Large Filing Separator Sheet

Case Number: 09-1066-EL-BGN

File Date: 12/21/09

Section: 1

Number of Pages: 200

Description of Document: Application
Volume 2

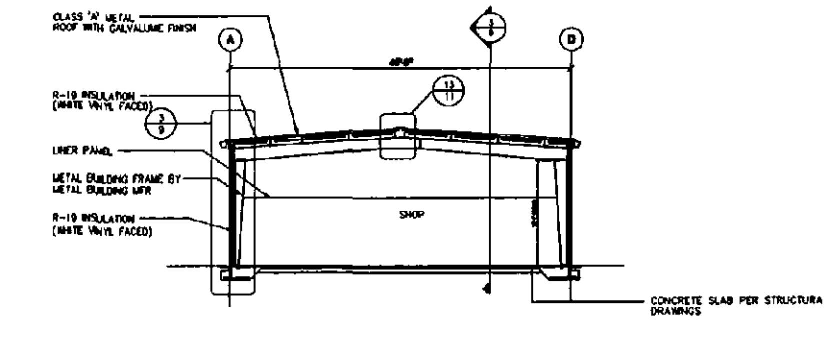
BEFORE
THE OHIO POWER SITING BOARD

In the Matter of the Application of **HEARTLAND WIND, LLC** for a Certificate to Site a Wind-Powered Electric Generation Facility in Van Wert County, Ohio and Paulding County, Ohio	)))))	Case No. 09-1066-EL-BGN

