% | 11.8% | 17.5% | 14.4% | 13.1% |
| $125,000 - $149,999 | 15.6% | 25.7% | 15.1% | 13.4% | 12.5% |
| $150,000 - $174,999 | 16.8% | 12.4% | 13.9% | 10.4% | 11.7% |
| $175,000 - $199,999 | 10.5% | 15.7% | 14.1% | 17.2% | 15.2% |
| $200,000 - $299,999 | 9.5% | 16.6% | 13.6% | 14.4% | 15.8% |
| $300,000+ | 14.1% | 11.9% | 14.5% | 12.6% | 15.2% |
| Median Housing Value | $161,064 | $185,447 | $160,953 | $160,953 | $166,874 |
| **MEDIAN MONTHLY RENT** | | | | | |
| <$250 | 10.2% | 10.2% | 10.0% | 9.5% | 7.7% |
| $250 - $499 | 26.6% | 23.6% | 25.8% | 23.5% | 19.2% |
| $500 - $749 | 33.4% | 29.6% | 32.7% | 30.2% | 26.4% |
| $750 - $999 | 12.8% | 17.3% | 14.5% | 17.2% | 24.9% |
| $1,000 - $1,249 | 1.1% | 3.1% | 0.8% | 4.1% | 8.4% |
| $1,249 - $1,500 | 0.0% | 0.1% | 0.0% | 1.9% | 2.3% |
| $1,500+ | 1.2% | 3.3% | 1.8% | 2.9% | 3.2% |
| No Cash Rent | 14.8% | 12.9% | 14.4% | 10.8% | 7.9% |
| Median Monthly Rent | $600 | $628 | $553 | $592 | $682 |

## 1.7 INCOME CHARACTERISTICS

At $55,467, the townships that will host the Facility have a slightly lower median household income than the townships and communities within five-miles of the Facility. However, this median household income is considerably higher than median household income in Champaign, Clark, Logan, Madison, and Union counties, as well as the State of Ohio. This is due in part, to substantially higher median household incomes in the townships of Union, Salem, and Wayne in Champaign County. The per capita income of $23,847 among those residing within the townships that will host the Facility is likewise slightly lower than the per capita income of residents in townships and communities within five miles of the Facility.

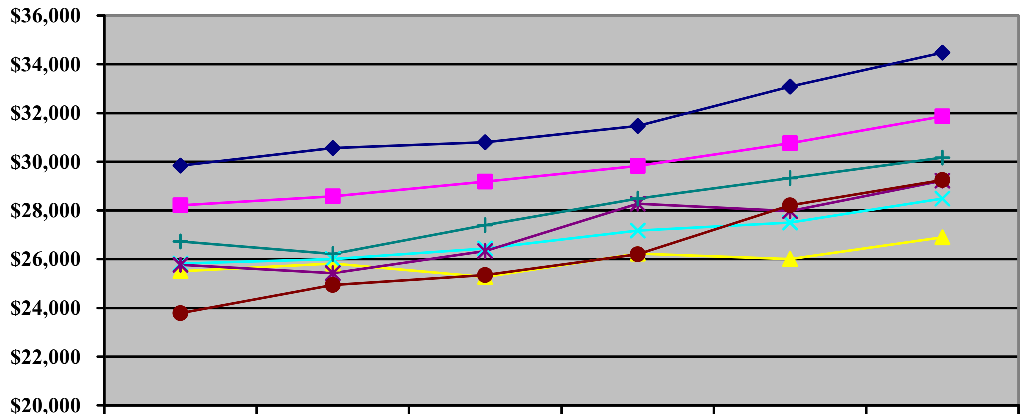
While median household income and per capita income help depict the financial state of a community, the poverty levels are what actually determine whether or not there is economic hardship or need. Poverty is measured by federal thresholds and the income associated with these thresholds. The official definition uses 48 thresholds that take into account family size, ranging from one to nine persons, and the presence and number of family members under 18 years old. Seen as a major discrepancy, poverty thresholds are not adjusted for regional, state, or local variation in the cost of living.

As of 2000, the poverty threshold ranged from $7,990 for one person over 65 years old, up to $37,076 for a family of nine or more persons with one related child under 18 years old. Each person over 18 years old added to the family unit increases the poverty threshold by approximately $3,000 to $5,000, however, each related child under 18 years old decreases the threshold by a slight amount.[7] For the purpose of this analysis, the individuals that are below the poverty level pertain to those who do not generate enough income to reach the aforementioned thresholds.

While poverty rates throughout the State of Ohio are higher, census data indicates that 8.4% of residents in townships that will host the Facility below the poverty level compared to 5.7% of residents in townships and communities within five miles of the Facility. Development of the Facility in these municipalities could possibly alleviate this situation with the positive economic impacts resulting from the project. A look at the HUD-Area Median Family Income (HAMFI) levels, seen in *Section 1.8: HUD Income Classifications*, depicts a more detailed profile of households that are deemed extremely low-income.

[7] U.S. Census Bureau, 2000

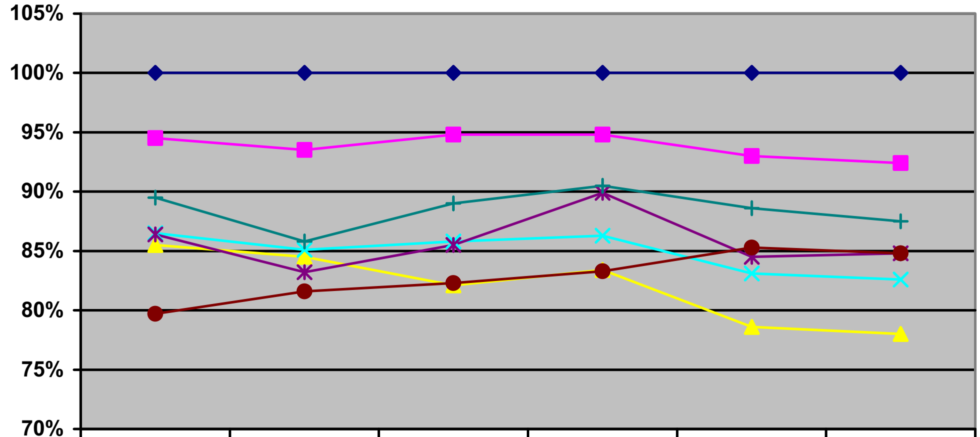
**Per Capita Income (2000 - 2005)**
(Source, Bureau of Economic Analysis, Ohio Office of Strategic Research)




| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|
| US | $29,843 | $30,562 | $30,795 | $31,466 | $33,090 | $34,471 |
| Ohio | $28,205 | $28,583 | $29,187 | $29,826 | $30,763 | $31,860 |
| Champaign | $25,510 | $25,822 | $25,274 | $26,229 | $26,009 | $26,891 |
| Clark | $25,820 | $25,997 | $26,432 | $27,167 | $27,507 | $28,485 |
| Logan | $25,771 | $25,424 | $26,328 | $28,273 | $27,972 | $29,218 |
| Madison | $23,787 | $24,934 | $25,348 | $26,204 | $28,213 | $29,245 |
| Union | $26,721 | $26,213 | $27,399 | $28,486 | $29,329 | $30,162 |

US Ohio Champaign Clark Logan Madison Union

**Per Capita Income as a Percentage of U.S. Figure**
(Source: Bureau of Economic Analysis, Ohioe Office of Strategic Research)




| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|
| US | 100% | 100% | 100% | 100% | 100% | 100% |
| Ohio | 94.5% | 93.5% | 94.8% | 94.8% | 93.0% | 92.4% |
| Champaign | 85.5% | 84.5% | 82.1% | 83.4% | 78.6% | 78.0% |
| Clark | 86.5% | 85.1% | 85.8% | 86.3% | 83.1% | 82.6% |
| Logan | 86.4% | 83.2% | 85.5% | 89.9% | 84.5% | 84.8% |
| Madison | 79.7% | 81.6% | 82.3% | 83.3% | 85.3% | 84.80% |
| Union | 89.5% | 85.8% | 89.0% | 90.5% | 88.6% | 87.5% |

US | Ohio | Champaign | Clark | Logan | Madison | Union

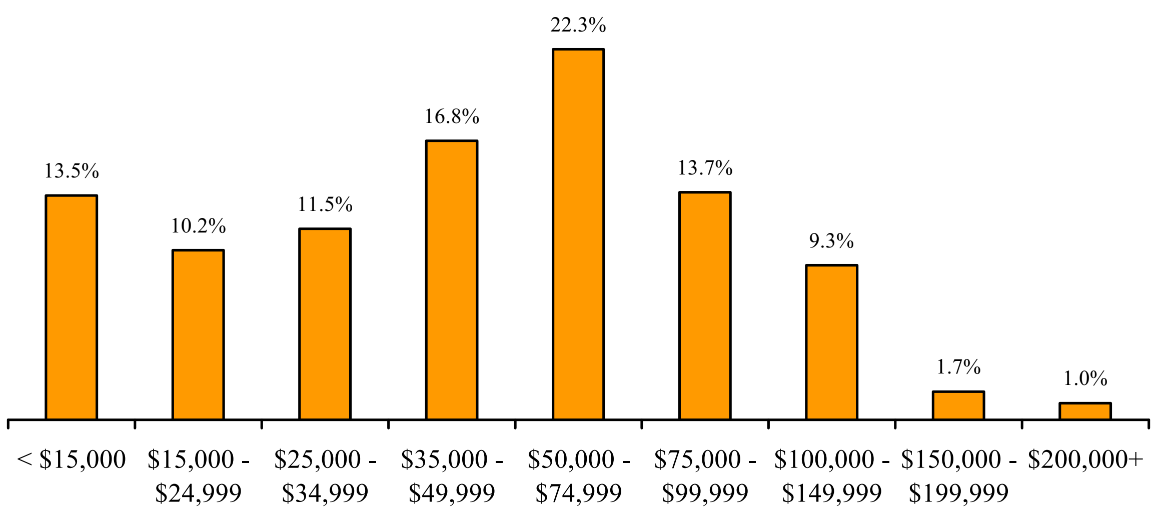
| **Income Characteristics**<br>(Source: EasiDemographics, 2007; Ohio Office of Strategic Research, 2005; US Census, 2000) | | | | | |
|---|---|---|---|---|---|
| | **Townships that will Host the Facility** | **Townships and Communities within 5 miles of the Facility** | **Host County: Champaign County** | **All Counties within 5 miles: Champaign, Clark, Logan, Madison and Union counties** | **State of Ohio** |
| Median Household Income | $55,467 | $60,512 | $51,045 | $49,937 | $49,103 |
| Per Capita Income | $23,847 (2007) | $25,952 (2007) | $26,891 (2005) | $29,218 (2005) | $31,860 (2005) |
| Individuals below Poverty (2000) | 2,273 | 2,829 | 2,890 | 26,683 | 1,170,698 |
| Percent of Population below Poverty (2000) | 8.4% | 5.6% | 7.4% | 8.6% | 10.6% |

A distribution of the household incomes in each geographic area reflects similar trends. Approximately 23.7% of all households in the townships that will host the Facility have incomes less than $25,000. This compares to 18.0% in the townships and communities within five-miles of the Facility; 21.2% in Champaign County; 24.6% in the collective area of Champaign, Clark, Logan, Madison and Union counties; and 23.4% of households in the State of Ohio. Likewise, 12.0% of households located within townships that host the Facility, and 16.1% of households within five-miles of the Facility have incomes in excess of $100,000. This is reflective of the considerable portion of households with high incomes in certain sections of Union Township (Champaign County), and Monroe Township (Logan County). Moreover, 33.6% and 24.3% of households, respectively within the townships of Allen and Union (in Union County), and 30.2% of households within Somerford Township (Madison County), have household incomes greater than $100,000. These relatively high household incomes are indicative of prospering economies within townships that will host the Facility and the townships and communities within five-miles of the Facility. However, as seen in succeeding sections of this report (most notably *Section 1.9: Public Assistance*), other factors such as the slowing economy, the decline of the manufacturing sector, and increasing energy costs have contributed to the financial hardships of some members of communities both within the townships that will host the Facility, and within five-miles of the Facility.

**Household Income Distribution: 2007**
(Source: Easi Demographics)

| | Townships that will Host the Facility | Townships and Communities within 5 miles of the Facility | Host County: Champaign County | All Counties within 5 miles: Champaign, Clark, Logan, Madison and Union counties | State of Ohio |
|---|---|---|---|---|---|
| <$15,000 | 13.5% | 9.2% | 11.8% | 13.2% | 12.8% |
| $15,000 - $24,999 | 10.2% | 8.8% | 9.4% | 11.4% | 10.6% |
| $25,000 - $34,999 | 11.5% | 9.9% | 11.2% | 12.8% | 11.5% |
| $35,000 - $49,999 | 16.8% | 15.7% | 16.7% | 19.0% | 16.0% |
| $50,000 - $74,999 | 22.3% | 23.6% | 23.2% | 25.2% | 20.1% |
| $75,000 - $99,999 | 13.7% | 16.8% | 15.0% | 16.5% | 13.1% |
| $100,000 - $149,999 | 9.3% | 12.9% | 9.9% | 12.3% | 10.7% |
| $150,000 - $199,999 | 1.7% | 2.2% | 1.6% | 2.3% | 2.5% |
| $200,000+ | 1.0% | 1.0% | 1.2% | 1.7% | 2.7% |

**Household Income Distribution,**
**Townships that will Host the Wind Farm, 2007**
(Source: EasiDemographics)



### 1.8 HUD Income Classifications

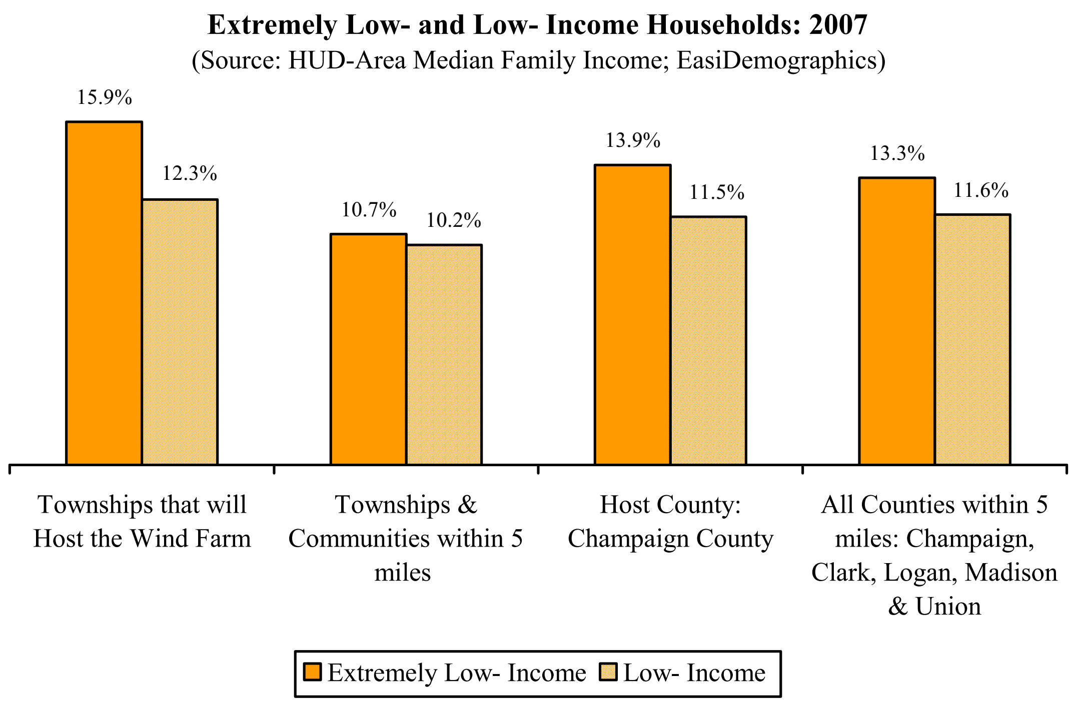
The HUD-Area Median Family Income (HAMFI) is often used to determine eligibility for many federal and state programs. The Department of Housing and Urban Development (HUD) classifies households into the following categories:

- Extremely Low-Income: ≤ 30% HAMFI
- Low-Income: 31% to 50% HAMFI
- Moderate-Income: 51% to 80% HAMFI
- Middle-Income: 81% to 95% HAMFI
- All Other Income: > 95% HAMFI

In 2007, Champaign County's HUD-Area Median Family Income (HAMFI) was $57,600. This figure was used to determine household income classification for Champaign County, as well as the townships of Concord, Goshen, Mad River, Rush, Salem, Union, Urbana and Wayne, the City of Urbana, and the villages of Mechanicsburg, Mutual, North Lewisburg and Woodstock. Logan County's 2007 HAMFI was slightly lower, at $54,300. In addition to Logan County, this figure was used to determine household income classifications for the townships of Monroe and Zane. In 2007, Clark County had the lowest HAMFI out of all geographic areas under study – at $52,500. This figure was used to determine household income classification for the County, as well as the townships of Moorefield and Pleasant, Northridge and the Village of Catawba. Lastly, Madison and Union counties are part of the designated Columbus, Ohio, Metropolitan Statistical Area, and as such, both had relatively higher HAMFI's of $64,200 in 2007. In addition to the two counties, this figure was used to determine household income classification for the townships of Allen and Union (in Union County), and the townships of Pike and Somerford (in Madison County).

As was the case with household and per capita incomes, there is much variation among residents throughout this region of Ohio. Approximately 28.2% of the households residing within the townships that will host the Facility could be considered extremely low-income or low-income. In comparison, the townships and communities within five-miles of the Facility have 20.9%, Champaign County has 25.4%, and the collective area of Champaign, Clark, Logan, Madison and Union counties have 24.9% of their population that is deemed extremely low-income or low-income. Several municipalities – including the City of Urbana and the Village of Mechanicsburg (both located in Champaign County) – have over 20% of their population deemed extremely low-income. This is indicative of a greater number of persons actually living in poverty within these jurisdictions than those that were regarded as such under the federal thresholds.

| Household Income Distribution: 2007<br>(Source: EasiDemographics; Analysis by Saratoga Associates) | | | | | |
|---|---|---|---|---|---|
| | **Townships that will Host the Facility** | **Townships and Communities within 5 miles of the Facility** | **Host County: Champaign County** | **All Counties within 5 miles: Champaign, Clark, Logan, Madison and Union counties** | **State of Ohio** |
| **Extremely Low-Income** | **1,732** | **2,297** | **2,198** | **16,703** | **N/A** |
| Percent of Total Households | 15.9% | 10.7% | 13.9% | 13.3% | N/A |
| **Low-Income** | **1,338** | **2,177** | **1,811** | **14,597** | **N/A** |
| Percent of Total Households | 12.3% | 10.2% | 11.5% | 11.6% | N/A |
| **Moderate-Income** | **2,134** | **3,689** | **3,046** | **23,835** | **N/A** |
| Percent of Total Households | 19.6% | 17.2% | 19.3% | 19.0% | N/A |
| **Middle-Income** | **937** | **1,660** | **1,381** | **10,532** | **N/A** |
| Percent of Total Households | 8.6% | 7.7% | 8.7% | 8.4% | N/A |
| **All Other Income** | **4,769** | **11,610** | **7,358** | **60,103** | **N/A** |
| Percent of Total Households | 43.7% | 54.2% | 46.6% | 47.8% | N/A |




## 1.9 PUBLIC ASSISTANCE

Another indicator of a community's economic condition is the amount of Public Assistance allocated to individuals and families. For the purpose of this analysis, two types of state funded programs were analyzed: Ohio Works First and Disability Assistance. The following tables outline the number of recipients enrolled within each program, as well as the expenditures incurred by the State to administer such programs over the past several years.

Ohio Works First is a state program designed to provide time-limited financial help to families through Ohio's Temporary Assistance for Needy Families program. Ohio Works First emphasizes employment, personal responsibility, and self-sufficiency. Champaign County, where all of the municipalities that host the Facility are found, saw an increase of 3.1% for persons enrolled in the Ohio Works First Program between 2003 and 2007. On the other hand, the number of recipients in the State of Ohio declined by 12.9% over the same period.

The total expenditures increased dramatically in Champaign, Logan and Madison counties, as a result of the additional recipients of the Ohio Works First Program. In 2007, the State program spent over $830,000 on such assistance to residents of Champaign County – an increase of 20.5% since 2003. Likewise, the Program distributed nearly $800,000 to residents of Logan County – an increase of 29.2% since 2003, and over $900,000 or a 30.3% increase in Madison County. The overall increase in the number of persons enrolled within the program, and the associated expenditures in Champaign, Logan and Madison counties relative to the State of Ohio, indicate that there may be increasing economic hardships among households within and around the Facility. This could be attributed to the slowing economy, the continued decline of the manufacturing sector, and increasing energy costs.

The creation of jobs and economic development initiatives resulting from the ripple effect of the Facility development could benefit low-and-moderate income households, as well as those displaced from work, and those relying on public assistance in the area. These economic benefits could prove beneficial in garnering public and political support for the Facility development.

**Ohio Works First, Combined: 2003 – 2007**
(Source: Ohio Department of Job and Family Services:
State Fiscal Year Public Assistance Statistics; 2003, 2005, and 2007)

| | Champaign County | Logan County | Clark County | Madison County | Union County | State of Ohio |
|---|---|---|---|---|---|---|
| Number of Recipients: Fiscal Year 2003 | 416 | 366 | 2,844 | 428 | 455 | 194,320 |
| Number of Recipients: Fiscal Year 2005 | 410 | 444 | 2,908 | 521 | 546 | 190,265 |
| Number of Recipients: Fiscal Year 2007 | 429 | 414 | 2,715 | 512 | 397 | 169,218 |
| Percent Change in Number of Recipients: Fiscal Year 2003 – Fiscal Year 2007 | 3.1% | 13.1% | -4.5% | 19.6% | -12.7% | -12.9% |
| Expenditures: Fiscal Year 2003 | $689,645 | $617,638 | $4,771,523 | $701,260 | $683,936 | $312,412,133 |
| Expenditures: Fiscal Year 2005 | $711,121 | $728,695 | $4,952,449 | $851,097 | $848,525 | $311,318,962 |
| Expenditures: Fiscal Year 2007 | $830,839 | $798,062 | $5,144,839 | $916,507 | $654,081 | $322,407,277 |
| Percent Change in Expenditures: Fiscal Year 2003 – Fiscal Year 2007 | 20.5% | 29.2% | 7.8% | 30.7% | -4.4% | 3.2% |

Disability Assistance is a program that assists individuals who have been deemed disabled by the Ohio Department of Job and Family Services and do not qualify for other assistance programs. Logan County, by far, saw the largest increase in residents receiving Disability Assistance, up 44 persons, or 169.2% between 2003 and 2007. As a result, the associated expenditures rose by 134%. Disability Assistance decreased by 4.9% in Champaign County between 2003 and 2007, and as such – the expenditures decreased by 15.3% over the same period. In comparison, the State of Ohio witnessed a decrease by nearly 2,000 persons receiving such assistance; accordingly, statewide spending decreased by 4.5% to adjust for the number of persons served.

**Disability Assistance: 2003 – 2007**
(Source: Ohio Department of Job and Family Services:
State Fiscal Year Public Assistance Statistics; 2003, 2005, and 2007)

| | Champaign County | Logan County | Clark County | Madison County | Union County | State of Ohio |
|---|---|---|---|---|---|---|
| Number of Recipients: Fiscal Year 2003 | 41 | 26 | 268 | 37 | 28 | 15,729 |
| Number of Recipients: Fiscal Year 2005 | 33 | 40 | 284 | 28 | 30 | 13,873 |
| Number of Recipients: Fiscal Year 2007 | 39 | 70 | 337 | 26 | 35 | 13,991 |
| Percent Change in Number of Recipients: Fiscal Year 2003 – Fiscal Year 2007 | -4.9% | 169.2% | 25.7% | -29.7% | 25.0% | -11.0% |
| Expenditures: Fiscal Year 2003 | $70,566 | $51,593 | $458,351 | $60,257 | $43,792 | $25,170,566 |
| Expenditures: Fiscal Year 2005 | $62,914 | $69,283 | $511,790 | $52,468 | $55,581 | $23,768,219 |
| Expenditures: Fiscal Year 2007 | $59,790 | $120,712 | $562,547 | $43,463 | $53,232 | $24,034,401 |
| Percent Change in Expenditures: Fiscal Year 2003 – Fiscal Year 2007 | -15.3% | 134.0% | 22.7% | -27.9% | 21.6% | -4.5% |

## 2.0 Existing Industries and Sources of Employment

An analysis of the U.S. Census Bureau's County Business Patterns in 2006 illustrates the predominant industries within Champaign, Logan, Clark, Madison and Union counties. The industries are broken down to reflect those with the largest number of employees and establishments.

The region's leading industries are health care and social assistance, retail trade and manufacturing. The health care and social assistance industry provides jobs to almost 2,000 persons or 18.2% of all employees in Champaign County; over 1,900 employees, or 10.6% of all employed in Logan County; and over 8,000 persons, or 17.9% of all employees in Clark County. In addition, the industry employs 1,096 persons, or 9.1% of those employed in Madison County, and over 1,700 persons, or 7.7% of those employed within Union County. In total, the sector employs almost 14,750 persons in close to 600 establishments within the five counties. Nearly half of these employees and establishments are in Clark County's health care centers including Community Mercy Health Partners – Springfield Regional Medical Center – Fountain/East, Springfield Regional Cancer Center, Mercy St. John's Center, Community Mercy Rehab Center and Mercy Surgery Center.

The retail trade sector has the greatest number of establishments in each county (with the exception of Union County where the construction industry has four more establishments than the retail trade industry). The large number of retail establishments likely provides fewer jobs per establishment than does the manufacturing and the health care and social assistance industries. Nevertheless, the industry employs almost 1,150 persons, or 10.5% of all employees in Champaign County; over 2,100 employees, or 11.7% of all employed in Logan County; over 6,880 persons, or 15.3% of all employees in Clark County; 2,145 persons, or 18.9% of employees in Madison County; and 2,062 employees, or 9.3% of those employed in Union County. Over 14,300 persons are employed within the retail trade industry throughout the five counties.

While health care and social assistance and retail trade are predominant industries, the manufacturing industry continues to be the biggest employer in Champaign, Logan, Madison and Union counties. The manufacturing industry provides jobs to almost 3,600 persons, or 32.7% of all employees in Champaign County. Manufacturing employs almost 7,300 workers or 16.2% of all employees in Clark County and nearly 5,900 employees, or 32.8% of all employees in Logan County. The industry employs an additional 2,937 persons, or 18.9% of all employees in Madison County, and almost 7,700 persons, or 34.9% of all employed in Union County. Although this industry employed the most number of workers in each county, the industry comprised only 6.8%, 7.2%, 5.8%, 6.6% and 4.3% of Champaign, Clark, Logan, Madison and Union counties' establishments, respectively. The manufacturing industry is Clark County's second largest industry, just behind health care and social assistance. In total, there exist over 27,300 persons employed in 380 manufacturing establishments within Champaign, Logan, Clark, Madison and Union counties. The majority of manufacturing centers around the manufacture of food; paper; plastics and rubber products; fabricated metal products; machinery; computer and electronic products; electrical equipment, appliances, and components; and transportation equipment.[8] This is not surprising given the proximity of Honda Motor Company, Honeywell International, and Dole Fresh Vegetables manufacturing plants.

While the manufacturing industry employs a substantial number of persons in the region, the industry is not as strong as it once was. Over the last ten years, the five-county region of Champaign, Clark, Logan, Madison and Union, lost 9,300 manufacturing jobs, declining by over 25% between 1996 and 2006. This is reflective of the manufacturing sector throughout the state; the number of manufacturing jobs throughout Ohio decreased by 23% – from 1.03 million jobs in 1996 to 797,000 jobs in 2006.

This dramatic decline indicates that the manufacturing industry needs to be restructured in order to meet current and future demands. This could be done through investing in renewable energy and energy efficiency. Such investment can create a variety of high-paying jobs, many of which can take advantage of the skilled manufacturing workforce, which is currently underutilized and underemployed in the region. Investment in wind energy can create many new jobs and foster new technology, while revitalizing the manufacturing sector and enhancing economic growth.[9]

This industrial restructuring has occurred in Pennsylvania, through various Gamesa turbine-manufacturing plants. One of these facilities employs 300 skilled manufacturing jobs, and is capable of producing two, 300-foot tall steel and carbon fiber wind turbines every day. In one year alone, the manufacturing facility can produce turbines capable of generating 700 megawatts of energy – enough to power nearly 200,000 homes a year.[10]

Clipper Windpower opened its wind turbine design and manufacturing facility in Iowa in 2001. Since then, the company employs over 500 persons and has manufactured approximately 6,500 MW of turbine parts for wind farms in Iowa, Maryland, Texas and Wyoming.[11] In addition, Suzlon Energy recently opened its first plant in the United States. The facility, which manufactures rotor blades and nose cones, opened with 275 employees in Minnesota nearly two years ago. These employees allowed the company to manufacture one blade a day. However, high demand has caused the company to have nearly doubled the number of employees since its June 2006 opening. The company now employs 500 persons, with the capacity to manufacture three blades a day. Nevertheless, the demand is so strong that the plant is struggling to keep up; blades and nose cones are currently experiencing a two-year backorder.[12]

[8] 2005 County Business Patterns, via U.S. Census Bureau
[9] Bezdek, Roger, *"Renewable Energy and Energy Efficiency: Economic Drivers for the 21st Century,"* Management Information Services, Inc., for the American Solar Energy Society, 2007.
[10] Department of Environmental Protection, *"Innovative Wind Turbine Manufacturing Plant Wins Excellence Awards,"* February 5, 2007.
[11] Clipper Windpower, via http://www.clipperwind.com/
[12] Depass, Dee, *"Windfall for Pipestone,"* Star Tribune, June 1, 2008, via http://www.startribune.com/business/19418074.html?page=1&c=y

The construction and operation of the Buckeye Facility is a positive step towards attracting and retaining such manufacturing companies to Southwest Central Ohio. In turn, this could greatly contribute to the much needed industrial restructuring throughout the region, and the State of Ohio.

**Employment Trends by Industry, Champaign County, 2006**
(Source: County Business Patterns)

| Industry | Champaign County | | | |
|---|---|---|---|---|
| | Total Employees | | Total Establishments | |
| | Number | Percent | Number | Percent |
| Forestry, Fishing, Hunting and Agriculture Support | 0-19 | 0.1% | 2 | 0.3% |
| Mining | 0-19 | 0.1% | 1 | 0.1% |
| Utilities | 0-19 | 0.2% | 3 | 0.4% |
| Construction | 357 | 3.3% | 79 | 11.7% |
| Manufacturing | 3,569 | 32.7% | 46 | 6.8% |
| Wholesale Trade | 195 | 1.8% | 31 | 4.6% |
| Retail Trade | 1,142 | 10.5% | 120 | 17.8% |
| Transportation and Warehousing | 236 | 2.2% | 28 | 4.2% |
| Information | 109 | 1.0% | 9 | 1.3% |
| Finance and Insurance | 248 | 2.3% | 42 | 6.2% |
| Real Estate and Rental and Leasing | 76 | 0.7% | 21 | 3.1% |
| Professional, Scientific, and Technical Services | 156 | 1.4% | 42 | 6.2% |
| Management of Companies and Enterprises | 20-99 | 0.5% | 3 | 0.4% |
| Administration, Support, Waste Management, Remediation Services | 1,000 | 9.2% | 27 | 4.0% |
| Educational Services | 250-499 | 2.9% | 3 | 0.4% |
| Health Care and Social Assistance | 1,986 | 18.2% | 50 | 7.4% |
| Arts, Entertainment, and Recreation | 82 | 0.8% | 12 | 1.8% |
| Accommodation and Food Services | 813 | 7.4% | 58 | 8.6% |
| Other Services | 533 | 4.9% | 93 | 13.8% |
| Unclassified Establishments | 7 | 0.1% | 3 | 0.4% |
| **TOTAL: ALL INDUSTRIES** | **10,918** | **100.0%** | **673** | **100.0%** |

**Employment Trends: Clark, Logan, Madison and Union Counties, 2006**

(Source: County Business Patterns)

| | Clark County | | | | Logan County | | | | Madison County | | | | Union County | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Employees | | Total Establishments | | Total Employees | | Total Establishments | | Total Employees | | Total Establishments | | Total Employees | | Total Establishments | |
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| Forestry, Fishing, Hunting and Agriculture Support | 0-19 | 0.0% | 4 | 0.2% | 0-19 | 0.0% | 1 | 0.1% | 20-99 | 0.3% | 1 | 0.1% | 0-19 | 0.1% | 1 | 0.1% |
| Mining | 20-99 | 0.2% | 6 | 0.2% | 60 | 0.3% | 6 | 0.6% | 0 | 0.0% | 0 | 0.0% | 20-99 | 0.1% | 3 | 0.3% |
| Utilities | 100-249 | 0.3% | 6 | 0.2% | 20-99 | 0.2% | 2 | 0.3% | 0-19 | 0.0% | 2 | 0.3% | 20-99 | 0.3% | 2 | 0.2% |
| Construction | 1,603 | 3.6% | 239 | 9.2% | 988 | 5.5% | 96 | 10.2% | 627 | 5.5% | 118 | 14.9% | 730 | 3.3% | 125 | 13.2% |
| Manufacturing | 7,296 | 16.2% | 186 | 7.2% | 5,889 | 32.8% | 55 | 5.8% | 2,937 | 25.9% | 52 | 6.6% | 7,687 | 34.9% | 41 | 4.3% |
| Wholesale Trade | 2,041 | 4.5% | 103 | 4.0% | 1,373 | 7.6% | 39 | 4.1% | 380 | 3.3% | 42 | 5.3% | 593 | 2.7% | 48 | 5.1% |
| Retail Trade | 6,882 | 15.3% | 455 | 17.6% | 2,107 | 11.7% | 165 | 17.5% | 2,145 | 18.9% | 130 | 16.4% | 2,062 | 9.3% | 121 | 12.8% |
| Transportation and Warehousing | 2,852 | 6.3% | 65 | 2.5% | 527 | 2.9% | 30 | 3.2% | 760 | 6.7% | 43 | 5.4% | 675 | 3.1% | 44 | 4.7% |
| Information | 530 | 1.2% | 27 | 1.0% | 124 | 0.7% | 15 | 1.6% | 63 | 0.6% | 7 | 0.9% | 95 | 0.4% | 13 | 1.4% |
| Finance and Insurance | 2,421 | 5.4% | 156 | 6.0% | 311 | 1.7% | 57 | 6.0% | 204 | 1.8% | 41 | 5.2% | 286 | 1.3% | 56 | 5.9% |
| Real Estate and Rental and Leasing | 439 | 1.0% | 92 | 3.6% | 154 | 0.9% | 32 | 3.4% | 74 | 0.7% | 30 | 3.8% | 125 | 0.6% | 40 | 4.2% |
| Professional, Scientific, and Technical Services | 932 | 2.1% | 161 | 6.2% | 790 | 4.4% | 52 | 5.5% | 551 | 4.9% | 57 | 7.2% | 2,112 | 9.6% | 78 | 8.2% |

**Employment Trends: Clark, Logan, Madison and Union Counties, 2006**

(Source: County Business Patterns)

| | Clark County | | | | Logan County | | | | Madison County | | | | Union County | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Employees | | Total Establishments | | Total Employees | | Total Establishments | | Total Employees | | Total Establishments | | Total Employees | | Total Establishments | |
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| Management of Companies and Enterprises | 465 | 1.0% | 16 | 0.6% | 71 | 0.4% | 4 | 0.4% | 20-99 | 0.4% | 4 | 0.5% | 1000 - 2499 | 7.9% | 4 | 0.4% |
| Administration, Support, Waste Management, Remediation Services | 1,533 | 3.4% | 100 | 3.9% | 1,142 | 6.4% | 43 | 4.6% | 748 | 6.6% | 31 | 3.9% | 2,163 | 9.8% | 75 | 7.9% |
| Educational Services | 2,122 | 4.7% | 22 | 0.8% | 0-19 | 0.1% | 5 | 0.5% | 20-99 | 0.5% | 7 | 0.9% | 81 | 0.4% | 6 | 0.6% |
| Health Care and Social Assistance | 8.055 | 17.9% | 309 | 11.9% | 1,908 | 10.6% | 86 | 9.1% | 1,096 | 9.7% | 66 | 8.3% | 1,703 | 7.7% | 84 | 8.9% |
| Arts, Entertainment, and Recreation | 431 | 1.0% | 43 | 1.7% | 384 | 2.1% | 21 | 2.2% | 61 | 0.5% | 10 | 1.3% | 71 | 0.3% | 15 | 1.6% |
| Accommodation and Food Services | 4,677 | 10.4% | 235 | 9.1% | 1,271 | 7.1% | 103 | 10.9% | 1,067 | 9.4% | 60 | 7.6% | 993 | 4.5% | 64 | 6.8% |
| Other Services | 2,466 | 5.5% | 362 | 14.0% | 820 | 4.6% | 130 | 13.8% | 484 | 4.3% | 87 | 11.0% | 832 | 3.8% | 119 | 12.6% |
| Unclassified Establishments | 0-19 | 0.0% | 4 | 0.2% | 0-19 | 0.0% | 2 | 0.2% | 0-19 | 0.1% | 3 | 0.4% | 10 | 0.0% | 7 | 0.7% |
| **TOTAL: ALL INDUSTRIES** | **44,937** | | **2,591** | | **17,977** | | **945** | | **11,350** | | **791** | | **22,055** | | **946** | |

An examination of the top employers within Champaign, Clark, Logan, Madison and Union counties reinforces the relative strength of the manufacturing, health care and social assistance, and retail trade industries in the region. The top employers in Champaign County provide jobs to over 3,300 persons, with the top two employers – Honeywell International, Inc., and KTH Parts Industries, Inc. – providing nearly 1,800 manufacturing jobs. Likewise, the top employer in Logan County – Honda Motor Company, Ltd., employs 3,400 persons in the manufacturing sector. The three largest employers in Clark County – Marathon/Speedway SuperAmerica LLC, Springfield City Board of Education, and Dole Fresh Vegetables – employ nearly 6,500 persons in the retail trade, government/education, and manufacturing sectors, while the Community Mercy Health Partners employ over 2,000 health care professionals. Likewise, Madison County's top employers provide jobs to over 3,500 persons, with the top two employers – Stanley Electric and Target – employing nearly half of these positions. Honda Motor Corporation employs over 7,500 persons, deeming it the largest employer in Union County, and the region. Other major employers in Union County include Scotts Miracle-Gro Company, Memorial Hospital of Union County and Goodyear Tire and Rubber Corporation.

The area's top companies employ residents throughout the region. In turn, this employment results in a positive economic impact on the Southwest Central Ohio region as a whole.

**Top Employers for Champaign, Clark, Logan, Madison and Union Counties, 2007**
(Source: State of Ohio Office of Strategic Research;
Madison County Chamber of Commerce; Union County Chamber of Commerce)

| Name of Employer | Location | Number of Employees | Type of Industry |
|---|---|---|---|
| **CHAMPAIGN COUNTY** | | | |
| Honeywell International, Inc. (Honeywell Aerospace) | 515 North Russell Street; 550 State Route 55 Urbana, Ohio | 1,000 | Manufacturing |
| KTH Parts Industries, Inc. | 1111 North Street Route 235 St. Paris, Ohio | 778 | Manufacturing |
| Urbana City Board of Education | 71 Wood Street Urbana, Ohio | 508 | Government/ Education |
| Graham Local Board of Education | 370 East Main Street St. Paris, Ohio | 478 | Government/ Education |
| Menasha Corporation/ORBIS | 200 Elm Street; 915 Phoenix Drive Urbana, Ohio | 280 | Manufacturing |
| Urbana University | 579 College Way Urbana, Ohio | 184 | Higher Education |
| Community Mercy Health Partners – Mercy Memorial Hospital | 904 – 906 Scioto Street Urbana, Ohio | 107 | Health care |
| Wal-Mart Stores, Inc. | 1840 East Route 36 Urbana, Ohio | N/A[12] | Trade |
| **Total Estimated Employment from Top Employers, Champaign County: 3,335+** | | | |

| Top Employers for Champaign, Clark, Logan, Madison and Union Counties, 2007 (Source: State of Ohio Office of Strategic Research; Madison County Chamber of Commerce; Union County Chamber of Commerce) | | | |
|---|---|---|---|
| **Name of Employer** | **Location** | **Number of Employees** | **Type of Industry** |
| **CLARK COUNTY** | | | |
| Marathon/Speedway SuperAmerica LLC | P.O. Box 1500 Springfield, Ohio | 2,435 | Trade (Customer Service) |
| Springfield City Board of Education | 700 South Limestone Street Springfield, Ohio | 2,396 | Government/ Education |
| Dole Fresh Vegetables | 600 Benjamin Drive Springfield, Ohio | 1,650 | Manufacturing |
| Gordon Food Service | 4980 Gateway Boulevard Springfield, Ohio | 1,550 | Trade |
| Assurant, Inc. | 1 Assurant Way Springfield, Ohio | 868 | Insurance |
| Ohio Masonic Home | 2655 West National Road Springfield, Ohio | 250 | Service |
| International Truck and Engine Corporation | 5975 – 6125 Urbana Road Springfield, Ohio | N/A[12] | Manufacturing |
| Wittenberg University | 200 West Ward Street; 734 Woodlawn Avenue Springfield, Ohio | 195+ | Higher Education |
| Community Mercy Health Partners – Springfield Regional Medical Center – Fountain/East; Springfield Regional Cancer Center; Mercy St. John's Center; Community Mercy Rehab Center; Mercy Surgery Center | 1343 North Fountain Blvd; 2615 East High Street; 148 West North Street; 100 West McCreight Ave.; 2600 – 2610 North Limestone Street; Springfield, Ohio | 2,027+ | Health care |
| **Total Estimated Employment from Top Employers, Clark County: 11,371+** | | | |
| **LOGAN COUNTY** | | | |
| Honda Motor Company, Ltd. | 230 Reynolds Avenue Bellefontaine, Ohio | 3,400 | Manufacturing |
| Bellefontaine City Board of Education | 820 Ludlow Road Bellefontaine, Ohio | 702 | Government/ Education |
| Nash-Finch Company | County Route 130 Bellefontaine, Ohio | 675 | Trade |
| Asahi Glass Company, Ltd./AGC Automotive | 1465 West Sandusky Ave. Bellefontaine, Ohio | 554 | Manufacturing |
| Daido Metal Company, Ltd. | 1215 South Greenwood St. Bellefontaine, Ohio | 372 | Manufacturing |
| HBD Industries, Inc. | 1301 West Sandusky Ave. Bellefontaine, Ohio | 323 | Manufacturing |
| Mary Rutan Hospital | 205 Palmer Avenue Bellefontaine, Ohio | 468 | Health care |

| Top Employers for Champaign, Clark, Logan, Madison and Union Counties, 2007 (Source: State of Ohio Office of Strategic Research; Madison County Chamber of Commerce; Union County Chamber of Commerce) | | | |
|---|---|---|---|
| **Name of Employer** | **Location** | **Number of Employees** | **Type of Industry** |
| Wal-Mart Stores, Inc. | 2281 South Main Street Bellefontaine, Ohio | N/A[13] | Trade |
| **Total Estimated Employment from Top Employers, Logan County: 6,494+** | | | |
| **MADISON COUNTY** | | | |
| Stanley Electric U.S. Company, Inc. | 420 East High Street London, Ohio | 752 | Manufacturing |
| Target Corporation | 1 Walker Way West Jefferson, Ohio | 750+ | Trade |
| Showa Demko KK/Showa Aluminum Corporation | 10500 Oday Harrison Rd. Mount Sterling, Ohio | 518 | Manufacturing |
| Nissen Chemitec/London Industries | 350 East High Street London, Ohio | 452 | Manufacturing |
| Kikuchi Metal et al/Jefferson Industries | 6670 State Route 29 West Jefferson, Ohio | 400+ | Manufacturing |
| Staples, Inc. | London, Ohio | 400+ | Trade |
| Battelle Memorial Institute | 1425 Plain City-Georgesville Road, Route 142 West Jefferson, Ohio | N/A[14] | Research and Development |
| London City Board of Education | 60 South Walnut Street London, Ohio | N/A[12] | Government/ Education |
| Madison County Hospital | 210 North Main Street London, Ohio | 270 | Health care |
| State of Ohio | Various locations | N/A[12] | Government |
| **Total Estimated Employment from Top Employers, Madison County: 3,542+** | | | |
| **UNION COUNTY** | | | |
| Honda Motor Corporation, Ltd | 11000 State Route 347 Marysville, Ohio | 7,546 | Manufacturing |
| Scotts Miracle-Gro Company | 14111 Scottslawn Road Marysville, Ohio | 1,012 | Manufacturing |
| Memorial Hospital of Union County | 500 London Avenue Marysville, Ohio | 609+ | Health Care |
| EDP, Inc./Goodyear Tire and Rubber Corporation | 13601 Industrial Parkway Marysville, Ohio | 318 | Manufacturing |
| Nestle R&D Center, Inc. | 809 Collins Avenue Marysville, Ohio | 225 | Research and Development |

[13] While the State of Ohio Office of Strategic Research considers this as a top employer, the actual or estimated number of employees is not available.

