DOE/EA-1820

FINAL
ENVIRONMENTAL ASSESSMENT

FOR

ARCHBOLD AREA LOCAL SCHOOL WIND PROJECT

ARCHBOLD
FULTON COUNTY, OHIO

U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Golden Field Office

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COVER SHEET

RESPONSIBLE AGENCY: U.S. Department of Energy

TITLE: *Final Environmental Assessment for Archbold Area Local School Wind Project, Archbold, Fulton County, Ohio* (DOE/EA-1820)

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Abstract: The U.S. Department of Energy (DOE) provided Federal funding to the Ohio Department of Development (ODOD) under the State Energy Program (SEP). ODOD proposes to provide $1,225,000 of its SEP funds to the Archbold Area Local School District (Archbold). Archbold would use these funds to design, permit, and construct a 750-kilowatt wind turbine adjacent to Archbold High School at 600 Lafayette Street, Archbold, Ohio. DOE has authorized ODOD to use a percentage of the Federal funding for preliminary activities, which include preparing this EA, conducting analysis, and agency consultation. Such activities are associated with the Proposed Action and do not significantly impact the environment nor represent an irreversible or irretrievable commitment by DOE in advance of its conclusion of the potential environmental impacts from the proposed project.

The wind turbine would provide 750 kilowatts of renewable energy to fulfill 40 percent of the school's annual electricity demands and help to reduce greenhouse gas emissions. Archbold has selected the Aeronautica 54-750 model wind turbine, which has a 177-foot rotor diameter and a 213-foot tower height. Overall, the turbine would stand 302 feet at its tallest blade tip extent. Approximately 1,000 feet of associated underground electrical transmission equipment would be installed to connect the wind turbine to the existing school switchgear. No new access roads or road improvements would be required for this project.

This EA analyzes the potential environmental impacts of the proposed construction, operation, and decommissioning of Archbold Area Local School Wind Energy Project and the alternative of not implementing this project (the No-Action Alternative).

Availability: This EA is available for review on the DOE Golden Field Office Reading Room Website, http://www.eere.energy.gov/golden/Reading_Room.aspx, and the DOE NEPA Website, http://nepa.energy.gov/DOE_NEPA_documents.htm.

ACRONYMS AND ABBREVIATIONS

APE	area of potential effect
Archbold	Archbold Area Local School District
BMPs	best management practices
CFR	*Code of Federal Regulations*
dBA	decibel on the A-weighted scale, used to approximate the human ear's response to sound
DNL	Day-Night Average Sound Level (also L_{dn})
DOE	U.S. Department of Energy
EA	Environmental Assessment
EMF	electromagnetic fields
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FONSI	Finding of No Significant Impact
L_{eq}	equivalent continuous sound level
L_{max}	maximum sound level
MBTA	*Migratory Bird Treaty Act*
NEPA	*National Environmental Policy Act*
NHPA	*National Historic Preservation Act*
NPDES	National Pollutant Discharge Elimination System
NTIA	National Telecommunications and Information Administration
ODOD	Ohio Department of Development Energy Resources Division
ODNR	Ohio Department of Natural Resources
ODOW	Ohio Department of Natural Resources Division of Wildlife
OHPO	Ohio Historic Preservation Office
OSHA	Occupational Safety and Health Administration
PM_n	particulate matter with an aerodynamic diameter less than or equal to *n* micrometers
Recovery Act	*American Recovery and Reinvestment Act of 2009*
SEP	State Energy Program
SHPO	State Historic Preservation Officer
U.S.C.	*United States Code*
USFWS	U.S. Fish and Wildlife Service

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1. INTRODUCTION

1.1 National Environmental Policy Act

The *National Environmental Policy Act* [42 United States Code (U.S.C.) 4321 *et seq.*; NEPA], the Council on Environmental Quality's NEPA regulations [40 *Code of Federal Regulations* (CFR), Parts 1500 to 1508], and the U.S. Department of Energy's (DOE's) NEPA implementing procedures (10 CFR Part 1021) require that DOE consider the potential environmental impacts of a proposed action before making a decision. This requirement applies to decisions about whether to provide different types of financial assistance to States and private entities.

In compliance with these regulations, this Environmental Assessment (EA)

- Examines the potential environmental impacts of the Proposed Action and the No-Action Alternative;
- Identifies unavoidable adverse environmental impacts of the Proposed Action;
- Describes the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity; and
- Characterizes any irreversible and irretrievable commitments of resources that would be involved should DOE decide to implement its Proposed Action.

DOE must meet these requirements before it can make a final decision to proceed with any proposed Federal action that could cause adverse impacts to human health or the environment. This EA provides DOE and other decisionmakers the information needed to make an informed decision about the installation, operation, and eventual decommissioning of the proposed wind turbine. The EA evaluates the potential individual and cumulative impacts of the proposed project. For purposes of comparison, this EA also evaluates the impacts that could occur if DOE did not provide funding (the No-Action Alternative), under which DOE assumes the project would not proceed. The EA does not analyze other action alternatives.

1.2 Background

The Archbold Area Local School District (Archbold) proposes to construct, operate, and eventually decommission a single 750-kilowatt wind turbine, along with approximately 1,000 feet of associated underground electrical transmission equipment adjacent to Archbold High School (on high school property) at 600 Lafayette Street in Archbold, Ohio (proposed project) (see Appendix A, Figures 1a, 1b, 2, and 3). The current estimated project cost is $1,875,000. The Ohio Department of Development's (ODOD's) Energy Resources Division selected this project to receive a $1,225,000 sub-grant. This sub-grant would come from a grant that the State of Ohio received from DOE under the DOE's State Energy Program (SEP) and the *American Recovery and Reinvestment Act of 2009* (Pub. L. 111-5, 123 Stat. 115; ARRA or Recovery Act). The purpose of SEP is to promote the conservation of energy and reduce dependence on imported oil by helping states develop comprehensive energy programs and by providing them with technical

and financial assistance. SEP is authorized under the *Energy Policy and Conservation Act*, as amended (42 U.S.C. 6321 *et seq*.).

States can use SEP funds for a wide variety of activities related to energy efficiency and renewable energy (42 U.S.C. 6321 *et seq*. and 10 CFR Part 420). In the Recovery Act, Congress appropriated $3.1 billion to SEP, and DOE issued the State of Ohio a grant in the amount of $96,083,000, pursuant to a Federal statutory formula for distributing the SEP funds. The potential use of Federal SEP funds to assist in the financing of the proposed project constitutes a Federal action subject to review under NEPA.

In compliance with Council on Environmental Quality and DOE NEPA regulations, this EA examines the potential environmental impacts of DOE's Proposed Action (providing funding for the Archbold Wind Energy Project) and the No-Action Alternative, under which DOE assumes the proposed project would not proceed. This EA also describes options that Archbold (sub-recipient) considered during development of its application to the State of Ohio, which is the recipient of Federal funding under the DOE SEP. This EA will provide DOE with the information needed to make an informed decision about whether allowing the State of Ohio to provide a portion of its Federal funds for the proposed project might result in significant environmental impacts.

1.3 Purpose and Need

1.3.1 DOE'S PURPOSE AND NEED

DOE's purpose and need is to ensure that SEP funds are used for activities that meet congressional statutory aims to improve energy efficiency, reduce dependence on imported oil, decrease energy consumption, and promote renewable energy. Funding provided as part of Ohio's SEP sub-grant to Archbold would partially satisfy the needs of DOE to assist U.S. cities, counties, states, and American Indian tribes through SEP to develop, promote, implement, and manage energy efficiency and conservation projects and programs designed to:

- Reduce fossil fuel emissions;
- Reduce the total energy use of the eligible entities;
- Improve energy efficiency in the transportation, building, and other appropriate sectors; and
- Create and retain jobs.

Congress enacted the Recovery Act to create jobs and restore economic growth through measures that, among other things, modernize the nation's infrastructure and improve energy efficiency. Provision of SEP funds for the proposed project would partially meet these goals.

1.3.2 OHIO'S PURPOSE AND NEED

Ohio's purpose and need is to grow the economy of the state by connecting companies and communities to financial and technical resources to deploy renewable energy technologies, and to support the goals of SEP and the Recovery Act to reduce energy costs, reduce reliance on

imported energy, reduce the impacts of energy production and energy use on the environment, and to preserve and create jobs.

Ohio is using its SEP Recovery Act funding for programs to increase the energy efficiency of businesses and industry while promoting deployment of clean energy projects that will help improve the cost-effectiveness and economic stability of businesses and industry in the state.

1.4 Ohio's SEP Project Selection Process

The Ohio SEP, administered by ODOD, includes five sub-programs:

- Deploying Renewable Energy in Ohio
- Making Efficiency Work
- Targeting Industry Efficiency
- Banking on New Energy Financing
- Setting the Stage for Ohio's Carbon Management Strategy

ODOD selected the Archbold Wind Energy Project to receive a sub-grant through ODOD's sub-program, "Deploying Renewable Energy in Ohio," which provides grants to public and private entities to fund a variety of renewable energy projects, including solar, wind, fuel cell, and waste to energy technologies. ODOD issued a Request for Proposals for the "Deploying Renewable Energy in Ohio" sub-program and used the following criteria for selection: project readiness; matching capabilities, financing, and cost effectiveness; economic impact on Ohio; project characteristics and potential for innovation; and a project's ability to (1) provide emission-free energy, and (2) create jobs during the construction of the project.

1.5 Public and Agency Involvement

1.5.1 DOE PUBLIC SCOPING PROCESS

On August 19, 2010, DOE sent postcards announcing the public scoping process and directing stakeholders to the DOE Golden Field Office Public Reading Room, where the scoping letter was available for review. DOE sent notices of public scoping to stakeholders and interested parties including local, State, and Federal agencies, the tribal representatives that are regularly notified regarding Federal actions in the state of Ohio, organizations, and the general public, to solicit public comments (see Appendix D, Attachment D1). The scoping letter described the proposed project and requested assistance in identifying potential issues to be evaluated in this EA. The public scoping period closed on September 9, 2010.

In response to the scoping letter, DOE received a letter from the U.S. Fish and Wildlife Service (USFWS) that was part of the ongoing consultation between DOE and the USFWS and is discussed in detail in Section 3.2.2.6 of this EA. This letter (dated September 2, 2010; see Appendix C, Attachment C3) concluded the USFWS consultation for the proposed project and indicated that the USFWS determined the proposed project is not likely to adversely affect the Indiana bat (*Myotis sodalis*).

1.5.2 PUBLIC INVOLVEMENT

Archbold has provided opportunities for public involvement since November 21, 2007, in an attempt to educate the public about this project and provide an opportunity for public comment. The opportunities have included public engagement by German Township, the Village of Archbold, Archbold School Board Meetings, and other presentations (see Table 1-1), as well as coverage of the project in local media outlets (see Appendix D, Attachment D2). Letters of public support for the project have been received by various public and private entities.

Table 1-1. List of Meetings with Meeting Dates

Meeting Date	Documented Meeting
04/16/2007	Archbold Area School's Board Meeting, Superintendent's Report
02/18/2008	Archbold Area Schools Board Meeting
03/31/2008	Regular Zoning Board Wind Study Tower Variance
04/21/2008	Superintendent's report Green Energy Award
05/12/2008	Regular Zoning Board Wind Turbine Ordinance Hearing
06/02/2008	Regular Zoning Board Wind Study Tower Variance Granted
06/16/2008	Archbold Area School's Board Meeting, Superintendent's Report
06/24/2008	Wind Study Tower Commissioning Public Press Conference
07/17/2008	TV Broadcast Wind Turbines might expand into Fulton County
09/15/2008	Archbold Area School's Board Meeting, Superintendent's Report
02/26/2009	Governor's Press Conference: Gov. Strickland visits re: wind initiatives
10/21/2009	Archbold Area School's Board Meeting
12/21/2009	Archbold Area School's Board Meeting, Superintendent's Report
02/15/2010	Archbold Area School's Board Meeting, Superintendent's Report
02/21/2010	German Township Regular Zoning Hearing
03/01/2010	Archbold Area School's Board Meeting, Combined Pettisville Schools Meeting
05/17/2010	Archbold Area School's Board Meeting, Superintendent's Report
06/11/2010	Archbold Area School's Board Meeting, Special Meeting
06/21/2010	Archbold Area School's Board Meeting, Special Meeting
09/09/2010	Archbold Evangelical Church, Special Meeting
09/16/2010	Archbold Area School's Board Meeting, Superintendent's Report
09/23/2010	Archbold Village Council, Regular Zoning Board Wind Turbine Variance
09/13/2010	Archbold Area School's Board Meeting, Superintendent's Report
10/18/2010	Archbold Area School's Board Meeting, Superintendent's Report
11/09/2010	Archbold Village Council, Regular Zoning Board Wind Turbine Zoning Variance
12/20/2010	Archbold Area School's Board Meeting, Superintendent's Report
01/11/2011	Archbold Area Schools Board meeting, Treasurer's Report

In addition, DOE and/or Archbold have contacted the following agencies and organizations:

- USFWS
- Federal Aviation Administration (FAA)
- U.S. Department of Commerce, National Telecommunications and Information Administration (NTIA)
- Ohio Historic Preservation Office (OHPO)
- The 57 tribal representatives with historic ties to the State of Ohio
- Ohio Department of Natural Resources (ODNR), Division of Wildlife (ODOW)
- Ohio Department of Transportation, Office of Aviation
- Archbold Village Board of Zoning

- German Township Board of Zoning

1.5.3 DRAFT ENVIRONMENTAL ASSESSMENT

DOE issued the Draft EA for comment on January 26, 2011, and posted it on the DOE Golden Field Office Reading Room Website (http://www.eere.energy.gov/golden/Reading_Room.aspx) and DOE NEPA Website (http://nepa.energy.gov). DOE sent postcards (Appendix D, Attachment D9) to the individuals listed in Appendix D, Attachment D8 of this EA to notify them of the EA's availability on the web and to announce a 15-day public comment period on the Draft EA. A Notice of Availability was published in the local paper, *The Archbold Buckeye*, and on the Archbold Area Local School District Website (see Appendix D, Attachment D10). The comment period ended on February 9, 2011. DOE received no comments on the Draft EA.

2. PROPOSED ACTION AND ALTERNATIVES

2.1 DOE's Proposed Action

DOE is proposing to authorize ODOD's expenditure of Federal SEP funding through a sub-grant to Archbold to design, permit, and construct a 750-kilowatt wind turbine to provide renewable energy to Archbold High School.

DOE authorized ODOD and Archbold to use a percentage of the Federal funding for preliminary activities, which include EA preparation and studies. These activities are associated with the Proposed Action and would not significantly impact the environment nor represent an irreversible or irretrievable commitment of resources in advance of DOE completing the NEPA process for the Proposed Action.

2.2 Ohio's Proposed Project

This proposed project was chosen based on the following ODOD criteria: project readiness; cost effectiveness; economic impact for Ohio; project characteristics and potential for innovation; and its ability to (1) provide emission-free energy and (2) create jobs during the construction of the project. For this proposed project, DOE is the Federal agency whose Proposed Action is to authorize funding. ODOD is the recipient of Federal funding and Archbold is the sub-recipient of this funding. The project would be implemented on Archbold High School's property in Archbold, Ohio.

The proposed project would include the installation, operation, and eventual decommissioning of a single 750-kilowatt wind turbine on the high school's campus. The turbine model selected is an Aeronautica 54-750 with a 177-foot rotor diameter and a 213-foot tower height. Overall, the turbine would stand 302 feet at its tallest blade tip extent. The turbine would be mounted on a monopole made up of tubular conical steel segments. This design would eliminate the need for guy wires for support of the wind turbine. Guy wires can be a challenge for birds and bats to locate and maneuver around, which can lead to injury or death. The proposed design would not include the use of lattice towers for support, which have been found to be roosting sites for birds at other wind project sites.

Approximately 1,000 feet of associated underground electrical transmission line would be installed to connect the wind turbine to the existing school switchgear. The project would meet all local, State, and Federal codes and regulations. No new access roads or improvements to existing roads would be required for this project.

2.2.1 PROJECT LOCATION

The turbine would be located at the west edge of the Archbold High School campus adjacent to the southwest corner of the school's football field (Figure 2-1 and Appendix A, Figures 1a, 1b, 2, and 3). The approximate center point of the turbine would be located at 41° 30′ 54.65″ north latitude and 84° 18′ 57.24″ west longitude at 727 feet above mean sea level (see Appendix A, Figure 4). The final footprint of the turbine base once the project is installed would be less than 16 feet in diameter, or 256 square feet. The proposed turbine location is surrounded by

agricultural fields adjacent on the west and Township Road 24 approximately 2,600 feet beyond. South of the school property are additional agricultural fields and a church approximately 1,250 feet to the south. There are public ball fields and a few residential neighborhoods farther to the south. To the north approximately 1,050 feet lies a residential trailer park. The proposed turbine location is about 155 feet southwest of the Archbold High School football stadium and track and about 60 feet northwest of the stadium parking lot. The high school building is about 550 feet east of the turbine site, with residential areas beyond.

Figure 2-1. Archbold Project Site and Vicinity

2.2.2 CONSTRUCTION AND INSTALLATION

Site construction would include installation of the foundation systems, turbine, transformer, electrical distribution wiring, and switchgear (see Figure 2-2 and Appendix A, Figure 5). No access roads and road improvements would be required due to accessibility to the site's existing roadways.

The turbine nacelle, blades, and tower would be staged on the school campus in the stadium parking lot and the adjacent field, thereby negating the need for construction of temporary access roads or other construction/laydown areas. Other construction vehicles are anticipated to access the site from a similar route.

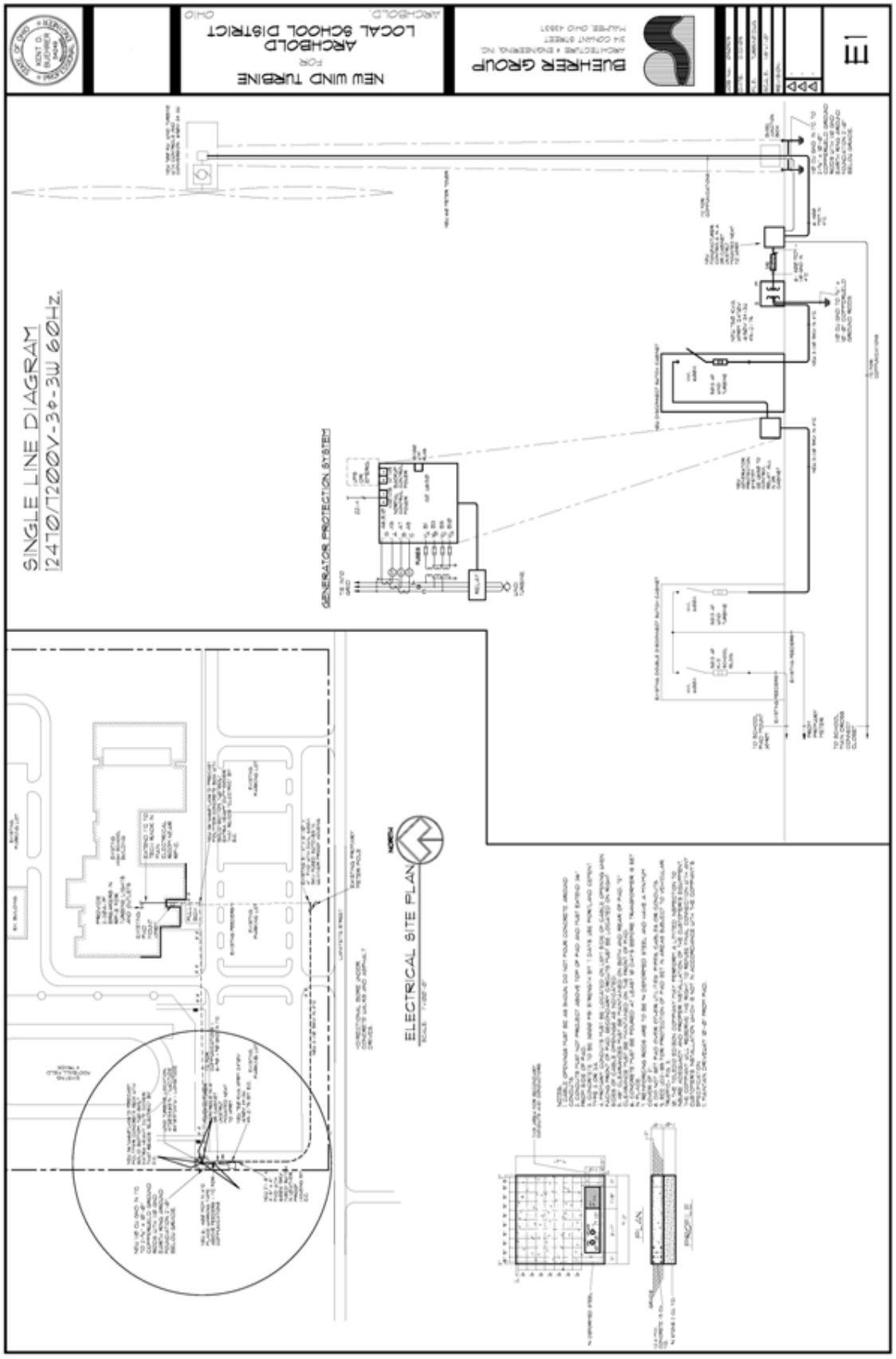


Figure 2-2. Site Plan

An area equal to the possible fall zone (332-foot radius) would be closed during the erection phase of the project. Crane pads would be used during erection as needed to protect the existing school roadways and surfaces. The foundation for the turbine would be composed of approximately 300 cubic yards of reinforced concrete. The foundation would be buried 10 feet underground and would require approximately 23,000 pounds of reinforcing steel.

The electrical grid interconnect of the turbine would be composed of the turbine's controller (contained within the turbine tower-based section), approximately 1,000 feet of buried 4-inch electrical conduits, including the portions of the run embedded within the turbine tower foundation, a 690- to 12,470-volt transformer, an automatic disconnect switch, a UL1741-compliant monitoring and control device and a fused disconnect within the school's existing switchgear. The system would also have a parallel run of 2-inch conduit for data transfer and control runs. The full system would meet all local, State, and Federal codes and regulations.

Construction would use best management practices (BMPs) and be performed in accordance with an approved erosion and sedimentation control plan and in compliance with all other applicable local, State, and Federal requirements. Construction activities for wind turbine foundation, tower erection, turbine nacelle placement, and blade installation would be contingent on temperature and weather conditions. The turbine nacelle and blades would be installed during calm wind periods. Foundations would not be installed during cold winter months. These and similar factors would determine the final construction timeline. The proposed project temporary disturbance area would not exceed 1 acre; thus, it would not exceed the threshold for National Pollutant Discharge Elimination System (NPDES) permitting.

The installation of the proposed project, including site preparation, erection, final commissioning, generator installation, and overall systems tie-in and startup, is scheduled to be completed within approximately 10 months of groundbreaking.

Construction activities would occur within a 2-acre footprint that is currently used as open space and overflow parking within the school's campus. During construction and for safety measures, these areas would be closed and secured using fencing, danger signs, and locked gates to prevent unauthorized individuals from entering the work zone.

The project has been reviewed by and received a favorable aeronautical determination from the FAA on August 19, 2010 (see Appendix C, Attachment C5).

White strobe lights at the minimum number, minimum intensity and minimum number of flashes per minute allowable by the FAA would be used at this site to ensure aviation safety. White strobe lights are used to minimize impacts to bird and bat species. Solid red or pulsating red warning lights would be avoided.

2.2.3 OPERATIONS AND MAINTENANCE

Archbold would operate and maintain the proposed project according to operating, maintenance, and safety procedures and requirements specifically recommended by the turbine's manufacturer, Aeronautica. Routine preventive maintenance and inspection of the turbine would be necessary to maximize performance and identify potential problems or escalating maintenance issues. The turbine would be remotely monitored daily to ensure operations were

proceeding efficiently. This monitoring would occur through the use of trained onsite staff and remote monitoring via a service provider contract. The turbine would have equipment installed with the ability to monitor and report faults both locally and remotely, as well as the ability to shut itself down automatically if a fault should occur outside the normal operating parameters of the turbine per the manufacturer's specifications. The turbine would also have the ability for onsite and remote shutdown by authorized personnel. For the first 5 years of operation, Archbold would contract out all formal service and maintenance functions to a nationally experienced firm. During this period, local staff and resources would be trained and gain experience in the maintenance and service procedures for the machine. A 5-year extended warranty would also be included in the initial purchase contract of the turbine from the original provider to optimize performance and safety. After this 5-year period, the service and maintenance plans and providers would be reevaluated and contracted as necessary. All routine servicing would be performed without using a crane to remove the turbine from the tower.

2.2.4 DECOMMISSIONING

Impacts from decommissioning the turbine would be similar to those related to construction. The turbine and other infrastructure are expected to have a useful life of at least 20 years. Retrofitting the turbine with upgrades may allow the turbine to produce efficiently for many years after the original useful life. When the project is terminated, Archbold would be responsible for decommissioning the turbine and other infrastructure and removing all facilities to a depth of approximately 3 feet below grade. Archbold would restore the soil surface as closely as possible to its original condition. Archbold would either remove underground facilities or they would be safely secured and left in place. Salvageable items (including fluids) would be sold, reused, or recycled as appropriate; unsalvageable material would be disposed of at authorized and approved disposal sites. Archbold would perform all decommissioning construction activities in accordance with the manufacturer's guidelines as well as all applicable Federal, State, and local regulations.

2.3 Alternatives

2.3.1 DOE ACTION ALTERNATIVE

The Ohio SEP funds are from a formula grant—the amount granted to the State is determined pursuant to a formula established in DOE's SEP grant procedures (10 CFR 420.11). Allocation of funds among the states is based on population and other factors. Recipients of these formula grants have broad discretion in how they use these funds.

This EA examines the potential environmental impacts of the DOE's Proposed Action (authorizing ODOD to provide a SEP sub-grant to fund the design, permitting, and construction of the Archbold Wind Energy Project) and the No-Action Alternative. This EA also describes options that Archbold (sub-recipient) considered during development of its application to the State of Ohio (direct SEP recipient). This EA provides DOE with the information necessary to make an informed decision about whether authorizing the State of Ohio to provide some of its SEP funds for the proposed project might result in significant environmental impacts.

2.3.2 DOE NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not authorize Ohio to use SEP funds for the design, permitting, and construction of the Archbold Wind Energy Project. DOE assumed for purposes of this EA that the project would not proceed without SEP funding. This assumption allows a comparison between the potential impacts of the project as proposed and the impacts of not proceeding with the project. Without the proposed project, Archbold operations would continue as otherwise planned, but without the installation or operation of the proposed wind turbine.

2.3.3 SITING OPTIONS CONSIDERED BY ARCHBOLD

Archbold considered five main sites for the location of the wind turbine at the Archbold High School campus. All of the potential sites are owned by Archbold and were similar with regard to environmental considerations, such as wildlife impact avoidance, wetland and stream avoidance, and compatibility with existing zoning and land uses. Further considerations used by Archbold for siting the turbine are the following:

- Distance from adjacent properties
- Maximization of distances to occupied structures (no closer than 1.25 times the blade tip height)
- Ease of access and adequate room for construction, installation, and maintenance
- Proximity to existing hardened roadways (minimization of new construction)
- Minimization of disruption of the school's operations
- Availability for educational programs (school, community, and college partnerships)
- Minimization of wind turbulence due to adjacent buildings and trees
- Utilization of previously disturbed land (avoidance of natural areas)
- Soil conditions (foundation suitability)
- Maximum avoidance of potential wildlife habitats
- Topography
- Wind resource optimization
- Existing infrastructure avoidance
- Utility interconnect distances
- Architectural, visual balance, and icon siting

The selected site was chosen out of the five proposed sites based on the above criteria. In addition to the considerations listed above, the alternative locations were declined based on the reasons listed below:

- Closer proximities to overall population densities;
- Greater possibility for shadow flicker impacts;
- Poor access for heavy construction equipment;
- Although not expected to be significant for any considered site, greater chance of acoustic propagation; and
- Increased installation costs.

This selection process was also reviewed with the Archbold Village Engineering Department and the Planning and Zoning Board, both of whom concurred on the decision and voted unanimously in favor of the proposed location (VAPC 2010) (see Appendix C, Attachment C8).

2.4 Required Agency Permits and Approval Types

Prior to construction, Archbold would obtain all required Federal, State, and local permits and approvals. The required permits and approvals are listed in Table 2-1. All permit documentation and approval letters are contained in Appendix C.

Table 2-1. Federal, State, and Local Permits and Approvals

Agency	Permit Approval / Type
Federal	
FAA	FAA Aeronautical Determination (issued August 19, 2010) (Appendix C, Attachment C5)
NTIA	Radio Frequency Transmission Approval (received October 18, 2010) (Appendix C, Attachment C6)
USFWS	Compliance with the *Endangered Species Act*, the *Migratory Bird Treaty Act*, and the *Bald and Golden Eagle Protection Act* (letter dated September 2, 2010) (Appendix C, Attachment C3)
State	
OHPO	Compliance with the NHPA (OHPO issued Determination of No Effect on June 21, 2010, issued December 6, 2010) (Appendix E, Attachment E1)
ODNR ODOW	Concurrence that the proposed project does not pose a substantial risk to State-protected species, including birds (pursuant to Ohio Revised Code Chapter 1531) (received August 27, 2010) (Appendix C, Attachment C1)
Local	
Village of Archbold Planning and Zoning Board	Height Variance Approval (received November 8, 2010) (Appendix C, Attachment C9)

2.5 Project Proponent-Committed Practices

Archbold has committed to the following measures and procedures to minimize or avoid environmental impacts if the proposed project is implemented.

2.5.1 BIRD, BAT, AND RAPTOR AVOIDANCE AND MINIMIZATION MEASURES

Project coordination occurred with USFWS and ODOW concerning the project's location and potential impacts on birds, bats, and other wildlife; rare, threatened, and endangered species; and other protected natural features. There are no known bald eagle nests in Fulton County, and the proposed project does not provide suitable habitat for migratory birds. The USFWS issued letters for the proposed project on September 21, 2009, and on September 2, 2010, wherein USFWS determined it is unlikely that the Archbold Wind Energy Project would adversely affect Federally listed species (see Appendix C, Attachments C2 and C3). The ODOW issued a letter

on August 27, 2010 (see Appendix C, Attachment C1) indicating that effects to State-listed species whose range coincides with the proposed project were not anticipated.

Archbold considered the USFWS *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* (USFWS 2003) and would take actions to minimize any potential adverse effects on wildlife associated with the proposed project through the following actions: use of a previously developed site, a smooth monopole tower (no guy wires or lattice towers), wildlife-friendly FAA obstruction lighting equipment and operation procedures, soil erosion/run-off prevention measures, and proper recycling and waste management procedures; minimization of construction areas; and contractual obligation of contractors and subcontractors to all above procedures.

2.5.2 HEALTH, SAFETY, AND NOISE

Archbold has prepared a health and safety plan, and would follow this plan, as well as all Occupational Safety and Health Administration (OSHA) requirements and Aeronautica 54-750 guidelines. Therefore, all facilities would include high-voltage warning signs. All construction activities would occur during normal working hours (7 a.m. to 7 p.m. Monday through Saturday) to avoid noise disturbances to surrounding areas. The construction of the proposed project would comply with all applicable Federal, State, and local requirements.

2.5.3 SOIL

Soil disturbance would not exceed 1 acre and would not require an NPDES permit under the *Clean Water Act* (33 U.S.C. 1251 *et seq*.). Archbold would implement its Sediment and Erosion Control Plan and use BMPs during construction and operation to protect topsoil and minimize soil erosion. BMPs would include, at a minimum, the following: containing excavated material, using silt fences, protecting exposed soil, stabilizing restored material, and revegetating disturbed areas with native plant species.

2.5.4 WASTE MANAGEMENT

Any waste generated during construction, operation, and decommissioning, including used lubricants, would be handled, collected, transferred, and reused/recycled in accordance with applicable Federal, State, and local regulations.

2.5.5 CULTURAL RESOURCES

Based on the archaeological and cultural study results (see Appendix E), encountering archaeological resources during excavation activities is not anticipated. However, if archaeological resources were identified in areas that would be excavated, all ground-disturbing activities would be halted immediately and OHPO would be consulted for resolution.

2.5.6 FLICKER EFFECTS

Based on the shadow flicker assessment (see Appendix B, Attachment B2) prepared for the Archbold Wind Energy Project, shadow flicker is not expected to have more than a minimal impact on any potential receptors (e.g., private residences or businesses). However, there would be a possibility of longer-term flicker at the nearby football stadium. Archbold has committed to temporarily shut down the turbine to lessen the shadow's impact on the stadium during periods

when shadowing events would overlap scheduled sporting or other use events. Additionally, should a local resident find shadow flicker to be an annoyance, Archbold would plant screening trees or purchase window coverings for the resident.

2.5.7 ICING AND FIRE

The turbine system would have an automated system fault shut-off triggered at a minimum by the following sensors: system temperature, power quality, vibration, over-speed, fire and icing (vibration caused by blade icing-induced imbalances automatically shut down the turbine). This system is designed to automatically send fault codes to preauthorized personnel through a web interface. The turbine's nacelle would have a cold-weather package including nacelle heaters. All icing-related turbine shutdowns would require a direct inspection and an onsite manual restart. The site personnel and the system maintenance personnel would shut down the turbine in the event of an icing condition. The site would adopt an ice safety zone around the turbine for implementation during icing events (Appendix D, Attachment D5). Further discussion of this topic can be found in Section 3.2.2.7 of this EA.

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

This chapter of this EA examines in detail the potential environmental impacts of the proposed project and the No-Action Alternative on the affected environmental resource areas.

3.1 No-Action Alternative

Under the No-Action Alternative, DOE would not authorize the use of Federal funds for the design, construction, and operation of the proposed project and thus assumes, for purposes of this EA, that the project would not go forward without SEP funding. Therefore, there would not be any impacts to the resource areas analyzed in this EA; however, the school would continue to use energy generated primarily from fossil fuels and no additional jobs would be created.

If the proposed project was not implemented, the amount of the school's electrical power that the proposed project could provide would continue to be purchased from First Energy Solutions. In 2009, First Energy Solutions generated electricity using coal (72.8 percent), oil (0.4 percent), natural gas (2.7 percent), nuclear (22.3 percent), and renewable energy sources (1.1 percent), which is similar to the overall national composition and includes emissions of carbon dioxide, nitrogen oxides, and sulfur dioxide (EPA 2010a). Thus, carbon dioxide emissions from electricity generation to serve the school would be higher under the No-Action Alternative and ODOD would not meet its objective of deploying emission-free energy.

3.2 Ohio's Proposed Project

3.2.1 CONSIDERATIONS NOT CARRIED FORWARD FOR FURTHER ANALYSIS

Consistent with Council on Environmental Quality and DOE NEPA implementing regulations and guidance, DOE focuses the analysis in an EA on topics with the greatest potential for significant environmental impact. For the reasons discussed below, the proposed project is not expected to have any measurable effects on certain resources; therefore, these resources are not carried forward for further analysis.

3.2.1.1 Water Resources

Floodplains and Wetlands

Pursuant to 10 CFR 1022, DOE reviewed USFWS National Wetlands Inventory maps (USFWS 2010) and Federal Emergency Management Agency floodplain maps (FEMA 1985) and identified no floodplains, wetlands, or surface water sources, such as streams or drainage channels, that are located on the proposed project site or that could be affected by the construction and operation of the proposed project (see Appendix A, Figures 6 and 7).

Wild and Scenic Rivers

No Ohio Scenic Rivers or waterways included in the National Wild and Scenic River System occur in the proposed project vicinity (USFWS 2010). The closest Ohio Scenic River is the Maumee, located in Henry County, approximately 13 miles south of the proposed project site (ODNR 2010). The closest National Scenic River is the Big and Little Darby Creek system, located in Union, Madison, Franklin, and Pickaway counties and about 110 miles southeast of

the proposed site (USDA Forest Service 2009) (see Appendix A, Figure 8). The proposed project would not affect State- or Federal-designated wild and scenic rivers.

Groundwater

Based on the review of existing Ohio Environmental Protection Agency and ODNR groundwater resource maps, the proposed project site is not located in an endorsed well-head protection area, where certain activities are restricted within an area designated by the Ohio Environmental Protection Agency as protected. Additionally, the proposed project area is not located within any designated Public Water System supply areas (sole-source aquifer, community/non-community systems, and drinking water source protection areas using groundwater/surface water). Groundwater is generally not a source of drinking water in this part of Fulton County. There are no private well-water supplies on or near the project site. The proposed project would not be expected to have any adverse effect on any groundwater resources.

Surface Water

In compliance with the *Clean Water Act*, the project site was investigated for surface water. The nearest surface-water body is a small pond located approximately 1 mile to the northeast of the proposed site. The nearest stream is an unnamed tributary to Flat Run, about 0.5 mile to the northwest of the school, which is part of the Lake Erie drainage system. No runoff or discharges from construction of the proposed project would directly enter neighboring bodies of water, including the small pond to the northeast or the unnamed stream to the northwest. Because ground-disturbing activity would affect less than 1 acre, an NPDES permit would not be required prior to any construction-related earthwork. However, Archbold has committed to using sediment and erosion pollution control BMPs in conformance with a plan specific to the proposed project.

3.2.1.2 Waste Management

Solid wastes that are anticipated to be generated during construction include equipment packaging materials and construction-related material debris. Solid wastes generated during operation of the turbines would be minimal. Solid wastes that are anticipated to be generated during decommissioning include dismantled equipment, which would likely be recycled, and construction-related material debris. Hazardous, regulated nonhazardous, and universal wastes are not anticipated to be generated during construction, operation, or decommissioning. All wastes generated over the life of the proposed project would be handled, collected, transferred, reused/recycled, and disposed of in accordance with all applicable Federal, State, and local regulations. Used oil (e.g., spent gear box oil, hydraulic fluid, and gear grease) would not be considered a waste because it can be reused and/or recycled. Used oil would be generated during operation of the proposed project and recycled utilizing a qualified recycling facility.

3.2.1.3 Intentional Destructive Acts

DOE considers intentional destructive acts (i.e., acts of sabotage or terrorism) in all its EAs and environmental impact statements (DOE 2006). Construction and operation of the proposed project would not involve the transportation, storage, or use of radioactive, explosive, or toxic materials. The proposed project would not offer any particularly attractive targets of opportunity for terrorists or saboteurs to inflict adverse impacts on human life, heath, or safety.

3.2.2 CONSIDERATIONS CARRIED FORWARD FOR FURTHER ANALYSIS

This section of the EA examines in detail the potential environmental impacts of the proposed project on the following resource areas:

- Land use
- Visual quality
- Noise
- Cultural resources
- Geology and soils
- Biological resources
- Health and human safety
- Transportation
- Socioeconomics and environmental justice
- Air quality and climate change
- Utilities and energy

3.2.2.1 Land Use

The project site is located on Archbold High School property. The school property is bounded to the north by a trailer park, a small residential area, and a four-rail-wide railroad corridor. To the west are several agricultural fields and Township Road 24. South of the school property are additional agricultural fields, a church, public ball fields, and a few residential neighborhoods further to the south. East of the school property are semi-rural residential areas, a commercial district, and State Road 66 (see Appendix A, Figure 3 for aerial view.) The Village of Archbold is less than 0.5 mile from the property to the northeast. Goll Woods Nature Preserve lies approximately 3 miles northwest of the project site

The majority of land in the immediate vicinity of the school is zoned as Special (S-1) (Village of Archbold 2008). In addition to Special, the following zoning areas exist within a 1-mile radius of the proposed project site: Low-Density Residential (R-2), Medium-Density Residential (R-3), Restricted Industrial (M-1), Central Business (B-1), and Highway and Commercial Business (B-2) (Village of Archbold 2008) (see Figure 3-1 and Appendix A, Figure 9). On June 16, 2008, the Council of the Village of Archbold amended Ordinance Number 02-38 to regulate the installation and use of wind turbines (Appendix C, Attachment C7). The revised ordinance, Section 152.085(A), was amended to allow the conditional use of wind turbines in General Industrial M-2, Agricultural, and Special (S-1) districts. The proposed Project required a variance from the Village of Archbold due to the proximity of the stadium and parking lot within the calculated fall zone of 332 feet. The Village of Archbold issued the variance for the proposed Project on November 8, 2010 (Appendix C, Attachment C9).

The proposed turbine site is located between the football stadium to the north, agricultural fields adjacent to the west on landscaped and a parking lot to the south. The turbine foundation would be placed in an area that consists of maintained grass (see Appendix A, Figure 3 for aerial view.).

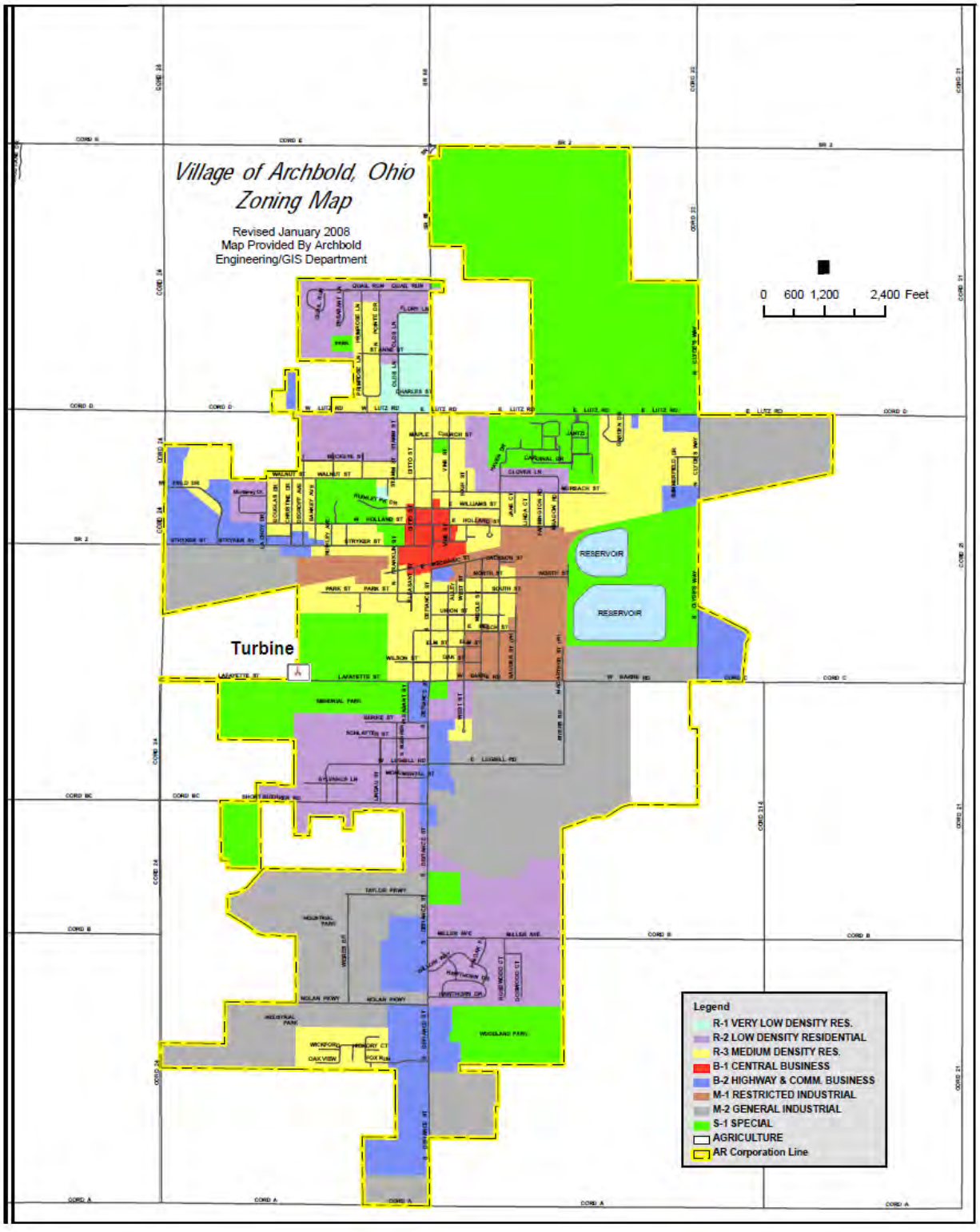


Figure 3-1. Village of Archbold Zoning Map

Direct and Indirect Impacts

Construction activities would result in temporary ground disturbance of 1,600 square feet of previously disturbed, developed land for the turbine foundation (ultimately a 256-square-foot permanent footprint) and 2,000 square feet of temporary ground disturbance associated with installation of the underground electrical wires. The overall use of the general area would not change as a result of construction and operation of the proposed project.

Neither direct nor indirect impacts on land use are expected to occur outside of the immediate project site. Land-disturbing activities would be relegated to the area needed for construction and operation of the proposed project. No other lands, including natural or residential areas, would be affected.

3.2.2.2 Visual Quality

Viewshed

Archbold is a rural community composed of the developed town area that is surrounded on all sides by agriculture and widely spaced, individual rural residences. Residential development borders the school property to the north, east, and west, with agricultural lands and individual rural residences bordering the west. The landscape surrounding the school property is generally flat. Residential development, and associated landscaping, act to limit views and residents on the outer edges of development that are nearest to the school have the most direct, ground level views of the project site. Expansive views over agricultural lands are often present because there are few trees to obscure views. Trees vary in height, but tend to range from 16 to 69 feet tall, and features taller than this would be visible above the tree line.

Vertical elements present in the landscape include farm silos, buildings, industrial facilities, power line poles, and communication towers (see Figure 3-2); however, only silos and communication towers, some which measure over 330 feet tall, are most often seen rising above the tree line. A number of these communication towers are located within 4 miles of the proposed project site (see Figure 3-3). Existing viewer groups in the area include residents, roadway users, recreationists, and occupants of nearby commercial facilities, and educational facilities. Potential receptors in the surrounding landscape include nearby residences and the Archbold school property.

Figure 3-2. Nearby Communication

A visual analysis was conducted for the proposed project to assess potential impacts on the local viewshed (Appendix B, Attachment B1). The results of a visual analysis were intended to give a sense of how the proposed wind turbine would appear to potential receptors (nearby residences or businesses) in the surrounding landscape. The actual visibility of the wind turbine in the surrounding area is affected by many factors: the size of the machine; tower and blade tip heights; turbine color; distance to the viewer; obstructions such as trees, hills, and buildings;

atmospheric conditions; sun angle; and the curvature of the earth. Of these factors, the overall height of a turbine, obstructions in the sightline between the viewer and the turbine, and the distance between the machine and the viewer have the potential for the greatest impact. Visual simulations were used to illustrate the effect of the proposed project from vantages that are representative of typical views that would be affected and include the 213 foot tower and blades, for a combined total height of 302 feet to the tallest blade.

Figure 3-3. Existing Tall Towers within 4 Miles of the Proposed Turbine Site

Table 3-1 lists the visualizations from the study. All referenced visual simulations for the properties are located in Appendix B, Attachment B1.

Figure 3-4 depicts the simulation of the wind turbine view from a playground located at the intersection of Saint Anne Street and Primrose Lane and the turbine rising over the tree line. Note that atmospheric conditions allow the turbine to recede, somewhat, into the view. The turbine also appears to be of similar height to the trees and barn to the middle right of the photo and is not a prominent visual feature in this viewshed.

Figure 3-5 depicts the wind turbine view from the nearest receptor, the Archbold Evangelical Church. The simulation shows that the turbine would be readily seen in the foreground from some vantages within the town and would be a prominent visual element.

Table 3-1. Archbold Visualization Receptor Locations

Archbold Visualizations						
Set Number	Picture Number	Distance from Turbine (miles)	Site Description	Latitude	Longitude	Direction
A-V-1	2093	2.00	Sauder Village Parking Lot	41° 32' 32.83" N	84° 18' 07.67" W	202°
A-V-2	2096	0.80	24218 County Road D	41° 31' 17.72" N	84° 19' 47.31" W	120°
A-V-3	2123	1.10	Playground off St. Anne and Primrose	41° 31' 55.08" N	84° 18' 43.40" W	180°
A-V-4	2125	1.20	Between Tracks and Murbach	41° 31' 27.84" N	84° 17' 45.41" W	250°
A-V-5	2127	0.40	Archbold Evangelical Church	41° 30' 44.34" N	84° 18' 07.61" W	41°
A-V-6	2130	0.50	Corner Sylvanus & Lawrence	41° 30' 30.98" N	84° 18' 49.26" W	345°
A-V-7	2133	1.90	County Road 25 (Between County Road E.50 and County Road B)	41° 29' 46.15" N	84° 20' 31.38" W	48°
A-V-8	2135	1.70	Corner of County Road 25 & County Road B	41° 30' 01.29" N	84° 20' 30.48" W	50°
A-V-9	2137	1.60	22291 County Road B	41° 30' 00.20" N	84° 17' 34.26" W	318°
A-V-10	2340	2.70	Corner of County Road 21 & County Road D	41° 31' 43.98" N	84° 16' 04.57" W	252°
A-V-11	2352	3.70	Historic Home - 4208 County Road 20	41° 31' 55.22" N	84° 14' 52.04" W	254°

Source: Appendix B, Attachment B1 of this EA.

Figure 3-4. Visual Simulation Depicted from Playground near the Intersection of Saint Anne Street and Primrose Lane

Figure 3-5. Visual Simulation Depicted from Archbold Evangelical Church

Direct and Indirect Impacts to the Viewshed

Visual resource impacts associated with installation of the turbine including construction equipment, excavated ground, and construction fencing would result in temporary visual impacts while the turbine is under construction. Residents, roadway users, recreationists, and occupants of nearby facilities may have a prominent view of the construction activities including site preparation, erection of the turbine, and the staging areas of the turbine nacelles, blades, and tower during the 10-month period of construction. Many of the surrounding farms would be able to see the proposed project due to the general openness of the region's farming landscape and the overall flat terrain surrounding the project site. Similar views would be present from within the town where open vantages would present views of the turbine.

The results of the visual analysis indicate that the proposed project would be visible to some of the local residents especially those in close proximity to the school and projects site. The proposed turbine's light-colored surface makes it stand out against its surroundings. While the turbine appears to be of similar height to the parking lot light poles, the turbine is much wider, which creates a larger visual massing. This, combined with the light coloring, makes the proposed turbine stand out as a contrasting and dominant visual element in the landscape.

The visibility of the proposed project to residents would be reduced as the distance from the proposed site location increased due to local obstruction proximities and densities to typical sightlines such as trees and buildings. Due to perspective, the turbine would appear as a very small element of the skyline for most locations, similar to the region's existing communication towers and granaries. However, because of the trees and other tall structures in the vicinity of the proposed project, there would be a minimal impact to the local viewshed.

Safety lighting in accordance with standards (FAA 2007) would be required on the turbine. Residential properties, public facilities, and commercial buildings are located close together within the town. Orientation of buildings and the presence of neighboring structures limit views to the immediate surroundings for most viewers, precluding views of the proposed project. In addition, existing vegetation within the town further acts to limit views. Because of these factors, most views of the wind turbine are seen by residents adjacent to the school while entering or exiting buildings and most of these viewers are often focused on their immediate surroundings. The lighting required by the FAA, such as safety light intensity and the number of lights being installed, would not be sufficient to create a source of light pollution that would cause viewers to redirect their attention from their immediate surroundings toward the project site. Therefore, effects on the local viewshed are anticipated to be minimal.

Shadow Flicker

Shadow flicker is the moving/flickering shadows produced when sunlight passes through the spinning rotor blades of a turbine. This phenomenon can become an annoyance to nearby residents when the shadows pass directly over their line of sight, i.e., windows or other transparent surfaces. While the adverse effects of shadows can be subjective, the shadows themselves can be precisely modeled for location and duration. For shadow receptor sites within a turbine shadow's reach (10 rotor diameters is standard, but the model used 6,560 feet, well beyond 10 rotor diameters), not all would receive shadow due to existing obstructions that block the shadow's path such as other buildings, hills, or trees.

While evergreen trees would fairly consistently block shadows year-round, deciduous trees would have a lesser impact in the winter months when they have no leaves. Additionally, the farther an observer is from the wind turbine, the smaller the portion of the sun being blocked, and this distance allows the shadow to diffuse (weaken). Although no official U.S. policy has been adopted, international standards appear to be in consensus that flickering shadows in excess of 30 hours per year impacting a particular location are considered a potential nuisance (see Appendix B, Attachment B2).

A shadow flicker analysis (see Appendix B, Attachment B2) was completed for the proposed project to evaluate the amount of shadow flicker that would be experienced by local residents. The analysis considered several aspects affecting the casting of shadows and potential impacts on local receptors, including the distance to receptors, angle of incoming solar insolation, and the amount of sunlight experienced at the project site during each of the four seasons.

The following are the closest receptors to the proposed wind turbine. It should be noted that although the high school building is approximately 550 feet from the proposed turbine, there are no windows on the turbine side of the building that would receive shadow flicker, and thus the high school building is not included in the nearest receptor list below.

Receptor A: The closest house to the southwest, approximately 2,780 feet from turbine at 2822 County Road 24. Effects would occur during portions of May, June, July, and August mornings with a total average of 3 hours of shadow flicker per year.

Receptor B: South End of Archbold High School football stadium, approximately 110 feet from turbine Blue Streak Drive. Shadows would be distinct on the southern portion of the stadium grounds during afternoons and sunsets throughout most of the year for an average of approximately 210 hours annually. As shown in Appendix B, Attachment B2, the specific location of these longer periods of flicker would be limited to the south end zone of the football field. The majority of the field and the spectator areas would be subject to shadow flicker for less than 40 hours per year.

Receptor C: Archbold Public Ball Fields, approximately 1,200 feet from the turbine on Lafayette Street. Shadows would be diffuse during portions of late-April through mid-August late evenings (after 7:30 p.m.) with a total average of about 28 hours of shadow flicker per year affecting some portion of the fields. This effect could be mitigated by turning off turbine during sporting events in those timeframes.

Receptor D: Closest house to the northeast, approximately 1,465 feet from the turbine at 101 Parkview Court. Effects would occur in late-November through mid-January evenings with a total average of approximately 3 hours of shadow flicker per year.

Although there is no established maximum standard for acceptable levels of exposure to shadow flicker, the Danish Wind Industry Association cites a court case in which the judge determined that 30 hours of shadow flicker per year as a tolerable level of shadow flicker (DWIA 2003). Therefore, shadow flicker effects would be below the threshold of potential concern at the closest receptor locations.

Because of the strobe-like effect of shadow flicker, there have been investigations into whether it might have the potential to produce epileptic seizures in individuals with photosensitivity. It has been determined that modern utility-scale wind turbines do not have the potential to cause these types of problems because of their relatively slow blade rotation. One study (Harding et al. 2008) reported that flickers with a frequency greater than 3 hertz could pose a potential for inducing photosensitive seizures (that is, a light flashing at a rate of more than 3 times per second). The American Epilepsy Foundation reports that lights flashing in the range of 5 to 30 hertz are most likely to trigger seizures and recommends that flash rates of visual alarms be kept under 2 hertz (Epilepsy Foundation 2010). A wind turbine with three blades would have to make a full revolution every second (or 60 revolutions per minute) to reach a frequency of 3 hertz. The Aeronautica 54-750 wind turbine proposed for this project operates at 25.3 revolutions per minute (Appendix D, Attachment D3). This would indicate a flicker frequency created by this wind turbine at less than one-half the rates identified with photosensitivity issues.

Some data suggest that shadow flicker has the potential to cause a disorienting effect on a small segment of the population. The data also suggest that rotor rotation below 2.5 hertz can avoid such effects (BLM 2005). As stated above, the rotor speeds involved with the project would be well below this level.

Direct and Indirect Impacts from Shadow Flicker

Although some parts of the school's building could receive flickering shadows (up to 30 hours per year), there are no windows on the turbine side of the building. The results of the analysis indicate that the stadium would receive shadows; however, the following considerations illustrate that this flickering would have minimal impacts:

- As stated above, only the south end of the football field would receive the 210 hours of annual flicker;

- For periods when shadowing events would overlap scheduled sporting or other use events, Archbold has adopted a policy that would temporarily shut down the turbine during the shadow's impact to the stadium; and

- It is likely that since the stadium would primarily be used 1 to 2 evenings or nights per week during the fall (and the shadow events occur for a few hours in the late afternoon or evening), the turbine shutdown measures likely would not be required frequently.

The results of the flicker study also show that diffused shadows may reach the public ball fields 1,200 feet southeast of the project site (less than 28 hours per year). Archbold would shut down the turbine during these overlapping events if the operation was found to be a nuisance by ball field users or spectators.

3.2.2.3 Noise

Noise is any unwanted, undesirable sound. It has the potential to interfere with communication, damage hearing, and, in many cases, is viewed as an annoyance. Noise can occur at different levels and frequencies, depending on the type of source and the distance away from the listener.

Sound is a result of fluctuating air pressure. The standard unit for measuring sound pressure levels is the decibel. A decibel is a unit that describes the amplitude (or difference between levels) of sound, equal to 20 times the logarithm to the base 10 of the ratio of the measured pressure to the reference pressure, which is 20 micropascals. Typically, environmental and occupational sound pressure levels are measured in decibels on an A-weighted scale (dBA). The A-weighted scale de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear [i.e., using the A-weighting filter adjusts certain frequency ranges (those that humans detect poorly)] (Colby et al. 2009). Table 3-2 shows some sound pressure levels associated with common activities measured in dBA.

Table 3-2. Typical Sound Pressure Levels Measured in the Environment and Industry

Noise Source At a Given Distance	A-Weighted Sound Level in Decibels	Qualitative Description
Carrier deck jet operation	140	
	130	Pain threshold
Jet takeoff (200 feet)	120	
Auto horn (3 feet)	110	Maximum vocal effort
Jet takeoff (1000 feet) Shout (0.5 feet)	100	
N.Y. subway station Heavy truck (50 feet)	90	Very annoying Hearing damage (8-hour, continuous exposure)
Pneumatic drill (50 feet)	80	Annoying
Freight train (50 feet) Freeway traffic (50 feet)	70 to 80	
	70	Intrusive (Telephone use difficult)
Air conditioning unit (20 feet)	60	
Light auto traffic (50 feet)	50	Quiet
Living room Bedroom	40	
Library Soft whisper (5 feet)	30	Very quiet
Broadcasting/Recording studio	20	
	10	Just audible

Adapted from Table E, "Assessing and Mitigating Noise Impacts", NY DEC, February 2001.
Table 3-2 is cited in Colby et al. 2009.

For a point source such as a stationary compressor or construction equipment, sound attenuates based on geometry at rate of 6 decibel per doubling of distance. For a line source such as free flowing traffic on a freeway, sound attenuates at a rate of 3 decibel per doubling of distance. Atmospheric conditions including wind, temperature gradients, molecular absorption, and humidity can change how sound propagates over distance and can affect the level of sound received at a given location. The degree to which the ground surface absorbs acoustical energy

also affects sound propagation for sources located close to the ground. Sound that travels over an acoustically absorptive surface such as grass attenuates at a greater rate than sound that travels over a hard surface such as pavement. The increased attenuation is typically about 1.5 per doubling of distance (Caltrans 2009). Barriers such as buildings and topography that block the line of sight between a source and receiver also increase the attenuation of sound over distance.

Table 3-3 provides definitions of commonly used acoustical terms.

Table 3-3. Definitions of Commonly Used Acoustical Terms

Sound Measurements	Definition
Decibel	A unitless measure of sound on a logarithmic scale, which indicates the squared ratio of sound pressure amplitude to a reference sound pressure amplitude. The reference pressure is 20 micropascals.
A-Weighted decibel (dBA)	Decibel on the A-weighted scale, used to approximate the human ear's response to sound.
Maximum Sound Level (L_{max})	The maximum sound level measured during the measurement period.
Minimum Sound Level (L_{min})	The minimum sound level measured during the measurement period.
Equivalent Continuous Sound Level (L_{eq})	The equivalent steady state sound level that in a stated period of time would contain the same acoustical energy as a time-varying sound level.
Percentile-Exceeded Sound Level (L_{xx})	The sound level exceeded "×" percent of a specific time period. L_{10} is the sound level exceeded 10 percent of the time. L_{90} is the sound level exceeded 90 percent of the time. L_{90} is often considered to be representative of the background ambient noise level in a given area.
Day-Night Average Sound Level (DNL or L_{dn})	The energy average of the A-weighted sound levels occurring during a 24-hour period, with 10 decibels added to the A-weighted sound levels occurring during the period from 10:00 p.m. to 7:00 a.m.
Frequency: hertz	The number of complete pressure fluctuations per second above and below atmospheric pressure.

Noise Guidelines and Regulations

The U.S. Environmental Protection Agency (EPA) identifies noise levels necessary to protect public health and welfare against hearing loss, annoyance, and activity interference in its document, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (EPA 1974). This criteria document recommends an exterior Day Night Average Sound Level (DNL) of 55 dBA for residential uses. However, the document contains recommendations only and the levels are not Federally enforceable. Furthermore, in 1981 the Federal Government concluded that noise issues were best handled at the State or local government level. As a result, EPA phased out Federal oversight of noise issues to transfer the primary responsibility of regulating noise to the State and local governments. However, EPA recommendations remain useful for assessing the affected environment.

EPA has also evaluated general public response to changes in noise levels. In general, an increase to ambient or average noise levels of 5 dBA would be noticeable to most people and may elicit widespread complaints. An increase of 20 dBA would likely result in vigorous community response. An increase of ambient noise levels of less than 3 dBA is usually considered minute.

The Village of Archbold Ordinance No. 08-24 relates to the installation and use of wind turbines. The Section 152.085(C) states:

> Noise levels shall be less than 60 dBA at the nearest property line, unless the property where the wind turbine is proposed abuts a residential district, in which case the maximum noise level shall be 50 dBA at any property line abutting a residential district.

Background Information on Wind Turbines and Noise

Operating wind turbines can generate two types of sound: first, the mechanical sound from components such as gearboxes, generators, yaw drives, and cooling fans, and second, the aerodynamic sound from the flow of air over and past the rotor blades. Modern wind turbine design has greatly reduced mechanical sound and it generally can be ignored in comparison to the aerodynamic sound, which is often described as a "swishing" or "whooshing" sound (BLM 2005).

Wind turbines produce a broad-band sound; that is, the sound occurs over a wide range of frequencies, including low-frequencies. Low-frequency sounds are in the range of 20 to 100 hertz and infrasonic sound (or infrasound) is low-frequency sound of less than 20 hertz. Compared to higher frequency sound, low-frequency sound propagates over longer distances, is transmitted through buildings more readily, and can excite structural vibrations (for example, rattling windows or doors). The threshold of perception, in decibels, also increases as the frequency decreases. For example, in the frequency range where humans hear best (in the low kilohertz), the threshold of hearing is at about 0 decibel, but at a frequency of only 10 hertz, the threshold of human hearing is at about 100 decibel (Rogers 2006).

Older designs of wind turbines, particularly those in which the blades were on the downwind side of the turbine tower, produced more low frequency sound as a result of the blades passing through more turbulent air as a result of the tower blocking wind flow. Modern, upwind turbines produce a broad band sound emission that includes low-frequency sounds, but not at the levels produced by older wind turbines. A primary cause for low-frequency sounds in modern turbines is the blade passing through the change in airflow at the front of the tower and this can be aggravated by unusually turbulent wind conditions.

The University of Massachusetts at Amherst reported (Rogers 2006) on noise measurements made at four different wind turbines ranging in size from 450 kilowatts to 2 megawatts. The results indicated that at distances of no more than 118 meters (387 feet) from the turbines, all infrasound levels were below human perception levels. The report further states that there is "no reliable evidence that infrasound below the hearing threshold produces physiological or psychological effects." This lack of effects at levels below the hearing threshold was supported by a scientific advisory panel comprised of medical doctors, audiologists, and acoustic professionals established by the American and Canadian Wind Energy Associations to review wind turbine sound and health effects (Colby et al. 2009). It was also supported by the findings from Canadian and Australian government reviews of available scientific literature (CMOH 2010; Australia NHMRC 2010).