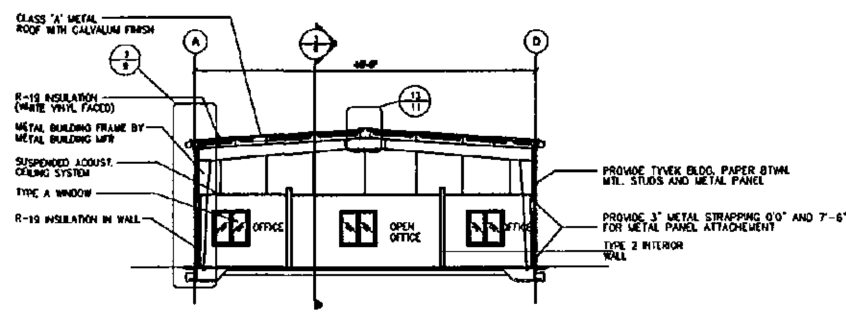
VOLUME II

APPENDICES A – Y

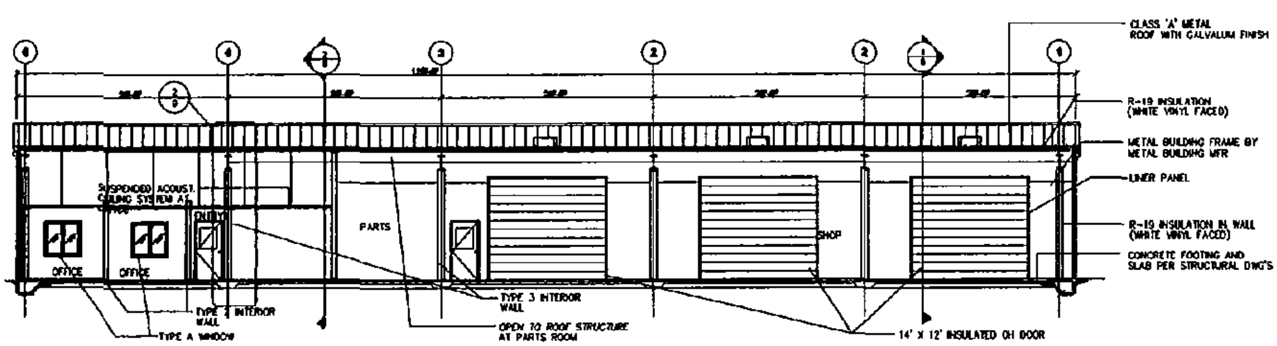
December 21, 2009



① SHOP BUILDING SECTION



③ OFFICE BUILDING SECTION



⑤ BUILDING SECTION

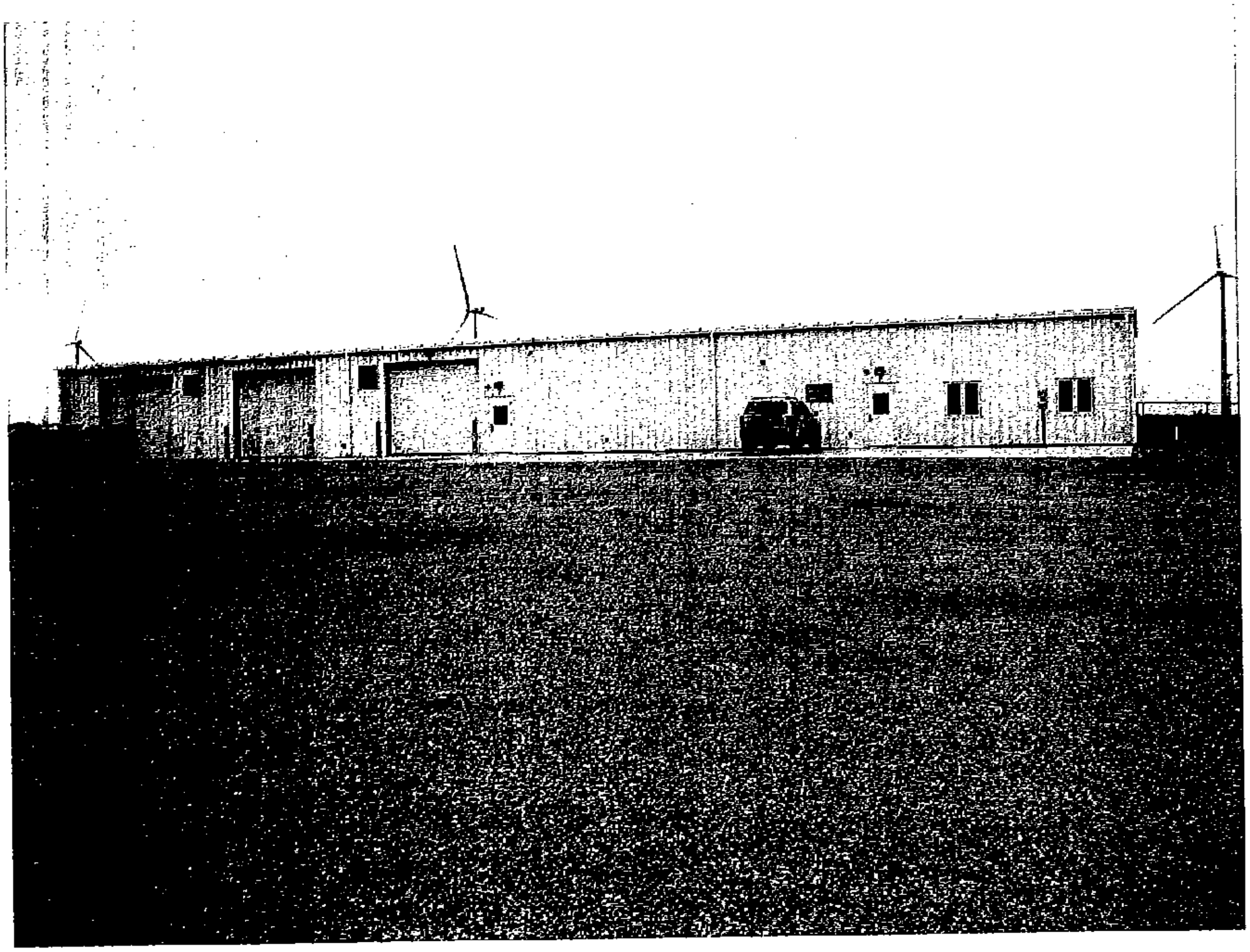
Scale: Not to Scale

IBERDROLA RENEWABLES

Typical O&M Building

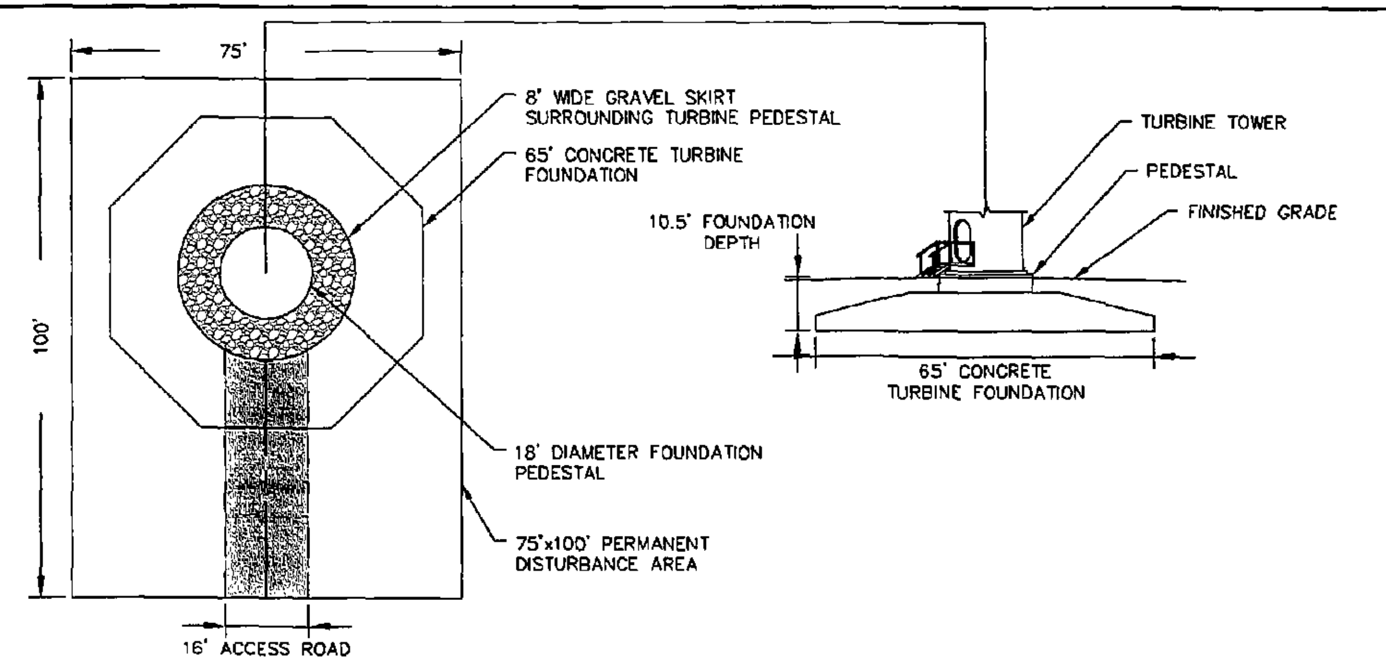
BLUE CREEK WIND FARM

CH2MHILL



IBERDROLA
RENEWABLES