[14] Battelle Memorial Institute employs over 20,000 worldwide. However, the number of employees at the West Jefferson site is unknown.

| Top Employers for Champaign, Clark, Logan, Madison and Union Counties, 2007 (Source: State of Ohio Office of Strategic Research; Madison County Chamber of Commerce; Union County Chamber of Commerce) | | | |
|---|---|---|---|
| **Name of Employer** | **Location** | **Number of Employees** | **Type of Industry** |
| Parker Hannifin Corporation | 14249 Industrial Parkway Marysville, Ohio | 198 | Manufacturing |
| Marysville Exempted Village Board of Education | 1000 Edgewood Drive Marysville, Ohio | N/A[12] | Government/ Education |
| State of Ohio | Various locations | N/A[12] | Government |
| Union County Government | 233 West Sixth Street (and various other locations) Marysville, Ohio | N/A[12] | Government |
| **Total Estimated Employment from Top Employers, Union County: 9,908+** | | | |
| **TOTAL ESTIMATED EMPLOYMENT FROM TOP EMPLOYERS, CHAMPAIGN, CLARK, LOGAN, MADISON, UNION COUNTIES: 34,650+** | | | |

## 3.0 Existing Tax Base and Tax Revenues

While neither the Office of the State of Ohio Auditor, nor the local government officially categorizes the assessed values of property into land use classifications, Geographic Information Systems data allows for such organization. With each county in Ohio having a different parcel data base structure, GIS was used to aggregate land uses into broad categories that included residential, agricultural, commercial, government, vacant, etc., through the use of property class codes. This information allows for the breakdown and comparison of the local tax base composition.

As seen in the accompanying table, the townships that will host the Facility have the greatest share of agricultural land when compared to all other geographic areas under study. Over 127,000 acres or nearly 87% of the lands in townships that will host the Facility are agricultural properties. Combined, agricultural lands within the townships that will host the Facility are valued at over $152 million. Likewise, agricultural land is the leading land use by acreage for the townships and communities within five-miles of the Facility, comprising 80.4% of all land, and a combined assessed valuation of $258.48 million for townships in Champaign, Clark, Logan, Madison and Union counties. The predominant agricultural use within each area under study emphasizes the rural character of the region, and as such deems this part of Ohio an ideal location for a potential wind farm. If sited properly, the Facility will not interfere with agricultural practices, but rather it will increase the productivity of the land by providing an additional revenue source to supplement traditional agricultural sources of income.

While residential land is the second most predominant land use classification in each geographic area under study, this type of use is far less concentrated than agricultural land. Residential land comprises over 11,806 acres, or 8.1% of all land in the townships that will host the Facility. However, all residential land within host townships have a combined assessed valuation of nearly $595 million – much greater than all other land uses under study. Similarly, residential land comprises 10.5% of all land in the townships within five-miles of the Facility. Likewise, the assessed valuation of this type of property is much greater in these geographic areas.

There exists nearly 4,052 acres of vacant land within the townships that will host the Facility. Combined, land used for commercial purposes, forestry, governmental, manufacturing, minerals and oil, non-commercial, and for utilities comprises only 2.3% of the total land in the townships that will host the Facility and 5.7% of land in the townships and communities within five-miles of the Facility. The abundance of agricultural land and the much lower proportion of land for commercial, residential and industrial properties reinforces the rural character of the communities that will host the Facility and within five miles of the Facility.

**Total Acreage and Assessed Valuation by Land Use Classification: Fiscal Year 2007**
(Source: Champaign, Clark, Logan, Madison, Union Counties, Ohio)

| Land Use Classification | Townships that will Host the Facility | | | Townships and Communities within 5 miles of the Facility | | | Host County: Champaign County | | | All Counties within 5 miles: Champaign, Clark, Logan, Madison and Union counties | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Acres | Percent of Total Acreage | Assessed Valuation | Total Acres | Percent of Total Acreage | Assessed Valuation | Total Acres | Percent of Total Acreage | Assessed Valuation | Total Acres | Percent of Total Acreage | Assessed Valuation |
| Agricultural | 127,243 | 86.8% | $152,025,230 | 178,923 | 80.4% | $258,484,300 | 237,861 | 86.5% | $303,286,440 | 1,146,870 | 81.0% | $1,386,480,740 |
| Commercial | 789 | 0.5% | $27,688,440 | 1,651 | 0.7% | $110,360,770 | 1,160 | 0.4% | $106,724,130 | 15,892 | 1.4% | $776,169,190 |
| Forestry | 211 | 0.1% | $231,880 | 749 | 0.3% | $1,698,500 | 1,157 | 0.4% | $2,856,280 | 1,557 | 0.0% | $3,061,050 |
| Government | 2,104 | 1.4% | $40,009,670 | 6,062 | 2.7% | $59,878,160 | 3,816 | 1.4% | $70,845,260 | 24,315 | 2.1% | $654,065,060 |
| Manufacturing | 93 | 0.1% | $10,145,330 | 2,491 | 1.1% | $212,544,200 | 557 | 0.2% | $83,634,670 | 11,701 | 0.7% | $2,152,926,910 |
| Minerals and Oil | 232 | 0.2% | $1,277,990 | 0 | 0.0% | $0 | 232 | 0.1% | $1,277,990 | 1,157 | 0.0% | $4,681,440 |
| Non-Commercial | 128 | 0.1% | $6,497,690 | 508 | 0.2% | $47,513,120 | 406 | 0.1% | $44,235,060 | 9.813 | 0.9% | $331,159,480 |
| Residential | 11,806 | 8.1% | $594,926,780 | 23,298 | 10.5% | $1,382,140,460 | 23,051 | 8.4% | $1,462,671,310 | 124,031 | 8.6% | $6,973,052,240 |
| Utilities | 0 | 0.0% | $1 | 0 | 0.0% | $21,410 | 0 | 0.0% | $21,410 | 245 | 0.0% | $3,797,610 |
| Vacant | 4,052 | 2.8% | $14,495,150 | 7,650 | 3.4% | $31,111,160 | 6,707 | 2.4% | $31,493,200 | 49,978 | 4.7% | $214,337,910 |
| Not Designated | 0 | 0.0% | $0 | 1,267 | 0.6% | $2,619,810 | 0 | 0.0% | $0 | 8,213 | 0.3% | $6,346,340 |
| **TOTAL: ALL LAND USE CLASS-IFICATIONS** | **146,658** | **100.0%** | **$847,298,161** | **222,599** | **100.0%** | **$2,106,371,890** | **274,948** | **100.0%** | **$2,116.045,750** | **1,393,772** | **100.0%** | **$12,506,077,970** |

# 4.0 Current County, Township, City and School District Budgets

## 4.1 MUNICIPAL BUDGETS

The following section illustrates municipal receipts and disbursements for the Fiscal Year 2005 budget within each County, Township and City that will host the Facility, as well as those jurisdictions located within the five-mile radius of the Facility. In general, the receipts and disbursements were fairly evenly balanced, with 11 out of the 17 townships and two out of the five counties levying a greater amount in receipts than what was disbursed. However, Champaign, Logan and Clark counties, as well as the townships of Concord, Mad River, Rush and Salem and the City of Urbana in Champaign County, the township Zane in Logan County, Pleasant Township in Clark County and Pike Township in Madison County expended more than what was generated over the fiscal year.

In addition to the budget, an examination of the amount of municipal debt gives insight into the economic stability of a given community. Not surprisingly, each county under study was carrying a considerable amount of debt in Fiscal Year 2005. The presence of debt is likely attributed to the greater provision of services (i.e. infrastructure, waste collection, etc.) that are spread out over a large, sparsely populated area. The level of indebtedness ranged from $8.1 million, or 7% of annual receipts in Clark County, to a debt load of $24.3 million, or 66% of annual receipts in Logan County.

While all of the counties under study are carrying debt, a majority of the municipalities were not indebted in Fiscal Year 2005. Five municipalities (four townships and the City of Urbana) under study are indebted; however, the only township that will host the Facility that is carrying debt load is Wayne Township in Champaign County. As of Fiscal Year 2005, Wayne Township was indebted nearly $123,000, which comprised 32.2% of the annual receipts. According to the Office of the State of Ohio Auditor, this outstanding debt is attributed to the construction of a new township building and maintenance facility. Four additional municipalities located within five-miles of the Facility were indebted, ranging from a low of $17,540 in the Township of Union in Union County, to $2,620,000 in the City of Urbana in Champaign County.

| Municipal Budgets: Fiscal Year 2005[15] (Source: Office of the State of Ohio Auditor) | | | |
|---|---|---|---|
| | **Total Receipts** | **Total Disbursements** | **Indebtedness** |
| **CHAMPAIGN COUNTY** | ***$27,497,188*** | ***$29,573,218*** | ***$3,712,429*** |
| Township of Concord | $213,734 | $221,207 | $0 |
| Township of Goshen | $344,597 | $296,060 | $0 |
| Township of Mad River | $387,858 | $422,442 | $32,356 |
| Township of Rush | $229,511 | $310,740 | $0 |
| Township of Salem | $296,044 | $342,929 | $0 |
| Township of Union | $337,528 | $295,309 | $0 |
| Township of Urbana | $469,082 | $451,109 | $0 |
| Township of Wayne | $381,939 | $305,581 | $122,810 |
| City of Urbana | $9,799,582 | $12,878,100 | $2,620,000 |
| | | | |
| **CLARK COUNTY** | ***$116,106,184*** | ***$137,542,612*** | ***$8,101,700*** |
| Township of Moorefield | $2,072,794 | $1,878,303 | $0 |
| Township of Pleasant | $672,846 | $584,511 | $78,890 |
| | | | |
| **LOGAN COUNTY** | ***$36,845,932*** | ***$48,113,323*** | ***$24,300,000*** |
| Township of Monroe | $328,192 | $306,767 | $0 |
| Township of Zane | $263,404 | $408,434 | $0 |
| | | | |
| **MADISON COUNTY** | ***$30,375,506*** | ***$29,562,825*** | ***$12,670,057*** |
| Township of Pike | $141,931 | $171,376 | $0 |
| Township of Somerford | $411,849 | $381,251 | $0 |
| | | | |
| **UNION COUNTY** | ***$44,765,128*** | ***$41,047,106*** | ***$28,925,000*** |
| Township of Allen | $2,857,102 | $1,714,268 | $0 |
| Township of Union | $416,404 | $337,102 | $17,520 |
| | | | |

## 4.2 SCHOOL DISTRICT TRENDS AND BUDGETS

Wind turbines are proposed to be hosted by four school districts. These include:

> Mechanicsburg Exempted Village School District
> Triad Local School District
> Urbana City School District
> West Liberty – Salem Local School District

[15] Fiscal Year 2005 was used in order to report consistency across taxing jurisdictions. This was the most recent year that such budgetary data was available for all counties and municipalities.

The Mechanicsburg Exempted Village School District is located within both Champaign and Madison counties, serving residents of the townships of Goshen and Union, as well as the entire villages of Mechanicsburg and Mutual in Champaign County, and the Township of Somerford in Madison County.

The Triad Local School District crosses into Champaign, Logan and Union counties. The school district extends into the townships of Rush, Union and Wayne, and encompasses the villages of North Lewisburg and Woodstock in Champaign County; the townships of Monroe and Zane in Logan County; and the Township of Allen in Union County.

The Urbana City School District is solely located within Champaign County. Its district boundary encompasses the City of Urbana, and extends into the townships of Union and Urbana.

The West Liberty-Salem Local School District is located within both Champaign and Logan counties. This school district serves students residing within the townships of Harrison and Salem, as well as small portions of Concord, Union and Wayne townships in Champaign County; and the townships of Liberty, Monroe and Union, and the entire Village of West Liberty in Logan County.

An additional six school districts are located within a five-mile radius of the Facility. They include:

- Benjamin Logan Local School District
- Fairbanks Local School District
- Graham Local School District
- Jonathan Alder Local School District
- London City School District
- Northeastern Local School District

The Benjamin Logan Local School District is solely located within Logan County. The district provides education to those residing within the townships of Bokes Creek, Jefferson, McArthur, Monroe, Perry, Richland, Rushcreek and Zane, as well as the villages of Belle Center, Rushsylvania, Valley Hi, West Mansfield and Zanesfield, and a very small portion of the City of Bellefontaine.

The Fairbanks Local School District is located in both Madison and Union counties. The district serves residents of the townships of Darby and Pike in Madison County, the townships of Allen, Darby, Jermone, Millcreek and Union, in addition to small parts of Dover and Paris townships, the City of Marysville, and the entire villages of Millford Center and Unionville Center in Union County.

The majority of the Graham Local School District is located within Champaign County, providing education to roughly half of Harrison Township, and most of the townships of Concord and Mad River. In addition, the district serves the entire townships of Adams and Johnson, as well as the villages of Christiansburg and St. Paris. The district boundaries extend slightly into Green Township in neighboring Shelby County.

A small section of the Jonathan Alder Local School District is located within the five-mile radius of the Facility. The district serves residents of Canaan and Monroe townships, and portions of Darby, Deer Creek, Jefferson and Somerford townships in Madison County. The district also serves the Village of Plain City, which is located on the border of Madison and Union counties. In addition, the school district encompasses roughly half of Jerome Township, in Union County.

A portion of the London City School District lies within the five-mile radius of the Facility, in Madison County. The district serves students residing in parts of Deer Creek and Somerford townships, as well as a small part of Union Township, and nearly the entire City of London. Students residing in Choctaw Lake are also served by the London City School District.

The Northeastern Local School District is primarily located within Clark County, with a portion of the district extending north into Champaign County. The school district serves parts of the Township of Union in Champaign County; the townships of Harmony, Moorefield and Pleasant, as well as the City of Springfield, Northridge and the entire villages of Catawba and South Vienna in Clark County.

The following charts illustrate the enrollment trends for the four school districts serving residents in townships that host the Facility, as well as the six school districts serving those residing within five-miles of the Facility.

The accompanying table shows the raw enrollment figures between the 2002-03 and 2006-07 academic years. Trends in student enrollment vary across the school districts. The largest enrollment change occurred in the Jonathan Alder Local School District, which saw an 11.1% increase in enrollment over the five-year period; this is equivalent to an addition of 211 students over the past five years. Enrollment for school districts within the townships that will host the Facility remained steady over the past five years, with a net increase of only 33 students or less than 1% increase in enrollment. School districts within five miles of the Facility experienced substantial growth in enrollment from 2003-2004 to 2006-2007, increasing by 654 students or 5.2% over 5 years. Only the Fairbanks Local School District experienced a slight decrease in enrollment.

Contrary to the trends occurring within the vicinity of the Facility, the State of Ohio has seen a slight reduction, amounting to a 0.2% loss in overall student enrollment over the five-year period.

| School District Enrollment: 2002-03 – 2006-07 Academic Years (Source: Ohio Department of Education) | | | | | | |
|---|---|---|---|---|---|---|
| **School District** | **2002-2003** | **2003-2004** | **2004-2005** | **2005-2006** | **2006-2007** | **Change in Enrollment** |
| **DISTRICTS HOSTING THE FACILITY** | | | | | | |
| Mechanicsburg Exempted Village School District | 1,086 | 1,110 | 1,130 | 1,099 | 1,064 | -2.0% -22 students |
| Triad Local School District | 2,388 | 2,356 | 2,359 | 2,316 | 2,334 | -2.3% -54 students |
| Urbana City School District | 876 | 850 | 850 | 860 | 916 | 4.6% +40 students |
| West Liberty-Salem Local School District | 1,152 | 1,160 | 1,202 | 1,230 | 1,221 | 6.0% +69 students |
| **Total School Districts Within Facility Boundary** | **5,502** | **5,476** | **5,541** | **5,505** | **5,535** | **0.6% +33 students** |
| **WITHIN 5 MILES OF FACILITY** | | | | | | |
| Benjamin Logan Local School District | 3,601 | 3,629 | 3,751 | 3,823 | 3,813 | 5.9% +212 students |
| Fairbanks Local School District | 1,996 | 1,966 | 1,943 | 1,946 | 1,964 | -1.6% -32 students |
| Graham Local School District | 2,201 | 2,189 | 2,202 | 2,317 | 2,266 | 3.0% +65 students |
| Jonathan Alder Local School District | 1,805 | 1,809 | 1,893 | 1,991 | 2,016 | 11.7% +211 students |
| London City School District | 2,045 | 2,081 | 2,067 | 2,090 | 2,161 | 5.7% +116 students |
| Northeastern Local School District | 930 | 928 | 960 | 990 | 1,017 | 9.4% +87 students |
| **Total School Districts Within 5 Miles** | **12,583** | **12,602** | **12,816** | **13,157** | **13,237** | **5.2% +654 students** |
| **STATE OF OHIO** | **1,838,068** | **1,843,898** | **1,845,351** | **1,842,943** | **1,835,188** | **-0.2% -2,880 students** |

A school district's operating cost is based primarily on the number of students it serves. As the amount of students in a district fluctuates, it is expected that the district's expenditures and revenues would adjust in order to accommodate these changes in enrollment. The main source for school district funding comes from general property (real estate) taxes collected from residents of the school distrct. As depicted in the following table, almost all of the school districts generated more in revenues than what was expended in 2007, except for the Urbana City School District, Jonathan Alder Local School District and Fairbanks Local School District. The slight net loss experienced within these three districts is likely attributed to the changes in student enrollment, as well as other capital improvement projects occuring throughout the school districts.

| School District Budgets, 2006-07 Academic Year (Source: Ohio Department of Education) | | | |
|---|---|---|---|
| | **Total Revenues** | **Total Expenditures** | **Net Revenues** |
| **WITHIN FACILITY BOUNDARY** | | | |
| Mechanicsburg Exempted Village School District | $7,212,689 | $6,582,714 | $629,975 |
| Triad Local School District | $9,325,162 | $8,547,376 | $777,786 |
| Urbana City School District | $19,860,910 | $20,290,492 | ($429,582) |
| West Liberty-Salem Local School District | $10,390,626 | $9,636,222 | $754,404 |
| **WITHIN 5 MILES OF FACILITY** | | | |
| Benjamin Logan Local School District | $16,387,477 | $16,293,344 | $94,133 |
| Fairbanks Local School District | $8,761,856 | $8,828,915 | ($67,060) |
| Graham Local School District | $15,982,802 | $15,439,456 | $543,346 |
| Jonathan Alder Local School District | $12,968,095 | $13,053,690 | ($85,595) |
| London City School District | $17,703,127 | $17,085,304 | $617,823 |
| Northeastern Local School District | $28,189,173 | $26,658,762 | $1,530,411 |

# 5.0 Current Tax Contributions to the Counties, Townships, Cities and School Districts

## 5.1 General Property (Real Estate) Tax Rates

### 5.1.1 Champaign County

For the purpose of this analysis, the 'County' tax rate is comprised of tax rates from the Champaign County General Fund, in addition to the Senior Citizens Fund, the Child Services Fund, the Lawnview Fund, and the Mental Health Fund. Both the Health District and the 911 Fund act as their own taxing jurisdictions. The 'Township' tax rate is comprised of tax rates originating from the Township General Fund, the Roads Fund, and the Park Fund. In Champaign County, the tax rates stemming from the Fire and Emergency Medical Services Fund were grouped with those of the Cemetery Fund to be consistent with how other counties report their tax rates and levies. Likewise, the 'School', 'Joint Vocational School' (JVS), and the 'Library' rates were combined for consistency purposes. The 'Corporation' tax rate is independent of the other rates.

The general property (real estate) tax rates for all jurisdictions under study are based on a tax rate per $1,000 assessed valuation for the Fiscal Year 2007. As indicated in the table, there are numerous taxing jurisdictions within Champaign County. Special district taxes represent the smallest tax rate – ranging from rates of $0.40 for the Health District and $1.00 for the 911 Fund, to a few dollars for the Fire/Ambulance/Cemetery Fund, depending on the residence of a given taxpayer. Not surprisingly, the school district taxes represent the largest component. Property owners of residential and agricultural land within Champaign County are likely to pay between $36.72 and $49.69 in general property (real estate) taxes per $1,000 assessed valuation, depending on which township and school district they reside in. Similarly, owners of industrial or commercial property are likely to pay between $37.53 and $52.11 in general property (real estate) taxes per $1,000 assessed valuation, depending on the location within the County.

**General Property (Real Estate) Tax Rates (per $1,000 Assessed Valuation), Townships within Champaign County: Fiscal Year 2007**
(Source: Champaign County Treasurers Office)

| Taxing Jurisdiction | Concord Township | Goshen Township | Mad River Township | Rush Township | Salem Township | Union Township | Urbana Township | Wayne Township |
|---|---|---|---|---|---|---|---|---|
| County | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| Health | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| Township (Range) | 4.30 | 1.70 - 3.10 | 4.80 | 0.60 - 6.30 | 0.00 - 2.60 | 1.30 - 3.80 | 0.10 -1.50 | 7.70 |
| 911 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| School/Joint Vocational School/Library (Range) | 36.75 - 39.50 | 42.05 | 34.80 - 60.70 | 31.00 | 36.75-60.70 | 31.00-60.70 | 34.80-60.70 | 31.00-39.50 |
| Fire/Ambulance/ Cemetery (Range) | 2.00 | 1.50 - 5.50 | 2.00 | 6.00 | 0.00 - 2.20 | 0.00 - 2.00 | 0.00 -2.30 | 5.60 |
| Corporation (Range) | -- | 0.00 - 7.20 | -- | 0.00 - 6.80 | 0.00 - 3.30 | 0.00 - 2.75 | 0.00 -3.30 | -- |
| **Total Rates (Range)** | **54.45 - 57.20** | **62.05-63.85** | **52.30 - 78.90** | **50.20-55.80** | **52.95-75.40** | **48.20-77.90** | **50.00-75.90** | **55.70-64.20** |
| *Reduction Factor (Agricultural/ Residential)* | *0.218213 - 0.317036* | *0.218101 - 0.221760* | *0.187227 - 0.513427* | *0.188282 - 0.221792* | *0.226520 - 0.497926* | *0.201918 - 0.498880* | *0.159799 - 0.508254* | *0.204659 - 0.304546* |
| *Reduction Factor (Other)* | *0.199631 - 0.302794* | *0.186900 - 0.189416* | *0.163976 - 0.339520* | *0.155969 - 0.186411* | *0.210837 - 0.316997* | *0.190115 - 0.336534* | *0.126264 - 0.321617* | *0.194588 - 0.297133* |
| **EFFECTIVE RATE (AG/RES)** | **39.07 - 42.57** | **48.52-49.69** | **38.39 - 43.07** | **40.75-43.42** | **37.45-40.96** | **38.47-46.28** | **37.32-42.01** | **44.30-44.65** |
| **EFFECTIVE RATE (OTHER)** | **39.88 - 43.58** | **50.30-51.92** | **43.05 - 52.11** | **42.37-45.48** | **38.09-51.50** | **38.66-51.68** | **43.68-51.60** | **44.86-45.12** |

### 5.1.2 CLARK COUNTY

For the purpose of this analysis, both the 'County' Fund and the 'Health District' Fund act as their own taxing jurisdictions, and therefore they have their own tax rates. The 'Township' Fund is comprised of current expenses and special levies, while the 'School' Fund is comprised of current expenses, bonds, special levies, and expenses incurred through the Joint Vocational School. Clark County also has a separate tax rate for cities and villages located within the boundary of the County. Similar to the other funds, these rates are derived from Current Expenses, Bonds and Special Levies. The County does not report specifics on items within the 'County', nor the 'Township' tax rates, although it is likely that funds including Fire, Ambulance, Cemetery, and others were included within these tax rates.

The general property (real estate) tax rates for all jurisdictions under study are based on a tax rate per $1,000 assessed valuation for the Fiscal Year 2007. As indicated in the table, there are not as many taxing jurisdictions within Clark County, as was seen in Champaign County. Health District taxes represent the smallest tax rate; all land uses are taxed a rate of $1.00 per $1,000 assessed valuation of their property, regardless of the location of the property within the County. Township taxes in both Moorefield range from $54.93 - $86.19 in Moorefield and from $71.30 to $72.70 in Pleasant Township. The County taxes a rate of $13.88 for all property, while school district taxes range from $35 to $66.25 in Moorefield and $50.02 in Pleasant. Property owners of residential and agricultural land within five miles of the Facility in Clark County are likely to pay between $44.85 and $54.30 in general property (real estate) taxes per $1,000 assessed valuation, depending on which township and school district they reside in. Similarly, owners of industrial or commercial pieces of property are likely to pay between $46.36 and $61.40 in general property (real estate) taxes per $1,000 assessed valuation, depending on the location within the County.

**General Property (Real Estate) Tax Rates (per $1,000 Assessed Valuation)**
**Townships within Clark County: Fiscal Year 2007**
(Source: Clark County Treasurers Office)

| Taxing Jurisdiction | Moorefield Township | Pleasant Township |
|---|---|---|
| County | 13.88 | 13.88 |
| Health | 1.00 | 1.00 |
| Township (Range) | 5.05 | 4.80 - 7.80 |
| 911 | -- | -- |
| School/Joint Vocational School/Library (Range) | 35.00 - 66.25 | 50.02 |
| Fire/Ambulance/Cemetery | -- | -- |
| Corporation | -- | -- |
| **Total Rates (Range)** | **54.93 - 86.19** | **71.30 - 72.70** |
| *Reduction Factor (Agricultural/Residential)* | *0.154360 - 0.370008* | *0.345043 - 0.348577* |
| *Reduction Factor (Other)* | *0.156005 -* | *0.302228 -* |

| General Property (Real Estate) Tax Rates (per $1,000 Assessed Valuation) Townships within Clark County: Fiscal Year 2007 (Source: Clark County Treasurers Office) | | |
|---|---|---|
| **Taxing Jurisdiction** | **Moorefield Township** | **Pleasant Township** |
| | *0.318472* | *0.307127* |
| **EFFECTIVE RATE (AG/RES)** | **44.85 - 54.30** | **46.45 - 47.62** |
| **EFFECTIVE RATE (OTHER)** | **46.36 - 61.40** | **49.40 - 50.73** |

### 5.1.3 Logan County

Logan County separates their tax rates to include 'County', 'School', 'Vocational Technology', 'Township' and 'Corporation'. With the exception of 'Corporation', each is split into two types of tax rates: 'agricultural/residential', and 'other'. For the purpose of this analysis, the 'School' tax rate was combined with the 'Vocational Technology' tax rate in order to be consistent with how other counties report their tax rates and levies. The County does not report specifics on items within the 'County', nor the 'Township' tax rates, although it is likely that funds including Fire, Ambulance, Cemetery, and others were included.

The general property (real estate) tax rates for all jurisdictions under study are based on a tax rate per $1,000 assessed valuation for the Fiscal Year 2007. As indicated in the table, there exist only three or four (depending on location) taxing jurisdictions for property within Logan County. For townships within five miles of the Facility, property taxes range from $4.83 to $5.86 of assessed value for properties in Monroe Township and from $5.10 to $5.25 in Zane Township. The County taxes range from $8.43 to $9.42 in each township, based on the land use. In addition, school district taxes range from $24.85 to $36.36, which is dependent on both the location and the land use classification of the property. Property owners of residential and agricultural land within five miles of the Facility in Logan County are likely to pay between $36.46 and $46.99 in general property (real estate) taxes per $1,000 assessed valuation, based on the township and school district they reside in. Similarly, owners of industrial or commercial pieces of property are likely to pay between $37.34 and $47.88 in general property (real estate) taxes per $1,000 assessed valuation, depending on the location within the County.

| General Property (Real Estate) Tax Rates (per $1,000 Assessed Valuation), Townships within Logan County: Fiscal Year 2007 (Source: Logan County Treasurers Office) | | |
|---|---|---|
| **Taxing Jurisdiction** | **Monroe Township** | **Zane Township** |
| County (Range) | 8.43 - 9.42 | 8.43 - 9.42 |
| Health | -- | -- |
| Township (Range) | 4.83 - 5.86 | 5.10 - 5.25 |
| 911 | -- | -- |

| General Property (Real Estate) Tax Rates (per $1,000 Assessed Valuation), Townships within Logan County: Fiscal Year 2007 (Source: Logan County Treasurers Office) | | |
|---|---|---|
| **Taxing Jurisdiction** | **Monroe Township** | **Zane Township** |
| School/Joint Vocational School/Library (Range) | 24.85 - 31.50 | 24.88 - 31.50 |
| Fire/ Ambulance/ Cemetery | -- | -- |
| Corporation (Range) | 0.00 - 1.20 | -- |
| **Total Rates (Range)** | ***46.55 - 58.85*** | ***46.55 - 56.65*** |
| *Reduction Factor (Agricultural/ Residential)* | -- | -- |
| *Reduction Factor (Other)* | -- | -- |
| **EFFECTIVE RATE (AG/RES)** | **38.29 - 46.99** | **38.41 - 45.03** |
| **EFFECTIVE RATE (OTHER)** | **39.10 - 47.88** | **39.53 - 46.17** |

### 5.1.4 MADISON COUNTY

Madison County reports its tax rates in specific categories, reflective of each taxing jurisdiction in the County. The 'County' Fund consists of the Senior Citizen Fund, the Veterans Relief Fund, the Mental Health Fund, the Mental Retardation and Developmental Disabilities Fund, the Health Services Fund, and the County's General Fund. The 'Township', '911', 'Corporation', and 'Fire/Ambulance/Cemetery' funds acted as their own reporting agencies, and therefore levy their own taxes. However, for the purpose of this analysis, the 'Schools', 'Library', and 'Joint Vocational School' funds were combined in order to be consistent with how other counties report their tax rates and levies.

The general property (real estate) tax rates for the townships of Monroe, Pike and Somerford, as well as all other jurisdictions within the County are based on a tax rate per $1,000 assessed valuation for the Fiscal Year 2007. As indicated in the table, 911 taxes represent the smallest component of taxes, at $0.80, regardless of the location within the County. The County taxes all residents at a rate of $9.80, while the township tax rates range from $0.90 in Pike Township to $3.50 in Somerford Township. In addition, school district taxes range from $40.15 to $47.80, which is dependent on both the location and the land use classification of the property. After the reduction factors are applied, property owners of residential and agricultural land within Madison County are likely to pay between $45.73 and $48.14 in general property (real estate) taxes per $1,000 assessed valuation, depending on which township and school district they reside in. Similarly, owners of industrial or commercial pieces of property are likely to pay approximately $48.00 in general property (real estate) taxes per $1,000 assessed valuation.

| General Property (Real Estate) Tax Rates (per $1,000 Assessed Valuation), Townships within Madison County: Fiscal Year 2007 (Source: Madison County Treasurers Office) | | |
|---|---|---|
| **Taxing Jurisdiction** | **Pike Township** | **Somerford Township** |
| County | 9.80 | 9.80 |
| Health | -- | -- |
| Township | 0.90 | 3.50 |
| 911 | 0.80 | 0.80 |
| School/Joint Vocational School/Library | 46.80 | 47.80 |
| Fire/Ambulance/Cemetery | 2.68 | 3.00 |
| Corporation | -- | -- |
| **Total Rates** | ***60.98*** | ***64.90*** |
| *Reduction Factor (Agricultural/Residential)* | *0.225748* | *0.295399* |
| *Reduction Factor (Other)* | *0.202072* | *0.247859* |
| **EFFECTIVE RATE (AG/RES)** | **47.21** | **45.73** |
| **EFFECTIVE RATE (OTHER)** | **48.66** | **48.81** |

### 5.1.5 UNION COUNTY

Union County reports their tax rates in six general categories: 'County', 'Health', 'School/Library', 'Joint Vocational School (JVS)', 'Township/Fire', and 'Corporation'. The 'County' Fund consists of the County's General Fund, in addition to the Mental Retardation and Developmental Disabilities Fund, the Mental Health Fund, and the 911 Fund. The 'Health District' Fund acts as their own taxing jurisdiction, and therefore they have their own tax rate. For the purpose of this analysis, the 'School/Library' Fund was combined with the 'Joint Vocational School' Fund to be consistent with how other counties report their tax rates and levies. The County does not report specifics on items included within the 'Township/Fire' tax rates, although it is likely that other related funds including Ambulance, Cemetery and Parks were included when calculating these tax rates.

The general property (real estate) tax rates for all jurisdictions under study are based on a tax rate per $1,000 assessed valuation for the Fiscal Year 2007. As indicated in the table, there are numerous taxing jurisdictions within Union County. Health District taxes represent the smallest component of taxes in the County, comprising $1.25 of the total tax rate. All property owners are charged a rate of $10.85 in County taxes, and depending on the location of the property, Township taxes range from $7.10 to $9.60 per $1,000 assessed valuation. School district taxes represent the largest component – ranging from $30.60 to $57.06, depending on the location of the property. Residential and agricultural landowners within Union County are likely to pay between $41.48 and $52.81 in general property (real estate) taxes per $1,000 assessed valuation, depending on which township and school district they are located in. Similarly, owners of industrial or commercial pieces of property are likely to pay between $44.42 and $62.81 in general property (real estate) taxes per $1,000 assessed valuation.

| General Property (Real Estate) Tax Rates (per $1,000 Assessed Valuation), Townships within Union County: Fiscal Year 2007 (Source: Union County Treasurers Office) | | |
|---|---|---|
| **Taxing Jurisdiction** | **Allen Township** | **Union Township** |
| County | 10.85 | 10.85 |
| Health | 1.25 | 1.25 |
| Township (Range) | 9.60 | 7.10 - 8.30 |
| 911 | -- | -- |
| School/Joint Vocational School/Library (Range) | 30.60 - 57.06 | 46.80 |
| Fire/Ambulance/Cemetery | (Included in Township) | (Included in Township) |
| Corporation | -- | 0.00 - 1.20 |
| **Total Rates (Range)** | ***52.30 - 78.76*** | ***67.20*** |
| *Reduction Factor (Agricultural/Residential)* | -- | -- |
| *Reduction Factor (Other)* | -- | -- |
| **EFFECTIVE RATE (AG/RES)** | **41.48 - 52.81** | **52.08** |
| **EFFECTIVE RATE (OTHER)** | **44.42 - 62.81** | **51.68** |

## 5.2 General Property (Real Estate) Tax Levy

### 5.2.1 Municipal Tax Levies

As seen in the accompanying table, Champaign County levied the least amount of general property (real estate) taxes, when compared to all other counties under study in Fiscal Year 2005, at just over $5 million. This is compared to the nearly $11.3 million levied in Logan County, $18.3 million in Clark County, $11.6 million in Union County and $9.5 million in Madison County. For townships within five miles of the Facility, tax levies at the municipal level ranged from nearly $31,000 in the Township of Pike (Madison County) to $2.06 million in the Township of Allen in Union County. However, the majority of the townships' tax levies ranged between $100,000 and $200,000 in Fiscal Year 2005. The construction and operation of the Facility will undoubtedly result in increased tax levies in the townships of Goshen, Rush, Salem, Union, Urbana and Wayne in Champaign County, the townships where the Facility is proposed to be located.

| **Municipal General Property (Real Estate) Tax Levy: Fiscal Year 2005**[16] (Source: Office of the State of Ohio Auditor) | |
|---|---|
| **Taxing Jurisdiction** | **Tax Levy** |
| **CHAMPAIGN COUNTY** | ***$5,016,974*** |
| Township of Concord | $96,976 |
| Township of Goshen | $161,154 |
| Township of Mad River | $202,294 |
| Township of Rush | $81,382 |
| Township of Salem | $130,920 |
| Township of Union | $173,625 |
| Township of Urbana | $199,418 |
| Township of Wayne | $189,130 |
| City of Urbana | $667,221 |
| **LOGAN COUNTY** | ***$11,286,382*** |
| Township of Monroe | $139,703 |
| Township of Zane | $97,951 |
| **CLARK COUNTY** | ***$18,309,439*** |
| Township of Moorefield | $1,358,643 |
| Township of Pleasant | $308,415 |
| **MADISON COUNTY** | ***$9,507,385*** |
| Township of Pike | $30,745 |
| Township of Somerford | $176,070 |
| **UNION COUNTY** | ***$11,606,766*** |
| Township of Allen | $2,061,674 |
| Township of Union | $229,664 |

### 5.2.2 SCHOOL DISTRICT TAX LEVIES

The four school districts within the townships that will host the Facility levied a total of over $10.2 million in general property (real estate) taxes over Fiscal Year 2007. When combined, the six school districts within a five-mile radius of the boundary of the Facility levied over $31.5 million in general property (real estate) taxes in 2007. Levies range from $1.5 million in the Mechanicsburg Exempted Village School District to nearly $10.2 million in the Northeastern Local School District. The variations in the school district tax levies are indicative of the relatively larger district boundaries, the land use composition within the district boundaries, and the greater number of students enrolled within some districts such as the Benjamin Logan Local School District, over others.

[16] Fiscal Year 2005 was used in order to report consistency across taxing jurisdictions. This was the most recent year that such budgetary data was available for all counties and municipalities.

| School Districts' General Property (Real Estate) Tax Levy: Fiscal Year 2007<br>(Source: Office of the State of Ohio Auditor) | |
|---|---|
| **Taxing Jurisdiction** | **Tax Levy** |
| **WITHIN FACILITY BOUNDARY** | |
| Mechanicsburg Exempted Village School District | $1,517,198 |
| Triad Local School District | $1,553,595 |
| Urbana City School District | $5,383,592 |
| West Liberty-Salem Local School District | $1,740,183 |
| | **$10,194,568** |
| **WITHIN FIVE MILES** | |
| Benjamin Logan Local School District | $5,178,567 |
| Fairbanks Local School District | $3,901,466 |
| Graham Local School District | $3,391,334 |
| Jonathan Alder Local School District | $3,954,577 |
| London City School District | $4,924,611 |
| Northeastern Local School District | $10,194,857 |
| | **$31,545,412** |

# 6.0 Community Character and Land Use Trends

## 6.1 COMMUNITY CHARACTER

For purposes of this analysis, community character is defined as the relationship between elements of the natural landscape and countywide patterns of land uses in and around the Facility. Such a bird's eye view is necessary to understand how the proposed Facility may affect the character of the proposal area, spread across Champaign County. Data for this analysis is derived from publicly available Geographic Information Systems sources, topographic maps, and imagery. Comprehensive plans, if available, were also reviewed to assess each community's official policy towards land use and community development.

The area around the Facility consists of predominantly agricultural uses. The land is made up of flat and rolling terrain consisting of croplands, farmsteads, meadows, and woodlots. Residential development within and around the Facility consists almost entirely of single-family multi-acre homesteads along rural roads. Homesteads and farms are comprised of large lot parcels, many in excess of 50 acres, and farms in excess of 200 acres. The rural land use patterns and rolling landscape are typical for much of western and central Ohio, outside of urban centers.

The area within five-miles of the Facility includes the City of Urbana. The corporate limits of these boundaries effectively demarcate the transition between town-scale development and the surrounding agricultural landscape. Residential development in this agricultural landscape consists of independently built farmsteads and single-family homes. A significant built feature is the Honda plant and test track, located alongside U.S. Route 33, to the east of the boundary of the Facility. This facility encompasses and is surrounded by lands dedicated to crop production.

The Mad River Valley and the gentle bluffs and hillsides on either side of the valley are the major landscape defining features of this area. The Mad River is approximately 60 miles in length, originating in Logan County to the north and flows south into the Great Miami River near Dayton. The length of the valley within and around the Project Area is overwhelmingly in active crop production.

The terrain of the Mad River Valley is itself a product of the last glaciation – approximately 10,000 years ago – and helps to understand the existing natural landscape. The gentle and forested bluffs to the east of the Valley consist of the Springfield Moraine and the Urbana Outwash, accumulations of several hundreds of feet thick of rock and sediment from retreating glaciers. In Monroe Township (Logan County), the valley floor has an elevation of approximately 1,100 feet above sea level, while Bald Knob to the east has an elevation of approximately 1,440 feet above sea level. These accumulations provide enough of an elevation difference to make the site attractive for wind-generated power.

In total, the characteristics of the land and prevailing development patterns are conducive to perpetuating the current community character.