Existing Noise Conditions

Ambient noise monitoring was conducted to establish baseline sound conditions in the area of the proposed wind turbine. Ambient noise monitoring was conducted at three locations indicated in Figure 3-6 and Appendix A, Figure 10. The monitoring sites surround the proposed wind

turbine site and were selected to be representative of several residential receptor areas near the wind turbine. The measurement positions were as follows:

Position 1: 224 Burke Street; Position 2: 204 Sylvanus Street; Position 3: 600 Park Street Lot 9

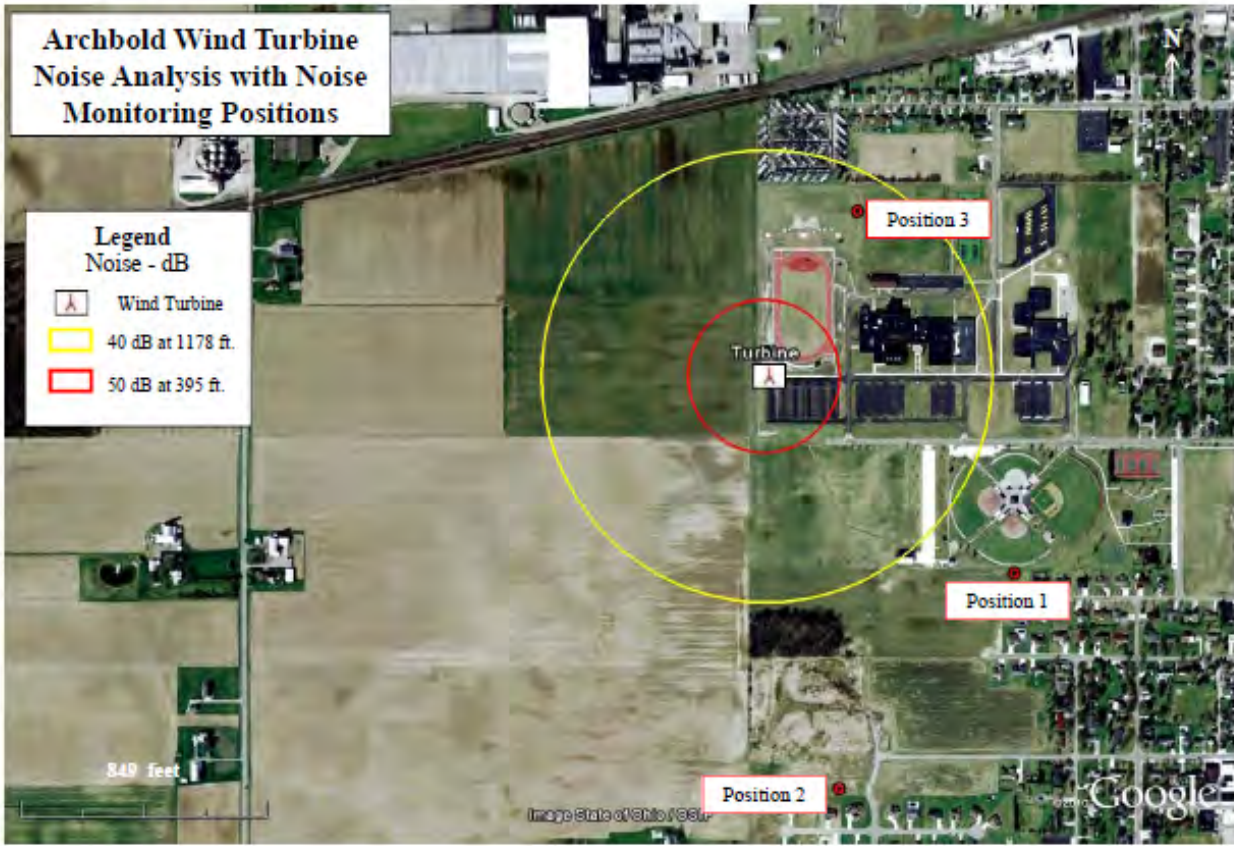


Figure 3-6. Monitoring Sites for Measuring Baseline Sound Conditions and Predicted Turbine Sound Level Contours

Measurements were conducted using Larson-Davis Model 820 Type I sound level meters. Data at each site were collected between the hours of 2 p.m. on Saturday, November 13, 2010, and 2 p.m. on Sunday, November 14, 2010. Table 3-4 provides a summary of the baseline sound monitoring results.

Table 3-4. Summary of Baseline Sound Monitoring Results in A-weighted Decibels

Monitoring Site	Distance to Turbine Site (feet)	L_{eq} 24-Hour	Hourly L_{90} Range	L_{eq} Daytime[a]	L_{eq} Nighttime[b]	DNL
Position 1	1,650	51.2	30.3 to 42.5	51.2	51.2	57.6
Position 2	2,200	49.2	29.8 to 37.6	48.5	50.1	56.4
Position 3	990	52.8	32.5 to 44.4	52.9	52.5	59.0

a. Daytime: 7 a.m. to 10 p.m.
b. Nighttime: 10 p.m. to 7 a.m.
Note: L_{eq} values and Position 1 are coincidentally the same.
DNL = Day-Night Average Sound Level; L_{eq} = equivalent continuous sound level; L_{90} = sound level exceeded 90 percent of the time.

Noise sources in the project area include auto and truck traffic, air-conditioning units, insects, birds, trains on the track north of the site, and activities at the school.

Direct and Indirect Impacts

Construction of the wind turbine would temporarily result in increased noise and vibration. Operation of the wind turbine would be a permanent source of noise until the turbine was decommissioned.

Construction of the turbine would involve the use of heavy construction including the equipment listed in Table 3-5. Table 3-5 also presents typical noise levels produced by this equipment. L_{max} sound levels at 50 feet are shown along with the typical acoustic use factor. The acoustic use factor is the percentage of time each piece of construction equipment is assumed to be operating at full power (i.e., its noisiest condition) during construction and is used to estimate L_{eq} values from L_{max} values. For example the L_{eq} value for a piece of equipment that operates at full power 50 percent of the time (acoustical use factor of 50) is 3 decibel less than the L_{max} value.

Table 3-5. Typical Construction Noise Emission Levels

Equipment	Typical Noise Level (L_{max})[a]	Acoustical Use Factor	Typical Noise Level (L_{eq})[a]
Compactor (ground)	83	20	76
Dozer	82	40	78
Dump Truck	76	40	72
Excavator	81	40	77
Generator	81	50	78
Grader	85	40	81
Pickup Truck	75	40	71
Warning Horn	83	5	70
Crane	81	16	73

Source: US DOT 2006.
a. A-weighted decibel level, measured at 50 feet.

The three noisiest pieces of equipment likely to operate at the same time include a grader, a dozer, and a generator. Simultaneous operation of this equipment would result in a noise level of 84 dBA (L_{eq}) at 50 feet. Based on the assumed simple geometric attenuation of 6 decibel per doubling of distance the noise level at the nearest residences (at about 1,000 feet) would be 58 dBA (L_{eq}). Because construction noise would be temporary and intermittent during daytime hours, no adverse effect from construction noise is expected. With regard to vibration, no highly dynamic equipment such as a pile driver would be used. Given this and the fact that residences are about 1,000 feet from the turbine site, no adverse vibration impacts from construction activity would occur.

Archbold has selected the Aeronautica 54-750 wind turbine,[1] and it has several characteristics that reduce aerodynamic sounds levels in comparison with other and primarily older wind turbine designs. The Aeronautica 54-750 is an upwind turbine, meaning the turbine faces into the wind and the wind encounters the rotor blades before the tower and the nacelle, which makes for

1. The noise analysis presented in this EA represents data for the Aeronautica 47-750 turbine. However, both the 54-750 and 47-750 are reported to have an A-weighted sound power level of 100.0 decibels. Accordingly, data for the Aeronautica 47-750 are considered to be representative of the Aeronautica 54-750, which is the turbine Archbold has selected.

quieter operations than a downwind turbine. It has relatively low rotational speeds and pitch control on the rotors, both of which reduce sound levels. Complete technical information including sound data is provided in Appendix D, Attachment D3.

Figure 3-7 shows A-weighted wind turbine sound pressure levels at 1.5 meters (5 feet) above ground level calculated by the wind turbine manufacturer at a wind speed of 8 meters (26 feet) per second.

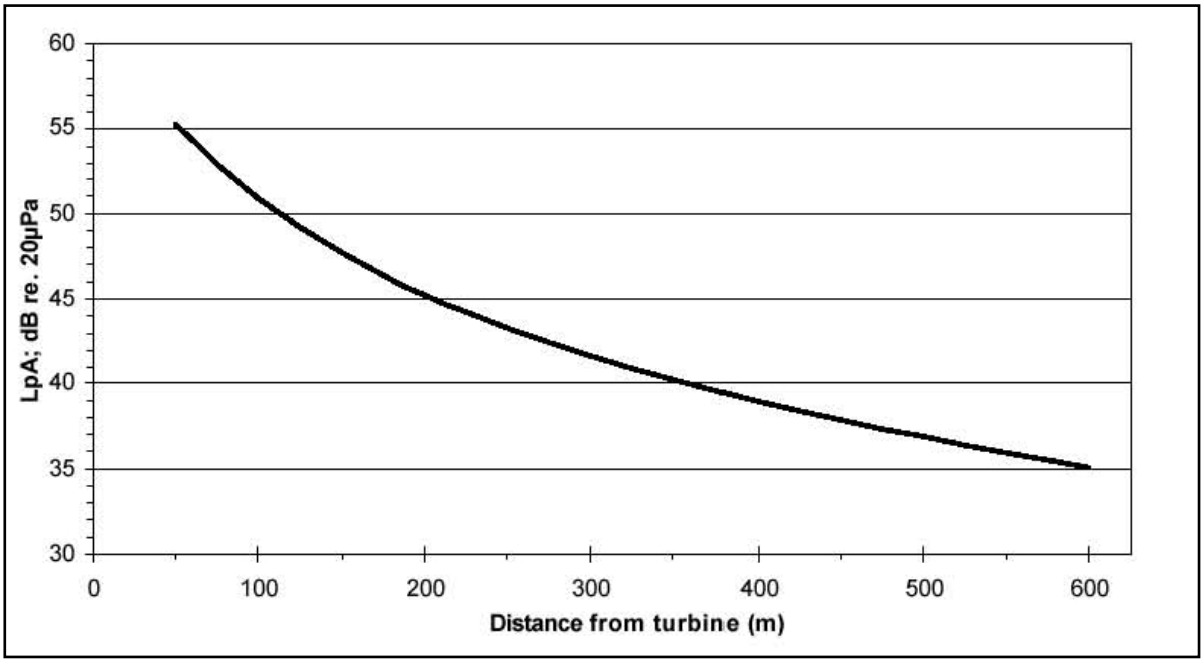


Figure 3-7. Aeronautica 54-750 Sound Pressure Level as a Function of Distance

Table 3-6 presents sound level values that have been provided by the manufacturer.

Table 3-6. Turbine Sound Levels at Various Distances

Distance (feet)	A-Weighted Sound Level
1,992	35
1,178	40
676	45

Table 3-7 summarizes the predicted steady state turbine sound level and the corresponding DNL value at each receptor location where measurements were taken. Measured DNL values are also shown. DNL can be calculated from the steady state sound level value assuming that the turbine operates continuously over a 24-hour period. The conversion between a steady state sound level and DNL is 6.4 dBA. For conservative purposes, 7 dBA was added to the steady state sound level to estimate DNL.

Table 3-7. Predicted Turbine DNL Sound Levels

Monitoring Site	Distance to Turbine Site (feet)	Predicted Turbine Steady State Sound Level (dBA)	Predicted Turbine DNL	Measured DNL
Position 1	1,650	37	44	57.6
Position 2	2,200	34	41	56.4
Position 3	990	42	49	59.0

dBA = A-weighted decibel; DNL = Day-Night Average Sound Level.

The predicted turbine sound levels in the range of 37 to 42 dBA are below the Village of Archbold's wind turbine noise standard of 50 dBA, and the DNL values in the range of 41 to 49 dBA are below the EPA recommended sound level of 55 DNL.

Figure 3-6 (above) shows the estimated 40 dBA and 50 dBA wind turbine noise contours. These contours indicate that no off-campus receptors would be included within the 50 dBA or the 48 dBA (equivalent to 55 DNL) noise contour.

Table 3-8 compares predicted steady state turbine sound levels to the range of L_{90} values measured at each site.

Table 3-8. Comparison of Predicted Turbine Noise Levels to Measured L_{90} Values

Monitoring Site	Distance to Turbine Site (feet)	Predicted Turbine Steady State Sound Level (dBA)	Hourly L_{90} Range
Position 1	1,650	37	30.3 to 42.5
Position 2	2,200	34	29.8 to 37.6
Position 3	990	42	32.5 to 44.4

dBA = A-weighted decibel.

Table 3-9 indicates that predicted wind turbine noise levels are expected to be at or above many of the hourly L_{90} values measured at each site. Therefore, turbine sound may be audible at nearby residences. Audibility does not necessarily mean an adverse noise effect will occur. The magnitude of the increase in noise level relative to ambient noise conditions is evaluated to determine the severity of the noise impact.

An adverse noise impact is considered to occur if the wind turbine noise is predicted to increase the ambient daytime or nighttime L_{eq} value at residences by more than 3 dBA. Tables 3-9 and 3-10 summarize the noise impact analysis.

Table 3-9. Daytime Noise Impact Analysis

Site	Daytime Ambient L_{eq} (dBA)	Turbine Sound (dBA)	Daytime Ambient plus Turbine Sound	Increase (dBA)
1	51.2	37	51.4	0.2
2	48.5	34	48.7	0.2
3	52.9	42	53.2	0.3

dBA = A-weighted decibel; L_{eq} = equivalent continuous sound level.

Table 3-10. Nighttime Noise Impact Analysis

Site	Nighttime Ambient L_{eq} (dBA)	Turbine Sound (dBA)	Nighttime Ambient plus Turbine Sound	Increase (dBA)
1	51.2	37	51.4	0.2
2	50.1	34	50.2	0.1
3	52.5	42	52.9	0.4

dBA = A-weighted decibel; L_{eq} = equivalent continuous sound level.

The results in Tables 3-9 and 3-10 indicate that operation of the proposed wind turbine would not result in noise increases greater than 3 dBA at residences in the project vicinity.

The proposed wind turbine would be located in close proximity to the Archbold High School track and football field. As indicated in Figure 3-6, turbine sound levels are predicted to exceed 50 dBA across the southwest portion of the track and field. Speech communication capabilities when background noise levels are greater than 50 dBA could require raised voices for distances up to 20 feet. Normal voice communications can occur when background noise levels are at or below 50 dBA (Nelson 1987). The Archbold High School building east of the proposed turbine location would be located within the range of 40 to 50 dBA. Normal speech communication would be maintained and individuals would be able to communicate with normal outdoor voices in the areas surrounding the school. In addition, the school buildings would provide further noise attenuation and turbine noise would not be audible by occupants of the buildings (students and teachers).

Primary outdoor activity areas at the Archbold Elementary School (further east from the high school) are largely beyond the 40 dBA contour and normal communication would not be impaired.

Based on the results presented above, operation of the proposed wind turbine would not result in adverse noise impacts.

3.2.2.4 Cultural Resources

The *National Historic Preservation Act* (16 U.S.C. 470 *et seq.*; NHPA) is the primary Federal law protecting cultural, historic, American Indian, and Native Hawaiian resources. Section 106 of the NHPA (36 CFR Part 800) requires Federal agencies to assess and determine the potential effects of their proposed undertakings on prehistoric and historic resources (e.g., sites, buildings, structures, and objects) and to develop measures to avoid or mitigate any adverse effects. Compliance with Section 106 requires consultation with a State Historic Preservation Officer (SHPO). Historic data were reviewed and analyzed by a senior architectural historian who meets the Secretary of the Interior's Professional Qualification Standards (36 CFR Part 61) in architectural history, history, or archaeology. On October 26, 2010, DOE requested Ohio SHPO consultation and submitted a Section 106 Compliance Report to OHPO (Appendix E, Attachments E2, E3, and E4).

In addition, pursuant to Section 106, DOE is required to consult with American Indian tribes about the potential effects of DOE's proposed undertakings on prehistoric and historic resources and to develop measures to avoid or mitigate any adverse effects. DOE uses a list maintained by the U.S. Bureau of Indian Affairs, entitled "Indian Entities Recognized and Eligible to Receive

Services from the U.S. Bureau of Indian Affairs" (72 FR 13648, March 22, 2007), to determine which tribes to contact. Based on this document, DOE determined that there are no Federally recognized tribes in the state of Ohio. Moreover, there is no Tribal Historic Preservation Officer for the State of Ohio according to the National Association of Tribal Historic Preservation Officers. However, DOE provided the Notice of Scoping and the Draft EA to 57 Tribal Nation representatives that are regularly notified of Federal actions in the State of Ohio.[2] To date, none of the tribes contacted has responded to DOE's scoping letter or Draft EA. DOE will continue its outreach to these tribal representatives by providing them with the Notice of Availability of this Final EA.

Consulting Party Participation

The following organizations were notified of the project through the DOE EA scoping process and were invited to comment on the Draft EA:

- Fulton County Historical Society
- Fulton County Commissioners
- Village of Archbold
- German Township Board of Trustees

Prior to the OHPO submission, the project was reviewed and made available for public comment in both School Board and Village Planning and Zoning meetings as part of Archbold's public involvement. The project has also been extensively covered in the local media. Appendix D, Attachment D2 contains a list of public meetings and newspaper articles related to the proposed project. Additionally, DOE sent Notice of Scoping postcards to Federal, State, and local agencies to solicit comments on the scope of potential environmental issues to be examined in this EA. Discussion of the scoping process used for the proposed project is provided in Section 1.5.1.

As part of DOE's ongoing responsibilities under NHPA, DOE sent a copy of the Draft EA and appendices related to historic and cultural resources to the consulting parties identified as part of the Section 106 consultation with OHPO.

Archaeological and Aboveground Areas of Potential Effects

The direct area of potential effect (APE) is defined as the area disturbed for construction of a project. However, there is no definitive rule for determining an indirect APE for a wind turbine, which can create both visual and audible effects on the adjacent properties, otherwise known as the aboveground APE.

Clarification of the Archaeological APE

The APE established for archaeological resources focuses on the zone of direct ground disturbance associated with the construction of the proposed project. The installation of the proposed project would result in temporary ground disturbing activities to 1,600 square feet for the turbine foundation (ultimately a 256-square-foot permanent footprint) and 2,000 square feet of temporary ground disturbance associated with installation of the underground electrical wires. The final permanent footprint of the turbine would be 256 square feet. The wind turbine foundation would extend approximately 10 feet below the ground surface.

2. List used by the U.S. Army Corps of Engineers Buffalo District for actions occurring in the State of Ohio.

Clarification of the Aboveground APE

In defining the aboveground APE, both direct and indirect effects were considered. As a conservative measure, a 2-mile APE for indirect effects was established based on the height of the proposed wind turbine, the surrounding topography, tree cover and urban forest in the vicinity of the proposed tower and simulated visualizations of the proposed wind turbine. Noise and flicker effects are quite localized and do not extend far beyond the school property, and therefore did not affect the indirect APE. Visual effects became the driver for selecting the APE. The 2-mile APE was selected as the maximum distance in which the tower would be seen (see Appendix E, Attachments E3 and E4). Direct, physical effects would only occur at the construction site itself. In determining the APE for indirect effects, the visual character and the setting of the surrounding area was considered, especially the presence of existing vertical structures in the viewshed. A computer-generated visual simulation of the viewshed of the proposed project as it would be viewed from public spaces was analyzed to determine an appropriate APE as well as potential impacts on the visual character of the community and the region's associated landscape. These are discussed in greater detail in Section 3.2.2.2 of this EA.

The likelihood of a clear, unobstructed view of the proposed project beyond 2 miles is small and diminishes rapidly as one travels farther away from the site. Varied topography, such as elevation changes, and other site-specific characteristics, such as power line corridors, structures associated with human development, tall towers, the tree canopy, and other natural areas all serve as common visual obstructions that block expansive views of a given project site from various directions. In particular, the extent to which a single turbine dominates the landscape diminishes with distance. A 2-mile APE is justified for determining the effects, including visual effects, of the proposed project, as it represents a reasonable effort to assess visual effects of the proposed project based on available technology and the existing physical character of the area.

Identification of Historic Aboveground Properties in APE

No properties listed on the *National Register of Historic Places* were identified within the APE. Three properties listed on the Ohio State Register of Historic Places in accordance with ORC 149.30 were found to be located within the 2-mile indirect APE established for this project. All three properties are located approximately 1.5 miles to the northeast of the proposed turbine site, at which distance the turbine would barely be visible and would appear very small on the horizon if visible at all. No archeological sites are likely to exist within or adjacent to the APE. No American Indian sites are listed, reported, or found within or near the APE. However, the absence of designated properties does not indicate that no properties could be listed or determined eligible. Archbold is a small farming community of about 4,200 people and may have been bypassed by the types of activities from which determinations of eligibility typically arise, such as Federally funded highway projects.

Because the APE for this undertaking is so large—a 2-mile radius around the turbine site—there were found to be more than 100 potentially eligible properties within the APE. For the purpose of analyzing potential effects to historic properties, the Section 106 submission assumed that all pre-1960s properties were eligible for listing in the *National Register of Historic Places*. The assumption applied only to the proposed project.

The Renaissance Group inventoried all buildings and structures built before 1960, located within the 2-mile radius indirect APE. A total of 159 properties were found to be constructed prior to

1960 within this 2-mile radius. These properties fall into two basic categories: urban use properties (almost all of them single-family homes) found in the Central Quadrant; and rural properties (nearly all of them farmhouses and farm structures), located within the other four quadrants. The qualities of these properties differ considerably from one quadrant to the next.

Identification Historic Below Ground Properties in APE

There are no National Register-listed properties within the direct APE for this undertaking. The direct APE, as discussed earlier, is limited to the area zone where ground-disturbing activities would occur for the proposed project. The direct APE is in an area that is located at the west edge of the Archbold High School campus at the southwest corner of the school's football field. This property has been used for decades as a football field for the local high school and has been graded and otherwise disturbed for construction of the field. In terms of potential for buried properties (e.g., archaeological sites), the parcel is so extensively modified, that no suspected intact archaeological site is believed to exist at the site.

Direct and Indirect Impacts

As noted above, the proposed turbine site has been used for decades as a football field and has been graded and otherwise disturbed for construction of the field. Therefore, it was determined that the parcel is so extensively modified, that no suspected intact archaeological site is believed to exist at the project site.

As discussed in Section 3.2.2.3, no property adjacent to the project site would be adversely affected by noise above or near the local ordinance levels or above the existing ambient levels. Also, no property adjacent to the project site would be affected by shadow flicker at or near internationally accepted standards of 30 hours or less and no listed or potentially listed historic property would receive any shadow (see Section 3.2.2.2). No direct impacts (ground-disturbing impacts) on listed or potentially listed historic properties or cultural assets are anticipated.

Visual impacts to historic properties are diminished greatly by the three variables which affect the potential for such impact: distance from the source; intervening barriers, and the degree to which the significance of historic properties depends upon an unobstructed setting. The closest properties—those within the Village of Archbold—are shielded from visual impacts by the urban forest. The rural properties do not benefit from the urban forest but are generally at such a distance as to make the visual impact minor . Furthermore, installation of the wind turbine would not introduce a visual element that would diminish the integrity of the significant features of any properties located within the APE. Therefore, DOE concluded that the undertaking would result in No Adverse Effect to any of the assumed historic properties within the APE.

On December 6, 2010, OHPO provided a written response to DOE indicating that its cultural resource review was complete and concurred with DOE "that the proposed project will have no adverse effects on historic properties" (Appendix E, Attachment E1). The OHPO also agreed that the site was unlikely to reveal presence of archeological resources and determined that an archeological survey was not warranted. However, if archaeological resources are encountered during construction, Archbold would halt construction activities and the OHPO would be contacted for further instruction regarding additional studies and/or potential mitigation measures required in accordance with the NHPA.

3.2.2.5 Geology and Soils

The majority (57 percent) of the soil found within the project site consists of Latty silty clay and Fulton silty clay loam (NRCS 2010). Table 3-11 shows a complete list of soils present within the project site. No soils listed by the U.S. Department of Agriculture as prime farmlands or unique or rare soils exist within the project site (NRCS 2010) (see also Appendix D, Attachment D7).

The nearest county for which seismic activity is available is Shelby County, located approximately 100 miles south of Fulton County and is not considered a significant seismic risk. Shelby County, has experienced more earthquakes than any other area in the state of Ohio, most of which were small (ODNR 2007). Approximately 40 felt earthquakes have occurred in this part of western Ohio, although most caused little to no damage.

Table 3-11. Fulton County, Ohio Project Site Soil Composition

Map Unit Symbol	Map Unit Name	Acres in Project Site	Percent of Project Site
DfA	Del Rey silt loam, 0 to 3 percent slopes	8.4	10.3
FtA	Fulton silty clay loam, 0 to 2 percent slopes	18.7	22.9
FtB	Fulton silty clay loam, 2 to 6 percent slopes	5.8	7.1
HkA	Haskins loam, 0 to 3 percent slopes	6.3	7.7
KfA	Kibbie loam, 0 to 3 percent slopes	11.7	14.4
Lc	Latty silty clay	22.1	27.1
Lf	Lenawee silty clay loam	8.5	10.4
Totals for Project Site		**81.7**	**100.0**

Direct and Indirect Impacts

Soil disturbance would occur as a result of site preparation and construction. Approximately 1,600 square feet of current open space would be disturbed for the foundation (permanent impact to 256 square feet) and another approximately 2,000 square feet of open space would be temporarily disturbed for the electrical interconnecting trench, for a total of approximately 3,600 square feet. Temporary and permanent ground-disturbing activities would be less than 1 acre and not require an NPDES Storm Water Program Permit. However, Archbold has committed to using sediment and erosion pollution control BMPs in conformance with a plan specific to the proposed project. Therefore, the proposed project would have a negligible effect on geology and soils.

Data reviewed from the Ohio Department of Natural Resources would suggest there is a low risk of seismic activity jeopardizing the structural integrity of the proposed wind turbine and foundation.

3.2.2.6 Biological Resources

Biological resources include native or naturalized plants and animals and the habitats that support their various life stages. Species that are considered sensitive, either under Federal or State law or regulations publicized by agencies, are specifically addressed in this section.

Project Site

The proposed project site consists of a fully developed high school site that includes various classroom, administration, and physical activity buildings and parking facilities. There are also ball fields, and a football stadium. The greater surrounding area is mainly rural residential and cultivated fields. The nearest wooded lot is approximately 1,250 feet south of the proposed turbine site. This wooded lot is completely isolated and lacks connectivity to any other wooded areas. The nearest stream corridor is 0.75 mile south of the site and it does contain a riparian canopy, except in a few scattered reaches of the stream.

Federally and State-listed Species

Information regarding the potential occurrence of Federally listed species was reviewed using the USFWS Endangered Species website and a list of potentially occurring listed species for Fulton County, Ohio (USFWS 2010). Federally listed species potentially occurring in Fulton County include Indiana bat (*Myotis sodalis*), endangered; Eastern Massasauga (*Sistrurus catenatus*), candidate species; and rayed bean mussel (*Villosa fabalis*), proposed as endangered.

The Renaissance Group requested that ODNR complete a review of the proposed project. According to the letter received from ODNR dated August 27, 2010, its review was conducted by an interdisciplinary team within ODNR in accordance with its authority under the *Fish and Wildlife Coordination Act* (48 Stat. 401, as amended; 16 U.S.C. 661 *et seq*.), NEPA, the *Coastal Zone Management Act*, Ohio Revised Code, and other applicable laws and regulations (see Appendix C, Attachment C1).

ODOW, a division under ODNR, identified State-listed species that may occur within the vicinity of the proposed project and the project's potential impacts on wildlife species (Appendix C, Attachment C1). The ODOW Ohio Biodiversity Database contains no data at this project site. ODOW's letter also indicated that the project lies within the range of the Indiana bat, a State- and Federally listed endangered species. Indiana bat habitat consists of suitable trees that include dead and dying trees of the species listed below with exfoliating bark, crevices, or cavities in upland areas or riparian corridors and living trees of the species listed below with exfoliating bark, cavities, or hollow areas formed from broken branches or tops. ODOW identified the following species of trees as having relatively high value as potential Indiana bat roost trees: shagbark hickory (*Carya ovata*), shellbark hickory (*Carya laciniosa*), bitternut hickory (*Carya cordiformis*), black ash (*Fraxinus nigra*), green ash (*Fraxinus pennsylvanica*), white ash (*Fraxinus americana*), shingle oak (*Quercus imbricaria*), northern red oak (*Quercus rubra*), slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), eastern cottonwood (*Populus deltoides*), silver maple (*Acer saccharinum*), sassafras (*Sassafras albidum*), post oak (*Quercus stellata*), and white oak (*Quercus alba*).

ODOW also identified the project site as being within the range of the rayed bean (*Villosa fabalis*), a State-endangered and Federal candidate mussel species. This species requires small headwater streams or sometimes large rivers for its habitat. The project site does not contain either small headwater streams or large rivers.

The project site also lies within the range of the Eastern Massasauga rattlesnake (*Sistrurus catenatus*), a State-endangered and a Federal candidate snake species that is typically found near

sedge meadows, peatlands, wet prairies, open woodlands, and shrublands, none of which exist within the project area.

Migratory Birds and Bald Eagle

The *Migratory Bird Treaty Act* (16 U.S.C. 703-7012; MBTA) implements four international conventions that provide for international protection of migratory birds. The MBTA prohibits taking, killing, possessing, transporting, or importing migratory birds, their eggs, parts, and nests, except when specifically authorized by the U.S. Department of the Interior. While the MBTA has no provision for allowing unauthorized take, USFWS recognizes that some migratory birds may be taken during activities such as wind turbine operation even if all reasonable measures to avoid a take have been implemented.

Bald and golden eagles are included under the MBTA, and are afforded additional legal protection under the *Bald and Golden Eagle Protection Act* (16 U.S.C. 668-668d). Both USFWS and ODNR reviewed the proposed project for potential adverse environmental impacts. USFWS indicated in its September 2, 201,0 letter that it has no records of bald eagle nesting within 5 miles of the project site and that the site did not generally provide high-quality bald eagle habitat.

The proposed project site is located in an area that is predominantly cultivated crops, which do not provide suitable nesting habitat for migrating birds or suitable stopover habitat for migrating birds that may move across the project area. The nearest Audubon-designated Important Bird Area is over 20 miles northeast, at the Oak Openings Park in Swanton, Ohio.

Direct and Indirect Impacts

The USFWS and ODOW determined that, due to the location of the proposed project and lack of suitable habitat, it was not likely to affect the Eastern Massasauga rattlesnake (see Appendix C, Attachments C1 and C3). Additionally, no in-water work is proposed; therefore, the UFSWS and ODOW determined the proposed project is not likely to affect the rayed bean mussel and ODOW further determined that a rayed bean survey would not be necessary.

ODOW determined that no effects to the Indiana bat would occur as a result of the proposed project unless potential tree habitat would be affected. The proposed project site is surrounded by agricultural lands with a few scattered trees in the immediate vicinity, and the nearest small stand of trees is more than 0.5 mile to the east. No suitable trees occur within the project site and no trees would be cut or affected by the construction and installation of the proposed project.

The USFWS provided a response to DOE's Notice of Scoping in which it stated that the proposed project lies within the range of the Indiana bat, but is not within 20 miles of hibernacula nor within 1,000 feet of a wooded lot. Based on this, the USFWS determined that the proposed wind turbine would not affect maternity, roosting, foraging, or commuting habitats and, thus, would not adversely affect the Indiana bat (see Appendix C, Attachment C3). Both ODNR and USFWS determined that the proposed project was not anticipated to affect any Federally or State-listed species.

During turbine siting, design, and installation of the proposed project, Archbold gave consideration to the recommendations contained within the *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* (USFWS 2003) and incorporated those

recommendations and included them as proponent-committed measures, as appropriate, to avoid and minimize potential impacts to migratory birds and bald and golden eagles. The proposed project is a single wind turbine located in already disturbed habitat. The proposed turbine design is a monopole, with no external features, and all electrical lines would be underground. The area around the proposed turbine location is mainly agricultural and does not provide significant bird habitat nor does the project fragment any such habitat. Although the proposed project would require temporary access and staging of approximately 2 acres, this area is predominantly maintained landscaped grass and an existing asphalt parking lot. Aviation lighting would utilize the minimum required by the FAA to minimize potential bird and bat impacts.

Any impacts to migratory birds are anticipated to be minor as a result of the proposed project. Additionally, because bald eagles are not known to nest within 5 miles of the turbine site and the turbine was sited in an area that does not generally provide high-quality bald eagle habitat, take of bald eagles is unlikely.

3.2.2.7 Human Health and Safety

Workers have the potential to be injured or killed during construction, operation, and decommissioning of wind turbines through industrial accidents such as falls, fires, and dropping or collapsing equipment. Such accidents are uncommon in the wind industry and are avoidable through implementation of proper safety practices and equipment maintenance.

Collapse of a turbine or breakage (and throwing) of one or more turbine blades is possible, but both are very unlikely occurrences. Debris falling from these occurrences would likely be limited to a calculated fall zone, which is defined to approximate the area around the base of the turbine that would likely receive the tower and turbine if it were to fall. The calculated fall zone for the project site was determined as an area equal to 1.1 times the total turbine height or a radius of approximately 332 feet (see Appendix A, Figure 4). No structures or buildings exist within this fall zone; however, a portion of the football stadium and parking lot are located within the fall zone (approximately 155 feet away). Estimates of blade throw vary, but MacQueen et al. (1983) estimate the probability of being struck outside the fall zone zones (i.e., within one blade diameter of the tower base) is about 10^{-7} per year (or one chance in 10 million) for a fixed building, and substantially less for people who are mobile.

Other potential sources of accidents are ice shedding and lightning. Ice shedding, or ice throw, refers to the phenomenon that can occur when ice accumulates on rotor blades and subsequently breaks free or melts and falls to the ground. Although a potential safety concern, it is important to note that, while more than 90,000 wind turbines have been installed worldwide, there has been no reported injury caused by ice thrown from a turbine (Tetra Tech EC, Inc. 2007). The proposed project would be supplied with ice sensors on the turbine blades. When ice forms, the sensors would engage and the turbine would not be permitted to rotate until the ice had melted. This technology is intended to prevent ice throws. Ice that has accumulated on the blades would fall to the foot of the turbine as it melts. To prevent accident or injury from ice that falls as it melts, the turbine manufacturer requires the area directly underneath to be a clear zone.

A study conducted for the National Renewable Energy Laboratory was successful in identifying damage mechanisms due to direct and indirect effects of lightning strikes on wind turbines.

Lightning strikes can cause extensive damage to the turbine blades, controllers, and power electronics (NREL 2002). However, this damage can be reduced by protection from tall nearby communication towers, integral blade protection in the form of conductors, bonding to minimize arcing, good turbine grounding, controller cable and controller shielding, and transient voltage surge suppression. The amount of lightning damage is a factor of the lightning activity in the area, the height and prominence of the turbine, the terrain, and the lightning protection system in place. According to the National Oceanic and Atmospheric Administration, Ohio has mid-range lightning activity (an average of 40 annual thunderstorm days).

According to the FAA, two airports, the Fulton County Airport in Bryan, Ohio, and the Williams County Airport in Wauseon, Ohio, are within a possible impacts range of less than 10 miles from the project site. All structures taller than 200 feet, as is the case with the proposed project, are required to have aircraft warning lights in accordance with requirements specified by the FAA.

An initial soil field and laboratory study was conducted for the proposed project site by Bowser Morner in 2006. Soils sampled exhibited concentrations of volatile organic compounds, semivolatile organic compounds, and metals well below Ohio Voluntary Action Program standards (Appendix D, Attachment D7).

The term electromagnetic field (EMF) refers to electric and magnetic fields that are present around any electrical device. Electric fields arise from the voltage or electrical charges and magnetic fields arise from the flow of electricity or current that travels along transmission lines, collector lines, substation transformers, house wiring, and electrical appliances. The intensity of the electric field is related to the voltage of the line and the intensity of the magnetic field is related to the current flow through the conductors (wire). EMFs can occur indoors and outdoors. While the general consensus is that electric fields pose no risk to humans, the question of whether exposure to magnetic fields potentially can cause biological responses or even health effects continues to be the subject of research and debate. However, wind turbines are not considered a significant source of EMF exposure since emissions levels around wind farms are low (CMOH 2010).

Because no fuel is used in wind energy projects, there would be no process waste streams generated during operation of the wind turbine that could cause health and safety concerns. Some lubricants are used in wind turbines, including gearbox oil, hydraulic fluid, and gear grease, that require periodic replacement. These lubricants would be managed in accordance with Federal, State, and local regulations.

Direct and Indirect Impacts

No adverse public health and safety impacts are anticipated from the proposed project. Safety signage would be posted around the tower (where necessary); transformers and other high-voltage facilities would be in conformance with applicable Federal, State, and local regulations.

All contractors, subcontractors, and their personnel would be required to comply with all Federal and State worker safety requirements, specifically all of the applicable requirements of OSHA. Safety procedures specific to the Aeronautica 54-750 turbine would be observed whenever work is done on the turbine.

The soil sample collected as part of the initial soil field and laboratory study exhibited concentrations of volatile organic compounds, semivolatile organic compounds, and metals well below Ohio Voluntary Action Program standards. Therefore, excavation of the soils would pose no risks to contractor health or to the environment in general (Bowser Morner 2006).

During construction, the project site would be secured as described in the *Turbine Use, Safety Policies and General Background* document (see Appendix D, Attachment D5). In addition, the Aeronautica 54-750 does not allow opportunities for outside climbing.

As described earlier, risk of turbine collapse is very rare (Klepinger 2007). Based on the extreme rarity of tower collapse or blade throw and the fact that people would not be located within the fall zone for extended periods of time, the risk to public safety due to such occurrences would be negligible.

The turbine system would have an automated system fault shut-off triggered, at a minimum, by the following sensors: system temperature, power quality, vibration, over-speed, fire and icing (vibration caused by blade icing-induced imbalances would automatically shut down the turbine). This system would also automatically send fault codes to preauthorized personnel through a web interface. The turbine's nacelle would have a cold-weather package including nacelle heaters. These heaters are designed to maintain nacelle temperatures above the dew-point and well above freezing. This system would automatically melt snow and ice accumulation on top of the nacelle. The turbine system would have a staff-accessible emergency shut-off. All icing-related turbine shutdowns would require a direct inspection and an onsite manual restart. The site personnel and the system maintenance personnel would shut down the turbine in the event of an icing condition. The site would adopt an ice safety zone around the turbine for implementation during icing events. If climatic conditions create or increase risk, Archbold would ensure the area is cleared.

The FAA issued a Determination of No Hazard to Air Navigation on August 19, 2010, for the proposed project (Appendix C, Attachment C5). Based on this determination, the proposed project is not anticipated to have more than a negligible effect on the safe and efficient utilization of navigable airspace by aircraft or on the operation of air navigation facilities. Aviation lighting would be in compliance with FAA standards (FAA 2007).

Based on the most current research on EMFs, the proposed wind turbine would not impact public health and safety due to EMFs because wind turbines are not considered a significant source of EMF.

3.2.2.8 Transportation

Vehicle traffic at Archbold High School can be divided into two sectors: offsite and onsite circulation. Offsite circulation consists of staff and student movements to and from school and school events. Onsite circulation consists of student movement, sporting event traffic, and school traffic within school property.

Turbine and associated facility delivery from the Boston, Massachusetts, area would use major transportation routes and state highways including U.S Highway 44, Interstate (I)-495 945, I-84, I-80, I-81, U.S. Highway 20, Ohio Route 66, and Ohio Route 20. Off-highway access to the

project site would be via Lafayette Street and Stryker Road, which provide access to Defiance Street, the main thoroughfare through the Village of Archbold (see Appendix D, Attachment D4). No new access or other roads would be necessary for construction and operation of the proposed project.

Direct and Indirect Impacts

During the construction phase of the project, a minor increase in vehicular traffic on the local roads surrounding the project site is anticipated. This traffic increase would occur for a period of approximately 6 to 8 weeks sporadically throughout the course of construction. It is doubtful that this increase would be noticeable over the present traffic generated on a daily basis with the school's normal activities. Overflow parking for the school would be closed due to the staging of the turbine nacelle, blades, and tower in the stadium parking lot, which could contribute to a temporarily slight increase in traffic on the school campus. No long-term or permanent impacts on the local transportation systems would occur as a result of the proposed project.

3.2.2.9 Socioeconomics and Environmental Justice

Executive Order 12898 (February 11, 1994) directs Federal agencies to identify and address "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." The racial makeup of Fulton County in the 2000 Census was 97.6 percent white, compared with 84.7 percent for the state of Ohio as a whole, with the remainder of both populations constituting minorities. The median household income for a household in Fulton County in 2008 was $51,772, compared with $48,011 for the state of Ohio as a whole. About 7.8 percent of individuals were below the poverty level in 2008, compared with 13.3 percent for the state of Ohio as a whole (Bureau of the Census 2010).

Direct and Indirect Impacts

No potential high and adverse impacts related to socioeconomics or environmental justice would occur as a result the proposed project. Therefore, there would be no disproportionately high and adverse socioeconomics- or environmental justice-related impacts on minority or low-income populations.

The construction of the proposed project is expected to generate a small, short-term increase in employment from the temporary construction-related jobs for the wind turbine. Operation of the proposed project is not anticipated to generate new jobs, as it would be maintained by the school district.

3.2.2.10 Air Quality and Climate Change

The affected air environment can be characterized in terms of concentrations of the criteria pollutants carbon monoxide, sulfur dioxide, particulate matter, nitrogen oxides, ozone, and lead. EPA has established National Ambient Air Quality affected environment and environmental impacts standards for these pollutants. There are two standards for particulate matter, one for particulates with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}) and one for particulates with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers ($PM_{2.5}$). Fulton County is an attainment area for all criteria pollutants, which

means that the levels of these pollutants in the air are below the EPA standards (EPA 2010b). The EPA has found that the "aggregate group of the well-mixed greenhouse gases" constitutes an air pollutant that contributes to climate change (EPA 2010a). Carbon dioxide is a greenhouse gas and the Archbold wind turbine would have an indirect impact on reducing carbon dioxide emissions from fossil fuel sources.

First Energy Solutions provides electricity to Archbold High School. First Energy Solutions currently has a mix of fuel sources, as shown in Table 3-12. First Energy Solutions reports an average estimated grid line loss of 6.14 percent, resulting in higher realized grid power offsets for renewable energy generating sites than their actual onsite production (EPA 2010b).

Table 3-12. First Energy Solutions Fuel Mix

Source Fuel Mix (percent)	
Coal	72.8
Oil	0.4
Natural Gas	2.7
Nuclear	22.3
Renewable	1.1

Direct and Indirect Impacts

The proposed project would be an emissions-free energy generation project that would not degrade air quality. Grading and construction for the proposed project would result in short-term air quality impacts, such as dust generated by clearing and grading activities, exhaust emissions from gas- and diesel-powered construction equipment, and vehicular emissions associated with the commuting of construction workers. Emissions from construction would be minimized to the extent practicable (for example, by watering dry roads) by following BMPs.

The proposed wind energy project is expected to generate approximately 1,440,406 kilowatt-hours per year, offsetting approximately 40 percent of electricity used by Archbold High School.

The information reported from the EPA's eGRID database for calendar year 2005 shows the fuel mix for the Archbold Area as 72.8 percent coal, 2.7 percent natural gas, and 0.4 percent oil, resulting in 75.9 percent fossil fuel use (EPA 2010a). Therefore, the annual carbon reduction associated with the proposed project is calculated as follows:

> 75.9 percent fossil fuel use × 2.0562 pounds of carbon dioxide per kilowatt-hour × 1,440,406 kilowatt-hours per year = 2,247,978 pounds of carbon dioxide per year.

The proposed project would reduce Archbold's carbon footprint by reducing its reliance on fossil fuels.

3.2.2.11 Utilities and Energy

Archbold High School is well served by utility infrastructure, including electrical power transmission and municipal potable water and sanitary sewer. Electricity is provided to the school by First Energy Solutions.

The National Telecommunications and Information Administration (NTIA) is responsible for managing the Federal spectrum and is involved in resolving technical telecommunications issues for the Federal government and private sector. This information aids in siting wind turbines, so they do not cause interference in radio, microwave, radar, and other frequencies, disrupting critical lines of communication. Upon submittal by a wind project proponent, the NTIA provides project specific information to the members of the NTIA's Interdepartment Radio Advisory Committee for review and comment on whether the proposed project could potentially interfere with Federal radio communication links.

Direct and Indirect Impacts

The electrical grid interconnect of the proposed project would be composed of the turbine's controller (contained within the turbine tower-based section), approximately 1,000 feet of buried 4-inch electrical conduits, including the portions of the run embedded within the turbine tower foundation, a 690- to 12,470-volt transformer, an automatic disconnect switch, a UL1741-compliant monitoring and control device and a fused disconnect within the school's existing switchgear. The system would also have a parallel run of 2-inch conduit for data transfer and control runs. The full system would meet all local, State, and Federal codes and regulations.

The proposed project would have a nameplate capacity of 750 kilowatts and would generate approximately 1,440,406 kilowatt-hours per year on average, or enough electricity to supply up to 146 homes each year (DOE 2010). The energy generated from the proposed project would meet approximately 40 percent of the school's annual electricity needs. The proposed project is anticipated to produce a total of 28,808,120 kilowatt-hours of clean electricity for the 20-year design life of the proposed project.

On October 18, 2010, NTIA issued a letter indicating that no Federal agencies identified any concerns regarding the blockage of their radio frequency transmissions (Appendix C, Attachment C6). No microwave communications exist in the areas surrounding the project site.

3.3 Irreversible and Irretrievable Commitment of Resources

A commitment of resources is irreversible when its primary or secondary impacts limit the future options for a resource or limit those factors that are renewable only over long periods of time. Examples of nonrenewable resources are minerals, including petroleum. An irretrievable commitment of resources refers to the use or consumption of a resource that is neither renewable nor recoverable for use by future generations. Examples of irretrievable resources are the loss of a recreational use of an area. While an action may result in the loss of a resource that is irretrievable, the action may be reversible. Irreversible and irretrievable commitments of resources are primarily related to construction activities.

For the proposed project, resources consumed during construction of the project, including labor, fossil fuels and construction materials, would be committed for the life of the project. Nonrenewable fossil fuels would be irretrievably lost through the use of gasoline- and diesel-powered construction equipment during construction. Approximately 256 square feet of land would be irreversibly committed during the functional life of the project. The expenditure of Recovery Act funding from DOE would also be irreversible.

3.4 Unavoidable Adverse Impacts

Unavoidable adverse impacts associated with the proposed project include:

- Long-term loss of approximately 256 square feet of vegetation resulting from the construction of the tower foundation;
- A minimal increase in noise levels during construction;
- Introduction of an additional vertical element into the existing viewshed; and
- Minimal shadow flicker impacts for the adjacent stadium.

These impacts are both temporary, in the case of the construction noise, and long-term, in regard to the loss of vegetation and visual and shadow flicker impacts. Overall, impacts of the proposed project on the environment and human health would be minimal.

3.5 The Relationship Between Local Short-Term Uses of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity

Short-term use of the environment, as the term is used in this document, is that used during the life of the project, whereas long-term productivity refers to the period of time after the project has been decommissioned, the equipment removed, and the land reclaimed and stabilized. The short-term use of the project area for the proposed project would not affect the long-term productivity of the area. If it is decided at some time in the future that the project has reached its useful life, the turbine, tower, and foundation could be decommissioned and the site reclaimed and revegetated to resemble the pre-disturbance conditions (mowed grass). The installation of a wind turbine at this site would not preclude using the land for purposes that were suitable prior to this project.

4. CUMULATIVE IMPACTS

Cumulative impacts are those potential environmental impacts that result "from the incremental impact of the action when added to other past, present, or reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

4.1 Reasonably Foreseeable Projects

DOE considered other proposed wind turbine projects for which Recovery Act grants have been sought in Ohio. DOE also examined other proposed wind turbine projects in the vicinity of the proposed project with respect to potential cumulative impacts. There are two non-DOE-funded wind turbine projects within 50 miles of Archbold: (1) the proposed Timber Road II 98-megawatt wind turbine project in Paulding County, Ohio; and (2) the recently expanded 1.8-megawatt Bowling Green wind turbine facility in Bowling Green, Ohio. According to the Ohio Siting Board (http://www.opsb.ohio.gov/Opsb/), there are two additional proposed wind turbine projects in the state of Ohio, both of which are over 100 miles from the Archbold site. The following list includes Recovery Act SEP-funded projects and reflects the status of the NEPA documentation being developed. Specific locations are shown in Appendix A, Figure 11. NEPA documentation related to these projects is located on the DOE Golden Field Office Reading Room Website at http://www.eere.energy.gov/golden/Reading_Room.aspx.

Green City Growers Wind Development – DOE/EA-1817
(Notice of Scoping issued August 2010)
1.5-megawatt wind turbine
Inner City of Cleveland Greenhouse 55th St. and Woodland Ave, Cleveland, Ohio 44104

Kilowatts for Kenston – DOE/EA-1819
(Final EA and FONSI issued February 2011)
600-kilowatt wind turbine
9500 Bainbridge Road, Chagrin Falls, Ohio 44023

Pettisville Local Schools Wind Energy Project – DOE/EA-1818
(Final EA and FONSI issued February 2011)
500-kilowatt wind turbine
232 Summit Street, Pettisville, Ohio 43553

Toledo Joint Apprenticeship and Training Committee
(Categorical Exclusion issued February 2010)
100-kilowatt wind turbine
803 Lime City Road, Rossford, Ohio 43460

City of Toledo – EA
(Project is in the early design phase)
1-megawatt Wind Turbine at Collins Park Wastewater Treatment Facility
Toledo, Ohio

Lincoln Electric – DOE/EA-1777
(Final EA and FONSI issued August 2010)
2.5-megawatt wind turbine
22800 St. Clair Ave, Euclid, Ohio 44123

Cuyahoga County Agriculture Society – DOE/EA-1815
(Final EA and FONSI issued February 2011)
600-kilowatt wind turbine
Cuyahoga County Fairgrounds, 164 Eastland Road, Berea, Ohio 44017

Each of the DOE-funded projects includes the construction and operation of a single wind turbine. The three projects closest to the Archbold Wind Energy Project are DOE-funded single turbines. The Pettisville Local Schools Project is just over 5 miles southwest of the Archbold site. The City of Toledo and the Toledo Joint Apprenticeship and Training Committee Project are approximately 38 miles to the northeast of Archbold in Wood County, Ohio. The Bowling Green Wind Turbine Facility is approximately 38 miles east of the Archbold site. Finally, the Timber Road II Wind Project is approximately 42 miles southwest of the Archbold site. All other listed DOE Recovery Act-funded proposed wind projects, Cuyahoga County Agricultural Society Project, Green City Growers, and Kilowatts for Kenston, are well over 100 miles east of the Archbold site.

The closest projects, Toledo Joint Apprenticeship, Timber Road II, City of Toledo, and Bowling Green do not share a known migratory bird pathway with the proposed Archbold project. The proposed project is not located within a known major migratory bird pathway, and areas between these projects are mainly cultivated fields or small- to medium-sized towns. Agricultural areas do not generally provide high-quality habitat for migratory birds. The USFWS determined that the proposed project was not likely to adversely affect the Indiana bat, but it is within the overall range of migrating Indiana bats. Although impacts to migrating Indiana bats as a result of the proposed project are unlikely, the proposed project may add to the overall small potential cumulative impact to migrating Indiana bats. DOE considers the proposed project's potential to add to cumulative impacts to migratory birds to be minimal.

4.2 Summary of Cumulative Impacts

4.2.1 GREENHOUSE GAS IMPACTS

While the scientific understanding of climate change continues to evolve, the Intergovernmental Panel on Climate Change Fourth Assessment Report has stated that warming of the earth's climate is unequivocal, and that warming is very likely attributable to increases in atmospheric greenhouse gases caused by human activities (anthropogenic) (IPCC 2007). The Panel's Fourth Assessment Report indicates that changes in many physical and biological systems, such as increases in global temperatures, more-frequent heat waves, rising sea levels, coastal flooding, loss of wildlife habitat, spread of infectious disease, and other potential environmental impacts are linked to changes in the climate system, and that some changes may be irreversible (IPCC 2007).

The proposed project would not have direct greenhouse gas emissions but would result in the reduction of emissions of greenhouse gases associated with electricity previously generated from fossil fuel sources. The Archbold Wind Energy Project would generate 1,440,406 kilowatts of emission-free electricity per year, corresponding to a reduction of 2,247,978 pounds per year of carbon dioxide-equivalent emissions. There would be small amounts of greenhouse gases emitted as a result of construction and transportation activities related to the proposed project.

4.2.2 VISUAL RESOURCES

The only other turbine visible from the Archbold location would be the proposed turbine in Pettisville, and it would only be visible in a few isolated locations. None of the other projects can be seen from Archbold. Thus, no cumulative impacts on visual resources are expected. The closest communication tower is just less than 1 mile away and stands 315 feet tall. There are three other towers within 2 miles of the proposed Archbold turbine site between 115 and 290 feet tall. Because of the flat terrain, vertical elements in the region can often be seen from over a mile, but appear relatively small on the horizon. The addition of the proposed wind turbine would provide an additional vertical structure within the viewshed. Overall, there would be a minimal cumulative impact on visual resources.

4.2.3 BIOLOGICAL RESOURCES

All of the DOE-funded wind turbine projects are reasonably foreseeable single wind turbine projects. Almost all of the listed projects (with the exception of the City of Toledo Project and the Toledo Joint Apprenticeship project, which received categorical exclusions) have received a letter from the USFWS and ODNR indicating that the Indiana bat is not likely to be adversely affected as a result of the turbines individually. ODOW and USFWS would require all of the above-referenced wind projects to consider or have considered the recommendations contained in the *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* (USFWS 2003) as part of their siting, design, and installation, thereby reducing potential impacts to migratory birds and other species. The two non-DOE-funded wind turbine projects (Timber Road II and Bowling Green) do not share a known migratory bird pathway with the proposed project, and the areas between these projects are mainly used for agricultural purposes. The potential to cumulatively impact migratory birds is minimal. The installation of the single wind turbine at the nearby Pettisville site and other projects in eastern Ohio (Bowling Green, Toledo, and Timber Road II) would negligibly increase a potentially low cumulative impact on migrating Indiana bats.

Because of the small scale of each individual project and the sufficient distance between projects, there are no reasonably foreseeable cumulative impacts.

5. REFERENCES

Australia NHMRC (Australia National Health and Medical Research Council) 2010. Wind Turbines and Health – A Rapid Review of the Evidence, July 2010. Available online at: http://www.nhmrc.gov.au/publications/synopses/new0048.htm (accessed on September 8, 2010).

BLM (Bureau of Land Management) 2005. "Chapter 5. Potential Impacts of Wind Energy Development and Analysis of Mitigation Measures." *Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States*. FES -5-11. June 2005. U.S. Department of the Interior, Bureau of Land Management.

Bowser-Morner 2006. *Soil Exploration, Proposed Football Field, Archbold High School, 600 Lafayette Street, Archbold, Fulton County, Ohio*. Report # 137436-0406-0205. April 24.

Bureau of the Census (U.S. Census Bureau) 2010. *Fulton County QuickFacts*. Available online at: http://quickfacts.census.gov/qfd/states/39/39051.html (accessed September 28, 2010).

Caltrans (California Department of Transportation) 2009. "Technical Noise Supplement." *Traffic Noise Analysis Protocol*. Sacramento, California. Available online at: http://www.dot.ca.gov/hq/env/noise/pub/tens_complete.pdf

CMOH (Ontario Chief Medical Officer of Health) 2010. *The Potential Health Impact of Wind Turbines*. Available online at: http://www.health.gov.on.ca/en/public/publications/ministry_reports/wind_turbine/wind_turbine.pdf (accessed September 19, 2010).

Colby, W.D.; Dobie, R.; Leventhall, G.; Lipscomb, D.M.; McCunney, R.J.; Seilo, M.T.; and Søndergaard, B. 2009. *Wind Turbine Sound and Health Effects: An Expert Panel Review*, prepared for American Wind Energy Association and Canadian Wind Energy Association. Available online at: http://www.awea.org/documents/AWEA_CanWEA_SoundWhitePaper_ExecSumm.pdf

DOE (U.S. Department of Energy) 2006. Memorandum. Office of NEPA Policy and Compliance. Need to Consider Intentional Destruction Acts in NEPA Documents. December 1, 2006.

DOE (U.S. Department of Energy) 2010. "Frequently Asked Questions – Electricity," *Energy Information Administration: Independent Statistics and Analysis*. Available online at: http://www.eia.doe.gov/energyexplained/index.cfm?page=electricity_home#tab2 (accessed December 29, 2010).

DWIA (Danish Wind Energy Association) 2003. "Shadow Casting from Wind Turbines." Available online at http://guidedtour.windpower.org/en/tour/env/shadow/index.htm (accessed January 17, 2011).

EPA (U.S. Environmental Protection Agency) 1974. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA Office of Noise Abatement and Control, U.S. Government Printing Office Washington, D.C. 20402, March.

EPA (U.S. Environmental Protection Agency) 2010a. *Archbold, Ohio Pollution Mix Current Grid Fuel Mixes and Resulting Pollution*, eGrid Online Database, accessed through http://oaspub.epa.gov/powpro/ept_pack.charts, September 27.

EPA (U.S. Environmental Protection Agency) 2010b.*Currently Designated Nonattainment Areas for All Criteria Pollutants*. Available online at: http://epa.gov/airquality/greenbk/ancl.html#OHIO (accessed September 16, 2010).

Epilepsy Foundation (American Epilepsy Foundation) 2010. "Photosensitivity and Epilepsy, Photosensitivity and Seizures." Available online at: http://www.epilepsyfoundation.org/about/photosensitivity (accessed March 20, 2010).

FAA (Federal Aviation Administration) 2007. "Obstruction Marking and Lighting," Advisory Circular, AC 70/7460-1K, Change 2. U.S. Department of Transportation.

FEMA (Federal Emergency Management Agency) 1985. *FIRM (Flood Insurance Rate) Map 01-02 for Archbold, Ohio*, Federal Emergency Management Agency, January.

Harding, G.; Harding, P.; and Wilkins, A. 2008. "Wind turbines, flicker, and photosensitive epilepsy: Characterizing the flashing that may precipitate seizures and optimizing guidelines to prevent them." *Epilepsia*, 49(6): 1095-1098.

IPCC (Intergovernmental Panel on Climate Change) 2007. "Summary for Policymakers," *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Available online at: http://www.ipcc.ch/ipccreports/ar4-wg1.htm (accessed August 18, 2010).

Klepinger, M. 2007. *Michigan Land Use Guidelines for Siting Wind Energy Systems*. Extension Bulletin WO-1053. Michigan State University Extension. October 2007. Available online at: http://www.emdc.msue.msu.edu/Bulletin/PDF/WO1053.pdf (accessed December 29, 2010).

MacQueen, J.F.; Ainslie, J.F.; Milborrow, D.J.; Turner, D.M.; Swift-Hook, D.T. 1983. "Risks associated with wind-turbine blade failures." Abstract. In *IEE Proceedings, Part A - Physical Science, Measurement and Instrumentation, Management and Education, Reviews* (ISSN 0143-702X), vol. 130, pt. A, no. 9, Dec. 1983, pp. 574-586.

Nelson, P.N., BSc, Ph.D., FIOA 1987. "Insulation of Buildings." *Transportation Noise Reference Book*. University Press, Cambridge, Great Britain.

NRCS (Natural Resources Conservation Service) 2010. *Soil Survey Map of Fulton County, Ohio, Web Soil Survey*, U.S. Department of Agriculture. Available online at: http://websoilsurvey.nrcs.usda.gov (accessed August 2010).

NREL (National Renewable Energy Laboratory) 2002. *Wind Turbine Lightning Protection Project 1999 – 2001*. NREL/SR-500-31115, May 2002. Prepared by McNiff Light Industry for NREL. Available online at: http://www.nrel.gov/docs/fy02osti/31115.pdf (accessed October 19, 2010).

ODNR (Ohio Department of Natural Resources) 2007. "Earthquakes and Seismic Risks in Ohio." *GeoFacts No. 3*. Available online at: http://www.dnr.state.oh.us/Portals/10/pdf/GeoFacts/geof03.pdf (accessed January 9, 2011).

ODNR (Ohio Department of Natural Resources) 2010. *Ohio Scenic Rivers Program.* Available online at: http://www.dnr.state.oh.us/tabid/985/default.aspx (accessed September 27, 2010).

PUCO (Public Utilities Commission of Ohio) 2010. Railroad Information System Crossing Information. Ohio Rail Development Commission. Available online at: http://gradecrossings.puco.ohio.gov/item.php? ID=2601&f1=FULTON (accessed August 21, 2010).

Rogers, A.L., Ph.D. 2006. *Wind Turbine Noise, Infrasound and Noise Perception*. Renewable Energy Research Laboratory, University of Massachusetts at Amherst. January 18. Available online at: http://www.windpoweringamerica.gov/ne_issues_sound.asp (accessed August 24, 2010).

Tetra Tech EC, Inc. 2007. "Exhibit 14 - Wind Turbine Ice Blade Throw." *Ice Shedding/Blade Throw Analysis*. Available online: http://www.horizonwindfarms.com/northeast-region/documents/under-dev/arkwright/Exhibit14_IceSheddingandBladeThrowAnalysis.pdf (accessed September 30, 2010).

USDA (U.S. Department of Agriculture) Forest Service 2009. "National Wild and Scenic Rivers Map." Continental United States, U.S. Forest Service, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, and National Atlas of the United States. Available online at: http://www.rivers.gov/maps/zoom/conus/conus.html (accessed September 27, 2010).

US DOT (U.S. Department of Transportation) 2006. *Construction Noise Handbook*. Final Report August 2006. Federal Highway Administration. Available online at: http://www.fhwa.dot.gov/Environment/noise/handbook/index.htm (accessed August 5, 2010).

USFWS (U.S. Fish and Wildlife Service) 2003. "Service Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines." Memorandum from the Deputy Director to Regional Directors, Regions 1–7. May 13. Available online at: http://www.fws.gov/habitatconservation/Service% 20Interim%20Guidelines.pdf (accessed September 28, 2010).