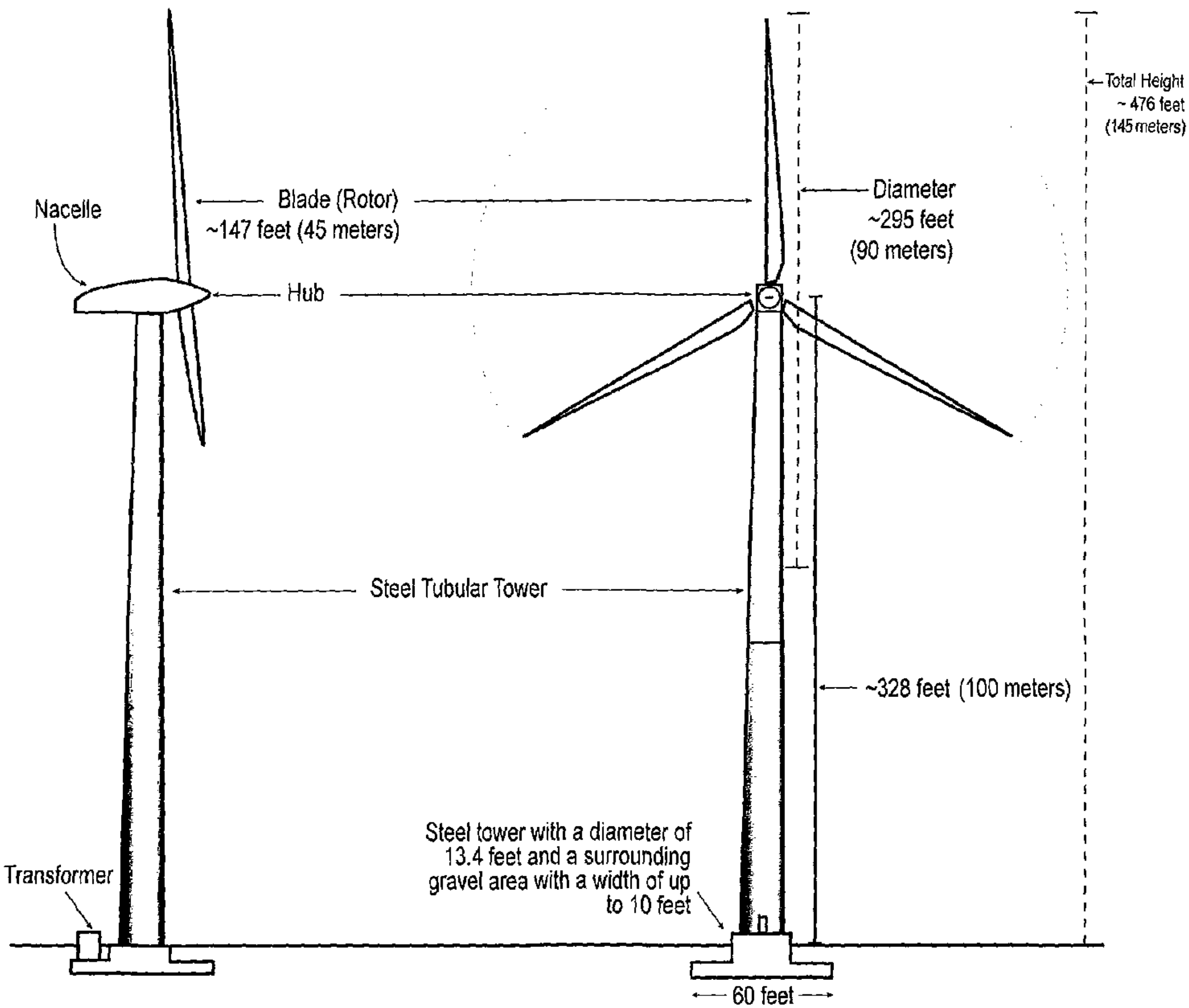
Photo of Typical O&M Building
BLUE CREEK WIND FARM



TYPICAL POST-CONSTRUCTION WIND TURBINE GENERATOR DISTURBANCE AREA

LAST REVISED: 12/10/09

TS09



IBERDROLA

Typical Wind Turbine and Tower

BLUE CREEK WIND FARM

CH2MHILL

General Cable Product Data Sheet

35kV Rated, 100% Insulation Level, Single

CONDUCTOR: 1000 KCMIL 61 Wires COMPRESS Aluminum Class B Strand STRANDFILL®