### 6.2 LAND USE TRENDS

As seen in *Section 3.0: Existing Tax Base and Tax Revenues*, agricultural uses are the predominant land use as measured by percent area of each geographic area under study. The townships that will host the Facility have the greatest share of agricultural land, when compared to all other geographic areas under study. Likewise, agricultural land is the leading land use by percentage of acreage for the townships and communities within five-miles of the Facility, for Champaign and Logan counties, and Clark, Madison and Union counties. The predominant agricultural use within each area under study emphasizes the rural character of the region, and with respect to compatibility with existing land uses, deems this part of Ohio an ideal location for a potential wind farm.

Comprehensive plans for Champaign, Clark and Madison counties indicate that current rural land uses are the preferred use for future development. Each comprehensive plan, in its discussion of land use policy, places primary emphasis on the preservation and protection of agricultural lands and open space. The underlying interests in taking this position is to limit development that takes agricultural land out of production (ensure viability of agricultural economy), limit costly public infrastructure (lower assessments), and to limit land-intensive sprawling development patterns (reduced quality of life).[17] Such policies indicate a positive disposition towards the anticipated low-impact nature of the proposed Facility. Moreover, location of the Facility in rural areas allows landowners to maintain the agricultural uses of these properties, while receiving additional income from lease payments.

[17] Champaign County Comprehensive Plan for Unincorporated Areas, March 2004; Madison County Ohio Comprehensive Plan, 2005; Comprehensive Land Use Plan for Clark County, 1999 (Draft). Plans were unavailable for both Logan and Union counties.

## 7.0 Economic Impacts of the Facility

The Regional Input-Output Modeling System (RIMS II) was used to determine the economic impacts of the proposed Facility to be located within Champaign County, Ohio. RIMS II was developed by the U.S. Department of Commerce, Bureau of Economic Analysis (BEA) as a method for estimating regional multipliers for impact analysis in output, earnings, and employment associated with a program or project under study.[18]

Using the RIMS II multipliers, an analysis of the economic impacts of the proposed Facility was conducted for the construction phase, as well as during operation of the proposed Facility. For better understanding of the economic impact analysis, definitions are as follows:

- ***Output:*** This refers to the sales receipt for the Facility. During each phase of construction, output refers to the total cost for the construction of the Facility. For the operation phase, output refers to the annual gross revenues derived from the operation of the wind farm.
- ***Earnings:*** During the construction phase, earnings refer to wages derived by construction workers. During the operation phase, wages come from two sources: from wages of wind farm employees; and from leases paid to landowners.
- ***Employment:*** This refers to the number of short-term jobs created during the construction phase, as well as the number of persons permanently employed at the Facility during operation.
- ***Multipliers:*** The use of regional economic multipliers is a standard way to identify the potential effects of a major change in a region's economy. These measures estimate the changes in output, income and employment resulting from an initial change in spending, specific to the region under study.[19]

The Facility is expected to create employment and income during both the construction phase and throughout the life of the Facility. The economic impact study quantifies the effect of one dollar spent as it ripples through the local economy, creating additional expenditures and jobs. Wind power development can expand the local economy through ripple effects, which stem from subsequent expenditures for goods and services made by first-round income from the development, and are expressed in terms of a *multiplier*.

A *direct effect or impact* arises from the first round of buying and selling. Direct effects include the purchase of inputs from local sources such as fuel, the spending of income earned by workers, annual labor revenues, and the income effect of taxes. These direct effects can be used to identify additional, subsequent rounds of buying and selling for other sectors and to identify the effect of spending by local households. The *indirect effect or impact* is the increase in sales of other industry sectors in the region,

[18] U.S. Department of Commerce, "Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II)," Third Edition 1997.
[19] Definition of Multipliers from "A Consumer's Guide to Regional Economic Multipliers," by Coughlin & Mandelbaum. http://research.stlouisfed.org/publications/review/91/01/Consumer_Jan_Feb1991.pdf.

which include further round-by-round sales. The *induced effect or impact* is the expenditures generated by increased household income resulting from direct and indirect effects. The *total effect or impact* is the sum of the direct, indirect, and induced effects.[20]

The amount of electricity that is generated by a wind farm will vary by location, taking into consideration the altitude, wind patterns, and the placement of the turbines in a given locale. For purposes of this study, since the exact turbine model and capacity are yet to be determined, the economic impacts of the Facility with 131.4 megawatts capacity, 146 megawatts capacity, or 182.5 megawatts capacity were analyzed during both construction and operation to provide a basis for the proposed Facility. RIMS II multipliers were used to determine economic impacts during both the construction phase and the operations phase of the Facility as a whole. Construction creates a one-time surge in economic activity, while operation and maintenance makes an on-going economic contribution by creating long-term jobs, continuing income streams for landowners and revenues for municipalities. Both construction phases and the operation phases were analyzed to offer a more comprehensive picture of the possible economic benefits of the Facility.

## 7.1 Economic Impacts of Construction

### 7.1.1 Economic Impacts of the Construction of a Facility with 131.4 MW Capacity

A Facility with a rated capacity of 131.4 megawatts would represent approximately [redacted] in investment. Approximately 67.5% of the [redacted] total budget is estimated as purchase and installation of the towers, turbines, and equipment. The remaining 32.5% represent expenditures for business services, labor and materials.

The construction of a Facility with a rated capacity of 131.4 megawatts will generate approximately 131 full time direct construction jobs[21] over an 18-month period.[22] While it is difficult to estimate the portion of employment that will be drawn from the local labor markets, it is recommended that Buckeye Wind enter into an agreement with local trade unions to ensure that the majority of the Facility is constructed with labor from the Southwest Central Ohio labor pool. Local construction employment will be primarily equipment operators, truck drivers, laborers and electricians. The balance of construction employment will include workers with necessarily special skills imported from outside the region for the duration of construction.

[20] National Wind Coordinating Committee. "*A Methodology for Assessing the Economic Development Impacts of Wind Power,"* June 2004.

[21] This figure was derived through an average of the estimated and actual number of construction workers used per MW of energy produced in 12 wind facilities throughout Colorado, Minnesota, New York, Ohio, Oklahoma, Oregon and Texas. Calculations made by Saratoga Associates based on these case studies indicated that each MW of energy demanded 0.9968 construction workers. As such, it is estimated that 131 construction workers will be needed to construct the Facility with a rated capacity of 131.4 MW.

[22] Construction duration was provided by Buckeye Wind.

The 131 created during construction will create a spin-off of approximately 1,554 jobs in other sectors of the economy, bringing the total economic impact of Facility construction to approximately 1,685. These estimates were based on a multiplier of 11.8647 jobs for every construction job in the region, as developed by the Bureau of Economic Analysis.[23] The [redacted] in original construction investment will generate an indirect and induced output of approximately [redacted] bringing the total impact on output at nearly $795 million.[24] Household earnings of 131 construction workers over an 18-month period are estimated at $7.236 million. These earnings will generate an economic spin-off of approximately $2.930 million, bringing the total economic impact of the Facility construction to nearly $10.166 million in earnings.[25]

### 7.1.2 Economic Impacts of the Construction of a Facility with 146 MW Capacity

A Facility with a rated capacity of 146 megawatts would represent approximately [redacted] in investment. Approximately 67.7% of the [redacted] total budget is estimated as purchase and installation of the towers, turbines, and equipment. The remaining 32.3% represent expenditures for business services, labor and materials.

The construction of a Facility with a rated capacity of 146 megawatts will generate approximately 146 full time direct construction jobs[26] over an 18-month period.[27] While it is difficult to estimate the portion of employment that will be drawn from the local labor markets, it is recommended that Buckeye Wind enter into an agreement with local trade unions to ensure that the majority of the Facility is constructed with labor from the Southwest Central Ohio labor pool. Local construction employment will be primarily equipment operators, truck drivers, laborers and electricians. The balance of construction employment will include workers with necessarily special skills imported from outside the region for the duration of construction.

The 146 jobs created during construction will create an economic spin-off of approximately 1,727 jobs in other sectors of the economy, bringing the total economic impact of the Facility construction to approximately 1,872 jobs.[28] The [redacted] in original construction investment will generate spin-offs in output estimated at approximately [redacted] bringing the total impact on

[23] RIMS II assigns a multiplier of 11.8647 for every construction job created in the Champaign/Clark/Logan/Madison/Union County, Ohio region.
[24] RIMS II assigns a multiplier of [redacted] for every dollar in construction investment in the Champaign/Clark/Logan/Madison/Union County, Ohio region.
[25] RIMS II assigns a multiplier of 0.4049 for every dollar of wages earned in the construction industry in the Champaign/Clark/Logan/Madison/Union County, Ohio region.
[26] This figure was derived through an average of the estimated and actual number of construction workers used per MW of energy produced in 12 wind facilities throughout Colorado, Minnesota, New York, Ohio, Oklahoma, Oregon and Texas. Calculations made by Saratoga Associates based on these case studies indicated that each MW of energy demanded 0.9968 construction workers. As such, it is estimated that 146 construction workers will be needed to construct the Facility with a rated capacity of 146 MW.
[27] Construction duration was provided by Buckeye Wind.
[28] RIMS II assigns a multiplier of 11.8647 for every construction job created in the Champaign/Clark/Logan/Madison/Union County, Ohio region.

output at approximately $880 million.[29] Household earnings of 146 construction workers over an 18-month period are estimated at $8.04 million. These earnings will generate a spin-off of approximately $3.255 million, bringing the total economic impact of the Facility construction to nearly $11.295 million in earnings.[30]

### 7.1.3 ECONOMIC IMPACTS OF THE CONSTRUCTION OF A FACILITY WITH 182.5 MW CAPACITY

A Facility with a rated capacity of 182.5 megawatts would represent approximately [redacted] in investment. Approximately 68.1% of the [redacted] total budget is estimated as purchase and installation of the towers, turbines, and equipment. The remaining 31.9% represent expenditures for business services, labor and materials.

The construction of a Facility with a rated capacity of 182.5 megawatts will generate approximately 182 full time direct construction jobs[31] over an 18-month period. While it is difficult to estimate the portion of employment that will be drawn from the local labor markets, it is recommended that Buckeye Wind enter into an agreement with local trade unions to ensure that the majority of the Facility is constructed with labor from the Southwest Central Ohio labor pool. Local construction employment will be primarily equipment operators, truck drivers, laborers and electricians. The balance of construction employment will include workers with necessarily special skills imported from outside the region for the duration of construction.

The 182 created during construction will create a spin-off of approximately 2,158 jobs in other sectors of the economy, bringing the total economic impact of Facility construction to approximately 2,340. These estimates were based on a multiplier of 11.8647 jobs for every construction job in the region, as developed by the Bureau of Economic Analysis.[32] The [redacted] in original construction investment will generate an indirect and induced output of approximately [redacted] bringing the total impact on output at approximately $1.09 billion.[33] Household earnings of 182 construction workers over an 18-month period are estimated at $10.050 million. These earnings will have a spin-off of approximately $4.069 million, bringing the total economic impact of the Facility construction to nearly $14.119 million in earnings.[34]

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[29] RIMS II assigns a multiplier of 1.5331 for every dollar in construction investment in the Champaign/Clark/Logan/Madison/Union County, Ohio region.

[30] RIMS II assigns a multiplier of 0.4049 for every dollar of wages earned in the construction industry in the Champaign/Clark/Logan/Madison/Union County, Ohio region.

[31] This figure was derived through an average of the estimated and actual number of construction workers used per MW of energy produced in 12 wind facilities throughout Colorado, Minnesota, New York, Ohio, Oklahoma, Oregon and Texas. Calculations made by Saratoga Associates based on these case studies indicated that each MW of energy demanded 0.9968 construction workers. As such, it is estimated that 182 construction workers will be needed to construct the Facility with a rated capacity of 182.5 MW.

[32] RIMS II assigns a multiplier of 11.8647 for every construction job created in the Champaign/Clark/Logan/Madison/Union County, Ohio region.

[33] RIMS II assigns a multiplier of [redacted] for every dollar in construction investment in the Champaign/Clark/Logan/Madison/Union County, Ohio region.

[34] RIMS II assigns a multiplier of 0.4049 for every dollar of wages earned in the construction industry in the Champaign/Clark/Logan/Madison/Union County, Ohio region.

**Buckeye Wind, Champaign County, Ohio**
Economic Impact Analysis of Construction

**Construction of Facility, 131.4 MW Capacity**

| NAICS Code | | Direct Impact ($000) | Multiplier | Indirect & Induced Impacts ($000) | Total Impact ($000) | Notes |
|---|---|---|---|---|---|---|
| 230000 | Construction | | | | | |
| | **Output ($000)** | $ [redacted] | [redacted] | | | Total gross output during construction is estimated at [redacted] for a facility with 131.4 MW total capacity |
| | **Earnings ($000)** | $ 7,236 | | $ 2,930 | $ 10,166 | |
| | Wages | $ 7,236 | 0.4049 | $ 2,930 | $ 10,166 | Average annual wage for Construction in the West Northwestern Ohio nonmetropolitan area is $36,830 |
| | **Employment (jobs)** | 131 | | 1,554 | 1,685 | |
| | Jobs | 131 | 11.8647 | 1,554 | 1,685 | Approximately 131 construction jobs are estimated over a period of 18 months based on 0.9968 FTE per MW. |

Assumptions:
1. Construction jobs are estimated at 0.9968 FTE per MW
2. Construction cost for a facility with 131.4 MW total capacity is estimated at [redacted] to include hard & soft costs
3. Construction cost for a facility with 146 MW total capacity is estimated at [redacted] to include hard & soft costs
4. Construction cost for a facility with 182.5 MW total capacity is estimated [redacted] to include hard & soft costs
5. Champaign County is classified by the Bureau of Labor Statistics as part of the West Northwestern Ohio nonmetropolitan area.

Sources:
RIMS II Multipliers, Bureau of Economic Analysis (Champaign/Clark/Logan/Madison/Union counties, Ohio)
Bureau of Labor Statistics, Occupational Employment Survey 2007.
Buckeye Wind for construction costs.

Prepared by Saratoga Associates,April 2009

**Buckeye Wind, Champaign County, Ohio**
Economic Impact Analysis of Construction

**Construction of Facility, 146 MW Capacity**

| NAICS Code | | Direct Impact ($000) | Multiplier | Indirect & Induced Impacts ($000) | Total Impact ($000) | Notes |
|---|---|---|---|---|---|---|
| 230000 | Construction | | | | | |
| | **Output ($000)** | $ [redacted] | [redacted] | [redacted] | [redacted] | Total gross output during construction is estimated at [redacted] for a facility with 146 MW total capacity |
| | **Earnings ($000)** | $ 8,040 | | $ 3,255 | $ 11,295 | |
| | Wages | $ 8,040 | 0.4049 | $ 3,255 | $ 11,295 | Average annual wage for Construction in the West Northwestern Ohio nonmetropolitan area is $36,830 |
| | **Employment (jobs)** | 146 | | 1,727 | 1,872 | |
| | Jobs | 146 | 11.8647 | 1,727 | 1,872 | Approximately 146 construction jobs are estimated over a period of 18 months based on 0.9968 FTE per MW. |

Assumptions:
1. Construction jobs are estimated at 0.9968 FTE per MW
2. Construction cost for a facility with 131.4 MW total capacity is estimated at [redacted] to include hard & soft costs
3. Construction cost for a facility with 146 MW total capacity is estimated a [redacted] to include hard & soft costs
4. Construction cost for a facility with 182.5 MW total capacity is estimated at [redacted]ion to include hard & soft costs
5. Champaign County is classified by the Bureau of Labor Statistics as part of the West Northwestern Ohio nonmetropolitan area.

Sources:
RIMS II Multipliers, Bureau of Economic Analysis (Champaign/Clark/Logan/Madison/Union counties, Ohio)
Bureau of Labor Statistics, Occupational Employment Survey 2007.
Buckeye Wind for construction costs.

Prepared by Saratoga Associates,April 2009

**Buckeye Wind, Champaign County, Ohio**
Economic Impact Analysis of Construction

**<u>Construction of Facility, 182.5 MW Capacity</u>**

| NAICS Code | | Direct Impact ($000) | Multiplier | Indirect & Induced Impacts ($000) | Total Impact ($000) | Notes |
|---|---|---|---|---|---|---|
| 230000 | Construction | | | | | |
| | **Output ($000)** | $ [redacted] | [redacted] | | | Total gross output during construction is estimated a[redacted]for a facility with 182.5 MW total capacity |
| | **Earnings ($000)** | $ 10,050 | | $ 4,069 | $ 14,119 | |
| | Wages | $ 10,050 | 0.4049 | $ 4,069 | $ 14,119 | Average annual wage for Construction in the West Northwestern Ohio nonmetropolitan area is $36,830 |
| | **Employment (jobs)** | 182 | | 2,158 | 2,340 | |
| | Jobs | 182 | 11.8647 | 2,158 | 2,340 | Approximately 182 construction jobs are estimated over a period of 18 months based on 0.9968 FTE per MW |

Assumptions:
1. Construction jobs are estimated at 0.9968 FTE per MW
2. Construction cost for a faciility with 131.4 MW total capacity is estimated at[redacted]to include hard & soft costs
3. Construction cost for a faciility with 146 MW total capacity is estimated at[redacted]to include hard & soft costs
4. Construction cost for a faciility with 182.5 MW total capacity is estimated a[redacted]to include hard & soft costs
5. Champaign County is classified by the Bureau of Labor Statistics as part of the West Northwestern Ohio nonmetropolitan area.

Sources:
RIMS II Multipliers, Bureau of Economic Analysis (Champaign/Clark/Logan/Madison/Union counties, Ohio)
Bureau of Labor Statistics, Occupational Employment Survey 2007.
Buckeye Wind for construction costs.

Prepared by Saratoga Associates,April 2009

## 7.2 Economic Impacts of Operation

### 7.2.1 Economic Impacts of Operation of a Facility with 131.4 MW Capacity

A Facility with rated capacity of 131.4 megawatts of power, is projected to generate approximately 12 full-time jobs, comprising of one (1) Operations Manager/Supervisor, eight (8) Operations and Maintenance technicians, one (1) parts/logistics person and two (2) customer service representatives.[35] Annual wages for the 12 full time employees are estimated at $0.569 million.[36] Leases to landowners are based on [redacted] With gross annual revenues of $[redacted] for the first year of operation, total annual leases to landowners for the first year of operation is estimated at $[redacted] for a 131.4 MW facility. Total direct earnings comprising of direct wages and leases paid to property owners are estimated at $[redacted] during operation of the Facility.

The twelve (12) full time jobs generated during project operation will generate a spin-off of 50 additional jobs in other sectors of the economy, based on a multiplier of 4.144 jobs for every job created in Power Generation and Supply, as developed by the Bureau of Economic Analysis.[37] This brings the total impact on jobs to 62 new jobs. These full time jobs create jobs in other sectors of the economy through expenditures derived from household wages that are spent. These full time jobs do not include other services to the Facility that may include snow plowing, landscaping, road repairs, among others. Total earnings from wages and leases to property owners are projected to have an indirect and induced impact of approximately $0.494 million, bringing the total economic impact on earnings at approximately $2.539 million for the first year of operation.[38] Output in the form of annual gross revenues from energy production are projected to total approximately [redacted][39] and an additional [redacted] in indirect and induced impacts. This brings the total economic impact of output to at approximately $66.751 million for the first year of operation.[40] Output, earnings and employment for succeeding years are estimated in *Section 7.2.4 Cumulative Economic Impacts of Operation*.

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[35] Positions and direct number of jobs information provided by Buckeye Wind.

[36] Total wages are derived from wages provided by the Bureau of Labor Statistics 2007. Positions include one (1) Operations Manager (General and Operations Manager), whose average annual wage in the West Northwestern Ohio region is $86,380;eight (8) O&M technicians (Electrical and Electronic Engineering Technicians), whose average annual wage is $45,890 per person; one (1) Parts/Logistics Person (Logistician); and two (2) Customer Service Representatives with average annual wage at $28,790 each.

[37] RIMS II assigns a multiplier of 4.144 for every job created under 2211A0 Power Generation and Supply in the Champaign/ Clark/Logan/Madison/Union County, Ohio region.

[38] RIMS II assigns a multiplier of 0.2414 for every dollar earned through wages and leases in the Power generation and supply industry in the Champaign/Clark/Logan/Madison/Union County, Ohio region.

[39] Estimated gross revenues were based on a 100 MW facility with annual gross revenues of [redacted] as provided by Buckeye Wind. A 131.4 megawatts facility is estimated to generate [redacted] in gross revenues for the first year of operation.

[40] RIMS II assigns a multiplier of [redacted] for every dollar of investment in Power Generation and Supply in the Champaign/Clark/Logan/Madison/Union County, Ohio region.

### 7.2.2 ECONOMIC IMPACTS OF OPERATION OF A FACILITY WITH 146 MW CAPACITY

A Facility with rated capacity of 146 megawatts of power, is projected to generate approximately 12 full-time jobs, comprising of one (1) Operations Manager/Supervisor, eight (8) Operations and Maintenance technicians, one (1) parts/logistics person and two (2) customer service representatives.[41] Annual wages for the 12 full time employees are estimated at $0.569 million.[42] Leases to landowners are based on [redacted] With gross annual revenues of $[redacted] for the first year of operation, total annual leases to landowners for the first year of operation is estimated at $[redacted] for a 146 MW facility. Total direct earnings comprising of direct wages and leases paid to property owners are estimated at $[redacted] during operation of the Facility.

The twelve (12) full time jobs generated during project operation will generate a spin-off of 50 additional jobs in other sectors of the economy, based on a RIMS II multiplier of 4.144 jobs for every job created in Power Generation and Supply, as developed by the Bureau of Economic Analysis.[43] This brings the total impact on jobs to 62 new jobs. These full time jobs create jobs in other sectors of the economy through expenditures derived from household wages that are spent. These full time jobs do not include other services to the Facility that may include snow plowing, landscaping, road repairs, among others. Total earnings from wages and leases to property owners are projected to have an indirect and induced impact of approximately $0.533 million, bringing the total economic impact on earnings at approximately $2.743 million for the first year of operation.[44] Output in the form of annual gross revenues from energy production are projected to total approximately [redacted][45] and an additional [redacted] in indirect and induced impacts. This brings the total economic impact of output to at approximately $74.168 million for the first year of operation.[46] Output, earnings and employment for succeeding years are estimated in *Section 7.2.4 Cumulative Economic Impacts of Operation*.

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[41] Positions and direct number of jobs information provided by Buckeye Wind.

[42] Total wages are derived from wages provided by the Bureau of Labor Statistics 2007. Positions include one (1) Operations Manager (General and Operations Manager), whose average annual wage in the West Northwestern Ohio region is $86,380;eight (8) O&M technicians (Electrical and Electronic Engineering Technicians), whose average annual wage is $45,890 per person; one (1) Parts/Logistics Person (Logistician); and two (2) Customer Service Representatives with average annual wage at $28,790 each.

[43] RIMS II assigns a multiplier of 4.144 for every job created under 2211A0 Power Generation and Supply in the Champaign/ Clark/Logan/Madison/Union County, Ohio region.

[44] RIMS II assigns a multiplier of 0.2414 for every dollar earned through wages and leases in the Power generation and supply industry in the Champaign/Clark/Logan/Madison/Union County, Ohio region.

[45] Estimated gross revenues were based on a 100 MW facility with annual gross revenues of [redacted] as provided by Buckeye Wind. A 146 megawatts facility is estimated to generate [redacted] in gross revenues for the first year of operation.

[46] RIMS II assigns a multiplier of [redacted] for every dollar of investment in Power Generation and Supply in the Champaign/Clark/Logan/Madison/Union County, Ohio region.

### 7.2.3 ECONOMIC IMPACTS OF OPERATION OF A FACILITY WITH 182.5 MW CAPACITY

A Facility with rated capacity of 182.5 megawatts of power, is projected to generate approximately 12 full-time jobs, comprising of one (1) Operations Manager/Supervisor, eight (8) Operations and Maintenance technicians, one (1) parts/logistics person and two (2) customer service representatives.[47] Annual wages for the 12 full time employees are estimated at $0.569 million.[48] Leases to landowners are based on [redacted] With gross annual revenues of [redacted] for the first year of operation, total annual leases to landowners for the first year of operation is estimated at [redacted] for a 182.5 MW facility. Total direct earnings comprising of direct wages and leases paid to property owners are estimated at $[redacted] during operation of the Facility.

The twelve (12) full time jobs generated during project operation will generate a spin-off of 50 additional jobs in other sectors of the economy, based on a multiplier of 4.144 jobs for every job created in Power generation and supply as developed by the Bureau of Economic Analysis.[49] This brings the total impact on jobs to 62 new jobs. These full time jobs create jobs in other sectors of the economy through expenditures derived from household wages that are spent. These full time jobs do not include other services to the Facility that may include snow plowing, landscaping, road repairs, among others. Total earnings from wages and leases to property owners are projected to have an indirect and induced impact of approximately $0.632 million, bringing the total economic impact on earnings at approximately $3.252 million for the first year of operation.[50] Output in the form of annual gross revenues from energy production are projected to total approximately [redacted][51] and an additional [redacted] in indirect and induced impacts. This brings the total economic impact of output to at approximately $92.709 million for the first year of operation.[52] Output, earnings and employment for succeeding years are estimated in *Section 7.2.4 Cumulative Economic Impacts of Operation*.

[47] Positions and direct number of jobs information provided by Buckeye Wind.
[48] Total wages are derived from wages provided by the Bureau of Labor Statistics 2007. Positions include one (1) Operations Manager (General and Operations Manager), whose average annual wage in the West Northwestern Ohio region is $86,380;eight (8) O&M technicians (Electrical and Electronic Engineering Technicians), whose average annual wage is $45,890 per person; one (1) Parts/Logistics Person (Logistician); and two (2) Customer Service Representatives with average annual wage at $28,790 each.
[49] RIMS II assigns a multiplier of 4.144 for every job created under 2211A0 Power Generation and Supply in the Champaign/ Clark/Logan/Madison/Union County, Ohio region.
[50] RIMS II assigns a multiplier of 0.2414 for every dollar earned through wages and leases in the Power generation and supply industry in the Champaign/Clark/Logan/Madison/Union County, Ohio region.
[51] Estimated gross revenues were based on a 100 MW facility with annual gross revenues of [redacted] as provided by Buckeye Wind. A 182.5 megawatts facility is estimated to generate $[redacted] in gross revenues for the first year of operation.
[52] RIMS II assigns a multiplier of [redacted] for every dollar of investment in Power Generation and Supply in the Champaign/Clark/Logan/Madison/Union County, Ohio region.

**Buckeye Wind, Champaign County, Ohio**
Economic Impact Analysis, First Year of Operation

**Facility, 131.4 MW Capacity**

| NAICS Code | | Direct Impact ($000) | Multiplier | Indirect & Induced Impacts ($000) | Total Impact ($000) | Notes |
|---|---|---|---|---|---|---|
| 2211A0 | Power generation & supply | | | | | |
| | **Output ($000)** | $ [redacted] | [redacted] | [redacted] | [redacted] [redacted] | Gross revenues are estimated at [redacted] during operation of the Wind Farm with a rated capacity of 131.4 MW |
| | **Earnings ($000)** | $ 2,046 | | $ 494 | $ 2,539 | Earnings comprise of wages for wind farm employees and leases for landowners |
| | Wages | $ 569 | 0.2414 | $ 137 | $ 707 | |
| | 1 Supervisor | 86 | | | | Average annual wage for General and Operations Manager in the West Northwestern Ohio nonmetropolitan area is $86,380 |
| | 2 O&M Customer Service Representatives | 58 | | | | Average annual wage for Customer Service Representatives in the West Northwestern Ohio nonmetropolitan area is $28,790. |
| | 8 O&M Technicians | 367 | | | | Average annual wage for Electrical and Electronic Engineering Technicians in the West Northwestern Ohio nonmetropolitan area is $45,890. |
| | 1 Parts/Logistics Staff | 58 | | | | Average annual wage for Logisticians in the West Northwestern Ohio nonmetropolitan region is $58,150 |
| | Leases | $ [redacted] | [redacted] | [redacted] | [redacted] [redacted] | Leases are estimated at [redacted]s. |
| | **Employment (jobs)** | 12 | 4.144 | 50 | 62 | Approximately 12 full time jobs are projected during Phase I Operation of the Wind Farm |

Assumptions:
1. Gross revenues are estimated at [redacted] for a facility with 131.4 MW capacity; [redacted] for a 146 MW facility and [redacted] for a 182.5 MW facility.
2. Leases estimated at [redacted]
3. It is estimated that 12 jobs will be created during Phase I Operation of the Wind Farm
4. Staff includes 1 Supervisor, 2 O&M Customer Representatives, 8 O&M technicians, 1 Parts/Logistics person
5. Earnings comprise of wages for wind farm employees and leases for landowners
6. Champaign County is classified by the Bureau of Labor Statistics as part of the West Northwestern Ohio nonmetropolitan area.
7. Wage data was derived from the Bureau of Labor Statistics, Occupational Employment Survey 2007.

Sources:
RIMS II Multipliers, Bureau of Economic Analysis (Champaign/Clark/Logan/Madison/Union counties, Ohio)
Bureau of Labor Statistics, Occupational Employment Survey 2007.
Buckeye Wind LLC

Prepared by Saratoga Associates, April 2009

**Buckeye Wind, Champaign County, Ohio**
Economic Impact Analysis, First Year of Operation

**Facility, 146 MW Capacity**

| NAICS Code | | Direct Impact ($000) | Multiplier | Indirect & Induced Impacts ($000) | Total Impact ($000) | Notes |
|---|---|---|---|---|---|---|
| 2211A0 | Power generation & supply | | | | | |
| | **Output ($000)** | $ [redacted] | [redacted] | [redacted] | [redacted] | Gross revenues are estimated at [redacted] during operation of the Wind Farm with a rated capacity of 146 MW |
| | **Earnings ($000)** | $ 2,210 | | $ 533 | $ 2,743 | Earnings comprise of wages for wind farm employees and leases for landowners |
| | Wages | $ 569 | 0.2414 | $ 137 | $ 707 | |
| | 1 Supervisor | 86 | | | | Average annual wage for General and Operations Manager in the West Northwestern Ohio nonmetropolitan area is $86,380 |
| | 2 O&M Customer Service Representatives | 58 | | | | Average annual wage for Customer Service Representatives in the West Northwestern Ohio nonmetropolitan area is $28,790. |
| | 8 O&M Technicians | 367 | | | | Average annual wage for Electrical and Electronic Engineering Technicians in the West Northwestern Ohio nonmetropolitan area is $45,890. |
| | 1 Parts/Logistics Staff | 58 | | | | Average annual wage for Logisticians in the West Northwestern Ohio nonmetropolitan region is $58,150 |
| | Leases | $ [redacted] | [redacted] | [redacted] | [redacted] | Leases are estimated at [redacted] |
| | **Employment (jobs)** | 12 | 4.144 | 50 | 62 | Approximately 12 full time jobs are projected during Phase I Operation of the Wind Farm |

Assumptions:
1. Gross revenues are estimated at [redacted] for a facility with 131.4 MW capacity; [redacted] for a 146 MW facility and [redacted] for a 182.5 MW facility.
2. Leases estimated a [redacted]
3. It is estimated that 12 jobs will be created during Phase I Operation of the Wind Farm
4. Staff includes 1 Supervisor, 2 O&M Customer Representatives, 8 O&M technicians, 1 Parts/Logistics person
5. Earnings comprise of wages for wind farm employees and leases for landowners
6. Champaign County is classified by the Bureau of Labor Statistics as part of the West Northwestern Ohio nonmetropolitan area.
7. Wage data was derived from the Bureau of Labor Statistics, Occupational Employment Survey 2007.

Sources:
RIMS II Multipliers, Bureau of Economic Analysis (Champaign/Clark/Logan/Madison/Union counties, Ohio)
Bureau of Labor Statistics, Occupational Employment Survey 2007.
Buckeye Wind LLC

Prepared by Saratoga Associates, April 2009

**Buckeye Wind, Champaign County, Ohio**
Economic Impact Analysis, First Year of Operation

**Facility, 182.5 MW Capacity**

| NAICS Code | | Direct Impact ($000) | Multiplier | Indirect & Induced Impacts ($000) | Total Impact ($000) | Notes |
|---|---|---|---|---|---|---|
| 2211A0 | Power generation & supply | | | | | |
| | **Output ($000)** | $ [redacted] | [redacted] | [redacted] | [redacted] | Gross revenues are estimated at [redacted] during operation of the Wind Farm with a rated capacity of 182.5 MW |
| | **Earnings ($000)** | $ 2,620 | | $ 632 | $ 3,252 | Earnings comprise of wages for wind farm employees and leases for landowners |
| | Wages | $ 569 | 0.2414 | $ 137 | $ 707 | |
| | 1 Supervisor | 86 | | | | Average annual wage for General and Operations Manager in the West Northwestern Ohio nonmetropolitan area is $86,380 |
| | 2 O&M Customer Service Representatives | 58 | | | | Average annual wage for Customer Service Representatives in the West Northwestern Ohio nonmetropolitan area is $28,790. |
| | 8 O&M Technicians | 367 | | | | Average annual wage for Electrical and Electronic Engineering Technicians in the West Northwestern Ohio nonmetropolitan area is $45,890. |
| | 1 Parts/Logistics Staff | 58 | | | | Average annual wage for Logisticians in the West Northwestern Ohio nonmetropolitan region is $58,150 |
| | Leases | $ [redacted] | [redacted] | [redacted] | [redacted] | Leases are estimated at [redacted]. |
| | **Employment (jobs)** | 12 | 4.144 | 50 | 62 | Approximately 12 full time jobs are projected during Phase I Operation of the Wind Farm |

Assumptions:
1. Gross revenues are estimated at [redacted] ion for a facility with 131.4 MW capacity; [redacted] ion for a 146 MW facility and [redacted] for a 182.5 MW facility.
2. Leases estimated at [redacted]
3. It is estimated that 12 jobs will be created during Phase I Operation of the Wind Farm
4. Staff includes 1 Supervisor, 2 O&M Customer Representatives, 8 O&M technicians, 1 Parts/Logistics person
5. Earnings comprise of wages for wind farm employees and leases for landowners
6. Champaign County is classified by the Bureau of Labor Statistics as part of the West Northwestern Ohio nonmetropolitan area.
7. Wage data was derived from the Bureau of Labor Statistics, Occupational Employment Survey 2007.

Sources:
RIMS II Multipliers, Bureau of Economic Analysis (Champaign/Clark/Logan/Madison/Union counties, Ohio)
Bureau of Labor Statistics, Occupational Employment Survey 2007.
Buckeye Wind LLC

Prepared by Saratoga Associates, April 2009

### 7.2.4 Cumulative Economic Impacts of Operation

Over a 20-year period of operation, projected economic impacts of the Facility are in the billions. A facility with rated capacity of 131.4 megawatts have a direct economic impact of over $717 million in output and $57.59 million in earnings, of which [redacted] are in workers' wages and almost [redacted] are in leases to landowners. Leases to landowners are based on [redacted] The twelve positions to be employed at the Facility remain constant throughout operations. A facility with 131.4 MW rated capacity will generate a spin-off of nearly $905 million in output, $13.9 million in earnings and 50 jobs in other sectors of the economy. Total economic impacts of a Facility with 131.4 MW will bring nearly $1.62 billion in output, almost $71.5 million in earnings and 62 jobs in employment during 20 years of operation.

A 146 megawatts facility will have a direct economic impact of over $797 million in output and $62.45 million in earnings, of which [redacted] are in workers' wages and over [redacted] are in leases to landowners. Leases to landowners are based on [redacted] The twelve positions to be employed at the Facility remain constant throughout operations. A facility with 146 MW rated capacity will have a spin-off of over $1.0 billion in output, nearly $15.1 million in earnings and 50 jobs in other sectors of the economy. Total economic impacts of a Facility with 146 MW will bring over $1.8 billion in output, over $77.5 million in earnings and 62 jobs in employment over 20 years of operation.

A Facility with a 182.5 megawatts rated capacity will have a direct economic impact of over $996 million in output, over $74.6 million in earnings, of which [redacted] are in wages and nearly [redacted] are in leases to landowners. Leases to landowners are based on [redacted] The twelve positions to be employed at the Facility remain constant throughout operations. A facility with 182.5 MW rated capacity generate a spin-off of over $1.25 billion in output, over $18.0 billion in earnings and 50 jobs in other sectors of the economy. These would bring the total economic impact of a Facility with 182.5 MW to over $2.25 billion in output, over $92.6 million in earnings and 62 jobs in employment over 20 years of operation.

| Summary of Projected Economic Impacts of Facility Operation (20 Years)[53] (Sources: RIMS II Multipliers, Buckeye Wind, Analysis by Saratoga Associates) | | | |
|---|---|---|---|
| | **131.4 MW** | **146 MW** | **182.5 MW** |
| **Direct Economic Impacts** | | | |
| Projected Output/ Gross Operating Revenues ($000) | $717,453 | $797,172 | $996,459 |
| Earnings ($000) | $57,586 | $62,448 | $74,602 |
| Wages ($000) | [redacted] | [redacted] | [redacted] |
| Leases ($000) | [redacted] | [redacted] | [redacted] |
| Jobs | 12 | 12 | 12 |
| **Indirect & Induced Impacts** | | | |
| Projected Output ($000) | $904,421 | $1,004,916 | $1,256,137 |
| Earnings ($000) | $13,901 | $15,075 | $18,009 |
| Jobs | 50 | 50 | 50 |
| **Total Economic Impacts** | | | |
| Projected Output ($000) | $1,621,874 | $1,802,088 | $2,252,596 |
| Earnings ($000) | $71,487 | $77,523 | $92,611 |
| Jobs | 62 | 62 | 62 |

[53] Two (2) percent annual growth was applied to Output and Earnings based on projections of 2 percent year-over-year growth in GDP made by the US Energy Information Administration. "Short-Term Energy Outlook," released January 13, 2009. http://www.eia.doe.gov/steo. Accessed on January 23, 2009.

**Buckeye Facility, Champaign County, Ohio**
Economic Impact Analysis - Cumulative Economic Impact of Operation (Yrs 1 - 20)

| | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 | Y8 | Y9 | Y10 | Y11 | Y12 | Y13 | Y14 | Y15 | Y16 | Y17 | Y18 | Y19 | Y20 | 20 Year Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Facility, 131.4 MW Capacity** | | | | | | | | | | | | | | | | | | | | | |
| **Direct Impact** | | | | | | | | | | | | | | | | | | | | | |
| Projected Output/Annual Gross Operating Revenues | $ 29,528 | $ 30,119 | $ 30,721 | $ 31,335 | $ 31,962 | $ 32,601 | $ 33,253 | $ 33,918 | $ 34,597 | $ 35,289 | $ 35,994 | $ 36,714 | $ 37,449 | $ 38,198 | $ 38,962 | $ 39,741 | $ 40,536 | $ 41,346 | $ 42,173 | $ 43,017 | $ 717,453 |
| Earnings | $ 2,046 | $ 2,087 | $ 2,128 | $ 2,171 | $ 2,214 | $ 2,259 | $ 2,304 | $ 2,350 | $ 2,397 | $ 2,445 | $ 3,214 | $ 3,278 | $ 3,343 | $ 3,410 | $ 3,478 | $ 3,548 | $ 3,619 | $ 3,691 | $ 3,765 | $ 3,840 | $ 57,586 |
| Wages | [redacted] | | | | | | | | | | | | | | | | | | | | |
| Leases | | | | | | | | | | | | | | | | | | | | | |
| Employment | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| **Indirect & Induced Impacts** | | | | | | | | | | | | | | | | | | | | | |
| Projected Output | $ 37,223 | $ 37,967 | $ 38,727 | $ 39,501 | $ 40,291 | $ 41,097 | $ 41,919 | $ 42,758 | $ 43,613 | $ 44,485 | $ 45,375 | $ 46,282 | $ 47,208 | $ 48,152 | $ 49,115 | $ 50,097 | $ 51,099 | $ 52,121 | $ 53,164 | $ 54,227 | $ 904,421 |
| Earnings | $ 494 | $ 504 | $ 514 | $ 524 | $ 535 | $ 545 | $ 556 | $ 567 | $ 579 | $ 590 | $ 776 | $ 791 | $ 807 | $ 823 | $ 840 | $ 856 | $ 874 | $ 891 | $ 909 | $ 927 | $ 13,901 |
| Wages | [redacted] | | | | | | | | | | | | | | | | | | | | |
| Leases | | | | | | | | | | | | | | | | | | | | | |
| Employment | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| **Total Impact** | | | | | | | | | | | | | | | | | | | | | |
| Projected Output | $ 66,751 | $ 68,086 | $ 69,448 | $ 70,837 | $ 72,253 | $ 73,698 | $ 75,172 | $ 76,676 | $ 78,209 | $ 79,774 | $ 81,369 | $ 82,996 | $ 84,656 | $ 86,350 | $ 88,077 | $ 89,838 | $ 91,635 | $ 93,468 | $ 95,337 | $ 97,244 | $ 1,621,874 |
| Earnings | $ 2,539 | $ 2,590 | $ 2,642 | $ 2,695 | $ 2,749 | $ 2,804 | $ 2,860 | $ 2,917 | $ 2,975 | $ 3,035 | $ 3,989 | $ 4,069 | $ 4,150 | $ 4,233 | $ 4,318 | $ 4,404 | $ 4,493 | $ 4,582 | $ 4,674 | $ 4,768 | $ 71,487 |
| Wages | [redacted] | | | | | | | | | | | | | | | | | | | | |
| Leases | | | | | | | | | | | | | | | | | | | | | |
| Employment | 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 | $ 62 |

Assumptions:
1.[redacted] annual growth was applied to Output and Earnings based projections of [redacted]-over-year growth in GDP by the Energy Information Administration.
2. Employment projections are projected to remain constant, based on positions projected for employment at the Wind Farm.
3. Employment information provided by Buckeye Wind LLC.