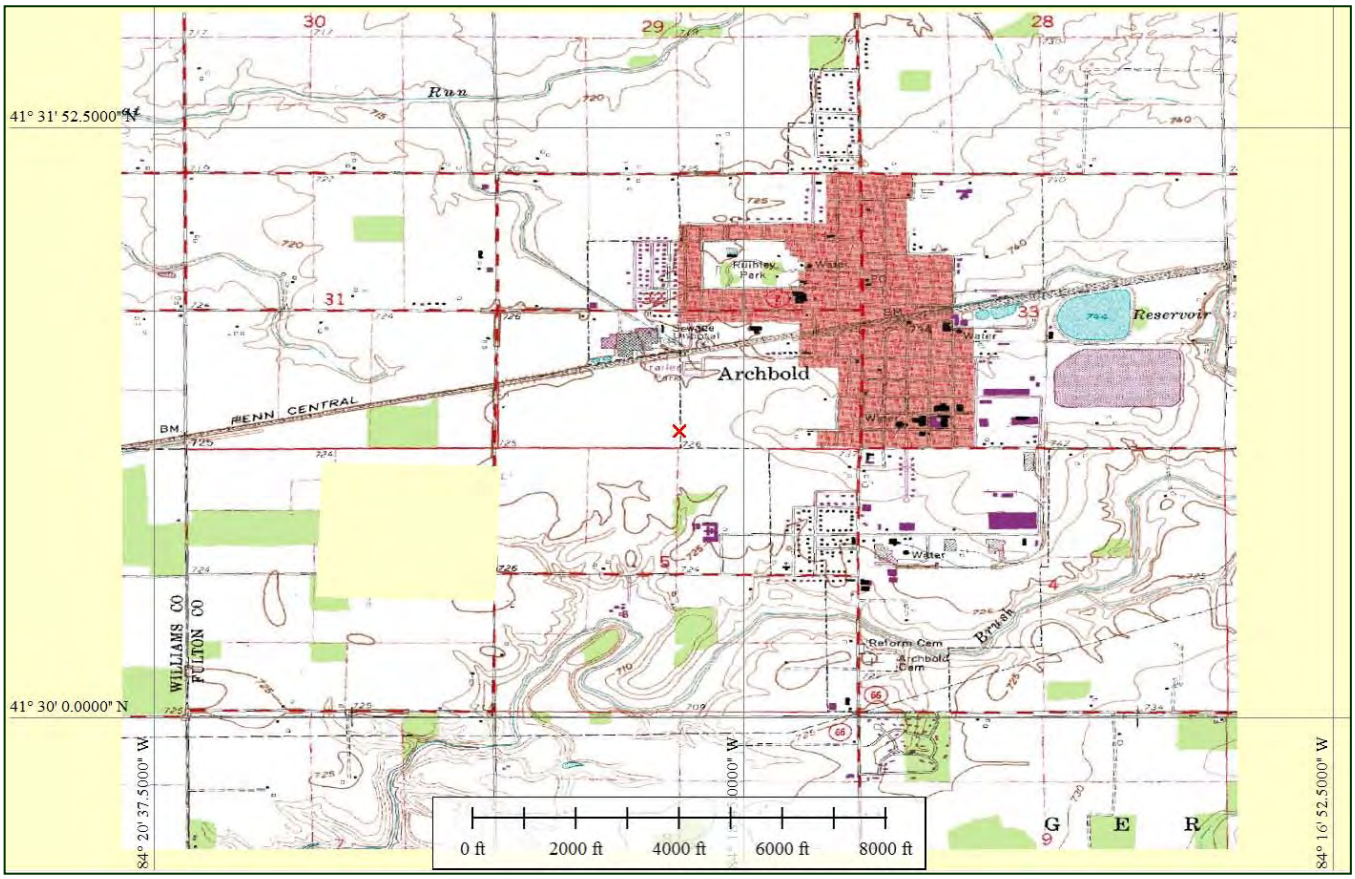
USFWS (U.S. Fish and Wildlife Service) 2010. *National Wetlands Inventory for Archbold, Ohio*. Retrieved August 2, 2010.

VAPC (Village of Archbold Planning Commission) 2010. *Archbold Planning Commission Minutes for August 23, 2010*.

Village of Archbold 2008. *Village of Archbold, Ohio Zoning Map*, Archbold Engineering/GIS Department, January.

APPENDIX A: FIGURES

Archbold Schools Wind Turbine Location



USGS Archbold Quad

× Wind Turbine Site Location:

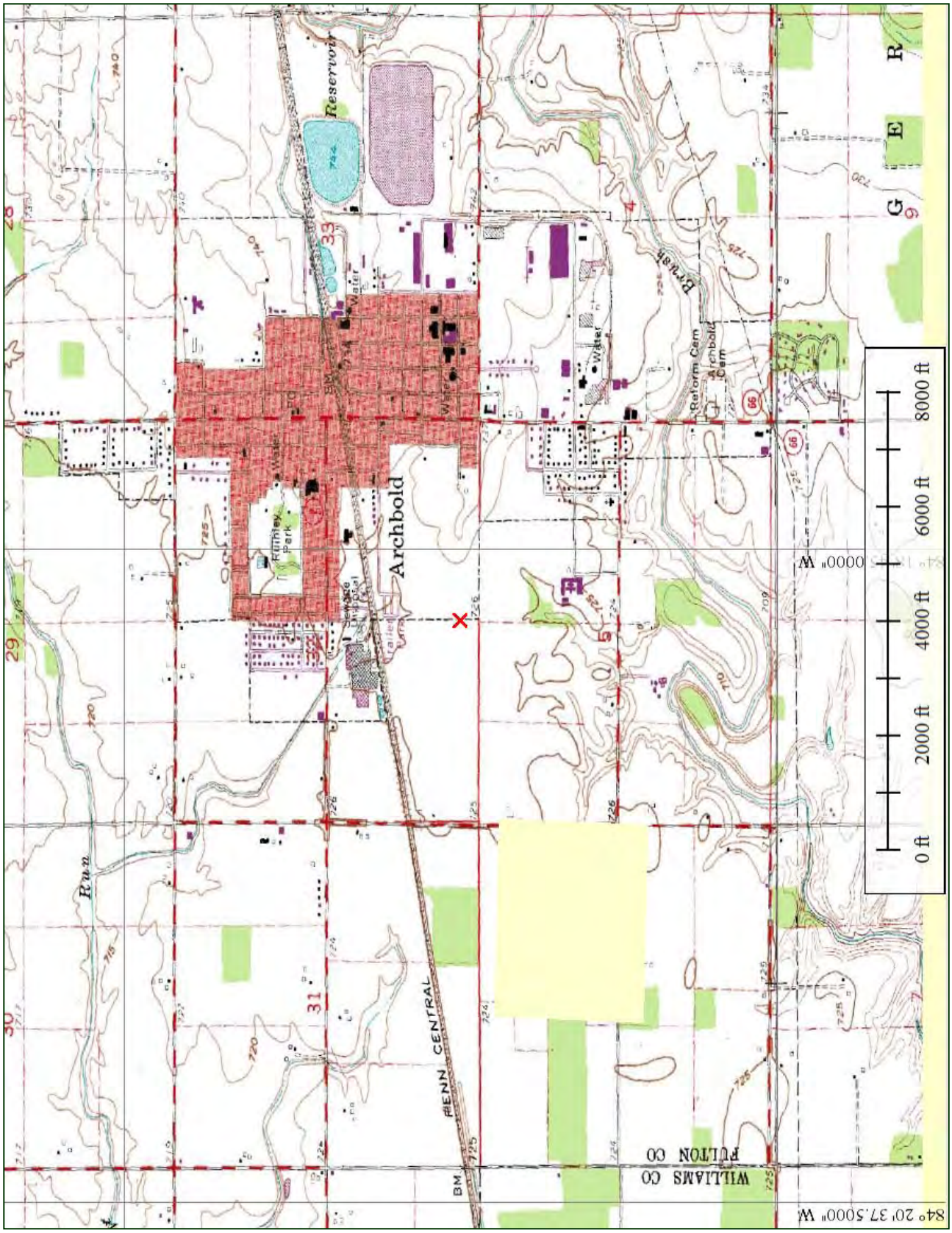
Archbold Local Schools
600 Lafayette Street
Archbold, Ohio 43502

Latitude: 41.515181
Longitude: -84.315900

Elevation: 727 Feet

Project Name: ***Archbold Area Schools Wind Turbine***	THE RENAISSANCE GROUP — A Conserve First Company — TRG
Source Information: *USGS, TRG Survey*	
Notes: × *Turbine Location*	Figure Name*: Turbine Location*

© Copyright 2010: Conserve First LLC



Project Name: ***Archbold Area Schools Wind Turbine***

Source Information: *USGS, TRG Survey*

Notes: ✕ *Turbine Location, USGS Archbold Quad*

THE RENAISSANCE GROUP
A Conserve First Company
TRG

Figure Name*: Topographic Map*

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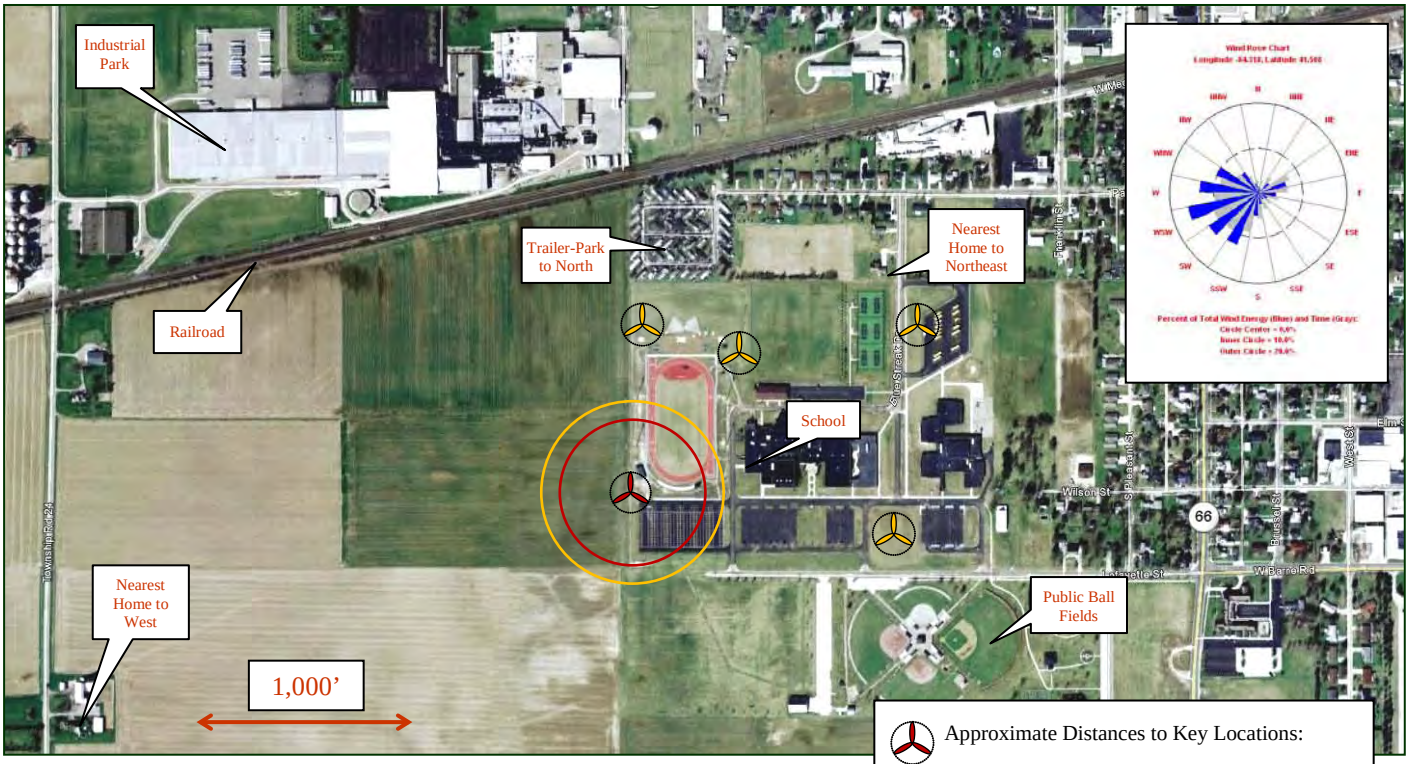
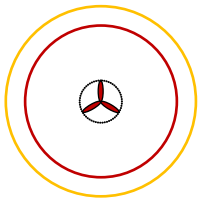
Railroad Corridor
Proposed Wind Turbine
Archbold High School
Image State of Ohio / OSIP
Imagery Date: Mar 1, 2006
41°30'59.43" N 84°18'56.07" W elev 727 ft
Eye alt 5052 ft
©2010 Google

Archbold Area Schools Turbine Placement, Fall Zone and Alternate Locations





Maximum Radius (1X Blade Tip Height) 335'
Maximum Radius (1,25X Blade Tip Height) 419'
Maximum Hub Height: 246'
Actual Blade Reach (Critical Fall Zone)

Proposed Turbine Location:

41° 30' 54.65" N
84° 18' 57.24" W
Elevation 727' (above sea-level)

Approximate Distances to Key Locations:

- 988' to nearest residence (trailer-park to North)
- 521' to school
- 350' to planned Lafayette Street extension
- 20' to Rupp property line (farm field to the West) (See support letter, formal easement to be obtained.)
- 1,160' to Public Ball Fields

Alternate Locations Considered (Declined Due To Reasons Listed):

- Closer distances to residences and inhabited structures.
- Closer proximities to overall population densities.
- Greater possibility for shadow flicker impacts.
- Poor access for heavy construction equipment.
- Longer electrical interconnect distances.
- Although not expected to be significant for any considered site, greater chance of acoustic propagation.
- Increased installation costs.
- Reduced power production from increased built environment and tree obstruction induced turbulence.

All sites are located on previously developed land and have similar benign environmental resource attributes and thus did not play into the final site selections. (Concurrence from ODNR and USFWS on selected site.)

Project Name: ***Archbold Area Schools Wind Turbine***	THE RENAISSANCE GROUP A Conserve First TRG
Source Information: *Aerial Photo, TRG Survey*	
Notes: *Turbine Location*	Figure Name: *Turbine Placement, Fall Zone and Alternate Locations*

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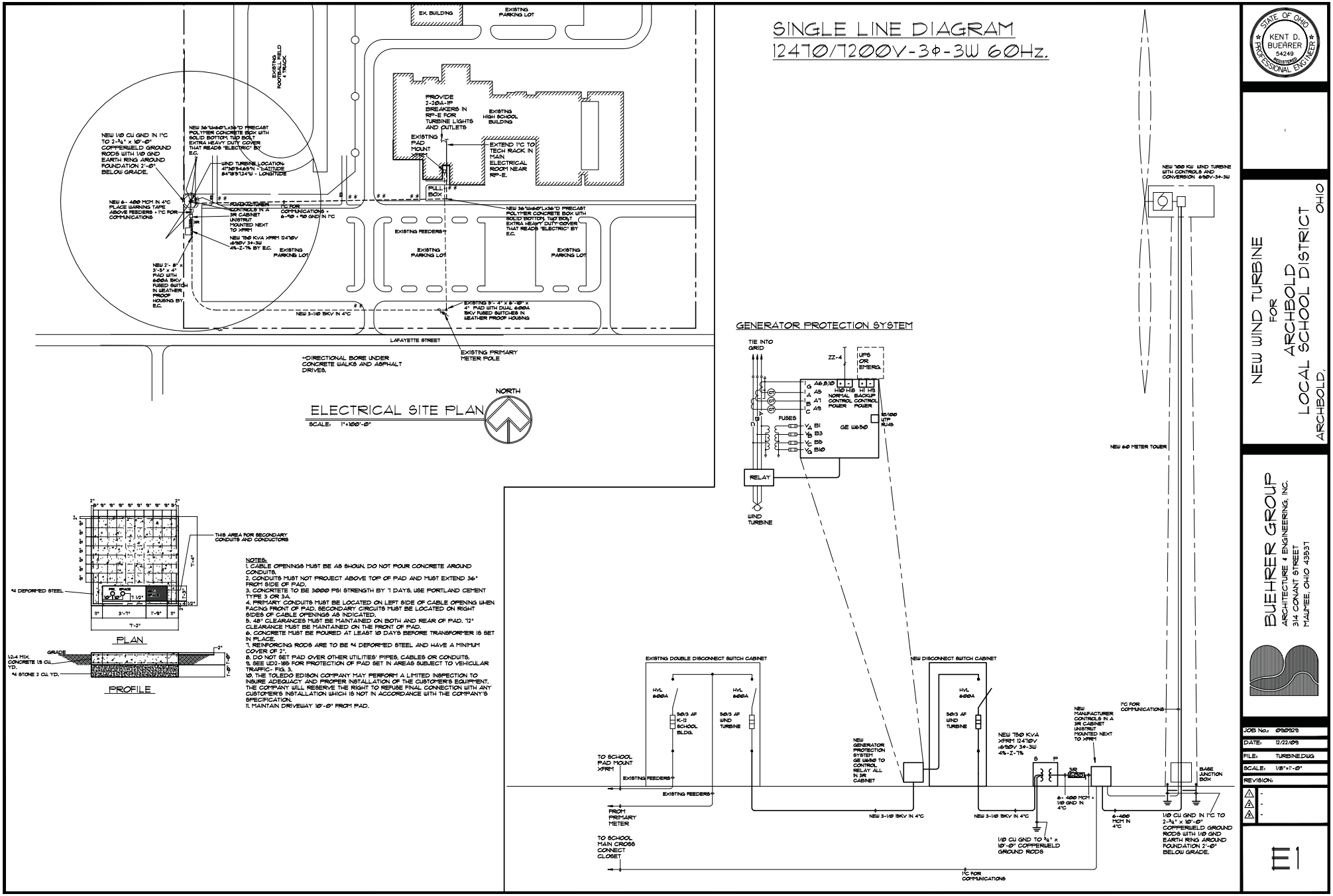


STATE OF OHIO
KENT D. BUEHRER
54249
REGISTERED
PROFESSIONAL ENGINEER

NEW WIND TURBINE
FOR
ARCHBOLD
LOCAL SCHOOL DISTRICT
ARCHBOLD, OHIO

BUEHRER GROUP
ARCHITECTURE + ENGINEERING, INC.
314 CONANT STREET
MAUMEE, OHIO 43537

JOB No.: 0307029
DATE: 12/22/03
FILE: TURBINE.DWG
SCALE: 1/8"=1'-0"
REVISION:
1 -
2 -
3 -

E1

U.S. Fish and Wildlife Service

National Wetlands Inventory

Archbold

Aug 2, 2010

Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deetwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

Riparian

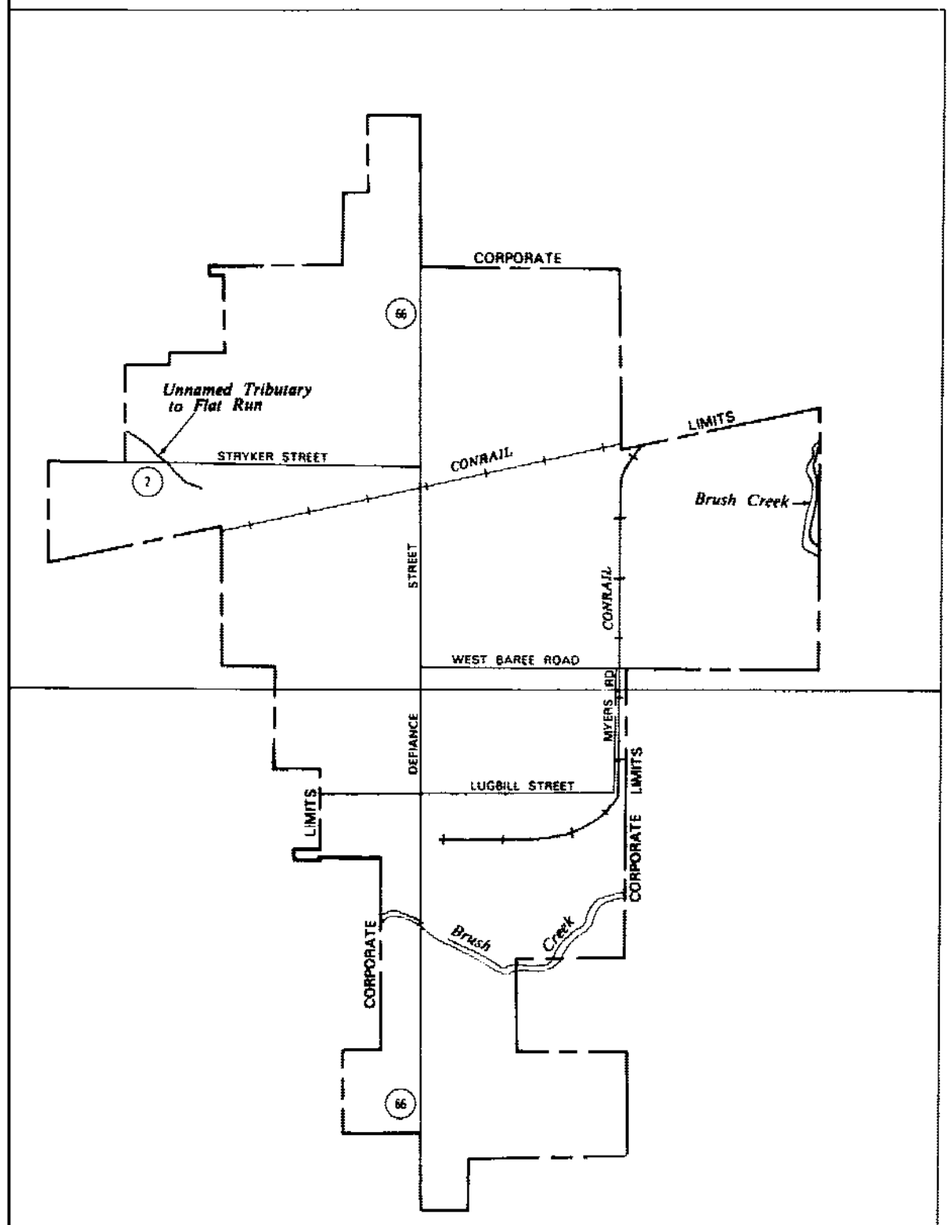
- Herbaceous
- Forested/Shrub

Status

- Digital
- Scan
- Non-Digital
- No Data

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

User Remarks:



KEY TO MAP

ZONE DESIGNATIONS*

ZONE C

ZONE A

ZONE C

Base Flood Elevation Line with elevation in feet	~~513~~
Base Flood Elevation where uniform within zone	(EL 987)
Elevation Reference Mark	$RM7_X$
River Mile	•M1.5

***EXPLANATION OF ZONE DESIGNATIONS**

A flood insurance map displays the zone designations for a community according to levels of designated flood hazards. The zone designations used by FEMA are:

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined
AO	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood (Medium shading)
C	Areas of minimal flooding (No shading)
D	Areas of undetermined, but possible, flood hazards
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for flood insurance purposes only; it does not necessarily show all areas subject to flooding in the community or all planimetric features outside special flood hazard areas.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at (800) 638-6620.

INITIAL IDENTIFICATION: SEPTEMBER 5, 1975

FLOOD HAZARD BOUNDARY MAP REVISIONS:

FLOOD INSURANCE RATE MAP EFFECTIVE: JANUARY 4, 1985

FLOOD INSURANCE RATE MAP REVISIONS:

FEDERAL EMERGENCY MANAGEMENT AGENCY

FIRM

FLOOD INSURANCE RATE MAP 01-02
MAP INDEX
VILLAGE OF ARCHBOLD, OH

FULTON COUNTY

COMMUNITY NUMBER 390603 A

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

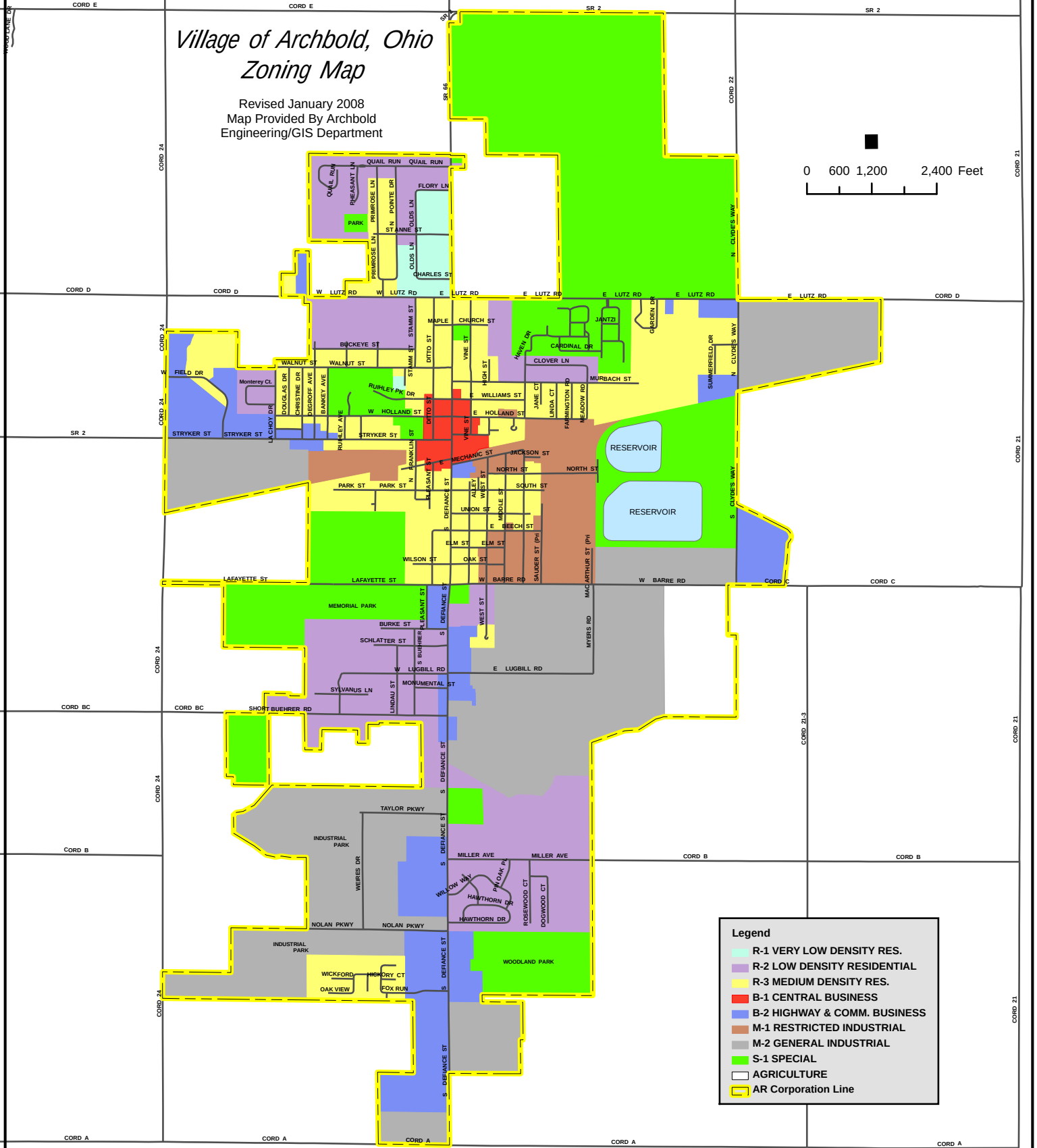
Ohio Department of Natural Resources
Natural Areas, Ohio Scenic Rivers Program
2045 Morse Road, Building C-3
Columbus, OH 43229-6693
(614) 265-6453

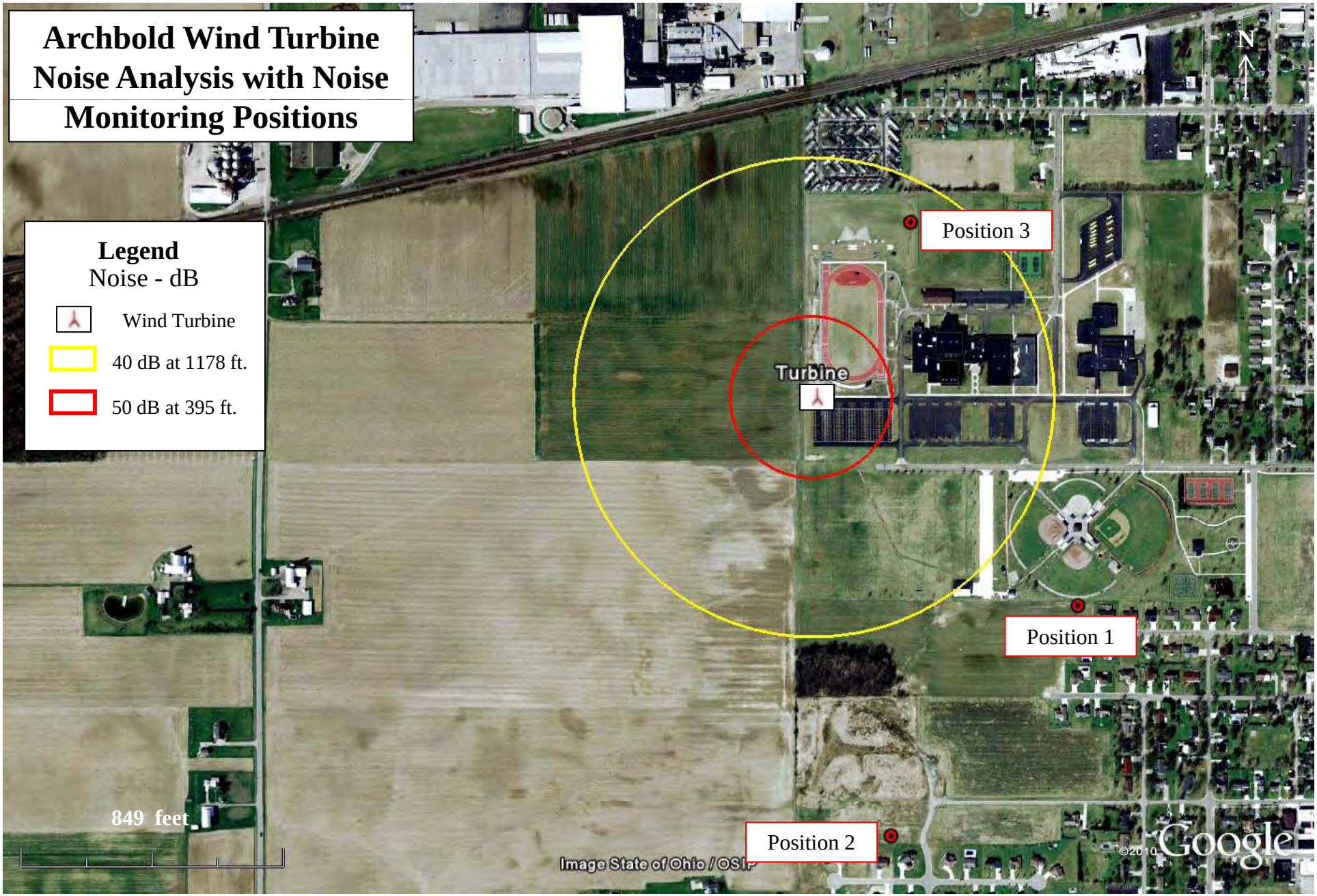
Ohio Scenic Rivers Program

Ohio Rivers also listed as National Wild and Scenic Rivers
Little Beaver Creek, Big and Little Darby Creeks and Little Miami River

Village of Archbold, Ohio Zoning Map

Revised January 2008
Map Provided By Archbold
Engineering/GIS Department




Archbold Wind Turbine
Noise Analysis with Noise
Monitoring Positions
Legend
Noise - dB
Wind Turbine
40 dB at 1178 ft.
50 dB at 395 ft.
N
Position 3
Turbine
Position 1
Position 2
849 feet
Image State of Ohio / OSIP
©2010 Google

ARRA SEP - Awarded Wind Turbine Projects in Ohio

Project Name: ***Applicable to All Ohio ARRA Wind Turbine Projects***	THE RENAISSANCE GROUP A Conserve First Company TRG
Source Information: *TRG Survey*	
Notes:	Figure Name*: ARRA SEP – Awarded Wind Turbine Projects in Ohio*

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APPENDIX B:

VISUALIZATION, PHOTO ANALYSIS & SHADOW FLICKER ANALYSIS

THE RENAISSANCE GROUP

A Conserve First Company

Archbold Area Schools
Wind Turbine Project
Turbine Visualization and Photo Analysis

Prepared for:
Archbold Area Schools

Prepared by:
The Renaissance Group, a Conserve First LLC Company
AAron Godwin, Founder, AAron@ConserveFirst.com
Dick Kotapish, GIS Specialist, Dick@ConserveFirst.com
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Kirtland, OH, 44094
(440) 256-2800
www.ConserveFirst.com

Submitted September 2, 2010

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Thank You for Choosing The Renaissance Group, a Conserve First LLC Company

Introduction

Although the visual impact of wind turbine installations is highly subjective, some people consider them a tremendous asset to their landscape and community and others say “not in my backyard”. This said, it is often beneficial to get a sense of what an installation will look like before it is installed. The actual visibility of a turbine installation is affected by many factors: the size of the machine, the number of machines, tower and blade tip heights, turbine color, distance to the viewer, obstructions such as trees, hills and buildings, atmospheric conditions, Sun angle and even the curvature of the Earth. All things considered, the overall height of a turbine, obstructions in the sightline between the viewer and the turbine and the distance between the machine and the viewer has the greatest impact. Even in open unobstructed ground very tall towers become very small in the distance and even the largest of machines can be blocked by relatively short obstructions close to the viewer. All this said, when in an open sightline in close proximity, a modern wind turbine can be an imposing or an awe inspiring presence in the view-shed pending ones point of view. In all such cases, few would argue that the turbine was not a significant element of the said view-shed. (Further understanding concerning the relative view-shed size of turbines at distance and their visibility in relation to obstructions can be viewed on the following addendums at the end of this report: Horizon View Impact Calculator, Example Turbine View Calculator, Wind Turbine Visibility Over Obstruction Tables and Sample Wind Turbine View Calculator.)

Methods

Using field surveys, mathematical modeling and stake holder interests, the study team identified representative sightline locations for actual turbine visualization studies. At these sites, precise location logs were taken with accompanying photographs toward the turbine site. Camera bearings were confirmed using detailed maps and compass bearings. The camera height above ground was approximately 68” and the tilt was maintained at zero degrees/level. The camera’s focal length was maintained at 28 mm which was entered into the rendering software and which approximates a typical person’s field of view for the camera used, or approximately 65%. WindPro 2.7, an internationally accepted wind project modeling software, was used to create the visualizations. The software uses the input data such as turbine location, viewer location, topographical baselines maps, turbine model and height, camera bearing, camera tilt and camera focal length to calculate the distance of the turbine, its perspective height, differential ground levels and Sun angles to correctly locate, scale and shade the turbine onto the base sightline photograph. The technician then verifies for scale and location using secondary plots. The technician also manually removes the portions of the turbine overlay that would be blocked by the obstruction shown in the photo that would between the viewer and the turbine.

Special consideration was given to identifying potentially historically or culturally significant view-sheds for historic buildings, sites and landscapes. This review was done in conjunction with the local Historical Society and utilizing the Ohio Historic Preservation Office database.

Panoramic photos were also taken at sample locations including the turbine installation site.

A Sony DSC-HX1 camera was used for all source imagery.

Results

See the following pages for representative turbine visualizations. Due to local obstruction proximities and densities to typical sightlines such as trees and buildings, much of the community will not be able to see the

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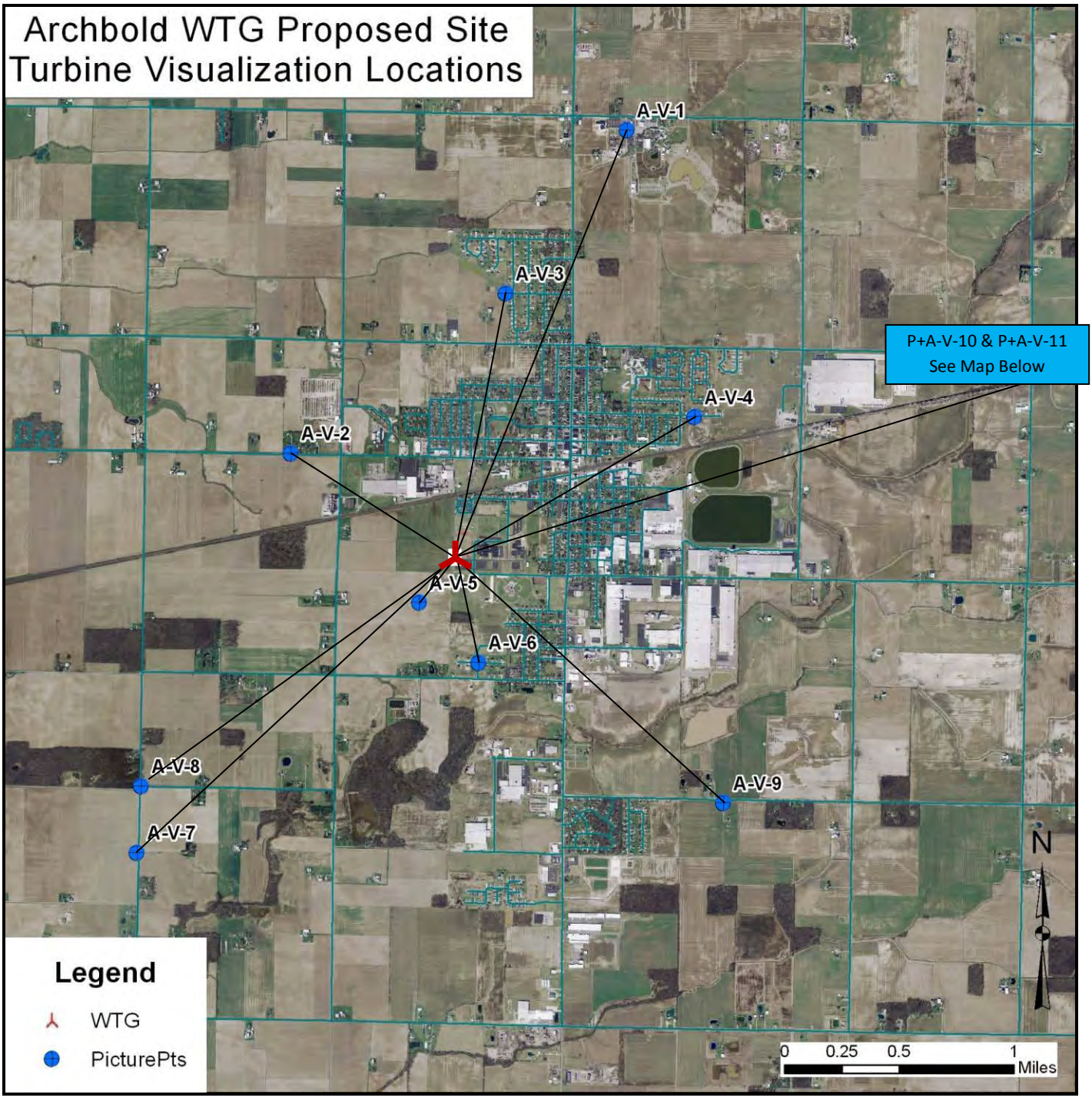
turbine. This said much of the surrounding farms will be able to see the turbine due to the general openness of the regions farming landscape and its overall flat terrain that surrounds the Village. This said, due to perspective, the turbine will appear as a very small element of the skyline for most locations similar to the regions existing communication towers and granaries.

No historical or cultural site view-sheds were found that would be significantly impacted by the turbines installation.

For sites not modeled, the Report's included "Visualization Tables" can be used to determine approximate turbine visibility in relationship to viewer obstructions. A "Sample Wind Turbine View Calculator" has also been developed to mathematically model locations of concern upon community request, a sample of which is included in this report.



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In addition to the above visualization, two visualizations were done from sample locations between Archbold and Pettisville where the turbines of both locations might be seen on the horizon, P+A-V-10 and P+A-V-11 (See map and the visualization photo log below).

Archbold and Pettisville Turbine Projects Visualization Locations Map

Archbold Visualizations

Set Number	Picture Number	Distance from Turbine (miles)	Site Description	Latitude	Longitude	Direction
A-V-1	2093	2.00	Sauder Village Parking Lot	41° 32' 32.83" N	84° 18' 07.67" W	202°
A-V-2	2096	0.80	24218 County Road D	41° 31' 17.72" N	84° 19' 47.31" W	120°
A-V-3	2123	1.10	Playground off St. Anne and Primrose	41° 31' 55.08" N	84° 18' 43.40" W	180°
A-V-4	2125	1.20	Between Tracks and Murbach	41° 31' 27.84" N	84° 17' 45.41" W	250°
A-V-5	2127	0.40	Archbold Evangelical Church	41° 30' 44.34" N	84° 18' 07.61" W	41°
A-V-6	2130	0.50	Corner Sylvanus & Lawrence	41° 30' 30.98" N	84° 18' 49.26" W	345°
A-V-7	2133	1.90	County Road 25 (Between County Road E.50 and County Road B)	41° 29' 46.15" N	84° 20' 31.38" W	48°
A-V-8	2135	1.70	Corner of County Road 25 & County Road B	41° 30' 01.29" N	84° 20' 30.48" W	50°
A-V-9	2137	1.60	22291 County Road B	41° 30' 00.20" N	84° 17' 34.26" W	318°
A-V-10	2340	2.70	Corner of County Road 21 & County Road D	41° 31' 43.98" N	84° 16' 04.57" W	252°
A-V-11	2352	3.70	Historic Home - 4208 County Road 20	41° 31' 55.22" N	84° 14' 52.04" W	254°

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Proposed Site Panoramic Photos Looking Out

Looking East

Looking South

Looking West

Looking North

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Turbine View Visualizations

A-V-1

Sauder Village Parking Lot
Barely Visible Behind Trees

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A-V-2

24218 County Road D

© Copyright 2010: Conserve First LLC

A-V-3

Playground off Saint Anne and Primrose

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A-V-4

Between Tracks and Murbach
Barely Visible Behind Houses, Next to Radio Tower

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A-V-5

Archbold Evangelical Church

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A-V-6

Corner of Sylvanus and Lawrence

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A-V-7

County Road 25, Between E.50 and County Road B
Blocked by Corn

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A-V-8

Corner of County Road 25 and County Road B
Turbine Blocked By Trees, But Would Be Visible 100’ North on Road

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A-V-9

22291 County Road B
Blocked by Trees and Farm

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A-V-10

Corner of County Road 21 and County Road D
Turbine Barely Visible to the West of the Granary

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A-V-11

4208 County Road 21
Turbine View Blocked by Bushes

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Example Images of Other Regional Tall Structures

Archbold Water Tower

Area Granaries

© Copyright 2010: Conserve First LLC

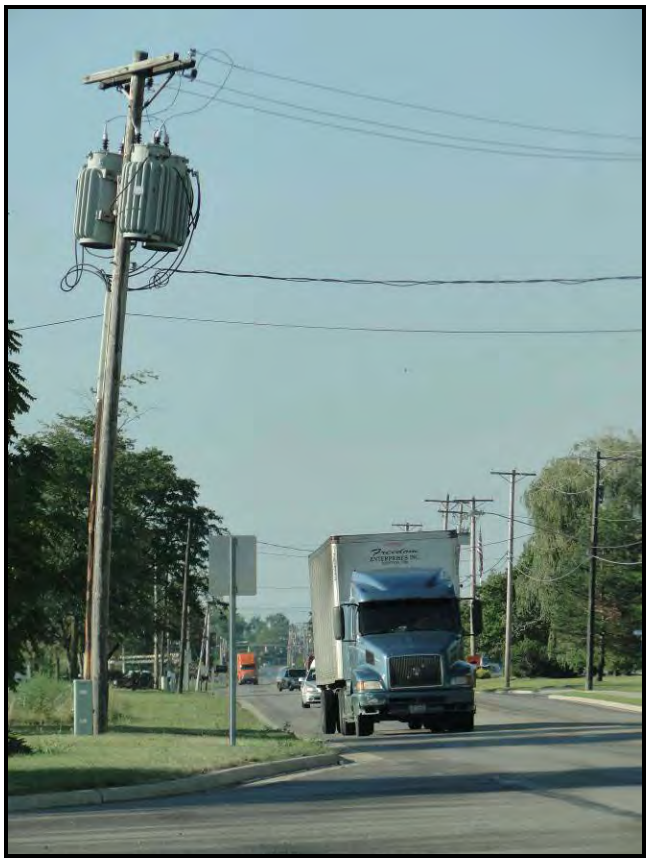
Area Farm Silos

Local Industrial Facilities

© Copyright 2010: Conserve First LLC

Downtown Archbold

Area Power Poles



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Samples of Area Communication Towers

(Also See Tall Tower Map and Tables Below)

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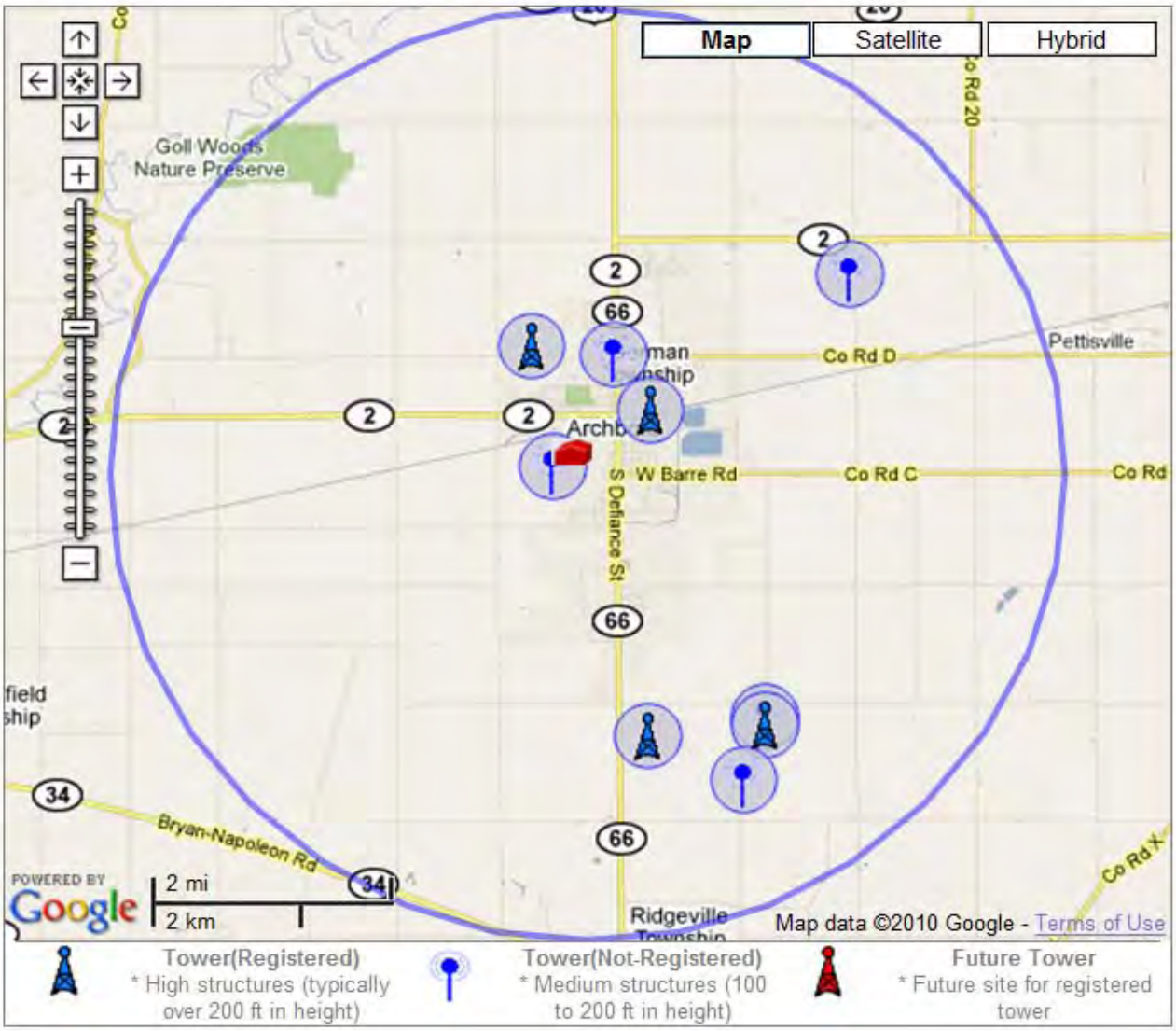
Existing Tall Towers Within 4 Miles of The Proposed Turbine Site



Registered Towers			
1	Felhc	315 feet	.80 miles
2	Towerco Assets Llc	200 feet	1.16 miles
3	Sba Towers, Inc.	290 feet	2.10 miles
4	Taylor University Broadcasting Inc Dba = Wbcl Radio	335 feet	2.63 miles

Non-Registered Towers			
1	Usa Mobile Communications, Inc. Ii	119 feet	.97 miles
2	Summit Christian College	335 feet	2.58 miles
3	360 Communications Company	199 feet	2.83 miles
4	Roger Arnos	328 feet	3.07 miles

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Antennas on Listed Towers

1	Ams Spectrum Holdings, Llc	328 feet	3.07 miles
	Nofziger Door Sales Inc	NA	3.07 miles
	Ams Spectrum Holdings, Llc	109 feet	3.07 miles
	Futronics Paging Inc.	NA	3.07 miles
	Pearl Gas Co	NA	3.07 miles
	Nextel License Holdings 4, Inc	98 feet	3.07 miles
	Quadco Rehabilitation Center Inc	NA	3.07 miles
	Snows Fire Protection Service Inc	NA	3.07 miles
	Beck, Kevin J	328 feet	3.07 miles
	Laidlaw Waste Systems Inc	328 feet	3.07 miles
	Overnite Transportation Company	312 feet	3.07 miles
	Mohre Electronics Company	328 feet	3.06 miles
2	Sauder Woodworking Co	NA	.57 miles
	Sauder Woodworking Co	NA	.57 miles
	Sauder Woodworking Co	NA	.57 miles
	Sauder Woodworking Co	121 feet	.57 miles
3	A G B Inc	69 feet	.65 miles
	Archbold, Village Of	79 feet	.65 miles
	Archbold, Village Of	NA	.65 miles
	Archbold, Village Of	79 feet	.65 miles
	Archbold, Village Of	79 feet	.65 miles
4	Felhc, Inc.	94 feet	.81 miles
	Felhc, Inc.	20 feet	.81 miles
	Felhc	299 feet	.81 miles
5	Tri Flo Inc	NA	.93 miles
	Bil Jax Inc	NA	.93 miles
6	Sauder Woodworking Co	121 feet	1.11 miles
	Sauder Woodworking Co	20 feet	1.11 miles
	Sauder Woodworking Co	121 feet	1.11 miles
	Sauder Manufacturing	121 feet	1.11 miles
	Sauder Woodworking Co	121 feet	1.11 miles
	Sauder Woodworking Co	98 feet	1.11 miles
	Sauder Woodworking Co	121 feet	1.11 miles
	Sauder Woodworking Co	121 feet	1.11 miles
	Sauder Woodworking Company	121 feet	1.11 miles
7	Napoleon Spring Works Inc	NA	1.54 miles
	Napoleon Spring Works Inc.	164 feet	1.54 miles
8	S W Mills Inc	NA	1.63 miles
	Aeschliman, John	NA	1.63 miles
	S W Mills Inc	NA	1.63 miles
9	Roadway Express	98 feet	2.11 miles
	Roadway Express	NA	2.11 miles
	Archbold Lawn Service	20 feet	2.11 miles
10	Taylor University Broadcasting, Inc.	335 feet	2.58 miles
	T & M Supply	335 feet	2.58 miles

See the Website below for full details on these sites including precise locations, heights and frequencies.

http://www.antennasearch.com/

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Single Antennas

11	Nextel License Holdings 4, Inc.	289 feet	2.10 miles
12	Archbold Area Schools	35 feet	.17 miles
13	Con Agra Grocery Products	59 feet	.47 miles
14	Sauders Tv & Appliance Inc	NA	.51 miles
15	Archbold Area Schools	NA	.62 miles
16	Fulton, County Of	NA	.64 miles
17	Hunt Foods Inc	NA	.72 miles
18	Bentley Enterprises	200 feet	.73 miles
19	Bil-jax, Inc	NA	.78 miles
20	Ohio Gas Company	39 feet	.78 miles
21	Campbell Soup Supply Company	NA	.81 miles
22	Hunt Weson	49 feet	.95 miles
23	Fairlawn Haven	39 feet	1.08 miles
24	Fry, Carl	NA	1.09 miles
25	Community Hospitals Of Williams County, Inc.	49 feet	1.10 miles
26	Rupp, Dexter	NA	1.50 miles
27	Sauder Farm Woodworking Company	66 feet	1.89 miles
28	Stuckey, Michael D	39 feet	1.91 miles
29	Nofzinger Electric Inc	NA	2.08 miles
30	Archbold Equipment Co Inc	NA	2.17 miles
31	Djm Llc	NA	3.52 miles
32	Four County Joint Vocational School	NA	3.82 miles
33	Heer Excavating Inc	98 feet	3.84 miles
34	Nobco, Inc.	85 feet	.68 miles
35	Fibertower Spectrum Holdings Llc	20 feet	3.92 miles

See the Website below for full details on these sites including but not limited to: precise locations, heights, frequencies and owners.

http://www.antennasearch.com/

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Sample Horizon View Impact Calculator

Rotor Diameter	187	Feet

Viewer Distance From Turbine		Percent of Total Horizon View-shed Affected	Percent of Total Average Persons Field of View Affected
Feet	Miles		
100	0.02	29.76%	100.00%
200	0.04	14.88%	89.29%
400	0.08	7.44%	44.64%
800	0.15	3.72%	22.32%
1,600	0.30	1.86%	11.16%
3,200	0.61	0.93%	5.58%
5,280	1.00	0.56%	3.38%
10,560	2.00	0.28%	1.69%
15,840	3.00	0.19%	1.13%
21,120	4.00	0.14%	0.85%
26,400	5.00	0.11%	0.68%
52,800	10.00	0.06%	0.34%

Assumptions:

Model assumes absolute worst case for all variables.

Viewer is stationary, focused and looking directly at and centered on the turbine.

Viewer's field of view is 60 degrees.

Model assumes no sightline obstructions, crystal clear atmospheric visibility and 100% of the turbine is visible.

Model assumes the largest rotor diameter under consideration for the site.

Model assumes the turbine rotor is perpendicular to and fully visible to the viewer.

Model assumes worst case as if the turbine rotor diameter influences the entire column of the horizon as if the turbine was a solid plane covering the entire portion of the horizon at a width of the turbine's rotor.

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Sample Turbine View Calculations

Baselines For Calculations

Turbine Height to Blade Tip	334	Feet
Turbine Height to Hub	246	Feet
Persons Eye Height Based on Level Ground.	5.5	Feet

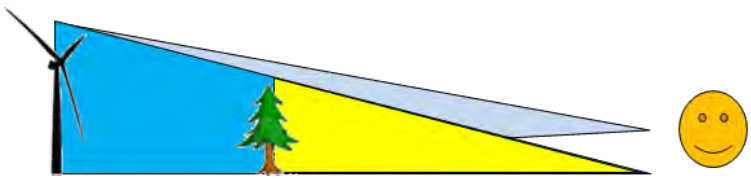
Listed Obstruction Height (Feet) Will Block Turbine View Within Listed Distance of Viewer (Feet)

		Typical One Story House or Short Tree		Typical Two Story House or Tree		Typical Tall Tree or Tall Building		Apparent Height of Turbine at 3' Arm's Length (Inches Tall) (If You Could See the Entire Turbine)
Obstruction Height (Feet)		17.5		35		70		
Minimum Visible Target to be Blocked		Hub Up	Blade Tip	Hub Up	Blade Tip	Hub Up	Blade Tip	
Viewer Distance From Turbine (Feet)	500	23	18	57	44	126	97	23.9
	1000	47	36	115	88	251	193	11.9
	1500	70	54	172	133	377	290	8.0
	2000	93	72	230	177	502	387	6.0
	2500	117	90	287	221	628	483	4.8
	3000	140	108	344	265	753	580	4.0
	3500	163	126	402	310	879	677	3.4
	4000	187	144	459	354	1004	774	3.0
	4500	210	162	517	398	1130	870	2.7
	5000	234	180	574	442	1255	967	2.4

Example: At a distance of 2,500 feet from the turbine your view of the turbine would be blocked by any 17.5 foot structure or tree if it was less than 90 feet from you. The apparent height of an unobstructed turbine view at this distance would 4.8 inches tall at a 3 foot arms length from your eye.

Typical community and natural obstructions will block the view of the turbine for many residences and businesses, even some in close proximity to the site.

Values are approximate.



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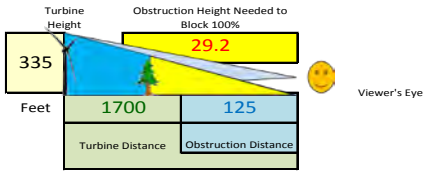
Sample Wind Turbine Visibility Over Obstructions Tables

Turbine Information:

	Feet	Meters
Tower Height	246.1	75.0
Rotor Diameter	177.2	54.0
Tip Height	334.6	102.0
Eye Height	5.0	1.5



Example: Using the tables below, a wind turbine 1700 feet away from you would be blocked by any obstruction over 24.8 feet tall 125 feet or less away from you. Based on flat ground and provided eye height. As can be seen, relatively low obstructions close to the viewer typical of many residential, urban or wooded areas will completely obstruct your view of a wind turbine.