Sources:
RIMS II Multipliers, Bureau of Economic Analysis (Champaign/Clark/Logan/Madison/Union counties, Ohio)
Bureau of Labor Statistics, Occupational Employment Survey 2007.
US Energy Information Administration
Buckeye Wind LLC

Prepared by Saratoga Associates, April 2009

**Buckeye Facility, Champaign County, Ohio**

Economic Impact Analysis - Cumulative Economic Impact of Operation (Yrs 1 - 20)

| | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 | Y8 | Y9 | Y10 | Y11 | Y12 | Y13 | Y14 | Y15 | Y16 | Y17 | Y18 | Y19 | Y20 | 20 Year Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Facility, 146 MW Capacity** | | | | | | | | | | | | | | | | | | | | | |
| **Direct Impact** | | | | | | | | | | | | | | | | | | | | | |
| Projected Output/Annual Gross Operating Revenues | $ 32,809 | $ 33,465 | $ 34,134 | $ 34,817 | $ 35,514 | $ 36,224 | $ 36,948 | $ 37,687 | $ 38,441 | $ 39,210 | $ 39,994 | $ 40,794 | $ 41,610 | $ 42,442 | $ 43,291 | $ 44,157 | $ 45,040 | $ 45,941 | $ 46,859 | $ 47,797 | $ 797,172 |
| Earnings | $ 2,210 | $ 2,254 | $ 2,299 | $ 2,345 | $ 2,392 | $ 2,440 | $ 2,488 | $ 2,538 | $ 2,589 | $ 2,641 | $ 3,493 | $ 3,563 | $ 3,635 | $ 3,707 | $ 3,781 | $ 3,857 | $ 3,934 | $ 4,013 | $ 4,093 | $ 4,175 | $ 62,448 |
| Wages | [redacted] | | | | | | | | | | | | | | | | | | | | |
| Leases | | | | | | | | | | | | | | | | | | | | | |
| Employment | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| **Indirect & Induced Impacts** | | | | | | | | | | | | | | | | | | | | | |
| Projected Output | $ 41,359 | $ 42,186 | $ 43,030 | $ 43,891 | $ 44,768 | $ 45,664 | $ 46,577 | $ 47,509 | $ 48,459 | $ 49,428 | $ 50,416 | $ 51,425 | $ 52,453 | $ 53,502 | $ 54,572 | $ 55,664 | $ 56,777 | $ 57,913 | $ 59,071 | $ 60,252 | $ 1,004,916 |
| Earnings | $ 533 | $ 544 | $ 555 | $ 566 | $ 577 | $ 589 | $ 601 | $ 613 | $ 625 | $ 637 | $ 843 | $ 860 | $ 877 | $ 895 | $ 913 | $ 931 | $ 950 | $ 969 | $ 988 | $ 1,008 | $ 15,075 |
| Wages | [redacted] | | | | | | | | | | | | | | | | | | | | |
| Leases | | | | | | | | | | | | | | | | | | | | | |
| Employment | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| **Total Impact** | | | | | | | | | | | | | | | | | | | | | |
| Projected Output | $ 74,168 | $ 75,651 | $ 77,164 | $ 78,708 | $ 80,282 | $ 81,887 | $ 83,525 | $ 85,196 | $ 86,900 | $ 88,638 | $ 90,410 | $ 92,219 | $ 94,063 | $ 95,944 | $ 97,863 | $ 99,820 | $ 101,817 | $ 103,853 | $ 105,930 | $ 108,049 | $ 1,802,088 |
| Earnings | $ 2,743 | $ 2,798 | $ 2,854 | $ 2,911 | $ 2,969 | $ 3,029 | $ 3,089 | $ 3,151 | $ 3,214 | $ 3,278 | $ 4,337 | $ 4,424 | $ 4,512 | $ 4,602 | $ 4,694 | $ 4,788 | $ 4,884 | $ 4,982 | $ 5,081 | $ 5,183 | $ 77,523 |
| Wages | [redacted] | | | | | | | | | | | | | | | | | | | | |
| Leases | | | | | | | | | | | | | | | | | | | | | |
| Employment | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 |

Assumptions:

1. [redacted] annual growth was applied to Output and Earnings based projections of [redacted]-over-year growth in GDP by the Energy Information Administration.
2. Employment projections are projected to remain constant, based on positions projected for employment at the Wind Farm.
3. Employment information provided by Buckeye Wind LLC.

Sources:

RIMS II Multipliers, Bureau of Economic Analysis (Champaign/Clark/Logan/Madison/Union counties, Ohio)

Bureau of Labor Statistics, Occupational Employment Survey 2007.

US Energy Information Administration

Buckeye Wind LLC

Prepared by Saratoga Associates, April 2009

**Buckeye Facility, Champaign County, Ohio**

Economic Impact Analysis - Cumulative Economic Impact of Operation (Yrs 1 - 20)

| | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 | Y8 | Y9 | Y10 | Y11 | Y12 | Y13 | Y14 | Y15 | Y16 | Y17 | Y18 | Y19 | Y20 | 20 Year Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Facility, 182.5 MW Capacity** | | | | | | | | | | | | | | | | | | | | | |
| **Direct Impact** | | | | | | | | | | | | | | | | | | | | | |
| Projected Output/Annual Gross Operating Revenues | $ 41,011 | $ 41,831 | $ 42,668 | $ 43,521 | $ 44,392 | $ 45,279 | $ 46,185 | $ 47,109 | $ 48,051 | $ 49,012 | $ 49,992 | $ 50,992 | $ 52,012 | $ 53,052 | $ 54,113 | $ 55,195 | $ 56,299 | $ 57,425 | $ 58,574 | $ 59,745 | $ 996,459 |
| Earnings | $ 2,620 | $ 2,672 | $ 2,726 | $ 2,780 | $ 2,836 | $ 2,892 | $ 2,950 | $ 3,009 | $ 3,069 | $ 3,131 | $ 4,193 | $ 4,277 | $ 4,363 | $ 4,450 | $ 4,539 | $ 4,630 | $ 4,722 | $ 4,817 | $ 4,913 | $ 5,011 | $ 74,602 |
| Wages | [redacted] | | | | | | | | | | | | | | | | | | | | |
| Leases | | | | | | | | | | | | | | | | | | | | | |
| Employment | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| **Indirect & Induced Impacts** | | | | | | | | | | | | | | | | | | | | | |
| Projected Output | $ 51,698 | $ 52,732 | $ 53,787 | $ 54,863 | $ 55,960 | $ 57,079 | $ 58,221 | $ 59,385 | $ 60,573 | $ 61,784 | $ 63,020 | $ 64,281 | $ 65,566 | $ 66,877 | $ 68,215 | $ 69,579 | $ 70,971 | $ 72,390 | $ 73,838 | $ 75,315 | $ 1,256,137 |
| Earnings | $ 632 | $ 645 | $ 658 | $ 671 | $ 685 | $ 698 | $ 712 | $ 726 | $ 741 | $ 756 | $ 1,012 | $ 1,033 | $ 1,053 | $ 1,074 | $ 1,096 | $ 1,118 | $ 1,140 | $ 1,163 | $ 1,186 | $ 1,210 | $ 18,009 |
| Wages | [redacted] | | | | | | | | | | | | | | | | | | | | |
| Leases | | | | | | | | | | | | | | | | | | | | | |
| Employment | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| **Total Impact** | | | | | | | | | | | | | | | | | | | | | |
| Projected Output | $ 92,709 | $ 94,564 | $ 96,455 | $ 98,384 | $ 100,352 | $ 102,359 | $ 104,406 | $ 106,494 | $ 108,624 | $ 110,796 | $ 113,012 | $ 115,273 | $ 117,578 | $ 119,930 | $ 122,328 | $ 124,775 | $ 127,270 | $ 129,816 | $ 132,412 | $ 135,060 | $ 2,252,596 |
| Earnings | $ 3,252 | $ 3,317 | $ 3,384 | $ 3,451 | $ 3,520 | $ 3,591 | $ 3,662 | $ 3,736 | $ 3,810 | $ 3,887 | $ 5,206 | $ 5,310 | $ 5,416 | $ 5,524 | $ 5,635 | $ 5,747 | $ 5,862 | $ 5,980 | $ 6,099 | $ 6,221 | $ 92,611 |
| Wages | [redacted] | | | | | | | | | | | | | | | | | | | | |
| Leases | | | | | | | | | | | | | | | | | | | | | |
| Employment | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 | 62 |

Assumptions:

1. [redacted] annual growth was applied to Output and Earnings based projections of [redacted]-over-year growth in GDP by the Energy Information Administration.
2. Employment projections are projected to remain constant, based on positions projected for employment at the Wind Farm.
3. Employment information provided by Buckeye Wind LLC.

Sources:

RIMS II Multipliers, Bureau of Economic Analysis (Champaign/Clark/Logan/Madison/Union counties, Ohio)

Bureau of Labor Statistics, Occupational Employment Survey 2007.

US Energy Information Administration

Buckeye Wind LLC

Prepared by Saratoga Associates, April 2009

# 8.0 Benefits to the Community

## 8.1 GENERAL

This Facility is expected to contribute positively to the local economy. During the construction phase, opportunities for employment will offer both direct and indirect benefits for local and regional residents. Long-term opportunities for increased income through the lease of land necessary to accommodate the proposed Facility, will offer both direct and indirect benefits for participating landowners, as well as municipalities with jurisdiction over proposed sites. Wind power development provides new economic activity and new family wage jobs.

The 131 to 182 jobs created by the Facility during construction, as well as the 12 permanent jobs created during operation would help increase business and household income in the region. In turn, this creates additional jobs, which further increase business and household income as spending of households increase.[54]

Local municipalities will benefit from Alternative Tax[55] revenues, which will generate additional taxes from the Facility owner to all taxing jurisdictions in which the Facility is located. [56] While the exact terms of the Alternative Tax payment are not yet known, it is anticipated that the Facility will result to a positive fiscal impact to host communities. In order for Ohio to meet the goals laid out in AEPS described in the introduction, it is critical that it adopt policies that would allow for a competitive rate of taxation for wind projects in Ohio as compared to rates in surrounding states. Reflective of the rates typical in surrounding states, and given Ohio leadership's expressed desire to support wind power as a viable and significant part of its energy portfolio and its future economy, it is projected that total annual payments will range from a low $6,000 per megawatt, medium at $7,000 per megawatt and high at $8,000 per megawatt.

In addition, Champaign County, as well as surrounding counties where purchases are made, will benefit from sales taxes due purchases of goods and services related to the Facility development. The primary source of sales taxes comes from the local purchases made by the construction, operation and maintenance crews, including the purchase of equipment and supplies such as hardware and convenience items. The second source of sales tax comes from the potential increase in disposable income from both landowners and Facility employees, which could be used for local expenditures. As of July 2008, the State of Ohio benefits 5.5% in sales taxes, while Champaign, Clark and Logan

[54] Northwest Economic Associates. *Assessing the Economic Development Impacts of Wind Power.* February 12, 2003.
[55] Property tax payments are expected to be an important part of the economic benefits of the Facility. While the tax treatment of wind facilities in Ohio is unclear, Buckeye Wind assumes that the tax payments generated from this project will be proportional and competitive with to those generated from similar facilities in neighboring states. As used in this document, "Alternative Tax" is meant to approximate the expected tax for this project and is not necessarily a direct reflection of current Ohio tax code.
[56] It is important to note that existing and future property owners are not, and will not be responsible for revenues associated with the Facility.

counties benefit 1.5%; Madison County benefits 1.25%, and Union County benefits 1.25% on purchases.

### 8.2 ALTERNATIVE TAX REVENUES

The construction and operation of Facility is anticipated to generate substantial Alternative Tax revenues to all taxing jurisdictions that host the Facility. Upon completion of construction, tax revenues will be distributed to the townships of Goshen, Rush, Salem, Union and Wayne in Champaign County, as well as the Urbana City School District, the Mechanicsburg Exempted Village School District, the Triad Local School District and the West Liberty – Salem Local School District.

The accompanying tables summarize the general property (real estate) tax revenues based on the Fiscal Year 2005 budget, the number of proposed turbines within each municipality, and the projected annual Alternative Tax revenues for each of the taxing jurisdictions that host the Facility based on a range of capacities and projected Alternative Tax revenues, typically expressed on a per megawatt basis. The facility is expected to range from a low of 131.4 megawatts, a medium of 146 megawatts, and high of 182.5 megawatts. Likewise, since the exact terms of the Alternative Tax payments are not yet known, the projected revenues depicted illustrate a range – from an estimated low at $6,000 per megawatt, medium at $7,000 per megawatt, and high at $8,000 per megawatt.

**Summary of Projected Annual Alternative Tax Revenues to Jurisdictions within Townships that will Host the Buckeye Wind Project, Based on Rated Capacity**
(Source: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates)

| Total Rated Capacity | Projected Annual Alternative Tax Revenues – Low @ $6,000/MW | Projected Annual Alternative Tax Revenues – Medium @ $7,000/MW | Projected Annual Alternative Tax Revenues – High @ $8,000/MW |
|---|---|---|---|
| 131.4 MW | $788,400 | $919,800 | $1,051,200 |
| 146 MW | $876,000 | $1,022,000 | $1,168,000 |
| 182.5 MW | $1,095,000 | $1,277,500 | $1,460,000 |

**Projected Annual Alternative Tax Revenues to Jurisdictions within Townships that will Host the Buckeye Wind Project, Rated Capacity of 131.4 MW**

(Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates)

| Taxing Jurisdiction | Fiscal Year 2005 General Property (Real Estate) Tax Levy | Percentage Distribution[57] | Projected Annual Alternative Tax Revenues – Low @ $6,000/MW | Projected Annual Alternative Tax Revenues – Medium @ $7,000/MW | Projected Annual Alternative Tax Revenues – High @ $8,000/MW |
|---|---|---|---|---|---|
| Township of Goshen (Champaign County) | $161,154 | 6.85% | $54,000 | $63,000 | $72,000 |
| Township of Rush (Champaign County) | $81,382 | 6.85% | $54,000 | $63,000 | $72,000 |
| Township of Salem (Champaign County) | $130,920 | 19.19% | $151,200 | $176,400 | $201,600 |
| Township of Union (Champaign County) | $173,625 | 28.77% | $226,800 | $264,600 | $302,400 |
| Township of Urbana (Champaign County) | $199,418 | 16.44% | $129,600 | $151,200 | $172,800 |
| Township of Wayne (Champaign County) | $189,130 | 21.92% | $172,800 | $201,600 | $230,400 |
| **TOTAL** | **$935,629**[58] | **100.0%** | **$788,400** | **$919,800** | **$1,051,200** |

[57] These percentages were based on a preliminary distribution of turbines and are not necessarily reflective of the currently proposed layout. The percentage distribution provides estimates of the probable fiscal impact on Townships that will host the Facility.
[58] Total may not add up due to rounding off.

**Projected Annual Alternative Tax Revenues to Jurisdictions within Townships that will Host the Buckeye Wind Project, Rated Capacity of 146 MW**

(Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates)

| Taxing Jurisdiction | Fiscal Year 2005 General Property (Real Estate) Tax Levy | Percentage Distribution[59] | Projected Annual Alternative Tax Revenues – Low @ $6,000/MW | Projected Annual Alternative Tax Revenues – Medium @ $7,000/MW | Projected Annual Alternative Tax Revenues – High @ $8,000/MW |
|---|---|---|---|---|---|
| Township of Goshen (Champaign County) | $161,154 | 6.85% | $60,000 | $70,000 | $80,000 |
| Township of Rush (Champaign County) | $81,382 | 6.85% | $60,000 | $70,000 | $80,000 |
| Township of Salem (Champaign County) | $130,920 | 19.19% | $168,000 | $196,000 | $224,000 |
| Township of Union (Champaign County) | $173,625 | 28.77% | $252,000 | $294,600 | $336,000 |
| Township of Urbana (Champaign County) | $199,418 | 16.44% | $144,600 | $168,000 | $192,000 |
| Township of Wayne (Champaign County) | $189,130 | 21.92% | $192,000 | $224,000 | $256,000 |
| **TOTAL** | **$935,629**[58] | **100.0%** | **$876,600** | **$1,022,600** | **$1,168,000** |

[59] These percentages were based on a preliminary distribution of turbines and are not necessarily reflective of the currently proposed layout. The percentage distribution provides estimates of the probable fiscal impact on Townships that will host the Facility.

**Projected Annual Alternative Tax Revenues to Jurisdictions within Townships that will Host the Buckeye Wind Project, Rated Capacity of 182.5 MW**

(Sources: Offices of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates)

| Taxing Jurisdiction | Fiscal Year 2005 General Property (Real Estate) Tax Levy | Percentage Distribution[60] | Projected Annual Alternative Tax Revenues – Low @ $6,000/MW | Projected Annual Alternative Tax Revenues – Medium @ $7,000/MW | Projected Annual Alternative Tax Revenues – High @ $8,000/MW |
|---|---|---|---|---|---|
| Township of Goshen (Champaign County) | $161,154 | 6.85% | $75,000 | $87,500 | $100,000 |
| Township of Rush (Champaign County) | $81,382 | 6.85% | $75,000 | $87,500 | $100,000 |
| Township of Salem (Champaign County) | $130,920 | 19.19% | $210,000 | $245,000 | $280,000 |
| Township of Union (Champaign County) | $173,625 | 28.77% | $315,000 | $367,500 | $420,000 |
| Township of Urbana (Champaign County) | $199,418 | 16.44% | $180,000 | $210,000 | $240,000 |
| Township of Wayne (Champaign County) | $189,130 | 21.92% | $240,000 | $280,000 | $320,000 |
| **TOTAL** | **$935,629**[58] | **100.0%** | **$1,095,000** | **$1,277,500** | **$1,460,000** |

[60] These percentages were based on a preliminary distribution of turbines and are not necessarily reflective of the currently proposed layout. The percentage distribution provides estimates of the probable fiscal impact on Townships that will host the Facility.

Regardless of the Alternative Tax payment, the revenues will be distributed to all taxing jurisdictions within each township, based upon the prevailing composition of the each township's tax base.[61] A projected Alternative Tax revenue distribution among various taxing jurisdictions for each township – for low, medium and high estimates – is shown in the following tables.

### 8.2.1 TOWNSHIP OF GOSHEN (CHAMPAIGN COUNTY)

The Township of Goshen is anticipated to receive roughly 6.85% of the annual Alternative Tax revenues generated by the Facility. A range of $6,000 to $8,000 per megawatt amounts to combined revenues ranging from a low of $54,000 to a high of $100,000 for distribution to taxing jurisdictions within the Township, depending upon rated capacity and the Alternative Tax revenue payment.

Based on a rated capacity of 131.4 megawatts, combined revenues generated by the Facility to taxing jurisdictions within the Township of Goshen will range from $54,000 to $72,000. All taxing jurisdictions within the Township of Goshen are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 33.7% up to 44.7% over the $161,154 levied through the General Property (Real Estate) taxes within the Township of Goshen in 2005.

**Alternative Tax Annual Revenue Distribution, Township of Goshen: Rated Capacity of 131.4 megawatts**
(Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates)

| | Percentage of Tax Base | Low @ $6,000/MW | Medium @ $7,000/MW | High @ $8,000/MW |
|---|---|---|---|---|
| Champaign County | 15.9% | $8,578 | $10,008 | $11,438 |
| Health Fund | 0.6% | $343 | $400 | $458 |
| Township | 3.8% | $2,059 | $2,402 | $2,745 |
| 911 Fund | 1.6% | $858 | $1,001 | $1,144 |
| Mechanicsburg Exempted Village School District/Joint Vocational School Fund/Library Funds | 66.8% | $36,071 | $42,083 | $48,095 |
| Fire/Ambulance/Cemetery Funds | 5.6% | $3,002 | $3,503 | $4,003 |
| Corporation Fund | 5.7% | $3,088 | $3,603 | $4,118 |
| **Total: All Funds** | **100.0%** | **$54,000** | **$63,000** | **$72,000** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $161,154 (2005)** | | **33.5%** | **39.1%** | **44.7%** |

[61] The percentages of payments distributed to local jurisdictions will vary over time, depending on tax rates. Theoretically, the percentage of the payments made each year will change based on the tax rate breakdown in a given fiscal year.

Based on a rated capacity of 146 megawatts, combined revenues generated by the Facility to taxing jurisdictions within the Township of Goshen will range from $60,000 to $80,000. All taxing jurisdictions within the Township of Goshen are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 37.2% up to 49.6% over the $161,154 levied through the General Property (Real Estate) taxes within the Township of Goshen in 2005.

**Alternative Tax Annual Revenue Distribution, Township of Goshen: Rated Capacity of 146 megawatts**
(Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates)

| | Percentage of Tax Base | Low @ $6,000/MW | Medium @ $7,000/MW | High @ $8,000/MW |
|---|---|---|---|---|
| Champaign County | 15.9% | $9,531 | $11,120 | $12,708 |
| Health Fund | 0.6% | $381 | $445 | $508 |
| Township | 3.8% | $2,288 | $2,669 | $3,050 |
| 911 Fund | 1.6% | $953 | $1,112 | $1,271 |
| Mechanicsburg Exempted Village School District/Joint Vocational School Fund/Library Funds | 66.8% | $40,079 | $46,759 | $53,439 |
| Fire/Ambulance/Cemetery Funds | 5.6% | $3,336 | $3,892 | $4,448 |
| Corporation Fund | 5.7% | $3,431 | $4,003 | $4,575 |
| **Total: All Funds** | **100.0%** | **$60,000** | **$70,000** | **$80,000** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $161,154 (2005)** | | **37.2%** | **43.4%** | **49.6%** |

Based on a rated capacity of 182.5 megawatts, combined revenues generated by the Facility to taxing jurisdictions within the Township of Goshen will range from $75,000 to $100,000. All taxing jurisdictions within the Township of Goshen are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 46.5% up to 62.0% over the $161,154 levied through the General Property (Real Estate) taxes in 2005 within the Township of Goshen.

**Alternative Tax Annual Revenue Distribution, Township of Goshen: Rated Capacity of 182.5 megawatts**
(Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates)

| | Percentage of Tax Base | Low @ $6,000/MW | Medium @ $7,000/MW | High @ $8,000/MW |
|---|---|---|---|---|
| Champaign County | 15.9% | $11,914 | $13,900 | $15,886 |
| Health Fund | 0.6% | $477 | $556 | $635 |
| Township | 3.8% | $2,859 | $3,336 | $3,813 |
| 911 Fund | 1.6% | $1,191 | $1,390 | $1,589 |
| Mechanicsburg Exempted Village School District/Joint Vocational School Fund/Library | 66.8% | $50,099 | $58,449 | $66,799 |

| Alternative Tax Annual Revenue Distribution, Township of Goshen: Rated Capacity of 182.5 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| Funds | | | | |
| Fire/Ambulance/Cemetery Funds | 5.6% | $4,170 | $4,865 | $5,560 |
| Corporation Fund | 5.7% | $4,289 | $5,004 | $5,719 |
| **Total: All Funds** | **100.0%** | **$75,000** | **$87,500** | **$100,000** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $161,154 (2005)** | | **46.5%** | **54.3%** | **62.0%** |

### 8.2.2 TOWNSHIP OF RUSH (CHAMPAIGN COUNTY)

Jurisdictions within the Township of Rush are anticipated to receive roughly 6.8% of the annual Alternative Tax revenues generated by the Facility. A range of $6,000 to $8,000 per megawatt amounts to combined revenues ranging from a low of $54,000 to a high of $100,000 for distribution to taxing jurisdictions within the Township, depending upon rated capacity and the Alternative Tax revenue payment.

Based on a rated capacity of 131.4 megawatts, combined revenues generated by the Facility for distribution to taxing jurisdictions within the Township of Rush will range from $54,000 to $72,000. All taxing jurisdictions within the Township of Rush are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 66.3% up to 88.5% over the $81,382 levied through the General Property (Real Estate) taxes within the Township of Rush in 2005.

| Alternative Tax Annual Revenue Distribution, Township of Rush: Rated Capacity of 131.4 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| Champaign County | 18.1% | $9,774 | $11,403 | $13,032 |
| Health Fund | 0.7% | $391 | $456 | $521 |
| Township | 6.2% | $3,372 | $3,934 | $4,496 |
| 911 Fund | 1.8% | $977 | $1,140 | $1,303 |
| Triad Local School District/Joint Vocational School Fund/Library Funds | 56.1% | $30,299 | $35,348 | $40,398 |
| Fire/Ambulance/Cemetery Funds | 10.9% | $5,864 | $6,842 | $7,819 |
| Corporation Fund | 6.2% | $3,323 | $3,877 | $4,431 |

| **Alternative Tax Annual Revenue Distribution, Township of Rush: Rated Capacity of 131.4 megawatts** (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| **Total: All Funds** | **100.0%** | **$54,000** | **$63,000** | **$72,000** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $81,382 (2005)** | | **66.3%** | **77.4%** | **88.5%** |

Based on a rated capacity of 146 megawatts, combined revenues generated by the Facility for distribution to taxing jurisdictions within the Township of Rush will range from $60,000 to $80,000. All taxing jurisdictions within the Township of Rush are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 7.3.7% up to 98.3% over the $81,382 levied through the General Property (Real Estate) taxes within the Township of Rush in 2005.

| **Alternative Tax Annual Revenue Distribution, Township of Rush: Rated Capacity of 146 megawatts** (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| Champaign County | 18.1% | $10,860 | $12,670 | $14,480 |
| Health Fund | 0.7% | $434 | $507 | $579 |
| Township | 6.2% | $3,747 | $4,371 | $4,995 |
| 911 Fund | 1.8% | $1,086 | $1,267 | $1,448 |
| Triad Local School District/Joint Vocational School Fund/Library Funds | 56.1% | $33,665 | $39,276 | $44,887 |
| Fire/Ambulance/Cemetery Funds | 10.9% | $6,516 | $7,602 | $8,688 |
| Corporation Fund | 6.2% | $3,692 | $4,308 | $4,923 |
| **Total: All Funds** | **100.0%** | **$60,000** | **$70,000** | **$80,000** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $81,382 (2005)** | | **73.7%** | **86.0%** | **98.3%** |

Based on a rated capacity of 182.5 megawatts, combined revenues generated by the Facility for distribution to taxing jurisdictions within the Township of Rush will range from $75,000 to $100,000. All taxing jurisdictions within the Township of Rush are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 92.1% up to almost 123% over the $81,382 levied through the General Property (Real Estate) taxes within the Township of Rush in 2005.

| Alternative Tax Annual Revenue Distribution, Township of Rush: Rated Capacity of 182.5 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| Champaign County | 18.1% | $13,575 | $15,837 | $18,100 |
| Health Fund | 0.7% | $543 | $633 | $724 |
| Township | 6.2% | $4,683 | $5,464 | $6,244 |
| 911 Fund | 1.8% | $1,357 | $1,584 | $1,810 |
| Triad Local School District/Joint Vocational School Fund/Library Funds | 56.1% | $42,081 | $49,095 | $56,109 |
| Fire/Ambulance/Cemetery Funds | 10.9% | $8,145 | $9,502 | $10,860 |
| Corporation Fund | 6.2% | $4,615 | $5,385 | $6,154 |
| **Total: All Funds** | **100.0%** | **$75,000** | **$87,500** | **$100,000** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $81,382 (2005)** | | **92.1%** | **107.5%** | **122.9%** |

### 8.2.3 TOWNSHIP OF SALEM (CHAMPAIGN COUNTY)

Jurisdictions within the Township of Salem are anticipated to receive roughly 19.2% of the annual Alternative Tax revenues generated by the Facility. A range of $6,000 to $8,000 per megawatt amounts to combined revenues ranging from a low of $151,200 to a high of $280,000 for distribution to taxing jurisdictions within the Township, depending upon rated capacity and the Alternative Tax revenue payment.

Based on a rated capacity of 131.4 megawatts, combined revenues generated by the Facility for distribution to taxing jurisdictions within the Township of Salem will range from $151,200 to $201,600. All taxing jurisdictions within the Township of Salem are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 115.5% up to 154% over the $130,920 levied through the General Property (Real Estate) taxes within the Township of Salem in 2005.

| Alternative Tax Annual Revenue Distribution, Township of Salem: Rated Capacity of 131.4 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| Champaign County | 15.6% | $23,561 | $27,487 | $31,414 |
| Health Fund | 0.6% | $942 | $1,099 | $1,257 |
| Township | 2.0% | $3,063 | $3,573 | $4,084 |

| Alternative Tax Annual Revenue Distribution, Township of Salem: Rated Capacity of 131.4 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| 911 Fund | 1.6% | $2,356 | $2,749 | $3,141 |
| West Liberty-Salem Local School District/ Joint Vocational School Fund Library Funds | 75.9% | $114,799 | $133,932 | $153,065 |
| Fire/Ambulance/Cemetery Funds | 1.7% | $2,592 | $3,024 | $3,456 |
| Corporation Fund | 2.6% | $3,887 | $4,535 | $5,183 |
| **Total: All Funds** | **100.0%** | **$151,200** | **$176,400** | **$201,600** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $130,920 (2005)** | | **115.5%** | **134.7%** | **154.0%** |

Based on a rated capacity of 146 megawatts, combined revenues generated by the Facility for distribution to taxing jurisdictions within the Township of Salem will range from $168,000 to $224,000. All taxing jurisdictions within the Township of Salem are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 128.3% up to 171.1% over the $130,920 levied through the General Property (Real Estate) taxes within the Township of Salem in 2005.

| Alternative Tax Annual Revenue Distribution, Township of Salem: Rated Capacity of 146 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| Champaign County | 15.6% | $26,178 | $30,541 | $34,905 |
| Health Fund | 0.6% | $1,047 | $1,222 | $1,396 |
| Township | 2.0% | $3,403 | $3,970 | $4,538 |
| 911 Fund | 1.6% | $2,618 | $3,054 | $3,490 |
| West Liberty-Salem Local School District/ Joint Vocational School Fund Library Funds | 75.9% | $127,554 | $148,813 | $170,072 |
| Fire/Ambulance/Cemetery Funds | 1.7% | $2,880 | $3,360 | $3,840 |
| Corporation Fund | 2.6% | $4,319 | $5,039 | $5,759 |
| **Total: All Funds** | **100.0%** | **$168,000** | **$196,000** | **$224,000** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $130,920 (2005)** | | **128.3%** | **149.6%** | **171.1%** |

Based on a rated capacity of 182.5 megawatts, combined revenues generated by the Facility for distribution to taxing jurisdictions within the Township of Salem will range from $210,000 to

$280,000. All taxing jurisdictions within the Township of Salem are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 160.4% up to 213.9% over the $130,920 levied through the General Property (Real Estate) taxes within the Township of Salem in 2005.

**Alternative Tax Annual Revenue Distribution, Township of Salem: Rated Capacity of 182.5 megawatts**
(Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates)

| | Percentage of Tax Base | Low @ $6,000/MW | Medium @ $7,000/MW | High @ $8,000/MW |
|---|---|---|---|---|
| Champaign County | 15.6% | $32,723 | $38,177 | $143,631 |
| Health Fund | 0.6% | $1,309 | $1,527 | $1,745 |
| Township | 2.0% | $4,254 | $4,963 | $5,672 |
| 911 Fund | 1.6% | $3,272 | $3,818 | $4,363 |
| West Liberty-Salem Local School District/ Joint Vocational School Fund Library Funds | 75.9% | $159,443 | $186,017 | $212,591 |
| Fire/Ambulance/Cemetery Funds | 1.7% | $3,600 | $4,199 | $4,799 |
| Corporation Fund | 2.6% | $5,399 | $6,299 | $7,199 |
| **Total: All Funds** | **100.0%** | **$210,000** | **$245,000** | **$280,000** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $130,920 (2005)** | | **160.4%** | **187.1%** | **213.9%** |

### 8.2.4 Township of Union (Champaign County)

Jurisdictions within the Township of Union are anticipated to receive roughly 28.8% of the annual Alternative Tax revenues generated by the Facility. Having the most number of turbines, the Township of Union is projected to have the highest increase in tax revenues, with fiscal benefits ranging from $226,000 up $420,000 per year, depending on the rated capacity and the Alternative Tax revenue payment.

Based on a rated capacity of 131.4 megawatts, combined revenues generated by the Facility for distribution to taxing jurisdictions within the Township of Union will range from $226,000 to $302,400. All taxing jurisdictions within the Township of Union are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 130.6% up to 174.2% over the $173,625 levied through the General Property (Real Estate) taxes within the Township of Union in 2005.

| Alternative Tax Annual Revenue Distribution, Township of Union: Rated Capacity of 131.4 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| Champaign County | 16.1% | $36,478 | $42,557 | $48,637 |
| Health Fund | 0.6% | $1,459 | $1,702 | $1,945 |
| Township | 4.1% | $9,302 | $10,852 | $4,864 |
| 911 Fund | 1.6% | $3,648 | $4,256 | $4,864 |
| Mechanicsburg Exempted Village School District/Triad Local School District/Urbana City School District/Joint Vocational School Fund/Library Funds[62] | 73.7% | $167,250 | $195,125 | $223,000 |
| Fire/Ambulance/Cemetery Funds | 1.6% | $3,648 | $4,256 | $4,864 |
| Corporation Fund | 2.2% | $5,016 | $5,852 | $6,688 |
| **Total: All Funds** | **100.0%** | **$226,800** | **$264,000** | **$302,400** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $173,625 (2005)** | | **130.6%** | **152.0%** | **174.2%** |

Based on a rated capacity of 146 megawatts, combined revenues generated by the Facility for distribution to taxing jurisdictions within the Township of Union will range from $252,000 to $336,000. All taxing jurisdictions within the Township of Union are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 145.1% up to 194.5% over the $173,625 levied through the General Property (Real Estate) taxes within the Township of Union in 2005.

| Alternative Tax Annual Revenue Distribution, Township of Union: Rated Capacity of 146 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| Champaign County | 16.1% | $40,531 | $47,286 | $54,041 |
| Health Fund | 0.6% | $1,621 | $1,891 | $2,162 |
| Township | 4.1% | $10,335 | $12,058 | $13,780 |
| 911 Fund | 1.6% | $4,053 | $4,729 | $5,404 |
| Mechanicsburg Exempted Village School District/Triad Local School District/Urbana | 73.7% | $185,834 | $215,806 | $247,778 |

[62] Within Union Township, an estimated 38.1% of the turbines and the associated Alternative Tax revenues would go to Mechanicsburg Exempted Village School District, 38.1% of the turbines and associated Alternative Tax revenue would go to Triad Local School District and 23.8% of the turbines and associated Alternative Tax revenue would go to Urbana City School District.

| Alternative Tax Annual Revenue Distribution, Township of Union: Rated Capacity of 146 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| City School District/Joint Vocational School Fund/Library Funds[63] | | | | |
| Fire/Ambulance/Cemetery Funds | 1.6% | $4,053 | $4,729 | $5,404 |
| Corporation Fund | 2.2% | $5,573 | $6,502 | $7,431 |
| **Total: All Funds** | **100.0%** | **$252,000** | **$294,000** | **$336,000** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $173,625 (2005)** | | **145.1%** | **169.3%** | **193.5%** |

Based on a rated capacity of 182.5 megawatts, combined revenues generated by the Facility for distribution to taxing jurisdictions within the Township of Union will range from $315,000 to $420,000. All taxing jurisdictions within the Township of Union are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 181.4% up to 241.9% over the $173,625 levied through the General Property (Real Estate) taxes within the Township of Union in 2005.

| Alternative Tax Annual Revenue Distribution, Township of Union: Rated Capacity of 182.5 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| Champaign County | 16.1% | $50,663 | $59,107 | $67,551 |
| Health Fund | 0.6% | $2,027 | $2,364 | $2,702 |
| Township | 4.1% | $12,919 | $15,072 | $17,226 |
| 911 Fund | 1.6% | $5,066 | $5,911 | $6,755 |
| Mechanicsburg Exempted Village School District/Triad Local School District/Urbana City School District/Joint Vocational School Fund/Library Funds[64] | 73.7% | $232,292 | $271,007 | $309,723 |
| Fire/Ambulance/Cemetery Funds | 1.6% | $5,066 | $5,911 | $6,755 |
| Corporation Fund | 2.2% | $6,966 | $8,127 | $9,288 |

[63] Within Union Township, an estimated 38.1% of the turbines and the associated Alternative Tax revenues would go to Mechanicsburg Exempted Village School District, 38.1% of the turbines and associated Alternative Tax revenue would go to Triad Local School District and 23.8% of the turbines and associated Alternative Tax revenue would go to Urbana City School District

[64] Within Union Township, an estimated 38.1% of the turbines and the associated Alternative Tax revenues would go to Mechanicsburg Exempted Village School District, 38.1% of the turbines and associated Alternative Tax revenue would go to Triad Local School District and 23.8% of the turbines and associated Alternative Tax revenue would go to Urbana City School District

| Alternative Tax Annual Revenue Distribution, Township of Union: Rated Capacity of 182.5 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| **Total: All Funds** | **100.0%** | **$315,000** | **$367,500** | **$420,000** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $173,625 (2005)** | | **181.4%** | **211.7%** | **241.9%** |

### 8.2.5 TOWNSHIP OF URBANA (CHAMPAIGN COUNTY)

Jurisdictions within the Township of Urbana are anticipated to receive roughly 16.4% of the annual Alternative Tax revenues generated by the Facility. A range of $6,000 to $8,000 per megawatt in Alternative Tax Revenues amounts to a combined payment ranging from a low of $129,600 to a high of $240,000 for distribution to taxing jurisdictions within the Township, depending upon rated capacity and the Alternative Tax revenue payment.

Based on a rated capacity of 131.4 megawatts, combined revenues generated by the Facility for distribution to taxing jurisdictions within the Township of Urbana will range from $129,600 to $172,800. All taxing jurisdictions within the Township of Urbana are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 65% up to 86.6% over the $199,418 levied through the General Property (Real Estate) taxes within the Township of Urbana in 2005.

| Alternative Tax Annual Revenue Distribution, Township of Urbana: Rated Capacity of 131.4 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| Champaign County | 15.9% | $20,653 | $24,096 | $27,538 |
| Health Fund | 0.6% | $826 | $964 | $1,102 |
| Township | 1.3% | $1,652 | $1,928 | $2,203 |
| 911 Fund | 1.6% | $2,065 | $2,410 | $2,754 |
| Urbana City School District/ Joint Vocational School Fund Library Funds | 76.1% | $98,620 | $115,057 | $131,493 |
| Fire/Ambulance/Cemetery Funds | 1.8% | $2,375 | $2,771 | $3,167 |
| Corporation Fund | 2.6% | $3,408 | $3,976 | $4,544 |
| **Total: All Funds** | **100.0%** | **$129,600** | **$151,200** | **$172,800** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $199,418 (2005)** | | **65.0%** | **75.8%** | **86.6%** |

A rated capacity of 146 megawatts will generate combined revenues ranging from $144,000 to $192,000 for distribution to taxing jurisdictions within the Township of Urbana. All taxing jurisdictions within the Township of Urbana are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 72.2% up to 96.3% over the $199,418 levied through the General Property (Real Estate) taxes within the Township of Urbana in 2005.

**Alternative Tax Annual Revenue Distribution, Township of Urbana:**
**Rated Capacity of 146 megawatts**
(Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates)

| | Percentage of Tax Base | Low @ $6,000/MW | Medium @ $7,000/MW | High @ $8,000/MW |
|---|---|---|---|---|
| Champaign County | 15.9% | $22,948 | $26,733 | $30,598 |
| Health Fund | 0.6% | $918 | $1,071 | $1,224 |
| Township | 1.3% | $1,836 | $2,142 | $2,488 |
| 911 Fund | 1.6% | $2,295 | $2,677 | $3,060 |
| Urbana City School District/ Joint Vocational School Fund Library Funds | 76.1% | $109,578 | $127,841 | $146,104 |
| Fire/Ambulance/Cemetery Funds | 1.8% | $2,639 | $3,079 | $3,519 |
| Corporation Fund | 2.6% | $3,786 | $4,418 | $5,049 |
| **Total: All Funds** | **100.0%** | **$144,000** | **$168,000** | **$192,000** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $199,418 (2005)** | | **72.2%** | **84.2%** | **96.3%** |

Based on a rated capacity of 182.5 megawatts, combined revenues generated by the Facility for distribution to taxing jurisdictions within the Township of Urbana will range from $180,000 to $240,000. All taxing jurisdictions within the Township of Urbana are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 90.3% up to 120.3% over the $199,418 levied through the General Property (Real Estate) taxes within the Township of Urbana in 2005.

**Alternative Tax Annual Revenue Distribution, Township of Urbana:**
**Rated Capacity of 182.5 megawatts**
(Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates)

| | Percentage of Tax Base | Low @ $6,000/MW | Medium @ $7,000/MW | High @ $8,000/MW |
|---|---|---|---|---|
| Champaign County | 15.9% | $28,685 | $33,466 | $38,247 |
| Health Fund | 0.6% | $1,147 | $1,339 | $1,530 |
| Township | 1.3% | $2,295 | $2,677 | $3,060 |
| 911 Fund | 1.6% | $2,869 | $3,347 | $3,825 |
| Urbana City School District/ Joint Vocational | 76.1% | $136,972 | $159,801 | $182,629 |

| Alternative Tax Annual Revenue Distribution, Township of Urbana: Rated Capacity of 182.5 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| School Fund Library Funds | | | | |
| Fire/Ambulance/Cemetery Funds | 1.8% | $3,299 | $3,849 | $4,398 |
| Corporation Fund | 2.6% | $4,733 | $5,522 | $6,311 |
| **Total: All Funds** | **100.0%** | **$180,000** | **$210,000** | **$240,000** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $199,418 (2005)** | | **90.3%** | **105.3%** | **120.3%** |

### 8.2.6 TOWNSHIP OF WAYNE (CHAMPAIGN COUNTY)

Jurisdictions within the Township of Wayne are anticipated to receive roughly 21.9% of the annual Alternative Tax Revenues generated by the Facility. A range of $6,000 to $8,000 per megawatt amounts to combined revenues ranging from a low $172,800 to a high $320,000 for distribution to taxing jurisdictions within the Township, depending upon the facility's rated capacity and the Alternative Tax revenue.

Based on a rated capacity of 131.4 megawatts, combined revenues generated by the Facility for distribution to taxing jurisdictions within the Township of Wayne will range from $172,800 to $230,400. All taxing jurisdictions within the Township of Wayne are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 91.4% up to 121.8% over the $189,130 levied through the General Property (Real Estate) taxes within the Township of Wayne in 2005.

| Alternative Tax Annual Revenue Distribution, Township of Wayne: Rated Capacity of 131.4 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| Champaign County | 16.7% | $28,824 | $33,628 | $38,432 |
| Health Fund | 0.7% | $1,153 | $1,345 | $1,537 |
| Township | 12.8% | $22,194 | $25,894 | $29,593 |
| 911 Fund | 1.7% | $2,882 | $3,363 | $3,843 |
| Triad Local School District/ /Joint Vocational School Fund/Library Funds | 58.8% | $101,605 | $118,539 | $135,473 |
| Fire/Ambulance/Cemetery Funds | 9.3% | $16,141 | $18,832 | $21,522 |

| Alternative Tax Annual Revenue Distribution, Township of Wayne: Rated Capacity of 131.4 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| **Total: All Funds** | **100.0%** | **$172,800** | **$201,600** | **$230,400** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $189,130 (2005)** | | **91.4%** | **106.6%** | **121.8%** |

A rated capacity of 146 megawatts will generate combined revenues ranging from $192,0000 to $256,000 for distribution to taxing jurisdictions within the Township of Wayne. All taxing jurisdictions within the Township of Wayne are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 101.5% up to 135.3% over the $189,130 levied through the General Property (Real Estate) taxes within the Township of Wayne in 2005.

| Alternative Tax Annual Revenue Distribution, Township of Wayne: Rated Capacity of 146 megawatts (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| Champaign County | 16.7% | $32,027 | $37,364 | $42,702 |
| Health Fund | 0.7% | $1,281 | $1,495 | $1,708 |
| Township | 12.8% | $24,661 | $28,771 | $32,881 |
| 911 Fund | 1.7% | $3,203 | $3,736 | $4,270 |
| Triad Local School District/ /Joint Vocational School Fund/Library Funds | 58.8% | $112,894 | $131,710 | $150,525 |
| Fire/Ambulance/Cemetery Funds | 9.3% | $17,935 | $20,924 | $23,913 |
| **Total: All Funds** | **100.0%** | **$192,000** | **$224,000** | **$256,000** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $189,130 (2005)** | | **101.5%** | **118.4%** | **135.3%** |

Based on a rated capacity of 182.5 megawatts, combined revenues generated by the Facility for distribution to taxing jurisdictions within the Township of Wayne will range from $240,000 to $320,000. All taxing jurisdictions within the Township of Wayne are anticipated to benefit considerably, regardless of the Alternative Tax revenue and payment schedule that is determined. Increases in tax revenues for distribution to taxing jurisdictions are projected to range from 126.9% up to 169.2% over the $189,130 levied through the General Property (Real Estate) taxes within the Township of Wayne in 2005.

| **Alternative Tax Annual Revenue Distribution, Township of Wayne: Rated Capacity of 182.5 megawatts** (Sources: Office of the State of Ohio Auditor; Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of Tax Base** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| Champaign County | 16.7% | $40,033 | $46,706 | $53,378 |
| Health Fund | 0.7% | $1,601 | $1,868 | $2,135 |
| Township | 12.8% | $30,826 | $35,963 | $41,101 |
| 911 Fund | 1.7% | $4,003 | $4,671 | $5,338 |
| Triad Local School District/ /Joint Vocational School Fund/Library Funds | 58.8% | $141,118 | $164,637 | $188,157 |
| Fire/Ambulance/Cemetery Funds | 9.3% | $22,419 | $26,155 | $29,892 |
| **Total: All Funds** | **100.0%** | **$240,000** | **$280,000** | **$320,000** |
| **Projected Increase in Tax Revenue Based on Gen. Property Tax Revenue: $189,130 (2005)** | | **126.9%** | **148%** | **169.2%** |

### 8.3 School Districts

None of the four school districts where the Facility is located or the additional six school districts that are located within five miles of the Facility are likely to be significantly affected by the addition of school-age children as a result of the Facility. It is likely that the children of the construction workers will already be enrolled in area schools. Given the expected creation of 12 long-term positions, it is likely that this will not significantly add to enrollment in any of the local school districts – neither those within the townships that will host the Facility, nor those within a five-miles of the Facility.

However, should the full-time employees not be available in the local workforce, the Facility will have to hire employees from outside of the region. If this is the case, up to 12 new households could relocate to the region. According to the 2007 American Community Survey of the State of Ohio, roughly 30% of households were comprised of families with school-aged children. Assuming that these potential new households would reflect the state average, it is projected that 4 of these potential new households would have school-aged children. Further, if each of these households is comprised of two school-aged children, it is projected that 8 new students could be added to one or more of the local school districts where the Facility is located.

| **Potential Impact on Local School Districts, Buckeye Facility** (Source: Ohio Department of Education; Office of the State of Ohio Auditor) | |
|---|---|
| Average Per Pupil Expenditure | $8,185 |
| Projected Number of New Students | 8 |
| Projected Annual Additional Cost to Local School Districts | $65,480 |
| Projected Annual Alternative Tax Revenues for Host School Districts | $548,644 - $1,016,007 |
| Projected Net Fiscal Impact to Local School Districts[65] | $483,164 - $950,527 |

Based on school spending data from the Ohio Department of Education, the four local school districts that host the Facility average an expenditure of approximately $8,185 per student. Assuming new households add 8 children to the local school districts, and the average pupil expenditures remain constant, it is projected that the local school districts will incur additional costs of $65,480 per academic year. These costs, however, will be more than offset by the Alternative Tax Revenues generated by the Facility. As seen in *Section 8.3: Alternative Tax Revenues*, the four school districts, combined with the Joint Vocational School and Library levies are projected to generate between $548,644 up to $1,016,000 in projected annual revenues and a net fiscal impact of $483,164 up to $950,527, depending on the Alternative Tax payment terms.

**Alternative Tax Annual Revenue Distribution, School Districts: Rated Capacity of 131.4 megawatts**

(Sources: Buckeye Wind; Analysis by Saratoga Associates)

| | **Percentage of School District Tax Base[66]** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
|---|---|---|---|---|
| Mechanicsburg Exempted Village School District/Joint Vocational School Fund/Library Funds | 18.6% | $99,793 | $116,426 | $133,058 |
| Triad Local School District /Joint Vocational School Fund/Library Funds | 38.6% | $195,626 | $228,230 | $260,834 |
| West Liberty-Salem Local School District/Joint Vocational School Fund/Library Funds | 20.0% | $114,799 | $133,932 | $153,065 |
| Urbana City School District/Joint Vocational School Fund/Library Funds | 22.6% | $138,426 | $161,497 | $184,567 |
| **Total: All Funds** | **100.0%** | **$548,644** | **$640,084** | **$731,524** |

[65] The Net Fiscal Impact to Local School Districts is calculated by subtracting the estimated additional costs to the School Districts from the Projected Annual Alternative Tax Revenues to Local School Districts.
[66] These percentages were based on a preliminary distribution of turbines and are not necessarily reflective of the currently proposed layout. The percentage distribution provides estimates of the probable fiscal impact on School Districts that will host the Facility.

| Alternative Tax Annual Revenue Distribution, School Districts: Rated Capacity of 146.0 megawatts (Sources: Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of School District Tax Base[67]** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| Mechanicsburg Exempted Village School District/Joint Vocational School Fund/Library Funds | 18.6% | $110,882 | $128,981 | $147,842 |
| Triad Local School District /Joint Vocational School Fund/Library Funds | 38.6% | $217,362 | $253,208 | $289,815 |
| West Liberty-Salem Local School District/Joint Vocational School Fund/Library Funds | 20.0% | $127,554 | $148,813 | $170,072 |
| Urbana City School District/Joint Vocational School Fund/Library Funds | 22.6% | $153,806 | $179,203 | $205,075 |
| **Total: All Funds** | **100.0%** | **$609,604** | **$710,205** | **$812,805** |

| Alternative Tax Annual Revenue Distribution, School Districts: Rated Capacity of 182.5 megawatts (Sources: Buckeye Wind; Analysis by Saratoga Associates) | | | | |
|---|---|---|---|---|
| | **Percentage of School District Tax Base[68]** | **Low @ $6,000/MW** | **Medium @ $7,000/MW** | **High @ $8,000/MW** |
| Mechanicsburg Exempted Village School District/Joint Vocational School Fund/Library Funds | 18.6% | $138,602 | $161,703 | $184,803 |
| Triad Local School District /Joint Vocational School Fund/Library Funds | 38.6% | $271,702 | $316,986 | $362,270 |
| West Liberty-Salem Local School District/Joint Vocational School Fund/Library Funds | 20.0% | $159,443 | $186,017 | $212,591 |
| Urbana City School District/Joint Vocational School Fund/Library Funds | 22.6% | $192,257 | $224,301 | $256,343 |
| **Total: All Funds** | **100.0%** | **$762,005** | **$889,006** | **$1,016,008** |

[67] These percentages were based on a preliminary distribution of turbines and are not necessarily reflective of the currently proposed layout. The percentage distribution provides estimates of the probable fiscal impact on School Districts that will host the Facility.
[68] These percentages were based on a preliminary distribution of turbines and are not necessarily reflective of the currently proposed layout. The percentage distribution provides estimates of the probable fiscal impact on School Districts that will host the Facility.

# 9.0 Potential Regional Impacts

## 9.1 Impacts on Population

As seen in *Section 1.1: Population Trends*, the population among townships that will host the Facility has increased by approximately 6.8% between 1990 and 2000. The population is estimated to have grown by less than 1% from 2000 and 2007. Although there will be a substantial number of short-term jobs created during the construction period, only 12 long-term jobs will be created during the operation of the Facility. As a result, the population both within the townships that will host the Facility, and within a five-miles of the Facility will most likely not be affected.

## 9.2 Impacts on Housing

As seen in *Section 1.6: Housing Characteristics*, the number of housing units located within the townships that will host the Facility has increased by less than 3% between 2000 and 2007, reflective of recent population trends. As demonstrated in *Section 9.1: Impacts on Population*, it is unlikely that either construction or operation of the Facility will affect the population in the region. As a result, the Facility is not likely to create a noticeable increase in the demand for housing.

## 9.3 Impacts on Property Values

Throughout the United States, many residents, business owners and visitors support wind energy, and believe it to have a positive effect (or no effect) within a typical rural community. However, one of the largest concerns regarding wind project construction among local residents is the aesthetics of the community and the effect on property values. It is claimed that wind projects risk disturbing the scenic quality and rural characteristics of a community's landscape.

While wind projects have been operating in California for decades, it is important to note that the concept of a "utility-scale" wind farm is rather novel in the Midwestern United States. As a result, limited opportunities to evaluate impacts currently exist. The review of existing studies indicates that it is difficult to generalize about potential property value impacts; projections of impacts using the current literature and methodologies are uncertain at best.

As such, there is no definitive understanding or conclusion on the impact that a wind power development has on property values. This report utilized the most recent findings of property value impacts for wind farms of analogous size, scope and location. This will present the most accurate depiction of what can be expected of the property value fluctuation (if any) in the area proximate to the Facility.

A recent study by Poletti and Associates examines property sales in Illinois and Wisconsin between 1998 and 2006. Over 150 sales transactions were examined for both residential and farmland properties within an area close to a wind farm and those in a controlled area with similar characteristics. The analysis concludes that there is no difference in property values in the areas near the wind farms when compared to other similar areas located further from the turbines in both Illinois and Wisconsin. Interestingly, new residential development is actually flourishing in close proximity to the 63-turbine wind farm near Mendota, Illinois. A 100-unit residential development is under construction, where homes are selling for $530,000 to $540,000 within 3,000 feet of the wind farm – approximately four times greater than Lee County's median housing value of $134,654.[69]

Though not specific to the Midwest, another study out of Bard College was conducted to measure the effect of wind turbines on real estate. The report analyzed the sale of 280 residential homes between 1996 and 2005. The homes were all located within either a one-mile or a five-mile radius of each of 20 turbines at the Fenner Facility in Madison County, New York. Results from the study denounced the widely held belief that turbines tend to lower the values of surrounding properties and homes. The study indicated that there were no adverse impacts on the property values of the homes within either a one-mile or a five-mile radius of the farm. The author of the study suggests that perhaps this was due to the wind farm fitting into the community's "sense of place," and the payments to the community balanced any adverse impacts that the turbines could have generated.[70]

### 9.4 Impacts on Landowners

Long-term opportunities for increased income through the lease of land will offer both direct and indirect benefits for participating landowners, as well as municipalities with jurisdiction over proposed sites. Landowners receive an annual lease payment, while still being able to farm and allow grazing on all areas surrounding wind turbines.

Land lease payments for landowners of properties that will host the Facility were calculated using 5% of the annual gross revenues during the first 10 years of operation of the Facility, and 7% for the next 10 years of operation. Depending on rated capacity for the Facility, a 131.4-megawatt facility is estimated to generate [redacted] in annual gross revenues for the first year of operation, with a projected [redacted] annual growth annually or a total of $717.45 million over twenty years. A 146-megawatt Facility will generate [redacted] in annual gross revenues for the first year of operation, increasing by [redacted] annually or a total of $797.17 million over twenty years. A 182.5-megawatt Facility is projected to produce [redacted] in gross revenues, or a total of $996.46 million over twenty years with a projected [redacted] annual growth.[71]

Assuming these conditions, it is projected that lease payments for the first 10 years will total [redacted] for a 131.4 megawatt facility, roughly [redacted] for a 146 megawatt facility, and over

[69] Poletti, Peter J., *"Wind Farms, Property Values Can Grow Together: New Study Shows Wind Turbines, Homes Co-Exist in Harmony,"* Poletti and Associates, 2007.
[70] Hoen, Ben. *"Impacts on Windmill Visibility on Property Values in Madison County, New York,"* May 2006.
[71] Two (2) percent annual growth was applied to Projected Gross Revenues based on projections of 2 percent year-over-year growth in GDP starting 2010 as per the US Energy Information Administration. "Short-Term Energy Outlook," released January 13, 2009. http://www.eia.doe.gov/steo. Accessed on January 23, 2009.

[redacted] for a 182.5 megawatt facility, based on projected lease payments of [redacted] For the next 10 years (years 11 to 20), a 131.4-megawatt Facility is projected to generate total lease payments of [redacted] a 146 megawatts facility is projected to provide lease payments totaling [redacted] and a 182.5 megawatts facility will provide lease payments totaling [redacted] based on a lease term of [redacted]

Over twenty years of operation, a 131.4 megawatts facility will provide a total of nearly [redacted] in lease payments for distribution to landowners. A 146 megawatts facility is projected to provide cumulative lease payments of approximately [redacted] distribution to landowners. A Facility with 182.5 megawatts capacity is projected to generate lease payments totaling [redacted] over 20 years of operation.

| Projected Annual Gross Revenues and Lease Payments[62]<br>(Sources: US Dept. of Energy; Analysis by Saratoga Associates) | | | | | | |
|---|---|---|---|---|---|---|
| | 131.4 MW | | 146 MW | | 182.5 MW | |
| | Projected Gross Revenues ($000) | Projected Lease Payments ($000) | Projected Gross Revenues ($000) | Projected Lease Payments ($000) | Projected Gross Revenues ($000) | Projected Lease Payments ($000) |
| **Lease Terms: 5% of Annual Gross Revenues** | | | | | | |
| Year 1 | [redacted] | | | | | |
| Year 2 | | | | | | |
| Year 3 | | | | | | |
| Year 4 | | | | | | |
| Year 5 | | | | | | |
| Year 6 | | | | | | |
| Year 7 | | | | | | |
| Year 8 | | | | | | |
| Year 9 | | | | | | |
| Year 10 | | | | | | |
| **Sub-Total (Yrs 1-10)** | | | | | | |
| **Lease Terms: 7% of Annual Gross Revenues** | | | | | | |
| Year 11 | [redacted] | | | | | |
| Year 12 | | | | | | |
| Year 13 | | | | | | |
| Year 14 | | | | | | |
| Year 15 | | | | | | |
| Year 16 | | | | | | |
| Year 17 | | | | | | |
| Year 18 | | | | | | |
| Year 19 | | | | | | |
| Year 20 | | | | | | |
| **Sub-Total (Yrs 11-20)** | | | | | | |
| **Total (Yrs 1-20)** | | | | | | |
| **Average /MW** | | | | | | |

## 9.5 IMPACTS ON COMMERCIAL AND INDUSTRIAL DEVELOPMENT

The construction and operation of the Facility will have a positive impact on commercial and industrial development in Champaign County, as well as throughout the Southwest Central Ohio region and the State.

Although wind power projects typically require a substantial number of inputs from outside the local area, there is considerable potential for the future development of wind turbine manufacturing in the State of Ohio. The Renewable Energy Policy Project issued a report on the location of manufacturing activity related to wind turbine development. The report measured the number of potential employees at existing companies capable of manufacturing turbine parts, such as rotors, nacelle and controls, gearbox and drive train, etc. As of 2004, Ohio is ranked number two in the country in terms of the number of employees at firms (with over 80,000 employees) that have the technical potential to become active manufacturers of wind turbine components. A detailed analysis reveals that the State of Ohio has the potential of becoming the largest producer of rotors, the second largest producer of nacelle and controls, as well as gearboxes and drive trains, the third largest producer of generators and power electronics, and the fourth largest producer of towers. These estimates from the Renewable Energy Policy Project were based on employment at potential active companies, average investment, and job creation potential.[72] Currently, manufacturers in the State of Ohio are already producing wind turbine components that include blade extenders, brakes, cooling systems, gear boxes, pitch drives, power electronics, rotor blades, tower flange and bolts, and yaw drives.[73]

The accompanying table shows the State's existing capability, in terms of the number of persons currently employed within each sub-sector, the associated annual payroll and the number of establishments with the technical potential to enter the wind turbine market (based on the manufacturing and production of the 20 major wind turbine components).

**Manufacturing Firms with Technical Potential to Enter Wind Turbine Market, State of Ohio: 2005**

(Source: Renewable Energy Policy Project; County Business Patterns via U.S. Census Bureau)

| NAICS Code | Industry | Total Employees | Annual Payroll ($1,000s) | Number of Establishments |
|---|---|---|---|---|
| 326199 | All Other Plastics Products | 41,610 | $1,366,694 | 528 |
| 331511 | Iron Foundries | 7,827 | $475,945 | 62 |
| 332312 | Fabricated Structural Metal | 2,546 | $113,848 | 171 |
| 332991 | Ball and Roller Bearings | 3,858 | $227,513 | 15 |
| 333412 | Industrial and Commercial Fans and Blowers | 1,076 | $49,564 | 17 |
| 333611 | Turbines, and Turbine Generator Set Units | 1,000 - 2,499 | N/A | 8 |
| 333612 | Speed Changer, Industrial High-Speed Drive, and Gear Manufacturing | 500-999 | N/A | 22 |
| 333613 | Mechanical Power Transmission Equipment | 918 | $47,334 | 15 |
| 334418 | Printed Circuit Assembly (Electronic Assembly) | 1,382 | $52,597 | 27 |
| 334519 | Other Measuring and Controlling Devices | 1,726 | $101,371 | 44 |

[72] Sterzinger, George and Matt Svrcek. *Wind Turbine Development: Location of Manufacturing Activity*. Renewable Energy Policy Project, (http://www.crest.org/articles/static/1/binaries/WindLocatorShort.pdf) September 2004, p.5.
[73] Sterzinger, George and Matt Svrcek. *Wind Turbine Development: Location of Manufacturing Activity*. Renewable Energy Policy Project, (http://www.crest.org/articles/static/1/binaries/WindLocatorShort.pdf) September 2004, pp. 18-37.

| Manufacturing Firms with Technical Potential to Enter Wind Turbine Market, State of Ohio: 2005 (Source: Renewable Energy Policy Project; County Business Patterns via U.S. Census Bureau) | | | | |
|---|---|---|---|---|
| **NAICS Code** | **Industry** | **Total Employees** | **Annual Payroll ($1,000s)** | **Number of Establishments** |
| 335312 | Motors and Generators | 4,138 | $182,830 | 38 |
| 335999 | All Other Miscellaneous Electrical Equipment and Component Manufacturing | 1,430 | $63,381 | 34 |
| **TOTAL: ALL INDUSTRIES** | | **68,011 – 70,009** | **$2,681,077+** | **951** |

While difficult to gauge the proposed Facility's exact impacts on job creation and investment, an analysis done by the Renewable Energy Policy Project for a proposed Renewable Portfolio Standard in Pennsylvania suggests that every 1,000 MW of wind power developed created a potential for 3,000 jobs in manufacturing.[74] If such standards were applied to the proposed Facility, a facility with a rated capacity of 131.4 MW would create (or retain) roughly 394 manufacturing jobs. A 146 MW facility would create 438 jobs, while a 182.5 MW facility will generate approximately 548 manufacturing jobs. Such investment will likely benefit the regions that are most in need of new manufacturing jobs.

Champaign County and other governmental entities in Southwest Central Ohio will need to determine whether and how to encourage the development of the domestic manufacturing capability. There are numerous state and federal funding opportunities that could assist in the investment of such renewable energy and clean technology in the region. These include, but are not limited to Renewable Energy grants and the Wind Production and Manufacturing Incentive Program – both funded through the Ohio Department of Development's Ohio; Distributed Energy Resource grants through the Ohio Department of Development's Office of Energy Efficiency; the Energy Efficiency Revolving Loan Fund; and a significant number of federal programs, grants and tax incentives to encourage investment in wind energy.

Moreover, renewable energy and clean technology is receiving substantial interest from Venture Capitalists. The National Venture Capital Association (NVCA) reports that in 2007, increases in venture capital investing could be attributed to record levels in Clean Technology and Life Sciences sectors, as well as in Internet-specific companies. Venture capital investment in Clean Technology grew by 46% to $2.2 billion in 201 deals in 2007. Eighty percent of venture capitalists predict that the Clean Technology sector will attract higher levels of venture financing in 2008 and years to come.[75] With the Obama Administration's agenda on investing in climate-friendly energy development and deployment, the location of wind farms in this region of Ohio will help move the region towards a more sustainable economy, as well as create a reputation for innovation.

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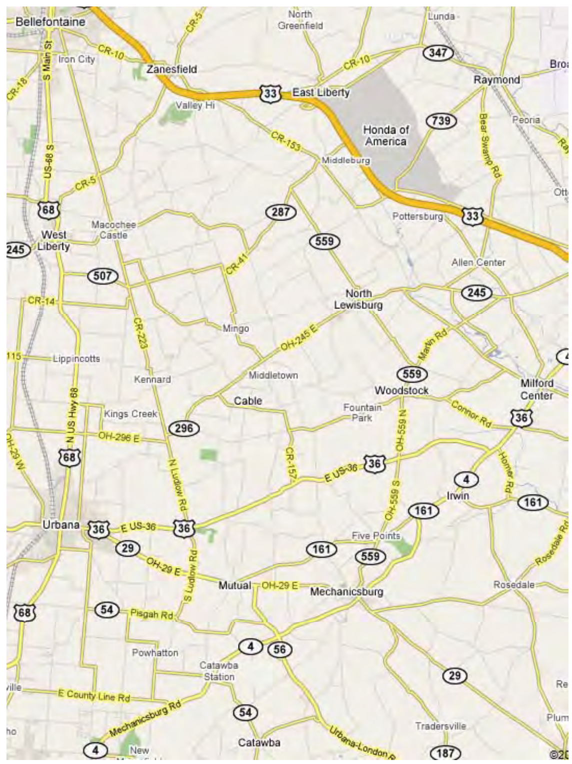
[74] Sterzinger, George and Matt Svrcek. *Wind Turbine Development: Location of Manufacturing Activity*. Renewable Energy Policy Project. (http://www.crest.org/articles/static/1/binaries/WindLocatorShort.pdf) September 2004.
[75] National Venture Capital Association, "2007 Venture Capital Investing Hits Six Year High at $29.4 Billion," Jan. 21, 2008.

## 9.6 IMPACTS ON TRANSPORTATION

### 9.6.1 VEHICULAR ACCESS

Given the rural nature of the townships that will host the Facility and surrounding areas, residents must rely heavily on automobile travel. This is accomplished through an intricate network of Interstate and State highways, in addition to county and local roads. The road network provides access to two metropolitan areas – Dayton and Columbus – and other regional and interstate destinations. The major highway that runs proximate to the proposed Facility is US Interstate Highway 70, which stretches from Baltimore, Maryland, to Utah and runs south of the Facility – through Columbus and Dayton. US Highway 68 is located west of the proposed Facility, and connects Bellefontaine and the City of Urbana. US Highway 33, located northeast of the site, connects Bellefontaine with Marysville and provides access to a major regional employer, Honda of America.




US Highway 36 runs through the townships that will host the Facility from the City of Urbana until it joins Highway 33 in Marysville, where it splits and continues to further points east.

Several State Highways run through the Facility and to areas within five miles of the Facility. State Highways 4, 29, 55, 161, 245, 287, 296, and 507 run through or near the site and are oriented along an east-west path. State Highway 4 connects Mechanicsburg to Springfield, while State Road 29 connects the City of Urbana to Mechanicsburg. State Roads 245 and 287 connect West Liberty to Marysville. State Highways 54, 56, 187, and 559 run with a north-south orientation. State Highway 56 intersects US Interstate Highway 70 further south of the Facility, providing access to points beyond the region.

Numerous country road and local roads also traverse the area, providing access and additional services to local residents near the Facility and within the five-mile radius of the Facility.

Given the limited number of nearby residents and the existence of alternate routes within the boundary of the Facility, temporary road closures during construction are not expected to create any significant adverse impacts on the vehicular transportation network. A more detailed transportation study will be conducted by an appropriate firm as retained by Buckeye Wind.

### 9.6.2 Rail Access

Three CSX-operated rail lines run in proximity to the site. The first CSX line follows Interstate Highway 75 south, running north of the site through Marysville towards Columbus. Connection to this rail exists in Bellefontaine via a CSX connecting line. This provides the area with a transit and freight link to and from various regional locations. The second CSX line follows Interstates 40 and 70 south of the site running from Columbus and points east through Springfield and Dayton before continuing west. The final CSX line runs between Bellefontaine and Urbana providing a freight and passenger connection between the two cities. While it is possible that turbine components for the Facility may be transported via rail, neither the construction phase nor the operation of the Facility is expected to create any significant adverse impacts on the rail network.

### 9.6.3 Air Access

The Facility is located within a one-hour drive to six major primary service and reliever airports. Port Columbus International Airport is the largest of the primary service airports in the area. Columbus Regional Airport Authority currently manages the airport, while also overseeing the operation of the area's reliever airports – Rickenbacker International Airport and Bolton Field. There are a total of 44 gates within three concourses at Port Columbus International Airport. The second major airport in the area – the James M. Cox Dayton International Airport – is located in Dayton. It is located north of the city and operated by the City of Dayton Department of Aviation. Nine airlines provide service within the two concourses at this airport. Rickenbacker International Airport provides commercial services to the Columbus area, but is not considered a primary airport. Limited passenger options exist at Rickenbacker, however, six cargo airline services operate out of the facility.

In addition to the three commercial service airports, three reliever airports also exist near the proposed Facility. Two are located in Columbus – Bolton Field and Ohio State University Airport – and one is located in Dayton – Dayton-Wright Brothers Airport. Many smaller municipal or private airfields are within proximity of the Facility. These are primarily used for recreational opportunities; however, the potential for other uses is available. The Grimes Field Urbana Municipal Airport is located just 1 mile outside the City of Urbana and offers services ranging from fuel sales, corporate hangers, private hangers, and aircraft refurbishing to a full service restaurant. There is also a small privately owned public access grass airstrip at the corner of State Route 29 and Three Mile Road.

Neither the construction phase nor the operation of the Facility is expected to create significant adverse impacts on air travel. A formal Obstruction Evaluation/Airport Airspace Analysis and any other appropriate notifications will be filed with the Federal Aviation Administration.

# 10.0 Mitigation Measures

## 10.1 SOCIOECONOMICS AND COMMUNITY SERVICES

Unlike other types of residential or commercial development, the proposed wind farm will have a minimal impact on the community, and will not require additional schools, police, fire, other emergency services, or other community facilities or services (including transportation infrastructure). Therefore, the need for mitigation has been eliminated. At the same time, expected Alternative Tax revenues will far exceed costs to provide any additional services. The proposed Facility is expected to benefit all residents and existing businesses and property owners by providing income and revenue to Champaign County, as well as all townships and school districts that will host the Facility.

## 10.2 DECOMMISSIONING PLAN FUNDING

Details of the Decommissioning Plan as developed by Buckeye Wind follow:

**Removal of Project Improvements**

a. At the termination of the lease, Buckeye Wind shall peaceably and quietly leave and return the lease area to the landowner. Buckeye Wind will dismantle and remove all project improvements,, and other property owned or installed by Buckeye Wind (except for footings and foundations which shall have all above ground protrusions removed and the footings and foundations then buried to a depth of 3-4 feet).

b. Buckeye Wind shall cause the disturbed areas to be re-graded to restore all slopes to their original grade as closely as possible.

c. Notwithstanding anything to the contrary, if a landowner requests, Buckeye Wind may, but shall not be obligated, to allow roads, foundations, buildings, structures, and other improvements to remain so long as doing so does not violate any permits or legal requirements.

**Performance (Reclamation) Bond**

a. By the 5th anniversary of the commercial operation date, Buckeye Wind shall provide a surety bond, letter of credit, or other security in a form reasonably acceptable to landowner and in an amount sufficient to cover the costs of removal and disposal of the project improvements, net of salvage value, and costs of restoration as set forth above.

b. The initial amount of such bond or undertaking shall be based on a study undertaken by a independent certified engineer that shall determine the estimated costs of removal and decommissioning and the salvage value of the improvements. Buckeye Wind may use the cost estimates to satisfy its performance security measures herein.

c. The amount of the bond or other undertaking shall be reviewed every 5th year from the commercial operation date and if a reasonable estimate of the decommissioning costs have increased, the bond or undertaking shall also be increased consistent with such estimate. The revised estimate shall be obtained from an independent certified engineer paid for by Buckeye Wind.

## 11.0 Summary and Conclusions

> The socioeconomic report satisfies the relevant requirements of Section 4906-13-07 of the Ohio Administrative Code to Implement Certification Requirements for Electric Generating Wind Facilities. The socioeconomic report specifically examines the regional demographics and economics; the existing industries and sources of employment; the existing tax base and tax revenues; the current county, township, city and school district budgets; the current tax contributions to the counties, townships, city and school districts; the community character and land use trends; the economic impacts of the wind farm; the benefits to the community; the potential regional impacts; and mitigation measures, assuming the Facility is constructed with a rated capacity of low at 131 MW, medium at 146 MW, and high at 182.5 MW.

> Economic impacts were studied during construction and operation of the Facility.

> A Facility with a rated capacity of 131.4 megawatts would represent approximately $313.65 million in investment and generate approximately 131 full time direct construction jobs over an 18-month period, with earnings estimated at $7.236 million. The construction of a 131.4 MW facility will create economic spin-offs of approximately 1,554 jobs in other sectors of the economy, $2.930 million in earnings and $480.864 million in output. Total economic impacts for the construction of a 131.4 MW facility would be $794.519 million in output, $10.166 million in earnings, and 1,685 jobs.

> A Facility with a rated capacity of 146 megawatts would represent approximately $347.379 million in investment and generate approximately 146 full time direct construction jobs over an 18-month period, with earnings estimated at $8.040 million. A 146 MW facility will create economic spin-offs of approximately 1,727 jobs in other sectors of the economy, $3.255 million in earnings and $532.567 million in output. Total economic impacts for the construction of a 146 MW facility would be $879.946 million in output, $11.295 million in earnings, and 1,8725 jobs.

> A Facility with a rated capacity of 182.5 megawatts would represent approximately $431.688 million in investment and generate approximately 182 full time direct construction jobs over an 18-month period, with earnings estimated at $10.05 million. A 182.5 MW facility will create economic spin-offs of approximately 2,158 jobs in other sectors of the economy, $4.069 million in earnings and $661.821 million in output. Total economic impacts for the construction of a 182.5 MW facility would be $1.09 billion in output, $14.119 million in earnings, and 2,340 jobs.

> Over 20 years, the operation of a 131.4 MW Facility represents a total of $717.453 million in revenues, $57.586 million in output, of which [redacted] are in workers' wages and almost [redacted] are in leases to landowners. The twelve positions to be employed at the Facility remain constant throughout operations. A facility with 131.4 MW rated capacity will generate a spin-off of nearly $905 million in output, $13.9 million in earnings and 50 jobs in other sectors of the economy. Total economic impacts of a Facility with 131.4 MW will bring nearly $1.62 billion in output, almost $71.5 million in earnings and 62 jobs during 20 years of operation.

- Over 20 years, the operation of a 146 MW Facility represents a total of $797.172 million in revenues, $62.448 million in output, of which [redacted] are in workers' wages and almost [redacted] are in leases to landowners. The twelve positions to be employed at the Facility remain constant throughout operations. A facility with 146 MW rated capacity will generate a spin-off of nearly $1.004 billion in output, $15.075 million in earnings and 50 jobs in other sectors of the economy. Total economic impacts of a Facility with 146 MW will bring nearly $1.802 billion in output, over $77.523 million in earnings and 62 jobs during 20 years of operation.

- Over 20 years, the operation of a 182.5 MW Facility represents a total of $996.459 million in revenues, $74.602 million in output, of which [redacted] are in workers' wages and almost [redacted] are in leases to landowners. The twelve positions to be employed at the Facility remain constant throughout operations. A facility with 182.5 MW rated capacity will generate a spin-off of nearly $1.256 billion in output, $18.009 million in earnings and 50 jobs in other sectors of the economy. Total economic impacts of a Facility with 146 MW will bring nearly $2.252 billion in output, over $92.611 million in earnings and 62 jobs during 20 years of operation.

- The construction and operation of Facility is anticipated to generate substantial Alternative Tax revenues to all taxing jurisdictions that host the Facility. Upon completion of construction, tax revenues will be distributed to the townships of Goshen, Rush, Salem, Union and Wayne in Champaign County, as well as the Urbana City School District, the Mechanicsburg Exempted Village School District, the Triad Local School District and the West Liberty – Salem Local School District.

- While the exact terms of the Alternative Tax payment are not yet known, it is anticipated that the Facility will result to a positive fiscal impact to host communities. It is projected that total annual payments will range from a low $6,000 per megawatt, medium at $7,000 per megawatt and high at $8,000 per megawatt. A 131.4 MW facility will provide annual Alternative Tax Revenues for distribution to taxing jurisdictions, ranging from a low $788,400, medium at $919,800, to high at $1,051,200. A 146 MW facility will provide annual Alternative Tax Revenues for distribution to taxing jurisdictions, ranging from a low $876,000, medium at $1,022,000, to high at $1,168,000. A 182.5 MW facility will provide annual Alternative Tax Revenues for distribution to taxing jurisdictions, ranging from a low $1,095,000, medium at $1,277,500, to high at $1,460,000.

- The four school districts, combined with the Joint Vocational School and Library levies are projected to generate between $548,644 up to $1,016,000 in projected annual revenues and a net fiscal impact of $483,164 up to $950,527, depending on the Alternative Tax payment terms.

*Appendix J*
*Noise Analysis for the Buckeye Wind Project*

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# ENVIRONMENTAL SOUND SURVEY AND NOISE IMPACT ASSESSMENT

## BUCKEYE WIND PROJECT

CHAMPAIGN COUNTY
OHIO

PREPARED FOR:

**EverPower Wind Holdings, Inc.**

Prepared by:

COMMONWEALTH OF VIRGINIA
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# CONTENTS

# 1.0 INTRODUCTION

Hessler Associates, Inc. has been retained by EverPower Wind Holdings, Inc. to evaluate potential environmental noise impacts from a proposed wind energy conversion project being developed in Champaign County, Ohio. Plans for the Buckeye Wind Project (The Project) currently call for the installation of approximately 70 wind turbines in the 1.8 to 2.5 MW size range. The specific make and model has not yet been determined. At the present time two candidates are being considered.

The study essentially consists of two phases: (1) a background sound level survey and (2) a computer modeling analysis of future turbine sound levels. The field survey of existing sound levels at the site was carried out to determine how much natural masking noise there might be - as a function of wind speed - at the nearest potentially sensitive receptors to the Project. The relevance of this is that high levels of background noise due to wind-induced natural sounds, such as tree rustle, would tend to reduce the audibility of the wind farm, while low levels of natural noise would permit operational noise from the turbines to be more readily perceptible. The audibility of, and potential impact from, any new noise source is largely a function of how much, if at all, it exceeds the pre-existing background level at a potentially sensitive noise receptor location.

In the second phase of the assessment an analytical noise model of the Project was developed to predict the sound level contours associated with the Project over the site area and thereby determine the potential for perceptibility relative to the background sound level.

# 2.0 BACKGROUND SOUND LEVEL SURVEY

## 2.1 OBJECTIVE AND MEASUREMENT QUANTITIES

The purpose of the survey was to determine what minimum environmental sound levels are consistently present and available at the nearest potentially sensitive receptors to mask or obscure potential noise from the Project. A number of statistical sound levels were measured in consecutive 10 minute intervals over the entire survey. Of these, the average (Leq) and residual (L90) levels are the most meaningful.

The average, or equivalent energy sound level (Leq), is literally the average sound level over each measurement interval. This is the “typical” sound level most likely to be observed at any given moment.

The L90 statistical sound level, on the other hand, is commonly used to conservatively quantify background sound levels. The L90 is the sound level exceeded during 90% of the measurement interval and has the quality of filtering out sporadic, short-duration noise events thereby capturing the quiet lulls between such events. It is this consistently present “background” level that forms a conservative or “worst-case” basis for evaluating the audibility of a new source.

An additional factor that is important in establishing the minimum background sound level available to mask potential wind turbine noise is the natural sound generated by the wind itself. Wind turbines only operate and produce noise when the wind exceeds a certain minimum cut-in speed of roughly 3 or 4 m/s at hub height. Turbine sound levels increase with wind speed up to about 8 to 10 m/s (measured at a standard elevation of 10 m) when the sound produced generally reaches a maximum and no longer increases because the rotor has reached a predetermined maximum rotational speed. Consequently, at moderate to high wind speeds when turbine noise is most significant the level of natural masking noise is normally also relatively high due to tree or grass rustle thus reducing the perceptibility of the turbines. In order to quantify this effect wind speed was measured over the entire sound level survey period at two on-site met towers for later correlation to the sound data.

## 2.2 SITE DESCRIPTION AND MEASUREMENT POSITIONS

The proposed Buckeye Project is generally located a few miles northeast of Urbana, Ohio in a predominantly agricultural area. The site area, which is roughly 9 miles north to south and 7 miles east to west, runs from the vicinity of the town of Mutual up to the environs of Cable in the northern part of Champaign County. The site terrain consists mostly of gently rolling hills with some relatively flat areas. In terms of vegetation, the area is primarily open farm land interrupted by a few scattered wooded areas.

Although the area generally consists of fairly large farms, a number of homes exist on smaller parcels of land between the larger farming properties. Private residences are more or less evenly distributed over the entire site area with intermittent areas of greater density around the small towns and other localities in the area. Turbines are planned throughout the area on fairly large tracts of open land between the residences.

In order to measure existing background sound levels that are representative of those experienced at homes in the vicinity of the turbines, sound level monitors were set up at 9 positions evenly distributed over the proposed project area.

**Graphic A** shows the site area, the proposed turbine locations and the sound level monitoring stations, which are also described below.

<u>Position 1 – 8077 Stevenson Road</u>

Monitor 1 was situated on a fence post in an open field behind the residence

**Figure 2.2.1** *Monitor 1 – Looking East*

Position 2 – 7498 CR 44

Monitor 2 was located on a post in rear of the residence. The area was surrounded by open farm fields.

**Figure 2.2.2** *Monitor 2 – Looking East*

Position 3 – 2953 Mt. Tabor Road

Monitor 3 was located in an open field on a utility pole along the driveway to the home.

**Figure 2.2.3** *Monitor 3 – Looking North*

Position 4 – 5559 State Road 245E

Monitor 4 was located an open area on a fence post behind the home.

**Figure 2.2.4** *Monitor 4*

Position 5 – 4557 Urbana Woodstock Road

Monitor 5 was positioned on a fence post among a line of trees dividing two fields and adjacent to several homes (across the road).

**Figure 2.2.5** *Monitor 5 – Looking North*

Position 6 – 47 N. Parkview Road

Monitor 6 was located on a tree in the rear yard of the house

**Figure 2.2.6** *Monitor 6 – Looking West*

Position 7 – 345 N. Mutual Union Road

Monitor 7 was attached to a utility pole in the side yard of the house.

**Figure 2.2.7** *Monitor 7 – Looking East*

Position 8 – Opposite 7400 Hwy. 161

Monitor 8 was supported on a young tree behind an unoccupied residence across the road from 7400.

**Figure 2.2.8** *Monitor 8 – Looking North towards Hwy. 161*

Position 9 – 2560 S. Mutual Union Road

Monitor 9 was located on a fencepost at the edge of a large open field behind a church in the village of Mutual.

**Figure 2.2.9** *Monitor 9 – Looking South*

## 2.3 INSTRUMENTATION AND SURVEY DURATION

Rion Model NL-22 and NL-32, ANSI Type 2, integrating sound level meters were used for the survey. Each instrument was enclosed in a weatherproof case fitted with a 12” microphone boom.

The microphones were protected from wind-induced self-noise by oversized 180 mm (7") diameter foam windscreens (ACO Model WS7-80T). The microphones were also situated at a fairly low elevation of about 1 m above grade so that they were exposed to relatively low wind speeds. As illustrated later in Figure 2.6.1 wind speed normally diminishes rapidly close to the ground, theoretically going to zero at the surface. At a height of 1 m the microphones were nominally exposed to inconsequential wind speeds of about 3 or 4 m/s during the wind conditions of greatest interest (6 to 8 m/s as measured at the IEC standard height of 10 m above grade). Wind tunnel testing [Ref. 8] of microphone self-noise for various windscreens (performed after completion of the Buckeye field survey) confirms that:

- Wind-induced false-signal noise occurs only in the lower frequencies, making the A-weighted sound level relatively insensitive to this effect[1].
- Significant upward skewing of the A-weighted sound level only begins to occur at wind speeds of around 15 to 20 m/s, which are generally well above the range of interest for wind project background surveys (roughly 3 to 8 m/s at 1 m above grade).
- The ACO WS7-80T windscreen (the type used in the Buckeye survey) was the best performing windscreen out of all tested; i.e. it offered the greatest protection against wind-induced distortion.

Consequently, the as-measured survey levels are considered valid and free of any significant self-generated contamination.

All the instruments were field calibrated with a Brüel and Kjær Type 4230 calibrator at the beginning of the survey and again at the end of the survey. The observed calibration drift was ranged from -0.1 dB to +0.3 dB.

Each of these instruments is designed for service as a long-term environmental sound level data logger measuring the A-weighted sound level. The meters were all set to continuously record a number of statistical parameters in 10 minute increments, such as the average (Leq), minimum, maximum, and residual (L90) sound levels. The survey period lasted 14 days beginning at noon on 1/11/08 and ending on 1/25/08.

As can be seen in the photographs in Section 2.2, the trees were bare and the survey was conducted under conservative wintertime conditions. Environmental sound levels are normally lowest at this time of year because wind-induced leaf rustle noise is absent and no insects are present. During the warm weather months significantly higher background sound levels, on the order of 5 to 7 dBA[2], can be expected due to these two principal causes.

---

[1] A-weighting intentionally suppresses the lower frequencies in order to make the overall sound correspond to the way it is subjectively perceived by the human ear. Low frequency sounds are much less perceptible than mid and high frequency sounds. The factors subtracted from the very lowest frequencies in the A-weighting process are large (on the order of 50 dB) and have the effect of canceling the increase caused by wind-induced distortion, which also occurs in the low frequencies. Sound levels without any weighting applied or C-weighted sound levels would, on the other hand, be dramatically affected by wind-induced distortion.

[2] Based on field tests at other wind project sites where identical surveys were completed under both winter and summer conditions. Using the winter sound level to define the year-round background level is highly conservative since much more masking sound generally exists during the warm weather months when people are outside, when windows are open and when the greatest potential for noise impacts exists. This reduction in the potential perceptibility of Project sound during the summer is ignored by using the wintertime background level as a design basis. In the wintertime people are normally inside most of the time with the windows shut and thus significantly more shielded from exterior sounds.