Obstruction Height \ Turbine Distance	100	125	150	175	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
10	38.0	31.4	27.0	23.8	21.5	16.0	13.2	11.6	10.5	9.7	9.1	8.7	8.3	8.0	7.7	7.5	7.4	7.2	7.1	6.9	6.8	6.7	6.6
20	70.9	57.7	49.0	42.7	38.0	27.0	21.5	18.2	16.0	14.4	13.2	12.3	11.6	11.0	10.5	10.1	9.7	9.4	9.1	8.9	8.7	8.5	8.3
30	103.9	84.1	70.9	61.5	54.4	38.0	29.7	24.8	21.5	19.1	17.4	16.0	14.9	14.0	13.2	12.6	12.1	11.6	11.2	10.8	10.5	10.2	9.9
40	136.9	110.5	92.9	80.3	70.9	49.0	38.0	31.4	27.0	23.8	21.5	19.7	18.2	17.0	16.0	15.1	14.4	13.8	13.2	12.8	12.3	11.9	11.6
50	169.8	136.9	114.9	99.2	87.4	59.9	46.2	38.0	32.5	28.5	25.6	23.3	21.5	20.0	18.7	17.7	16.8	16.0	15.3	14.7	14.2	13.7	13.2
60	202.8	163.2	136.9	118.0	103.9	70.9	54.4	44.6	38.0	33.3	29.7	27.0	24.8	23.0	21.5	20.2	19.1	18.2	17.4	16.6	16.0	15.4	14.9
70	235.8	189.6	158.8	136.9	120.4	81.9	62.7	51.2	43.5	38.0	33.8	30.6	28.1	26.0	24.2	22.8	21.5	20.4	19.4	18.6	17.8	17.1	16.5
80	268.7	216.0	180.8	155.7	136.9	92.9	70.9	57.7	49.0	42.7	38.0	34.3	31.4	29.0	27.0	25.3	23.8	22.6	21.5	20.5	19.7	18.9	18.2
90	301.7	242.3	202.8	174.5	153.3	103.9	79.2	64.3	54.4	47.4	42.1	38.0	34.7	32.0	29.7	27.8	26.2	24.8	23.5	22.5	21.5	20.6	19.8
100	334.6	268.7	224.8	193.4	169.8	114.9	87.4	70.9	59.9	52.1	46.2	41.6	38.0	35.0	32.5	30.4	28.5	27.0	25.6	24.4	23.3	22.3	21.5
125	NA	334.6	279.7	240.5	211.0	142.4	108.0	87.4	73.7	63.9	56.5	50.8	46.2	42.5	39.3	36.7	34.4	32.5	30.8	29.2	27.9	26.7	25.6
150	NA	NA	334.6	287.6	252.2	169.8	128.6	103.9	87.4	75.6	66.8	59.9	54.4	50.0	46.2	43.0	40.3	38.0	35.9	34.1	32.5	31.0	29.7
175	NA	NA	NA	334.6	293.4	197.3	149.2	120.4	101.1	87.4	77.1	69.1	62.7	57.4	53.1	49.4	46.2	43.5	41.1	38.9	37.0	35.4	33.8
200	NA	NA	NA	NA	334.6	224.8	169.8	136.9	114.9	99.2	87.4	78.3	70.9	64.9	59.9	55.7	52.1	49.0	46.2	43.8	41.6	39.7	38.0
225	NA	NA	NA	NA	NA	252.2	190.4	153.3	128.6	111.0	97.7	87.4	79.2	72.4	66.8	62.1	58.0	54.4	51.4	48.6	46.2	44.0	42.1
250	NA	NA	NA	NA	NA	279.7	211.0	169.8	142.4	122.7	108.0	96.6	87.4	79.9	73.7	68.4	63.9	59.9	56.5	53.5	50.8	48.4	46.2
500	NA	NA	NA	NA	NA	NA	NA	334.6	279.7	240.5	211.0	188.1	169.8	154.8	142.4	131.8	122.7	114.9	108.0	102.0	96.6	91.7	87.4
1000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	334.6	304.7	279.7	258.6	240.5	224.8	211.0	198.9	188.1	178.5	169.8

Obstruction Height \ Turbine Distance	2100	2200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100	3200	3300
10	6.6	6.5	7.5	7.4	7.2	7.1	6.9	6.8	6.7	6.6	6.6	6.5	6.4	6.4	6.3	6.3	6.2	6.2	6.1	6.1	6.1	6.0	6.0
20	8.1	8.0	10.1	9.7	9.4	9.1	8.9	8.7	8.5	8.3	8.1	8.0	7.9	7.7	7.6	7.5	7.4	7.4	7.3	7.2	7.1	7.1	7.0
30	9.7	9.5	12.6	12.1	11.6	11.2	10.8	10.5	10.2	9.9	9.7	9.5	9.3	9.1	9.0	8.8	8.7	8.5	8.4	8.3	8.2	8.1	8.0
40	11.3	11.0	15.1	14.4	13.8	13.2	12.8	12.3	11.9	11.6	11.3	11.0	10.7	10.5	10.3	10.1	9.9	9.7	9.5	9.4	9.3	9.1	9.0
50	12.8	12.5	17.7	16.8	16.0	15.3	14.7	14.2	13.7	13.2	12.8	12.5	12.2	11.9	11.6	11.3	11.1	10.9	10.7	10.5	10.3	10.2	10.0
60	14.4	14.0	20.2	19.1	18.2	17.4	16.6	16.0	15.4	14.9	14.4	14.0	13.6	13.2	12.9	12.6	12.3	12.1	11.8	11.6	11.4	11.2	11.0
70	16.0	15.5	22.8	21.5	20.4	19.4	18.6	17.8	17.1	16.5	16.0	15.5	15.0	14.6	14.2	13.9	13.5	13.2	13.0	12.7	12.4	12.2	12.0
80	17.6	17.0	25.3	23.8	22.6	21.5	20.5	19.7	18.9	18.2	17.6	17.0	16.5	16.0	15.5	15.1	14.8	14.4	14.1	13.8	13.5	13.2	13.0
90	19.1	18.5	27.8	26.2	24.8	23.5	22.5	21.5	20.6	19.8	19.1	18.5	17.9	17.4	16.9	16.4	16.0	15.6	15.2	14.9	14.6	14.3	14.0
100	20.7	20.0	30.4	28.5	27.0	25.6	24.4	23.3	22.3	21.5	20.7	20.0	19.3	18.7	18.2	17.7	17.2	16.8	16.4	16.0	15.6	15.3	15.0
125	24.6	23.7	36.7	34.4	32.5	30.8	29.2	27.9	26.7	25.6	24.6	23.7	22.9	22.2	21.5	20.8	20.3	19.7	19.2	18.7	18.3	17.9	17.5
150	28.5	27.5	43.0	40.3	38.0	35.9	34.1	32.5	31.0	29.7	28.5	27.5	26.5	25.6	24.8	24.0	23.3	22.7	22.1	21.5	21.0	20.5	20.0
175	32.5	31.2	49.4	46.2	43.5	41.1	38.9	37.0	35.4	33.8	32.5	31.2	30.1	29.0	28.1	27.2	26.4	25.6	24.9	24.2	23.6	23.0	22.5
200	36.4	35.0	55.7	52.1	49.0	46.2	43.8	41.6	39.7	38.0	36.4	35.0	33.7	32.5	31.4	30.4	29.4	28.5	27.7	27.0	26.3	25.6	25.0
225	40.3	38.7	62.1	58.0	54.4	51.4	48.6	46.2	44.0	42.1	40.3	38.7	37.2	35.9	34.7	33.5	32.5	31.5	30.6	29.7	28.9	28.2	27.5
250	44.2	42.5	68.4	63.9	59.9	56.5	53.5	50.8	48.4	46.2	44.2	42.5	40.8	39.3	38.0	36.7	35.5	34.4	33.4	32.5	31.6	30.8	30.0
500	83.5	79.9	131.8	122.7	114.9	108.0	102.0	96.6	91.7	87.4	83.5	79.9	76.7	73.7	70.9	68.4	66.0	63.9	61.8	59.9	58.2	56.5	54.9
1000	162.0	154.8	258.6	240.5	224.8	211.0	198.9	188.1	178.5	169.8	162.0	154.8	148.3	142.4	136.9	131.8	127.1	122.7	118.7	114.9	111.3	108.0	104.9

Obstruction Height \ Turbine Distance	3400	3500	3600	3700	3800	3900	4000	4100	4200	4300	4400	4500	4600	4700	4800	4900	5000	5100	5200	5300	5400	5500	5600
10	6.0	5.9	5.9	5.9	5.9	5.8	5.8	5.8	5.8	5.8	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.6	5.6	5.6	5.6	5.6	5.6
20	6.9	6.9	6.8	6.8	6.7	6.7	6.6	6.6	6.6	6.5	6.5	6.5	6.4	6.4	6.4	6.3	6.3	6.3	6.3	6.2	6.2	6.2	6.2
30	7.9	7.8	7.7	7.7	7.6	7.5	7.5	7.4	7.4	7.3	7.2	7.2	7.1	7.1	7.1	7.0	7.0	6.9	6.9	6.9	6.8	6.8	6.8
40	8.9	8.8	8.7	8.6	8.5	8.4	8.3	8.2	8.1	8.1	8.0	7.9	7.9	7.8	7.7	7.7	7.6	7.6	7.5	7.5	7.4	7.4	7.4
50	9.8	9.7	9.6	9.5	9.3	9.2	9.1	9.0	8.9	8.8	8.7	8.7	8.6	8.5	8.4	8.4	8.3	8.2	8.2	8.1	8.1	8.0	7.9
60	10.8	10.7	10.5	10.3	10.2	10.1	9.9	9.8	9.7	9.6	9.5	9.4	9.3	9.2	9.1	9.0	9.0	8.9	8.8	8.7	8.7	8.6	8.5
70	11.8	11.6	11.4	11.2	11.1	10.9	10.8	10.6	10.5	10.4	10.2	10.1	10.0	9.9	9.8	9.7	9.6	9.5	9.4	9.4	9.3	9.2	9.1
80	12.8	12.5	12.3	12.1	11.9	11.8	11.6	11.4	11.3	11.1	11.0	10.9	10.7	10.6	10.5	10.4	10.3	10.2	10.1	10.0	9.9	9.8	9.7
90	13.7	13.5	13.2	13.0	12.8	12.6	12.4	12.2	12.1	11.9	11.7	11.6	11.4	11.3	11.2	11.1	10.9	10.8	10.7	10.6	10.5	10.4	10.3
100	14.7	14.4	14.2	13.9	13.7	13.5	13.2	13.0	12.8	12.7	12.5	12.3	12.2	12.0	11.9	11.7	11.6	11.5	11.3	11.2	11.1	11.0	10.9
125	17.1	16.8	16.4	16.1	15.8	15.6	15.3	15.1	14.8	14.6	14.4	14.2	14.0	13.8	13.6	13.4	13.2	13.1	12.9	12.8	12.6	12.5	12.4
150	19.5	19.1	18.7	18.4	18.0	17.7	17.4	17.1	16.8	16.5	16.2	16.0	15.7	15.5	15.3	15.1	14.9	14.7	14.5	14.3	14.2	14.0	13.8
175	22.0	21.5	21.0	20.6	20.2	19.8	19.4	19.1	18.7	18.4	18.1	17.8	17.5	17.3	17.0	16.8	16.5	16.3	16.1	15.9	15.7	15.5	15.3
200	24.4	23.8	23.3	22.8	22.3	21.9	21.5	21.1	20.7	20.3	20.0	19.7	19.3	19.0	18.7	18.5	18.2	17.9	17.7	17.4	17.2	17.0	16.8
225	26.8	26.2	25.6	25.0	24.5	24.0	23.5	23.1	22.7	22.2	21.9	21.5	21.1	20.8	20.5	20.1	19.8	19.5	19.3	19.0	18.7	18.5	18.2
250	29.2	28.5	27.9	27.3	26.7	26.1	25.6	25.1	24.6	24.2	23.7	23.3	22.9	22.5	22.2	21.8	21.5	21.2	20.8	20.5	20.3	20.0	19.7
500	53.5	52.1	50.8	49.5	48.4	47.3	46.2	45.2	44.2	43.3	42.5	41.6	40.8	40.1	39.3	38.6	38.0	37.3	36.7	36.1	35.5	35.0	34.4
1000	102.0	99.2	96.6	94.1	91.7	89.5	87.4	85.4	83.5	81.7	79.9	78.3	76.7	75.1	73.7	72.3	70.9	69.6	68.4	67.2	66.0	64.9	63.9

Obstruction Height \ Turbine Distance	5700	5800	5900	6000	6100	6200	6300	6400	6500	6600	6700	6800	6900	7000	7100	7200	7300	7400	7500	7600	7700	7800	7900
10	5.6	5.6	5.6	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.4	5.4	5.4	5.4	5.4	5.4
20	6.2	6.1	6.1	6.1	6.1	6.1	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.8	5.8
30	6.7	6.7	6.7	6.6	6.6	6.6	6.6	6.5	6.5	6.5	6.5	6.5	6.4	6.4	6.4	6.4	6.4	6.3	6.3	6.3	6.3	6.3	6.3
40	7.3	7.3	7.2	7.2	7.2	7.1	7.1	7.1	7.0	7.0	7.0	6.9	6.9	6.9	6.9	6.8	6.8	6.8	6.8	6.7	6.7	6.7	6.7
50	7.9	7.8	7.8	7.7	7.7	7.7	7.6	7.6	7.5	7.5	7.5	7.4	7.4	7.4	7.3	7.3	7.3	7.2	7.2	7.2	7.1	7.1	7.1
60	8.5	8.4	8.4	8.3	8.2	8.2	8.1	8.1	8.0	8.0	8.0	7.9	7.9	7.8	7.8	7.7	7.7	7.7	7.6	7.6	7.6	7.5	7.5
70	9.0	9.0	8.9	8.8	8.8	8.7	8.7	8.6	8.6	8.5	8.4	8.4	8.3	8.3	8.3	8.2	8.2	8.1	8.1	8.0	8.0	8.0	7.9
80	9.6	9.5	9.5	9.4	9.3	9.3	9.2	9.1	9.1	9.0	8.9	8.9	8.8	8.8	8.7	8.7	8.6	8.6	8.5	8.5	8.4	8.4	8.3
90	10.2	10.1	10.0	9.9	9.9	9.8	9.7	9.6	9.6	9.5	9.4	9.4	9.3	9.2	9.2	9.1	9.1	9.0	9.0	8.9	8.9	8.8	8.8
100	10.8	10.7	10.6	10.5	10.4	10.3	10.2	10.2	10.1	10.0	9.9	9.8	9.8	9.7	9.6	9.6	9.5	9.5	9.4	9.3	9.3	9.2	9.2
125	12.2	12.1	12.0	11.9	11.8	11.6	11.5	11.4	11.3	11.2	11.2	11.1	11.0	10.9	10.8	10.7	10.6	10.6	10.5	10.4	10.4	10.3	10.2
150	13.7	13.5	13.4	13.2	13.1	13.0	12.8	12.7	12.6	12.5	12.4	12.3	12.2	12.1	12.0	11.9	11.8	11.7	11.6	11.5	11.4	11.3	11.3
175	15.1	14.9	14.8	14.6	14.5	14.3	14.2	14.0	13.9	13.7	13.6	13.5	13.4	13.2	13.1	13.0	12.9	12.8	12.7	12.6	12.5	12.4	12.3
200	16.6	16.4	16.2	16.0	15.8	15.6	15.5	15.3	15.1	15.0	14.8	14.7	14.6	14.4	14.3	14.2	14.0	13.9	13.8	13.7	13.6	13.5	13.3
225	18.0	17.8	17.6	17.4	17.2	17.0	16.8	16.6	16.4	16.2	16.1	15.9	15.7	15.6	15.4	15.3	15.2	15.0	14.9	14.8	14.6	14.5	14.4
250	19.5	19.2	19.0	18.7	18.5	18.3	18.1	17.9	17.7	17.5	17.3	17.1	16.9	16.8	16.6	16.4	16.3	16.1	16.0	15.8	15.7	15.6	15.4
500	33.9	33.4	32.9	32.5	32.0	31.6	31.2	30.8	30.4	30.0	29.6	29.2	28.9	28.5	28.2	27.9	27.6	27.3	27.0	26.7	26.4	26.1	25.9
1000	62.8	61.8	60.9	59.9	59.0	58.2	57.3	56.5	55.7	54.9	54.2	53.5	52.8	52.1	51.4	50.8	50.2	49.5	49.0	48.4	47.8	47.3	46.7

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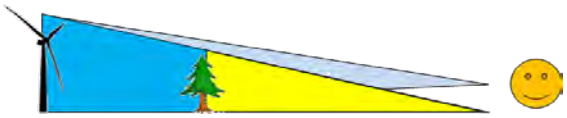
Sample Wind Turbine View Calculator

		Address	Longitude	Latitutude
Project Turbine	Archbold Area Schools	600 Lafayette Street Archbold Ohio	84°18'57.24"W	41°30'54.65"N

Suject Viewpoint Property

Point of View Sample



	User Inputs	Calculations	
Turbine Information:	Feet	Meters	Notes:
Tower Height	213.3	65.0	
Rotor Diameter	177.2	54.0	
Tip Height	301.8	92.0	
Turbine Location Elevation Above Sea-level	727.0	221.6	
Viewpoint Information:	Feet	Meters	Notes:
Viewpoint Distance From Turbine	500.0	152.4	
Viewpoint Eye Height Above Ground	5.5	1.7	
Viewpoint Ground Elevation Above Sea-level	730.0	222.5	
Net Viewpoint Ground Elevation Above Sea-level	735.5	224.2	Eye height + ground elevation above sea-level (Level Line For Calculations)
Obstruction Information:	Feet	Meters	Notes:
Obstruction Distance From Viewpoint	125.0	38.1	
Obstruction Height Above Ground	35.0	10.7	
Obstruction Ground Elevation Above Sea-level	729.0	222.2	
Net Obstruction Height Above Sea-Level	764.0	232.9	
Results:			Notes:
Will The Turbine Be Visible?	Yes	62.2%	Percent of Total Turbine and Tower
Relative Visible Turbine Height at Obstruction Distance	47.0	14.3	Feet / Meters Usefull for landscape scale
Actual Portion of Turbine Showing	187.8	57.3	Feet / Meters
Will Blades Be Visible?	Yes	100%	Percent Rotor Diameter
Will Hub Be Visible?	Yes		
Apparent Height of Visible Portion of Turbine, at Distance From Eye	0.751	0.2	Feet / Meters
Below	9.0	22.9	Inches / Centimeters
Distance From Eye	2	0.61	Feet / Meters

Although this calculator does take into account relative topography, it does not take into account the width of obstructions or their shape. It calculates on a single vertical plane at a time. Although a good guide, it should only be used as a rough indicator of the magnitude of potential turbine visibility from a particular viewpoint.

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THE RENAISSANCE GROUP

A Conserve First Company

Archbold Area Schools
Wind Turbine Project
Shadow Flicker Analysis

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www.ConserveFirst.com

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Thank You for Choosing The Renaissance Group, a Conserve First LLC Company

Introduction

Proposed Turbine Location: Archbold Schools, NW Corner of Stadium Parking Lot
600 Lafayette Street
Archbold, Ohio 43502

Latitude: 41° 30’ 54.65” N
Longitude: 84° 18’ 57.24” W

While all tall objects cast shadows, wind turbines, due to their spinning blades, can cause moving/flickering shadows which can become an annoyance, especially in residential areas when they pass over windows. Fortunately, while the adverse effects of shadows can be subjective, the shadows themselves can be precisely modeled for location and duration. While modeling shadows for location knowing the latitude of site, the topography and the height and rotor diameter of a wind turbine is a precise science, quantifying the frequency of the shadow’s actual occurrence is more difficult due to changing weather patterns affecting the actual Sun’s intensity and presence. Further, weather patterns affect the orientation of the wind turbines blades as they follow the wind and hence their orientation to the Sun and the site. In short, on a cloudy day, there will be no shadows, and similarly, when the blades are parallel or close to parallel to the observer, none to limited moving shadow will be visible, and of course, if the wind is not sufficiently blowing to rotate the blades of the turbine, you will not have any moving shadow. Further, it is important to note the higher the angle of the Sun, the shorter the reach of the shadow and the smaller the area of potential impact. Further yet, it also important to note, due to the diffusion of light over distance, shadow intensity drops off significantly with distance. The thickness of the obstruction to the Sun, in this case the blades, also plays significantly into the actual apparent intensity and realized length of shadows. It is for these reasons that shadow distances over ten rotor diameters away from the turbine are considered insignificant. For shadow receptor sites within a turbine’s shadow’s reach, not all will receive shadow due to existing obstructions that block the shadows path such as other buildings, hills or trees. While evergreen trees will fairly consistently block shadows year-round, deciduous trees will have a lesser impact in the winter months when they have no leaves. Pending the density of the tree stand, single tree to an entire wooded area, winter shadows in these situations can go from being just slightly diffused to still totally obstructed. To properly model the true impacts of shadow flicker, all these considerations must be taken into account. Unobstructed shadows in latitudes similar to this study site will typically have a bow tie or flatten cross shape. In the winter, the sun rises lower on the horizon in the Southeast and sets in the Southwest and in the Summer, the Sun rises in the Northeast and sets in the Northwest all creating a path or area of potential shadow. The southern portion of the bowtie typically is larger due to there being more sunny days in the Summer although Winter shadows will be longer overall and tend to last for longer periods due to the lower angle of the Sun’s rays. You will typically see more impacts in alignment with the site’s predominate wind direction due to the corresponding predominate turbine blade orientation perpendicular to this direction and thus more visible moving shadows in this direction.

Although no official US policy has been adopted, international standards appear to be in consensus that flickering shadows in excess of thirty hours per year impacting a particular location

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are considered a potential nuisance.[i] This said, the qualitative impacts of the shadows are subjective.

When considering potential health impacts from wind turbine shadows/flicker, photosensitivity triggered epilepsy is the only issue that is discussed and has been dismissed for mid to large scale modern wind turbines such as the one being considered by the site due to turbine operating frequencies being too low to trigger seizures. According to the British Epilepsy Association, approximately five percent of individuals with epilepsy have sensitivity to light, and most people with photosensitive epilepsy are sensitive to flickering around 16-25Hz (Hertz or Hz = 1 flash per second), although some people may be sensitive to rates as low as 3Hz and as high as 60Hz (British Epilepsy Association, 2007). Specific to wind power projects, the British Epilepsy Association (2007) states that there is no evidence that wind turbines can trigger seizures, and newer wind commercial scale turbines are built to operate at a frequency of 1Hz or less. This conclusion is also supported by the epilepsy thresholds published by the American Epilepsy Foundation.[ii] Therefore, health effects due to projected shadow flicker are not anticipated or further evaluated. The primary concern with shadow flicker is the annoyance it could cause for adjacent home and business owners.

Methods

WindPro 2.7, an internationally accepted software modeling tool, was used to generate the areas of potential shadow flicker impact around the proposed turbine installation site. The software imports historic weather variable averages from the nearest national weather station to obtain average numbers of days with sunshine and the average wind direction distributions. Local Latitude drives the solar path models. Local topographical information is input to determine if there are any natural geographic influences such as hills or valleys. The turbine information including tower height and rotor diameter are input as variables to the location's shadow source models. Rotor diameter is also used to determine the study area of influence, a ten rotor diameters radius around the turbine or 1870 feet for the largest rotor diameter being considered for this site, based on internationally accepted standards.[iii] Wind turbine operational variables for the site are also input which correspond to the turbine's overall percentage of operational time such as percentage of time when the wind speed is too low to rotate the blades and industry norms for availability driven from scheduled and unscheduled maintenance downtime. Wind speed Weibull distributions are from The Renaissance Group and State of Ohio wind data sets and models. Trees and other local obstructions are not considered in the base model (although can be added if desired) and thus the model can be considered a worst case, as if no obstructions existed. If a particular shadow receptor is found to be of potential concern, a receptor specific analysis of potential shadow flicker hours and occurrence periods/times is conducted, otherwise, the results are plotted for the area as a whole as average not-to-exceed threshold iso-lines on the map. Models were run at a two thousand meter hyper-conservative distance well beyond the likely observable shadows for this location and the turbines under consideration. For the stadium and playing field locations, extra-wide and tall receptor windows were used of 100' x 100' to better insure potential impact recording. With this in mind, it is important to note that the model records all potential impacts as if

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they impacted the entire receptor, while in reality, they will only impact a relatively small portion of these large receptors at a given time.

Results

See “Archbold WTG Shadow Flicker Analysis” map for a visualization of the results. No homes or occupied business structures outside the owner’s property within the turbines shadow influence will receive significant flickering shadows of over 30 hours per year. While some of the school’s buildings will receive shadows, there are no windows on the turbine side of the buildings. While the stadium will receive significant shadows, the majority of these shadow events will occur when the facility is not in use in the winter (See WindPro Receptor Analysis for detailed data for this receptor location). For the periods when shadowing events will overlap scheduled sporting or other use events, the school has adopted a policy that will temporarily shut down the turbine during the shadows impact on the stadium. To a far lesser extent, less than 10 hours per year, diffuse shadows may reach the public ball fields to the southeast (See WindPro Receptor Analysis for detailed data for this receptor location). Similar to the stadium policy, the turbine may be shut down during these overlapping events if they prove to be a nuisance. The financial loss to the school district from this policy will be minimal due to the short duration of the shadow events and the fact the sporting events typically only last a few hours, and further, the shutdowns will only need to occur during sunny weather. (See below for further information and recommendations for the potentially impacted receptor sites.) (Also see “Turbine Use, Safety Policies and General Background” document for information on the Schools Turbine policies relating to shadow flicker.)

Models were run using a hyper-conservative two thousand meters, a distance well beyond the industry norm of ten rotor diameters, to insure full reporting of potential impacts. The models show the same iso-lines contour results for general shadow hour thresholds based on the actual average site conditions, but the tabular information shows worse case shadow hours and the potential hours of impact for particular receptor locations, as if it was always sunny. Also, note the further away from the turbine a receptor is the less intense the shadow will be. Beyond ten rotor diameters, shadows will be diffuse and difficult to see.

Overview of Tabular Results for Particular Sample Receptors:

- Receptor A: Closest House to the Southwest, 2780+ Feet Away: 2822 County Road 24; Shadows will be highly diffuse, if visible at all, as the receptor is well outside ten rotor diameters and likely substantially blocked by the farms outbuildings, but possible during portions of May, June, July and August mornings with a total average of 3 hours of moving shadow per year.

- Receptor B: South End of Archbold High School Stadium, as close as 110 Feet Away: Blue Streak Drive; Shadows will be distinct on southern portion of the stadium grounds during afternoons and sunsets throughout the year likely requiring the turbine to be turned off during sunny evening sporting events to avoid player distraction with a total average of about 210 hours of moving shadow per year. (Note study indicates impact at the receptor, even it shadow only touches a small portion of the receptor.)

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- Receptor C: Archbold Public Ball Fields, As Close As 1200 Feet Away: Lafayette Street; Shadows will be diffuse, as the receptor is at the outer reaches of ten rotor diameters, but possible during portions of late April through mid August late evenings (after 7:30PM) with a total average of about 28 hours of moving shadow per year impacting some portion of the fields possibly requiring the turbine to be turned off during sunny sunset sporting events to avoid player distraction. (Note study indicates impact at the receptor, even it shadow only touches a small portion of the receptor.)

- Receptor D: Closest House to the Northeast, As Close As 1465 Feet Away: 101 Parkview Court; Shadows will be diffuse, as the receptor is at the outer reaches of ten rotor diameters and may be blocked by existing evergreen trees, but possible during portions of late November through mid January evenings with a total average of about 3 hours of moving shadow per year. (Note study indicates impact at the receptor, even it shadow only touches a small portion of the receptor.)

The duration of particular shadow events can vary from a minute to hours pending the receptor. See the following tables at the end of this report for precise dates and times where shadows could occur for each listed sample receptor.

Note the iso-line diagram on the following page shows hour thresholds of shadow impact based on average site conditions with results being referenced to one meter squares of potential impact, i.e. a meter square area within an iso-line area will receive up to the threshold of shadow hours per year. As the tabular information represents larger areas and adds up the entire receptor as if it was one location, its cumulative hour results may be higher. This equates to watching if a shadow will enter a window to watching if it will enter any portion of an entire ball field or yard. Although impacts can be subjective, shadows impacting a specific receptor window are considered significantly more severe than those that impact a yard.

Recommendations

Based on the study findings, no occupied structure will receive over 30 hours of moving shadow per year, the currently accepted consensus on nuisance thresholds for moving shadows/flickering. No local, State or Federal policy or regulation exists to govern shadow flicker thresholds. This said, some receptors will receive some shadow which the affect of will be subjective to the receptor owners' views on the project and their sensitivity. With this in mind, the study authors would recommend that the project site owner follow the guidelines and mediation strategies outlined in "Turbine Use, Safety Policies and General Background".

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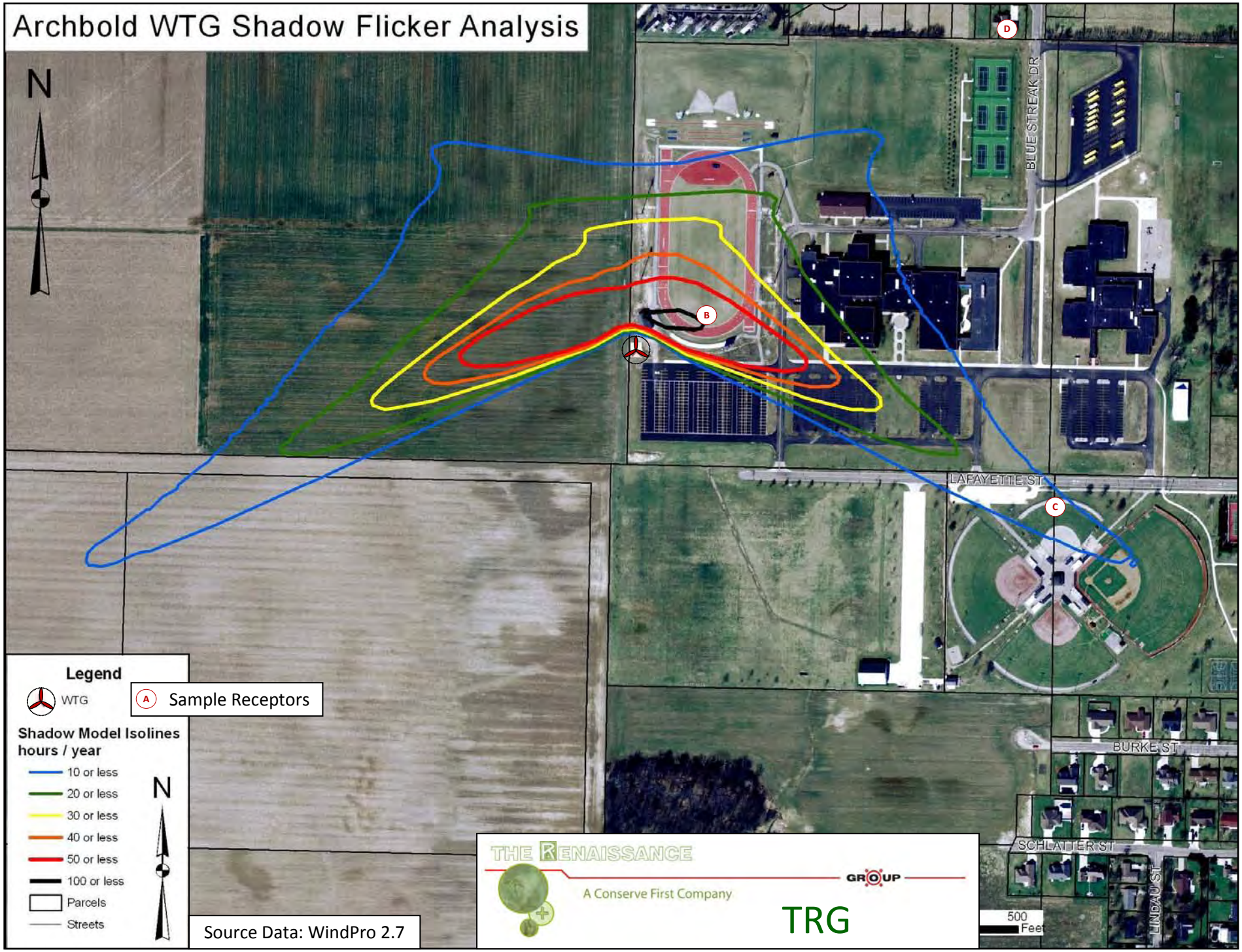

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Project:
Archbold

Description:
Shadow Receptor Potential Impacts Analysis, 2000 Meters

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Calculated:
8/28/2010 6:51 PM/2.7.473

SHADOW - Main Result

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

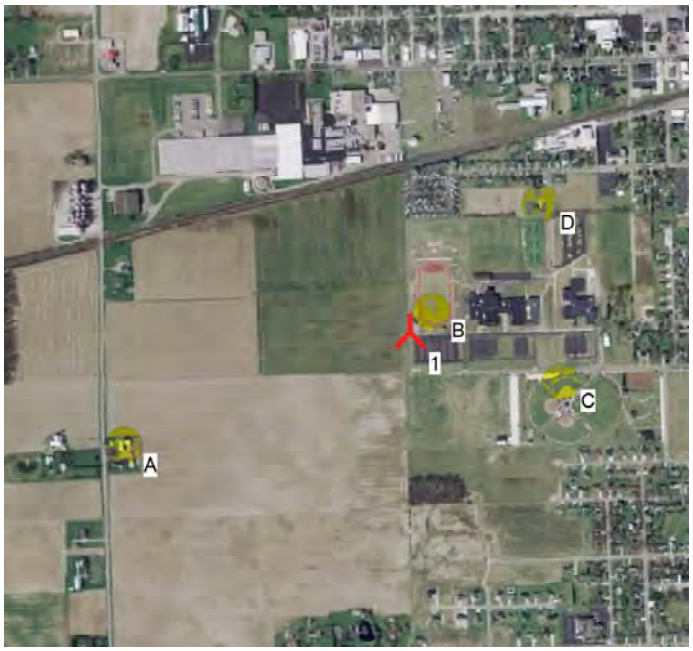
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
227	217	324	570	498	353	263	290	423	680	776	830

W	WNW	NW	NNW	Sum
755	671	460	318	7,655

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: FultonXYZ.wpo (1)
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m



Scale 1:20,000
New WTG Shadow receptor

WTGs

	UTM WGS84 Zone: 16 East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
	UTM WGS84 Zone: 16		[m]					[kW]	[m]	[m]	[m]	[RPM]
1	723,980	4,599,428	221.5	Unison U54-750kW 750 5...	Yes	Unison	U54-750kW-750	750	54.0	75.0	1,088	25.0

Shadow receptor-Input

No.	UTM WGS84 Zone: 16 East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
			[m]	[m]	[m]	[m]	[°]	[°]	
A	723,221	4,599,127	220.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
B	724,038	4,599,484	222.3	30.0	30.0	0.2	-180.0	90.0	"Green house mode"
C	724,380	4,599,298	222.1	30.0	30.0	0.2	-180.0	90.0	"Green house mode"
D	724,326	4,599,770	221.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

Calculation Results

Shadow receptor

No.	Shadow, expected values Shadow hours per year [h/year]
A	2:41
B	209:08
C	28:13
D	3:16

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Project:
Archbold

Description:
The Renaissance Group

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8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com
Calculated:
8/28/2010 6:51 PM/2.7.473

SHADOW - Main Result

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	Unison U54-750kW 750 54.0 !O! hub: 75.0 m (2)	853:59	243:19

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Project:
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Description:
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8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com

Calculated:
8/28/2010 6:51 PM/2.7.473

SHADOW - Calendar

Shadow receptor: A - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (1)

Assumptions for shadow calculations

Maximum distance for influence	2,000 m
Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
227	217	324	570	498	353	263	290	423	680	776	830	755	671	460	318	7,655

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:50	07:14	07:22	06:36	06:07	06:07	06:32	07:03	07:34	07:09	07:44
	17:18	17:53	18:28	20:01	20:34	21:04	21:16	20:57	20:14	19:21	17:34	17:09
2	08:05	07:49	07:12	07:20	06:34	06:06	06:08	06:33	07:04	07:35	07:10	07:45
	17:19	17:54	18:29	20:02	20:35	21:05	21:16	20:56	20:12	19:19	17:32	17:09
3	08:05	07:48	07:11	07:19	06:33	06:06	06:08	06:34	07:05	07:36	07:11	07:46
	17:20	17:56	18:30	20:03	20:36	21:06	21:15	20:55	20:10	19:17	17:31	17:08
4	08:05	07:47	07:09	07:17	06:32	06:05	06:09	06:35	07:06	07:37	07:12	07:47
	17:21	17:57	18:31	20:05	20:37	21:06	21:15	20:54	20:09	19:16	17:30	17:08
5	08:05	07:46	07:07	07:15	06:31	06:05	06:09	06:36	07:07	07:38	07:14	07:48
	17:22	17:58	18:32	20:06	20:38	21:07	21:15	20:53	20:07	19:14	17:29	17:08
6	08:05	07:45	07:06	07:14	06:29	06:51 (1) 06:05	06:10	06:37	07:08	07:39	07:15	07:49
	17:23	17:59	18:33	20:07	20:39	7 06:58 (1) 21:08	21:15	20:51	20:05	19:12	17:28	17:08
7	08:04	07:44	07:04	07:12	06:28	06:50 (1) 06:04	06:11	06:38	07:09	07:40	07:16	07:50
	17:24	18:01	18:35	20:08	20:40	10 07:00 (1) 21:08	21:15	20:50	20:04	19:11	17:27	17:08
8	08:04	07:43	08:02	07:11	06:27	06:49 (1) 06:04	06:11	06:39	07:10	07:41	07:17	07:51
	17:25	18:02	19:36	20:09	20:41	12 07:01 (1) 21:09	21:14	20:49	20:02	19:09	17:25	17:08
9	08:04	07:42	08:01	07:09	06:26	06:48 (1) 06:04	06:12	06:40	07:11	07:42	07:18	07:52
	17:26	18:03	19:37	20:10	20:42	14 07:02 (1) 21:10	21:14	20:48	20:00	19:07	17:24	17:08
10	08:04	07:40	07:59	07:07	06:25	06:47 (1) 06:04	06:13	06:41	07:12	07:43	07:20	07:53
	17:27	18:04	19:38	20:11	20:43	16 07:03 (1) 21:10	21:14	20:46	19:57	19:06	17:23	17:08
11	08:04	07:39	07:58	07:06	06:24	06:47 (1) 06:04	06:13	06:42	07:13	07:45	07:21	07:54
	17:28	18:06	19:39	20:12	20:44	16 07:03 (1) 21:11	21:13	20:45	19:55	19:04	17:22	17:08
12	08:03	07:38	07:56	07:04	06:23	06:47 (1) 06:03	06:14	06:43	07:14	07:46	07:22	07:54
	17:29	18:07	19:40	20:13	20:45	16 07:03 (1) 21:11	21:13	20:44	19:54	19:03	17:21	17:08
13	08:03	07:37	07:54	07:02	06:21	06:47 (1) 06:03	06:15	06:44	07:15	07:47	07:23	07:55
	17:30	18:08	19:41	20:14	20:47	16 07:03 (1) 21:12	21:12	20:42	19:52	19:01	17:20	17:08
14	08:03	07:35	07:53	07:01	06:20	06:47 (1) 06:03	06:16	06:45	07:16	07:48	07:25	07:56
	17:31	18:09	19:43	20:15	20:48	16 07:03 (1) 21:12	21:12	20:41	19:50	18:59	17:19	17:08
15	08:02	07:34	07:51	06:59	06:19	06:47 (1) 06:03	06:16	06:46	07:17	07:49	07:26	07:57
	17:32	18:11	19:44	20:16	20:49	16 07:03 (1) 21:13	21:11	20:40	19:48	18:58	17:19	17:09
16	08:02	07:33	07:49	06:58	06:18	06:48 (1) 06:03	06:17	06:47	07:18	07:50	07:27	07:57
	17:33	18:12	19:45	20:18	20:50	14 07:02 (1) 21:13	21:11	20:38	19:47	18:56	17:18	17:09
17	08:01	07:31	07:48	06:56	06:17	06:48 (1) 06:03	06:18	06:48	07:19	07:51	07:28	07:58
	17:35	18:13	19:46	20:19	20:51	13 07:01 (1) 21:14	21:10	20:37	19:45	18:55	17:17	17:09
18	08:01	07:30	07:46	06:55	06:17	06:49 (1) 06:03	06:19	06:49	07:20	07:52	07:29	07:59
	17:36	18:14	19:47	20:20	20:52	12 07:01 (1) 21:14	21:09	20:35	19:43	18:53	17:16	17:09
19	08:00	07:29	07:44	06:53	06:16	06:50 (1) 06:04	06:20	06:50	07:21	07:53	07:31	07:59
	17:37	18:16	19:48	20:21	20:53	11 07:01 (1) 21:14	21:09	20:34	19:41	18:52	17:15	17:10
20	08:00	07:27	07:42	06:51	06:15	06:52 (1) 06:04	06:21	06:51	07:22	07:55	07:32	08:00
	17:38	18:17	19:49	20:22	20:53	7 06:59 (1) 21:15	21:08	20:32	19:40	18:50	17:15	17:10
21	07:59	07:26	07:41	06:50	06:14	06:54 (1) 06:04	06:21	06:52	07:23	07:56	07:33	08:01
	17:39	18:18	19:50	20:23	20:54	2 06:56 (1) 21:15	21:07	20:31	19:38	18:49	17:14	17:11
22	07:59	07:24	07:39	06:48	06:13	06:04	06:22	06:53	07:24	07:57	07:34	08:01
	17:41	18:19	19:51	20:24	20:55	21:15	21:06	20:29	19:36	18:47	17:13	17:11
23	07:58	07:23	07:37	06:47	06:12	06:04	06:23	07:03 (1) 06:54	07:25	07:58	07:35	08:02
	17:42	18:20	19:53	20:25	20:56	21:15	21:06 5	07:08 (1) 20:28	19:35	18:46	17:13	17:12
24	07:57	07:21	07:36	06:46	06:12	06:05	06:24	07:01 (1) 06:55	07:27	07:59	07:36	08:02
	17:43	18:22	19:54	20:26	20:57	21:15	21:05 8	07:09 (1) 20:26	19:33	18:44	17:12	17:12
25	07:56	07:20	07:34	06:44	06:11	06:05	06:25	07:00 (1) 06:56	07:28	08:00	07:38	08:02
	17:44	18:23	19:55	20:27	20:58	21:16	21:04 11	07:11 (1) 20:25	19:31	18:43	17:11	17:13
26	07:56	07:18	07:32	06:43	06:10	06:05	06:26	06:59 (1) 06:57	07:29	08:02	07:39	08:03
	17:45	18:24	19:56	20:28	20:59	21:16	21:03 13	07:12 (1) 20:23	19:29	18:42	17:11	17:14
27	07:55	07:17	07:31	06:41	06:09	06:06	06:27	06:58 (1) 06:58	07:30	08:03	07:40	08:03
	17:47	18:25	19:57	20:29	21:00	21:16	21:02 14	07:12 (1) 20:22	19:28	18:40	17:11	17:14
28	07:54	07:15	07:29	06:40	06:09	06:06	06:28	06:58 (1) 06:59	07:31	08:04	07:41	08:03
	17:48	18:26	19:58	20:31	21:01	21:16	21:01 15	07:13 (1) 20:20	19:26	18:39	17:10	17:15
29	07:53		07:27	06:38	06:08	06:06	06:29	06:58 (1) 07:00	07:32	08:05	07:42	08:04
	17:49		19:59	20:32	21:02	21:16	21:00 15	07:13 (1) 20:19	19:24	18:37	17:10	17:16
30	07:52		07:26	06:37	06:08	06:07	06:30	06:58 (1) 07:01	07:33	08:06	07:43	08:04
	17:50		20:00	20:33	21:02	21:16	20:59 16	07:14 (1) 20:17	19:23	18:36	17:09	17:16
31	07:51		07:24		06:07		06:31	06:57 (1) 07:02		08:08		08:04
	17:52		20:00		21:03		20:58 17	07:14 (1) 20:15		18:35		17:17
Potential sun hours	296	297	370	399	449	454	461	429	375	344	297	286
Total, worst case					98	1	14	1 7		8		
Sun reduction					0.61		0.69	0.65				
Oper. time red.					0.87		0.87	0.87				
Wind dir. red.					0.72		0.72	0.72				
Total reduction					0.39		0.43	0.41				
Total, real					7		7 9	6 4		3		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

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Project:
Archbold

Description:
The Renaissance Group

THE RENAISSANCE GROUP
A Conserve First Company

Printed/Page
8/28/2010 6:51 PM / 4
Licensed user:
Conserve First LLC, d/b/a The Renaissance Group, Renewables
8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com
Calculated:
8/28/2010 6:51 PM/2.7.473

SHADOW - Calendar

Shadow receptor: B - Shadow Receptor: 30.0 × 30.0 Azimuth: -180.0° Slope: 90.0° (7)

Assumptions for shadow calculations

Maximum distance for influence	2,000 m
Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
227	217	324	570	498	353	263	290	423	680	776	830	755	671	460	318	7,655

Idle start wind speed: Cut in wind speed from power curve

	January		February		March		April		May		June	
1	08:04		13:57 (1)		07:50		13:55 (1)		07:14		13:45 (1)	
	17:18	113	15:50 (1)	159	17:53	159	16:34 (1)	201	18:28	201	17:06 (1)	190
2	08:05		13:58 (1)		07:49		13:55 (1)		07:12		13:45 (1)	
	17:19	113	15:51 (1)	161	17:54	161	16:36 (1)	202	18:29	202	17:07 (1)	187
3	08:05		13:58 (1)		07:48		13:55 (1)		07:10		13:44 (1)	
	17:20	114	15:52 (1)	163	17:55	163	16:38 (1)	203	18:30	203	17:07 (1)	184
4	08:05		13:58 (1)		07:47		13:54 (1)		07:09		13:43 (1)	
	17:21	115	15:53 (1)	165	17:57	165	16:39 (1)	204	18:31	204	17:07 (1)	181
5	08:05		13:58 (1)		07:46		13:53 (1)		07:07		13:43 (1)	
	17:22	116	15:54 (1)	167	17:58	167	16:40 (1)	204	18:32	204	17:07 (1)	178
6	08:05		13:58 (1)		07:45		13:53 (1)		07:06		13:42 (1)	
	17:23	117	15:55 (1)	169	17:59	169	16:42 (1)	205	18:33	205	17:07 (1)	174
7	08:04		13:58 (1)		07:44		13:53 (1)		07:04		13:41 (1)	
	17:24	119	15:57 (1)	171	18:01	171	16:44 (1)	206	18:35	206	17:07 (1)	171
8	08:04		13:57 (1)		07:43		13:53 (1)		08:02		14:41 (1)	
	17:25	120	15:57 (1)	173	18:02	173	16:46 (1)	207	19:36	207	18:08 (1)	168
9	08:04		13:58 (1)		07:42		13:53 (1)		08:01		14:40 (1)	
	17:26	121	15:59 (1)	175	18:03	175	16:48 (1)	207	19:37	207	18:07 (1)	165
10	08:04		13:58 (1)		07:40		13:52 (1)		07:59		14:40 (1)	
	17:27	122	16:00 (1)	177	18:04	177	16:49 (1)	208	19:38	208	18:08 (1)	161
11	08:04		13:58 (1)		07:39		13:52 (1)		07:58		14:39 (1)	
	17:28	124	16:02 (1)	178	18:06	178	16:50 (1)	209	19:39	209	18:08 (1)	158
12	08:03		13:57 (1)		07:38		13:52 (1)		07:56		14:38 (1)	
	17:29	125	16:02 (1)	180	18:07	180	16:52 (1)	209	19:40	209	18:07 (1)	155
13	08:03		13:58 (1)		07:37		13:52 (1)		07:54		14:37 (1)	
	17:30	126	16:04 (1)	182	18:08	182	16:54 (1)	210	19:41	210	18:07 (1)	151
14	08:03		13:57 (1)		07:35		13:51 (1)		07:53		14:37 (1)	
	17:31	128	16:05 (1)	183	18:09	183	16:54 (1)	210	19:43	210	18:07 (1)	147
15	08:02		13:57 (1)		07:34		13:51 (1)		07:51		14:37 (1)	
	17:32	130	16:07 (1)	185	18:11	185	16:56 (1)	210	19:44	210	18:07 (1)	144
16	08:02		13:57 (1)		07:33		13:51 (1)		07:49		14:36 (1)	
	17:33	131	16:08 (1)	186	18:12	186	16:57 (1)	210	19:45	210	18:06 (1)	140
17	08:01		13:57 (1)		07:31		13:50 (1)		07:47		14:36 (1)	
	17:35	133	16:10 (1)	188	18:13	188	16:58 (1)	210	19:46	210	18:06 (1)	137
18	08:01		13:57 (1)		07:30		13:50 (1)		07:46		14:36 (1)	
	17:36	134	16:11 (1)	189	18:14	189	16:59 (1)	210	19:47	210	18:06 (1)	134
19	08:00		13:57 (1)		07:28		13:49 (1)		07:44		14:36 (1)	
	17:37	136	16:13 (1)	191	18:16	191	17:00 (1)	209	19:48	209	18:05 (1)	129
20	08:00		13:57 (1)		07:27		13:49 (1)		07:42		14:36 (1)	
	17:38	137	16:14 (1)	192	18:17	192	17:01 (1)	209	19:49	209	18:05 (1)	126
21	07:59		13:56 (1)		07:26		13:48 (1)		07:41		14:36 (1)	
	17:39	139	16:15 (1)	193	18:18	193	17:01 (1)	209	19:50	209	18:05 (1)	123
22	07:59		13:57 (1)		07:24		13:48 (1)		07:39		14:36 (1)	
	17:40	141	16:18 (1)	194	18:19	194	17:02 (1)	208	19:51	208	18:04 (1)	118
23	07:58		13:56 (1)		07:23		13:47 (1)		07:37		14:36 (1)	
	17:42	143	16:19 (1)	196	18:20	196	17:03 (1)	207	19:53	207	18:03 (1)	115
24	07:57		13:56 (1)		07:21		13:47 (1)		07:36		14:38 (1)	
	17:43	144	16:20 (1)	197	18:22	197	17:04 (1)	205	19:54	205	18:03 (1)	112
25	07:56		13:55 (1)		07:20		13:46 (1)		07:34		14:38 (1)	
	17:44	147	16:22 (1)	198	18:23	198	17:04 (1)	204	19:55	204	18:02 (1)	109
26	07:56		13:55 (1)		07:18		13:47 (1)		07:32		14:38 (1)	
	17:45	148	16:23 (1)	198	18:24	198	17:05 (1)	203	19:56	203	18:01 (1)	105
27	07:55		13:56 (1)		07:17		13:46 (1)		07:31		14:40 (1)	
	17:47	150	16:26 (1)	199	18:25	199	17:05 (1)	201	19:57	201	18:01 (1)	102
28	07:54		13:55 (1)		07:15		13:46 (1)		07:29		14:41 (1)	
	17:48	152	16:27 (1)	200	18:26	200	17:06 (1)	199	19:58	199	18:00 (1)	99
29	07:53		13:55 (1)						07:27		14:42 (1)	
	17:49	154	16:29 (1)						19:59	197	17:59 (1)	95
30	07:52		13:55 (1)						07:25		14:44 (1)	
	17:50	156	16:31 (1)						20:00	195	17:59 (1)	92
31	07:51		13:55 (1)						07:24		14:46 (1)	
	17:52	157	16:32 (1)						20:00	192	17:58 (1)	
Potential sun hours	296		297						370		399	
Total, worst case		4105		5109				6363				4250
Sun reduction		0.36		0.41				0.41				0.57
Oper. time red.		0.87		0.87				0.87				0.87
Wind dir. red.		0.71		0.71				0.71				0.71
Total reduction		0.23		0.26				0.26				0.35
Total, real		925		1308				1623				1502

	May		June	
1	14:47 (1)		06:36	
	17:57 (1)	89	20:34	89
2	14:49 (1)		06:34	
	17:56 (1)	85	20:35	85
3	14:51 (1)		06:33	
	17:55 (1)	82	20:36	82
4	14:53 (1)		06:32	
	17:54 (1)	80	20:37	80
5	14:55 (1)		06:31	
	17:53 (1)	76	20:38	76
6	14:58 (1)		06:29	
	17:50 (1)	67	20:41	67
7	15:00 (1)		06:28	
	17:49 (1)	64	20:42	64
8	15:02 (1)		06:27	
	17:47 (1)	62	20:43	62
9	15:04 (1)		06:26	
	17:45 (1)	56	20:45	56
10	15:06 (1)		06:25	
	17:44 (1)	54	20:46	54
11	15:09 (1)		06:24	
	17:42 (1)	51	20:47	51
12	15:10 (1)		06:22	
	17:40 (1)	48	20:49	48
13	15:13 (1)		06:21	
	17:39 (1)	46	20:50	46
14	15:15 (1)		06:20	
	17:37 (1)	43	20:51	43
15	15:16 (1)		06:19	
	17:36 (1)	41	20:52	41
16	15:18 (1)		06:16	
	17:33 (1)	38	20:52	38
17	15:19 (1)		06:18	
	17:32 (1)	35	20:53	35
18	15:22 (1)		06:16	
	17:30 (1)	33	20:54	33
19	15:24 (1)		06:16	
	17:28 (1)	30	20:55	30
20	15:26 (1)		06:15	
	17:27 (1)	27	20:56	27
21	15:27 (1)		06:14	
	17:25 (1)	24	20:57	24
22	15:30 (1)		06:13	
	17:24 (1)	20	20:58	20
23	15:31 (1)		06:12	
	17:21 (1)	16	20:59	16
24	15:33 (1)		06:11	
	17:20 (1)	10	21:00	10
25	15:35 (1)		06:11	
	17:18 (1)		21:01	
26	15:36 (1)		06:10	
	17:16 (1)		21:02	
27	15:38 (1)		06:09	
	17:15 (1)		21:02	
28	15:39 (1)		06:09	
			06:07	
29	15:41 (1)		06:08	
			21:02	
30	15:43 (1)		06:08	
			21:02	
31			06:07	
			21:03	
Potential sun hours			449	
Total, worst case		1380		
Sun reduction		0.61		
Oper. time red.		0.87		
Wind dir. red.		0.71		
Total reduction		0.38		
Total, real		527		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

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Project:
Archbold

Description:
The Renaissance Group

THE RENAISSANCE GROUP
A Conserve First Company

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8/28/2010 6:51 PM / 5
Licensed user:
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8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com
Calculated:
8/28/2010 6:51 PM/2.7.473

SHADOW - Calendar

Shadow receptor: B - Shadow Receptor: 30.0 × 30.0 Azimuth: -180.0° Slope: 90.0° (7)

Assumptions for shadow calculations

Maximum distance for influence	2,000 m
Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
227	217	324	570	498	353	263	290	423	680	776	830	755	671	460	318	7,655

Idle start wind speed: Cut in wind speed from power curve

	July		August		September		October		November		December	
1	06:07		06:32		16:11 (1) / 07:03		15:08 (1) / 07:34		14:18 (1) / 07:09		13:22 (1) / 07:44	
	21:16		20:57	57	17:08 (1) / 20:14	158	17:46 (1) / 19:21	209	17:47 (1) / 17:34	176	16:18 (1) / 17:09	124
2	06:08		06:33		16:10 (1) / 07:04		15:05 (1) / 07:35		14:18 (1) / 07:10		13:22 (1) / 07:45	
	21:16		20:56	60	17:10 (1) / 20:12	161	17:46 (1) / 19:19	208	17:46 (1) / 17:32	174	16:16 (1) / 17:09	122
3	06:08		06:34		16:08 (1) / 07:05		15:02 (1) / 07:36		14:18 (1) / 07:11		13:23 (1) / 07:46	
	21:15		20:55	63	17:11 (1) / 20:10	165	17:47 (1) / 19:17	208	17:46 (1) / 17:31	172	16:15 (1) / 17:08	121
4	06:09		06:35		16:07 (1) / 07:06		15:00 (1) / 07:37		14:18 (1) / 07:12		13:23 (1) / 07:47	
	21:15		20:54	65	17:12 (1) / 20:09	167	17:47 (1) / 19:16	207	17:45 (1) / 17:30	171	16:14 (1) / 17:08	120
5	06:09		06:36		16:05 (1) / 07:07		14:57 (1) / 07:38		14:17 (1) / 07:14		13:23 (1) / 07:48	
	21:15		20:53	69	17:14 (1) / 20:07	171	17:48 (1) / 19:14	207	17:44 (1) / 17:29	169	16:12 (1) / 17:08	119
6	06:10		06:37		16:02 (1) / 07:08		14:54 (1) / 07:39		14:17 (1) / 07:15		13:24 (1) / 07:49	
	21:15		20:51	72	17:14 (1) / 20:05	174	17:48 (1) / 19:12	207	17:44 (1) / 17:28	167	16:11 (1) / 17:08	117
7	06:11		06:38		16:01 (1) / 07:09		14:51 (1) / 07:40		14:17 (1) / 07:16		13:24 (1) / 07:50	
	21:15		20:50	74	17:15 (1) / 20:04	178	17:49 (1) / 19:11	206	17:43 (1) / 17:26	165	16:09 (1) / 17:08	116
8	06:11		06:39		15:59 (1) / 07:10		14:48 (1) / 07:41		14:17 (1) / 07:17		13:24 (1) / 07:51	
	21:14		20:49	78	17:17 (1) / 20:02	181	17:49 (1) / 19:09	205	17:42 (1) / 17:25	163	16:07 (1) / 17:08	115
9	06:12		06:40		15:58 (1) / 07:11		14:46 (1) / 07:42		14:17 (1) / 07:18		13:25 (1) / 07:52	
	21:14		20:48	80	17:18 (1) / 20:00	183	17:49 (1) / 19:07	205	17:42 (1) / 17:24	162	16:07 (1) / 17:08	114
10	06:13		06:41		15:56 (1) / 07:12		14:43 (1) / 07:43		14:18 (1) / 07:20		13:26 (1) / 07:53	
	21:14		20:46	83	17:19 (1) / 19:57	187	17:50 (1) / 19:06	204	17:42 (1) / 17:23	159	16:05 (1) / 17:08	113
11	06:13		06:42		15:54 (1) / 07:13		14:40 (1) / 07:45		14:18 (1) / 07:21		13:26 (1) / 07:54	
	21:13		20:45	86	17:20 (1) / 19:55	190	17:50 (1) / 19:04	203	17:41 (1) / 17:22	157	16:03 (1) / 17:08	113
12	06:14		06:43		15:52 (1) / 07:14		14:37 (1) / 07:46		14:18 (1) / 07:22		13:26 (1) / 07:54	
	21:13		20:44	90	17:22 (1) / 19:54	192	17:49 (1) / 19:03	202	17:40 (1) / 17:21	155	16:01 (1) / 17:08	112
13	06:15		06:44		15:50 (1) / 07:15		14:35 (1) / 07:47		14:18 (1) / 07:23		13:27 (1) / 07:55	
	21:12		20:42	93	17:23 (1) / 19:52	194	17:49 (1) / 19:01	201	17:39 (1) / 17:20	154	16:01 (1) / 17:08	111
14	06:16		06:45		15:48 (1) / 07:16		14:33 (1) / 07:48		14:18 (1) / 07:24		13:27 (1) / 07:56	
	21:12		20:41	96	17:24 (1) / 19:50	196	17:49 (1) / 18:59	200	17:38 (1) / 17:19	152	15:59 (1) / 17:08	110
15	06:16		06:46		15:47 (1) / 07:17		14:31 (1) / 07:49		14:18 (1) / 07:26		13:28 (1) / 07:57	
	21:11		20:40	99	17:26 (1) / 19:48	198	17:49 (1) / 18:58	199	17:37 (1) / 17:19	150	15:58 (1) / 17:09	110
16	06:17		16:38 (1) / 06:47		15:45 (1) / 07:18		14:29 (1) / 07:50		14:18 (1) / 07:27		13:29 (1) / 07:57	
	21:11	7	16:45 (1) / 20:38	102	17:27 (1) / 19:47	201	17:50 (1) / 18:56	198	17:36 (1) / 17:18	148	15:57 (1) / 17:09	109
17	06:18		16:34 (1) / 06:48		15:43 (1) / 07:19		14:27 (1) / 07:51		14:19 (1) / 07:28		13:29 (1) / 07:58	
	21:10	13	16:47 (1) / 20:37	105	17:28 (1) / 19:45	203	17:50 (1) / 18:55	197	17:36 (1) / 17:17	147	15:56 (1) / 17:09	109
18	06:19		16:32 (1) / 06:49		15:41 (1) / 07:20		14:25 (1) / 07:52		14:19 (1) / 07:29		13:30 (1) / 07:59	
	21:09	18	16:50 (1) / 20:35	109	17:30 (1) / 19:43	204	17:49 (1) / 18:53	196	17:35 (1) / 17:16	144	15:54 (1) / 17:09	109
19	06:20		16:30 (1) / 06:50		15:38 (1) / 07:21		14:24 (1) / 07:53		14:19 (1) / 07:30		13:30 (1) / 07:59	
	21:09	22	16:52 (1) / 20:34	113	17:31 (1) / 19:41	205	17:49 (1) / 18:52	195	17:34 (1) / 17:15	143	15:53 (1) / 17:10	108
20	06:20		16:28 (1) / 06:51		15:36 (1) / 07:22		14:23 (1) / 07:55		14:19 (1) / 07:32		13:32 (1) / 08:00	
	21:08	26	16:54 (1) / 20:32	116	17:32 (1) / 19:40	206	17:49 (1) / 18:50	194	17:33 (1) / 17:15	141	15:53 (1) / 17:10	108
21	06:21		16:27 (1) / 06:52		15:34 (1) / 07:23		14:22 (1) / 07:56		14:19 (1) / 07:33		13:32 (1) / 08:01	
	21:07	28	16:55 (1) / 20:31	120	17:34 (1) / 19:38	207	17:49 (1) / 18:49	192	17:31 (1) / 17:14	140	15:52 (1) / 17:11	108
22	06:22		16:25 (1) / 06:53		15:32 (1) / 07:24		14:21 (1) / 07:57		14:20 (1) / 07:34		13:33 (1) / 08:01	
	21:06	32	16:57 (1) / 20:29	123	17:35 (1) / 19:36	208	17:49 (1) / 18:47	191	17:31 (1) / 17:13	137	15:50 (1) / 17:11	108
23	06:23		16:23 (1) / 06:54		15:30 (1) / 07:25		14:20 (1) / 07:58		14:20 (1) / 07:35		13:33 (1) / 08:02	
	21:06	34	16:57 (1) / 20:28	126	17:36 (1) / 19:35	209	17:49 (1) / 18:46	190	17:30 (1) / 17:13	136	15:49 (1) / 17:12	108
24	06:24		16:22 (1) / 06:55		15:27 (1) / 07:26		14:19 (1) / 07:59		14:20 (1) / 07:36		13:35 (1) / 08:02	
	21:05	36	16:58 (1) / 20:26	130	17:37 (1) / 19:33	210	17:49 (1) / 18:44	189	17:29 (1) / 17:12	134	15:49 (1) / 17:12	108
25	06:25		16:20 (1) / 06:56		15:25 (1) / 07:28		14:18 (1) / 08:00		14:20 (1) / 07:37		13:35 (1) / 08:02	
	21:04	39	16:59 (1) / 20:25	134	17:39 (1) / 19:31	210	17:48 (1) / 18:43	187	17:27 (1) / 17:11	133	15:48 (1) / 17:13	108
26	06:26		16:19 (1) / 06:57		15:23 (1) / 07:29		14:18 (1) / 08:02		14:21 (1) / 07:39		13:36 (1) / 08:03	
	21:03	42	17:01 (1) / 20:23	137	17:40 (1) / 19:29	210	17:48 (1) / 18:42	186	17:27 (1) / 17:11	131	15:47 (1) / 17:13	109
27	06:27		16:18 (1) / 06:58		15:20 (1) / 07:30		14:18 (1) / 08:03		14:21 (1) / 07:40		13:36 (1) / 08:03	
	21:02	44	17:02 (1) / 20:22	141	17:41 (1) / 19:28	211	17:49 (1) / 18:40	184	17:25 (1) / 17:10	130	15:46 (1) / 17:14	109
28	06:28		16:16 (1) / 06:59		15:18 (1) / 07:31		14:18 (1) / 08:04		14:21 (1) / 07:41		13:37 (1) / 08:03	
	21:01	47	17:03 (1) / 20:20	144	17:42 (1) / 19:26	210	17:48 (1) / 18:39	183	17:24 (1) / 17:10	128	15:45 (1) / 17:15	110
29	06:29		16:15 (1) / 07:00		15:15 (1) / 07:32		14:18 (1) / 08:05		14:21 (1) / 07:42		13:38 (1) / 08:04	
	21:00	50	17:05 (1) / 20:19	148	17:43 (1) / 19:24	210	17:48 (1) / 18:37	181	17:22 (1) / 17:10	126	15:44 (1) / 17:16	110
30	06:30		16:14 (1) / 07:01		15:13 (1) / 07:33		14:18 (1) / 08:06		14:22 (1) / 07:43		13:39 (1) / 08:04	
	20:59	52	17:06 (1) / 20:17	151	17:44 (1) / 19:23	209	17:47 (1) / 18:36	180	17:22 (1) / 17:09	125	15:44 (1) / 17:16	111
31	06:31		16:12 (1) / 07:02		15:10 (1) /				08:08		14:22 (1) /		08:04		13:57 (1)
	20:58	55	17:07 (1) / 20:15	155	17:45 (1) /				18:35	178	17:20 (1) /		17:17	112	15:49 (1)
Potential sun hours	461		429		375		344		297		286	
Total, worst case	545		3219		5808		6092		4489		3481	
Sun reduction	0.69		0.65		0.55		0.51		0.27		0.20	
Oper. time red.	0.87		0.87		0.87		0.87		0.87		0.87	
Wind dir. red.	0.71		0.71		0.71		0.71		0.71		0.71	
Total reduction	0.43		0.40		0.34		0.32		0.17		0.13	
Total, real	233		1301		1988		1941		764		438	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

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Project:
Archbold

Description:
The Renaissance Group

THE RENAISSANCE GROUP
A Conserve First Company

Printed/Page
8/28/2010 6:51 PM / 6

Licensed user:
Conserve First LLC, d/b/a The Renaissance Group, Renewables
8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com

Calculated:
8/28/2010 6:51 PM/2.7.473

SHADOW - Calendar

Shadow receptor: C - Shadow Receptor: 30.0 × 30.0 Azimuth: -180.0° Slope: 90.0° (10)

Assumptions for shadow calculations

Maximum distance for influence	2,000	m
Minimum sun height over horizon for influence	3	°
Day step for calculation	1	days
Time step for calculation	1	minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
227	217	324	570	498	353	263	290	423	680	776	830	755	671	460	318	7,655

Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April		May		June		July		August		September	October	November	December
1	08:04	07:50	07:14	07:22		06:36		19:51 (1)	06:07		19:39 (1)	06:07		19:49 (1)	06:32		19:47 (1)	07:03	07:34	07:09	07:44
	17:18	17:53	18:28	20:01		20:34	21	20:12 (1)	21:04	49	20:28 (1)	21:16	42	20:31 (1)	20:57	46	20:33 (1)	20:14	19:21	17:34	17:09
2	08:04	07:49	07:12	07:20		06:34		19:48 (1)	06:06		19:40 (1)	06:08		19:48 (1)	06:33		19:48 (1)	07:04	07:35	07:10	07:45
	17:19	17:54	18:29	20:02		20:35	24	20:12 (1)	21:05	49	20:29 (1)	21:16	43	20:31 (1)	20:56	44	20:32 (1)	20:12	19:19	17:32	17:09
3	08:05	07:48	07:10	07:19		06:33		19:47 (1)	06:06		19:41 (1)	06:08		19:49 (1)	06:34		19:49 (1)	07:05	07:36	07:11	07:46
	17:20	17:55	18:30	20:03		20:36	26	20:13 (1)	21:06	48	20:29 (1)	21:15	43	20:32 (1)	20:55	42	20:31 (1)	20:10	19:17	17:31	17:08
4	08:05	07:47	07:09	07:17		06:32		19:46 (1)	06:05		19:41 (1)	06:09		19:48 (1)	06:35		19:50 (1)	07:06	07:37	07:12	07:47
	17:21	17:57	18:31	20:04		20:37	29	20:15 (1)	21:06	47	20:28 (1)	21:15	44	20:32 (1)	20:54	40	20:30 (1)	20:09	19:16	17:30	17:08
5	08:05	07:46	07:07	07:15		06:31		19:44 (1)	06:05		19:42 (1)	06:09		19:48 (1)	06:36		19:51 (1)	07:07	07:38	07:14	07:48
	17:22	17:58	18:32	20:06		20:38	32	20:16 (1)	21:07	46	20:28 (1)	21:15	45	20:33 (1)	20:53	38	20:29 (1)	20:07	19:14	17:29	17:08
6	08:05	07:45	07:06	07:14		06:29		19:42 (1)	06:05		19:42 (1)	06:10		19:49 (1)	06:37		19:51 (1)	07:08	07:39	07:15	07:49
	17:23	17:59	18:33	20:07		20:39	34	20:16 (1)	21:08	46	20:28 (1)	21:15	45	20:34 (1)	20:51	35	20:26 (1)	20:05	19:12	17:28	17:08
7	08:04	07:44	07:04	07:12		06:28		19:41 (1)	06:04		19:42 (1)	06:11		19:48 (1)	06:38		19:52 (1)	07:09	07:40	07:16	07:50
	17:24	18:01	18:35	20:08		20:40	36	20:17 (1)	21:08	45	20:27 (1)	21:15	46	20:34 (1)	20:50	33	20:25 (1)	20:04	19:11	17:26	17:08
8	08:04	07:43	08:02	07:10		06:27		19:40 (1)	06:04		19:43 (1)	06:11		19:48 (1)	06:39		19:54 (1)	07:10	07:41	07:17	07:51
	17:25	18:02	19:36	20:09		20:41	38	20:18 (1)	21:09	44	20:27 (1)	21:14	47	20:35 (1)	20:49	30	20:24 (1)	20:02	19:09	17:25	17:08
9	08:04	07:42	08:01	07:09		06:26		19:38 (1)	06:04		19:44 (1)	06:12		19:48 (1)	06:40		19:55 (1)	07:11	07:42	07:18	07:52
	17:26	18:03	19:37	20:10		20:42	41	20:19 (1)	21:10	43	20:27 (1)	21:14	48	20:36 (1)	20:48	28	20:23 (1)	20:00	19:07	17:24	17:08
10	08:04	07:40	07:59	07:07		06:25		19:38 (1)	06:04		19:44 (1)	06:13		19:47 (1)	06:41		19:56 (1)	07:12	07:43	07:20	07:53
	17:27	18:04	19:38	20:11		20:43	42	20:20 (1)	21:10	43	20:27 (1)	21:14	49	20:36 (1)	20:46	26	20:22 (1)	19:57	19:06	17:23	17:08
11	08:04	07:39	07:58	07:06		06:24		19:37 (1)	06:04		19:45 (1)	06:13		19:47 (1)	06:42		19:57 (1)	07:13	07:45	07:21	07:54
	17:28	18:06	19:39	20:12		20:44	44	20:21 (1)	21:11	42	20:27 (1)	21:13	49	20:36 (1)	20:45	24	20:21 (1)	19:55	19:04	17:22	17:08
12	08:03	07:38	07:56	07:04		06:22		19:36 (1)	06:03		19:45 (1)	06:14		19:47 (1)	06:43		19:59 (1)	07:14	07:46	07:22	07:54
	17:29	18:07	19:40	20:13		20:45	46	20:22 (1)	21:11	42	20:27 (1)	21:13	50	20:37 (1)	20:44	20	20:19 (1)	19:54	19:03	17:21	17:08
13	08:03	07:37	07:54	07:02		06:21		19:36 (1)	06:03		19:46 (1)	06:15		19:46 (1)	06:44		20:00 (1)	07:15	07:47	07:23	07:55
	17:30	18:08	19:41	20:14		20:46	47	20:23 (1)	21:12	41	20:27 (1)	21:12	51	20:37 (1)	20:42	18	20:18 (1)	19:52	19:01	17:20	17:08
14	08:03	07:35	07:53	07:01		06:20		19:35 (1)	06:03		19:46 (1)	06:16		19:46 (1)	06:45		20:01 (1)	07:16	07:48	07:24	07:56
	17:31	18:09	19:43	20:15		20:47	49	20:24 (1)	21:12	41	20:27 (1)	21:12	52	20:38 (1)	20:41	16	20:17 (1)	19:50	18:59	17:19	17:08
15	08:02	07:34	07:51	06:59		06:19		19:35 (1)	06:03		19:47 (1)	06:16		19:46 (1)	06:46		20:03 (1)	07:17	07:49	07:26	07:57
	17:32	18:11	19:44	20:16		20:48	50	20:25 (1)	21:13	40	20:27 (1)	21:11	52	20:38 (1)	20:40	12	20:15 (1)	19:48	18:58	17:18	17:09
16	08:02	07:33	07:49	06:58		06:18		19:35 (1)	06:03		19:47 (1)	06:17		19:46 (1)	06:47		20:06 (1)	07:18	07:50	07:27	07:57
	17:33	18:12	19:45	20:18		20:49	51	20:26 (1)	21:13	40	20:27 (1)	21:11	53	20:39 (1)	20:38	8	20:14 (1)	19:47	18:56	17:18	17:09
17	08:01	07:31	07:47	06:56		06:17		19:34 (1)	06:03		19:47 (1)	06:18		19:45 (1)	06:48			07:19	07:51	07:28	07:58
	17:34	18:13	19:46	20:19		20:50	53	20:27 (1)	21:14	40	20:27 (1)	21:10	53	20:38 (1)	20:37			19:45	18:55	17:17	17:09
18	08:01	07:30	07:46	06:54		06:16		19:34 (1)	06:03		19:47 (1)	06:19		19:45 (1)	06:49			07:20	07:52	07:29	07:59
	17:36	18:14	19:47	20:20		20:51	54	20:28 (1)	21:14	40	20:27 (1)	21:09	54	20:39 (1)	20:35			19:43	18:53	17:16	17:09
19	08:00	07:28	07:44	06:53		06:16		19:34 (1)	06:03		19:47 (1)	06:20		19:45 (1)	06:50			07:21	07:53	07:30	07:59
	17:37	18:16	19:48	20:21		20:52	54	20:28 (1)	21:14	40	20:27 (1)	21:03	54	20:39 (1)	20:34			19:41	18:52	17:15	17:10
20	08:00	07:27	07:42	06:51		06:15		19:35 (1)	06:04		19:48 (1)	06:20		19:45 (1)	06:51			07:22	07:55	07:32	08:00
	17:38	18:17	19:49	20:22		20:53	55	20:30 (1)	21:15	39	20:27 (1)	21:08	55	20:40 (1)	20:32			19:40	18:50	17:15	17:10
21	07:59	07:26	07:41	06:50		06:14		19:35 (1)	06:04		19:48 (1)	06:21		19:45 (1)	06:52			07:23	07:56	07:33	08:01
	17:39	18:18	19:50	20:23		20:54	55	20:30 (1)	21:15	39	20:27 (1)	21:07	55	20:40 (1)	20:31			19:38	18:49	17:14	17:11
22	07:59	07:24	07:39	06:48		06:13		19:35 (1)	06:04		19:49 (1)	06:22		19:45 (1)	06:53			07:24	07:57	07:34	08:01
	17:40	18:19	19:51	20:24		20:55	54	20:29 (1)	21:15	39	20:28 (1)	21:06	55	20:40 (1)	20:29			19:36	18:47	17:13	17:11
23	07:58	07:23	07:37	06:47		06:12		19:35 (1)	06:04		19:48 (1)	06:23		19:44 (1)	06:54			07:25	07:58	07:35	08:02
	17:42	18:20	19:53	20:25		20:56	54	20:29 (1)	21:15	40	20:28 (1)	21:06	55	20:39 (1)	20:28			19:35	18:46	17:13	17:12
24	07:57	07:21	07:36	06:45		06:11		19:36 (1)	06:04		19:48 (1)	06:24		19:44 (1)	06:55			07:26	07:59	07:36	08:02
	17:43	18:22	19:54	20:26		20:57	54	20:30 (1)	21:15	40	20:28 (1)	21:05	55	20:39 (1)	20:26			19:33	18:44	17:12	17:12
25	07:56	07:20	07:34	06:44		06:11		19:36 (1)	06:05		19:48 (1)	06:25		19:45 (1)	06:56			07:27	08:00	07:37	08:02
	17:44	18:23	19:55	20:27		20:58	53	20:29 (1)	21:16	40	20:28 (1)	21:04	54	20:39 (1)	20:25			19:31	18:43	17:11	17:13
26	07:56	07:18	07:32	06:43		06:10		19:36 (1)	06:05		19:49 (1)	06:26		19:45 (1)	06:57			07:29	08:02	07:39	08:03
	17:45	18:24	19:56	20:28		20:59	53	20:29 (1)	21:16	40	20:29 (1)	21:03	53	20:38 (1)	20:23			19:29	18:42	17:11	17:13
27	07:55	07:17	07:31	06:41	19:58 (1)	06:09		19:37 (1)	06:05		19:49 (1)	06:27		19:45 (1)	06:58			07:30	08:03	07:40	08:03
	17:47	18:25	19:57	20:29	10 20:08 (1)	21:00	53	20:30 (1)	21:16	40	20:29 (1)	21:02	52	20:37 (1)	20:22			19:28	18:40	17:10	17:14
28	07:54	07:15	07:29	06:40	19:55 (1)	06:09		19:37 (1)	06:06		19:49 (1)	06:28		19:45 (1)	06:59			07:31	08:04	07:41	08:03
	17:48	18:26	19:58	20:31	13 20:08 (1)	21:01	52	20:29 (1)	21:16	41	20:30 (1)	21:01	51	20:36 (1)	20:20			19:26	18:39	17:10	17:15
29	07:53		07:27	06:38	19:53 (1)	06:08		19:38 (1)	06:06		19:49 (1)	06:29		19:46 (1)	07:00			07:32	08:05	07:42	08:04
	17:49		19:59	20:32	16 20:09 (1)	21:02	51	20:29 (1)	21:16	41	20:30 (1)	21:00	49	20:35 (1)	20:19			19:24	18:37	17:10	17:16
30	07:52		07:25	06:37	19:52 (1)	06:08		19:38 (1)	06:07		19:48 (1)	06:30		19:46 (1)	07:01			07:33	08:06	07:43	08:04
	17:50		20:00	20:33	19 20:11 (1)	21:02	51	20:29 (1)	21:16	42	20:30 (1)	20:59	49	20:35 (1)	20:17			19:22	18:36	17:09	17:16
31	07:51		07:24			06:07		19:39 (1)				06:31		19:46 (1)	07:02				08:07		08:04
	17:52		20:00			21:03	50	20:29 (1)				20:58	48	20:34 (1)	20:15				18:35		17:17
Potential sun hours	296	297	370	399		449			454			461			429			375	344	297	286
Total, worst case					58		1406			1267			1551			460					
Sun reduction					0.57		0.61			0.62			0.69			0.65					
Oper. time red.					0.87		0.87			0.87			0.87			0.87					
Wind dir. red.					0.64		0.64			0.64			0.64			0.64					
Total reduction					0.32		0.34			0.34			0.38			0.36					
Total, real					18		481			435			593			167					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

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Project:
Archbold

Description:
The Renaissance Group

THE RENAISSANCE GROUP
A Conserve First Company

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8/28/2010 6:51 PM / 7

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Conserve First LLC, d/b/a The Renaissance Group, Renewables
8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com

Calculated:
8/28/2010 6:51 PM/2.7.473

SHADOW - Calendar

Shadow receptor: D - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (11)

Assumptions for shadow calculations

Maximum distance for influence	2,000 m
Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.47	4.37	4.90	7.57	8.91	9.33	10.21	9.01	6.89	5.70	2.71	1.87

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
227	217	324	570	498	353	263	290	423	680	776	830	755	671	460	318	7,655

Idle start wind speed: Cut in wind speed from power curve

	January		February	March	April	May	June	July	August	September	October	November		December	
1	08:04	15:56 (1)	07:50	07:14	07:22	06:36	06:07	06:07	06:32	07:03	07:34	07:09		07:44	15:45 (1)
	17:18	26 16:22 (1)	17:53	18:28	20:01	20:34	21:04	21:16	20:57	20:14	19:21	17:34		17:09	21 16:06 (1)
2	08:04	15:56 (1)	07:49	07:12	07:20	06:34	06:06	06:08	06:33	07:04	07:35	07:10		07:45	15:45 (1)
	17:19	27 16:23 (1)	17:54	18:29	20:02	20:35	21:05	21:16	20:56	20:12	19:19	17:32		17:09	22 16:07 (1)
3	08:05	15:57 (1)	07:48	07:10	07:19	06:33	06:06	06:08	06:34	07:05	07:36	07:11		07:46	15:45 (1)
	17:20	26 16:23 (1)	17:55	18:30	20:03	20:36	21:06	21:15	20:55	20:10	19:17	17:31		17:08	23 16:08 (1)
4	08:05	15:57 (1)	07:47	07:09	07:17	06:32	06:05	06:09	06:35	07:06	07:37	07:12		07:47	15:45 (1)
	17:21	26 16:23 (1)	17:57	18:31	20:05	20:37	21:06	21:15	20:54	20:09	19:16	17:30		17:08	24 16:09 (1)
5	08:05	15:58 (1)	07:46	07:07	07:15	06:31	06:05	06:09	06:36	07:07	07:38	07:14		07:48	15:45 (1)
	17:22	26 16:24 (1)	17:58	18:32	20:06	20:38	21:07	21:15	20:53	20:07	19:14	17:29		17:08	24 16:09 (1)
6	08:05	15:59 (1)	07:45	07:06	07:14	06:29	06:05	06:10	06:37	07:08	07:39	07:15		07:49	15:45 (1)
	17:23	25 16:24 (1)	17:59	18:33	20:07	20:39	21:08	21:15	20:51	20:05	19:12	17:28		17:08	25 16:10 (1)
7	08:04	16:00 (1)	07:44	07:04	07:12	06:28	06:04	06:11	06:38	07:09	07:40	07:16		07:50	15:45 (1)
	17:24	24 16:24 (1)	18:01	18:35	20:08	20:40	21:08	21:15	20:50	20:04	19:11	17:26		17:08	26 16:11 (1)
8	08:04	16:00 (1)	07:43	08:02	07:10	06:27	06:04	06:11	06:39	07:10	07:41	07:17		07:51	15:45 (1)
	17:25	24 16:24 (1)	18:02	19:36	20:09	20:41	21:09	21:14	20:49	20:02	19:09	17:25		17:08	26 16:11 (1)
9	08:04	16:01 (1)	07:42	08:01	07:09	06:26	06:04	06:12	06:40	07:11	07:42	07:18		07:52	15:46 (1)
	17:26	23 16:24 (1)	18:03	19:37	20:10	20:42	21:10	21:14	20:48	20:00	19:07	17:24		17:08	26 16:12 (1)
10	08:04	16:02 (1)	07:40	07:59	07:07	06:25	06:04	06:13	06:41	07:12	07:43	07:20		07:53	15:45 (1)
	17:27	22 16:24 (1)	18:04	19:38	20:11	20:43	21:10	21:14	20:46	19:57	19:06	17:23		17:08	27 16:12 (1)
11	08:04	16:03 (1)	07:39	07:58	07:06	06:24	06:03	06:13	06:42	07:13	07:45	07:21		07:54	15:46 (1)
	17:28	21 16:24 (1)	18:06	19:39	20:12	20:44	21:11	21:13	20:45	19:55	19:04	17:22		17:08	26 16:12 (1)
12	08:03	16:04 (1)	07:38	07:56	07:04	06:22	06:03	06:14	06:43	07:14	07:46	07:22		07:54	15:46 (1)
	17:29	19 16:23 (1)	18:07	19:40	20:13	20:45	21:11	21:13	20:44	19:54	19:03	17:21		17:08	27 16:13 (1)
13	08:03	16:05 (1)	07:37	07:54	07:02	06:21	06:03	06:15	06:44	07:15	07:47	07:23		07:55	15:47 (1)
	17:30	18 16:23 (1)	18:08	19:41	20:14	20:46	21:12	21:12	20:42	19:52	19:01	17:20		17:08	27 16:14 (1)
14	08:03	16:06 (1)	07:35	07:53	07:01	06:20	06:03	06:16	06:45	07:16	07:48	07:24		07:56	15:47 (1)
	17:31	16 16:22 (1)	18:09	19:43	20:15	20:47	21:12	21:12	20:41	19:50	18:59	17:19		17:08	28 16:15 (1)
15	08:02	16:08 (1)	07:34	07:51	06:59	06:19	06:03	06:16	06:46	07:17	07:49	07:26		07:57	15:47 (1)
	17:32	14 16:22 (1)	18:11	19:44	20:16	20:49	21:13	21:11	20:40	19:48	18:58	17:18		17:08	27 16:14 (1)
16	08:02	16:10 (1)	07:33	07:49	06:58	06:18	06:03	06:17	06:47	07:18	07:50	07:27		07:57	15:48 (1)
	17:33	10 16:20 (1)	18:12	19:45	20:18	20:50	21:13	21:11	20:38	19:47	18:56	17:18		17:09	27 16:15 (1)
17	08:01	16:13 (1)	07:31	07:47	06:56	06:17	06:03	06:18	06:48	07:19	07:51	07:28		07:58	15:48 (1)
	17:34	6 16:19 (1)	18:13	19:46	20:19	20:51	21:14	21:10	20:37	19:45	18:55	17:17		17:09	28 16:16 (1)
18	08:01		07:30	07:46	06:54	06:16	06:03	06:19	06:49	07:20	07:52	07:29		07:59	15:48 (1)
	17:36		18:14	19:47	20:20	20:51	21:14	21:09	20:35	19:43	18:53	17:16		17:09	28 16:16 (1)
19	08:00		07:28	07:44	06:53	06:16	06:03	06:20	06:50	07:21	07:53	07:30		07:59	15:49 (1)
	17:37		18:16	19:48	20:21	20:52	21:14	21:09	20:34	19:41	18:52	17:15		17:10	28 16:17 (1)
20	08:00		07:27	07:42	06:51	06:15	06:04	06:20	06:51	07:22	07:55	07:32		08:00	15:50 (1)
	17:38		18:17	19:49	20:22	20:53	21:15	21:08	20:32	19:40	18:50	17:15		17:10	28 16:18 (1)
21	07:59		07:26	07:41	06:50	06:14	06:04	06:21	06:52	07:23	07:56	07:33		08:01	15:50 (1)
	17:39		18:18	19:50	20:23	20:54	21:15	21:07	20:31	19:38	18:49	17:14		17:11	28 16:18 (1)
22	07:59		07:24	07:39	06:48	06:13	06:04	06:22	06:53	07:24	07:57	07:34		08:01	15:50 (1)
	17:40		18:19	19:51	20:24	20:55	21:15	21:06	20:29	19:36	18:47	17:13		17:11	28 16:18 (1)
23	07:58		07:23	07:37	06:47	06:12	06:04	06:23	06:54	07:25	07:58	07:35		08:02	15:51 (1)
	17:42		18:20	19:53	20:25	20:56	21:15	21:06	20:28	19:35	18:46	17:13		17:12	28 16:19 (1)
24	07:57		07:21	07:36	06:45	06:11	06:04	06:24	06:55	07:26	07:59	07:36		08:02	15:51 (1)
	17:43		18:22	19:54	20:26	20:57	21:15	21:05	20:26	19:33	18:44	17:12		17:12	28 16:19 (1)
25	07:56		07:20	07:34	06:44	06:11	06:05	06:25	06:56	07:27	08:00	07:37	15:51 (1)	08:02	15:52 (1)
	17:44		18:23	19:55	20:27	20:58	21:16	21:04	20:25	19:31	18:43	17:11	5 15:56 (1)	17:13	28 16:20 (1)
26	07:56		07:18	07:32	06:43	06:10	06:05	06:26	06:57	07:29	08:02	07:39	15:49 (1)	08:03	15:52 (1)
	17:45		18:24	19:56	20:28	20:59	21:16	21:03	20:23	19:29	18:42	17:11	10 15:59 (1)	17:13	28 16:20 (1)
27	07:55		07:17	07:31	06:41	06:09	06:05	06:27	06:58	07:30	08:03	07:40	15:47 (1)	08:03	15:53 (1)
	17:47		18:25	19:57	20:29	21:00	21:16	21:02	20:22	19:28	18:40	17:10	14 16:01 (1)	17:14	27 16:20 (1)
28	07:54		07:15	07:29	06:40	06:09	06:06	06:28	06:59	07:31	08:04	07:41	15:46 (1)	08:03	15:54 (1)
	17:48		18:26	19:58	20:31	21:01	21:16	21:01	20:20	19:26	18:39	17:10	16 16:02 (1)	17:15	27 16:21 (1)
29	07:53			07:27	06:38	06:08	06:06	06:29	07:00	07:32	08:05	07:42	15:45 (1)	08:04	15:54 (1)
	17:49			19:59	20:32	21:02	21:16	21:00	20:19	19:24	18:37	17:10	18 16:03 (1)	17:16	28 16:22 (1)
30	07:52			07:25	06:37	06:08	06:07	06:30	07:01	07:33	08:06	07:43	15:46 (1)	08:04	15:55 (1)
	17:50			20:00	20:33	21:02	21:16	20:59	20:17	19:22	18:36	17:09	19 16:05 (1)	17:16	27 16:22 (1)
31	07:51			07:24		06:07		06:31	07:02		08:08			08:04	15:55 (1)
	17:52			20:00		21:03		20:58	20:15		18:35			17:17	27 16:22 (1)
Potential sun hours	296		297	370	399	449	454	461	429	375	344	297		286	
Total, worst case		353											82		822
Sun reduction		0.36											0.27		0.20
Oper. time red.		0.87											0.87		0.87
Wind dir. red.		0.71											0.71		0.71
Total reduction		0.23											0.17		0.13
Total, real		79											14		103

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)		First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

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Project:
Archbold

Description:
The Renaissance Group

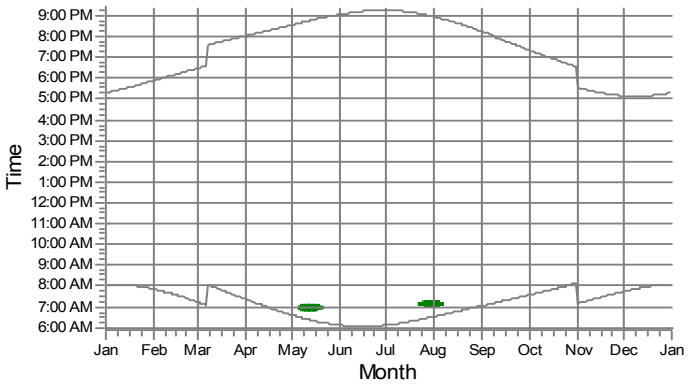
Printed/Page
8/28/2010 6:51 PM / 8

Licensed user:
Conserve First LLC, d/b/a The Renaissance Group, Renewables
8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717
AAron Godwin / AAron@ConserveFirst.com

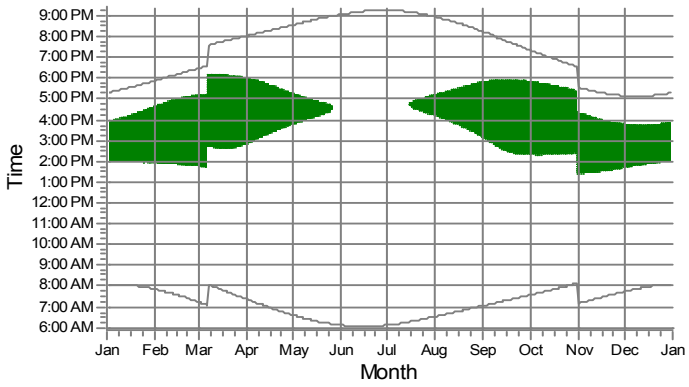
Calculated:
8/28/2010 6:51 PM/2.7.473

SHADOW - Calendar, graphical

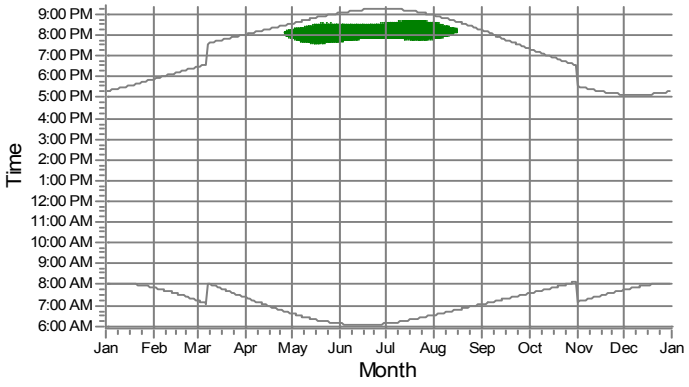
A: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (1)



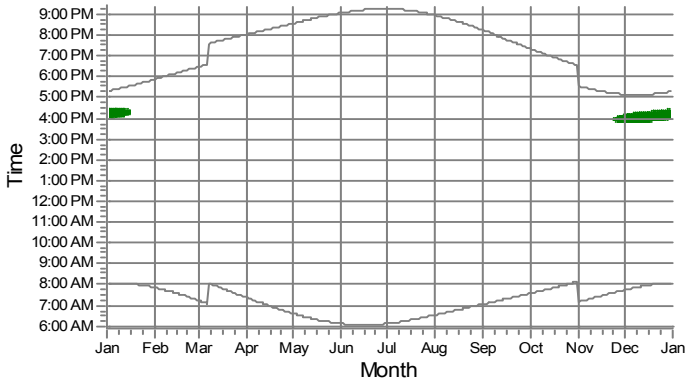
B: Shadow Receptor: 30.0 × 30.0 Azimuth: -180.0° Slope: 90.0° (7)



C: Shadow Receptor: 30.0 × 30.0 Azimuth: -180.0° Slope: 90.0° (10)



D: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (11)



WTGs

1: Unison U54-750kW 750 54.0 !O! hub: 75.0 m (2)

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Turbine Use, Safety Policies and General Background

Security:

- Tower Climbing: The wind turbine utilizes a smooth exterior monopole tower with no climbing surfaces or apparatus. Tower climbing is only achieved through the use of an internal ladder system. This system is only reachable through a locked plate steel door.
- Availability: Only preauthorized personnel will be given access to the internal tower and turbine systems.

Tower Climbing Safety:

- Safety Climb: For maintenance personnel climbing of the tower, an OSHA approved "safety climb" system is included in the tower climbing system. This system is comprised of a ladder, a steel cable for the safety climb device, a full body harness designed and approved for the purpose, a locking safety climb device, safety lanyards with self-locking clips and additional tie-in points throughout the turbine system where a cable system is not available.
- OSHA approved safety equipment such as hardhats will be worn by all maintenance personnel climbing or working on the turbine.
- No individual shall climb the tower without a partner.

Electrical Safety:

- All electrical components and their installations shall meet all Local, State and Federal applicable laws and regulations.
- The turbine system shall meet UL1741 and IEC requirements for Utility Grid Protection in case of Grid power failures or power quality abnormalities.
- All electrical supply/grid interconnect services to and from the turbine shall be in buried conduits.
- The turbine system will have a staff accessible emergency shut-offs.
    - Utility room
    - Tower base
    - Nacelle
    - Remote through "Web" interface.

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- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration, over-speed, fire and icing.
    - This system will also automatically send fault codes to preauthorized personnel through a "Web" interface.
- All safety sensors and equipment shall fault to a turbine fault state in case of their own failure.

Fire:

- The turbine shall have fire detection devices at the tower base and within the nacelle that shall be linked to the Site's existing fire detection/alarm systems (if present).
- The local fire department shall be contacted and a fire/emergency response plan shall be adopted.
- Although formal fire suppression systems are extremely rare for wind turbines, the site shall investigate passive and active fire suppression systems for possible implementation in the turbine system.
- Local fire department approved fire extinguishers shall be located within the tower base and within the nacelle.
- The turbine system will have staff accessible emergency shut-offs.
    - Utility room
    - Tower base
    - Nacelle
    - Remote through "Web" interface.
- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration, over-speed, fire and icing.
    - This system will also automatically send fault codes to preauthorized personnel through a "Web" interface.
- Safety zones similar to any fire related incident will be utilized, if a fire should occur.

Lightening:

- The turbine system is equipped with a full grounding loop meeting or exceeding all Local, State and Federal regulations concerning grounding and lightening protection.
- Surge suppressing technology will be utilized to protect key electronics.
- See fire policies above.

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Icing:

- Although icing of wind turbines is very rare and safety issues related to icing even rarer, it can occur, similar to any built structure (roofs, power lines, stadium lights, etc.).
- Although not an absolute brake, blade icing induced airfoil shape spoiling will naturally reduce the efficiency of the blades and thus reduce their rotational speed.
- Although formal icing detection systems are extremely rare for wind turbines, the site shall investigate active icing detection systems for possible implementation in the turbine system.
- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration, over-speed, fire and icing (vibration caused by blade icing induced imbalances will automatically shut down the turbine).
    - This system will also automatically send fault codes to preauthorized personnel through a "Web" interface.
- The turbine's nacelle will have a cold-weather package including nacelle heaters. These heaters are designed to maintain nacelle temperatures above the dew-point and well above freezing. This system will automatically melt snow and ice accumulation on top of the nacelle.
- The turbine system will have a staff accessible emergency shut-offs.
    - Utility room
    - Tower base
    - Nacelle
    - Remote through "Web" interface.
- All icing related turbine shut-downs will require a direct inspection and an on-site manual restart.
- The site personnel and the system maintenance personnel will shut down the turbine in the event of an icing condition.
- The site shall adopt an ice safety zone around the turbine for implementation during icing events, if they should occur.

High Wind:

- The turbine automatically shuts down in high winds and turns itself out of the wind.
- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration,

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over-speed, fire and icing (vibration caused by blade icing induced imbalances will automatically shut down the turbine).
    - This system will also automatically send fault codes to preauthorized personnel through a "Web" interface.

Aviation Safety:

- The project has been review by both FAA and ODOT and "No Hazard to Aviation" determinations were issued.
- An FAA approved red obstruction marking light will be located on top of the nacelle.

Shadow Flicker:

- Although all structures cast shadows, shadows from wind turbines that reach occupied structures or areas can be considered a nuisance due to the fact that they move or flicker as the blades rotate in front of the Sun.
- A formal shadow flicker study has been conducted for the site based on the turbine's rotor diameter and height, the site latitude and longitude, weather records, existing site topography and the existing area obstructions.
- Per international standards, shadow flicker impacting a particular location above 30 hours per year is considered a potential nuisance. While the turbine's shadow will reach some of the area properties, no residential or business property locations will receive more than 30 hours of shadow per year. Other factors that mitigate the shadows' impact include:
    - Shadow intensity drops off with distance. Shadow edges soften and shadow bodies become more muted. Shadows beyond ten rotor diameters from the tower base are considered insignificant with shadows within five rotor diameters being the most significant.
    - Shadows move and do not remain in one spot for extended periods of time.
    - The longest extended period shadows occur in the winter when there are fewer sunny days.
    - Many local natural and built environmental elements such as trees will block or significantly diffuse shadows.
- If extended adverse shadows should impact a particular dwelling, the wind turbine site owner will take one or more of the following mitigating measures:
    - Plant evergreen trees to block the shadow.
    - Provide blinds for the dwelling.
    - Turn off the turbine during the shadowing periods that excessively affect the dwelling.

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Sound:

- Wind turbines of the size to be installed are inherently quite devices, especially over distance, and are typically very hard to hear over the wind itself and the existing ambient area noise levels.
    - Sound from a single wind turbines typically comes from the following areas:
        - Wind noise off of the blades as they are driven by the wind (swooshing that drops off over distance and typically competes with the area's natural wind noise).
        - Drive-train noise (mechanical sound typically not heard outside the immediate vicinity of the turbine).
        - Yaw system noise (mechanical sound typically not heard outside the immediate vicinity of the turbine and that is only present when the turbine turns into the wind).
        - Electrical noise from the turbine's electrical equipment and transformer (buzz, typically not heard outside the immediate vicinity of the turbine).
- Sound modeling for the proposed wind turbine supports that turbine produced audio levels will not exceed any local code or ordinance at the site's property lines. To be conservative, this modeling was done at an 8 mps/17.9 mph wind speed, well above site averages.
- Sound measurement of existing ambient sound levels for both day and evening periods at multiple locations surrounding the site show existing ambient sound levels above what the wind turbine will produce.

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References

British Epilepsy Association. 2007.
Photosensitive Epilepsy. Epilepsy Action, Yeadon Leeds,UK. Department for Business Enterprise & Regulatory Reform (BERR).
http://www.berr.gov.uk/whatwedo/energy/sources/renewables/planning/onshore-wind

Business Enterprise and Regulatory Reform (BERR), United Kingdom Department. 2009.
Onshore Wind: Shadow Flicker.
http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file35240.pdf

Graham Harding, Pamela Harding, Arnold Wilkins (2008)
Wind turbines, flicker, and photosensitive epilepsy: Characterizing the flashing that may precipitate seizures and optimizing guidelines to prevent them.
http://www.mfe.govt.nz/rma/call-in-turitea/submissions/186changeappendix3.pdf

Klepinger, Michael. February 2007.
Michigan Land Use Guidelines for Siting Wind Energy Systems.
Michigan State Extension Bulletin.

National Research Council (NRC) of the National Academies. 2007.
Environmental Impacts of Wind Energy Projects.
Committee on Environmental Impacts of Wind Energy Projects, Board on Environmental Studies and Toxicology. Division of Earth and Life Sciences. The National Academies Press, Washington, DC.

Sustainable Energy Authority Victoria. 2003.
Policy Planning and Guidelines for Development of Wind Energy Facilities in Victoria.
Sustainable Energy Authority Victoria, Melbourne Victoria, Australia.

US Department of Interior (DOI). 2005.
Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States.
Bureau of Land Management.

[i] The only known shadow flicker regulation to date was enacted in Germany, where a court ruled that the maximum allowable flicker would be 30 hours per year (Klepinger, 2007). In addition, Dobesch and Kury (2001) recommended that shadow flicker should not exceed 30 hours per year, and the guidelines for wind power development in the State of Victoria, Australia state that shadow flicker may not exceed 30 hours per year at any dwelling in the surrounding area (Sustainable Energy Authority Victoria, 2003). Since there are no known national or local regulations that govern shadow flicker in the United States, New York State, or Steuben County, the 30-hour per year threshold is used in this analysis to determine potentially impacted structures.
http://www.eon.com/en/downloads/Appendix_M_Shadow_Flicker_Modeling_Report.pdf

[ii] Epilepsy Foundation. (n.d.). Photosensitivity and Epilepsy.
http://www.epilepsyfoundation.org/about/photosensitivity/

[iii] As there is a possibility of a turbine model change on the project, the worst case largest model under consideration was used for the shadow flicker models.

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APPENDIX C:

AGENCY COORDINATION AND APPROVALS

Delivered by email
From: *Mitch, Brian (Brian.Mitch@dnr.state.oh.us)*
Sent: *Friday, August 27, 2010 12:21 PM*
To: *AAron Godwin (AAron@conservefirst.com)*
Subject: *10-0277; Ohio Wind Schools Wind Turbine Projects*

ODNR COMMENTS TO:
Aaron Goodwin, The Renaissance Group, 8281 Euclid Chardon Road, Suite E, Kirtland, Ohio 44094

Project: The project consists of the installation of several single wind turbine projects located in the cities of Archbold, Pettisville, Berea, Cleveland, and Chagrin Falls, Ohio. All turbines will be less than 750kW.

The Ohio Department of Natural Resources (ODNR) has completed a review of the above referenced projects. These comments were generated by an inter-disciplinary review within the Department. These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the National Environmental Policy Act, the Coastal Zone Management Act, Ohio Revised Code and other applicable laws and regulations. These comments are also based on ODNR's experience as the state natural resource management agency and do not supersede or replace the regulatory authority of any local, state or federal agency nor relieve the applicant of the obligation to comply with any local, state or federal laws or regulations.

Fish and Wildlife: The ODNR, Division of Wildlife (DOW) has the following comments.

Archbold Area Schools Project:
The project is within the range of the Indiana bat (*Myotis sodalis*), a state and federally endangered species. The following species of trees have relatively high value as potential Indiana bat roost trees: Shagbark hickory (*Carya ovata*), Shellbark hickory (*Carya laciniosa*), Bitternut hickory (*Carya cordiformis),* Black ash (*Fraxinus nigra*), Green ash (*Fraxinus pennsylvanica*), White ash (*Fraxinus americana*), Shingle oak (*Quercus imbricaria*), Northern red oak (*Quercus rubra*), Slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), Eastern cottonwood (Populus deltoides), Silver maple (*Acer saccharinum*), Sassafras (*Sassafras albidum*), Post oak (*Quercus stellata*), and White oak (*Quercus alba*). Indiana bat habitat consists of suitable trees that include dead and dying trees of the species listed above with exfoliating bark, crevices, or cavities in upland areas or riparian corridors and living trees of the species listed above with exfoliating bark, cavities, or hollow areas formed from broken branches or tops. If suitable trees occur within the project area, these trees must be conserved. If suitable habitat occurs on the project area and trees must be cut, cutting must occur between September 30 and April 1. If suitable trees must be cut during the summer months of April 2 to September 29, a net survey must be conducted in May or June prior to cutting. *If no tree removal is proposed, the project is not likely to impact this species.*

The project is within the range of the rayed bean (*Villosa fabalis*), a state endangered and federal candidate mussel species. If there is a history of mussels near the proposed project area, it may be necessary for a professional malacologist approved by the DOW to conduct a mussel survey in the project area. *If no in-water work is proposed, the project is not likely to impact this species and a survey would not be necessary.*

The project is within the range of the Eastern massasauga (*Sistrurus catenatus*), a state endangered and a federal candidate snake species. *Due to the location of the project, the project is not likely to impact this species.*

The ODNR, Ohio Biodiversity Database contains no data at this project site.

Pettisville Local Schools Project:

The project is within the range of the Indiana bat (*Myotis sodalis*), a state and federally endangered species. The following species of trees have relatively high value as potential Indiana bat roost trees: Shagbark hickory (*Carya ovata*), Shellbark hickory (*Carya laciniosa*), Bitternut hickory (*Carya cordiformis),* Black ash (*Fraxinus nigra*), Green ash (*Fraxinus pennsylvanica*), White ash (*Fraxinus americana*), Shingle oak (*Quercus imbricaria*), Northern red oak (*Quercus rubra*), Slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), Eastern cottonwood (Populus deltoides), Silver maple (*Acer saccharinum*), Sassafras (*Sassafras albidum*), Post oak (*Quercus stellata*), and White oak (*Quercus alba*). Indiana bat habitat consists of suitable trees that include dead and dying trees of the species listed above with exfoliating bark, crevices, or cavities in upland areas or riparian corridors and living trees of the species listed above with exfoliating bark, cavities, or hollow areas formed from broken branches or tops. If suitable trees occur within the project area, these trees must be conserved. If suitable habitat occurs on the project area and trees must be cut, cutting must occur between September 30 and April 1. If suitable trees must be cut during the summer months of April 2 to September 29, a net survey must be conducted in May or June prior to cutting. *If no tree removal is proposed, the project is not likely to impact this species.*

The project is within the range of the rayed bean (*Villosa fabalis*), a state endangered and federal candidate mussel species. If there is a history of mussels near the proposed project area, it may be necessary for a professional malacologist approved by the DOW to conduct a mussel survey in the project area. *If no in-water work is proposed, the project is not likely to impact this species and a survey would not be necessary.*

The project is within the range of the Eastern massasauga (*Sistrurus catenatus*), a state endangered and a federal candidate snake species. *Due to the location of the project, the project is not likely to impact this species.*

The ODNR, Ohio Biodiversity Database contains no data at this project site.

Cuyahoga County Fairgrounds Project:

The project is within the range of the Indiana bat (*Myotis sodalis*), a state and federally endangered species. There is a record for this species about 4.3 miles from this project site. The following species of trees have relatively high value as potential Indiana bat roost trees: Shagbark hickory (*Carya ovata*), Shellbark hickory (*Carya laciniosa*), Bitternut hickory (*Carya cordiformis),* Black ash (*Fraxinus nigra*), Green ash (*Fraxinus pennsylvanica*), White ash (*Fraxinus americana*), Shingle oak (*Quercus imbricaria*), Northern red oak (*Quercus rubra*), Slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), Eastern cottonwood (Populus deltoides), Silver maple (*Acer saccharinum*), Sassafras (*Sassafras albidum*), Post oak (*Quercus stellata*), and White oak (*Quercus alba*). Indiana bat habitat consists of suitable trees that include dead and dying trees of the species listed above with exfoliating bark, crevices, or cavities in upland areas or riparian corridors and living trees of the species listed above with exfoliating bark, cavities, or hollow areas formed from broken branches or tops. If suitable trees occur within the project area, these trees must be conserved. If suitable habitat occurs on the project area and trees must be cut, cutting must occur between September 30 and April 1. If suitable trees must be cut during the summer months of April 2 to September 29, a net survey must be conducted in May or June prior to cutting. *If no tree removal is proposed, the project is not likely to impact this species.*

The project is within the range of the bald eagle (*Haliaeetus leucocephalus*), a state threatened species. *However, the Ohio Biodiversity Database currently has no records of this species near the project area.*

The project is within the range of the Canada darner (*Aeshna canadensis*), a state endangered dragonfly. *Due to the mobility of this species, the project is not likely to impact this species.*

The project is within the range of the black bear (*Ursus americanus*), a state endangered species, and the bobcat (*Lynx rufus*), a state endangered species. *Due to the mobility of these species, the project is not likely to have an impact on these species.*

The project is within the range of the golden-winged warbler (*Vermivora chrysoptera*), a state endangered bird, the piping plover (*Charadrius melodus*), a state and federally endangered bird species, the king rail (*Rallus elegans*), a state endangered bird, and the yellow-bellied sapsucker (*Sphyrapicus varius*), a state endangered bird. *Due to the location of the project and the habitat requirements of these species, the project is not likely to impact these species.*

The ODNR, Ohio Biodiversity Database contains no data at this project site.

Kenston Local Schools Project:
The project is within the range of the Indiana bat (*Myotis sodalis*), a state and federally endangered species. There is a record for this species about seven miles from the project area. The following species of trees have relatively high value as potential Indiana bat roost trees: Shagbark hickory (*Carya ovata*), Shellbark hickory (*Carya laciniosa*), Bitternut hickory (*Carya cordiformis),* Black ash (*Fraxinus nigra*), Green ash (*Fraxinus pennsylvanica*), White ash (*Fraxinus americana*), Shingle oak (*Quercus imbricaria*), Northern red oak (*Quercus rubra*), Slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), Eastern cottonwood (Populus deltoides), Silver maple (*Acer saccharinum*), Sassafras (*Sassafras albidum*), Post oak (*Quercus stellata*), and White oak (*Quercus alba*). Indiana bat habitat consists of suitable trees that include dead and dying trees of the species listed above with exfoliating bark, crevices, or cavities in upland areas or riparian corridors and living trees of the species listed above with exfoliating bark, cavities, or hollow areas formed from broken branches or tops. If suitable trees occur within the project area, these trees must be conserved. If suitable habitat occurs on the project area and trees must be cut, cutting must occur between September 30 and April 1. If suitable trees must be cut during the summer months of April 2 to September 29, a net survey must be conducted in May or June prior to cutting. *If no tree removal is proposed, the project is not likely to impact this species.*

The project is within the range of the bald eagle (*Haliaeetus leucocephalus*), a state threatened species. *However, the Ohio Biodiversity Database currently has no records of this species near the project area.*

The project is within the range of the snuffbox (*Epioblasma triquetra*), a state endangered mussel, and the eastern pondmussel *(Ligumia nasuta*), a state endangered mussel. If there is a history of mussels near the proposed project area, it may be necessary for a professional malacologist approved by the DOW to conduct a mussel survey in the project area. *If no in-water work is proposed, the project is not likely to impact these species and a survey would not be necessary.*

The project is within the range of the American emerald (*Cordulia shurtleffi*), a state endangered dragonfly, the frosted whiteface (*Leucorrhinia frigida*), a state endangered dragonfly, and the racket-tailed emerald (*Dorocordulia libera*), a state endangered dragonfly. *Due to the mobility of these species, the project is not likely to impact these species.*

The project is within the range of the black bear (*Ursus americanus*), a state endangered species, and the bobcat (*Lynx rufus*), a state endangered species. *Due to the mobility of these species, the project is not likely to have an impact on these species.*

The project is within the range of the yellow-bellied sapsucker (*Sphyrapicus varius*), a state endangered bird. *Due to the location of the project and the habitat requirements of this species, the project is not likely to have an impact on this species.*

The project is in the range of the snowshoe hare (*Lepus americanus*), a state endangered species. *Due to the location of the project area, the project is not likely to have an impact on this species.*

The ODNR, Ohio Biodiversity Database contains no data at this project site.

Geological Survey: The ODNR, Division of Geological Survey has the following comments.
The Archbold site is on soft lacustrine silt and clay and the bedrock is 150 feet deep. The Pettisville site is on soft lacustrine sand and the bedrock is 145 feet deep. Both of these sites may require deepened foundations.

The Division of Geological Survey has no significant geologic concerns with the other two sites.

ODNR appreciates the opportunity to provide these comments. Please contact Brian Mitch at (614) 265-6378 if you have questions about these comments or need additional information.

Brian Mitch, Environmental Review Manager
Ohio Department of Natural Resources
Environmental Services Section
2045 Morse Road, Building F-3
Columbus, Ohio 43229-6693
Office: (614) 265-6378
Fax: (614) 262-2197
brian.mitch@dnr.state.oh.us

United States Department of the Interior

FISH AND WILDLIFE SERVICE

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(614) 416-8993 / FAX (614) 416-8994

September 21, 2009

Mr. AAron Godwin
The Renaissance Group
10299 Longview Drive
Kirtland, Ohio 44094

TAILS# 31420-2009-TA-1156

Dear Mr. Godwin:

This is in response to your September 14, 2009 letter requesting our review of a proposed wind energy project in Fulton County, Ohio. The project involves installation of a small (225 kW-750 kW), single wind turbine at the Archbold Schools Site, Fulton County, Ohio. Currently, the project area is composed of an open field adjacent to an existing school. The landscape surrounding the school is residential and agricultural in nature. This information is solicited to support an application for ARRA stimulus funding.

There are no Federal wilderness areas, wildlife refuges, or designated critical habitat within the vicinity of the project area.

The following comments are being provided pursuant to the Endangered Species Act (ESA), Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and Fish and Wildlife Act of 1956. This information is being provided to assist you in making an informed decision regarding wildlife issues, site selection, project design, and compliance with applicable laws.

The Fish and Wildlife Service (Service) supports the development of wind power as an alternative energy source, however, wind power projects can have negative impacts on wildlife and their habitats if not sited and designed with potential wildlife and habitat impacts in mind. Selection of the best sites for turbine placement is enhanced by ruling out sites with known, high concentrations of birds and/or bats passing within the rotoswept area of the turbines or where the effects of habitat fragmentation will be detrimental. In support of wind power generation as a wildlife-friendly, renewable source of power, development sites with comparatively low bird, bat and other wildlife values, would be preferable and would have relatively lower impacts on wildlife.

ENDANGERED SPECIES COMMENTS:

The proposed project lies within the range of the **Indiana bat** (*Myotis sodalis*), a Federally listed endangered species. Since first listed as endangered in 1967, their population has declined by nearly 60%. Several factors have contributed to the decline of the Indiana bat, including the loss and degradation of suitable hibernacula, human disturbance during hibernation, pesticides, and the loss and degradation of forested habitat, particularly stands of large, mature trees. Fragmentation of forest habitat may also contribute to declines. During the winter Indiana bats hibernate in caves and abandoned mines. Summer habitat requirements for the species are not well defined but the following are considered

important:

1. Dead or live trees and snags with peeling or exfoliating bark, split tree trunk and/or branches, or cavities, which may be used as maternity roost areas.

2. Live trees (such as shagbark hickory and oaks) which have exfoliating bark.

3. Stream corridors, riparian areas, and upland woodlots which provide forage sites.

The Service currently has no records for Indiana bats within 5 miles of the project area, and the immediate and greater project areas do not support suitable habitat. Therefore, we do not anticipate any impact on this species.

The project lies within the range of the rayed bean mussel and eastern massasauga federally listed candidate species. Due to the project type, size, and location, we do not anticipate any impact on these species or their habitats. Should the project design change, or during the term of this action, additional information on listed or proposed species or their critical habitat become available, or if new information reveals effects of the action that were not previously considered, consultation with the Service should be initiated to assess any potential impacts.

MIGRATORY BIRD COMMENTS:

The Migratory Bird Treaty Act (16 U.S.C. 703-712; MBTA) implements four treaties that provide for international protection of migratory birds. The MBTA prohibits taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior. Bald and golden eagles are afforded additional legal protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). Unlike the Endangered Species Act, neither the MBTA nor its implementing regulations at 50 CFR Part 21, provide for permitting of "incidental take" of migratory birds. No bald eagle nests are known to occur in Fulton County, and we are not aware of any eagle staging or congregation areas in this county. Therefore, we do not anticipate any impact on this species.

The Service's Office of Law Enforcement serves its mission to protect Federal trust wildlife species, in part, by actively monitoring industries known to negatively impact wildlife, and assessing their compliance with Federal law. These industries include oil/gas productions sites, cyanide heap/leach mining operations, industrial waste water sites, and wind power sites. There is no threshold as to the number of birds incidentally killed by wind power sites, or other industry, past which the Service will seek to initiate enforcement action. However, the Service is less likely to prioritize enforcement action against a site operator that is cooperative in seeking and implementing measures to mitigate takes of protected wildlife.

Research into the actual causes of bat and bird collisions with wind turbines is limited. To assist Service field staffs in review of wind farm proposals, as well as aid wind energy companies in developing best practices for siting and monitoring of wind farms, the Service published *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* (2003). We encourage any company/licensee proposing a new wind farm to consider the following excerpted suggestions from the guidelines in an effort to minimize impacts to migratory birds and bats.

1) Pre-development evaluations of potential wind farm sites to be conducted by a team of Federal and/or State agency wildlife professions with no vested interest in potential sites;

2) Rank potential sites by risk to wildlife;

3) Avoid placing turbines in documented locations of federally-listed species;

4) Avoid locating turbines in known bird flyways or migration pathways, or near areas of high bird concentrations (i.e., rookeries, leks, refuges, riparian corridors, etc.);

5) Avoid locating turbines near known bat hibernation, breeding, or maternity colonies, in migration corridors, or in flight paths between colonies and feeding areas;

6) Configure turbine arrays to avoid potential avian mortality where feasible. Implement storm water management practices that do not create attractions for birds, and maintain contiguous habitat for area-sensitive species;

7) Avoid fragmenting large, contiguous tracts of wildlife habitat;

8) Use tubular supports with pointed tops rather than lattice supports to minimize bird perching and nesting opportunities;

9) If taller turbines (top of rotorswept area is greater than 199 feet above ground level) require lights for aviation safety, the minimum amount of lighting specified by the Federal Aviation Administration (FAA) should be used. Unless otherwise requested by the FAA, only white strobe lights should be used at night, and should be of the minimum intensity and frequency of flashes allowable. Red lights should not be used, as they appear to attract night-migrating birds at a higher rate than white lights;

10) Adjust tower height to reduce risk of strikes in areas of high risk for wildlife.

The full text of the guidelines is available at http://www.fws.gov/habitatconservation/wind.pdf. The Service believes that implementing these guidelines may help reduce mortality caused by wind turbines. We encourage you to consider these guidelines in the planning and design of the project. We particularly encourage placement of turbines away from any large wetland, stream corridor, or wooded areas, including the areas mentioned previously, and avoid placing turbines between nearby habitat blocks.

Thank you for the opportunity to provide comments on this proposed project. Please contact biologist Megan Seymour at extension 16 in this office if we can be of further assistance.

Sincerely,

Angela L. Boyer

for Mary Knapp, Ph.D.
Supervisor

Cc: Mr. Keith Lott, ODNR, Old Woman Creek, 2514 Cleveland Road East, Huron, OH 44839
Mr. Brian Mitch, ODNR, REALM, Columbus, OH

United States Department of the Interior

FISH AND WILDLIFE SERVICE

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(614) 416-8993 / FAX (614) 416-8994

September 2, 2010

DOE Golden Field Office
c/o Melissa Rossiter
1617 Cole Boulevard
Golden, CO 80401

Dear Ms. Rossiter:

This is in response to your Notice of Public Scoping for the proposed Archbold School District Wind Turbine, which involves the construction and operation of a single 600-750 kW wind turbine at the school, located at 600 Lafayette Street, Archbold, Fulton County, Ohio. Funding for the project is being sought through the Department of Energy (DOE). The following comments are being provided pursuant to the Endangered Species Act (ESA), Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and Fish and Wildlife Act of 1956. This information is being provided to assist you in making informed decisions regarding wildlife issues, site selection, and project design, and to assist you with complying with the applicable Federal wildlife laws.

The Fish and Wildlife Service (Service) supports the development of wind power as an alternative energy source; however, wind power projects can have avoidable negative impacts on wildlife and their habitats if not sited and designed with potential wildlife and habitat impacts in mind. Generally speaking, selection of the best sites for turbine placement is enhanced by ruling out sites with known, high concentrations of birds and/or bats passing nearby the rotorswept area of the turbines or where the effects of habitat fragmentation will be detrimental.

ENDANGERED SPECIES COMMENTS:
The ESA prohibits the "take" of any listed species. Take is defined as, among other things, to harass, harm, wound, or kill. Harm and harass are further defined by regulation. Harm includes habitat modification or degradation that results in death or injury. Harass means to cause injury by disrupting normal behavior patterns such as breeding, feeding, or sheltering. The ESA also prohibits Federal agencies from funding, authorizing, or carrying-out, in full or in part, any action that is likely to adversely modify critical habitat. For reasons described below, we believe your project is not likely to adversely affect Indiana bats. The project additionally lies within the range of the **rayed bean** (*Villosa fabalis*) and **eastern massasauga** (*Sistrurus catenatus catenatus*), Federal candidate species. However no suitable habitat for either of these species occurs within the project area and no impact to these species is anticipated.

Indiana Bat
Your proposed project lies within the range of the Indiana bat (*Myotis sodalis*), a federally listed endangered species. Since first listed as endangered in 1967, their population has declined by nearly 60 percent. Several factors have contributed to the decline of the Indiana bat, including the loss and degradation of suitable hibernacula, human disturbance during hibernation, pesticides, and the loss,

fragmentation, and degradation of forested habitat, particularly stands of large, mature trees.
During the winter, Indiana bats hibernate in caves and abandoned mines. These caves are critical for the survival of the species and several have been officially designated as critical habitat. In the spring and fall, Indiana bats migrate between their summer and winter habitats. Knowledge of the migratory behavior of Indiana bats is limited. Anecdotal information and available data give some insights into their flight behavior. Data from a few studies from the eastern portion of the range indicate that Indiana bats will fly at the canopy level during migration. Anecdotal information and data from closely related species, however, indicate that they may also fly at higher elevations especially over open areas. Upon arriving at their summer grounds, females form maternity colonies while males tend to roost singly. Summer habitat for Indiana bats includes roosting, foraging, and commuting areas. Roosting habitat is generally described as wooded areas containing trees or snags with peeling or exfoliating bark, split tree trunk and/or branches, or cavities. Foraging habitat includes stream corridors, riparian areas, and upland woodlots, and commuting habitat includes wooded areas, tree-lines or wooded hedgerows and other such wooded pathways that connect roosting and foraging areas. Information to date indicates that Indiana bats predominately forage, roost, and travel within wooded habitats or along their edges and are rarely found in open areas. Drawing from all existing data, we believe it is highly unlikely for summering Indiana bats to use open areas that are greater than 1000 feet from a wooded edge or area. Extensive research has shown that Indiana bats are highly philopatric to both their hibernation and summer areas. Thus, loss or degradation of these traditionally used areas is likely to cause harm to Indiana bats.

Wind energy facilities in various habitats across the U.S. and Canada have been documented to cause "widespread and often extensive fatalities of bats" (Arnett *et al.* 2008). At this time, research into the mechanisms that cause mortality of bats at wind power sites is ongoing but collision and barotrauma associated with moving turbine blades are clear proximate causes of death. Also, research on how to avoid fatalities is continuing. Currently, only a few operational tools have shown some success at avoiding or minimizing take, e.g., feathering of turbines during times when bats are most at risk has been shown to reduce mortality in some situations. Clearly, siting is important measure for avoiding and minimizing impacts. Siting recommendations to avoid impacts during the summer and winter periods are easier to provide, while the uncertainties relating to Indiana bat migration lend some difficulty to predicting where on the landscape we would expect Indiana bats to occur.

We have integrated what we know about Indiana bat ecology, the siting and operational specifics of your project, and what we know about turbine and bat interactions to assess the impacts of your project on Indiana bats. For reasons described below we believe your project is unlikely to adversely affect fall swarming and wintering Indiana bats but may adversely affect migrating and summering Indiana bats.

Winter (and fall swarming) Period
In fall just before entering caves for hibernation, Indiana bats use the surrounding forested area to forage and build up fat reserves for their 6-7 month hibernation period. Data available suggest that Indiana bats will forage up to 10 to 20 miles from their hibernacula. Turbines placed within this fall swarming range may take Indiana bats. As the location of your proposed wind turbine is not within 20 miles of any known or suspected Indiana bat hibernacula, we believe it is unlikely that your project will take Indiana bats during the fall swarming and hibernation periods.

Migration Period
The vast majority of the document fatalities across U.S. and Canada have occurred during the fall *migratory* season (Arnett *et al.* 2008). Most of these mortalities were "long-distant migratory tree bats," which are a group of bats that exhibit substantially different behaviors during migration than species like Indiana bat. It is currently suspected that these differences make the long-distant migratory tree bats more susceptible to exposure to wind turbines than other guilds of bats. Although not as frequently recorded,

there have been a notable number of fatalities for other species of bats as well, with a single Indiana bat mortality incident detected at a wind power facility in Indiana. These observations confirm that other bats, including Indiana bats, are also susceptible to mortality from wind turbines during the migration period.

Interactions between bats and wind turbines, particularly small-size, single turbines, are poorly understood, and therefore appropriate siting of wind power facilities to avoid and minimize take remains our most effective tool. Generally speaking, we expect that Indiana bats are substantially less vulnerable to take at small wind facilities. However, there is a confounding factor of blade height with the smaller-sized turbines. As indicated above, we lack data on the height at which Indiana bats fly while migrating. Mortality of little brown bat (*Myotis lucifugus*) at wind facilities across the range indicate that this closely related species migrates at heights typical of the rotorswept area of commercial turbines. This coupled with the record of an Indiana bat killed at a commercial wind facility suggest that Indiana bats may often fly at heights that intersect commercial sized turbines during migration. This mortality event occurred in an unforested area. Thus, we believe that Indiana bats are susceptible to wind turbine mortality anywhere within the range of Indiana bats. At small scale wind sites, the area of exposure is substantially less than the cumulative rotorswept area of a commercial sized facility, and thus, so too is the likelihood of an Indiana bat intersecting a turbine.

In areas where suitable habitat is nearby, however, the risk of mortality during migration is higher. Data from migration studies indicate that Indiana bats will fly at or above the tree canopy level during the migration period. The rotorswept area associated with small-size turbines will intersect the area that Indiana bats are known to use at times during migration. For this reason, we believe in order to minimize the chance of taking Indiana bats during the migratory period, the wind turbine should be located greater than 1000 feet from woodlots and forested streams corridors.

Summer Period
Although monitoring to date shows that mortality is greatest during the fall migration period, substantial bat fatalities have been recorded during the summer, including *Myotis* species. For this reason, we believe turbines sited within or near (1000 ft) suitable Indiana bat summer habitat may lead to the take of Indiana bats.

In addition to the direct take due to collision and barotrauma associated with turbine operation, habitat manipulation needed to construct the wind turbines can also have adverse effects on Indiana bats. Extensive research has been conducted on the behavior and habitat use of Indiana bats during the summer period. Briefly, female Indiana bats form colonies ranging from 25 to 300 adult bats, with an average around 80. Each female rears a single pup. The colony typically has a single tree within wooded areas in which they roost together for most of the summer with decreasing frequency/dependency in latter part of the summer. Male Indiana bats are sometimes found among females, but more typically they roost singly or smaller groups. At dusk, the adults and volant young depart the roost tree to search for insect prey throughout the night. Their foraging habitat is primarily restricted to woodlots and forested streams although they will forage along the forest edge and tend to avoid open areas. Although there are observations of Indiana bats flying over open space, the vast majority of the records are within 1000 feet of a forested edge. Thus, we believe wind turbines constructed within 1000 feet of suitable habitat are likely to pose a threat to Indiana bats. Data also show that colonies show strong fidelity to their summer areas. Loss, modification or fragmentation of their traditional summer areas—whether or not such destruction occurs during summer period--can lead to adverse impacts to colonies.

Based on the information provided, your wind turbine will be located greater than 1000 feet from woodlots and forested streams corridor and beyond 20 miles of any known hibernacula. Further, all

associated construction activity will not affect potentially suitable roosting, foraging or commuting habitats. These measures will, we believe, substantially minimize the potential exposure of Indiana bats to your wind turbine and harm through habitat modification. Therefore, we do not believe your project poses adverse impacts to Indiana bats. If this incorrect, however, further consultation with this office is necessary to comply with the ESA.

> *Note: Research on the interaction of wind turbines and bats is active but in the beginning stages. As we indicated previously, there is still a great amount of uncertainty regarding the impacts of wind turbines on Indiana bat, particularly small scale wind facilities. Data are rapidly becoming available, and hence, our conclusions and recommendations necessarily evolve as this new information becomes available. We understand that DOE, in consultation with the Service, may be undertaking a regional monitoring program to help resolve some of the uncertainty surrounding impacts from small scale wind turbines. As these data become available, we will adapt our conclusions and recommendations accordingly. Please note that we currently believe that sufficient evidence suggests siting turbines greater than 20 miles from known hibernacula and farther than 1000 feet from summer habitat will likely avoid adverse impacts to Indiana bats. However, if new information reveals that these beliefs are in err, DOE will reinitiate consultation with the Service and you may be instructed to take further precautions (such as curtailing operations) to avoid or minimize the take of Indiana bats.*

MIGRATORY BIRD COMMENTS:

The Migratory Bird Treaty Act (16 U.S.C. 703-712; MBTA) implements four treaties that provide for international protection of migratory birds. The MBTA prohibits taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior. While the MBTA has no provision for allowing unauthorized take, the U.S. Fish and Wildlife Service (FWS) recognizes that some birds may be taken during activities such as wind turbine operation even if all reasonable measures to avoid take are implemented. The U.S. Fish and Wildlife Service's Office of Law Enforcement carries out its mission to protect migratory birds not only through investigation and enforcement, but also through fostering relationships with individuals and industries that proactively seeks to eliminate their impacts on migratory birds. Although it is not possible under the MBTA to absolve individuals, companies, or agencies from liability (even if they implement avian mortality avoidance or similar conservation measures), the Office of Law Enforcement focuses on those individuals, companies, or agencies that take migratory birds with disregard for their actions and the law, especially when conservation measures have been developed but are not properly implemented.

Your project lies within the range of the bald eagle (*Haliaeetus leucocephalus*), a species included under the Migratory Bird Treaty Act, but also afforded additional legal protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). The Bald and Golden Eagle Act prohibits the take of eagles without a permit. Interactions between eagles and turbines, particularly small single turbines, are poorly understood, and therefore appropriate siting of wind power facilities to avoid and minimize take remains our most effective tool. Because so little is known about interactions between eagles and single, small turbines, and how multiple small turbines across the landscape may affect eagles, it is difficult to predict if and how this project may affect eagles. However, the siting of the turbine in areas that generally do not provide high quality eagle habitat, and the small size and rotor-swept area of the turbine, leads us to believe that take of bald eagles from operation of the turbine is unlikely to occur. Additionally, bald eagle nests are not known to currently occur within the project area or within 5 miles of the project area. The FWS has recently finalized official agency guidelines to assist project proponents in avoiding and minimizing impacts to migratory birds, including bald eagles. We encourage you to consider those aspects of the guidelines detailed below to minimize impacts to all migratory birds.

Note: As explained above for endangered species, given the uncertainties associated with the effects of small scale turbines locally and cumulatively on birds and bats, we are working with DOE to develop a research program. Although the precise study design has yet to be agreed upon, we anticipate this program will entail monitoring at a subset of DOE-funded small-scale wind turbines. This would aid in our assessment of future wind power projects, test the assumptions we are currently making, and promote the conservation of eagles.

The full text of the Service's guidelines is available at http://www.fws.gov/habitatconservation/wind.pdf. The Service believes that implementing these guidelines may help reduce mortality caused by wind turbines. We particularly encourage you to consider the following excerpted suggestions from the Service's guidelines in an effort to minimize impacts to all migratory birds and bats.

1) Pre-development evaluations of potential wind farm sites to be conducted by a team of Federal and/or State agency wildlife professions with no vested interest in potential sites.

2) Rank potential sites by risk to wildlife.

3) Avoid placing turbines in documented locations of federally-listed species.

4) Avoid locating turbines in known bird flyways or migration pathways, or near areas of high bird concentrations (i.e., rookeries, leks, State or Federal refuges, staging areas, wetlands, riparian corridors, etc.). Avoid known daily movement flyways and areas with a high incidence of fog, mist or low visibility.

5) Avoid placing turbines near known bat hibernation, breeding, or maternity colonies, in migration corridors, or in flight paths between colonies and feeding areas.

6) Configure turbine arrays to avoid potential avian mortality where feasible (i.e., group turbines and orient rows of turbines parallel to known bird movements). Implement storm water management practices that do not create attractions for birds, and maintain contiguous habitat for area-sensitive species.

7) Avoid fragmenting large, contiguous tracts of wildlife habitat. Wherever practical, place turbines on lands already disturbed and away from intact healthy native habitats. If not practical, select fragmented or degraded habitats over relatively intact areas.

8) Minimize roads, fences, and other infrastructure. Wherever possible, align collection lines and access roads to minimize disturbance.

9) Develop a habitat restoration plan for the proposed site that avoids or minimizes negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species (i.e., avoid attracting prey animals used by raptors).

10) Use tubular supports with pointed tops rather than lattice supports to minimize bird perching and nesting opportunities. Avoid placing external ladders and platforms on tubular towers to minimize perching/nesting. Avoid use of guy wires for turbine or meteorological tower supports. All existing guy wires should be marked with bird deterrents (Avian Power Line Interaction Committee 1996).

11) If taller turbines (top of rotor-swept area is greater than 199 feet above ground level) require lights for aviation safety, the minimum amount of lighting specified by the Federal Aviation

Administration (FAA) should be used. Unless otherwise requested by the FAA, only white strobe lights should be used at night, and should be of the minimum intensity and frequency of flashes allowable.

12) Adjust tower height to reduce risk of strikes in areas of high risk for wildlife.

13) Wherever feasible, place electric power lines underground or on the surface as insulated, shielded wire to avoid electrocution of birds. Use recommendations of the Avian Power Line Interaction Committee (1996) for any required above-ground lines, transformers, or conductors.