## 2.4 SURVEY WEATHER CONDITIONS

The weather conditions during the survey were mostly clear and cold with very little precipitation. The only precipitation occurred on January 13 and 17 when each time less than 0.1" of rain/snow fell.

The general weather parameters of temperature, barometric pressure and wind for the survey period, as observed in at a weather station on McAdams Road within the project area near the village of Cable, are illustrated in the graph below.

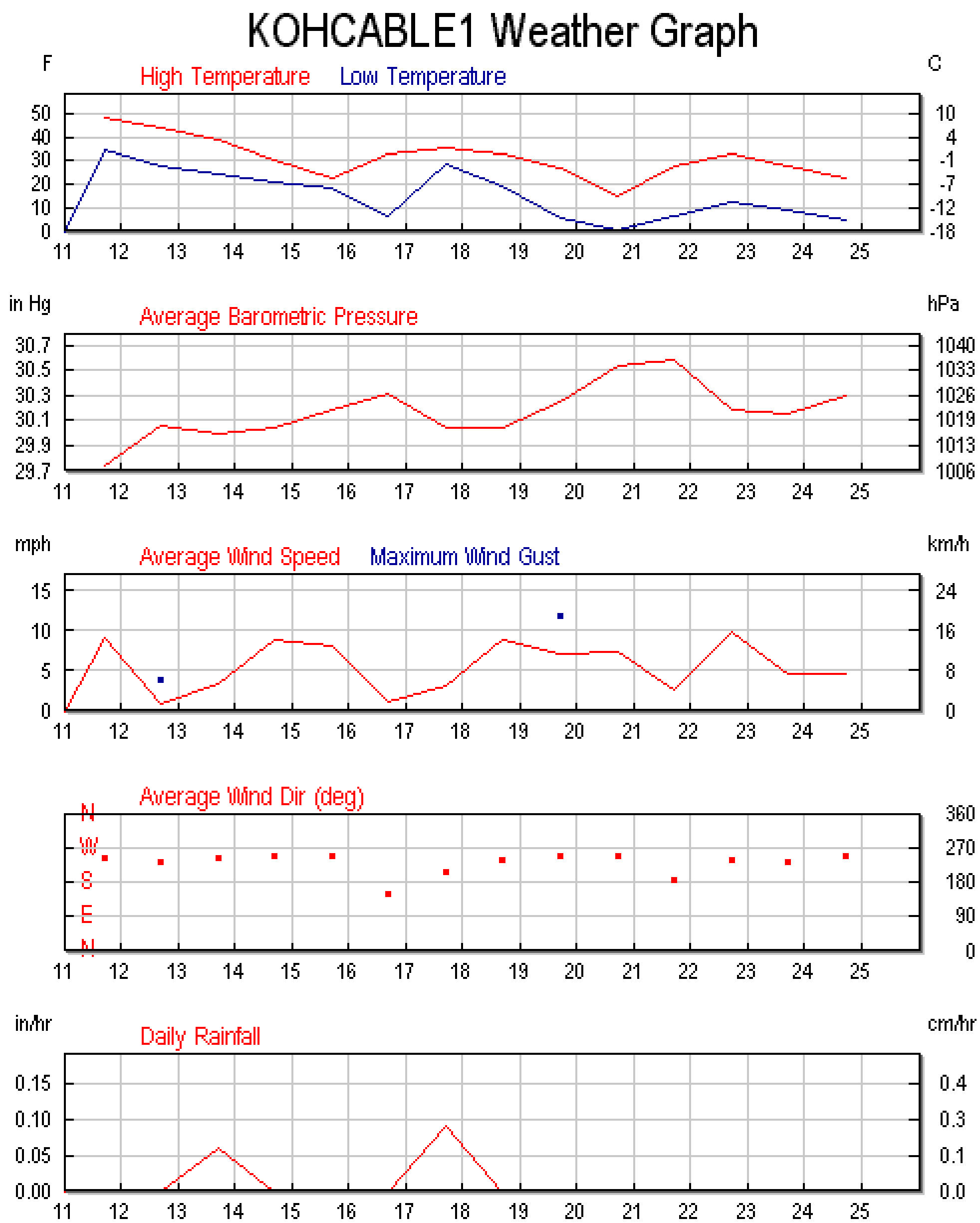


**Figure 2.4.1** *General Weather Data for the Survey Period as Observed Near Cable, OH*

A much more detailed record of the wind speed at the site was measured at a two met towers (Sites 01 and 02) distributed over the project area. Figure 2.4.2 below shows the wind speed measured in 10 minute increments at an anemometer height of 40 m. Since the wind speeds are fairly uniform between the two locations, which are separated by a number of miles, the arithmetic average is considered a reasonably representative record of the typical wind speed over the entire site area.

In Figure 2.4.3 this average is normalized from an elevation of 40 m to a standard elevation of 10 m in accordance with IEC Standard 61400-11 [Ref. 1]. This 10 m height, explained in more detail in Section 2.6 below, is relevant because all wind turbine sound levels are expressed as a function of wind speed at this standard elevation.

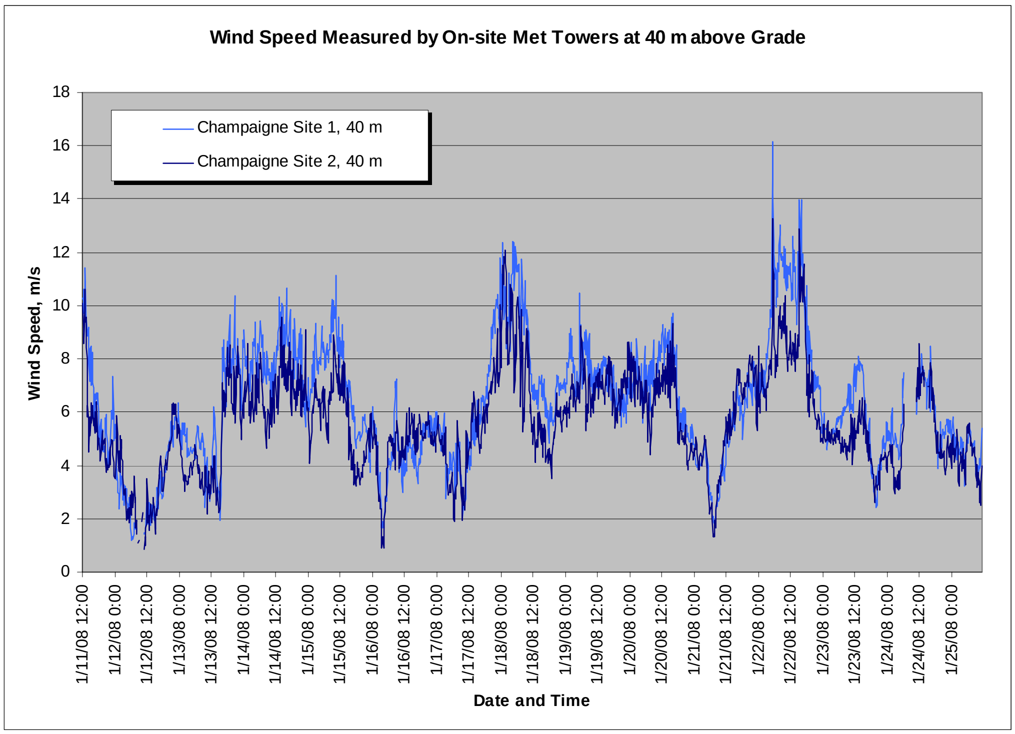


**Figure 2.4.2** *Wind Speed vs. Time Measured by On-Site Met Towers During the Survey Period*

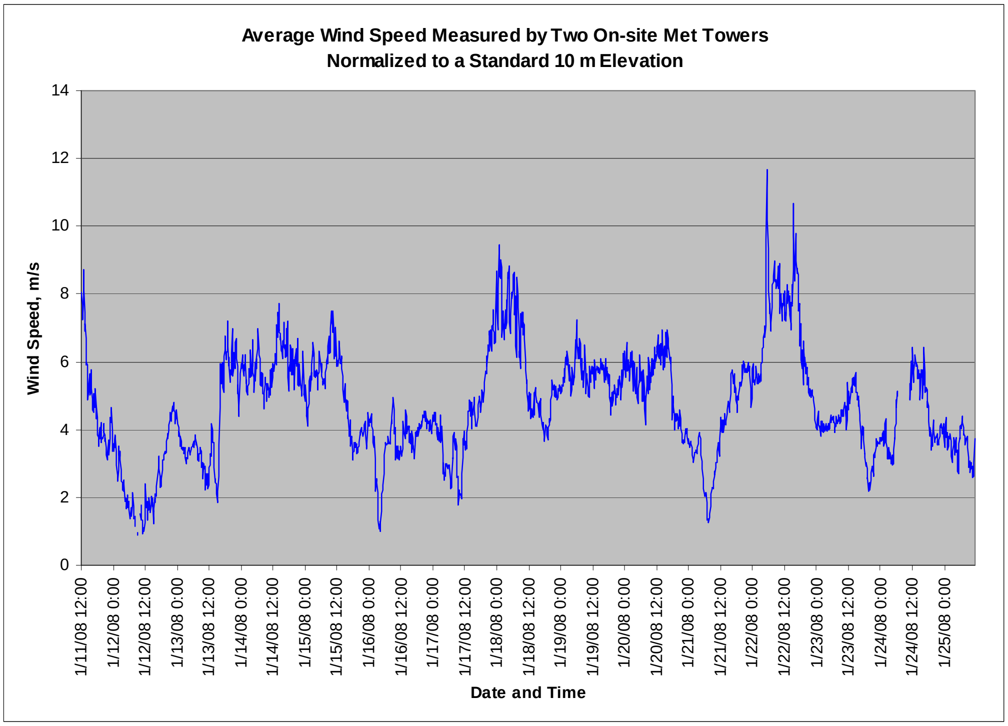


**Figure 2.4.3** *Average Site-wide Wind Speed vs. Time Normalized to 10 m*

## 2.5 OVERALL SURVEY RESULTS

As discussed above in Section 2.1 the L90, or residual, sound level is a conservative measure of background sound levels in the sense that it filters out short-duration, sporadic noise events that cannot be relied upon to provide consistent and continual masking noise to obscure potential turbine noise. This level represents the quiet, momentary lulls between all relatively short duration events, such as cars passing by or tractor activity in a neighboring field. As such, it is the near "worst-case" background level with regard to evaluating potential impacts from a new source since it represents essentially the lowest amount of masking sound.

The L90 sound levels over consecutive 10 minute periods for all 9 positions are plotted below in Figure 2.5.1.

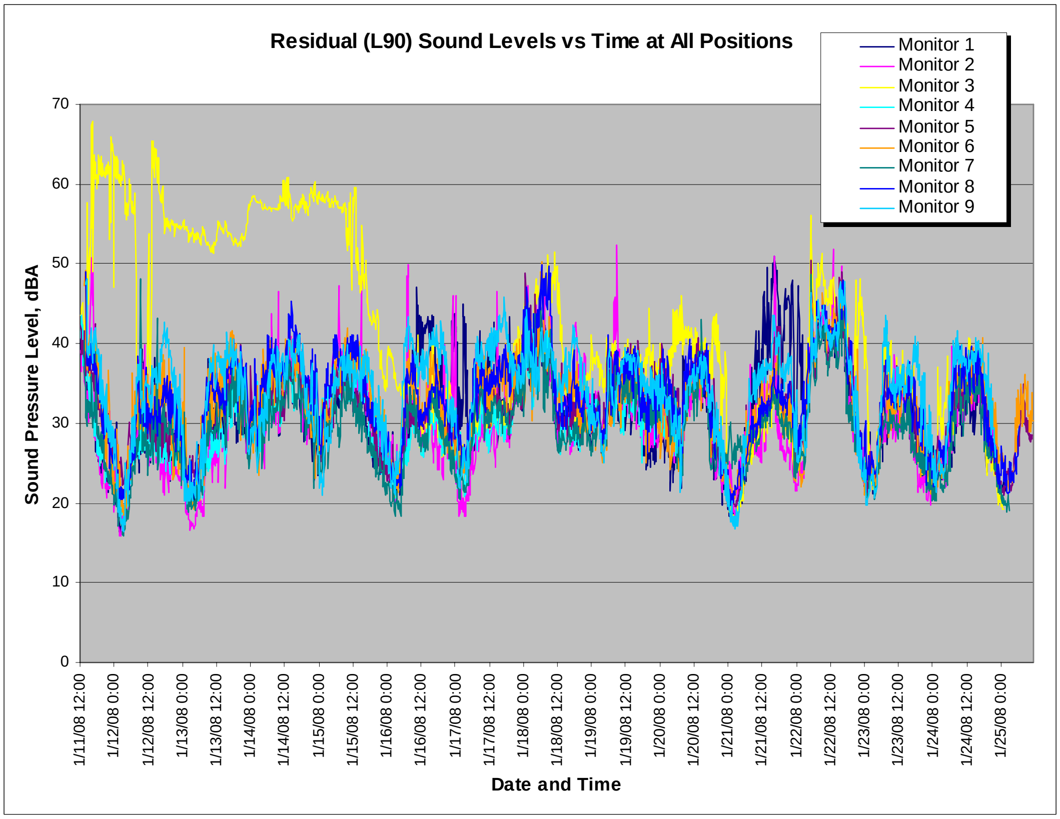


**Figure 2.5.1** *10 minute L90 Sound Levels at All Monitoring Positions*

This plot shows that the L90 sound levels at these very widely distributed locations closely follow the same trends - except at Positions 3 where an apparent instrument malfunction produced spurious data for the first few days (only) of the survey. Omitting this position, the uniformity of sound levels over these many and widely distributed locations is more evident (Figure 2.5.2).

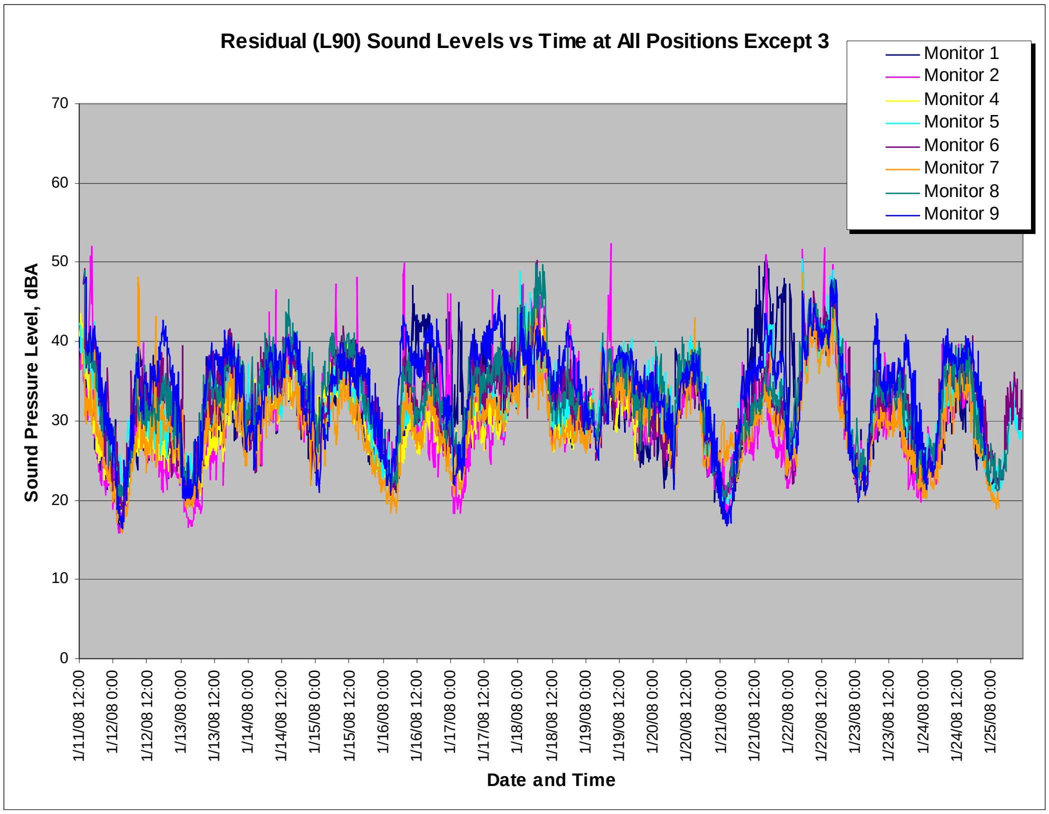


**Figure 2.5.2** *10 minute L90 Sound Levels at All Monitoring Positions Except 3*

The consistency in level and behavior as a function of time between these 8 monitoring stations is remarkable given the fact that they were spread out over an area of roughly 77 square miles in a variety of settings. Because of this uniformity it can be concluded that the average sound level of these 8 positions would reasonably represent the sound level anywhere in the vicinity of the site and can be used as a design level. The likelihood of the sound level being substantially and consistently different at a location between the monitoring points is obviously extremely remote. The average, design, L90 sound level is plotted in Figure 2.5.3.

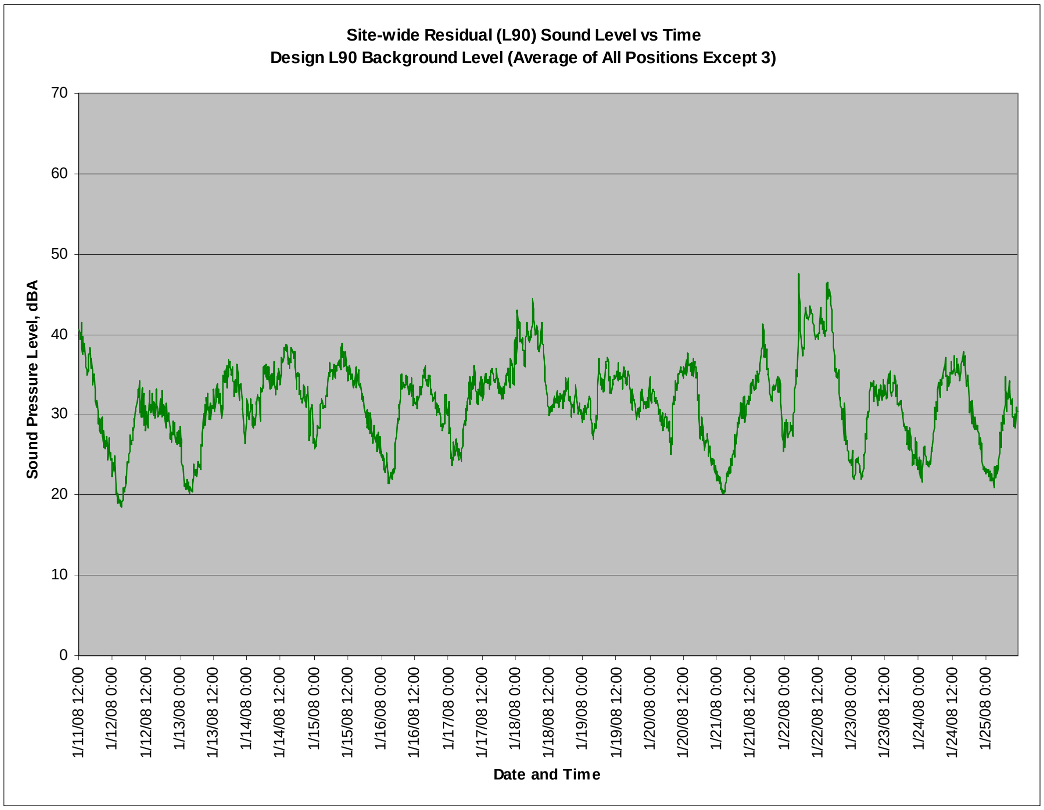


**Figure 2.5.3** *Average L90 Sound Level – Design Level*

Figure 2.5.4 compares the average background L90 sound level to the average wind speed measured by the on-site met towers.

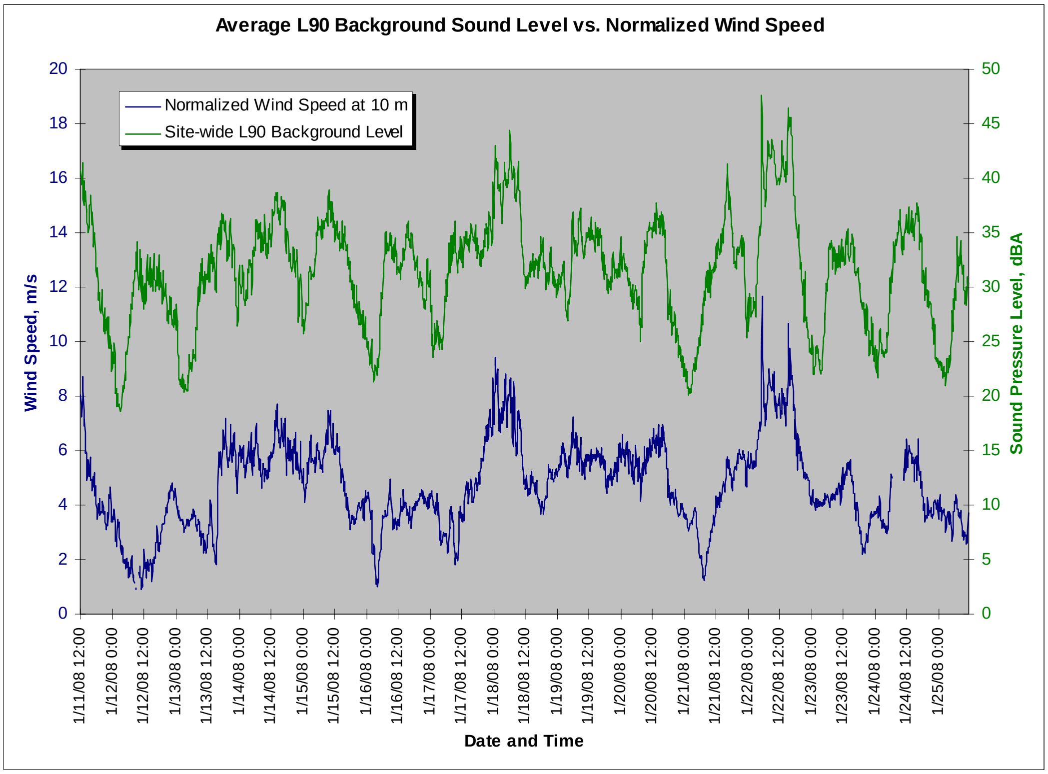


**Figure 2.5.4** *Design L90 Sound Level Compared to Wind Speed*

This plot shows that the near-minimum (L90) background sound levels over the site area are clearly related to wind speed and largely driven by wind-induced natural sounds, although an underlying diurnal, or day-night, variation is also visible where there is brief minimum in the early morning hours on most days.

The dependency of sound levels on both wind speed and time of day can be quantified by re-plotting the sound data as a function of wind speed for the daytime (7:00 a.m. to 10 p.m.) and nighttime (10 p.m. to 7:00 a.m.) periods. These regression analyses are shown in Figures 2.5.5 and 2.5.6.

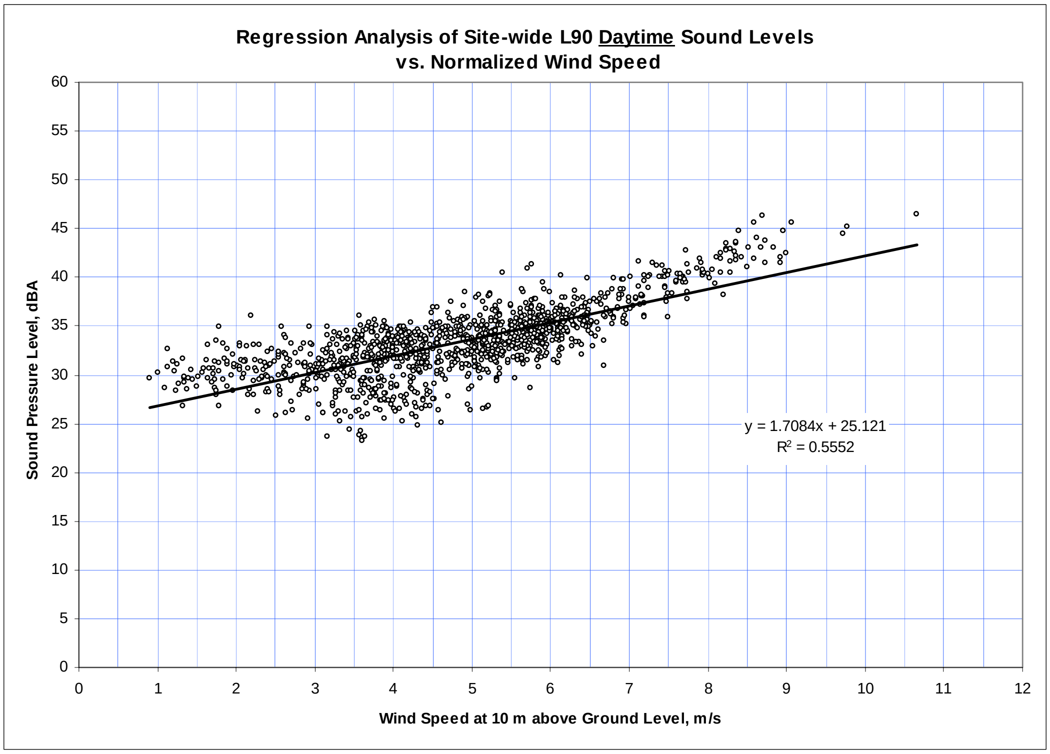


**Figure 2.5.5** *Correlation Between the L90 Background Level and Wind Speed - **Daytime***

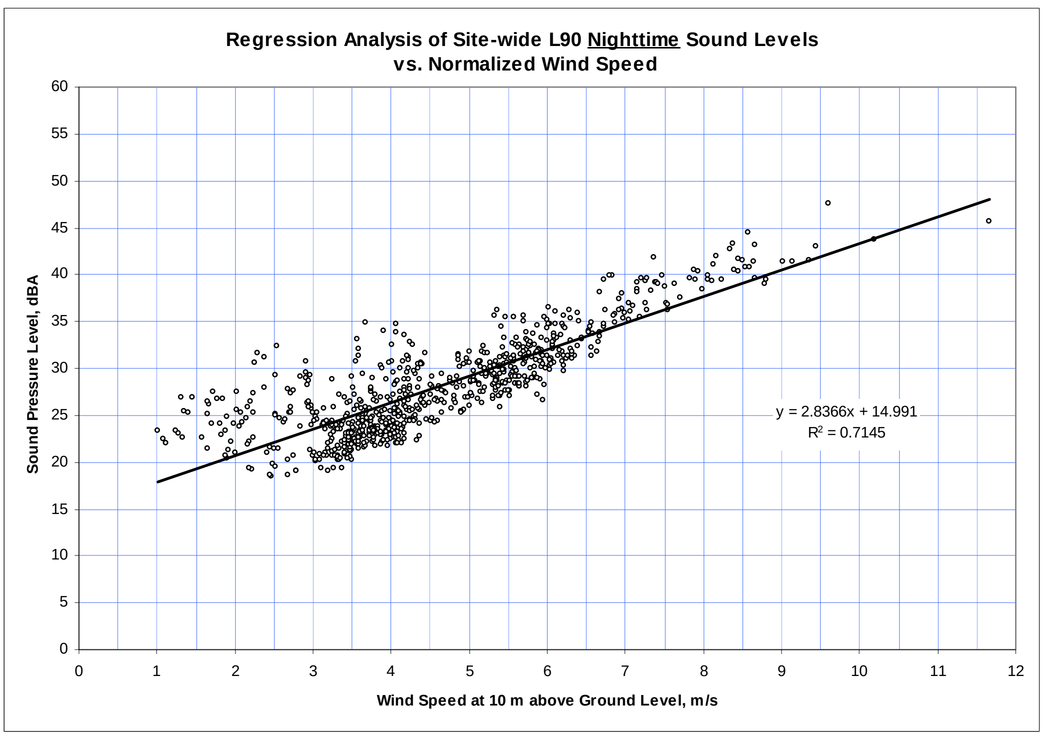


**Figure 2.5.6** *Correlation Between the L90 Background Level and Wind Speed - **Nighttime***

These plots show that sound levels clearly increase with increasing wind speed regardless of the time day. In general, the nighttime levels have a greater dependency on wind (steeper slope to the trendline) and reach extremely low levels in the 20 to 25 dBA range during calm wind conditions while daytime levels remain relatively elevated during low wind conditions. At higher wind speeds the daytime and nighttime sound levels are nearly the same. The following table summarizes the residual (L90) background levels that characterize the site environment over the range of wind speeds relevant to turbine operation.

**Table 2.5.1** *Measured L90 Background Sound Levels as a Function of Wind Speed*

| Integer Wind Speed at Standardized Elev. of 10 m, m/s | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|
| **Daytime L90** Sound Level, dBA | **32** | **34** | **35** | **37** | **39** | **40** | **42** |
| **Nighttime L90** Sound Level, dBA | **26** | **29** | **32** | **35** | **38** | **41** | **43** |

The sound levels in Table 2.5.1 can be considered "worst-case" because these background levels represent the lowest levels that are likely to be observed for brief periods during intermittent lulls in all forms of environmental sound (both natural and man-made). By definition, the L90 sound level does not occur over long periods and does not characterize the sound level that is most commonly present. The sound level that is more likely to actually exist most of the time is the average, or Leq, sound level, which may be regarded as the "typical" sound level. The Leq(10 min) sound levels measured over the survey period are plotted below.

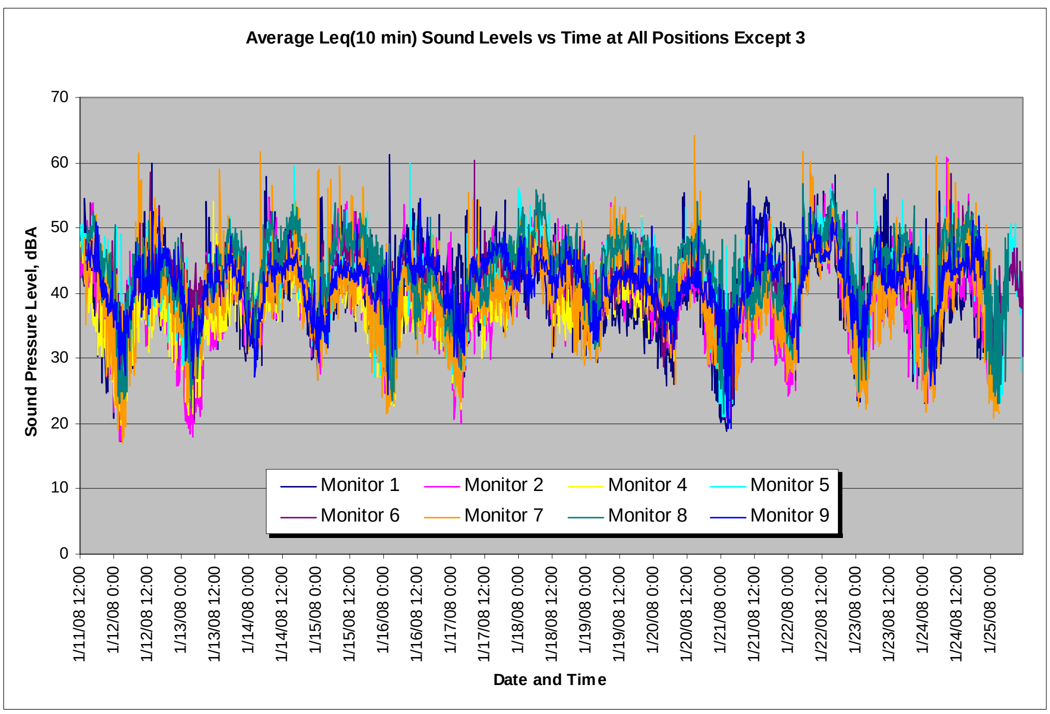


**Figure 2.5.7** *Average Sound Levels Measured at All Positions (Except 3)*

Although the levels are (naturally) less tightly grouped than in the case of the L90 (Figure 2.5.1), there is still a general uniformity and temporal consistency over all eight widely dispersed positions. Since Leq levels are more easily influenced by sporadic local noise events, such traffic or farm activity, there is a natural tendency for the Leq levels to be less uniform than the L90, which essentially filters out short-duration noise events and defines the underlying minimum level. Nevertheless, it is clear from Figure 2.5.7 that the arithmetic mean of all eight positions would reasonably represent the site-wide average, or "typical" sound level as a function of time. This average design level is plotted in Figure 2.5.8.

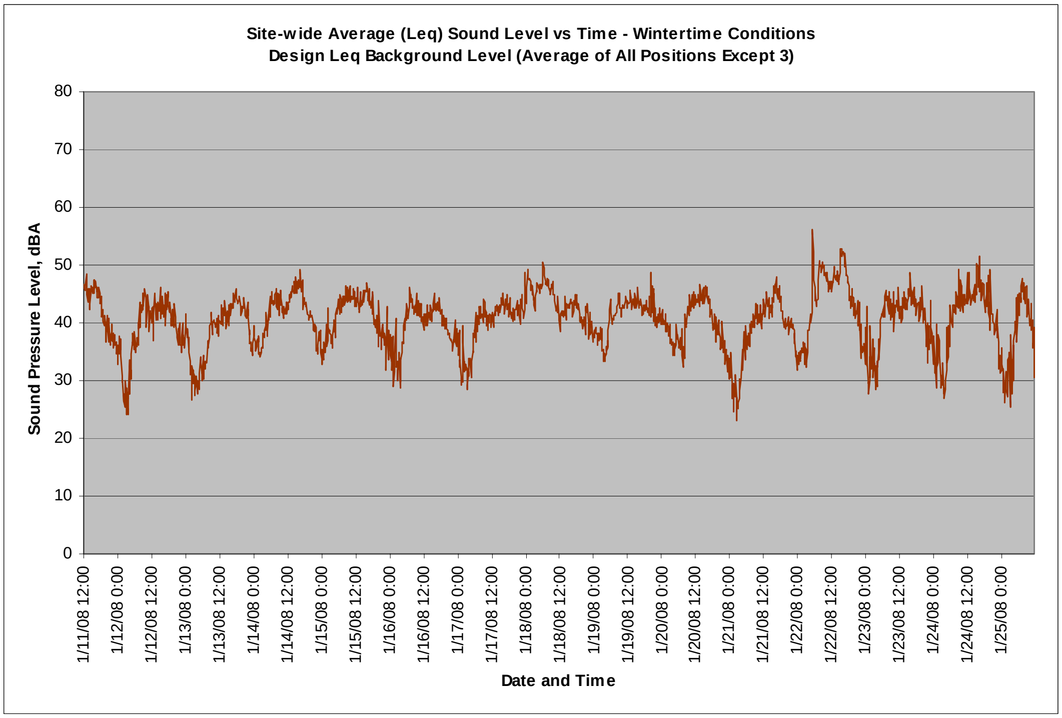


**Figure 2.5.8** *Site-wide Average Sound Level*

This design level is compared to the concurrent wind speed in Figure 2.5.9.

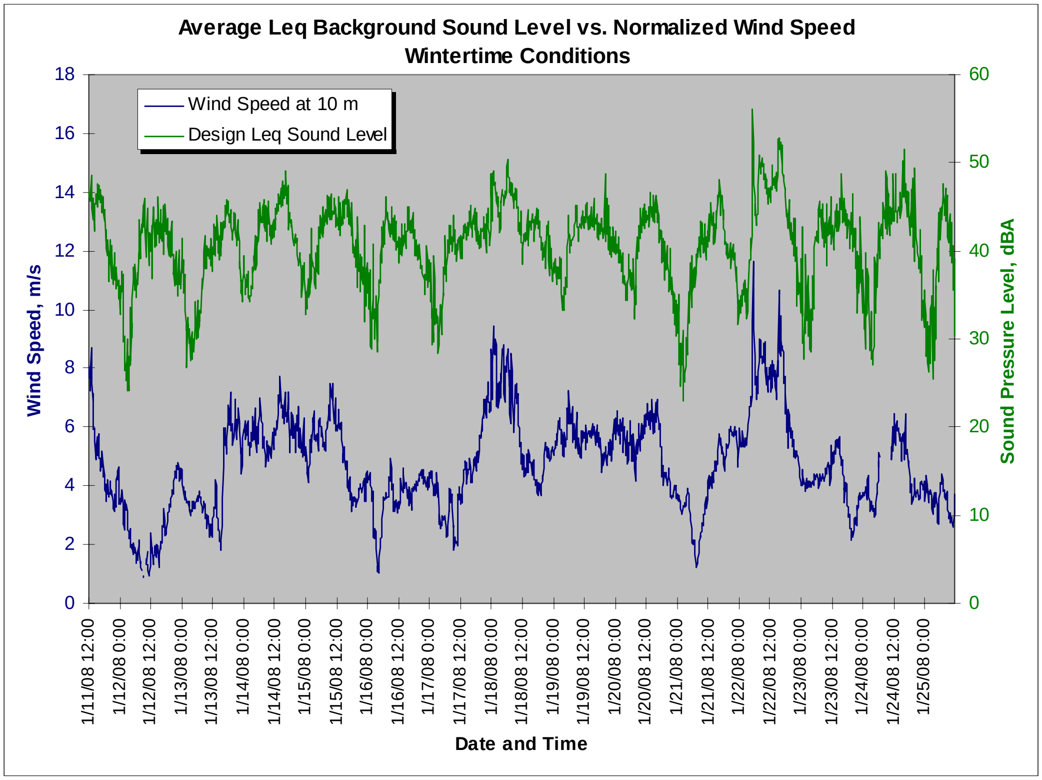


**Figure 2.5.9** *Design Leq Sound Level Compared to Wind Speed*

While the periods of relatively high winds have corresponding spikes in sound level, indicating a definite correlation, much of the time the relationship between the average sound level and wind speed is obscured by the day-night variation. Nevertheless, the regression analyses below of the daytime and nighttime levels, as a function of wind speed, show that there is still a general dependency on wind speed; i.e. sound levels increase with wind speed.

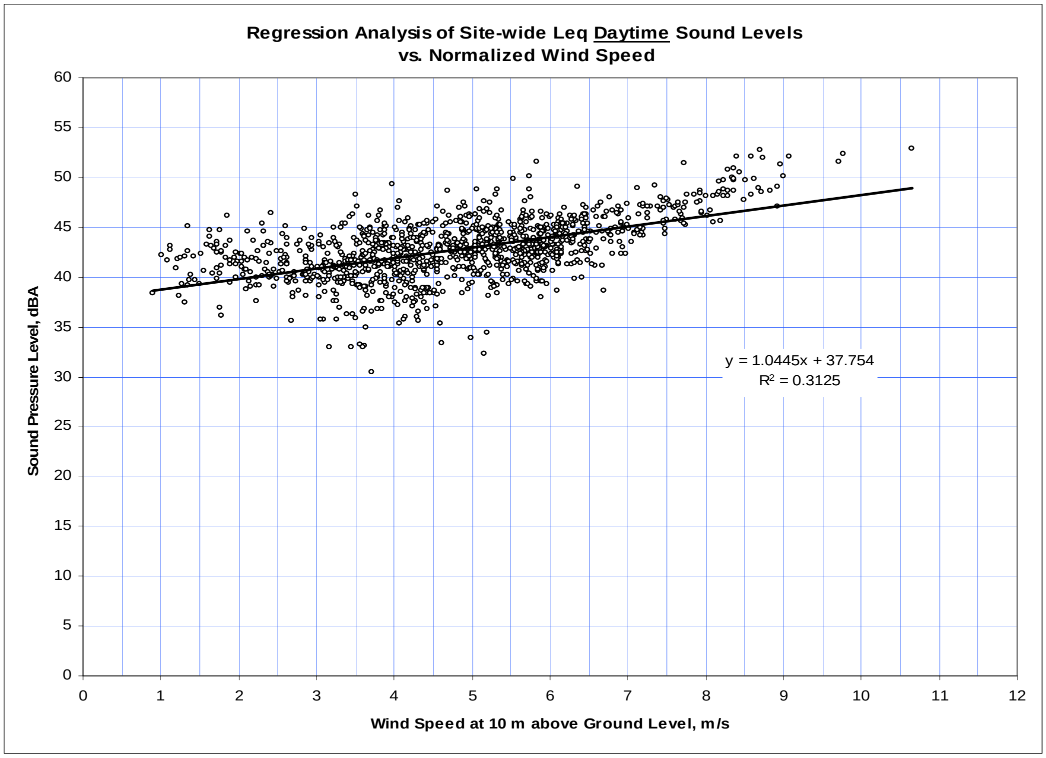


**Figure 2.5.10** *Correlation Between the Leq Background Level and Wind Speed – Daytime*

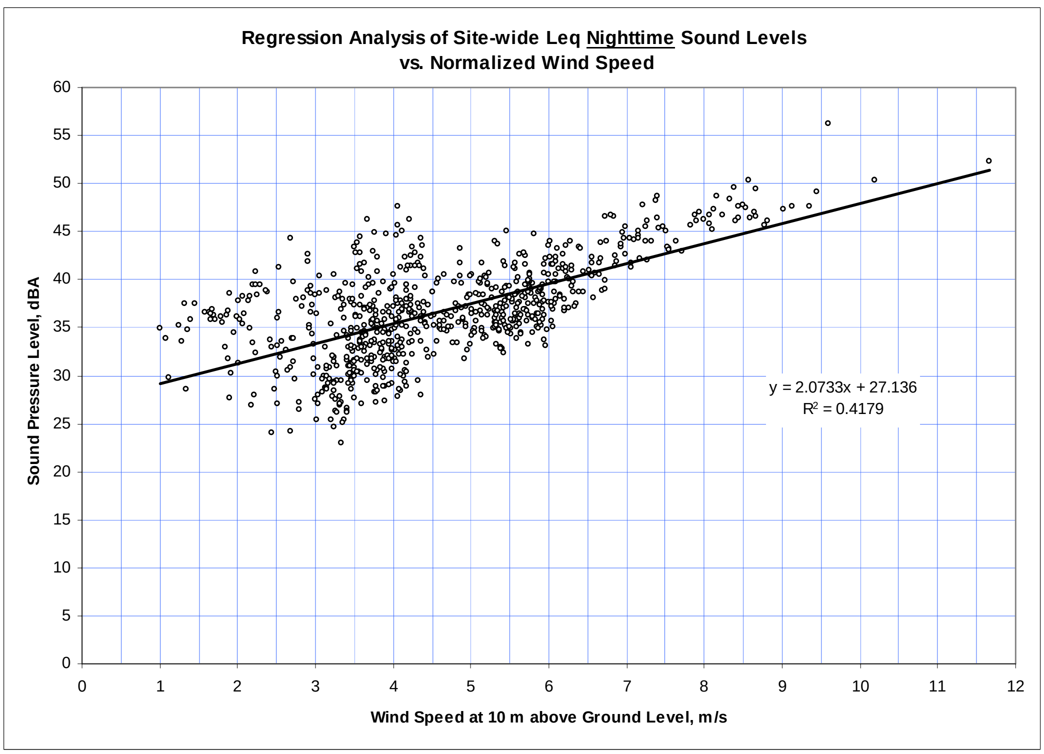


**Figure 2.5.10** *Correlation Between the Leq Background Level and Wind Speed - Nighttime*

As with the L90 levels, the nighttime levels have a somewhat stronger dependency on wind speed.

The following table summarizes the "typical", Leq background levels that characterize the site environment over the range of wind speeds relevant to turbine operation.

**Table 2.5.2** *Measured Leq Background Sound Levels as a Function of Wind Speed*

| Integer Wind Speed at Standardized Elev. of 10 m, m/s | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|
| **Daytime Leq** Sound Level, dBA | **42** | **43** | **44** | **45** | **46** | **47** | **48** |
| **Nighttime Leq** Sound Level, dBA | **35** | **38** | **40** | **42** | **44** | **46** | **48** |

These average levels range from about 6 to 10 dBA higher than the residual, L90 levels (Table 2.5.1).

## 2.6 WIND SPEED AS A FUNCTION OF ELEVATION ABOVE GROUND LEVEL

Below about 100 m, wind speed varies with elevation above the ground due to friction with the surface and obstacles, such as trees. Because this roughness varies from place to place measurements of wind turbine sound power levels carried out in accordance with IEC Standard 61400-11 [Ref. 1] are normalized to, and reported in terms of, the wind speed at a reference height of 10 m. This enables the nominal sound level of different makes and models of wind turbines to be compared on a uniform basis.

The conversion of wind speed at one elevation to the related speed at another elevation is calculated from a formula in the IEC standard (Equation (7), Section 8), which describes a logarithmic profile. This profile was determined empirically from wind speed measurements at various heights over a long period of time and is intended to represent average or normal conditions. It should be understood that the shape of this curve can certainly vary from this norm during temperature inversions and other atmospheric conditions that occur a small percentage of the time but as a design condition this curve reasonably captures the wind speed profile during most normal conditions.

As an example, the wind profile resulting from Eqn.(7) is shown graphically below in Figure 2.6.1 for the case where the wind is normalized to a speed of 8 m/s at 10 m. The shape of the profile curve varies with wind speed becoming flatter at low speeds and more curved at higher speeds.

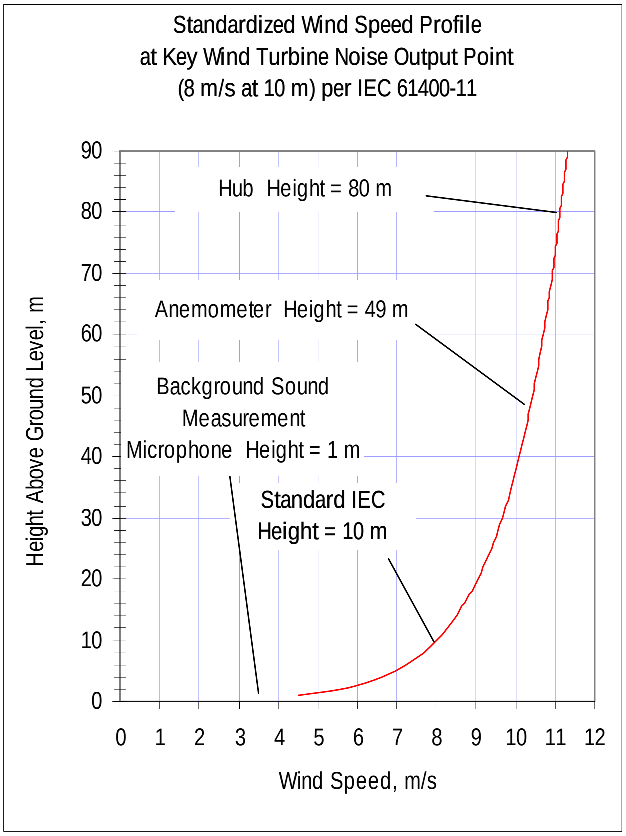


**Figure 2.6.1** *Typical Wind Speed Profile above the Surface*

## 3.0 PROJECT NOISE MODELING AND IMPACT ASSESSMENT

### 3.1 ASSESSMENT CRITERIA

#### 3.1.1 *General Sound Impacts at Residences*

There are no national or state laws that would specifically limit Project noise. In the absence of any specific or absolute noise level limits, potential noise from the Project will be evaluated in terms of its likely audibility or perceptibility relative to the background sound level at residences – where people are most likely to be most of the time.

In general, a new broadband noise source without any distinctive character to it, such as tonality or impulsiveness, must have a sound level that is about 5 dBA higher than the background before it begins to be perceptible to most people. For wind turbines, however, the threshold of perception is somewhat lower because the sound sometimes has a mildly periodic quality associated with blade "swish" that makes it more readily perceptible than a steady, bland sound of the same magnitude. The sound level rises and falls slightly at about 1 second intervals, since only the down-coming blade briefly generates aerodynamic noise followed by a very short pause until the next blade comes around. This phenomenon, referred to as amplitude modulation, makes wind turbines more readily perceptible than other sounds of comparable magnitude. Although this modulation in the sound has a "frequency" of about 1 Hz it is *not* low frequency or infrasonic noise, as is often mistakenly believed. Because of this characteristic wind turbine noise is normally perceptible when its overall A-weighted sound level is less than 5 dBA above the background level.

Having said that, however, setting the nominal impact threshold at a point 5 dBA above the prevailing background level represents a reasonable design target in the sense that it balances the interests of all parties. On the one hand, the allowable sound level must not be so low and restrictive that, for all practical purposes, nothing can be built while, on the other hand, the project sound level must not be so loud that it leads to legitimate disturbance at a large number of homes. A design goal of limiting the project sound level to 5 dBA over the background strikes a reasonable balance between these extremes. This approach is commonly used in siting analyses for all types of new infrastructure projects and is currently being used for numerous wind energy projects in New York State, for example, per a set of guideline recommendations [Ref. 10] promulgated by that State's Department of Environmental Conservation (NYSDEC).

It is important to note, though, that this threshold point does *not* define the limit of audibility. Beyond it project sound levels will be relatively low during most normal conditions and the likelihood of widespread adverse reaction to project noise is considered small. In order to make the project completely inaudible or preclude the possibility of *any* adverse reaction to noise at all under all atmospheric conditions, vast setback distances would be required – distances that would probably be impossible to realize at most potential wind project sites east of the Mississippi River.

One additional point on this design approach is that for wind turbine projects in particular the threshold of potential disturbance can not and should not be *rigidly* defined as a specific absolute or relative decibel level because reaction to wind turbine noise is highly subjective and individual. For example, experience on other projects indicates that many people have no adverse reaction to levels that are much more than 5 dB over the ambient while complaints have been received from locations where the sound level from the project is equivalent to or even below the background level. Consequently, a 5 dBA increase should be viewed as the center point of a fairly wide gray area of potential reaction and is intended to strike a reasonable balance between the interests of the project developer and non-participating neighbors rather than define a hard and fast boundary between acceptable and unacceptable sound levels.

### 3.1.2 *Sound Impacts at Project Boundaries*

The relative design criterion described above is considered appropriate for application at existing permanent residences where people actually are most of the time. At the boundaries of the Project, or, more specifically, at the property lines of adjoining non-participating land parcels it is not practical to use a ambient-based, incremental increase design criterion since that would effectively limit any development to a few turbines on vast tracts of land. A relatively low Project sound level at property lines is also unnecessary in just about every case because no one is usually permanently present at the fringe of a land parcel to be potentially affected by noise.

In the rare instances where property line noise limits have been imposed on wind turbine developments (in our experience with dozens of projects), an absolute noise limit of 50 dBA is typically used. This limit reasonably caps Project sound levels at property lines and will be adopted as a design goal here.

## 3.2 TURBINE SOUND LEVELS

The starting point for any wind turbine noise modeling study is the sound level, or more specifically, the sound power level of the turbine model that will be used in the Project. At the present time two different makes and models of turbine are being considered:

- Nordex N90/2500 LS – 90 m rotor, 2.5 MW power output
- REpower MM92 – 92 m rotor, 2.0 MW power output

The sound emissions from both turbines are similar, as might be expected since both have nearly identical rotors. The overall sound power levels of each unit as a function of wind speed is tabulated below. These levels come from field tests of operating units carried out by independent acoustical engineers [Refs. 7 and 9] in accordance with IEC 61400-11 [Ref. 1]. A uniform 80 m hub height is assumed.

**Table 3.2.1** *Sound Power Levels vs. Wind Speed of Candidate Turbine Models*

| **Wind Speed at 10 m Height, m/s** | **Nordex N90/2500 LS Sound Power Level, dBA re 1 pW** | **REpower MM92 Sound Power Level, dBA re 1 pW** |
|---|---|---|
| 4 | 98 | - |
| 5 | 101 | 101.6 |
| 6 | 103 | 103.6 |
| 7 | 104 | 104.4 |
| 8 | 104.5 | 105 |
| 9 | 104.8 | 105 |
| 10 | 105 | 105 |

Because the REpower values are slightly higher, the modeling studies will rely exclusively on these sound levels as inputs.

It is important to note in this context that a sound *power* level is not the same thing as a sound *pressure* level, which is the familiar quantity measured by instruments and perceived by the ear. A power level is a specialized, calculated measure, expressed in terms of Watts, that is primarily used for acoustical modeling and in design analyses. It is a function of both the sound pressure level produced by a source at a particular distance and the effective radiating area or physical size of the source. The basic mathematical relationship between power and pressure is as follows:

$$Lw = Lp + 10 \log (A), \text{ dB re 1 pW}$$

Where,

Lw = Sound Power Level
Lp = Sound Pressure Level
A = The effective radiating surface area at the point of the pressure level measurement, $m^2$

In general, the ostensible magnitude of a sound power level is always considerably higher than the sound pressure level near a source because of the area term. For example, the sound pressure level at 100 m from a wind turbine might be about 53 dBA and the area term at this distance ($10 \log (4\pi 100^2)$) would be 51 dBA with a resulting total power level of 104 dBA re 1 pW (the units of power levels are always denoted as decibels with reference to 1 picoWatt, or $10^{-12}$ W).

The fundamental advantage of a power level is that the sound pressure level of the source can be calculated at any distance; hence its importance to noise modeling.

## 3.3 CRITICAL DESIGN LEVELS

From the field survey it was determined that the background sound level varies with wind speed and time of day. From Table 3.2.1 in the preceding section it can be seen that the turbine sound levels also vary with wind speed. The two values must be compared under the same wind conditions for the comparison to be meaningful. For example, it would be incorrect to compare the maximum turbine sound level, which requires high winds for it to occur, to the background sound level on a calm night.

In terms of potential noise impacts the worst-case combination of background and turbine sound levels would occur at the wind speed where the background level is lowest relative to the turbine sound level – or, in other words, where the differential between the background level and turbine sound power level is greatest.

The following chart compares the sound power levels of the design turbine (the REpower MM92) to the daytime L90 and Leq background levels measured during the survey. In both cases, the maximum differential occurs during 6 m/s wind conditions. At lower and higher wind speeds the differentials are lower indicating that turbine noise is less perceptible relative to the background level.

**Table 3.3.1** *Comparison of **Daytime** Background and REpower MM92 Turbine Sound Levels to Determine Critical Design Level (at Maximum Differential)*

| Wind Speed at 10 m, m/s | 4 | 5 | **6** | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|
| Turbine Sound Power Level, dBA re 1 pW | - | 101.6 | **103.6** | 104.4 | 105 | 105 | 105 |
| **Typical** Background Sound Level, **Leq**, dBA | 42 | 43 | **44** | 45 | 46 | 47 | 48 |
| Differential, dB **Maximum in Bold** | - | 58.6 | **59.6** | 59.3 | 58.9 | 57.8 | 56.8 |
| **Worst-Case** Background Sound Level, **L90**, dBA | 32 | 34 | **35** | 37 | 39 | 40 | 42 |
| Differential, dB **Maximum in Bold** | - | 67.9 | **68.2** | 67.3 | 66.2 | 64.5 | 62.8 |

At night the critical wind speed shifts down to 5 m/s as illustrated in Table 3.3.2. Even though the turbine sound level is slightly lower at 5 m/s the potential for impact is slightly greater than it would be at 6 m/s.

**Table 3.3.2** *Comparison of **Nighttime** Background and REpower MM92 Turbine Sound Levels to Determine Critical Design Level (at Maximum Differential)*

| Wind Speed at 10 m, m/s | 4 | **5** | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|
| Turbine Sound Power Level, dBA re 1 pW | - | **101.6** | 103.6 | 104.4 | 105 | 105 | 105 |
| **Typical** Background Sound Level, **Leq**, dBA | 35 | **38** | 40 | 42 | 44 | 46 | 48 |
| Differential, dB **Maximum in Bold** | - | **64.1** | 64.0 | 62.8 | 61.3 | 59.2 | 57.1 |
| **Worst-Case** Background Sound Level, **L90**, dBA | 26 | **29** | 32 | 35 | 38 | 41 | 43 |
| Differential, dB **Maximum in Bold** | - | **72.4** | 71.6 | 69.6 | 67.3 | 64.5 | 61.6 |

The following table summarizes the design parameters, representing critical conditions, to be used in the modeling assessment.

**Table 3.3.3** *Summary of Critical Design Parameters*

| **Conditions** | **Critical Wind Speed at 10 m, m/s** | **Design Turbine Sound Power Level, dBA re 1 pW** | **Measured Background Sound Level, dBA** | **Nominal Impact Threshold (Background + 5 dBA), dBA** |
|---|---|---|---|---|
| Typical Daytime | 6 | 103.6 | 44 | 49 |
| Worst-Case Daytime | 6 | 103.6 | 35 | 40 |
| Typical Nighttime | 5 | 101.6 | 38 | 43 |
| Worst-Case Nighttime | 5 | 101.6 | 29 | 34 |

The frequency content of the REpower MM92 turbine sound power level that goes along with the A-weighted values of 103.6 and 101.6 dBA is not given in the manufacturer's sound emissions information [Ref. 9]; consequently, octave band spectra values have been estimated based on the 8 m/s spectrum of the Nordex turbine. Each band has been adjusted by a uniform constant to make the spectrum add up to the known A-weighted overall value.

**Table 3.3.4** *Design Sound Power Level Frequency Spectra*

| Octave Band Center Frequency, Hz | 31.5 | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | dBA |
|---|---|---|---|---|---|---|---|---|---|---|
| Est. REpower MM92 Sound Power at **6 m/s**, dB re 1 pW | **118** | **114** | **110** | **107** | **100** | **95** | **95** | **90** | **79** | **103.6** |
| Est. REpower MM92 Sound Power at **5 m/s**, dB re 1 pW | **116** | **112** | **108** | **105** | **98** | **93** | **93** | **88** | **77** | **101.6** |

As mentioned above, the frequency spectrum of the MM92 turbine is not given in the manufacturer's sound information, so it is not known whether sound emissions of this model are tonal or not. What can be said is that it would be highly unusual for the sound to have any tones since just about all turbines of this general size class have a smooth, broadband frequency spectrum.

## 3.4 NOISE MODELING METHODOLOGY

Using the design sound power level spectra in Table 3.3.4 above, Project sound levels were calculated using the Cadna/A®, ver. 3.7 noise modeling program developed by DataKustik, GmbH (Munich). This software enables the Project and its surroundings, including terrain features, to be realistically modeled in three-dimensions. The modeling software is essentially an automated version of ISO 9613-2 *Acoustics – Attenuation of sound during propagation outdoors* [Ref. 3], which is the primary worldwide standard for such calculations.

The rolling topography of this site has been incorporated into the model using topographical maps of the area.

Each turbine is represented as a point noise source at a height of 80 m above the local ground surface (typical design hub height).

A somewhat conservative ground absorption coefficient of 0.5 has been assumed in the model since all of the intervening ground between the turbines and potentially sensitive receptors is essentially open farmland, which is acoustically soft. The ground absorption coefficient (from ISO 9613) ranges from 0 for water or hard concrete surfaces to 1 for absorptive surfaces such as farm fields, woods or sand. Consequently, a ground absorption coefficient on the order of 0.8 or 0.9 could be justified here; however, to be conservative a value of 0.5 has been used.

The downwind sound level – the value measured in the IEC sound power level test - is assumed to exist in all directions simultaneously. This approach essentially represents a hypothetical situation where the wind is blowing from all directions at the same time making the predictions valid for any given wind direction.

In general, then, the model represents a theoretical worst-case condition at any given receptor point based on the following assumptions:

- **Critical Wind Speeds –** 6 and 5 m/s wind conditions are modeled representing the points where the least amount of masking noise is likely to be present relative to the turbine sound level
- **Wintertime Background Levels** – the background survey was conducted under wintertime conditions when ambient levels are normally at an annual minimum (without leaves rustling or summer insects). Summertime levels are normally found to be 5 to 7 dBA, which is substantial.
- **Conservative L90 Background Level –** assessments based on the L90 background represent the potential impact only during momentarily lulls in environmental background. Most of the time (90% of the time) a higher background sound level will actually exist.
- **Low Ground Porosity** – normally open fields are considered more acoustically absorptive than assumed in the model
- **Observer Outside –** the plotted sound levels occur outside; sound levels inside of any dwelling will be 10 to 20 dBA lower
- **Downwind Sound Level –** the downwind sound level is assumed to exist in all directions from every unit

## 3.5 PRELIMINARY NOISE MITIGATION STUDIES

The turbine locations and general site plan for this Project have been in development for quite some time and the current layout has been shaped to a very large degree by concerns about potential noise impacts. At least 7 or 8 previous site plans have been modeled over the last year with a view towards proactively identifying and alleviating any significant noise impacts. Applying the general criteria outlined in Section 3.1, many turbines have been moved further from residences or to entirely different properties and an even larger number have been completely removed from the Project to reduce the potential for adverse noise impacts. The current site plan is the result of this extensive noise mitigation effort.

## 3.6 MODEL RESULTS – CURRENT SITE PLAN

### 3.6.1 *Daytime Conditions*

Sound contour plots for "typical" and "worst-case" daytime conditions are shown in Plots 1A – 1D.

**Plots 1A and 1B**, showing the northern and southern halves of the project, respectively, illustrate the sound emissions of the Project during a critical 6 m/s wind (when the Project is nominally most likely to be audible above the background level) with the impact threshold of 49 dBA based on the measured Leq background level of 44 dBA. These plots show that a sound level of 49 dBA occurs fairly close to each turbine and well short of any homes. Consequently, there is a very low probability of an adverse impact during these conditions; i.e. turbine sound levels will not be 5 dBA or more above the background and may, in fact, be comparable to or below the typical (Leq) environmental sound level of 44 dBA.

If the background level is based on the L90, on the other hand, the potential impact threshold moves considerably outward, as shown in **Plots 1C and 1D**. In this instance, a few residences, most of which are project participants, fall inside the nominal 40 dBA – but the vast majority of residences in the area are outside of this zone.

### 3.6.2 *Nighttime Conditions*

During the night, when somewhat lower background sound levels evidently exist, there is a greater potential that the turbines will be clearly audible at some residences, but only during lulls in the background level.

**Plots 2A and 2B** show the Project sound emissions during a critical 5 m/s wind plotted out to the nominal (background plus 5 dBA) design threshold of 43 dBA based on the typical measured Leq background level. As with the daytime "typical" case, all homes in the Project area lie outside of the threshold.

When the background level momentarily decreases, however, it appears likely that the Project will become distinctly audible, at least intermittently, over a fairly wide area (**Plots 2C and 2D**). Because a nighttime L90 of only 29 dBA was measured during critical 5 m/s wind conditions the nominal impact threshold is about 34 dBA. Because there are a number of homes with predicted sound level of more than 34 dBA some adverse reaction to Project noise appears to be possible during these particular conditions.

Although this model indicates that there is a potential for a moderate noise impact, it is important to realize that this particular case combines a number of assumptions that taken together intentionally represent the worst possible impact during normal atmospheric conditions, such as:

- A 5 m/s wind speed is represented. Turbine audibility would be lower at all other wind speeds higher and lower.
- The background masking sound is based on the L90 level, which captures momentary lulls in the background level
- The background level was measured during wintertime conditions, when environmental sound levels are normally the lowest
- Few people are actually outside in the winter or engaging in activities where environmental quiet is important
- The wind would need to be blowing from all the nearest turbines directly towards the point of observation
- Observer outside (inside levels should be 10 to 20 dBA lower)
- Maximum critical turbine sound level

These conservative assumptions and worst-case conditions have been consciously adopted for the analysis because the perceptibility of turbine noise varies with atmospheric conditions, such as during temperature inversions and periods of unusual wind stratification. Consequently, there are likely to be times, when these conditions exist, when the actual sound will exceed the conservatively predicted levels in the plots. Of course, there will also be times, probably the majority of the time, when the perceptibility of Project noise will be less than indicated in the graphics.

As a general additional comment, it is important to note that in the particular case of wind turbine noise a 5 dBA increase does not represent the point of inaudibility. Operational sound emissions from wind turbines are often unsteady and variable with time largely because the wind does not always blow in a completely smooth and ideal manner. When unsettled air or gusty winds interact with the rotor, or the airflow is not perfectly perpendicular to the rotor plane, an increase in turbulence and noise results. On top of this, turbines often (although not always) produce a periodic swishing sound. These characteristics make operational noise more perceptible than it would be if it were bland and continuous in nature. Consequently, wind turbines can commonly be discerned at fairly large distances even though the actual sound level may be relatively low and/or comparable to the magnitude of the background level; therefore the possibility of impacts at residences beyond the impact thresholds shown in the plots certainly cannot be ruled out. There may also be times, due to wind and atmospheric conditions, when project sound levels temporarily increase to levels that are significantly higher than the predicted mean levels. During these - usually brief - periods of elevated noise complaints also may occur.

### 3.6.3 *Property Line Sound Levels*

**Plots 3A and 3B** were prepared specifically to show the relationship between the 50 dBA sound contour and the boundaries of participating land parcels. A 50 dBA design target is assumed, since it represents a reasonable and common limit for property line sound levels associated with wind projects. As these plots show, sound levels of 50 dBA or more are almost entirely confined to participating properties. There are only a few places where units are sited close to boundaries where sound levels may exceed 50 dBA (by no more than a few decibels) for a short distance into a neighboring property. In a few places turbines are shown on ostensibly non-participating land parcels but our understanding is that final leasing arrangements are imminent/likely but have not yet been concluded.

## 3.7 LOW FREQUENCY NOISE

Modern wind turbines of the type proposed for this project do not generate low frequency or infrasonic noise to any significant extent and no impact of any kind is expected from this. Early wind turbines with the blades downwind of the support tower were prone to producing a periodic thumping noise each time a blade passed the tower wake - but this effect no longer exists with the upwind blade arrangement used today.

Concerns about excessive low frequency noise from proposed wind farms are commonly voiced but they have apparently grown out of misinformation or anecdote (probably stemming from early downwind turbine designs) without any basis in current fact. The widespread belief that wind turbines generate excessive or even harmful amounts of low frequency or infrasonic noise is evidently based on a confusion of the amplitude modulation typical of wind turbines (i.e. the periodic swishing sound with a frequency of about 1 Hz) with low frequency sound. Another, and probably more likely, explanation is that any measurement taken during windy conditions will erroneously exhibit elevated levels of low frequency noise caused by wind flowing over the microphone tip - whether a wind turbine is present or not. This self-induced, false-signal distortion is commonly mistaken for actual noise from wind turbines (see Ref. 8 for more information on self-induced wind noise).

A study by Sondergaard [Ref. 4] was carried out with the specific objective of determining whether large wind turbines produce significant low frequency noise. Extremely careful measurements were made based on the IEC 61400-11 measurement procedure using multiple elaborate microphone windscreens to preclude low frequency self-noise contamination. The results of this testing show that for a typical turbine its sound levels taper down steadily in magnitude towards the low end of the frequency spectrum and that the sound energy below about 40 Hz is actually comparable to the sound energy in the natural rural environment where the measurements were made (as shown in Figure 3.7.1).

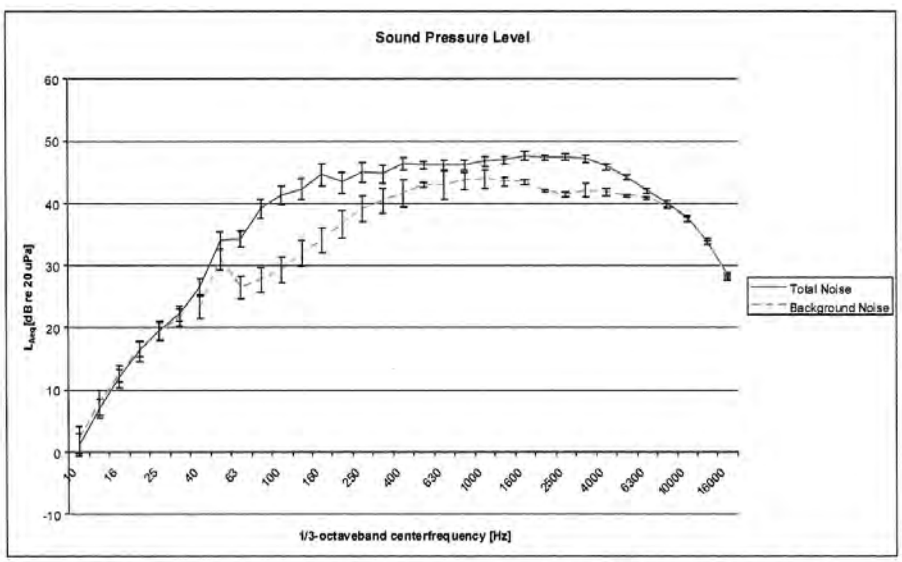


**Figure 21 Spectra of total noise and background noise for a 1.5 MW wind turbine. A 50 Hz frequency from a nearby power line influences the measurements.**

**Figure 3.7.1** *Measured Turbine Sound Level down to 10 Hz Relative to Background Sound Level (Sondergaard)*

The plot below of on-off measurements made by Hessler Associates at an operating project similar to Buckeye shows an almost identical result.

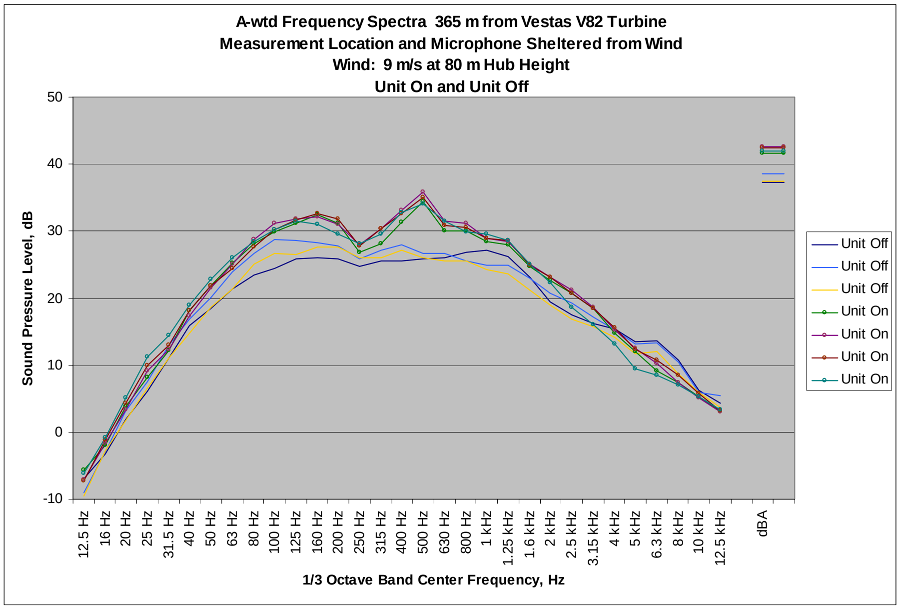


**Figure 3.7.2** *Measured Turbine Sound Level Spectrum down to 12.5 Hz Relative to Background Sound Level (Hessler)*

## 3.8 CONSTRUCTION NOISE

Noise from construction activities associated with the Project is likely to temporarily constitute a moderate, unavoidable impact at some of the homes in the Project area. Assessing and quantifying these impacts is somewhat difficult because construction activities will constantly be moving from place to place around the site leading to highly variable impacts with time at any given point.

In general, the maximum potential noise impact at any single residence might be analogous to a few days to a few weeks of repair or repaving work occurring on a nearby road or to the sound of machinery operating on a nearby farm. More commonly (at houses that are some distance away), the sounds from Project construction are likely to be faintly perceived as the far off sound of diesel-powered earthmoving equipment characterized by such things as irregular engine revs, back up alarms, gravel dumping and the clanking of metal tracks.

Construction of the Project is anticipated to consist of several principal activities:

- Access road construction and electrical tie-in line trenching
- Site preparation and foundation installation at each turbine site
- Material and subassembly delivery
- Erection

The individual pieces of equipment likely to be used for each of these phases and their typical sound levels, as reported in the *Power Plant Construction Noise Guide* (Empire State Electric Energy Research Corp. [Ref. 6]), are shown below in Table 3.8.1. It should be noted that the reference used for equipment sound levels is quite old, dating back to 1977, and that the levels in it are roughly 5 dBA higher than the values that can be found in more recent references, such as from the FHWA [Ref. 11] for modern construction equipment. These older, higher values have been deliberately used purely to be conservative. Also shown are the maximum total sound levels that might temporarily occur at a typical minimum setback distance of 1000 ft. and the distance at which construction sound levels are likely to become inconsequential (at a level of about 35 dBA). A value of 35 dBA is used here because construction noise, unlike operational noise from the project, has no dependency on wind speed and is likely to occur during times of calm when background sound levels are minimal. A sound level of 35 dBA during the day – when construction occurs – can generally be considered a negligible sound level even in the almost total absence of any natural environmental background sound.

**Table 3.8.1** *Construction Equipment Sound Levels by Phase*

| Equipment Description | Typ. Sound Level at 50 ft., dBA [Ref. 6] | Est. Maximum Total Level at 50 ft. per Phase, dBA* | Max. Sound Level at 1000 ft., dBA | Distance at which Construction Noise is likely to fall to 35 dBA, ft. |
|---|---|---|---|---|
| **Road Construction and Electrical Line Trenching** | | | | |
| Dozer, 250-700 hp | 88 | 92 | 63 | 7600 |
| Front End Loader, 300-750 hp | 88 | | | |
| Grader, 13-16 ft. blade | 85 | | | |
| Excavator | 86 | | | |
| **Foundation Work, Concrete Pouring** | | | | |
| Piling Auger | 88 | 88 | 59 | 5900 |
| Concrete Pump, 150 cu yd/hr | 84 | | | |
| **Material and Subassembly Delivery** | | | | |
| Off Hwy Hauler, 115 ton | 90 | 90 | 61 | 6700 |
| Flatbed Truck | 87 | | | |
| **Erection** | | | | |
| Mobile Crane, 75 ton | 85 | 85 | 56 | 4800 |

* Not all vehicles are likely to be in simultaneous operation. Maximum level represents the highest level realistically likely at any given time.

What the values in this table generally indicate is that, depending on the particular activity, sounds from construction equipment are likely to be at least intermittently audible at distances of up to 7600 feet. At the very worst, however, sound levels ranging from 56 to 63 dBA might temporarily occur over several weeks at the nearest homes to turbine construction sites. Such levels would not generally be considered acceptable on a permanent basis or outside of normal daytime working hours (when all project construction is planned), but as a temporary, daytime occurrence construction noise of this magnitude may go unnoticed by many in the area. For others, project construction noise may be an unavoidable but temporary impact.

There may be some cases where road construction or trenching operations occur closer to homes. Higher sound levels are certainly possible if this work occurs very close to any homes. For example, a short-term sound level of about 80 dBA is theoretically possible where the distance to nearby work is about 200 feet. Every effort should be made in these cases to inform any affected residents in advance that this kind of work will be occurring, when it is anticipated and how long it is expected to last.

Noise from the very small amount of daily vehicular traffic to and from the current site of construction should be negligible in magnitude relative to normal traffic levels and temporary in duration at any given location.

## 4.0 CONCLUSIONS

A two-week field survey of existing background sound levels at nine positions distributed throughout the proposed Buckeye Wind Project was carried out to determine how much natural masking sound there might be in the area and how it might affect the perceptibility of noise from the Project.

In general, sound levels throughout the site area show a definite dependency on wind speed underlying a daily pattern of quiet sound levels at night and higher sound levels during the day. Typical sound levels, quantified by the average, or Leq, level, ranged from 43 to 44 dBA during the day at key wind speeds of 5 to 6 m/s and from 38 to 40 dBA at night under the same wind conditions. The Leq sound level is the level most likely, statistically, to be observed at any given moment. The residual, or L90, sound levels were found to range from 34 to 35 dBA during the day and from 29 to 32 dBA at night during 5 to 6 m/s wind conditions. The L90 statistical sound level captures the momentary, quiet lulls between sporadic noise events. A higher sound level exists 90% of the time.

At higher wind speeds, beyond 6 m/s, the background level continues to rise while the turbine sound level essentially tops out and levels off making Project noise progressively less audible under high wind conditions. At lower wind speeds turbine noise diminishes rapidly going to zero below the cut-in wind speed of around 3 m/s at the hub height.

The projected noise emissions from the Project were conservatively modeled and mapped over the site area in accordance with appropriate ISO standards. The site topography was accurately recreated in three-dimensions in the model. An analysis of the wind-dependent sound power levels associated with the two turbine models currently being considered for the Project was carried out to identify the critical wind speed conditions, both during the day and at night, when turbine noise is potentially loudest relative to the amount of background masking sound. From this analysis it was determined that wind speeds of 6 m/s and 5 m/s during the day and night, respectively, were the critical conditions.

The turbine locations and general site plan for this Project have been in development for quite some time and the current layout has been shaped to a very large degree by concerns about potential noise impacts. At least 7 or 8 previous site plans have been modeled over the last year with a view towards proactively identifying and alleviating any significant noise impacts. Many turbines have been moved further from residences or to entirely different properties and an even larger number have been completely removed from the Project to reduce the potential for adverse noise impacts. The current site plan is the result of this extensive noise mitigation effort.

In the absence of any regulatory noise limits for the Project, a design goal threshold of 5 dBA above the background level was used to represent the potential impact threshold. Noise models of Project sound levels were developed for daytime and nighttime conditions based on both the “typical” (Leq) and “worst-case” (L90) background levels. These analyses indicate all residences within the Project area lie outside of the nominal impact threshold, regardless of time of day, based on the average measured background level at critical wind speeds. It is only during “worst-case" nighttime conditions when the background sound level momentarily reaches a minimum that Project noise is likely to be distinctly audible at a significant number of residences.

It is important to note that the modeling has been carried out in a consciously conservative manner and lower sound levels than shown in the plots and discussed above may actually occur much of the time. This approach was taken in recognition of two facts uniquely relevant to wind turbine noise:

1) Predictions made using ISO 9613, the worldwide standard for noise propagation calculations, characterize sound levels under average or normal conditions. There will be times when atmospheric conditions, temperature gradients and wind shear gradients cause sound levels at any given location to vary above and below the nominal prediction value largely because wind turbine sound originates at a high elevation above the ground making it more susceptible to atmospheric influences. This means that somewhat higher sound levels from the Project may well occur from time to time.

2) The audibility of wind turbine noise relative to normal wind-driven environmental sound is enhanced by the fact that the sound may not be steady but rather might has a periodic quality to it, often described as a swishing sound. This amplitude modulation, or repeated raising and lowering of the sound level makes turbine noise perceptible at significantly lower levels than an invariant sound of the same magnitude. In addition, the general sound (whether a swish is present or not) is likely to vary with time making it more noticeable than it might otherwise be.

Consequently, every possible conservative assumption has been employed in the assessment to allow some design margin for these circumstances and avoid underestimating the potential impact of the Project.

Although concerns are often raised with respect to low frequency or infrasonic noise emissions from wind turbines, no adverse impact of any kind related to low frequency noise is expected from this Project. The widespread belief that wind turbines generate excessive or even harmful amounts of low frequency noise is evidently based on misinformation, measurement error (wind-induced low frequency self-noise) or a confusion of the amplitude modulation typical of wind turbines (i.e. the periodic swishing sound with a frequency of about 1 Hz) with low frequency sound. Numerous studies show that the low frequency content in the sound spectrum of a typical wind turbine is no higher than that of many other common sounds.

Unavoidable but mild noise impacts may occur during the construction phase of the project. Construction noise, sounding similar to that of distant farming equipment is anticipated to be sporadically audible at many homes within the immediate project vicinity on a temporary basis. The maximum magnitude of construction sound levels at the nearest homes to individual turbine locations is not expected to exceed 56 to 63 dBA depending on the particular activity. Higher levels are possible where homes are relatively close to trenching and/or road building activities.

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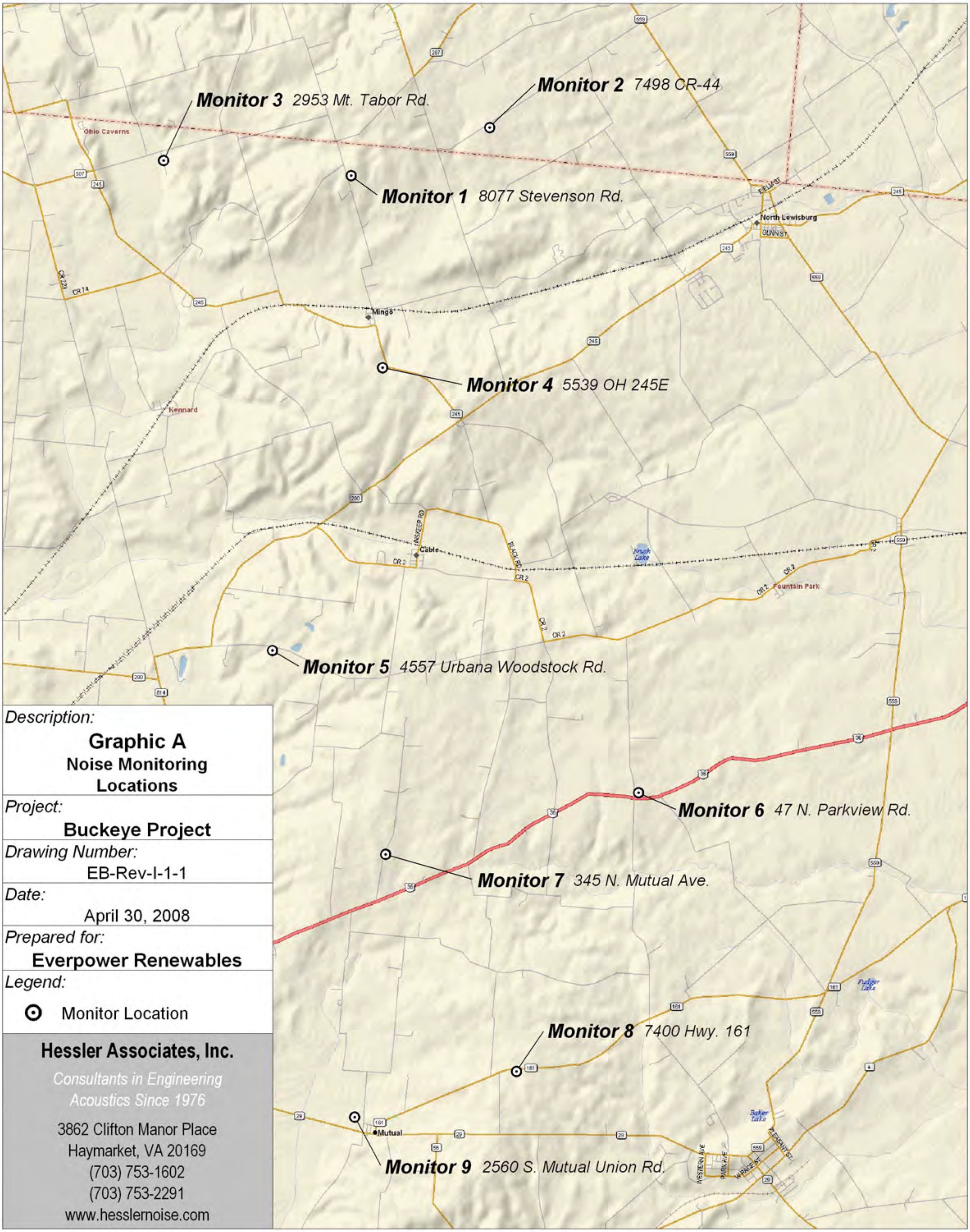
11. U. S. Dept. of Transportation, Federal Highway Administration, *Roadway Construction Noise Model User's Guide*, Table 1, Jan. 2006.