WATER RESOURCE COMMENTS:
Generally speaking, streams and wetlands provide valuable habitat for fish and wildlife resources, and the filtering capacity of wetlands helps to improve water quality. Naturally vegetated buffers surrounding these systems are also important in preserving their wildlife-habitat and water quality-enhancement properties. Furthermore, forested riparian systems (wooded areas adjacent to streams) provide important stopover habitat for birds and bats migrating through the region. As such, we also recommend that impacts to streams and wetlands be avoided, and buffers surrounding these systems be preserved even in areas where endangered species are not to occur. The proposed activities do not constitute a water-dependent activity, as described in the Section 404(b)(1) guidelines, 40 CFR 230.10. Therefore, practicable alternatives that do not impact aquatic sites are presumed to be available, unless clearly demonstrated otherwise. Therefore, before applying for a Section 404 permit, the client should closely evaluate all project alternatives that do not affect streams or wetlands, and if possible, select an alternative that avoids impacts to the aquatic resource. If water resources will be impacted, the Corps of Engineers should be contacted for possible need of a Section 404 permit.

These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the Endangered Species Act of 1973, as amended, and are consistent with the intent of the National Environmental Policy Act of 1969 and the U. S. Fish and Wildlife Service's Mitigation Policy. This letter provides technical assistance only and does not serve as a completed section 7 consultation document.

Thank you for the opportunity to provide comments on this proposed project. Please contact Megan Seymour of this office for further information.

Sincerely,

Mary Knapp

Mary Knapp, Ph.D.
Field Supervisor

Cc: Brian Mitch, ODNR, Columbus, OH
Keith Lott, ODNR, Huron, OH

OHIO DEPARTMENT OF TRANSPORTATION
AVIATION
2829 W. DUBLIN-GRANVILLE ROAD • COLUMBUS, OH • 43235-2786

August 5, 2010

Archbold Schools
Attn: AAron Godwin
8281 Euclid Chardon Rd. # E
Kirtland, OH 44094

Proposal: Wind Turbine
Lat: N41°-30'-54.65"
Lon: W84°-18'-57.24"
Height: 335 ft AGL 1062 ft AMSL

Subject: APPLICATION FOR CONSTRUCTION/ALTERATION PERMIT
Aeronautical Study No: 2010-DOT-664-OE

To Whom It May Concern,

The purpose of this letter is to notify you that your application concerning construction at the specified latitude, longitude and proposed height does not require a permit from this office. Your proposal falls outside the limits set forth in Section 4561.32 of the Ohio Revised Code. However, this does not exempt you from filing with the FAA or contacting local zoning authorities regarding compliance with local zoning ordinances.

If you have any questions, please call; (614)387-2346.

Respectively,

E-SIGNATURE
_____
John A. Milling, Aviation Specialist
ODOT Office of Aviation
2829 W. Dublin-Granville Road
Columbus, OH 43235

AN EQUAL OPPORTUNITY EMPLOYER

Federal Aviation Administration
Air Traffic Airspace Branch, ASW-520
2601 Meacham Blvd.
Fort Worth, TX 76137-0520

Aeronautical Study No.
2010-WTE-10896-OE
Prior Study No.
2009-WTE-8657-OE

Issued Date: 08/19/2010

Dave Deskins, Superintendent
Archbold Schools
600 Lafayette St.
Archbold, OH 43502

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Wind Turbine Archbold Schools Wind Turbine
Location:	Archbold, OH
Latitude:	41-30-54.65N NAD 83
Longitude:	84-18-57.24W
Heights:	335 feet above ground level (AGL) 1062 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

As a condition to this Determination, the structure is marked and/or lighted in accordance with FAA Advisory circular 70/7460-1 K Change 2, Obstruction Marking and Lighting, white paint/synchronized red lights - Chapters 4,12&13(Turbines).

It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be completed and returned to this office any time the project is abandoned or:

_____ At least 10 days prior to start of construction (7460-2, Part I)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part II)

This determination expires on 08/19/2012 unless:

(a) extended, revised or terminated by the issuing office.
(b) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO

SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

Additional wind turbines or met towers proposed in the future may cause a cumulative effect on the national airspace system. This determination is based, in part, on the foregoing description which includes specific coordinates and heights . Any changes in coordinates will void this determination. Any future construction or alteration requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this 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 2010-WTE-10896-OE.

Signature Control No: 128939283-129829833 (DNE -WT)
Michael Blaich
Specialist

UNITED STATES DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Washington, D.C. 20230

OCT 18 2010

Ms. Caroline Mann
Office of Energy Efficiency and Renewable Energy (EE-40)
US Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Re: Archbold Area Wind Project, in Fulton County, OH

Dear Ms. Mann:

In response to your request on August 18, 2010, the National Telecommunications and Information Administration provided to the federal agencies represented in the Interdepartment Radio Advisory Committee (IRAC) the plans for the Archbold Area Local School Wind Energy Project, located in Fulton County, Ohio.

After a 45 day period of review, no federal agencies identified any concerns regarding blockage of their radio frequency transmissions.

While the IRAC agencies did not identify any concerns regarding radio frequency blockage, this does not eliminate the need for the wind energy facilities to meet any other requirements specified by law related to these agencies. For example, this review by the IRAC does not eliminate any need that may exist to coordinate with the Federal Aviation Administration concerning flight obstruction.

Thank you for the opportunity to review these proposals.

Sincerely,

Edward M. Davison
Deputy Associate Administrator
Office of Spectrum Management

Archbold

ORDINANCE NO. 08-24

AMENDING ORDINANCE NO. 02-38 TO REGULATE THE INSTALLATION AND USE OF WIND TURBINES

BE IT ORDAINED by the Council of the Village of Archbold, Ohio, as follows:

Section 1. Ordinance 02-38 is hereby amended to add Section 152.085 regulating wind turbines as follows:

Section 152.085(A) Wind Energy Conversion Systems (WECS) shall be a Conditional Use only in the M-2 General Industrial, Agricultural, and S-1 Special districts, and shall require Planning Commission review as per Section 152.162 of Ordinance 02-38. To obtain a Conditional Use permit a WECS must meet all of the requirements specified in Section 152.085(C) of this ordinance. WECS shall not be allowed in any residential district.

Section 152.085(B) DEFINITIONS

WECS . Wind Energy Conversion System: An electrical generating facility comprised of one or more wind turbines and accessory facilities, including but not limited to: power lines, transformers, substations and meteorological towers, that operate by converting the kinetic energy of wind into electrical energy. The energy may be used on-site or distributed into the electrical grid.

Fall Zone: An area defined as a distance of at least 125% of the total height of the total structure from any property line, occupied building, and public or private road or right-of-way.

Feeder Line: Any power line that carries electrical power from one or more wind turbines or individual transformers associated with an individual wind turbine to the point of interconnection with the electric power grid.

Meteorological Tower: For the purposes of this Wind Energy Conversion System Ordinance, meteorological towers are those towers which are erected primarily to measure wind speed and directions plus other data relevant to siting WECS.

Property line: The boundary line of the area over which the entity applying for a WECS permit has legal control for the purposes of installation of a WECS. This control may be attained through fee title ownership, easement, or other appropriate legal relationship between the project developer and landowner.

Rotor diameter: The diameter of the circle described by the moving rotor blades.

Substations: Any electrical facility designed to convert electricity produced by wind turbines to a voltage greater than (35,000 KV) for interconnection with high voltage transmission lines.

Total height: The highest point, above ground level, reached by a rotor tip or any other part of the WECS.

Tower: Towers include vertical structures that support the electrical generator, rotor blades, or meteorological equipment.

Wind Turbine: A wind turbine is any piece of electrical generating equipment that converts the kinetic energy of blowing wind into electrical energy through the use of airfoils or similar devices to capture the wind.

Section 152.085(C) Requirements

(a) The application for conditional use shall include a scale site drawing showing the proposed location of all facilities to be constructed, the dimensions of the property, proposed heights, and the distance to all buildings and property lines.
(b) All WECS towers shall be sited so as to provide a safe fall zone.
(c) All moving rotor blades shall be a minimum of 30 feet from ground level.
(d) Noise levels shall be less than 60 dBA at the nearest property line, unless the property where the wind turbine is proposed abuts a residential district, in which case the maximum noise level shall be 50 dBA at any property line abutting a residential district.
(e) All permanent wind turbine towers shall be self supporting. No guy wires will be allowed on permanent structures.
(f) All towers shall be made non-climbable in a manner approved by the Archbold Village Engineer.
(g) All electrical wires leading to or from a wind turbine shall be buried underground. All connections to transmission lines and/or substations shall be buried underground.
(h) A color scheme of the tower and turbine assembly shall be submitted to the Planning Commission and shall be subject to its approval.
(i) Wind energy facilities shall not be artificially lighted, except to the extent required by the FAA or other applicable authority.
(j) A shadow flicker study to determine any potential negative impact on surrounding properties shall be conducted prior to Planning Commission hearing of the conditional use and the report shall be included in the conditional use application. The study shall be at the applicant's expense, and shall be performed by a neutral third party approved by the Archbold Village Engineer.
(k) A study to determine any possible interference with radio, television, or cellular telephone communication shall be conducted prior to hearing of the application by Planning Commission, and the results shall be included in the conditional use application. The study shall be at the applicant's expense, and shall be performed by a neutral third party approved by the Archbold Village Engineer.
(l) Any tower or structure associated with a WECS that remains unused for any

reason for more than 30 days shall be dismantled and removed from the property no later than 90 days from the time use of the equipment has ceased. A plan for dismantling and removal of the equipment shall be included in the conditional use application.

Section 2. It is hereby found and determined that all formal actions of this Council concerning and relating to the passage of this ordinance were adopted in an open meeting of this Council, and that all deliberations of this Council and of any of its committees that resulted in such formal action were in meetings open to the public, in compliance with all legal requirements including Section 121.22 of the Ohio Revised Code.

Section 3. This ordinance shall take effect and be in full force from and after the earliest date allowed by law.

First reading: May 19, 2008

Second reading: June 2, 2008

Third reading: June 16, 2008

Passed: June 16, 2008

James S. Wyse, Mayor

Attest:

Laurie J. Storrer, Clerk of Council

Village of Archbold
Planning Commission Minutes
August 23, 2010, 7:00 pm

Commission members present: Jim Wyse, Ed Leininger, Lin Ross, Doug Rupp, Denny Meyer

Secretary: Dennis Howell

Planning Director/Zoning Inspector: Carma Grime

Interested Parties: Aaron Godwin, Krystal Naylor, Scott Miller, David Deskins, Kris Juillard, Bruce Rupp, Tom Warner, Bob Seaman, Phil Nofziger, Andy Brodbeck, Tony Warnacke, Bob Aschliman

President Ed Leininger called the meeting to order at 7:00 pm. He asked the members to consider the minutes from November 24, 2008. Lin Ross moved to approve the minutes and Denny Meyer seconded. All vote aye, motion approved.

Ed Leininger led the committee to vote for new officers of the Planning Commission. Denny Meyer moved to elect Ed Leininger as president, seconded by Doug Rupp. All voted aye, motion approved.

Denny Meyer moved to elect Jim Wyse as Vice-President, seconded by Doup Rupp. All voted aye, motion approved.

Ed asked Carma Grime to present the issue. Carma told the planning commission that Archbold High School has been studying the effects of a wind turbine to help reduce the cost of their electrical usage. After a year of study they have decided to move forward with this project. Archbold High School is in a S1 special zone. A wind turbine is a conditional use in an S1 zone in accordance with the Zoning Ordinance Section 152.085. Archbold High School is requesting a conditional use permit for a wind turbine on school property which is to be reviewed by the planning commission.

Ed introduced Mr. David Deskins and asked him to introduce his guest and present his request. Mr. Deskins told the committee that the Archbold High School has spent a couple of years doing research studying the possibility of installing a wind turbine at the school district to help with offsetting costs of electricity but also as an educational benefit for students. Archbold School is working in conjunction with Pettisville School and Northwest State Community College as they pursue this. They are asking the planning commission to approve the Archbold School District's request for a variance to the Village of Archbold's tower policy that would allow them to move forward and install a wind tower on school district property. They also are asking that the commission remain open to the possibility for filing an easement if one is determined necessary for the property that is adjacent to the school district to the west. He introduced Aaron Godwin,

who is with the Renaissance Group. Mr. Godwin is the founder and CEO of that group. He is interested in supporting Ohio and alternative energy in the state.

Mr. Godwin spoke to the group about wind turbine energy. His group has been involved in helping communities invest in themselves and get a return on their investment. They have been looking into this as a jobs issue. Most people don't realize that Ohio is number two in potential jobs from creating the equipment that goes into this industry. There are over 900 companies involved in Ohio right now in producing this equipment and there are thousands of companies that could be involved for small component parts. While the whole economy has been having challenges over the last few years, the wind industry has been growing in double digits every year. Mr. Godwin told the committee about how they were able to get grants for the Archbold School wind project but since a lot of the grant money was Federal money that meant they had to perform a lot of studies.

He showed through pictures and data on how the spot for the wind turbine was determined. He brought the preliminary results of all the tests and data gathered. He showed the group the data on the fall zones of the areas considered for the wind turbine. It would take a catastrophic incident such as a tornado to make the turbine fall. The impact of the machine on populated areas is minimal but they want to try to avoid all occupied structures. The location chosen has the least wind obstructions and so there is a boost from the power output. This project is about savings to the school district.

There was a study on the noise from the wind turbine. The tests were performed both in the daytime and evening to determine the sound levels of the village. The ambient levels in town are louder both in the daytime and evening at 40 – 80 decibels then a wind turbine would be. The turbine ambient level is at about 40 – 50 decibels.

There was a study on shadows of the turbine done over a year's time to see if there was any impact on residents or businesses to make sure the turbine shadow was not a nuisance. The only potential problem with shadows was the stadium and ball field in winter right before sunset, but he told the group that the turbine could be shut down for games or special events. The turbines are self monitoring but can also be monitored through the internet, and through cell phones. If there is any kind of adverse issue the turbine will turn itself off or it can be turned off manually.

The next study was to look at the visual impact of the turbine to the community. Most of the community will not be able to see the wind turbine because of the trees and buildings except for the southwest corner of the Village of Archbold. The turbine will be best seen from the rural areas or farmland. This turbine will be smaller than Bowling Green's wind turbines. The radio tower in town is taller than the turbine they will put up at the school. Archbold has seven towers in the community already.

Ed asked the committee if they had any questions. No one responded. Ed opened the questions up to the guests. Mr. Godwin took questions about the shadows and the sound. He said that the smaller the turbine the more noise. He suggested not to take his word about the sound but to go stand underneath a turbine.

Dennis told the group that the planning commission does not record easements. That would be for the county recorder. That issue would be between the school board and any other property owner. Ed asked what would happen in the future if the property by the wind tower would want to be developed as an occupied property. Dennis said if the property was incorporated into the Village, they would not allow any building permits and if the property is outside the village, the Village of Archbold would not have any jurisdiction. The group discussed the fall zone. Mr. Godwin says normally the tower will crumple upon itself in the worst case scenario. There have been only two citizens killed by wind turbines. One was a sky diver and one was a suicide. He told the group this is a non climbable, slippery steel structure. The climbing is all in the inside with a locked steel door. Carma asked the board, since the school is proposing a white tower and white blades, if someone wanted to pay to have Archbold Blue Streaks painted on the tower would they have to come before the board for approval. Any change would have to come back to the planning commission. Ed asked if there were any more questions or comments from the guests. Ed thanked everyone for coming to the meeting. Ed asked if the board had anymore questions or comments.

Jim made a motion to approve the conditional use for the wind tower, with a variance for the fall zone, seconded by Lin. Ed Leininger called the roll.

Jim Wyse – Yes
Lin Ross – Yes
Denny Meyer – Yes
Doug Rupp – Yes
Ed Leininger - Yes

Dennis mentioned to the group that this issue also has to be approved by council.

Jim made a motion to adjourn, seconded by Lin. All voted aye. The meeting adjourned at approximately at 8:00 pm.

Respectively submitted,

Deb Volkman

_____ _____

Dennis Howell
Secretary, Archbold Planning Commission

Ed Leininger
President, Archbold Planning Commission

Village of Archbold

P.O. Box 406, 300 N. Defiance
Archbold, OH 43502-0406
Phone 419 445 4726 - FAX 419 445 0908
email ksrupp@archbold.com

Letter of Transmittal

Date: November 11, 2010

TO: Mr. David Deskins, Superintendent
Archbold Area Schools
600 Lafayette Street
Archbold, OH 43502

Transmitted: (i) 2 certified copies of Ordinance #10-65
(ii) a certified copy of the minutes of the November 8 Council meeting

Copy to: Dennis Howell, Village Administrator

Kathy S. Rupp
Director of Finance

ORDINANCE NO. 10-65

AN ORDINANCE TO ACCEPT THE RECOMMENDATION OF ARCHBOLD PLANNING COMMISSION FOR A CONDITIONAL USE

Whereas the Archbold Area School Board has applied for a permit to install a Wind Energy Conversion System (Wind Turbine), and

Whereas per Ordinance 08-24 Wind Turbines are a Conditional Use, and

Whereas the Archbold Planning Commission met according to law on August 23, 2010 and voted unanimously to recommend approval of the Conditional Use, now therefore

The Village Council of Archbold, Ohio hereby ordains:

Section 1. That the Archbold Planning Commission held a Public Hearing on August 23, 2010 to consider a request from the Archbold Area School Board for a Conditional Use, said Conditional Use being construction of a Wind Turbine in an S-1 Special district.

Section 2. That the Archbold Planning Commission unanimously recommended the approval of the Conditional Use requested as shown in the minutes from the Archbold Planning Commission meeting on August 23, 2010.

Section 3. That Council held a Public Hearing on Monday, November 8, 2010 in consideration of the Planning Commission recommendation.

Section 4. That Council hereby approves the Conditional Use requested, as recommended by Planning Commission.

Section 5. It is hereby found and determined that all formal actions of this Council concerning and relating to the passage of this ordinance were adopted in an open meeting of this Council, and that all deliberations of this Council and of any of its committees that resulting in such formal action were in meetings open to the public, in compliance with all legal requirements including Section 121.22 of the Ohio Revised Code.

Section 6. This ordinance shall take effect and be in full force from and after the earliest date allowed by law.

Passed: November 8, 2010

James S. Wyse, Mayor

Attest:

Laurie J. Storrer, Clerk of Council

I hereby certify this to be a true and original copy.

Laurie J. Storrer, Clerk of Council

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Section 6. This ordinance shall take effect and be in full force from and after the earliest date allowed by law.

Passed: November 8, 2010

James S. Wyse, Mayor

Attest:

Laurie J. Storrer, Clerk of Council

I hereby certify this to be a true and original copy

Laurie Storrer, Clerk of Council

COUNCIL MINUTES
November 8, 2010

On Monday, November 8, 2010 at 7:00 p.m., a Public Hearing was held in Council Chambers for public comment regarding conditional use by Archbold Area Schools for a wind turbine. There being no comment from anyone present, Village Mayor, Jim Wyse, closed the public hearing, and opened the regular Council meeting. Present were Kevin Eicher, Ed Leininger, Jeff Fryman, Vaughn Bentz and Kevin Morton. Kenny Cowell was absent.

Village Administrator, Dennis Howell, then presented the following item of legislation:

ORDINANCE 10-65: ACCEPTING A CONDITIONAL USE FOR A WIND TURBINE.

Present for discussion were school board members John Lugbill, Phil Nofziger, and Scott Miller, as well as Dave Deskins, Superintendent of Archbold Area Schools. Dennis Howell presented a slide showing the location for the wind tunnel, and Village Zoning Inspector, Carma Grime stated the location and plans met all the requirements of the United States Dept. of Energy. Following discussion, Kevin Eicher moved to pass Ordinance 10-65, seconded by Vaughn Bentz.

Roll: Yeas: Eicher, Leininger, Fryman, Bentz, Morton
Nays: None. **Ordinance 10-65 passed.**

Mr. Howell then presented the next item of legislation as follows:

RESOLUTION 10-68: ACCEPTING ANDREW P. MOSER AND KALEB C. TORBET AS PROBATIONARY PART-TIME POLICE OFFICERS AND DECLARING AN EMERGENCY.

Chief of Police, Martin Schmidt, was present as was Kaleb Torbet. Following discussion, Kevin Morton moved to suspend the rule that requires a resolution of general nature to be read on three separate days. Ed Leininger seconded the motion.

Roll: Yeas: Leininger, Fryman, Bentz, Morton, Eicher
Nays: None. Motion carried.

Jeff Fryman then moved to pass Resolution 10-68, seconded by Vaughn Bentz.

Roll: Yeas: Fryman, Bentz, Morton, Eicher, Leininger
Nays: None. **Resolution 10-68 passed.**

There being no additions or corrections to the minutes of the October 25, 2010 Council meeting, Kevin Eicher moved to approved, seconded by Kevin Morton.

Roll: Yeas: Bentz, Morton, Eicher, Leininger, Fryman
Nays: None. **Motion carried.**

Following review of the invoices by members of the Finance Committee, Ed Leininger moved to pass the Claims Ordinance, seconded by Vaughn Bentz.

Roll: Yeas: Morton, Eicher, Leininger, Fryman, Bentz.
Nays: None. **Claims Ordinance passed.**

Kevin Eicher then moved that Council go into **Executive Session** to discuss Personnel and Property matters. Jeff Fryman seconded the motion.

Roll: Yeas: Eicher, Leininger, Fryman, Bentz, Morton
Nays: None. **Motion carried.**

Mayor Wyse recalled the meeting to order following the session. No action was taken on issues discussed.

Dennis Howell presented the following item next:

RESOLUTION 10-62: ACCEPTING BIDS FOR THE PURCHASE OF CHEMICALS FOR 2011 AND DECLARING AN EMERGENCY.

Following discussion, Kevin Morton moved to suspend the rule that requires a resolution of general nature to be read on three separate days. Kevin Eicher seconded the motion.

Roll: Yeas: Leininger, Fryman, Bentz, Morton, Eicher
Nays: None. Motion carried.

Vaughn Bentz then moved to pass Resolution 10-62, seconded by Ed Leininger.

Roll: Yeas: Fryman, Bentz, Morton, Eicher, Leininger
Nays: None. **Resolution 10-62 passed.**

The next item presented is as follows:

RESOLUTION 10-63: ACCEPTING THE BID OF RODNEY BUEHRER FOR THE RENT OF FARM GROUND AND DECLARING AN EMERGENCY.

Dennis Howell mentioned that Mr. Buehrer is the current renter and the contract is for three years. Following discussion, Ed Leininger moved to suspend the rule that requires a resolution of general nature to be read on three separate days. Kevin Eicher seconded the motion.

Roll: Yeas: Bentz, Morton, Eicher, Leininger, Fryman
Nays: None. Motion carried.

Vaughn Bentz then moved to pass Resolution 10-63, seconded by Kevin Morton.

Roll: Yeas: Morton, Eicher, Leininger, Fryman, Bentz
Nays: None. **Resolution 10-63 passed.**

The following item was then presented to Council:

RESOLUTION 10-64: ACCEPTING THE BID OF HANK'S PLUMBING AND HEATING FOR CONTRACT 4-10 CLEAR WELL VALVE CHAMBER, AND DECLARING AN EMERGENCY.

Following discussion, Jeff Fryman moved to suspend the rule that requires a resolution of general nature to be read on three separate days. Kevin Eicher seconded the motion.

Roll: Yeas: Eicher, Leininger, Fryman, Bentz, Morton
Nays: None. Motion carried.

Ed Leininger then moved to pass Resolution 10-64, seconded by Kevin Morton.

Roll: Yeas: Leininger, Fryman, Bentz, Morton, Eicher
Nays: None. **Resolution 10-64 passed.**

Mr. Howell presented the following item of legislation next.

ORDINANCE 10-66: REGULATING THE USE OF LICENSING OF GOLF CARTS WITHIN THE VILLAGE.

Jeff Fryman informed Council that the Police and Fire Committee had discussed this and gave their recommendation, and Dennis Howell said Village Solicitor, Mark Hagens, had also reviewed it. Following discussion, Kevin Eicher moved to pass Ordinance 10-66, seconded by Jeff Fryman.

Roll: Yeas: Fryman, Bentz, Morton, Eicher, Leininger
Nays: None. **Ordinance 10-66 passed.**

Dennis Howell then presented the following item:

RESOLUTION 10-67: AUTHORIZING THE VILLAGE ADMINISTRATOR TO EXECUTE A CONTRACT WITH FULTON COUNTY FOR TORNADO SIREN MAINTENANCE AND DECLARING AN EMERGENCY.

Dennis Howell noted that the terms are identical to the current contract. Following discussion, Vaughn Bentz moved to suspend the rule that requires a resolution of general nature to be read on three separate days. Kevin Morton seconded the motion.

Roll: Yeas: Bentz, Morton, Eicher, Leininger, Fryman
Nays: None. Motion carried.

Ed Leininger then moved to pass Resolution 10-67, seconded by Kevin Eicher.

Roll: Yeas: Morton, Eicher, Leininger, Fryman, Bentz
Nays: None. **Resolution 10-67 passed.**

Council then reviewed the minutes of the October meetings of the Utility and Finance Committees.

Council also reviewed the following October 2010 reports:

- Street Department Report
- Finance Report
- Police Report
- Income Tax Report
- Zoning Permits

There were two items of correspondence; one from the Ohio EPA, and the other the FCBDD newsletter.

There being no further business to discuss, Kevin Eicher moved to adjourn the meeting, seconded by Jeff Fryman. All agreed; motion carried.

Laurie J. Storrer
Clerk

James L. Ryse
Mayor

I hereby certify this to be a true and original copy. Laurie J. Storrer
Laurie J. Storrer, Clerk of Council

APPENDIX D:

SUPPORTING DOCUMENTATION

Department of Energy
Golden Field Office
1617 Cole Boulevard
Golden, Colorado 80401-3393

August 19, 2010

SUBJECT: Notice of Scoping – A-SEP-61 – 600 to 750 kW Single Wind Turbine: *Arch bold Area Local School Wind Energy Project*, Fulton County, Archbold, Ohio

The U.S. Department of Energy (DOE) is proposing to provide federal funding to the Archbold School District to construct and operate a 600 to 750kW wind turbine in Fulton County, Ohio. The proposed project would construct and operate a wind turbine located on the Archbold School District property within the town of Archbold. Details of the proposed wind turbine are provided in the attachment to this Scoping Notice. Pursuant to the requirements of the National Environmental Policy Act (NEPA) the Council on Environmental Quality (CEQ) regulations for implementing the procedural provision of NEPA (40 CFR Parts 1500-1508), and DOE's implementing procedures for compliance with NEPA (10 CFR 1021), DOE is preparing an Environmental Assessment (EA) to:

- Identify any adverse environmental effects that cannot be avoided should this proposed project be implemented.
- Evaluate viable alternatives to the proposed project.
- Describe the relationship between local and short-term uses of the environment and the maintenance and enhancement of long-term productivity.
- Characterize any irreversible and irretrievable commitments of resources that would be involved should this proposed project be implemented.

Potential Environmental Effects or Issues Identified for the Environmental Assessment

The EA will describe and analyze any potential impacts on the environment that would be caused by the project and will identify possible mitigation measures to reduce or eliminate those impacts. At a minimum, DOE will evaluate potential impacts that may result from the proposed project related to:

- Land Use
- Biological Resources
- Cultural Resources
- Noise
- Safety and Occupational Health
- Socioeconomics and Environmental Justice
- Utilities
- Traffic and Transportation
- Aviation Hazards
- Electromagnetic Interferences
- Aesthetics and Shadow Flicker
- Water Resources

Development of a Reasonable Range of Alternatives
DOE is required to consider a reasonable range of alternatives to the proposed action during an environmental review. The definition of alternatives is governed by the "rule of reason", as described within the CEQ regulations regarding the administration of NEPA. An EA must consider a reasonable range of options that could accomplish the agency's purpose and need and minimize environmental impacts. Reasonable alternatives are those that may be feasibly carried out based on environmental, technical, and economic factors.

As part of the EA, the No Action Alternative will be addressed. The need for project redesign, or a project alternative, will be determined during the course of environmental review.

Public Scoping

The DOE is sending this letter to interested federal, state and local agencies to provide information on issues to be addressed in the EA. Agencies are invited to indentify the issues within their statutory responsibilities that should be considered in the EA. The general public is also invited to submit comments on the scope of the EA

This letter and the draft EA, when it is available, will be posted in the DOE Golden Field Office online reading room: http://www.eere.energy.gov/golden/Reading_Room.aspx.

The DOE Golden Field Office welcomes your input throughout our NEPA process, but to ensure that your comments are received in time to be considered in the draft EA, please provide them on or before September 9, 2010 to:

Melissa Rossiter
NEPA Document Manager
Department of Energy
1617 Cole Boulevard
Golden, CO 80401
Melissa.Rossiter@go.doe.gov

We look forward to hearing from you.

Sincerely,

Melissa Rossiter

Attachment

Archbold School District Wind Turbine

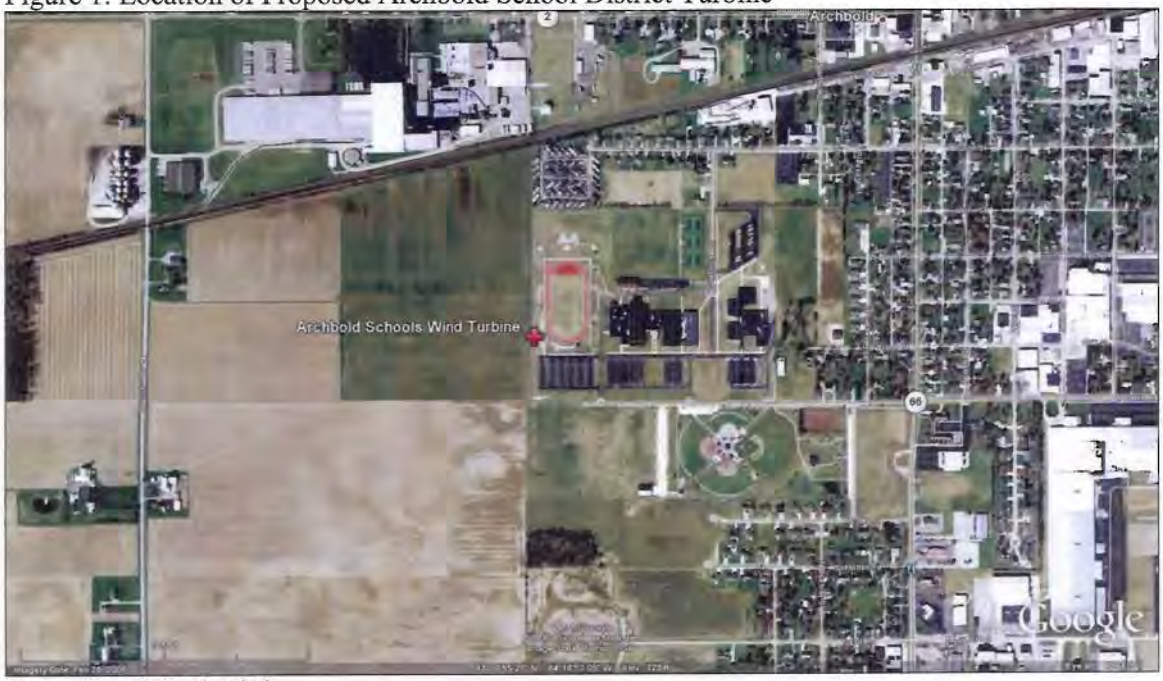
The U.S. Department of Energy is proposing to provide up to $750,000 to the Archbold School District for construction and operation of a 600 to 750 kW single wind turbine. The School District proposes to design, permit, construct, operate and maintain the 600 to 750 kW wind turbine located at 600 Lafayette Street, Archbold, Ohio (see Figure 1).

Latitude: 41-30-54.65N NAD 83
Longitude: 84-18-57.24W

The DOE funding for this project would be paid for by the American Recovery and Reinvestment Act of 2009 and would include the following components:

- A single 600 to 750 kW new turbine on a 60 to 75 meter tower
- Associated generator and below ground collector cables
- Underground transmission lines and connection to the Archbold School District internal energy distribution system

Figure 1. Location of Proposed Archbold School District Turbine



Source: Google Earth, 2010.

Archbold Public Involvement

The Archbold Area Schools has provided opportunities for public involvement since November 21, 2010 in an attempt to educate the public about this project and provide an opportunity for public comment.

Media Coverage:

Archbold Buckeye – July 28, 2010 - School Board Okays Wind Turbine Action
Crescent News - July 21, 2010 - Archbold board approves resolution for wind turbines
Archbold Buckeye – June 16, 2010 - Archbold School Board Looking Into Wind Turbine Financing Options
Crescent News - June 15, 2010 - Archbold board approves resolution for wind turbine project
Archbold Buckeye – April 14, 2010 - Call For New Study Delays Wind Turbines
Archbold Buckeye – March 17, 2010 - No New Developments On Wind Turbine Project
Archbold Buckeye – March 10, 2010 - Wind Turbine Funding Unclear
Crescent News - February 17, 2010 - Archbold updated on turbine project
Archbold Buckeye – February 17, 2010 - Wind Project Up In The Air, Deskins Says
Archbold Buckeye – February 10, 2010 - Distrust Of Deskins Why?
Archbold Buckeye – February 3, 2010 - School Board Okays Wind Consultant Deal
Archbold Buckeye – January 27, 2010 - WEB EXTRA
Archbold Buckeye – December 30, 2009 - Reap The Wind
Archbold Buckeye – December 23, 2009 - Borrow $400,000 For School Wind Turbine?
Crescent News - December 7, 2009 - Archbold, Pettisville land $1.5M grant
Archbold Buckeye – December 2, 2009 - Wind Power Money Comes To Archbold, Pettisville Schools
Archbold Buckeye – November 18, 2009 - School Board Hears About Success Day
Archbold Buckeye – September 2, 2009 - Preliminary Wind Data Promising
Archbold Buckeye – May 20, 2009 - Archbold Wind Study Continues; Fayette May Put Turbine Up First
Archbold Buckeye – January 21, 2009 - Wind Tower Data Promising: Deskins
Archbold Buckeye – August 13, 2008 - Archbold Isn't The Only School Studying Wind Energy Benefits
Archbold Buckeye – June 4, 2008 - Council Grants Permit For Wind Test Tower
Archbold Buckeye – June 4, 2008 - School Districts To Split Capital Budget Cash
Archbold Buckeye – June 25, 2008 - Wind Test Tower Stands Tall
Archbold Buckeye – April 23, 2008 - Wind Turbine Could Be In Line For State Capital Budget Funds Archbold Buckeye – April 16, 2008 - BREAKING NEWS
Archbold Buckeye – April 2, 2008 - Wind Test Tower Passes Hurdle
Archbold Buckeye – March 5, 2008 - Planning Commission Approves Requests From Jim King, School Board
Archbold Buckeye – March 5, 2008 - CORRECTION
Archbold Buckeye – February 20, 2008 - Wind Power Talks Exciting
Archbold Buckeye – February 13, 2008 - School May Get Wind Study Tower
Archbold Buckeye – December 5, 2007 - Archbold Wind Study Reduces Electricity Bills
Archbold Buckeye – November 21, 2007 - Archbold Schools Wind Team Still Studies Issue

In addition, the following agencies and organizations have been contacted by the Archbold Area Schools and/or DOE:

- United States Fish and Wildlife Service (USFWS)
- Federal Aviation Administration (FAA)
- United States Department of Commerce – National Telecommunications and Information Administration (NTIA)
- Ohio Historic Preservation Office (OHPO)
- Ohio Department of Natural Resources (ODNR), Division of Wildlife (ODOW)
- Ohio Department of Natural Resources (ODNROhio Department of Transportation Office of Aviation
- Ohio Department of Development Energy Resources Division
- Archbold Village Board of Zoning
- German Township Board of Zoning

AERONAUTICA 54-750

When Megawatt-Class Turbines Are Just Too Big

These workhorses provide plenty of power for schools, industrial parks, shopping centers, neighborhood net-metering, Green Communities, wind parks and more!

- **3/4 Megawatt (750kW) design - for Class III winds**
- **Low profile: less than 270' tall on a 55m tower**
- **Active Stall Regulation (ASR) allows blades to be optimized for both low and high wind conditions**
- **Dual-wound 200/750 kW Generator**

Located in an IEC Class III wind area? *Aeronautica Windpower* is proud to introduce the 54-750: a Queen-size machine designed with a larger rotor for 'distributed wind' applications at lower wind sites. Many good wind sites just cannot accommodate huge, utility-scale turbines. A large number of sites, especially populated areas, are better suited to a smaller size machine. The 54-750 is the perfect fit.

More easily permitted, erected, and financed than its larger brothers, the 54-750 is a great choice for municipal projects, commercial/industrial sites, college or high school campuses, and other places where 'behind the meter', or net -metered power can be utilized.

With its low profile, ultra-low noise signature, and highly efficient output, the 54-750 provides the perfect balance between economic output and acceptable size. And *Aeronautica* wind turbines are *all manufactured in the United States*, reducing shipping costs and delivery times.

Fast Facts:

Orientation: *Upwind*	Rotor Diameter: *54m*
Rotor Speed: *~25.3RPM*	Active-Stall Regulated
Hub Height: *65 or 55m*	Blades: *Fiber Reinforced Polyester*

American Energy from America's Hometown

AERONAUTICA Windpower

Plymouth, MA **1-800-360-0132** www.AeronauticaWind.com

54-750 kW System Specifications:

Blades
3 blades, upwind orientation
Fiberglass reinforced polyester

Rotor

Power regulation:	Active Stall Regulation (ASR).
Rotor size:	54m diameter (177') (std—other configs. avail.)
Rotor speed:	25.3 rpm nominal
Swept area:	2,289 m^2
Tilt angle:	4°
Coning angle:	3.0° forward.
Tip speed:	62 – 63 m/s at full load.
Pitch angle:	Active Stall Regulation
Pitch bearings:	4-point ball bearings.
Air brake, normal:	Pitch to -20°, actuated by the Active Stall Regulation system.
Air brake, emergency:	Pitch to -85° fail safe, activated by accumulators in hub.
Nominal pitch speed:	7.5 °/sec
Mechanical brake:	A fail-safe type disk brake.
Brake torque:	1.8 times of nominal torque (approx).
RPM max. value:	1920 (60 Hz), 1600 (50 Hz), on the high-speed shaft.

Generator

Nom. Electric Power:	200/750 kW (dual wound)
Generator:	Closed, Synchronous induction, 4/6 pole DW, IP54 or 55.
Generator speed:	1200/1800 (60 Hz) or 1000/1500 (50 Hz) rpm synchronous
Loss in generator:	3 - 4 % at nominal power dependent on type
Generator cut-in:	Thyristor controlled gradual cut-in
Grid connection:	60 Hz – 690V or 50 Hz – 690V

Operational:

Yaw motors:	4 pcs. w/electrical brakes built in
Yaw brakes:	4 pcs. disk hydraulic brakes
Yaw bearing:	4-point ball bearing
Cut-in wind speed:	3-4 m/s, based on 10 min average
Cut-out wind speed:	25 m/s, based on 2 min average
Controller:	CC–Electronic (Mitsubishi PLC)
Noise:	100 dBA Sound Power (at Nacelle)

Monopole Tower
Conical Steel, White, 65m and 50m towers available
Nacelle access: interior tower ladder through locked door

Weights:

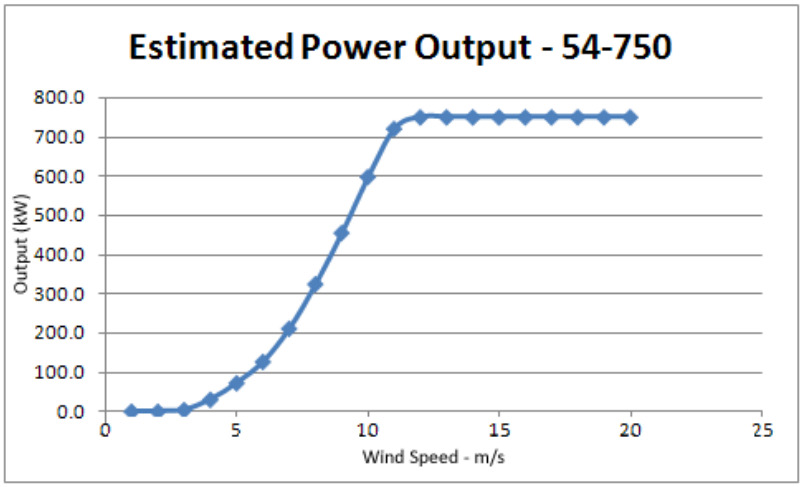
Mass of blades: (3):	Approx. 16,000 lbs (7,200 kg)
Mass of nacelle:	Approx. 48,400 lbs (22.000 kg)
Mass of hub:	Approx. 17,600 lbs (8.000 kg)
Mass total, excl tower:	Approx. 81,200 lbs (36.909 kg)

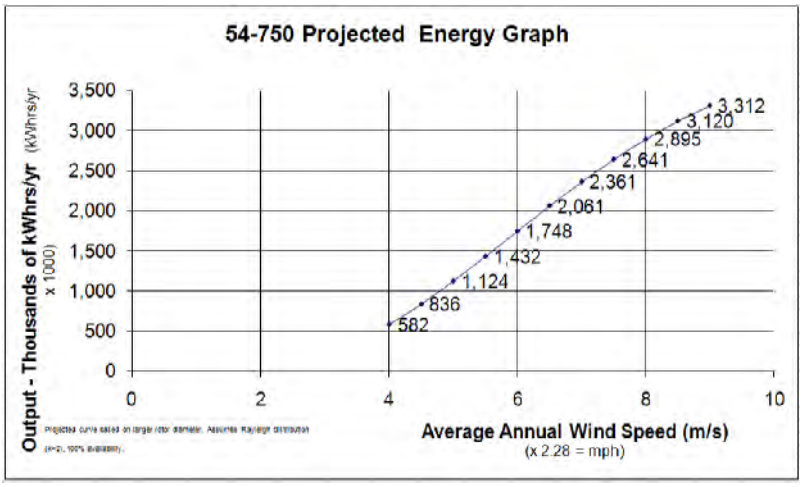
Certification: Variant of our 47-750 turbine, which is design Certified by DNV for IEC 61400 Ed. 3 Class IB and IIA

Safety Issues
Induction generator has inherent anti-islanding
Fail-safe hydraulic disk brake
Grid monitoring for shutdown and operational performance
Shipping: All Prices are FOB our plant

Warranty: Standard warranty is for two years on the drive train and on all major parts. Extended warranties are available.

Installation: Aeronautica Windpower, LLC is only a supplier of equipment. We can, however, refer you to local installers or dealers for a complete installation.
Service Agreements: Annual Service Contracts are strongly advised and are available from local dealers and installers.

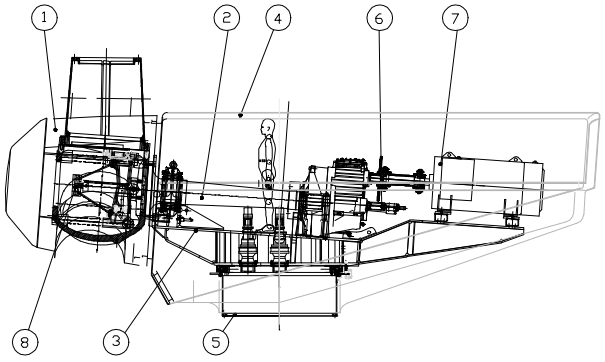




The Power and Energy Curves shown are estimated for a 750kW turbine, with a 54m rotor, double wound generator, and Active Stall Regulation. The power curve is valid for 1.225kg/m3 air density, clean blades and undisturbed horizontal air flow. For the Energy Graph, a Rayleigh wind speed distribution and 100% availability is assumed.

Power Curve Table

m/s	kW
1	0.0
2	0.0
3	4.0
4	30.4
5	72.6
6	126.7
7	211.2
8	324.7
9	455.4
10	598.0
11	720.7
12	750.0
13	750.0
14	750.0
15	750.0
16	750.0
17	750.0
18	750.0
19	750.0
20	750.0



1. Rotor System 2. Transmission 3. Yaw System and Mainframe 4. Nacelle Cover 5. Tower 6. Hydraulic Station (not shown) 7. Generator 8. Pitch system

AERONAUTICA Windpower

11 Resnik Road, Plymouth, MA 02360
1-800-360-0132 www.AeronauticaWind.com

Technical note

NOISE EMISSION FROM NORWIN-47-ASR-600 / 750 kW

Summary:

The noise emission at the reference wind speed 8 m/s, 10 m above ground, expressed as the A-weighted sound level in dB re. 1 pW, ($L_{WA,ref}$), is 100.00 dB. The relation between the noise emission and the wind speed is +0.3 dB pr. m/s.

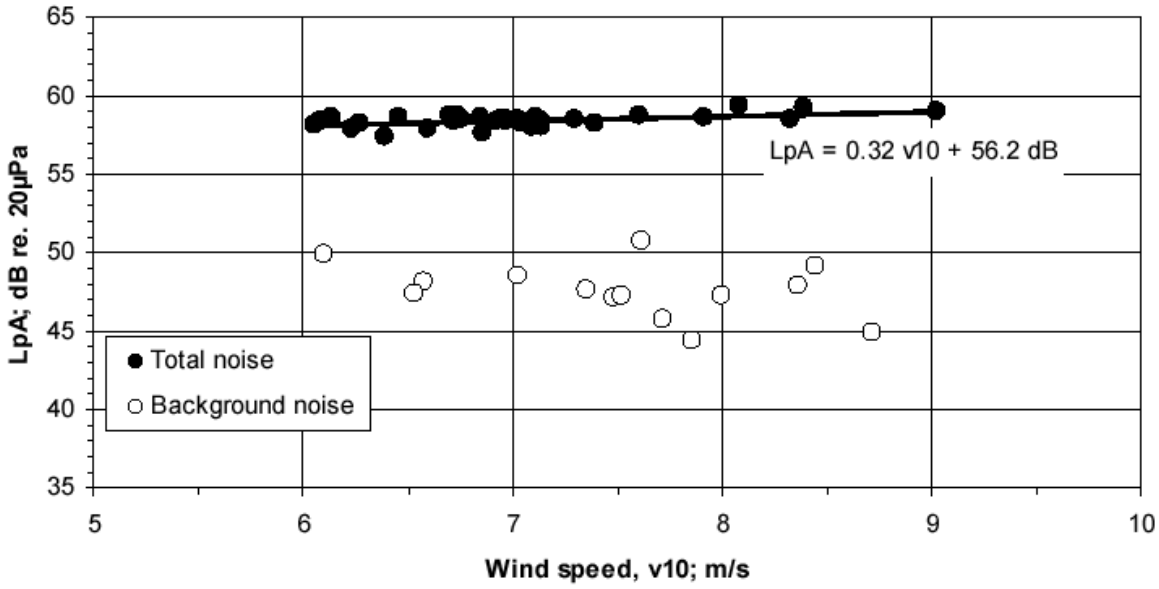
Measuring setup and method:

The noise emission is measured in compliance to the guidelines given in regulation no. 304/1991, *Bekendtgørelse om støj fra vindmøller*, published by the Danish Environmental Agency. The noise is measured with a microphone placed on the ground (acoustically reflecting plate 1.5 x 2.0 m^2), 50 m down-wind from the turbine. The noise is measured with and without the wind turbine operating, to establish the signal to noise relation.

The wind speed is measured with a cup-anemometer placed 10 m above ground, 50 m up-wind from the turbine.

Noise emission curves:

Figure 1.: A-weighted sound pressure level on the ground 50 m down-wind from the turbine.



There are no clearly audible tones present in the noise.

Figure 2.: The A-weighted sound pressure level, Lpa in dB re 20 µPa, 1.5 m above ground, calculated as function of the distance from the wind turbine, according to DEA regulation no. 304/1991

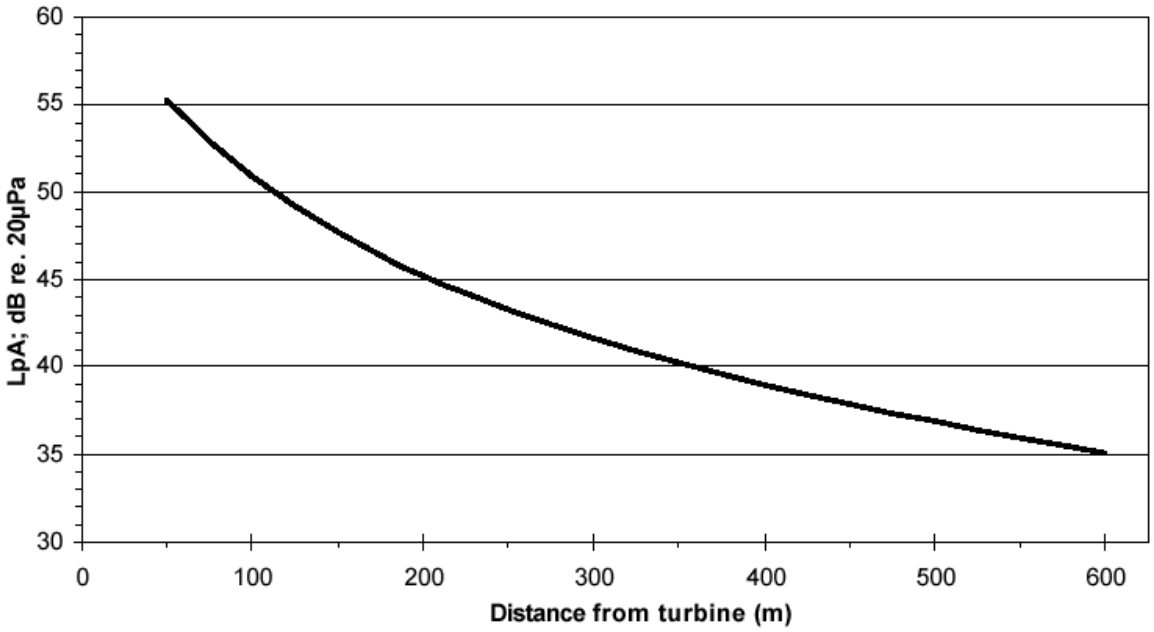


Figure 3.: From calculations the following key values have been extracted:

L_{pA}; dB re 20 µPa	Distance, m
35	607
40	359
45	206

Archbold Turbine Equipment Transportation Plan:

Likely delivery route for turbine: Subject to change with equal or greater weight handling roads being selected. In all cases for turbine components, cranes and other materials, oversized or overweight loads and routes will be permitted through the standard processes of the state/s of travel and utilize transport equipment and procedures suitable to meet or exceed all regulatory requirements for the path of travel and the equipment being transported. (Heaviest expected single turbine component load expected is 62,000 lbs with a max width of 14'.)

Aeronautica Turbine Supply , 11 Resnik Rd, Plymouth, MA 02360

1.	Head **east** on **Resnik Rd** toward **Scobee Cir** About 1 min	go 0.4 mi total 0.4 mi
2.	Continue onto **Christa McAuliffe Blvd**	go 0.1 mi total 0.5 mi
3.	Turn **right** at **Commerce Way** About 2 mins	go 0.6 mi total 1.1 mi
4.	Turn **left** to merge onto **US-44 W** About 17 mins	go 14.0 mi total 15.2 mi
5.	At the traffic circle, continue straight to stay on **US-44 W** About 1 min	go 0.2 mi total 15.4 mi
6.	Merge onto **I-495 N** via the ramp to **MA-24/Marlboro/Boston** About 40 mins	go 43.0 mi total 58.4 mi
7.	Take exit **22** for **I-90** toward **Mass/Pike/Boston/Albany Ny** Toll road About 1 min	go 0.6 mi total 58.9 mi
8.	Keep **left** at the fork, follow signs for **I-90 W/Springfield/Albany** and merge onto **I-90 W** Partial toll road About 29 mins	go 27.7 mi total 86.6 mi
9.	Take exit **9** to merge onto **I-84 W** toward **US-20/Hartford/New York City** Partial toll road Passing through Connecticut, New York Entering Pennsylvania About 3 hours 53 mins	go 231 mi total 318 mi
10.	Take the exit on the **left** onto **I-81 S** toward **Wilkes-Barre** About 34 mins	go 36.3 mi total 354 mi
11.	Take exit **151B** to merge onto **I-80 W** toward **Bloomsburg** Entering Ohio About 4 hours 15 mins	go 277 mi total 631 mi
12.	Take the exit onto **I-80 W** Partial toll road About 2 hours 50 mins	go 184 mi total 814 mi
13.	Take exit **34** for **OH-108** Toll road About 2 mins	go 0.8 mi total 815 mi
14.	Turn **left** at **OH-108 S** About 2 mins	go 1.3 mi total 816 mi
15.	Turn **right** at **US-20 Alt W** About 10 mins	go 8.2 mi total 825 mi
16.	Turn **left** at **OH-66 S** About 8 mins	go 4.0 mi total 829 mi
17.	Turn **right** at **Lafayette St** About 1 min	go 0.4 mi total 829 mi

Turbine Installation Site, Archbold Schools, Lafayette Street, Archbold, Ohio

All other materials and equipment will likely be transported from within the State of Ohio and follow a similar route off of Route 80.

Turbine Use, Safety Policies and General Background

Security:

- Tower Climbing: The wind turbine utilizes a smooth exterior monopole tower with no climbing surfaces or apparatus. Tower climbing is only achieved through the use of an internal ladder system. This system is only reachable through a locked plate steel door.
- Availability: Only preauthorized personnel will be given access to the internal tower and turbine systems.

Tower Climbing Safety:

- Safety Climb: For maintenance personnel climbing of the tower, an OSHA approved "safety climb" system is included in the tower climbing system. This system is comprised of a ladder, a steel cable for the safety climb device, a full body harness designed and approved for the purpose, a locking safety climb device, safety lanyards with self-locking clips and additional tie-in points throughout the turbine system where a cable system is not available.
- OSHA approved safety equipment such as hardhats will be worn by all maintenance personnel climbing or working on the turbine.
- No individual shall climb the tower without a partner.

Electrical Safety:

- All electrical components and their installations shall meet all Local, State and Federal applicable laws and regulations.
- The turbine system shall meet UL1741 and IEC requirements for Utility Grid Protection in case of Grid power failures or power quality abnormalities.
- All electrical supply/grid interconnect services to and from the turbine shall be in buried conduits.
- The turbine system will have a staff accessible emergency shut-offs.
    - Utility room
    - Tower base
    - Nacelle
    - Remote through "Web" interface.

- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration, over-speed, fire and icing.
    - This system will also automatically send fault codes to preauthorized personnel through a "Web" interface.
- All safety sensors and equipment shall fault to a turbine fault state in case of their own failure.

Fire:

- The turbine shall have fire detection devices at the tower base and within the nacelle that shall be linked to the Site's existing fire detection/alarm systems (if present).
- The local fire department shall be contacted and a fire/emergency response plan shall be adopted.
- Although formal fire suppression systems are extremely rare for wind turbines, the site shall investigate passive and active fire suppression systems for possible implementation in the turbine system.
- Local fire department approved fire extinguishers shall be located within the tower base and within the nacelle.
- The turbine system will have staff accessible emergency shut-offs.
    - Utility room
    - Tower base
    - Nacelle
    - Remote through "Web" interface.
- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration, over-speed, fire and icing.
    - This system will also automatically send fault codes to preauthorized personnel through a "Web" interface.
- Safety zones similar to any fire related incident will be utilized, if a fire should occur.

Lightening:

- The turbine system is equipped with a full grounding loop meeting or exceeding all Local, State and Federal regulations concerning grounding and lightening protection.
- Surge suppressing technology will be utilized to protect key electronics.
- See fire policies above.

over-speed, fire and icing (vibration caused by blade icing induced imbalances will automatically shut down the turbine).

- This system will also automatically send fault codes to preauthorized personnel through a "Web" interface.

Aviation Safety:

- The project has been review by both FAA and ODOT and "No Hazard to Aviation" determinations were issued.
- An FAA approved red obstruction marking light will be located on top of the nacelle.

Shadow Flicker:

- Although all structures cast shadows, shadows from wind turbines that reach occupied structures or areas can be considered a nuisance due to the fact that they move or flicker as the blades rotate in front of the Sun.
- A formal shadow flicker study has been conducted for the site based on the turbine's rotor diameter and height, the site latitude and longitude, weather records, existing site topography and the existing area obstructions.
- Per international standards, shadow flicker impacting a particular location above 30 hours per year is considered a potential nuisance. While the turbine's shadow will reach some of the area properties, no residential or business property locations will receive more than 30 hours of shadow per year. Other factors that mitigate the shadows' impact include:
  - Shadow intensity drops off with distance. Shadow edges soften and shadow bodies become more muted. Shadows beyond ten rotor diameters from the tower base are considered insignificant with shadows within five rotor diameters being the most significant.
  - Shadows move and do not remain in one spot for extended periods of time.
  - The longest extended period shadows occur in the winter when there are fewer sunny days.
  - Many local natural and built environmental elements such as trees will block or significantly diffuse shadows.
- If extended adverse shadows should impact a particular dwelling, the wind turbine site owner will take one or more of the following mitigating measures:
  - Plant evergreen trees to block the shadow.
  - Provide blinds for the dwelling.
  - Turn off the turbine during the shadowing periods that excessively affect the dwelling.

Icing:

- Although icing of wind turbines is very rare and safety issues related to icing even rarer, it can occur, similar to any built structure (roofs, power lines, stadium lights, etc.).
- Although not an absolute brake, blade icing induced airfoil shape spoiling will naturally reduce the efficiency of the blades and thus reduce their rotational speed.
- Although formal icing detection systems are extremely rare for wind turbines, the site shall investigate active icing detection systems for possible implementation in the turbine system.
- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration, over-speed, fire and icing (vibration caused by blade icing induced imbalances will automatically shut down the turbine).
    - This system will also automatically send fault codes to preauthorized personnel through a "Web" interface.
- The turbine's nacelle will have a cold-weather package including nacelle heaters. These heaters are designed to maintain nacelle temperatures above the dew-point and well above freezing. This system will automatically melt snow and ice accumulation on top of the nacelle.
- The turbine system will have a staff accessible emergency shut-offs.
    - Utility room
    - Tower base
    - Nacelle
    - Remote through "Web" interface.
- All icing related turbine shut-downs will require a direct inspection and an on-site manual restart.
- The site personnel and the system maintenance personnel will shut down the turbine in the event of an icing condition.
- The site shall adopt an ice safety zone around the turbine for implementation during icing events, if they should occur.

High Wind:

- The turbine automatically shuts down in high winds and turns itself out of the wind.
- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration,

Sound:

- Wind turbines of the size to be installed are inherently quite devices, especially over distance, and are typically very hard to hear over the wind itself and the existing ambient area noise levels.
    - Sound from a single wind turbines typically comes from the following areas:
        - Wind noise off of the blades as they are driven by the wind (swooshing that drops off over distance and typically competes with the area's natural wind noise).
        - Drive-train noise (mechanical sound typically not heard outside the immediate vicinity of the turbine).
        - Yaw system noise (mechanical sound typically not heard outside the immediate vicinity of the turbine and that is only present when the turbine turns into the wind).
        - Electrical noise from the turbine's electrical equipment and transformer (buzz, typically not heard outside the immediate vicinity of the turbine).
- Sound modeling for the proposed wind turbine supports that turbine produced audio levels will not exceed any local code or ordinance at the site's property lines. To be conservative, this modeling was done at an 8 mps/17.9 mph wind speed, well above site averages.
- Sound measurement of existing ambient sound levels for both day and evening periods at multiple locations surrounding the site show existing ambient sound levels above what the wind turbine will produce.

Wind Resource Report, Site Wind Characteristics

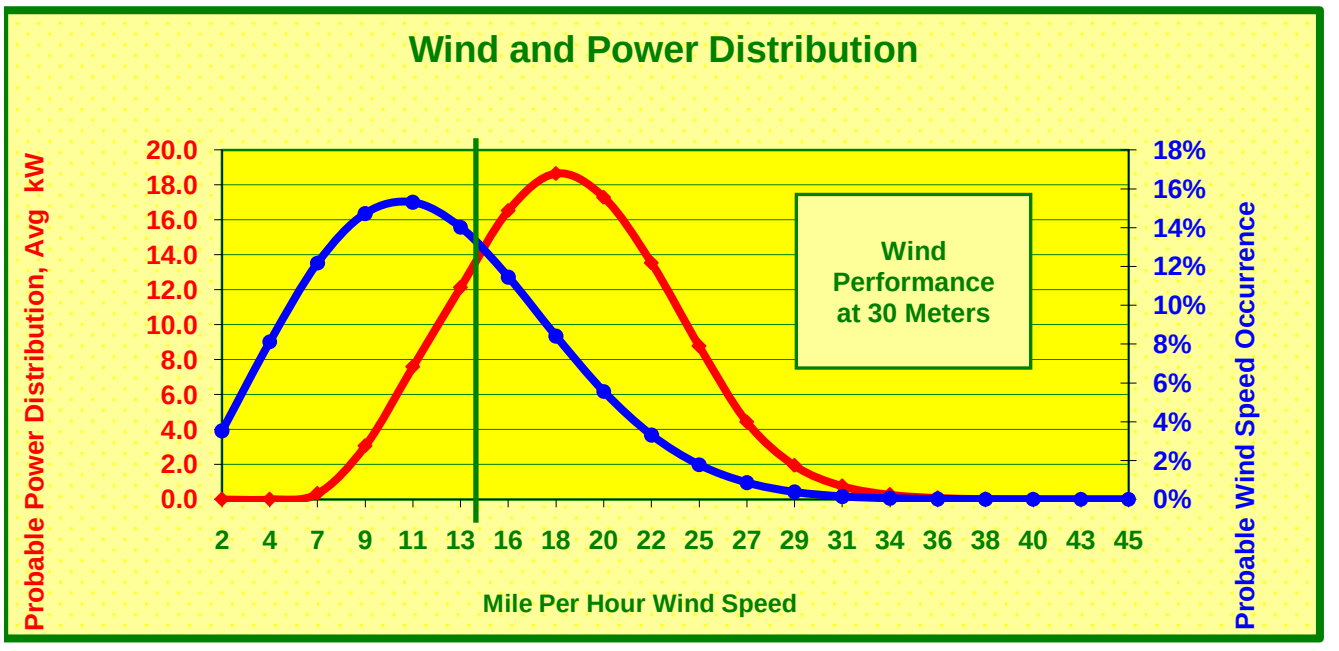
Archbold High School Site

Turbine Model Used For Estimates: Aeronautica / Norwin 54-750
Meter Description: High School 1

Weibull Performance Calculations:

Yearly Average Wind Speed		Turbine Power Curve For Given Average Wind Speeds (kW)	Site Weather Constants	Wind Probability (f)	Average Net kW @ V	Area Wind Dist.:	Area Power Dist.:
Bin (m/s)	(mph)						
1	2.24	*0.0*	0.00	3.53%	0.000		
2	4.47	*0.0*	0.00	8.12%	0.000		
3	6.71	*4.0*	2.74	12.17%	0.333		
4	8.95	*30.4*	20.79	14.73%	3.061	79.3%	37.6%
5	11.18	*72.6*	49.64	15.30%	7.596		
6	13.42	*126.7*	86.64	14.01%	12.141		
7	15.66	*211.2*	144.42	11.45%	16.541		
8	17.90	*324.7*	222.03	8.41%	18.663		
9	20.13	*455.4*	311.41	5.56%	17.302		
10	22.37	*598.0*	408.92	3.31%	13.546	20.3%	61.3%
11	24.61	*720.7*	492.82	1.78%	8.782		
12	26.84	*750.0*	512.85	0.86%	4.434		
13	29.08	*750.0*	512.85	0.38%	1.940		
14	31.32	*750.0*	512.85	0.15%	0.764		
15	33.55	*750.0*	512.85	0.05%	0.271		
16	35.79	*750.0*	512.85	0.02%	0.086		
17	38.03	*750.0*	512.85	0.00%	0.025	0.2%	1.1%
18	40.26	*750.0*	512.85	0.00%	0.006		
19	42.50	*750.0*	512.85	0.00%	0.001		
20	44.74	*750.0*	512.85	0.00%	0.000		
			Totals:	99.84%	105.493	99.8%	100.0%

12.24	Site Average Wind Speed (MPH) at 30 Meters



Wind Resource Report, Site Wind Characteristics

Archbold High School Site

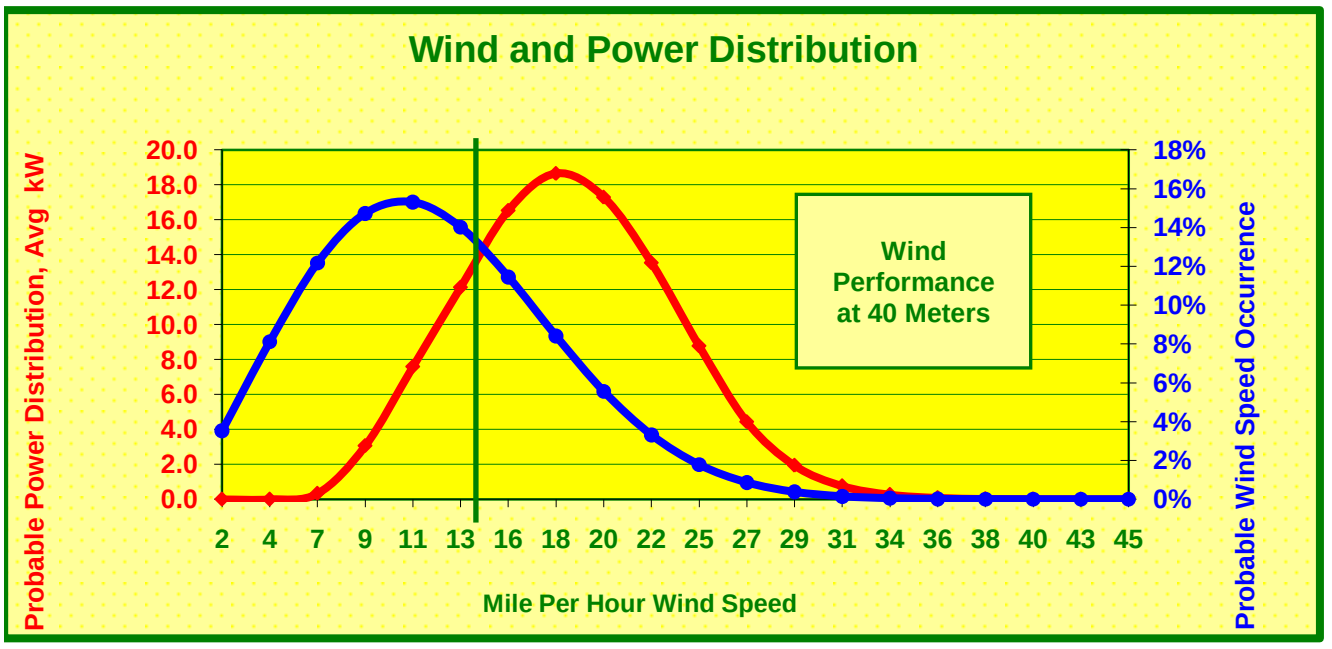
Turbine Model Used For Estimates: Aeronautica / Norwin 54-750

Meter Description: High School 1

Weibull Performance Calculations:

Yearly Average Wind Speed		Turbine Power Curve For Given Average Wind Speeds (kW)	Site Weather Constants	Wind Probability (f)	Average Net kW @ V	Area Wind Dist.:	Area Power Dist.:
Bin (m/s)	(mph)						
1	2.24	*0.0*	0.00	2.89%	0.000		
2	4.47	*0.0*	0.00	6.71%	0.000		
3	6.71	*4.0*	2.83	10.29%	0.291		
4	8.95	*30.4*	21.51	12.86%	2.767	72.3%	29.4%
5	11.18	*72.6*	51.37	14.00%	7.190		
6	13.42	*126.7*	89.65	13.61%	12.199		
7	15.66	*211.2*	149.44	11.98%	17.896		
8	17.90	*324.7*	229.75	9.61%	22.072		
9	20.13	*455.4*	322.22	7.05%	22.719		
10	22.37	*598.0*	423.12	4.74%	20.069	26.8%	67.9%
11	24.61	*720.7*	509.94	2.93%	14.926		
12	26.84	*750.0*	530.67	1.66%	8.796		
13	29.08	*750.0*	530.67	0.86%	4.569		
14	31.32	*750.0*	530.67	0.41%	2.177		
15	33.55	*750.0*	530.67	0.18%	0.950		
16	35.79	*750.0*	530.67	0.07%	0.380		
17	38.03	*750.0*	530.67	0.03%	0.139	0.7%	2.7%
18	40.26	*750.0*	530.67	0.01%	0.046		
19	42.50	*750.0*	530.67	0.00%	0.014		
20	44.74	*750.0*	530.67	0.00%	0.004		
			Totals	99.87%	137.203	99.9%	100.0%

13.38	Site Average Wind Speed (MPH) at 40 Meters



Wind Resource Report, Site Wind Characteristics

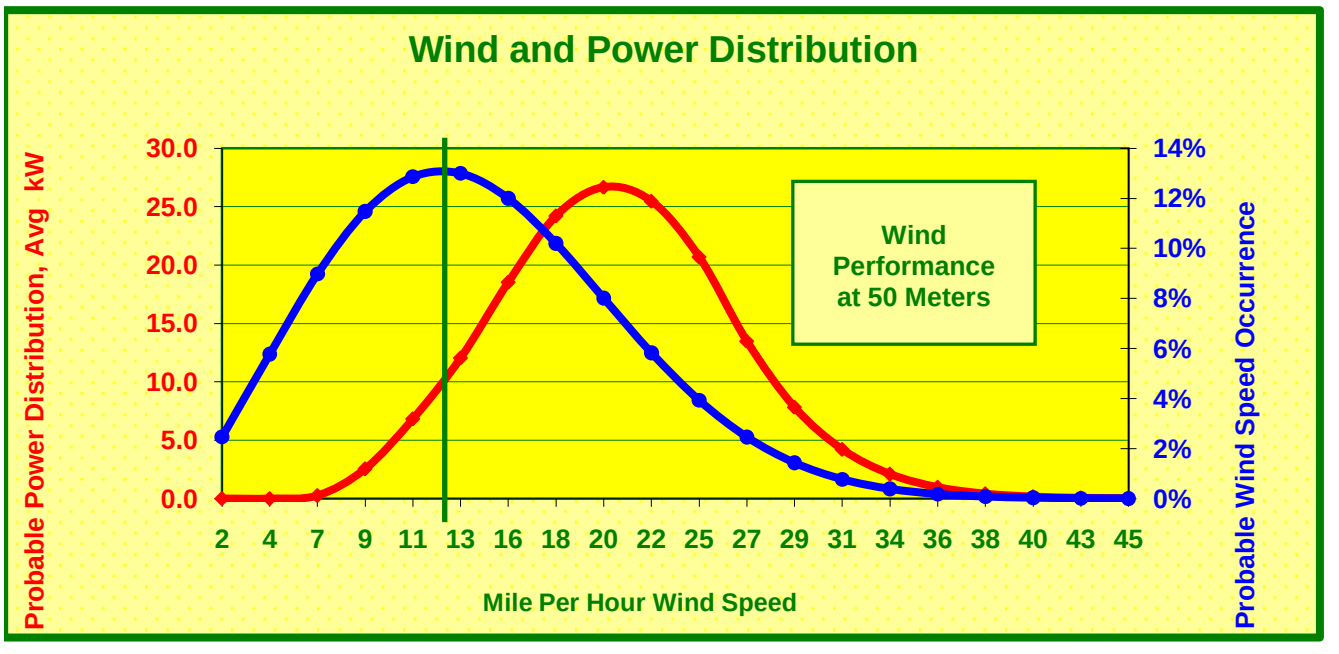
Archbold High School Site

Turbine Model Used For Estimates: Aeronautica / Norwin 54-750
Meter Description: High School 1

Weibull Performance Calculations:

Yearly Average Wind Speed		Turbine Power Curve For Given Average Wind Speeds (kW)	Site Weather Constants	Wind Probability (f)	Average Net kW @ V	Area Wind Dist.:	Area Power Dist.:
Bin (m/s)	(mph)						
1	2.24	*0*	0.00	2.47%	0.000		
2	4.47	*0*	0.00	5.78%	0.000		
3	6.71	*4*	2.93	8.98%	0.263		
4	8.95	*30.4*	22.23	11.48%	2.552	66.6%	24.2%
5	11.18	*72.6*	53.09	12.87%	6.832		
6	13.42	*126.7*	92.65	13.00%	12.047		
7	15.66	*211.2*	154.44	12.00%	18.541		
8	17.90	*324.7*	237.44	10.20%	24.221		
9	20.13	*455.4*	333.02	8.01%	26.676		
10	22.37	*598*	437.30	5.83%	25.477	31.9%	71.1%
11	24.61	*720.7*	527.03	3.93%	20.708		
12	26.84	*750*	548.45	2.46%	13.484		
13	29.08	*750*	548.45	1.43%	7.828		
14	31.32	*750*	548.45	0.77%	4.216		
15	33.55	*750*	548.45	0.38%	2.105		
16	35.79	*750*	548.45	0.18%	0.974		
17	38.03	*750*	548.45	0.08%	0.418	1.5%	4.8%
18	40.26	*750*	548.45	0.03%	0.166		
19	42.50	*750*	548.45	0.01%	0.061		
20	44.74	*750*	548.45	0.00%	0.021		
			Totals	99.89%	166.589	99.9%	100.0%

14.34	Site Average Wind Speed (MPH) at 50 Meters



Wind Resource Report, Site Wind Characteristics

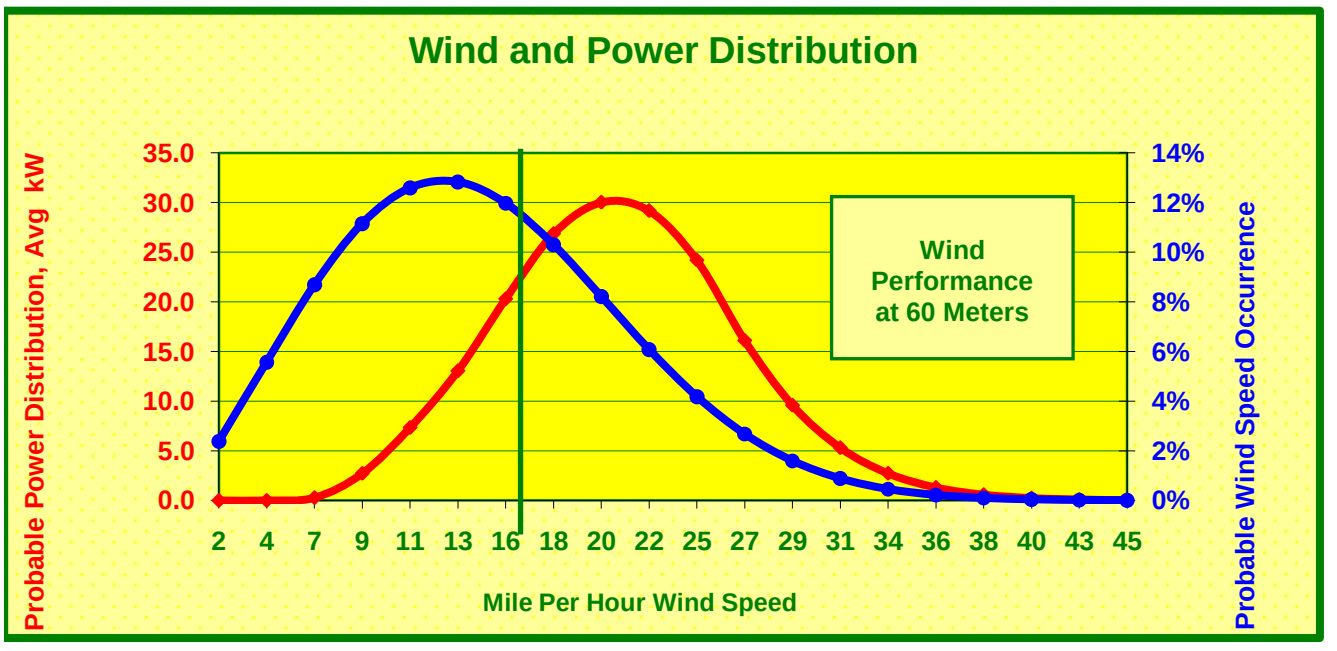
Archbold High School Site

Turbine Model Used For Estimates: Aeronautica / Norwin 54-750
Meter Description: High School 1

Weibull Performance Calculations:

Yearly Average Wind Speed		Turbine Power Curve For Given Average Wind Speeds (kW)	Site Weather Constants	Wind Probability (f)	Average Net kW @ V	Area Wind Dist.:	Area Power Dist.:
Bin (m/s)	(mph)						
1	2.24	*0.00*	0.00	2.42%	0.000		
2	4.47	*0.00*	0.00	5.66%	0.000		
3	6.71	*4.00*	3.02	8.82%	0.266		
4	8.95	*30.40*	22.95	11.30%	2.594	65.8%	23.5%
5	11.18	*72.60*	54.81	12.71%	6.968		
6	13.42	*126.70*	95.65	12.91%	12.346		
7	15.66	*211.20*	159.44	11.99%	19.111		
8	17.90	*324.70*	245.13	10.26%	25.142		
9	20.13	*455.40*	343.80	8.12%	27.918		
10	22.37	*598.00*	451.45	5.96%	26.918	32.5%	71.4%
11	24.61	*720.70*	544.08	4.06%	22.116		
12	26.84	*750.00*	566.20	2.57%	14.577		
13	29.08	*750.00*	566.20	1.51%	8.578		
14	31.32	*750.00*	566.20	0.83%	4.689		
15	33.55	*750.00*	566.20	0.42%	2.380		
16	35.79	*750.00*	566.20	0.20%	1.121		
17	38.03	*750.00*	566.20	0.09%	0.490	1.6%	5.1%
18	40.26	*750.00*	566.20	0.04%	0.199		
19	42.50	*750.00*	566.20	0.01%	0.074		
20	44.74	*750.00*	566.20	0.00%	0.026		
			Totals:	99.89%	175.514	99.9%	100.0%

14.47	Site Average Wind Speed (MPH) at 60 Meters



Wind Resource Report, Site Wind Characteristics

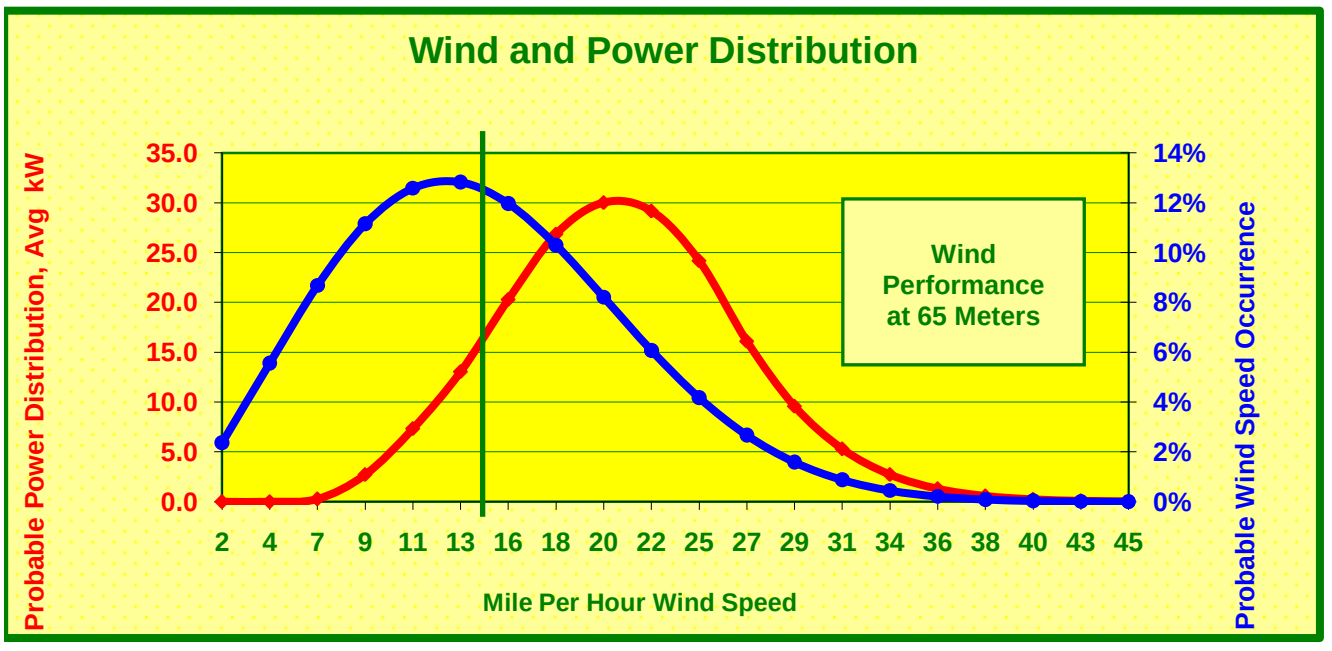
Archbold High School Site

Turbine Model Used For Estimates: Aeronautica / Norwin 54-750
Meter Description: High School 1

Weibull Performance Calculations:

Yearly Average Wind Speed		Turbine Power Curve For Given Average Wind Speeds (kW)	Site Weather Constants	Wind Probability (f)	Average Net kW @ V	Area Wind Dist.:	Area Power Dist.:
Bin (m/s)	(mph)						
1	2.24	*0*	0.00	2.39%	0.000	65.5%	23.3%
2	4.47	*0*	0.00	5.61%	0.000		
3	6.71	*4*	3.12	8.75%	0.273		
4	8.95	*30.4*	23.68	11.22%	2.658		
5	11.18	*72.6*	56.55	12.65%	7.151		
6	13.42	*126.7*	98.69	12.86%	12.696		
7	15.66	*211.2*	164.51	11.98%	19.702		
8	17.90	*324.7*	252.92	10.28%	25.998	32.8%	71.5%
9	20.13	*455.4*	354.72	8.17%	28.972		
10	22.37	*598*	465.80	6.02%	28.048		
11	24.61	*720.7*	561.37	4.12%	23.153		
12	26.84	*750*	584.19	2.63%	15.341		
13	29.08	*750*	584.19	1.55%	9.080		
14	31.32	*750*	584.19	0.86%	4.996	1.6%	5.3%
15	33.55	*750*	584.19	0.44%	2.554		
16	35.79	*750*	584.19	0.21%	1.213		
17	38.03	*750*	584.19	0.09%	0.534		
18	40.26	*750*	584.19	0.04%	0.218		
19	42.50	*750*	584.19	0.01%	0.083		
20	44.74	*750*	584.19	0.00%	0.029		
			Totals	99.89%	182.700	99.9%	100.0%

14.53 Site Average Wind Speed (MPH) at 65 Meters



Wind Resource Report, Site Wind Characteristics

Archbold High School Site

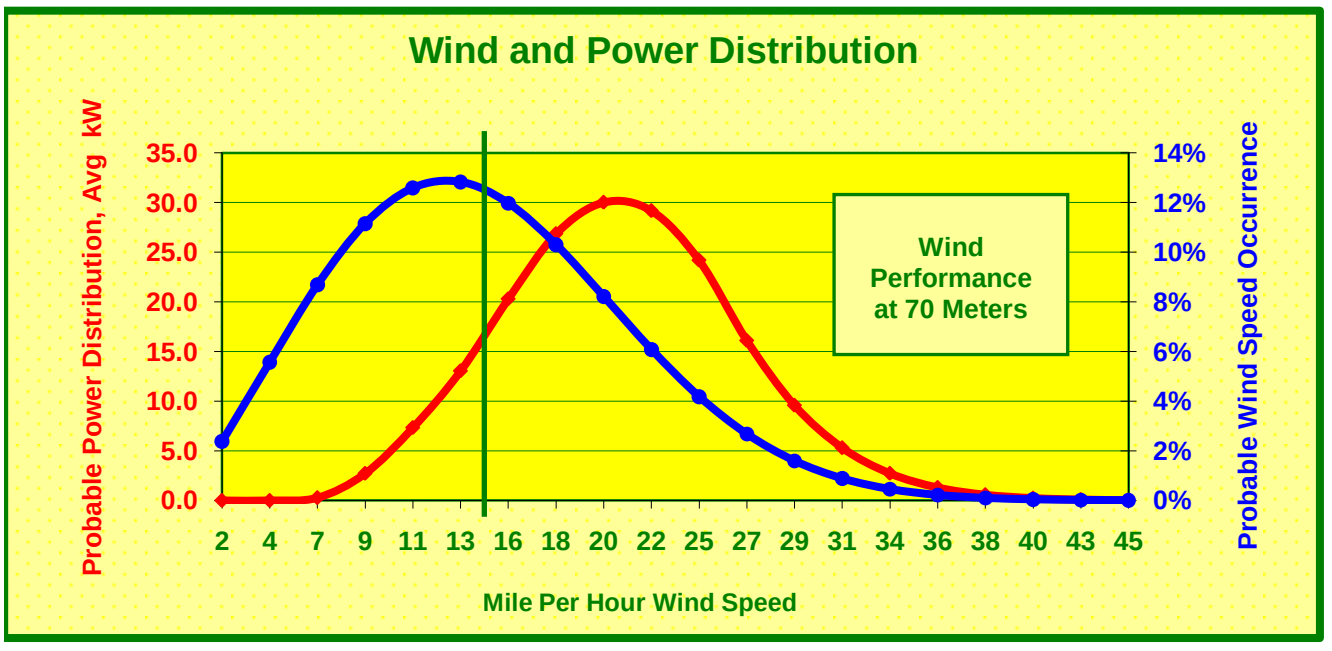
Ohio Wind Model Data Based

Turbine Model Used For Estimates: Aeronautica / Norwin 54-750
Meter Description: High School 1

Weibull Performance Calculations:

Yearly Average Wind Speed		Turbine Power Curve For Given Average Wind Speeds (kW)	Site Weather Constants	Wind Probability (f)	Average Net kW @ V	Area Wind Dist.:	Area Power Dist.:
Bin (m/s)	(mph)						
1	2.24	*0*	0.00	2.37%	0.000	65.2%	23.0%
2	4.47	*0*	0.00	5.57%	0.000		
3	6.71	*4*	3.21	8.68%	0.279		
4	8.95	*30.4*	24.41	11.15%	2.722		
5	11.18	*72.6*	58.29	12.58%	7.335		
6	13.42	*126.7*	101.73	12.82%	13.046		
7	15.66	*211.2*	169.57	11.97%	20.292		
8	17.90	*324.7*	260.70	10.30%	26.851	33.0%	71.6%
9	20.13	*455.4*	365.63	8.21%	30.020		
10	22.37	*598*	480.13	6.08%	29.172		
11	24.61	*720.7*	578.64	4.18%	24.184		
12	26.84	*750*	602.16	2.67%	16.101		
13	29.08	*750*	602.16	1.59%	9.581		
14	31.32	*750*	602.16	0.88%	5.303	1.7%	5.4%
15	33.55	*750*	602.16	0.45%	2.729		
16	35.79	*750*	602.16	0.22%	1.305		
17	38.03	*750*	602.16	0.10%	0.579		
18	40.26	*750*	602.16	0.04%	0.239		
19	42.50	*750*	602.16	0.02%	0.091		
20	44.74	*750*	602.16	0.01%	0.032		
			Totals	99.89%	189.861	99.9%	100.0%

14.58 Site Average Wind Speed (MPH) at 70 Meters



Wind Resource Report, Site Wind Characteristics

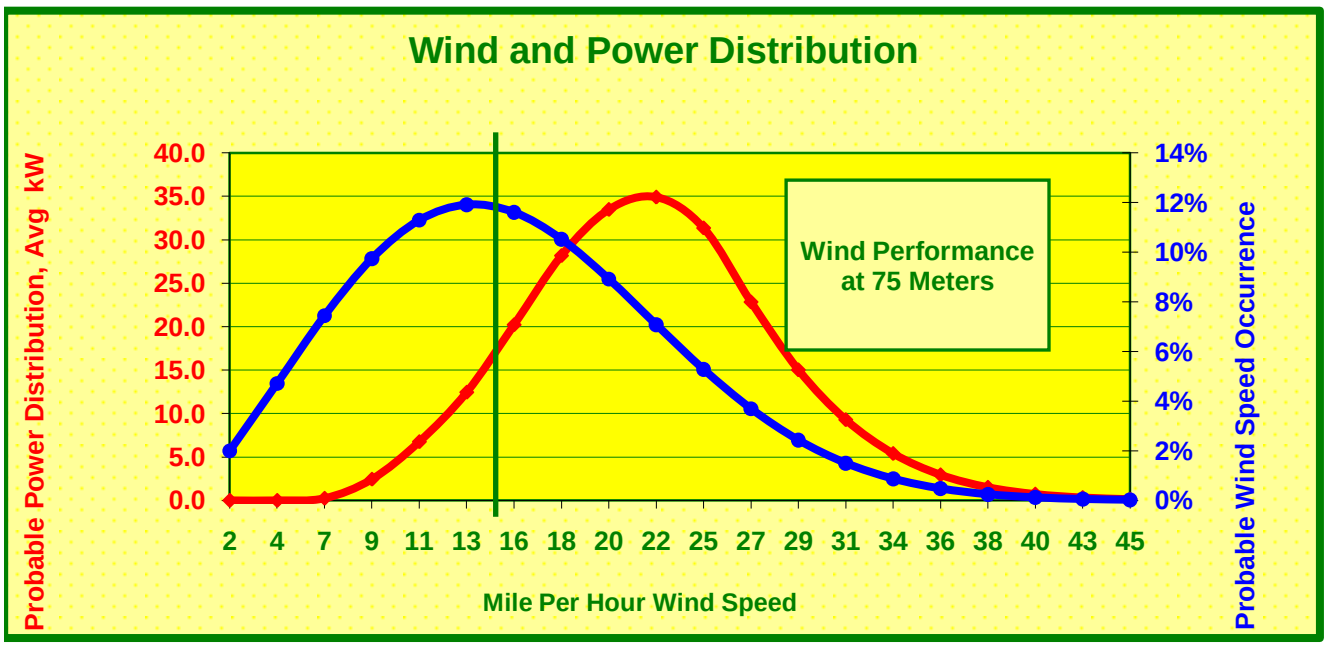
Archbold High School Site

Turbine Model Used For Estimates: Aeronautica / Norwin 54-750
Meter Description: High School 1

Weibull Performance Calculations:

Yearly Average Wind Speed		Turbine Power Curve For Given Average Wind Speeds (kW)	Site Weather Constants	Wind Probability (f)	Average Net kW @ V	Area Wind Dist.:	Area Power Dist.:
Bin (m/s)	(mph)						
1	2.24	*0.0*	0.00	2.30%	0.000	63.9%	22.0%
2	4.47	*0.0*	0.00	5.39%	0.000		
3	6.71	*4.0*	3.46	8.43%	0.292		
4	8.95	*30.4*	26.32	10.87%	2.861		
5	11.18	*72.6*	62.85	12.33%	7.752		
6	13.42	*126.7*	109.69	12.66%	13.888		
7	15.66	*211.2*	182.84	11.92%	21.796		
8	17.90	*324.7*	281.10	10.37%	29.153	34.0%	71.9%
9	20.13	*455.4*	394.26	8.37%	33.008		
10	22.37	*598.0*	517.71	6.29%	32.548		
11	24.61	*720.7*	623.93	4.40%	27.434		
12	26.84	*750.0*	649.30	2.87%	18.609		
13	29.08	*750.0*	649.30	1.74%	11.307		
14	31.32	*750.0*	649.30	0.99%	6.403	2.0%	6.0%
15	33.55	*750.0*	649.30	0.52%	3.379		
16	35.79	*750.0*	649.30	0.26%	1.660		
17	38.03	*750.0*	649.30	0.12%	0.760		
18	40.26	*750.0*	649.30	0.05%	0.323		
19	42.50	*750.0*	649.30	0.02%	0.128		
20	44.74	*750.0*	649.30	0.01%	0.047		
			Totals	99.89%	211.346	99.9%	100.0%

14.80 Site Average Wind Speed (MPH) at 75 Meters



Wind Resource Report, Site Wind Characteristics

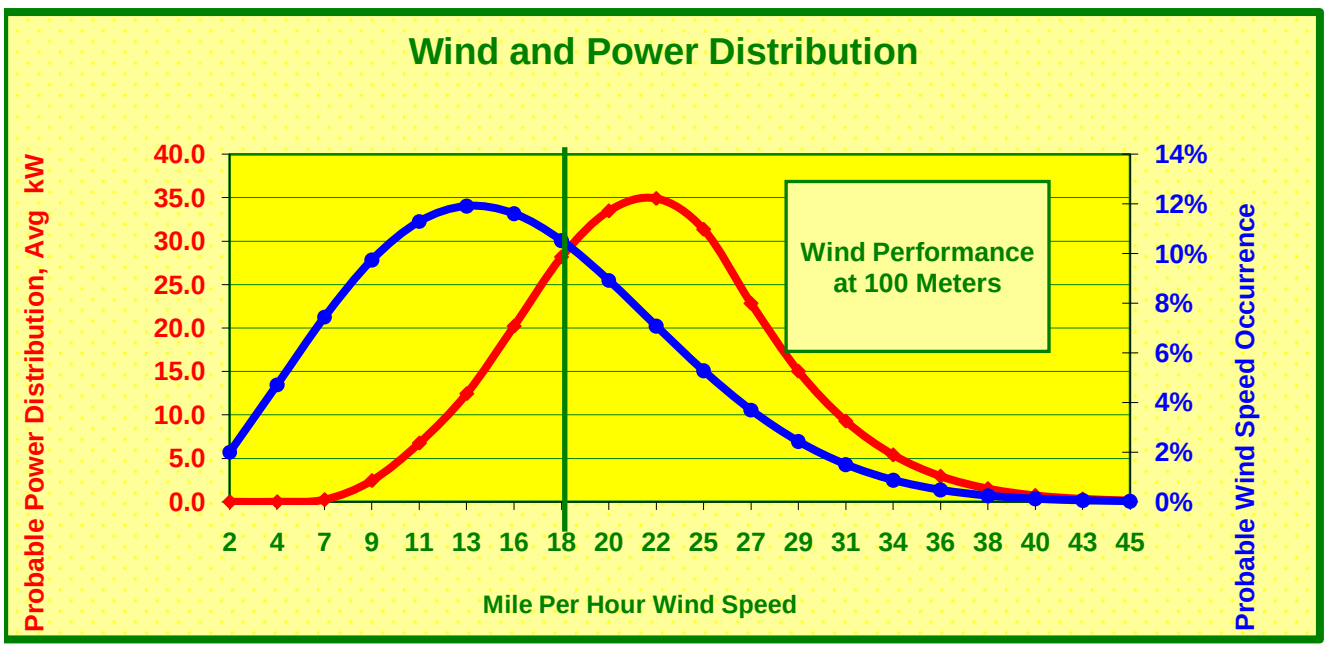
Archbold High School Site

Turbine Model Used For Estimates: Aeronautica / Norwin 54-750
Meter Description: High School 1

Weibull Performance Calculations:

Yearly Average Wind Speed		Turbine Power Curve For Given Average Wind Speeds (kW)	Site Weather Constants	Wind Probability (f)	Average Net kW @ V	Area Wind Dist.:	Area Power Dist.:
Bin (m/s)	(mph)						
1	2.24	*0*	0.00	1.99%	0.000		
2	4.47	*0*	0.00	4.71%	0.000		
3	6.71	*4*	3.30	7.44%	0.245		
4	8.95	*30.4*	25.08	9.74%	2.442	58.7%	18.5%
5	11.18	*72.6*	59.89	11.29%	6.761		
6	13.42	*126.7*	104.51	11.91%	12.451		
7	15.66	*211.2*	174.21	11.61%	20.222		
8	17.90	*324.7*	267.84	10.52%	28.183		
9	20.13	*455.4*	375.65	8.92%	33.490		
10	22.37	*598*	493.27	7.08%	34.917	37.9%	72.6%
11	24.61	*720.7*	594.49	5.28%	31.360		
12	26.84	*750*	618.66	3.69%	22.845		
13	29.08	*750*	618.66	2.43%	15.028		
14	31.32	*750*	618.66	1.50%	9.291		
15	33.55	*750*	618.66	0.87%	5.397		
16	35.79	*750*	618.66	0.48%	2.946		
17	38.03	*750*	618.66	0.24%	1.510	3.3%	8.9%
18	40.26	*750*	618.66	0.12%	0.726		
19	42.50	*750*	618.66	0.05%	0.328		
20	44.74	*750*	618.66	0.02%	0.139		
			Totals	99.90%	228.281	99.9%	100.0%

15.75	Site Average Wind Speed (MPH) at 100 Meters



SOIL EXPLORATION,
PROPOSED WIND TURBINE,
ARCHBOLD SCHOOLS,
600 LAFAYETTE STREET,
ARCHBOLD, FULTON COUNTY, OHIO

The Renaissance Group
c/o Buehrer Group Architecture & Engineering, Inc.
Attention: Sam Muhsen, P.E., SECB, LEED AP
314 Conant Street
Maumee, Ohio 43537-3358

Report No. 152731-1110-2635

November 30, 2010

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Geotechnical Laboratory Report

Report To:	The Renaissance Group	**Date:**	November 30, 2010
c/o:	Buehrer Group Architecture & Engineering, Inc.	**Laboratory Job No.:**	152731
Attention:	Sam Muhsen, P.E., SECB, LEED AP 314 Conant Street Maumee, Ohio 43537-3358	**Report No.:**	152731-1110-2635
		Report Consists of 22 Pages	

Report On: SOIL EXPLORATION,
Proposed Wind Turbine, Archbold Schools, 600 Lafayette Street,
Archbold, Fulton County, Ohio

Ladies and Gentlemen:

Bowser-Morner, Inc. has completed the authorized subsurface exploration and geotechnical engineering evaluation at the above referenced project. The following report briefly reviews our exploration procedures, describes existing site and subsurface conditions, and presents our evaluations, conclusions, and recommendations.

1.0 AUTHORIZATION

The purpose of this subsurface exploration and geotechnical engineering evaluation was to determine the subsurface conditions at the project site and to analyze these conditions as they relate to foundation design and construction. All work was performed in accordance with Bowser-Morner technical proposal No. T-19886, dated October 26, 2010, and its attached *Proposal Acceptance Sheet* between The Renaissance Group and Bowser-Morner, Inc., dated November 3, 2010. The scope of the exploration included subsurface drilling and sampling, limited laboratory testing, engineering evaluation of the field and laboratory data, and the preparation of this report.

2.0 WORK PERFORMED

2.1 Field Exploration

During this exploration, two soil test borings were drilled at the approximate locations shown on the attached *Boring Location Plan*. The borings were drilled to a depth of 40 feet. Boring locations were established in the field by Bowser-Morner by measuring

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distances and estimating right angles from existing site features. Boring elevations were not obtained. Since these measurements are not precise, the locations shown on the *Boring Location Plan* should be considered approximate.

All soil sampling and standard penetration testing was conducted in general accordance with ASTM D 1586. The borings were advanced by a truck-mounted drilling rig by mechanically twisting hollow-stem augers into the soil. At regular intervals, soil samples were obtained with a standard 2-inch O. D. split spoon sampler driven 18 inches into the soil with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and designated the "standard penetration resistance." The standard penetration resistance, or "N" value, when properly evaluated, is an index of the soil's strength, density, and ability to support foundations. The disturbed samples recovered by the split spoon sampler were visually classified in the field, logged, sealed in glass jars, and returned to the laboratory for testing and evaluation by a geotechnical engineer.

In Boring 2, the split spoon samplers were fitted with liners to obtain samples of the subsurface soils for laboratory unconfined compressive strength testing. Although the liner samples are disturbed due to pounding from the standard penetration test and the thick sidewalls of the split spoon sampler and liner, they are protected from swelling and other post-sampling disturbances and, therefore, are less disturbed than conventional split spoon samples. The unconfined compressive strength test results obtained from liner samples, while approximate, do provide the geotechnical engineer with a means to evaluate relative soil strengths.

Boring Logs indicating soil descriptions, penetration resistances, and observed ground-water levels are attached.

2.2 Previous Soil Explorations

Bowser-Morner previously performed a soil exploration for the proposed football field bleachers in April 2006. During this study, Bowser-Morner reviewed relevant soil boring and laboratory data from the previous geotechnical study to assist in the evaluation of this project.

2.3 Laboratory Testing

In the laboratory, each of the samples recovered from the borings was examined and visually classified by a geotechnical engineer. In addition, samples of cohesive soils from the split spoon samplers were tested to determine the soil's approximate strength using a hand-held, calibrated spring penetrometer. These values were used by the geotechnical engineer to assist in the evaluation of the relative strengths of the subsurface soils and to aid in classification of the samples.

Nine unconfined compressive strength tests were performed on the disturbed samples recovered by the liner samplers. These tests were performed on a constant rate of strain apparatus with a deformation rate adjusted to cause failure of the sample in less than 10 minutes. Note that care should be utilized in applying these test values due to the method of sampling. The results of these tests have been summarized and tabulated below.

Boring and Sample No.	Sample Depth (ft)	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (psf)	Strain at Failure (%)
2 - 2	3.5 - 5.0	23.6	103.8	7,025	7.5
2 - 3	6.0 - 7.5	22.3	105.8	2,617	7.1
2 - 4	8.5 - 10.0	18.8	120.5	4,546	20.0
2 - 5	13.5 - 15.0	21.9	105.8	4,417	20.0
2 - 6	18.5 - 20.0	23.0	101.8	2,460	18.2
2 - 7	23.5 - 25.0	30.1	97.5	4,742	14.8
2 - 8	28.5 - 30.0	29.6	95.8	3,502	15.1
2 - 9	33.5 - 35.0	22.6	115.3	4,072	20.0
2 - 10	38.5 - 40.0	16.5	119.0	5,457	20.0

Soil samples are normally retained in our laboratory for a period of 60 days before they are discarded. To view the samples or arrange for longer storage of samples, please contact us.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Description

The proposed site is located adjacent to and southwest of the existing football field at Archbold High School in Archbold, Fulton County, Ohio.

3.2 Soil Profile

Data from the soil test borings are shown on the attached *Boring Logs*. The subsurface conditions discussed in the following paragraphs and those shown on the *Boring Logs* represent an estimate of the subsurface conditions based on interpretation of the boring data using normally accepted geotechnical engineering judgments. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times.

Geologically, the project site is situated in a glacial ground moraine that consists of till containing an unsorted, unstratified mixture of clay, silt, sand and coarser fragments deposited discontinuously by advancing ice. Overlying the glacial till is a layer of laminated silts and clays of lacustrine origin.

Topsoil covers the ground surface at both boring locations and was recorded by the drillers as 5 to 8 inches in thickness. Below the topsoil are fill materials. The fill materials consist predominantly of brown and dark brown silt with varying amounts of clay, sand and gravel. The fill materials extended to depths between 2 and 2.5 feet. Underlying the fill are lacustrine soil materials generally described as medium stiff to stiff brown and gray silt and clay or clay and silt. At Boring 1, the soil at 2.5 feet deep is sandy and at 6 feet is saturated silt. The lacustrine soil extended to depths between 32 and 33.5 feet, where glacial till was encountered. The glacial till was described as gray clay and silt with some sand and a trace of gravel. The glacial till extended to the bottom of both borings.

The estimated undrained shear strength of the lacustrine soil in the top 15 feet of the soil profile is in the range of 2,000 to 3,500 pounds per square foot (psf). Below 15 feet, the undrained shear strength is in the range of 1,200 to 2,300 psf. The glacial till has undrained shear strength on the order of 2,000 to 2,500 psf.

3.3 Groundwater Observations

During the field exploration, the drilling rods and sampling equipment were continuously checked by the drillers for indications of groundwater or seepage. The *Boring Logs* list our driller's observations of groundwater or seepage. Three readings are recorded on the logs. The initial groundwater level indicates the depth(s) at which groundwater or seepage was initially noted by the drillers as the boring was being advanced and the intensity of the seepage. The completion groundwater level represents the depth groundwater was observed in the borehole immediately after the completion of the hole. The last reading on the *Boring Logs* represents the depth groundwater was observed in the borehole after an increment of time has passed. In this case, both the depth and time are listed.

Groundwater was encountered in both boring locations at depths between 5.5 and 6 feet.

Groundwater levels fluctuate with seasonal and climatic variations and may be different at other times. More specific information regarding groundwater levels, standard penetration resistances, and soil descriptions is detailed on the attached *Boring Logs*.

4.0 PROPOSED CONSTRUCTION

It is our understanding that the proposed construction is to consist of a new wind turbine. The turbine will be 197 feet tall to the hub. We understand that the vertical load for the tower will be about 115 kips with a lateral load of about 50 kips and an overturning moment of about 5,000 kip-ft. The proposed foundation is a reinforced concrete mat that is octagonal and has a nominal width of 40 feet. If these assumptions are not appropriate for the intended construction, please contact us so we can re-evaluate our recommendations.

5.0 EVALUATIONS AND CONCLUSIONS

The following evaluations and conclusions are based on our interpretation of the field and laboratory data obtained during the exploration and our experience with similar subsurface conditions. Soil penetration data and laboratory data have been used to estimate allowable bearing pressures using commonly accepted geotechnical engineering practices. Subsurface conditions in uninvestigated locations between borings may vary considerably from those encountered in the borings. If structure location, loadings, or levels are changed, we request we be advised so we may re-evaluate our recommendations.

5.1 Foundations

The proposed wind turbine may be supported on either a mat foundation bearing in the glacial soils or on deep foundations. Mat foundations bearing on the original undisturbed glacial silty clay soil may be designed for a net allowable soil bearing capacity of 4,000 pounds per square foot (psf) at frost depth (3.5 feet) or below.

Deep foundations may also be used. Drilled piers are typically selected for this application. Drilled piers may be designed for a combination of skin resistance and end-bearing. The following typical soil profile can be used to estimate drilled pier capacities.

Design Soil Profile
(Ultimates – Use F. S. = 3.0 for Design)

Approx. Depth (ft)	Typical Soil Deposit	Ultimate Skin Resistance {Compression} (psf)	Ultimate End Bearing (psf)
0.0 – 2.5	Fill	---	---
2.5 – 15.0	Stiff Lacustrine Silt and Clay	1,300	20,000
15.0 – 33.5	Medium Stiff Lacustrine	1,000	15,000
33.5 – 40.0	Glacial Till	1,300	20,000

The values given in the above tables are ultimates and should be divided by a suitable factor-of-safety to achieve the design working capacities of the piles. A factor-of-safety of 3.0 is recommended for this application. Skin friction values are reduced for drilled piers for uplift conditions. For uplift capacity, the above skin friction values should be multiplied by 0.7.

Settlement under static load conditions for either a mat foundation or a drilled pier should be small and likely will be less than 0.5 inches for an octagonal mat foundation that is placed at a depth of 5 feet and has a nominal width of 40 feet.

5.2 Foundation Construction and Evaluation

5.2.1 Spread Footings

Bottoms of foundation excavations should be evaluated by a geotechnical engineer prior to the placement of reinforcing steel and concrete to verify adequate bearing materials are present and all debris, mud, and loose, frozen, or water-softened soils are removed.

Foundation excavations should be concreted as soon as practical after they are excavated. Water should not be allowed to pond in any excavation. If an excavation is left open for an extended period, a thin mat of lean concrete should be placed over the bottom to minimize damage to the bearing surface from weather or construction activities. Foundation concrete should not be placed on frozen or flooded subgrades.

5.2.2 Drilled Piers

If drilled piers are chosen as a design alternate, it would be our recommendation they be installed in substantial accordance with the attached *Suggested Items for Inclusion in the Specification for Drilled Piers*. Drilled piers installation should be continuously monitored by Bowser-Morner to verify adequate bearing materials are present, to check that the drilled piers are plumb and bells are properly sized, and to help ensure that the bottom of the caissons have been properly cleaned.

5.3 Special Inspections

The International Building Code (IBC) requires "Special Inspections". These inspections are required in 14 major categories of work and are over and above the inspections that building officials commonly provide per Section 109. The purpose of the special inspector is to review aspects of construction that require special knowledge and training that the code official does not possess.

For each project, the Department of Commerce's Division of Industrial Compliance requires the principal designer to identify which materials and contracted work require special inspections and specify the frequency of inspection. The designer is to submit this completed list with the building permit application.

At the completion of the project, a *Final Report of Special Inspections* must be submitted by the registered design professional in responsible charge of the project in order to receive the final occupancy permit.

Bowser-Morner, Inc. is capable of providing the special inspection services. Based on our current understanding of your project, we have developed the following summary of the required Special Inspections:

SOILS AND FOUNDATIONS – 1704.4	
Item	**Scope**
1. Shallow Foundations	*Inspect soils below footings for adequate bearing capacity and consistency with geotechnical report.* *Inspect removal of unsuitable material and preparation of subgrade prior to placement of controlled fill.*
2. Deep Foundations: Drilled Piers:	*Inspect installation of drilled pier foundations. Verify pier diameter, bell diameter, lengths, embedment into bedrock, and suitability of end bearing strata.*
3. Load Testing	*Compressive load testing (ASTM D1143)* *Tensile load testing (ASTM D3689)*
Cast-in-Place Concrete – 1704.4	
1. Mix Design	*Review concrete batch tickets and verify compliance with approved mix design. Verify that water added at the site does not exceed that allowed by the mix design.* *Mix designs, mix verifications.*
2. Material Certification	
3. Reinforcement Installation	*Inspect size, spacing, cover, positioning, and grade of reinforcing steel. Verify that reinforcing bars are free of form oil or other deleterious materials. Inspect bar laps and mechanical splices. Verify that bars are adequately tied and supported on chairs or bolsters*
4. Post-Tensioning Operations	*Inspect placement, stressing, grouting, and protection of post-tensioning tendons. Verify that tendons are correctly positioned, supported, tied, and wrapped. Record tendon elongations.*
5. Welding of Reinforcing	*Visually inspect all reinforcing steel welds. Verify weldability of reinforcing steel. Inspect preheating of steel when required.*
6. Anchor Rods	*Inspect size, positioning, and embedment of anchor rods. Inspect concrete placement and consolidation around anchors.*
7. Concrete Placement	*Inspect placement of concrete. Verify that concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated*
8. Sampling and Testing of Concrete	*Test concrete compressive strength (ASTM C31 and C39), slump (ASTM C143), air-content (ASTM C231 or C173), and temperature (ASTM C1064).*
9. Curing and Protection	*Inspect curing, cold weather protection, and hot weather protection procedures.*

Structural Steel – 1704.2 and 1704.3	
1. Fabricator Certification/Quality Control Procedures ☐ Fabricator Exempt	*Review shop fabrication and quality control procedures.*
2. Material Certification	*Review certified mill test reports and identification markings on wide-flange shapes, high-strength bolts, nuts, and welding electrodes.*
3. Open Web Steel Joists	*Inspect installation, field welding, and bridging of joists.*
4. Bolting	*Inspect installation and tightening of high-strength bolts. Verify that splines have separated from tension control bolts. Verify proper tightening sequence. Continuous inspection of bolts in slip-critical connections.*
5. Welding	*Visually inspect all welds. Inspect pre-heat, post-heat, and surface preparation between passes. Verify size and length of fillet welds.* *Ultrasonic testing of all full-penetration welds.*
6. Shear Connectors	*Inspect size, number, positioning, and welding of shear connectors. Inspect suds for full 360-degree flash. Ring test all shear connectors with a 3-pound hammer. Bend test all questionable studs to 15 degrees.*
7. Structural Details	*Inspect steel frame for compliance with structural drawings, including bracing, member configuration, and connection details.*
8. Metal Deck	*Inspect welding and side-lap fastening of metal roof and floor deck.*

5.4 Soil Seismic Site Classification

We have evaluated the available soil profile data developed during this study to determine the Site Class in accordance with the 2009 International Building Code. The test borings for this project did not extend to 100 feet deep and, therefore, we have estimated the depth to rock based on records we keep on file. We have also estimated the soil strength and soil types below the bottoms of the on-site borings. Based on this analysis, we have determined the Site Class is D. We may be able to upgrade the class to C with seismic wave testing. We can perform this service.

5.5 Groundwater Control

During the field exploration, groundwater was encountered in both boring locations at depths between 5.5 and 6 feet. We do not expect significant difficulties with groundwater during mat foundation; however, it may be problematic for caisson construction. Groundwater flow into caisson excavations that pass through the saturated silty soil layers may be moderate in some holes, and caving conditions may occur. As with any open excavation, groundwater may accumulate in foundation excavations. We anticipate that the amount of water, if any, that does accumulate will be light. Any water that does accumulate should be pumped out prior to placing concrete.

The amount and type of dewatering required during construction will depend on the weather and groundwater levels at the time of construction and the effectiveness of the contractor's techniques in preventing surface runoff from entering open excavations. Typically, groundwater levels are highest during winter and spring months and lower in summer and early fall.

5.6 Slopes and Temporary Excavation

The owner and the contractor should make themselves aware of and become familiar with applicable local, state, and federal safety regulations, including current OSHA excavation and trench safety standards. Construction site safety generally is the sole responsibility of the contractor. The contractor shall also be solely responsible for the means, methods, techniques, sequences, and operations of construction operations. Bowser-Morner is providing the following information solely as a service to the client. Under no circumstances should Bowser-Morner's provision of the following information be construed to mean Bowser-Morner is assuming responsibility for construction site safety or the contractor's activities; such responsibility is not implied and should not be inferred.

The contractor should be aware that slope height, slope inclination, and excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, or federal safety regulations, e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations. Such regulations are strictly enforced and, if not followed, the owner, the contractor, or earthwork or utility subcontractors could be liable for substantial penalties.

For this site, the overburden soil encountered in our exploration is mostly silty clay of lacustrine origin. Some fill, estimated at depths of 2 to 2.5 feet or more, will be encountered. We anticipate OSHA will classify the fill materials as Type C. The underlying naturally occurring undisturbed clay soils would be likely classified as Type B.

Note: Soils encountered in the construction excavations may vary significantly across the site. Our preliminary soil classifications are based solely on the materials encountered in widely spaced borings. The contractor should verify similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, Bowser-Morner recommends we be contacted immediately to evaluate the conditions encountered.

If any excavation, including a utility trench, is extended to a depth of more than 20 feet, OSHA requires the side slopes of such excavation be designed by a professional engineer.

6.0 QUALIFICATIONS

The evaluations, conclusions, and recommendations in this report are based on our interpretation of the field and laboratory data obtained during the exploration, our understanding of the project, and our experience with similar sites and subsurface conditions. Data used during this exploration included, but was not necessarily limited to:

- two exploratory borings performed during this study;
- observations of the project site by our staff;
- results of limited laboratory soil testing;
- preliminary site plans and drawings furnished by Buehrer Group Architecture & Engineering, Inc.;
- limited interaction with Mr. Sam Muhsen; and
- published soil or geologic data of this area.

In the event changes in the project characteristics are planned, or if additional information or differences from the conditions anticipated in this report become apparent, Bowser-Morner, Inc. should be notified so the conclusions and recommendations contained in this report can be reviewed and, if necessary, modified or verified in writing.

The subsurface conditions discussed in this report and those shown on the *Boring Logs* represent an estimate of the subsurface conditions based on interpretation of the boring data using normally accepted geotechnical engineering judgments. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times.

Regardless of the thoroughness of a subsurface exploration, there is the possibility conditions between borings will differ from those at the boring locations, conditions are not as anticipated by designers, or the construction process has altered the soil conditions. As variations in the soil profile are encountered, additional subsurface sampling and testing may be necessary to provide data required to re-evaluate the recommendations of this report. Consequently, after submission of this report, it is recommended Bowser-Morner be authorized to perform additional services to work with the designer(s) to minimize errors and/or omissions regarding the interpretation and implementation of this report.

Prior to construction, we recommend that Bowser-Morner:

- work with the designers to implement the recommended geotechnical design parameters into plans and specifications;
- consult with the design team regarding interpretation of this report;
- establish criteria for the construction observation and testing for the soil conditions encountered at this site; and
- review final plans and specifications pertaining to geotechnical aspects of design.

During construction, we recommend that Bowser-Morner:

- observe the construction, particularly site preparation, fill placement, and foundation excavation or installation;
- perform in-place density testing of all compacted fill;
- perform materials testing of soil and other materials as required; and
- consult with the design team to make design changes in the event differing sub-surface conditions are encountered.

If Bowser-Morner is not retained for these services, we shall assume no responsibility for construction compliance with the design concepts, specifications, or recommendations.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. No other warranty, expressed or implied, is made.

The scope of our services did not include an environmental assessment for the presence or absence of hazardous or toxic materials in the soil, surface water, groundwater, or air, on, within, or beyond the site studied. Our work also did not include anything related to mold. Our scope of services also did not include an evaluation for the presence or absence of wetlands or protected species. Any statements in the report or on the *Boring Logs* regarding odors, staining of soils, or other unusual items or conditions observed are strictly for the information of our client.

To evaluate the site for possible environmental liabilities, we recommend an environmental assessment, consisting of a detailed site reconnaissance, a record review, and report of findings. Additional subsurface drilling and sampling, including groundwater sampling, may be required. The presence or absence of wetlands or protected species should be determined by a wetlands study. Bowser-Morner, Inc. can provide these services and would be pleased to provide a cost proposal to perform these studies, if requested.

This report has been prepared for the exclusive use of The Renaissance Group for specific application to Proposed Wind Turbine at Archbold Schools in Archbold, Fulton County, Ohio. Specific design and construction recommendations have been provided in the various sections of the report. The report should, therefore, be used in its entirety. This report is not a bidding document and shall not be used for that purpose. Anyone reviewing this report must interpret and draw their own conclusions regarding specific construction techniques and methods chosen. Bowser-Morner is not responsible for the independent conclusions, opinions, or recommendations made by others based on the field exploration and laboratory test data presented in this report.

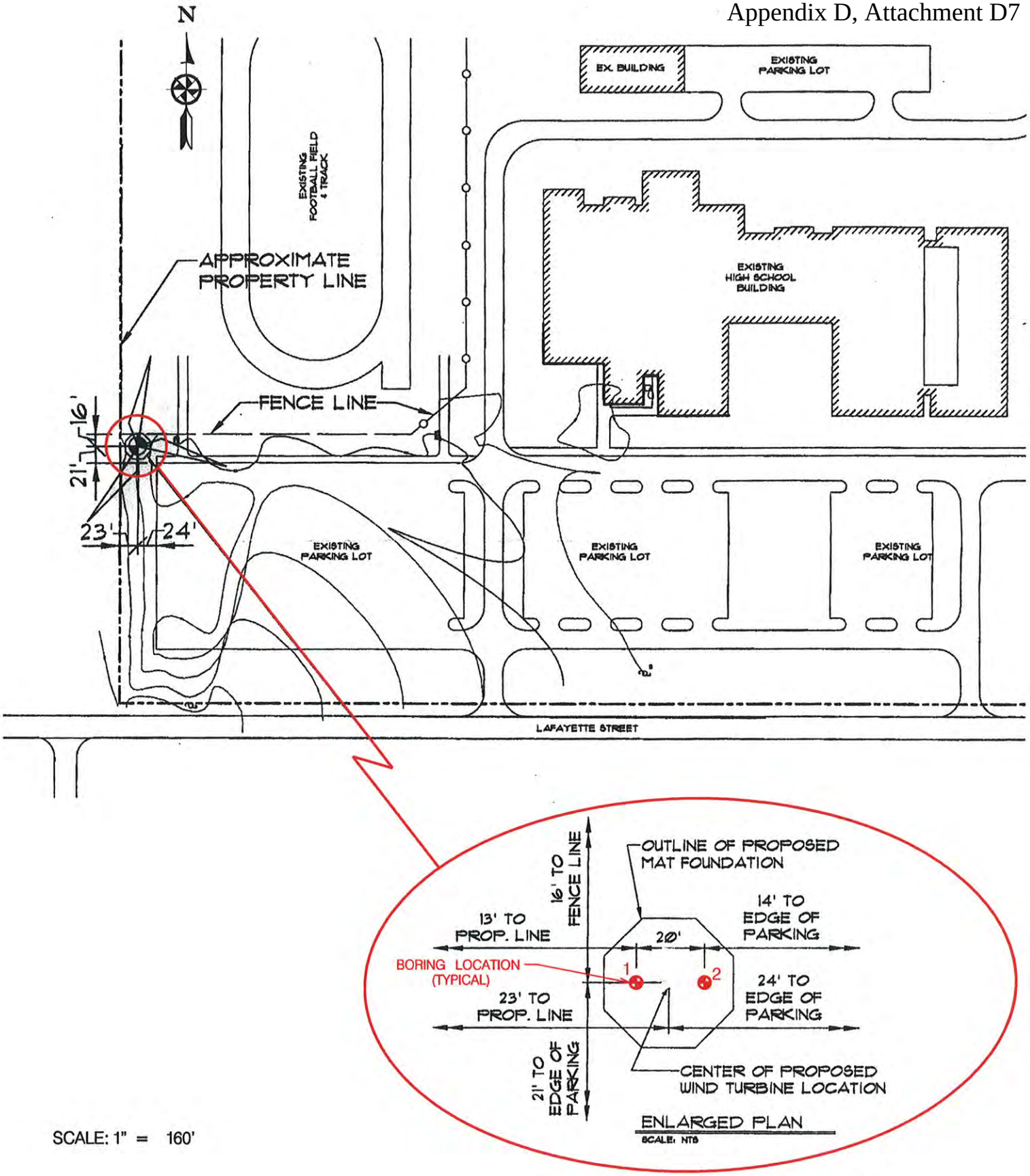
Respectfully submitted,

BOWSER-MORNER, INC.

A. K. Rashid, E.I.
Geotechnical Engineer

J. R. Hoppenjans, P.E., F. ASCE, D. GE
Vice President, District Manager, Chief Engineer

AKR/JRH:caw
Attachments: *Boring Location Plan*
Boring Log Terminology
Boring Logs
Suggested Items for Inclusion in the Specification for Drilled Piers
2-Client (1 via e-mail to sam@buehrergroup.com and 1 bound copy via U. S. mail)
1-The Renaissance Group, Attn: Mr. Aaron Godwin (1 bound via U. S. mail)



SCALE: 1" = 160'

DATE: 11-17-10
JOB NO. 152731

BORING LOCATION PLAN
PROPOSED WIND TURBINE
ARCHBOLD SCHOOLS
600 LAFAYETTE STREET
ARCHBOLD, FULTON COUNTY, OHIO

BOWSER MORNER.

BORING LOG TERMINOLOGY

Stratum Depth:

Distance in feet and/or inches below ground surface.

Description of Materials:

When the color of the soil is uniform throughout, the color recorded will be such as brown, gray, or black and may be modified by adjectives such as light and dark. If the soil's predominant color is shaded by a secondary color, the secondary color precedes the primary color, such as gray and brown, yellow and brown. If two major and distinct colors are swirled throughout the soil, the colors will be modified by the term mottled, such as mottled brown and gray.

There are two types of visual classification methods currently used by Bowser-Morner, Inc. The first is ASTM D2488. This method results in classifications such as "lean clay". The second method is the ASEE system or Burmister system. This system results in classifications such as "silt and clay, with traces of sand" and is described below.

Particle Size		Visual
Boulders		Larger than 8"
Cobbles		8" to 3"
Gravel:	Coarse	3" to 3/4"
	Fine	3/4" to 2 mm
Sand:	Coarse	2 mm to 0.6 mm (pencil size)
	Medium	0.6 mm to 0.2 mm (table sugar & salt size)
	Fine	0.2 mm to 0.06 mm (powdered sugar size)
Silt		0.06 mm to 0.002 mm
Clay		0.002 mm and smaller (particles of silt and clay size are not visible to the naked eye)

Soil Components	
Major Components	**Minor Component Term**
Gravel	Trace.....1 - 10%
Sand	Some.....11 - 35%
Silt	And.....36 - 50%
Clay	

Moisture Content	
Term	**Relative Moisture**
Dry	Powdery
Damp	Moisture content below plastic limit
Moist	Moisture content above plastic limit, but below liquid limit
Wet	Moisture content above liquid limit

Condition of Soil Relative to Compactness (Granular Material)	
Condition	**N**
Very Loose	5 blows/ft or less
Loose	6 to 10 blows/ft
Medium Dense	11 to 30 blows/ft
Dense	31 to 50 blows/ft
Very Dense	51 blows/ft of more

Condition of Soil Relative to Consistency (Cohesive Material)	
Condition	**Approximate Undrained Shear Strength**
Very Soft	Less than 250 psf
Soft	250 to 500 psf
Medium Stiff	500 to 1,000 psf
Stiff	1,000 to 2,000 psf
Very Stiff	2,000 to 4,000 psf
Hard	Greater than 4,000 psf

Sample Number:

Sample numbers are designated consecutively, increasing with depth for each boring.

Sample Type:

"A" Split spoon, 2-inch O.D., 1-3/8-inch I.D., 18 inches in length.
"B" One of the following:
- Power Auger Sample
- Piston Sample
- Liner Sample
- Denison Sample
- Sonic Sample

"C" Shelby Tube 3-inch O.D., except where noted.

Sample Depth:

The depth below top of ground at which the sample was taken.

Blows per 6 inches on Sampler:

The number of blows required to drive a 2-inch O.D., 1-3/8-inch I.D., split spoon sampler, using a 140-pound hammer with a 30-inch free fall, is recorded for 6 inch drive increments. (Example: 3/8/9)

"N" Blows/Feet:

Standard penetration resistance. This value is based on the total number of blows required for the last 12 inches of penetration. (Example: 3/8/9 : N = 8 + 9 = 17)

Water Observations:

The depth of water recorded in the test boring is measured from the top of ground to the top of the water level. Initial depth indicates the water level during boring, completion depth indicates the water level immediately after boring, and depth after "X" number of hours indicates the water level after letting the water rise or fall over a time period. Water observations in pervious (sand and gravel) soils are considered reliable ground water levels for that date, Water observations in impervious (silt and clay) soils cannot be considered accurate unless records are made over a time period of several days to a month. Factors such as weather, soil porosity, etc. will cause the ground water level to fluctuate for both pervious and impervious soils.

CLIENT
THE RENAISSANCE GROUP

JOB NO.
152731

PROJECT
PROPOSED WIND TURBINE, ARCHBOLD SCHOOLS, 600 LAFAYETTE STREET, ARCHBOLD, FULTON COUNTY, OHIO

BORING STARTED **11/15/10** | BORING COMPLETED **11/15/10**
DRILLER **Clint J.** | METHOD **3 1/4" HSA**
TYPED BY **kms**

B-1 Boring No.
Sheet 1 of 2

PROJECT LOCATION
LAT. LONG.
SURFACE ELEVATION
BORING LOCATION
As shown on Boring Location Plan.