*Description:*

**Graphic A**
**Noise Monitoring Locations**

*Project:*
**Buckeye Project**

*Drawing Number:*
EB-Rev-I-1-1

*Date:*
April 30, 2008

*Prepared for:*
**Everpower Renewables**

*Legend:*
⊙ Monitor Location

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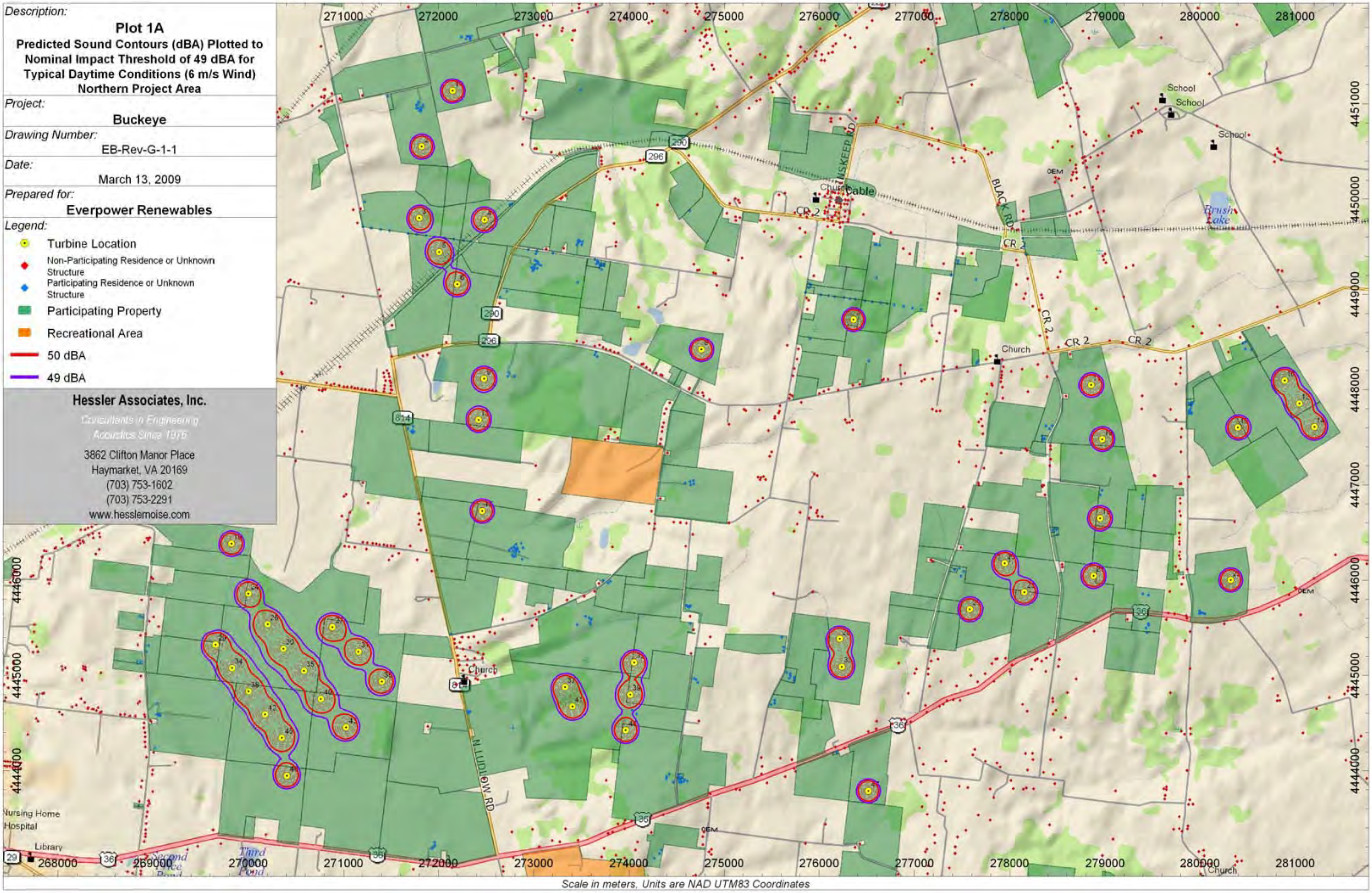
Description:
Plot 1A
Predicted Sound Contours (dBA) Plotted to Nominal Impact Threshold of 49 dBA for Typical Daytime Conditions (6 m/s Wind)
Northern Project Area
Project:
Buckeye
Drawing Number:
EB-Rev-G-1-1
Date:
March 13, 2009
Prepared for:
Everpower Renewables
Legend:
Turbine Location
Non-Participating Residence or Unknown Structure
Participating Residence or Unknown Structure
Participating Property
Recreational Area
50 dBA
49 dBA
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4451000
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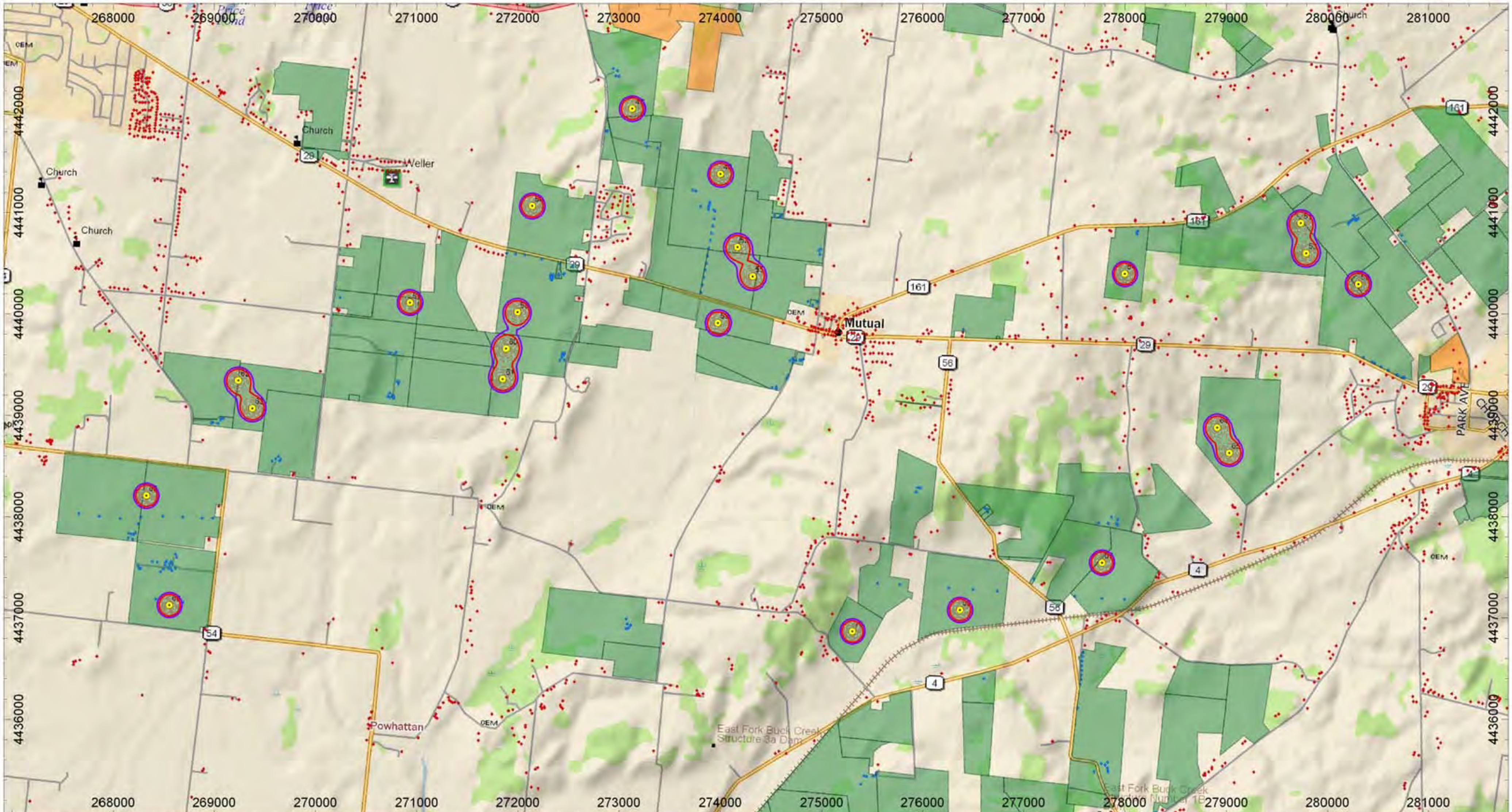
4449000
4448000
4447000
4446000
4445000
4444000
School
School
School
Church
Cable
CR 2
BLACK RD
Church
Brush Lake
Church
N LUDLOW RD
Nursing Home
Hospital
Library
Second
Third
Pond
Church
290
296
814
36
29
CEM
Scale in meters, Units are NAD UTM83 Coordinates




| | |
|---|---|
| *Project:* | *Description:* |
| **Buckeye** | **Plot 1B** |
| *Prepared for:* | **Predicted Sound Contours (dBA) Plotted to Nominal Impact Threshold of 49 dBA for Typical Daytime Conditions (6 m/s Wind) - Southern Project Area** |
| **Everpower Renewables** | |
| *Date:* March 13, 2009 | *Drawing #:* EBII-Rev-G-1-2 |

*Legend:*

- Non-Participating Residence or Unknown Structure
- Participating Property
- Turbine Location
- Participating Residence or Unkown Structure
- Recreational Area
- 50 dBA
- 49 dBA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N W E S

*Description:*

**Plot 1C**

**Predicted Sound Contours (dBA) Plotted to Nominal Impact Threshold of 40 dBA for Worst Case Daytime Conditions (6 m/s Wind) Northern Project Area**

*Project:*

**Buckeye**

*Drawing Number:*

EB-Rev-G-1-3

*Date:*

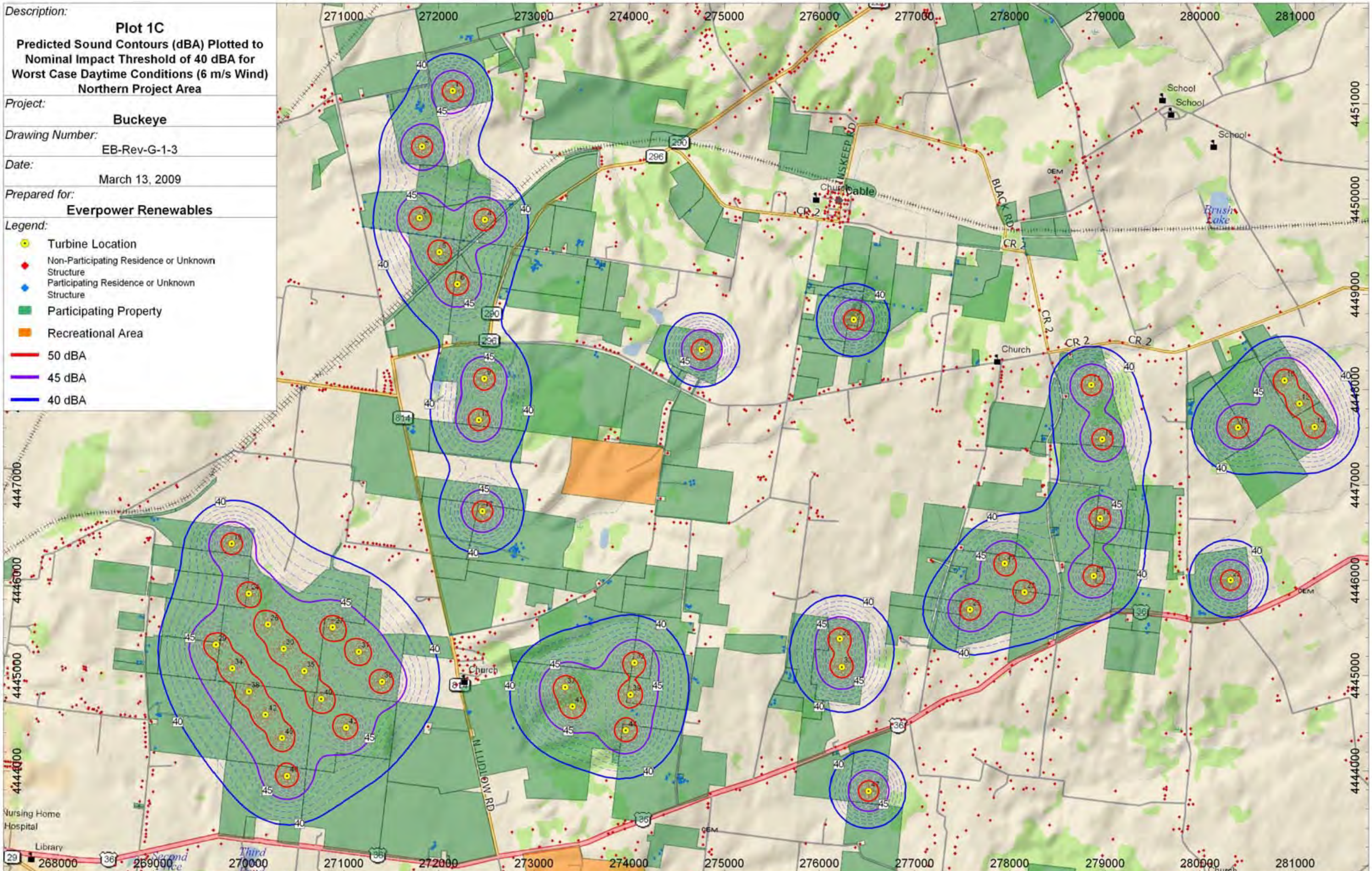
March 13, 2009

*Prepared for:*

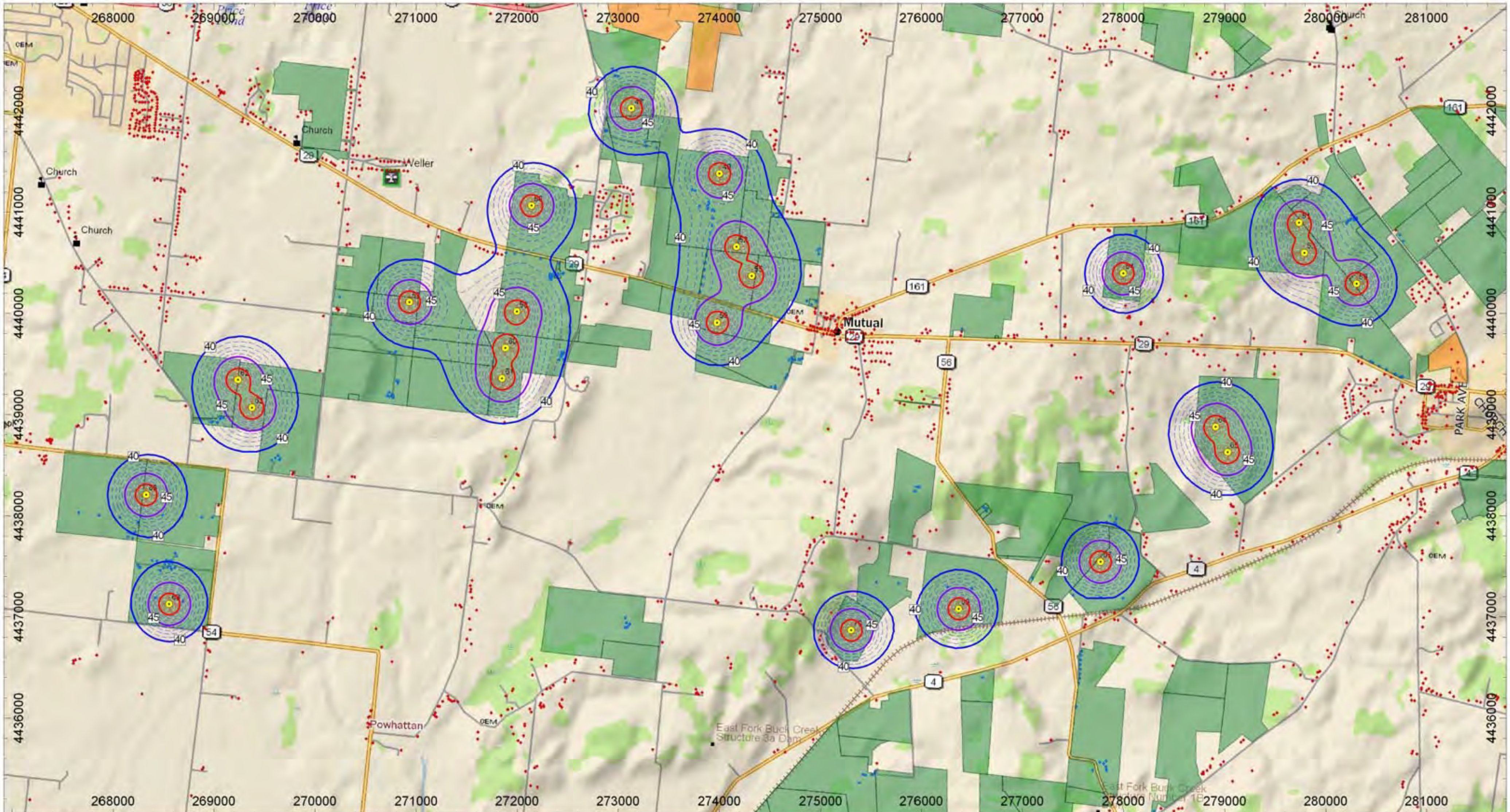
**Everpower Renewables**

*Legend:*

- Turbine Location
- Non-Participating Residence or Unknown Structure
- Participating Residence or Unknown Structure
- Participating Property
- Recreational Area
- 50 dBA
- 45 dBA
- 40 dBA




*Scale in meters, Units are NAD UTM83 Coordinates*




Project: **Buckeye**

Prepared for: **Everpower Renewables**

Date: March 13, 2009

Drawing #: EBII-Rev-G-1-2

Description:

**Plot 1D**

**Predicted Sound Contours (dBA) Plotted to Nominal Impact Threshold of 40 dBA for Worst Case Daytime Conditions (6 m/s Wind) Southern Project Area**

Legend:

- Non-Participating Residence or Unkown Structure
- Participating Residence or Unkown Structure
- 50 dBA
- Participating Property
- Recreational Area
- 45 dBA
- Turbine Location
- 40 dBA

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N W E S

*Description:*

**Plot 2A**

**Predicted Sound Contours (dBA) Plotted to Nominal Impact Threshold of 43 dBA for Typical Nighttime Conditions (5 m/s Wind) Northern Project Area**

*Project:*

**Buckeye**

*Drawing Number:*

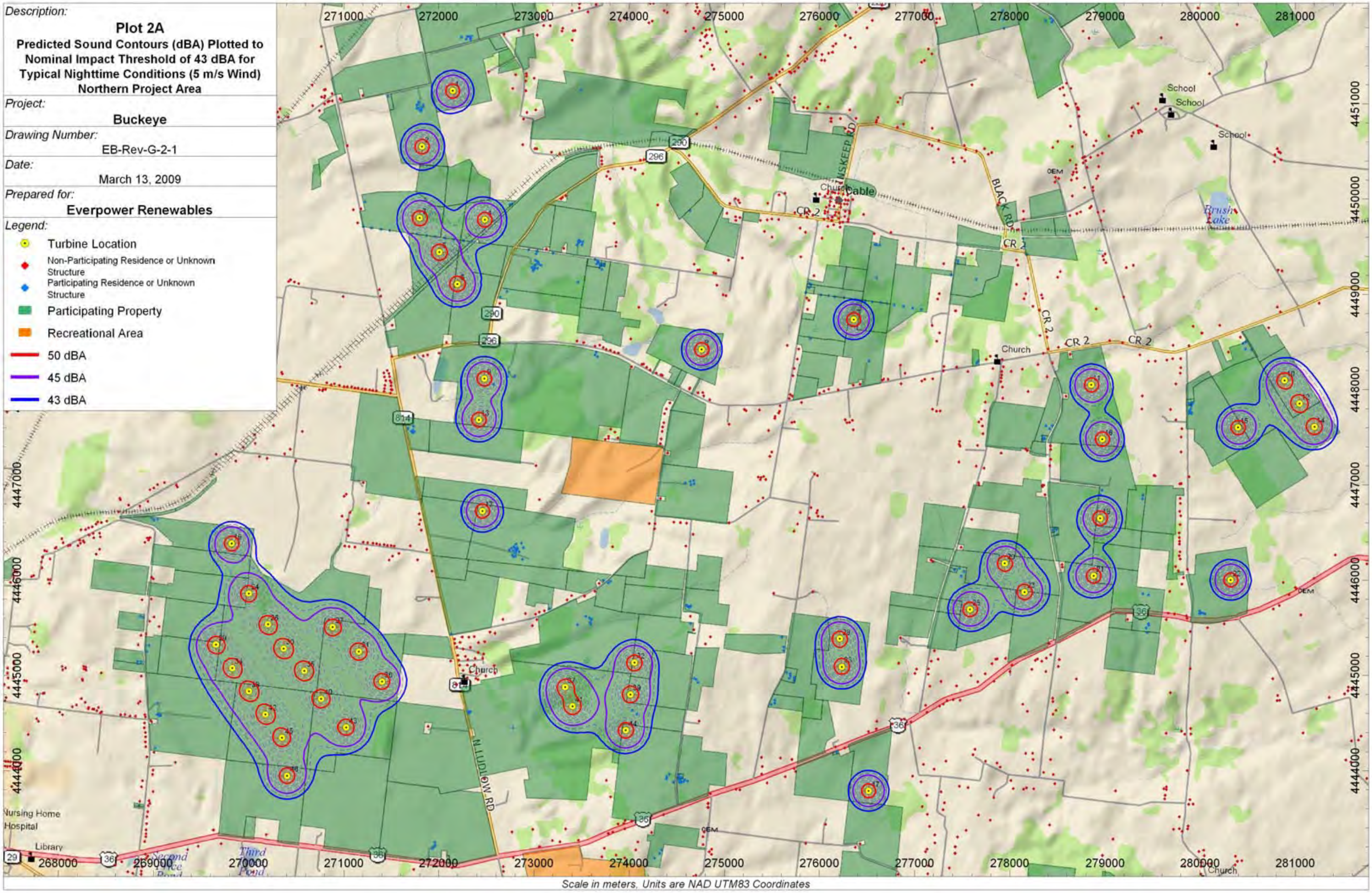
EB-Rev-G-2-1

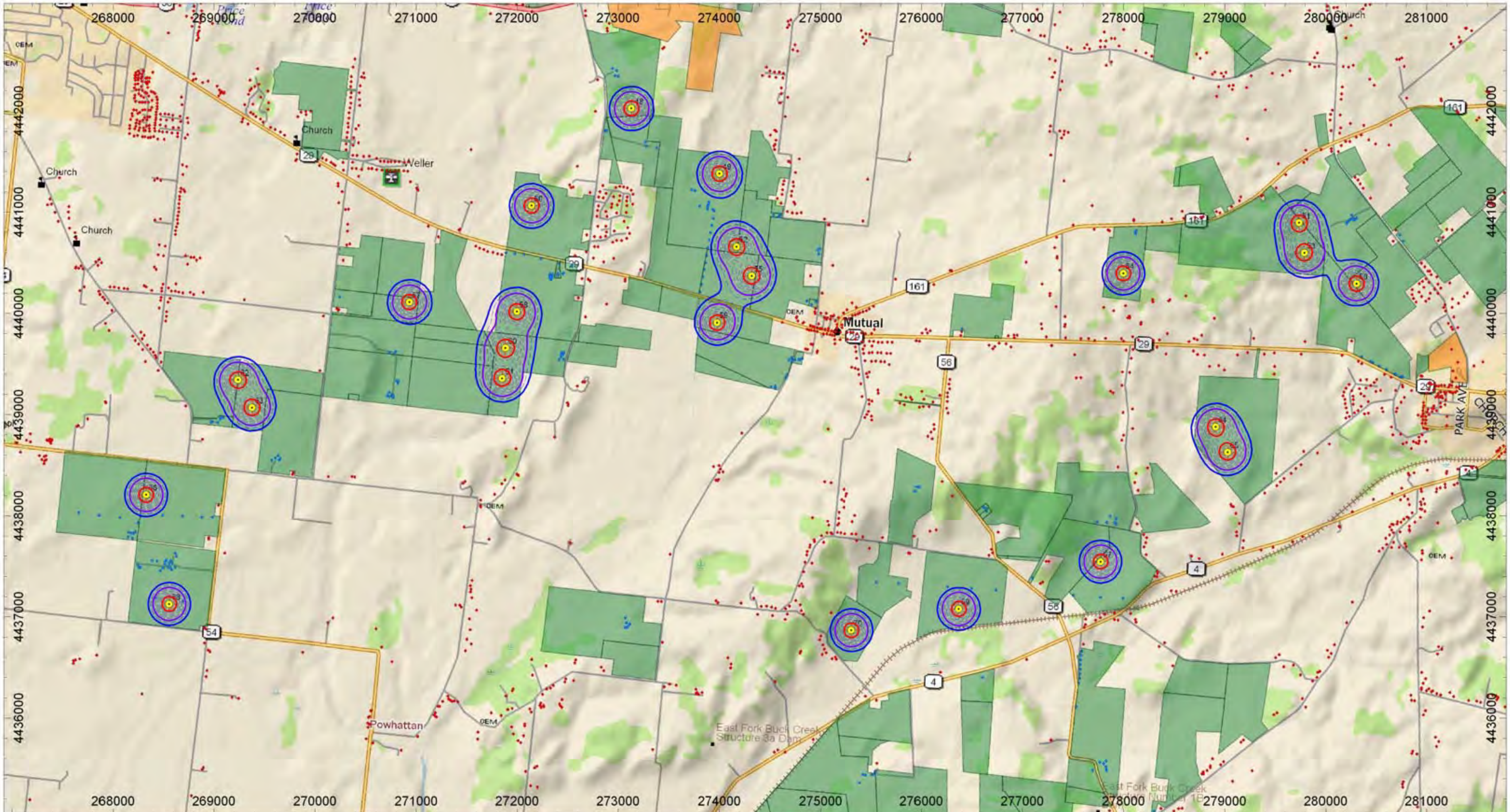
*Date:*

March 13, 2009

*Prepared for:*

**Everpower Renewables**






| Project: | Description: | Legend: |
|---|---|---|
| **Buckeye** | **Plot 2B** | Non-Participating Residence or Unkown Structure |
| Prepared for: **Everpower Renewables** | **Predicted Sound Contours (dBA) Plotted to Nominal Impact Threshold of 43 dBA for Typical Nighttime Conditions (5 m/s Wind) Southern Project Area** | Participating Residence or Unkown Structure |
| Date: March 13, 2009 | | Participating Property |
| Drawing #: EBII-Rev-G-2-1 | | Recreational Area |
| | | Turbine Location |
| | | 50 dBA |
| | | 45 dBA |
| | | 43 dBA |

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N W E S

*Description:*

**Plot 2C**

**Predicted Sound Contours (dBA) Plotted to Nominal Impact Threshold of 34 dBA for Worst Case Nighttime Conditions (5 m/s Wind) Northern Project Area**

*Project:*

**Buckeye**

*Drawing Number:*

EB-Rev-G-2-2

*Date:*

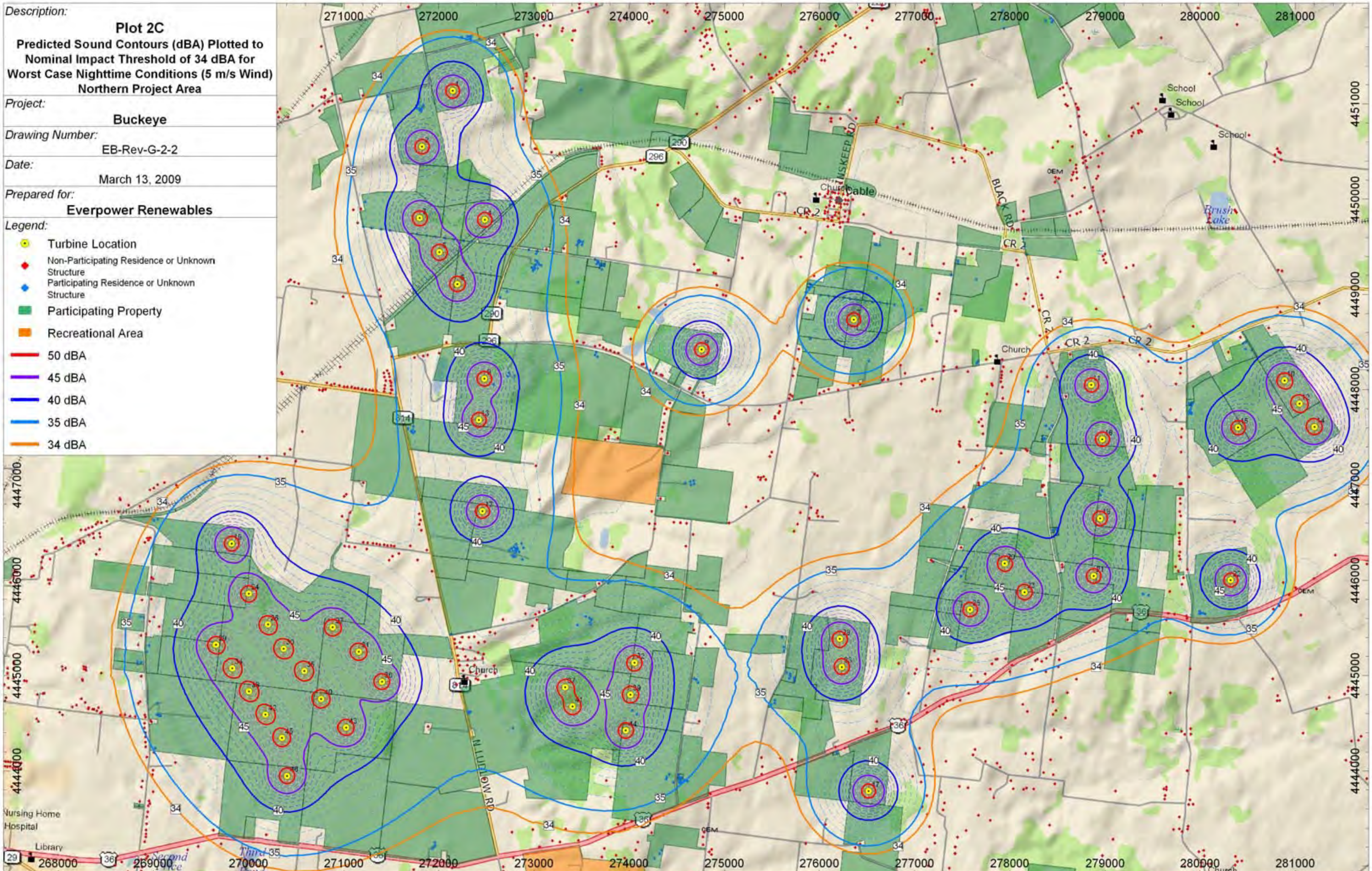
March 13, 2009

*Prepared for:*

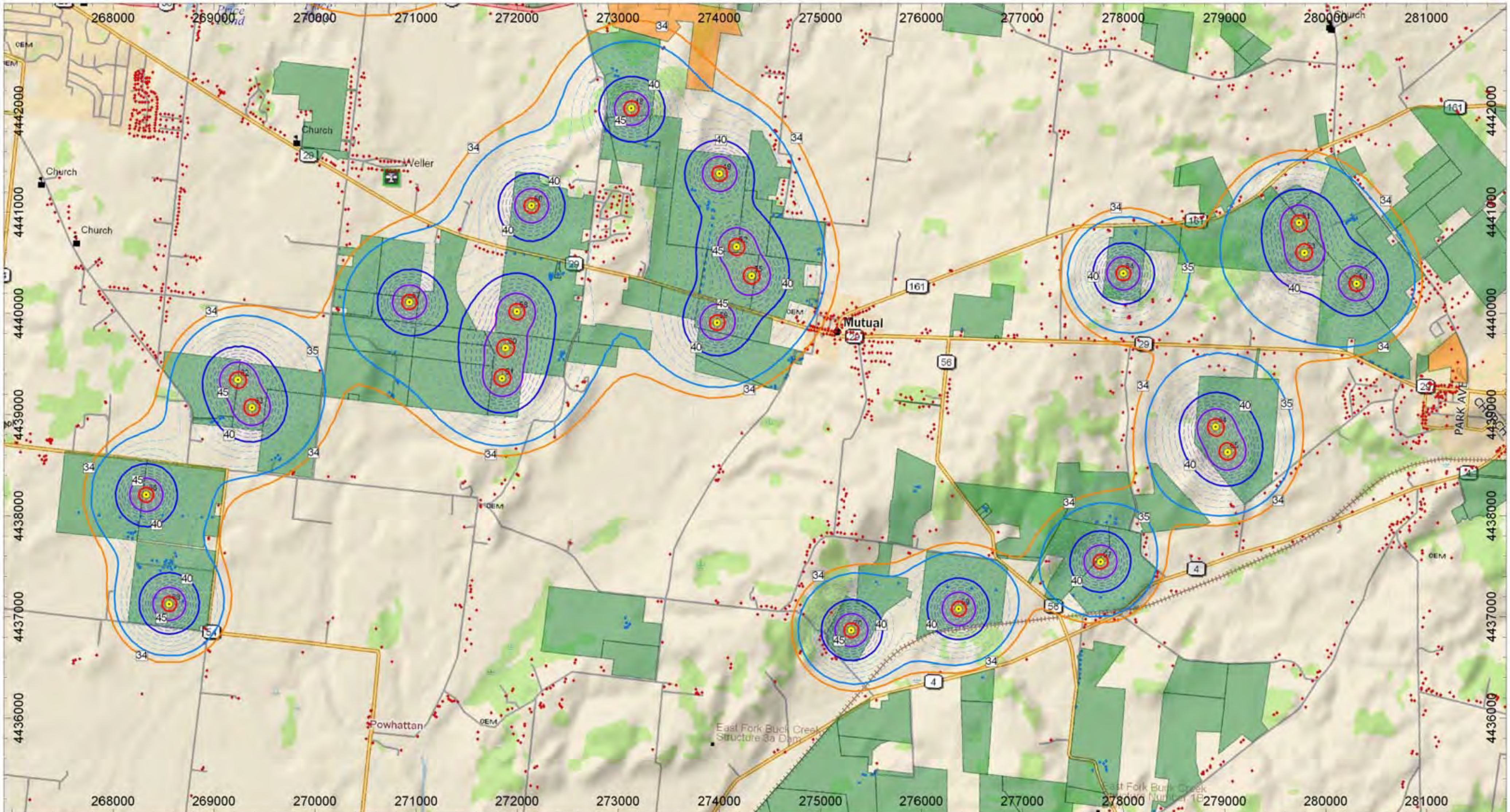
**Everpower Renewables**

*Legend:*

- Turbine Location
- Non-Participating Residence or Unknown Structure
- Participating Residence or Unknown Structure
- Participating Property
- Recreational Area
- 50 dBA
- 45 dBA
- 40 dBA
- 35 dBA
- 34 dBA




*Scale in meters, Units are NAD UTM83 Coordinates*




| Project: | Description: | Legend: |
|---|---|---|
| **Buckeye** | **Plot 2D** | Non-Participating Residence or Unkown Structure; Participating Residence or Unkown Structure; 40 dBA |
| Prepared for: **Everpower Renewables** | **Predicted Sound Contours (dBA) Plotted to Nominal Impact Threshold of 34 dBA for Worst Case Nighttime Conditions (5 m/s Wind) Southern Project Area** | Participating Property; Recreational Area; 35 dBA |
| Date: March 13, 2009 — Drawing #: EBII-Rev-G-2-2 | | Turbine Location; 45 dBA; 34 dBA |

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*Description:*

**Plot 3A**

**Predicted Sound Contours (dBA) Plotted to Typical Property Line Design Goal of 50 dBA (6 m/s Wind Conditions) Northern Project Area**

*Project:*

**Buckeye**

*Drawing Number:*

EB-Rev-G-3-1

*Date:*

March 13, 2009

*Prepared for:*

**Everpower Renewables**

*Legend:*

- Turbine Location
- Non-Participating Residence or Unknown Structure
- Participating Residence or Unknown Structure
- Participating Property
- Recreational Area
- 50 dBA


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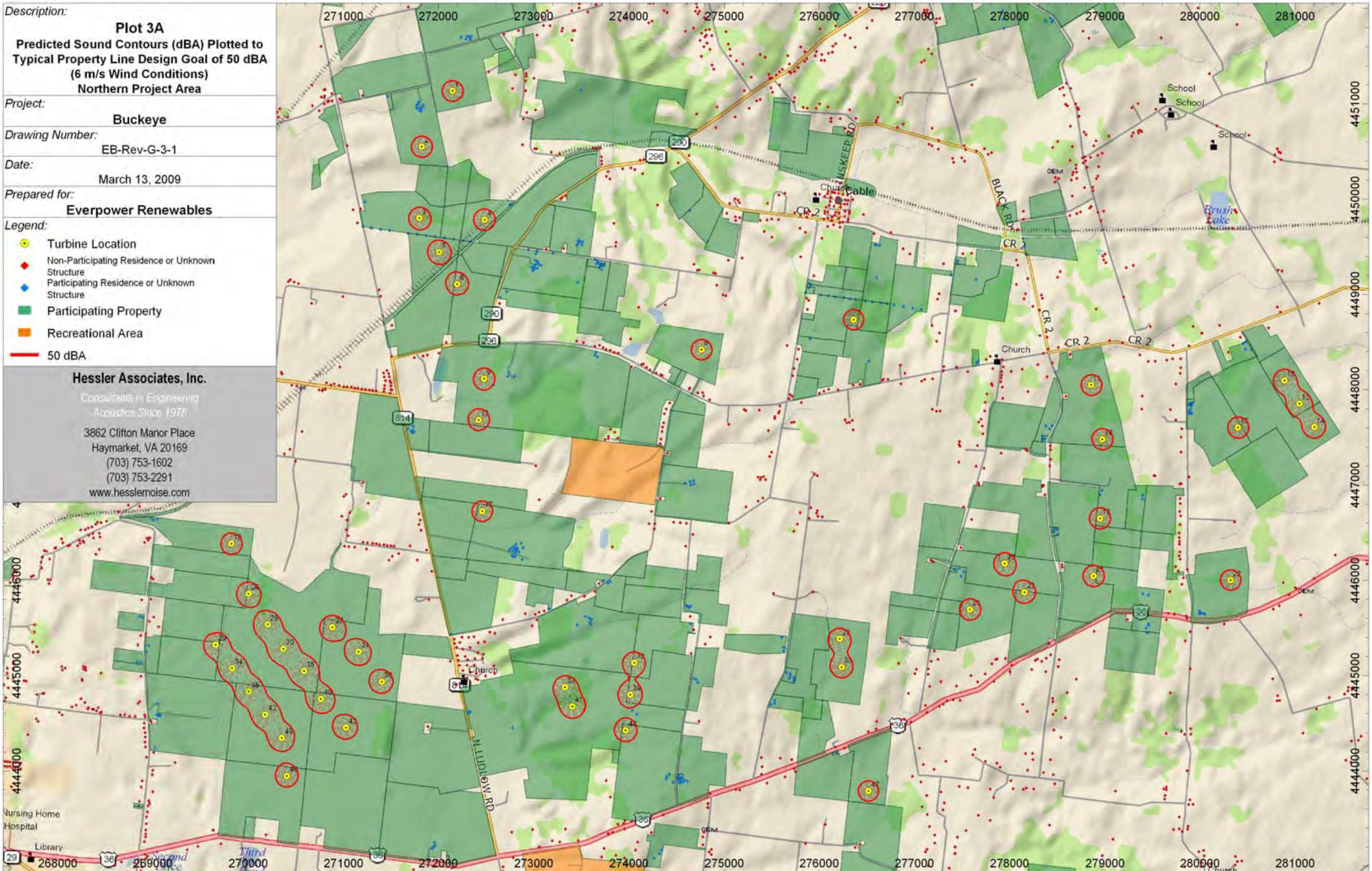
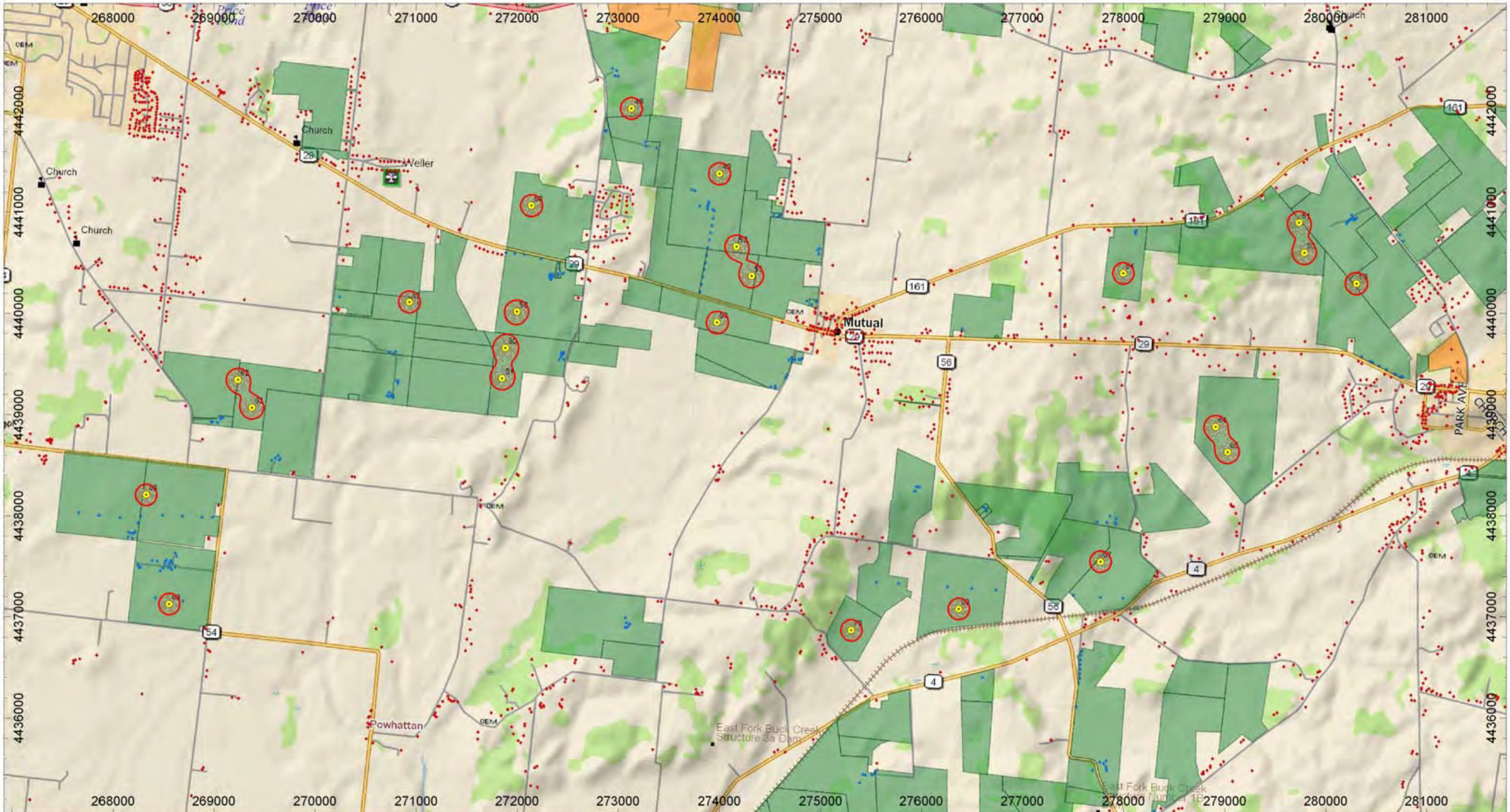



*Scale in meters, Units are NAD UTM83 Coordinates*




Project: **Buckeye**

Prepared for: **Everpower Renewables**

Date: March 13, 2009

Drawing #: EBII-Rev-G-3-1

Description:

**Plot 3B**

**Predicted Sound Contours (dBA) Plotted to Typical Property Line Design Goal of 50 dBA (6 m/s Wind Conditions) Southern Project Area**

Legend:

- Non-Participating Residence or Unknown Structure
- Participating Residence or Unkown Structure
- 50 dBA
- Participating Property
- Recreational Area
- Turbine Location

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