DEPTH	SAMPLE NO.	SAMPLER TYPE / RECOVERY	GRAPHIC LOG	VISUAL CLASSIFICATION OF THE MATERIAL	BLOW COUNTS	N VALUE, blows/ft. (10 20 30 40 50 60 70 80 90)	REMARKS
				Topsoil			
1.0	1A			(FILL) Very stiff gray and brown silt, some clay, some sand, trace of gravel	6 6 7	◇13	
3.0	2A			Medium stiff brown silt and sand, moist	5 6 6	◇12	▽
6.0	3A			Stiff brown and gray silt, some clay, trace of sand, wet	5 9 8	◇17	
9.0	4A			Medium stiff gray clay and silt, trace of sand, moist	2 4 5	◇9	
14.0	5A			Medium stiff gray silt, some clay, trace of sand, wet	3 5 6	◇11	
19.0	6A			Medium stiff gray clay and silt, trace of sand, moist	3 4 5	◇9	

Continued Next Page

WATER LEVEL MEASUREMENTS

	DEPTH	DATE
INITIAL	5.5	▽ 11/15/2010
AT COMPLETION	NONE	▼ 11/15/2010
OTHER	N/A	▼ N/A

A—SPLIT SPOON
B—ROCK CORE
C—SHELBY TUBE
D—SOIL PROBE
E—AUGER CUTTINGS
F—SONIC

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GINT Report Used: NEWLOGIN Report No.: 152731.1110.XXXX.GPJ GINT Template Used: NEWLOGIN.GDT Date Printed: 11/30/10

CLIENT
THE RENAISSANCE GROUP

JOB NO
152731

PROJECT
PROPOSED WIND TURBINE, ARCHBOLD SCHOOLS, 600 LAFAYETTE STREET, ARCHBOLD, FULTON COUNTY, OHIO

BORING STARTED **11/15/10** | BORING COMPLETED **11/15/10**
DRILLER **Clint J.** | METHOD **3 1/4" HSA**
TYPED BY **kms**

B-1 Boring No.
Sheet 2 of 2

PROJECT LOCATION
LAT. LONG.
SURFACE ELEVATION
BORING LOCATION
As shown on Boring Location Plan.

DEPTH	SAMPLE NO.	SAMPLER TYPE / RECOVERY	GRAPHIC LOG	VISUAL CLASSIFICATION OF THE MATERIAL	BLOW COUNTS	N VALUE, blows/ft. (10 20 30 40 50 60 70 80 90)	REMARKS
23.0–33.0							
24.0	7A				3, 4, 6	10	
29.0	8A				4, 5, 6	11	
34.0	9A			Medium stiff gray clay and silt, some sand, trace of gravel, moist	4, 5, 8	13	
39.0	10A				3, 6, 8	14	
40.0				Bottom of boring at 40.0 feet			

COMMENTS

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CLIENT
THE RENAISSANCE GROUP

JOB NO.
152731

PROJECT
PROPOSED WIND TURBINE, ARCHBOLD SCHOOLS, 600 LAFAYETTE STREET, ARCHBOLD, FULTON COUNTY, OHIO

BORING STARTED **11/15/10** | BORING COMPLETED **11/15/10**
DRILLER **Clint J.** | METHOD **3 1/4" HSA**
TYPED BY **kms**

B-2 Boring No.
Sheet 1 of 2

PROJECT LOCATION
LAT. LONG.
SURFACE ELEVATION
BORING LOCATION
As shown on Boring Location Plan.

DEPTH	SAMPLE NO.	SAMPLER TYPE / RECOVERY	GRAPHIC LOG	VISUAL CLASSIFICATION OF THE MATERIAL	BLOW COUNTS	N VALUE, blows/ft. (10 20 30 40 50 60 70 80 90)	REMARKS
0.0				Topsoil			
1.0	1A			(FILL) Very stiff brown and dark brown silt, some clay, trace of sand, moist	7 7	◇ 14	
2.0				Very stiff clay and silt, trace of sand, moist	7		
3.0					6		
4.0	2A				7 7	◇ 14	
5.0							
6.0							▽
7.0	3A			Very stiff brown silt, some clay, trace of sand, moist	7 6 8	◇ 14	
8.0							
9.0	4A			Stiff gray clay and silt, trace of sand, moist	3 9 5	◇ 14	
10.0							
11.0							
12.0							
13.0							
14.0	5A				5 10 12	◇ 22	
15.0							
16.0							
17.0							
18.0							
19.0	6A				2 3 4	◇ 7	
20.0							
21.0							
22.0							

Continued Next Page

WATER LEVEL MEASUREMENTS

	DEPTH	DATE
INITIAL	6.0	▽ 11/15/2010
AT COMPLETION	NONE	▽ 11/15/2010
OTHER	N/A	▽ N/A

A — SPLIT SPOON
B — ROCK CORE
C — SHELBY TUBE
D — SOIL PROBE
E — AUGER CUTTINGS
F — SONIC

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CLIENT
THE RENAISSANCE GROUP

JOB NO.
152731

PROJECT
PROPOSED WIND TURBINE, ARCHBOLD SCHOOLS, 600 LAFAYETTE STREET, ARCHBOLD, FULTON COUNTY, OHIO

BORING STARTED **11/15/10** BORING COMPLETED **11/15/10**
DRILLER **Clint J.** METHOD **3 1/4" HSA**
TYPED BY **kms**

B-2 Boring No.
Sheet 2 of 2

PROJECT LOCATION
LAT. LONG.
SURFACE ELEVATION
BORING LOCATION
As shown on Boring Location Plan.

DEPTH	SAMPLE NO.	SAMPLER TYPE / RECOVERY	GRAPHIC LOG	VISUAL CLASSIFICATION OF THE MATERIAL	BLOW COUNTS	N VALUE, blows/ft. (10 20 30 40 50 60 70 80 90)	REMARKS
23.0–24.0	7A				3 3 8	◇ 11	
24.0–25.0							
25.0–26.0							
26.0–27.0							
27.0–28.0							
28.0–29.0	8A				5 5 9	◇ 14	
29.0–30.0							
30.0–31.0							
31.0–32.0							
32.0–33.0				Stiff gray clay and silt, some sand, trace of gravel, moist	3 5 7	◇ 12	
33.0–34.0							
34.0–35.0	9A						
35.0–36.0							
36.0–37.0							
37.0–38.0							
38.0–39.0							
39.0–40.0	10A				6 7 10	◇ 17	
40.0–41.0				Bottom of boring at 40.0 feet			
41.0–42.0							
42.0–43.0							
43.0–44.0							
44.0–45.0							
45.0–46.0							
46.0–47.0							
47.0–48.0							

GINT Report Used: NEWLOGIN Report No.: 152731.1110.XXXX.GPJ GINT Template Used: NEWLOGIN.GDT Date Printed: 11/19/10

SUGGESTED ITEMS FOR INCLUSION IN THE SPECIFICATION FOR DRILLED PIERS

1. The Contractor shall furnish all labor and equipment necessary or incidental to the completion of all drilled piers in strict accordance with drawings and specifications.

2. The piers shall be formed by means acceptable to the Owner.

3. The work includes the excavation of all materials encountered, both wet and dry, and the removal of all excavated material from the job site.

4. The maximum variation of the center of piers from the required location shall be no greater than 50 mm (1 inch) at the ground surface, and no pier shall be out of plumb more than 1% (one percent).

5. The diameter of each pier and bell shall conform to the dimensions shown on the drawings.

6. If boulders are encountered in the piers, they shall be removed as extra work. The Contractor shall establish in his contract a unit price for removing boulders. Boulders are considered as being larger than 0.028 cubic meter (one cubic foot) in size. Smaller material shall not be classified as boulders.

7. Drilled piers shall extend to the depth shown on the drawings unless otherwise specified by the Owner or his representative.

8. The depth of drilled piers, for contract work purposes, is shown on the drawings. If, in order to reach suitable material (as determined by the Owner or his representative), the depth of piers is deeper or more shallow, the price shall be adjusted in accordance with the contract.

9. Each pier shall be examined by the Owner or his representative to confirm that the pier is bearing on suitable material, that the bell is of the required size, and that it is free of debris and water before concrete is placed. The Contractor shall case any pier into which

workmen or other personnel will enter and will use confined space entry procedures. Concrete shall not be placed until the pier is approved by the Owner or his representative.

The Contractor shall provide a mechanical device on the belling tool to measure the size of any required bell. Observation of the soil cuttings and measurement made from the ground surface shall be used to assess the suitability of the bearing material and size and depth of the shaft. If there is any question as to the suitability of the excavation, the Contractor shall install a full-length casing into the shaft and provide all equipment necessary to enter the hole for inspection by the Owner or his representative. Confined space entry procedures will be required.

10. The Contractor shall provide and operate all equipment necessary to pump and remove all water that may be encountered in the construction of piers, without additional payment therefor. The Contractor shall case all piers where necessary to shut off the flow of water and belling shall be done in a dry shaft below the casing.

11. The drilled pier shall be filled with concrete as specified below. In instances where it is necessary to case a shaft, the shaft shall be filled with concrete prior to extraction of the casing. The casing shall be pulled by a slow, even lift. Once begun, the pulling shall be continuous and additional concrete shall be placed to keep the shaft full.

12. Concrete shall be produced, placed, and protected in accordance with ACI 301 unless otherwise stated. Concrete shall have a minimum compressive strength of 20,700 kPa (3,000 psi) in 28 days. It shall be placed with a slump of 75 mm to 150 mm (3 to 6 inches).

13. Concreting of the piers shall be done in such a manner that segregation of the concrete is avoided. The concrete shall be placed by means of an "elephant's trunk" or funnel so that the concrete is deposited in the center of the shaft and does not impact on reinforcing steel or the sides of the shaft.

14. The placing of concrete for any one pier shall be continuous. Any interruption in the progress of excavation, protection of the excavation with steel liners, or placing of the concrete must have the approval of the Owner or his representative.

Archbold Area Schools Wind Energy Project Mailing List

Company	Title	Department	Last	First	Address	Address Line 2	City	State	Zip Code	email	Phone
Fulton County Economic Development	Director		Arend	Lisa	152 South Fulton Street	Suite 230	Wauseon	OH	43567-1726		
Federal Aviation Administration		Air Traffic Airspace Branch, ASW-520	Blaich	Mike	2601 Meacham Blvd.		Forth Worth	TX	76137-0520		
Fulton County Regional Planning Director	Director		Brown	Steven	152 South Fulton Street	Suite 230	Wauseon	OH	46567		
United States Senate (D-OH)	Senator		Brown	Sherrod	713 Hart Senate Office Building		Washington	DC	20510		
Ohio Senate		District 1	Buehrer	Steve	1 Capitol Square	1st Floor	Columbus	OH	43215		
U.S. Department of Commerce / NTIA Herbert C Hoover Building (HCHB)		National Telecommunications and Information Administration	Davidson	Edward M.	1401 Constitution Avenue, N.W.		Washington	DC	20230		
Ohio Historic Preservation Office	Department Head	Resource Protection and Review	Epstein	Mark	1982 Velma Avenue		Columbus	OH	43211-2497	guy@orcoast.com	961-1762
Meyer, Glitzenstein & Crystal			Eubanks	William	1601 Connecticut Ave NW,	Suite 700	Washington	DC	20009		996-2859
Meyer, Glitzenstein & Crystal			Glitzenstein	Eric	1601 Connecticut Ave NW,	Suite 700	Washington	DC	20009	SAllen@pewtrusts.org	(503) 231-2718
		USFWS	Gosse	Jeff	1 Federal Drive		Fort Snelling	WI	55111-4056		
Ohio House of Representative		District 74	Goodwin	Bruce W.	77 South High Street	10th Floor	Columbus	OH	43215-6111		
Office of Regional Environmental and Government Affairs - North Attn: SAIE-ESDH	Assistant Secretary of Army (Installations & Environment)		Hartman	Dr. James	5179 Hoadley Road		Aberdeen Proving Ground	MD	21010-5401		
Ohio Department of Development	Energy Public Policy Liaison		Huddle	Patricia	77 South High Street	PO Box 1001	Columbus	OH	43216-1001		
Ohio Department of Development	Advanced Energy Program Manager		Meqadows	David	78 South High Street	PO Box 1002	Columbus	OH	43216-1001		
United States Congress	Congressman	District 5	Latta	Robert	1045 North Main Street, Ste 6	Suite 6	Bowling Green	OH	43402		
Ohio Division of Wildlife	Wind Energy Wildlife Biologist		Lott	Keith	2514 Cleveland Road East		Huron	OH	44839		
ODOT Office of Aviation			Milling	John	2829 W. Dublin-Granville Road		Columbus	OH	43235		
		ODNR	Mitch	Brian	2054 Morse Road	Building F-3	Columbus	OH	43229		
Ohio Schools Facilities Commission			Murry	Richard C.	10 West Broad Street	Suite 1400	Columbus	OH	43215		
Sierra Club Ohio Chapter	Chair		Nagel	Enid	131 North High Street	#605	Columbus	OH	43125	Ann_E_Gray@fws.gov	503-231-6909
Ohio Department of Development		Ohio Energy Resources Division	Payne	Greg	77 South High Street	PO Box 1001	Columbus	OH	43216-1001	dlindly@co.lincoln.or.us	
National Audubon Society	General Counsel		Scott	Michelle P.	225 Varick Street	7th floor	New York	NY	10014		
Ohio Division of Wildlife			Scott	Dave	2514 Cleveland Road East		Huron	OH	44839		
Ohio Historic Preservation Office	Project Manager	Resource Protection and Review	Cook	Justin	1982 Velma Avenue		Columbus	OH	43211-2497	cabbott@peak.org	563-2257
United States Fish and Wildlife Service			Seymour	Megan	4625Morse Road, Suite 104	Suite 104	Columbus	OH	43216-1001		
Ohio Air Quality Development Authority			Shanahan	Mark	50 West Broad Street	Suite 1718	Columbus	OH	43215		
Ohio Public Utility Commission			Siegfried	Stuart	180 East Broad Street		Columbus	OH	43125		
Grange Insurance Audubon Center	Center Director		Starck	Heather	505 W. Whittier Street		Columbus	OH	43215	Onno_Husing@class.orednet.org	
Northwest State Community College	President		Stuckey	Dr. Thomas	22600 State Route 34		Archbold	OH	43502		
National Audubon Society	Important Bird Area Coordinator and Staff Biologist		Van Fleet	Kim	225 Varick Street	7th floor	New York	NY	10014	poconnor@occc.cc.or.us	574-7109
Untied State Senate (R-OH)	Senator		Voinovish	George	524 Hart Senate Office Building		Washington	DC	20510		
Ohio House of Representative, District 75		District 75	Wachtmann	Lynn R.	77 South High Street	10th Floor	Columbus	OH	43215-6111		
National Audubon Society	Vice President		Wallis	Phil	225 Varick Street	7th floor	New York	NY	10014	867-3474	
Ohio Environmental Protection Agency	Chief	Office of Federal Facility Oversight	Winston	Tom	401 East 5th Street		Dayton	OH	45402-2911	Cplybon@surfrider.org	867-3982
Village of Archbold	Mayor		Wyse	Jim	Post Office Box 406 300 North Defiance		Archbold	OH	43502		
Board of Education		Archbold Area Schools			600 Lafayette Street		Archbold	OH	43502		
Fulton County Commissioners					152 South Fulton Street		Wauseon	OH	43567		
Fulton County Historical Society					229 Monroe Street		Wauseon	OH	43567		
German Township Board of Trustees					5001 State Route 66		Archbold	OH	43502		
Governor's Office		Riffe Center			77 South High Street	30th Floor	Columbus	OH	43125-6108		
Eastern Band of Cherokee Indians of North Carolina	NAGPRA Officer		Holt	Clara P	P.O. Box 455		Cherokee	NC	28719		
Absentee-Shawnee Tribe of Indians of Oklahoma	Tribal Historic Preservation Officer		Kaniatobe	Karen	2025 South Gordon Cooper Drive		Shawnee	OK	74801-9381		
Chief, Eastern Shawnee Tribe of Oklahoma	Chief		Wallace	Glenna	P.O. Box 350		Seneca	MO	64865		
United Keetoowah Band of Cherokee Indians of Oklahoma	Historic Preservation Coordinator		Stopp	Lisa	P.O. Box 746		tahlequah	OK	74465-0746		
Forest County Potawatomi Community of Wisconsin Potawatomi Indians	Chairman		Frank	Harold	P.O. Box 340		Crandon	WI	54520		
Huron Potawatomi Nation			Spurr	Laura	2221 1½ Mile Road		Fulton	MI	49052		
THPO, Lac Courte Oreilles Band of Lake Superior Chippewa Indians of Wisconsin			Smith	Jerry	13394 West Trepania		Hayward	WI	54843		
Delaware Nation	NAGPRA Director		Wahahrockah-Tasi	Phyllis	P.O. Box 825		Anadarko	OK	73005		
Cherokee Nation of Oklahoma	NAGPRA		Allen	Richard	P.O. Box 948		Tahlequah	OK	74465		
Shawnee Tribe	Tribal Administrator		Hawkins	Rebecca	P.O. Box 189		Miami	OK	74355		
Red Cliff Band of Lake Superior Chippewa Indians of Wisconsin	Chairman		DePerry	Pat	P.O. Box 529		Bayfield	WI	54814		
Minnesota Chippewa Tribe, Fond du Lac Reservation Business Committee	Chairman		Peacock	Robert	1720 Big Lake Road		Cloquet	MN	55720		
Peoria Tribe of Oklahoma	Chief		Froman	John	PO Box 1527	118 S. Eight Tribe Trail	Miami	OK	74355		
Minnesota Chippewa Tribe, Executive Committee	President		DeFoe	Peter	Box 217		Cass Lake	MN	56633		
Ottawa Tribe of Oklahoma	Chief		Todd	Charles	P.O. Box 110		Miami	OK	74355		
Little River Band of Ottawa Indians of Michigan	Chairman		Guenthardt	Robert	375 River Street		Manistee	MI	49660-2729		
Prairie Band of Potawatomi Indians of Kansas			Wahwasuck	Badger	16281 Q Road Government Center		Mayetta	KS	66509		
Red Lake Band of Chippewa Indians			Jourdain, Jr.	Floyd	P.O. Box 550		Red Lake	MN	56671		

Archbold Area Schools Wind Energy Project Mailing List

Company	Title	Department	Last	First	Address	Address Line 2	City	State	Zip Code	email	Phone
Saginaw Chippewa Indian Tribe of Michigan	Chief		Peters	Philip G.	Isabella Reservation	7070 East Broadway Road	Mount Pleasant	MI	48858		
Seneca-Cayuga Tribe of Oklahoma	Chief		Howard	LeRoy	P.O. Box 1283		Miami	OK	74355		
Delaware Nation NAGPRA Office			Francis	Tamara	P.O. Box 825		Anadarko	OK	73005		
Seneca-Cayuga Tribe of Oklahoma	Chief		Spicer	Paul	P.O. Box 1283	R2301 East Steve Owens Blvd.	Miami	OK	74355		
Absentee-Shawnee Tribe of Oklahoma	Governor		Nuckolls	Larry	2025 Gordon Cooper Drive		Shawnee	OK	74801		
Miami Nation of Oklahoma	Chief		Leonard	Floyd	P.O. Box 1326	202 South Eight Tribes Trail	Miami	ok	74355		
Oneida Tribe of Indians of Wisconsin	Chairman		Danforth	Gerald	P.O. Box 365		Oneida	WI	54155		
Seneca Nation of Indians	President		Snyder, Sr.	Barry E.	P.O. Box 231		Salamanca	NY	14779		
St. Regis Mohawk Tribe	Chief		Ransom	Jim	412 State Route 37		Akwesasne	NY	13655		
Tuscarora Nation	Chief		Henry	Leo R.	2006 Mount Hope Road		Lewiston	NY	14092		
Chippewa-Cree Tribe of the Rocky Boy's Reservation	Chairman		Boy	Alvin Windy	RR 1, P.O. Box 544		Box Elder	MT	59521		
Grand Traverse Band of Ottawa and Chippewa Indians of Michigan	Chairman		Kewaygoshkum	Robert	2605 NW Bayshore Drive		Peshawbestown	MI	49682		
Keweenaw Bay Indian Community of L'Anse and Ontonagon Bands of Chippewa Indians	Chairman		Cohen	Summer Sky	107 Beartown Road		Baraga	MI	49908		
Little Travers Bay Band of Odawa Indians of Michigan	Tribal Chairman		Ettawageshik	Frank	7500 Odawa Circle		Harbor Spings	MI	49740		
Match-e-be-nash-she-wish - Band of Pottawatomi Indians of Michigan	Chairman		Sprague	D. K.	P.O. Box 218		Door	MI	49323		
Minnesota Chippewa Tribe	Chairman		Des Champe	Norman	Grnade Portage Reservation Business Committee	83 Steven Street	Grnade Portage	MN	55605		
THPO, Minnesota Chippewa Tribe, Mille Lac Reservation Business Committee			Boyd	Brenda	43408 Oodena Drive		Onamia	MN	56359		
Minnesota Chippewa Tribe	Chairman		Donald	Gary	Nett Lake Reservation Business Committee	P.O. Box 16	Nett Lake	MN	55772		
THPO, Lac du Flambeau Band of Lake Superior Chippewa Indians			Jackson	Kelly	P.O. Box 67		Lac du Flambeau	WI	54538		
Pokagon Band of Potawatomi Indians			Miller	John	901 Spruce Street	PO Box 180	Dowagiac	MI	49047		
Sokaogon Chippewa Community Lake Band of Chippewa Indians, Wisconsin	Chairwoman		Rachal	Sandra L.	3051 Sand Lake Road		Crandon	WI	54520		
Tonawanda Band of Seneca Indians of New York			Hill	Darwin	7027 Meadville Road		Basom	NY	14013		
Wyandotte Nation - Attn: Ms. Sherri Clemons	Chief		Bearskin	Leaford	P.O. Box 250		Wyandotte	OK	74370		
Turtle Mountain Band of Chippewa Indians	THPO, Office of Archaeology and Historic Preservation		Grant	Brady	P.O. Box 900		Belcourt	ND	58316		
THPO, Miami Tribe of Oklahoma			Olds	Julie	202 South Eight Tribes Trail	P.O. Box 1326	Miami	OK	74355		
Sault Ste. Marie Tribe of Chippewa Indians of Michigan			Pavlat, Sr.	Cecil E.	523 Ashmun Street		Sault Ste. Marie,	MI	49783		
THPO, Seneca Nation of Indians			Mitchell	Kathleen	PO Box 231		Salamanca	NY	14779		
St. Croix Chippewa Indians of Wisconsin	Chairman		Emery	Albert	P.O. Box 287		Hertel	WI	54845		
Cayuga Nation	Chief		Halftown	Clint	PO Box 11		Versailles	NY	14168		
Cherokee Nation of Oklahoma			Halftown	Clint	P.O. Box 948		Ada	OK	74820		
Citizen Potawatomi Nation	Chairperson		Barrett	John	1601 South Gordon Copper Drive		Shawnee	OK	74801		
Loyal Shawnee Tribe			Squirrel	James	Route 4, Box 30		Jay	OK	74346		
Delaware Nation	President		French	Edgar	P.O. Box 825		Anadarko	OK	73005		
Oneida Indian Nation	Nation Representative		Halbritter	Raymond	223 Genesse Street		Oneida	NY	13421		
Onondaga Indian Nation	Chief		Powless, Jr.	Irving	258 Route 11a		Nedrow	NY	13120		
Shawnee Tribe	Chairman		Sparkman	Ron	P.O. Box 189		Miami	OK	74355		
Tonawanda Band of Seneca	Chief		Hill	Rodger	7027 Meadville Road		Basom	NY	14013		
			Bostleman	Ken	224 Burke St		Archbold	OH	43502		
			Swisher	Vic	204 Sylvanus St.		Archbold	OH	43502		
			Humbert	Derek	600 Park St. Lot 9		Archbold	OH	43502		

NOTICE OF PUBLIC SCOPING

The U.S. Department of Energy (DOE) has prepared a draft Environmental Assessment (EA) to analyze and describe the potential environmental impacts associated with:

Archbold Area Local School Wind Energy Project

DOE's Golden Field Office has prepared an EA in accordance with the National Environ-mental Policy Act (NEPA). Archbold Local Schools is proposing to use American Reinvestment and Recovery Act funds from DOE for the purchase and installation of a single 750 kW wind turbine at Archbold High School in Archbold, Fulton County, Ohio. The draft EA is available for review on the DOE Golden Field Office website:

http://www.eere.energy.gov/golden/Reading_Room.aspx

No formal public scoping meeting is currently planned for this project. Public comments on any potential issues and/or associated environmental impacts of implementing the proposed action will be accepted until ***February 9, 2011***. You may submit comments to the DOE Golden Field Office c/o Melissa Rossiter, 1617 Cole Boulevard, Golden, CO 80401, or by email to Melissa.Rossiter@go.doe.gov.

 New West Technologies

State of Ohio, Fulton County, ss.

Mary Huber being duly sworn, says she is the general manager of the Archbold Buckeye, a weekly newspaper published in the Village of Archbold, County of Fulton and State of Ohio, and of general circulation in said County, and that the printed notice attached to this affidavit was published in said newspaper each week for consecutive weeks, the first publication being made on Wednesday, the 26th day of January, 2011, and the last publication being made on Wednesday, the 26th day of January, 2011.

Mary Huber

Nancy L. Hogrefe

NOTARIAL SEAL STATE OF OHIO

Nancy L. Hogrefe
NOTARY PUBLIC, STATE OF OHIO
My Commission Expires March 29, 2012

Sworn to, before me, and subscribed in my presence, this 26th day of January, 2011.

NOTICE OF PUBLIC SCOPING

The U.S. Department of Energy (DOE) has prepared a draft Environmental Assessment (EA) to analyze and describe the potential environmental impacts associated with:

Archbold Area Local School Wind Energy Project

DOE's Golden Field Office has prepared an EA in accordance with the National Environmental Policy Act (NEPA). Archbold Local Schools is proposing to use American Reinvestment and Recovery Act funds from DOE for the purchase and installation of a single 750 kW wind turbine at Archbold High School in Archbold, Fulton County, Ohio. The draft EA is available for review on the DOE Golden Field Office website:

http://www.eere.energy.gov/golden/Reading_Room.aspx

No formal public scoping meeting is currently planned for this project. Public comments on any potential issues and/or associated environmental impacts of implementing the proposed action will be accepted until ***February 9, 2011***. You may submit comments to the **DOE Golden Field Office** c/o Melissa Rossiter, 1617 Cole Boulevard, Golden, CO 80401, or by email to Melissa.Rossiter@go.doe.gov.

APPENDIX E:

HISTORICAL AND CULTURAL DOCUMENTATION

Department of Energy
Golden Field Office
1617 Cole Boulevard
Golden, Colorado 80401-3393

October 25, 2010

Ms. Laura Segna
Resource Protection and Review
Ohio Historic Preservation Office
1982 Velma Avenue
Columbus, Ohio 43211-2497

RE: Pettisville Local Schools Wind Turbine Project (DOE/EA - 1818)
232 Summit Street, Pettisville, Fulton County, Ohio

Dear Ms. Segna:

The U.S. Department of Energy (DOE) has granted the Ohio Department of Development (ODOD) State Energy Program (SEP) funding through the Energy Policy and Conservation Act, as amended (43 U.S.C § 6321 et seq. with funds appropriated under the American Reinvestment and Recovery Act of 2009. ODOD selected Pettisville Local School District to receive a grant through Ohio's SEP to facilitate the construction and operation of a single 750 kilowatt wind turbine that would stand approximately 300 feet at its tallest extent that is intended to provide electricity to the newly constructed Pettisville Pre-Kindergarten through Twelfth Grade School Campus (proposed project). The DOE funding of the wind turbine represents the proposed federal undertaking.

This letter initiates consultation with your office pursuant to Section 106 of the National Historic Preservation Act (NHPA) and its implementing regulations 36 CFR Part 800 "Protection of Historic Properties" (Section 106) for the proposed project. An OHPO Section 106 Review – Project Summary Form is enclosed for your reference (Enclosure A).

To assist in the development of the Section 106 consultation materials, the DOE enlisted the assistance of Mr. Stephen D. Mikesell, a senior architectural historian who meets the Secretary of the Interior's Professional Qualification Standards (36 CFR Part 61) in architectural history, history or archeology. Mr. Mikesell's *Section 106 Compliance Report for Pettisville Local Schools Wind Energy Project* (report), utilized data gathered by The Renaissance Group (TRG) related to historic properties registered or eligible for listing on the National Register of Historic Places (NRHP) within the Area of Potential Effect (APE) (Enclosure B).

Although there are some cultural resources in the indirect APE, DOE has determined that the proposed undertaking will result in No Adverse Effect on any NRHP listed or eligible

properties or archeological resources. If you agree with DOE's determination that there will be no effects to historic or archaeological resources, please concur, as your concurrence is required for DOE's record of compliance under Section 106.

DOE is preparing an Environmental Assessment (EA) for the proposed project in compliance with the National Environmental Policy Act (NEPA). As part of the public notification for the EA for the proposed project, public participation will be integrated into the NEPA EA process. Documentation of DOE Section 106 consultation with OHPO will be included in the EA, which will be open for public comment for 15 days. Documentation of DOE's Section 106 consultation with OHPO will be included in the EA, which will be open for public comment for 15 days. All notices of the EA public comment period will reference the public's ability to comment on the proposed Undertaking's potential effects on NRHP listed and eligible properties. DOE finds this public participation process to be consistent with 36 CFR 800.2*(d)*.

Should you have any questions about this information, please contact me at Melissa.Rossiter@go.doe.gov or 720-356-1566.

Thank you in advance for your consideration.

Sincerely,

Melissa Rossiter
NEPA Document Manager
U.S. Department of Energy
1617 Cole Boulevard
Golden, CO 80401

Attachments

cc: Mark Epstein, Department Head, OHPO
Franco Ruffini, Deputy SHPO, OHPO
James Huth, Advanced Energy Program Manager, ODOD
AAron Godwin, Owners Representative, Renaissance Group
Stephen Switzer, Pettisville School District Superintendent
Steve Mikesell, ICF International

OHIO HISTORICAL SOCIETY
Ohio Historic Preservation Office

OHIO HISTORIC PRESERVATION OFFICE: RESOURCE PROTECTION AND REVIEW

Section 106 Review - Project Summary Form

For projects requiring a license from the Federal Communications Commission, please use FCC Forms 620 or 621. DO NOT USE THIS FORM.

SECTION 1: GENERAL PROJECT INFORMATION

All contact information provided must include the name, address and phone number of the person listed. Email addresses should also be included, if available. Please refer to the Instructions or contact an OHPO reviewer (mailto:Section106@ohiohistory.org) if you need help completing this Form. Unless otherwise requested, we will contact the person submitting this Form with questions or comments about this project.

Date: **October 22, 2010**

Name/Affiliation of person submitting form: **Melissa Rossiter, NEPA Document Manager, Department of Energy**

Mailing Address: **1617 Cole Boulevard, Golden, CO 80401**

Phone/Fax/Email: **720-356-1566/Melissa.Rossiter@go.doe.gov**

A. Project Info:

1. This Form provides information about:
   New Project Submittal:
   YES ☒ NO ☐

   Additional information relating to previously submitted project:
   YES ☐ NO ☒

   OHPO/RPR Serial Number from previous submission:

2. Project Name (if applicable):
   Pettisville Local Schools Wind Energy Poject

3. Internal tracking or reference number used by Federal Agency, consultant, and/or applicant to identify this project (if applicable):
   DOE/EA 1818

B. Project Address or vicinity:
232 Summit Street

C. City/Township:
Pettisville

D. County:
Fulton

E. Federal Agency and Agency Contact. *If you do not know the federal agency involved in your project, please contact the party asking you to apply for Section 106 Review, not OHPO, for this information. HUD Entitlement Communities acting under delegated environmental review authority should list their own contact information.*

Melissa Rossiter
NEPA Document Manager
Department of Energy
1617 Cole Boulevard
Golden, CO 80401
Melissa.Rossiter@go.doe.gov

F. Type of Federal Assistance. *List all known federal sources of federal funding, approvals, and permits to avoid repeated reviews.*

Grant, American Recovery and Reinvestment Act; DOE State Energy Program

G. State Agency and Contact Person (if applicable):

James Huth
Advanced Energy Program Manager
Ohio Energy Resources Division
James.Huth@development.ohio.gov

H. Type of State Assistance:

Same as above, assistance is provided by Federal Government but being distributed by the State through the State Energy Program

I. Is this project being submitted at the direction of a state agency **solely** under Ohio Revised Code 149.53 or at the direction of a State Agency? *Answering yes to this question means that you are sure that no federal funding, permits or approvals will be used for any part of your project, and that you are seeking comments only under ORC 149.53.*

YES ☐ NO ☒

J. Public Involvement- Describe how the public has been/will be informed about this project and its potential to affect historic properties. Please summarize how they will have an opportunity to provide comments about any effects to historic properties. (This step is required for all projects under 36 CFR § 800.2):

Project has been in the local spotlight for the last 18 months.

The Fulton County Historical Society has been contacted and assisted in the identification of any Historical Properties within the APE. The project has been reviewed and was available for public comment in both School Board and Village Planning and Zoning meetings. The project has been extensively covered in the local media. See Attachment 3 for full list and copy of all articles and public involvement.

K. Please list other consulting parties that you have contacted/will contact about this project, such as Indian Tribes, Certified Local Governments, local officials, property owners, or preservation groups. (See 36 CFR § 800.2 for more information about involving other consulting parties). Please summarize how they will have an opportunity to provide comments:

The following parties were notified of the project through the Department of Energy, Enviromental Assessment Process. They were allowed an opportunity to comment on the project through the scoping process and will be notified again when the draft EA is released to allow for further comment.

Steven Brown, Director
Fulton County Regional Planning Director
152 South Fulton Street, Suite 230
Wauseon, Ohio 43567

Lisa Arend, Director
Fulton County Economic Development
152 South Fulton Street, Suite 280
Wauseon, Ohio 43567-1726

Fulton County Commissioners
152 South Fulton Street
Wauseon, Ohio 43567

Western Reserve Historical Society
10825 East Blvd.
Cleveland, OH 44106

Western Reserve Heritage Association
P.O. Box 314
14485 N. Cheshire Street
Burton, OH 44021

The Clinton Township Trustees
230 Clinton Street
Wauseon, Ohio 43567

Fulton County Historical Society
229 Monroe Street
Wauseon, Ohio 43567

Tribes:
Bad River Band of the Lake Superior Tribe of Chippewa Indians
Citizen Potawatomi Nation
Forest County Potawatomi Community
Keweenaw Bay Indian Community
Little Traverse Bay Bands of Odawa Indians
Pokagon Band of Potawatomi Indians
Seneca-Cayuga Tribe
Turtle Mountain Band of Chippewa Indians
Bay Mills Indian Community
Hannahville Indian Community
Lac Courte Oreilles Band of Lake Superior Chippewa
Match-e-be-nash-she-wish Band of Pottawatomi
Prairie Band of Potawatomi Nation
St. Croix Chippewa Band of Lake Superior Chippewa
Sokaogon Chippewa Community
Wyandotte Tribe of Oklahoma
Chippewa-Cree Tribe of the Rocky Boy's Reservation
Delaware Tribe of Indians
Nottawaseppi Huron Band of the Potawatomi Indians
Little River Band of Ottawa Indians
Ottawa Tribe of Oklahoma
Red Cliff Band of Lake Superior Chippewa
Seneca Nation of Indians
Tonawanda Seneca Nation

SECTION 2: PROJECT DESCRIPTION AND AREA OF POTENTIAL EFFECTS (APE)

Provide a description of your project, its site, and geographical information. You will also describe your project's Area of Potential Effects (APE). Please refer to the Instructions or contact an OHPO reviewer if you need help with developing the APE or completing this form.

For challenging projects, provide as much information as possible in all sections, and then check the box in Section 5.A. to ask OHPO to offer preliminary comments or make recommendations about how to proceed with your project consultation. This is recommended if your project involves effects to significant historic properties or if there may be challenging procedural issues related to your project. Please note that providing information to complete all Sections will still be required and that asking OHPO for preliminary comments may tend to delay completion of the review process for some projects.

A. Does this project involve any Ground-Disturbing activity: YES ☒ NO ☐
(If **Yes**, you must complete all of Section 2.A. If **No**, proceed directly to Section 2. B.)

1. General description of width, length and depth of proposed ground disturbing activity:
The turbine's foundation will not be larger than 40' x 40' (or 1600 square feet). The base of the foundation will likely be 20' under the finished ground level. Other excavation will include electrical and data conduit runs, not to exceed 1,000' long x 2' wide x 3' deep for up to an aditional 2,000 square feet of disturbed land. Of all of this, only a foundation pier, not to be larger than 16' x 16' will be visible above the finished ground (or 256 square feet).

2. Narrative description of previous land use and past ground disturbances, if known:
The previous use of the land includes farming, although construction is already underway for an unrealated addition to the schools and their associated playing fields and parking lots. All of the proposed ground disturbance will affect land that has been previously disturbed during prior use and construction projects on the campus.

3. Narrative description of current land use and conditions:
Construction is already underway on this project site for an unrealated addition to the schools and their associated playing fields and parking lots.

4. Does the landowner know of any archaeological resources found on the property?
YES ☐ NO ☒ If yes, please describe:

B. Submit the exact project site location on a USGS 7.5-minute topographic quadrangle map for all projects. Map sections, photocopies of map sections, and online versions of USGS maps are acceptable as long as the location is clearly marked. Show the project's Area of Potential Effects (APE). It should be clearly distinguished from other features shown on the map:
1. USGS Quad Map Name:
Pettisville USGS Quad Map
2. Township/City/Village Name:
Pettisville, Ohio
See Attachment 2

C. Provide a street-level map indicating the location of the project site; road names must be

identified and legible. Your map must show the exact location of the boundaries for the project site. Show the project's Area of Potential Effects (APE). It should be clearly distinguished from other features shown on the map:

D. Provide a verbal description of the APE, including a discussion of how the APE will include areas with the potential for direct and indirect effects from the project. Explain the steps taken to identify the project's APE, and your justification for the specific boundaries chosen:

See Enclosure B - Section 106 Compliance Report for Pettisville Local Schools Wind Energy Project

E. Provide a detailed description of the project. This is a critical part of your submission. Your description should be prepared for a cold reader who may not be an expert in this type of project. The information provided must help support your analysis of effects to historic properties, not other types of project impacts. Do not simply include copies of environmental documents or other types of specialized project reports. If there are multiple project alternatives, you should include information about all alternatives that are still under active consideration:

See Attachment 1 - Project Overview

SECTION 3: IDENTIFICATION OF HISTORIC PROPERTIES

Describe whether there are historic properties located within your project APE. To make that determination, use information generated from your own Background Research and Field Survey. Then choose one of the following options to report your findings. Please refer to the Instructions and/or contact an OHPO reviewer if you are unsure about how to identify historic properties for your project.

If you read the Instructions and you're still confused as to which reporting option best fits your project, or you are not sure if your project needs a survey, you may choose to skip this section, but provide as much supporting documentation as possible in all other Sections, then check the box in Section 5.A. to request preliminary comments from OHPO. After reviewing the information provided, OHPO will then offer comments as to which reporting option is best suited to document historic properties for your project. Please note that providing information to complete this Section will still be required and that asking OHPO for preliminary comments may tend to delay completion of the review process for some projects.

Recording the Results of Background Research and Field Survey:

A. Summary of discussions and/or consultation with OHPO about this project that demonstrates how the Agency Official and OHPO have agreed that no Field Survey was necessary for this project (typically due to extreme ground disturbance or other special circumstances). Please **attach copies** of emails/correspondence that document this agreement. You must explain how the project's potential to affect both archaeological and historic resources were considered.

B. A table that includes the minimum information listed in the OHPO Section 106 Documentation Table (which is generally equivalent to the information found on an inventory form). This information must be printed and mailed with the Project Summary Form. To provide sufficient information to complete this Section, you must also include summary observations from your field survey, background research and eligibility determinations for each property that was evaluated in the project APE.

C. OHI (Ohio Historic Inventory) or OAI (Ohio Archaeological Inventory) forms- New or updated inventory forms may be prepared using the OHI pdf form with data population capabilities, the Internet IForm, or typed on archival quality inventory forms. To provide sufficient information to complete this Section, you must include summary observations

from your field survey and background research. You must also include eligibility determinations for each property that was evaluated in the project APE

D. A historic or archaeological survey report prepared by a qualified consultant that meets professional standards. The survey report should meet the Secretary of the Interior's Standards and Guidelines for Identification and OHPO Archaeological Guidelines. You may also include new inventory forms with your survey, or update previous inventory forms. To complete this section, your survey report must include summary observations from your field survey, background research and eligibility determinations for each property that was evaluated within the APE.

E. Project Findings. Based on the conclusions you reached in completing Section 3, please choose one finding for your project. There are (mark one):

☒ Historic Properties Present in the APE:
☐ No Historic Properties Present in the APE:

SECTION 4: SUPPORTING DOCUMENTATION

This information must be provided for all projects.

A. Photographs must be keyed to a street-level map, and should be included as attachments to this application. Please label all forms, tables and CDs with the date of your submission and project name, as identified in Section 1. You must present enough documentation to clearly show existing conditions at your project site and convey details about the buildings, structures or sites that are described in your submission. Faxed or photocopied photographs are not acceptable. See Instructions for more info about photo submissions or 36 CFR § 800.11 for federal documentation standards.
    1. Provide photos of the entire project site and take photos to/from historic properties from/towards your project site to support your determination of effect in Section 5.
    2. Provide current photos of all buildings/structures/sites described.
B. Project plan, specifications, site drawings and any other media presentation that conveys detailed information about your project and its potential to affect historic properties.
C. Copies or summaries of any comments provided by consulting parties or the public.

SECTION 5: DETERMINATION OF EFFECT

A. **Request Preliminary Comments.** For challenging projects, provide as much information as possible in previous sections and ask OHPO to offer preliminary comments or make recommendations about how to proceed with your project consultation. This is recommended if your project involves effects to significant historic properties, if the public has concerns about your project's potential to affect historic properties, or if there may be challenging procedural issues related to your project. Please be aware that providing information in all Sections will still be required and that asking OHPO for preliminary comments may tend to delay completion of the review process for some projects.

    1. We request preliminary comments from OHPO about this project:
    YES ☐ NO ☒

2. Please specify as clearly as possible the particular issues that you would like OHPO to examine for your project (for example- help with developing an APE, addressing the concerns of consulting parties, survey methodology, etc.):

B. **Determination of Effect.** If you believe that you have gathered enough information to conclude the Section 106 process, you may be ready to make a determination of effect and ask OHPO for concurrence, while considering public comments. Please select and mark one of the following determinations, then explain the basis for your decision on an attached sheet of paper:

☐ **No historic properties will be affected** based on 36 CFR § 800.4(d) (1). Please explain how you made this determination:

☒ **No Adverse Effect** [36 CFR § 800.5(b)] on historic properties. This finding cannot be used if there are no historic properties present in your project APE. Please explain why the Criteria of Adverse Effect, [36 CFR Part 800.5(a) (1)], were found not to be applicable for your project:

Although no Federally, State or Locally listed properties were found within the 2 Mile APE, some unlisted properties were found that could potentially qualify for future listing, although none would be considered iconic, histrically unique or rare samples or locations of reported strong significant historic activities. Of these properties, none would be affected adversely by the installation of the wind turbine on the Pettisville Schools campus. None of these properties would receive noise from the turbine (see Attachment 7, "Ambient and Turbine Produced Sosund Level Anaylsis") or flicker from the turbine (see attachment 9, "Shadow Flicker Analysis". None of the properties are within close proximity to the site. None of the properties have designed view elements facing the wind turbine site. None of the properties have a clear view of the turbine and of those that could potentially see the turbine from some location on their property, the turbine would only represent a partial view/minor visual element above the existing natural and environment horizon elements such as telephone poles and trees. (See Attachment 8, "Turbine Visualizations and Photo Report" for sample turbine views)

The nearest Federally listed property is over 3 miles from the site and will not be able to see the turbine.

At 1.5 miles, even if the turbine was fully visible through an unobstructed view on level terrain, due to perspective, the

turbine will only appear to be .9 inches tall at a distance of 2 feet from the viewer's eye, barely perceptible on the horizon. For almost all locations, some obstructions exist taking the likely visibility from no visibility to less than .9 inches at this distance.

No archelogical or native american sites were reported or found.

The project was unanimously approved by the local planning and zoning board.

☐ **Adverse Effect** [36 CFR § 800.5(d) (2)] on historic properties. Please explain why the criteria of adverse effect, [36 CFR Part 800.5(a) (1)], were found to be applicable to your project. You may also include an explanation of how these adverse effects might be avoided, reduced or mitigated:

Please print and mail completed form and supporting documentation to:

Ohio Historic Preservation Office
Attn: Mark J. Epstein, Department Head
Resource Protection and Review
1982 Velma Avenue
Columbus, OH 43211-2497

ARRA GRANT PROGRAM QUESTIONNAIRE
OHIO STATE HISTORIC PRESERVATION OFFICE (SHPO)

This Section to be Completed by Grantee

Grantee Name:	Pettisville Local School District		
Contact Person:	Stephen Switzer AAron Godwin	Title:	Superintendent Owner's Representative
E-Mail Address:	sswitzer@pettisvilleschools.org; AAron@ConserveFirst.com		
Project Address:	Post Office Box 53001, 232 Summit Street, Pettisville, Ohio 43553		

Any Alteration of Structure or Site?: Building Structure/ Site is: (Check One if Applicable)

- ☐ 50 years of age or older?
- ☐ Listed on the National Register of Historic Places?
- ☐ Located in a historic district?

If you answered positively to any of the above questions, complete **Attachment D - Historic Preservation Compliance Form**

Date: May 5, 2010

Section 106 Compliance Report for Pettisville Local Schools Wind Energy Project

Pettisville, Fulton County, Ohio

October 22, 2010
Prepared for: U.S. Department of Energy
Prepared by: Stephen D. Mikesell, ICF International

Purpose of Document

This document was prepared on behalf of the U.S. Department of Energy (DOE), for an Ohio Department of Development (ODOD) State Energy Program (SEP) grant for a single wind turbine for Pettisville Local Schools (proposed project or proposed turbine). This report is intended to achieve Section 106 compliance for DOE for their funding of the proposed wind turbine project at the Pettisville School playing field. This report is a focused Section 106 compliance document and relies on technical studies prepared for this project by The Renaissance Group (TRG), who are acting as the Owner's Representative for Pettisville Schools. Also included in this submission are numerous other documents that were prepared as appendices for the National Environmental Policy Act (NEPA) compliant Environmental Assessment (EA) that DOE is preparing for this project. While all of the documents are attached to this Section 106 submission, the most pertinent of the documents which were used in this evaluation are referenced herein and located in Enclosure 1. The most relevant attachments are: Attachment 5, Pettisville Project Area Maps, and Attachment 6, Non-Listed Properties. Also useful for your review are Attachment 8, the Visualization Report, used to analyze visual impacts, Attachment 7, Sound Analysis, used to analyze the potential for noise impacts, and Attachment 9, Flicker Analysis, used to analyze shadow flicker impacts. The findings of these technical reports are summarized below to analyze the potential for adverse effects.

1. Qualifications of Preparer

This Section 106 Compliance Document was prepared by Stephen D. Mikesell. Mr. Mikesell is a senior architectural historian with ICF International. He has worked for 30 years in the Section 106 compliance field. Before coming to ICF in February 2010, he worked for nine years as the Deputy State Historic Preservation Officer for the State of California. Between 1991 and 2001, he was a partner in a mid-sized cultural resource management firm, specializing in Section 106 compliance. Before 1980 and 1991, he worked as an architectural historian with the State of California, first with the State Historic Preservation Office (SHPO) and later with the California State Department of Transportation.

2. Summary of Findings

Based on a review of the documents and data provided by TRG, DOE has determined that the proposed project will result in No Adverse Effect to properties that might qualify for listing in the National Register of Historic Places. Because the Area of Potential Effects (APE) for this undertaking is large – a two mile radius, or four mile diameter from the turbine site – there are hundreds of potentially eligible properties within the APE. For the purpose of analyzing potential effects to historic properties, this report assumes that all pre-1960s properties are eligible for listing in the National Register of Historic Places (NRHP). This assumption applies only to this proposed undertaking. This report concludes that, even if every older property was National Register eligible, there would not be an adverse effect to any historic properties.

3. Project Description

DOE has provided a SEP grant to ODOD, which selected Pettisville Local School District to receive a portion of its SEP grant funds. DOE would authorize the recipient to continue to expend Federal funding to design, permit , and construct the proposed project for which an EA is underway. The proposed project is a single 750-kilowatt wind turbine, and approximately 2,000 feet of associated electrical underground transmission equipment, at Pettisville's Pre-Kindergarten through Twelfth Grade School which is located at 232 Summit Street, Pettisville, Ohio. The proposed project would provide electricity directly to the high school, reducing electrical demands of the school and lowering the carbon footprint associated with daily operations. The proposed project would be an Aeronautica 750kW turbine mounted on a tower that is 213 feet tall with a 177 feet diameter rotor. At its tallest extent, when a rotor is straight up, the total height of the proposed project would be about 300 feet. (Attachment 1 contains a more detailed project overview).

The proposed turbine site is a parcel that has been farmed continuously until recently. The site has been under construction since 2009 for development of a high school ball field. (Attachment 2 contains the site location on a USGS Topographic Map).

The proposed project is an undertaking (36 CFR 800) because the majority of funding derives from a American Recovery and Reinvestment Act funded SEP grant, which is appropriated to the DOE and distributed through the state of Ohio.

4. Consulting Party Participation

As part of the public notification for the EA for the proposed project, public participation as allowed per 36 CFR Part 800 will be integrated into the NEPA EA. Documentation of DOE Section 106 consultation with OHPO will be included in the EA, which will be open for public comment for 15 days.

The following are some of the organizations notified of the project through the DOE EA scoping process and these organizations will be invited to comment on the Draft EA when it is released to the public.

- Fulton County Historical Society
- Fulton County Commissioners
- Western Reserve Historical Society
- Western Reserve Heritage Association
- The Clinton Township Trustees

According to Indian Entities Recognized and Eligible to Receive Services from the US Bureau of Indian Affairs in Federal Register, Volume 72, Number 55 dated March 22, 2007 (72 FR 13648) and the National Association of Historic Preservation Officers at http://www.nathpo.org, there are no Federally-recognized Tribes in the State of Ohio nor is there a Tribal Historic Preservation Officer for Ohio.

However, DOE has provided the Notice of Availibilty to 57 tribal representatives that are regularly notified of Federal Actions in the state of Ohio.

Prior to this submission, the proposed project was reviewed and made available for public comment at both School Board and Village Planning and Zoning meetings. The proposed project has also been extensively covered in the local media. Attachment 3 contains a list of public meetings and newspaper articles related to the proposed project.

5. Inventory and Evaluation

The proposed project will directly impact a very small piece of land. The foundation for the turbine and associated equipment, and associated construction zones, are expected to be less than one acre in an area that is already under construction for the school's new ball field. The actual foundation will permanently affect approximately 256 square feet. The proposed turbine has the potential to have visual and noise impacts to properties far from the school grounds where the turbine would be installed.

a. Area of Potential Effect

The Pettisville turbine project has two APEs. First, the direct APE, is the area of actual ground disturbance, the 1,600 square foot area that would be excavated for the256 square foot foundation and an additional 2,000 feet that would be excavated for the associated underground electrical transmission equipment. The staging area would be approximately two acres, but no other excavation would take place within this area.

Second is indirect APE. There is no definitive rule for determining the indirect APE for a wind turbine, which can create both visual and audible effects on the adjacent properties. The proposed undertaking involves installation of a tower that is approximately 213 feet tall, with a total height of about 300 feet when the rotor is vertical. As a conservative measure, the proponent has elected to study a two mile APE for indirect effects. This indirect APE was developed based on the height of the proposed project, the surrounding topography, tree cover, and urban forest in the vicinity of the proposed project and simulated visualizations of the proposed project. Noise and flicker effects are quite localized and do not extend far beyond the school property. The two mile APE was selected as the maximum distance from which the proposed project will be seen.

b. Inventory of Properties Identified

There are no previously-identified historic properties (properties previously listed in or determined eligible for listing in the National Register of Historic Places) within the direct or indirect APEs for this proposed undertaking (Attachment 4). The absence of designated properties does not indicate that no properties could be listed or determined eligible. Pettisville is a small farming community of approximately 2,000 people and has likely been bypassed by many of the activities from which determinations of eligibility typically arise, such as Tax Act projects, federally-funded highway projects, etc.

c. National Register eligibility of properties, direct APE

There are no National Register-listed properties within the direct APE for the proposed undertaking. The direct APE, as discussed earlier, is the construction zone for the proposed project. The direct APE is illustrated in the photograph below. As noted, the parcel for the proposed project was farmed until a year ago and is currently under construction to serve as a playing field for the school district. There are no buildings on the site. The parcel is so extensively modified, as shown in the photograph, that there is no reason to suspect that an intact archaeological site exists at this property.

d. National Register eligibility of properties, indirect APE

To determine the potential for adverse effects to historic properties TRG inventoried all buildings and structures built before 1960, located within the 2 mile radius from the proposed project. The results of this inventory may be seen in Attachment 5 “Pettisville Project Area Maps,” and Attachment 6, “Pettisville Non-Listed Properties.” Each entry in Attachment 6 includes a photograph of the property as well as the estimated date of construction (which was provided by the local auditor). Each entry also includes a “located in” field, with the name of the quadrant in which that property is located and a Map ID number, which corresponds to a number highlighted on the quadrant map in which the property is

located. To facilitate an assessment of potential visual impacts, each entry also includes a note of the radius (.5 mile, 1 mile, 1.5 mile, or 2 miles) in which the property is located.

There are 140 properties shown in Attachment 6. These properties fall into two categories: urban use properties (nearly all are single family homes) found in the Central Quadrant and rural properties (nearly all are farmhouses and farm structures), located within the other four quadrants. The qualities of these properties differ considerably from one quadrant to the next. The discussion below summarizes the properties within each quadrant. Attachment 6 contains photographs and more specific information about the properties discussed below.

Central Quadrant Properties: The Central Quadrant properties were mostly built in the first two decades of the 20th century. These were likely in-town homes for prosperous farmers or local merchants and service sector workers. There are 26 properties that were inventoried within this quadrant. All but six of these are single family urban homes. The other properties are two churches, a cemetery, a grain elevator, a store, and a barn which is now used as a store. Nearly all of the homes have an estimated date of construction around 1900, which was used by the local auditor for homes constructed in the 1880 to 1910 range. All of these properties are within ½ mile of the proposed project.

Northwest Quadrant Properties: There are only four properties within this quadrant, two of which are not 50 years old. The two older properties are a farm built in 1900 (423), which is one mile from the proposed project and a barn dating to 1900 (645), which is located two miles from the proposed project.

Northeast quadrant properties: There are six older farm complexes in this quadrant (23, 57, 158, 277, 287, and 295). Four of these have estimated dates of construction in 1900. 277 has an estimated date of construction in 1844, although from the picture it appears likely that the structure was constructed approximately a century later. 287 has an estimated date of construction in 1960 but it is likely a 19th century home. Three of these properties are 1.5 miles from the proposed project and the other three are 2 miles away.

Southwest quadrant properties: There are 16 potentially historic properties in this quadrant, one church and farms. The vast majority of these farm houses have an estimated date of construction of 1900 (an estimate used by the local auditor). Four of these properties are within the .5 mile radius from the proposed project and the rest are 1.5 mile to 2 miles from the proposed project.

Southeast quadrant properties: This quadrant has 15 potentially historic properties, a Mennonite Church and farms. Most of these properties have an estimated date of construction in 1900 (an estimate used by the local auditor). There are two homes from the 1860s, one from the 1940s (although it appears to be much older), and the Mennonite Church, which dates to 1960. Most of these properties are a considerable distance from the proposed project. Five are 2 miles away, three are 1.5 miles away, six are 1 mile away, and one farm is located less than a mile away from the proposed project.

6. Application of Criteria of Adverse Effect

In applying the Criteria of Adverse Effect, it is useful to consider both the nature of the potential impacts and the character of the resources, specifically the qualities that make them eligible for listing in the National Register. The definition of an adverse effect in 36 CFR 800.5 (a) (1) is when "an undertaking may alter, directly or indirectly, any of the characteristics that qualify the property for listing in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling or association."

The ACHP regulations also provide specific examples of adverse effects. These examples are discussed below, as there are different examples that might apply to potential impacts from ground disturbance, noise, and visual impacts.

a. Assessment of impacts from ground disturbance.

As noted in Section 4 above, there are no buildings at the project site and there is no reason to suspect that any intact archaeological sites could have survived the many years of farming and the more recent construction activity arising from conversion of this site from farming to school uses. DOE has determined that the proposed undertaking will have No Effect within the direct APE because there are no properties there that qualify for listing in the National Register and no intact archeological sites.

b. Assessment of impacts from noise.

Potential noise impacts for this undertaking are discussed in detail in Attachment 7, "Pettisville Local Schools Wind Turbine Project Ambient and Turbine Produced Sound Level Analysis." The analysis concludes two things which are pertinent to a potential adverse effect. First, the ambient noise level in the immediate vicinity of the proposed project site is relatively high because of the presence of a busy rail line nearby, as well as truck and automobile traffic. Second, it concludes that the projected project noise output will only exceed 50 dB within a 200 foot radius, which restricts this impact to the playfield in which the proposed project will be constructed.

Relying upon the analysis in Attachment 7, DOE has determined that there will be No Effect to historic properties owing to auditory impacts associated with the installation of the proposed project.

c. Assessment of impacts from visual impacts.

Visual impacts vary due to at least three variables: the distance of a historic property from the visual intrusion; intervening barriers that might diminish visual impacts; and the degree to which the significance of a property hinges upon the presence or absence of visual intrusions.

The potential visual effects from the proposed project are simulated in a series of photo simulations in Attachment 8, "Pettisville Local Schools Wind Turbine Project Turbine Visualization and Photo Analysis." These simulations take into account the distance from the turbine and intervening barriers. These

simulations do not take into account the degree to which the potential significance of historic properties hinge upon the absence of visual intrusions, which is discussed in this report.

As noted in Section 5 above, the potential historic resources within the indirect APE fall into two categories: urban properties which are mapped on the Central Quadrant; and rural properties, which are mapped on the other four quadrants. The Central Quadrant properties are mostly within a half mile of the proposed project, with a few located a mile away.

In Attachment 8, the photo simulations P-V-4, 6, 7, and 9 all illustrate the view of the proposed project within the Central Quadrant (within one-half mile of the proposed project). PV-4 shows the proposed project from just across the street, where it is highly visible. PV-6 shows the proposed project from a cemetery not far from the school. However, at the remainder of the downtown sites the proposed project cannot be seen, because of the dense urban forest of mature trees that block the view of the turbine. The photo simulation below is a typical scene near the center of Pettisville and the turbine is entirely masked by the urban forest. Most of the trees in this view will lose their leaves during fall and winter but the density of the tree cover makes it unlikely the turbine would be visible from this view, even during winter and fall.

PV-8 shows the view of from approximately 1.11 miles away from the proposed project. From here, the proposed project is invisible because of the urban forest, which disguises the proposed project from in most of the downtown area. PV-11 is 1.2 miles away and is from the vantage point of a historic resource (528). At this distance, the proposed project is scarcely visible and represents a small presence on the horizon (photo simulation below). The proposed project is barely visible to the left of the wooden power pole, near the center of the photo simulation.

PV-2 shows the turbine at less than two miles away but from an unbroken sightline across agricultural fields. The turbine can hardly be seen. PV-10 shows the turbine at a distance more than two miles. It can barely be detected.

The photo simulations in Attachment 8 show two things clearly. First, the downtown properties (those in the Central Quadrant) are protected from visual impacts by the presence of the urban forest. Second, the farm properties (in the other four quadrants) are protected chiefly by distance from the turbine.

Attachment 8 also helps analyzes the impact of visual intrusions on the significance of the potential historic properties within the APE. The photographs on pages 17 and 18 and the table on pages 19 and 20 indicate that tall industrial structures are not unusual aspects of the rural landscape of Ohio. The photographs on page 17 show the visual presence of granaries, which are nearly as tall as the proposed project and larger in other respects. The photograph at the bottom of that page shows the visual presence of granaries behind a historic home, a 1900 residence in the southeast quadrant (352). The photographs on page 18 show other types of tall buildings in the area, including a communication tower that appears to be taller than the proposed project. A photograph at the bottom of that page shows one of the potential historic resources, a tall silo that appears to be as tall as a six or seven story building (170). The communications tower photograph is reproduced below.

The general conclusion from Attachment 8 is that the urban and rural properties in and near Pettisville do not exist in a setting free from industrial-type visual impacts. The granaries and silos are integral parts of the agricultural context while other tall structures such as communication towers are located where they can be free from obstructions. These types of tall structures have long been a part of this and most other rural areas of the United States.

This analysis shows that the potential significance of the many properties within a two mile radius of the proposed tower do not derive their significance from the absence of tall structures and visual intrusions. Therefore, it is unlikely that construction of the proposed project would diminish the setting for one of the properties within that radius and render it ineligible for listing in the National Register.

Visual impacts are based on at least three variables: the distance of a historic property from the visual intrusion; intervening barriers that might diminish visual impacts; and the degree to which the significance of a property hinges upon the presence or absence of visual intrusions.

Relying upon the analysis and photo simulations in Attachment 8, DOE has determined that there will be No Adverse Effect to historic properties because the proposed undertaking will not introduce a visible element that will diminish the integrity of the significant historic features of any of the properties within the APE. The closest properties, those located in the community of Pettisville, are shielded from visual impacts by the urban forest. The rural properties do not benefit from the urban forest but are generally at a distance as to make the visual impact insignificant. Finally, the presence of other vertical elements

such as granaries, silos, and communication towers indicate that the potential significance of these properties does not derive from a pristine setting. In fact, many of these tall elements, particularly silos and granaries, have been around for as long as most of the potential historic properties. Taking into account the three elements of visual impacts, DOE has determined that the proposed undertaking will result in No Adverse Effect to any of the assumed historic properties within the APE.

d. Assessment of impacts from shadow flicker impacts.

A shadow flicker analysis (Attachment 9) was completed for the proposed project area to determine the amount of shadow flicker that would be experienced for local receptors as a result of proposed turbine construction. The analysis considered several aspects affecting the casting of shadows and potential impacts on local receptors, including the distance to receptors, angle of incoming solar insolation, and the amount of sunlight experienced at the project site during each of the four seasons.

Results of the shadow flicker analysis indicate that no homes or occupied business structures outside the school would receive significant flickering shadows of over 30 hours per year. While some of the farm to the southwest would receive summer morning shadows, the farm's outbuildings would block most of the shadows from reaching the farmhouse.

Relying upon the analysis in Attachment 9, DOE has determined that there will be No Effect to historic properties owing to shadow flicker impacts associated with the installation of the proposed project.

7. Conclusions

This report supports DOE's conclusion that the proposed project will result in No Adverse Effects to properties that may qualify for listing in the National Register of Historic Places.

February 7, 2011

Melissa Rossiter
NEPA Document Manager
U.S. Department of Energy
1617 Cole Boulevard
Golden, CO 80401

Dear Ms. Rossiter:

RE: Pettisville Local Schools Wind Energy Project, Fulton County, Ohio

This is in response to your correspondence dated October 25, 2010, (received October 28, 2010). Our comments are made pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, and the associated regulations at 36 CFR Part 800.

The Pettisville Local School District proposes to use funds from the Ohio Department of Development (ODOD) State Energy Program to facilitate the construction of a 300' wind turbine adjacent to the new school playing fields south of County Road D. You have requested the comments of the Ohio Historic Preservation Office regarding the effects of this project on historic properties.

We have reviewed the information submitted by the Renaissance Group, consultant for this Section 106 submission. The Renaissance Group's report concludes that the proposed wind turbine will have no adverse effect on properties listed in or eligible for listing in the National Register of Historic Places (NRHP) located within the Area of Potential Effects (APE). Since the proposed wind turbine site is buffered by the Pettisville Local Schools complex, fields and several blocks of apparently non-historic development, mainly houses built in the later decades of the twentieth century, it is our opinion that no historic properties will be affected by this project. In addition, the project site is unlikely to yield significant archeological resources. In future submissions, however, please identify the location of all areas of ground disturbance.

No further coordination with this office is necessary unless there is a change in the project. If historic properties are identified during implementation of the project, please notify our office pursuant to 36 CFR Section 800.13.

If you have any questions, please contact me by phone at (614) 298-2000 or by email at jbertram@ohiohistory.org. Thank you.

Sincerely,

Jamie Bertram

Jamie Bertram, Project Reviews Manager
Resource Protection and Review

Cc: James Huth, Advanced Energy Program Manager, Ohio Energy Resources Division, Ohio Department of Development, Post Office Box 1001, Columbus, Ohio 43216-1001
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