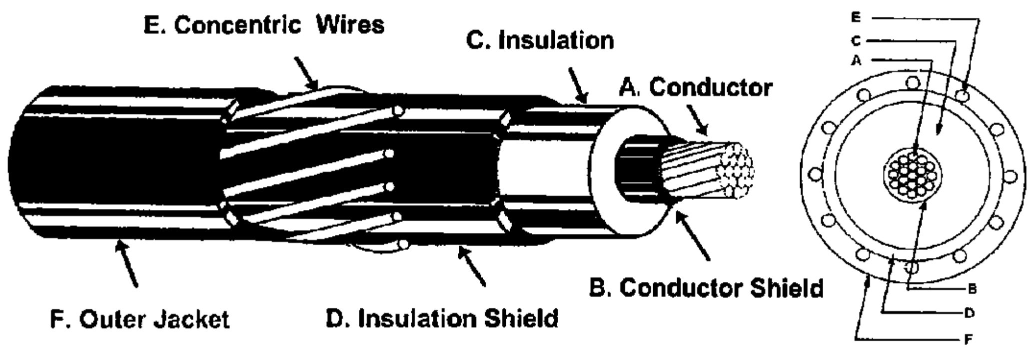
B. CONDUCTOR SHIELD: Extruded Semiconducting Thermoset Polymer

C. INSULATION: Extruded Tree Retardant Crosslinked Polyethylene EmPowr®Link

D. INSULATION SHIELD: Extruded Semiconducting Thermoset Polymer and Swellable Powder

E. CONCENTRIC NEUTRAL: 20 × #10 AWG Bare Copper Concentric Neutral Wires

F. OUTER JACKET: Encapsulated Linear Low Density Polyethylene



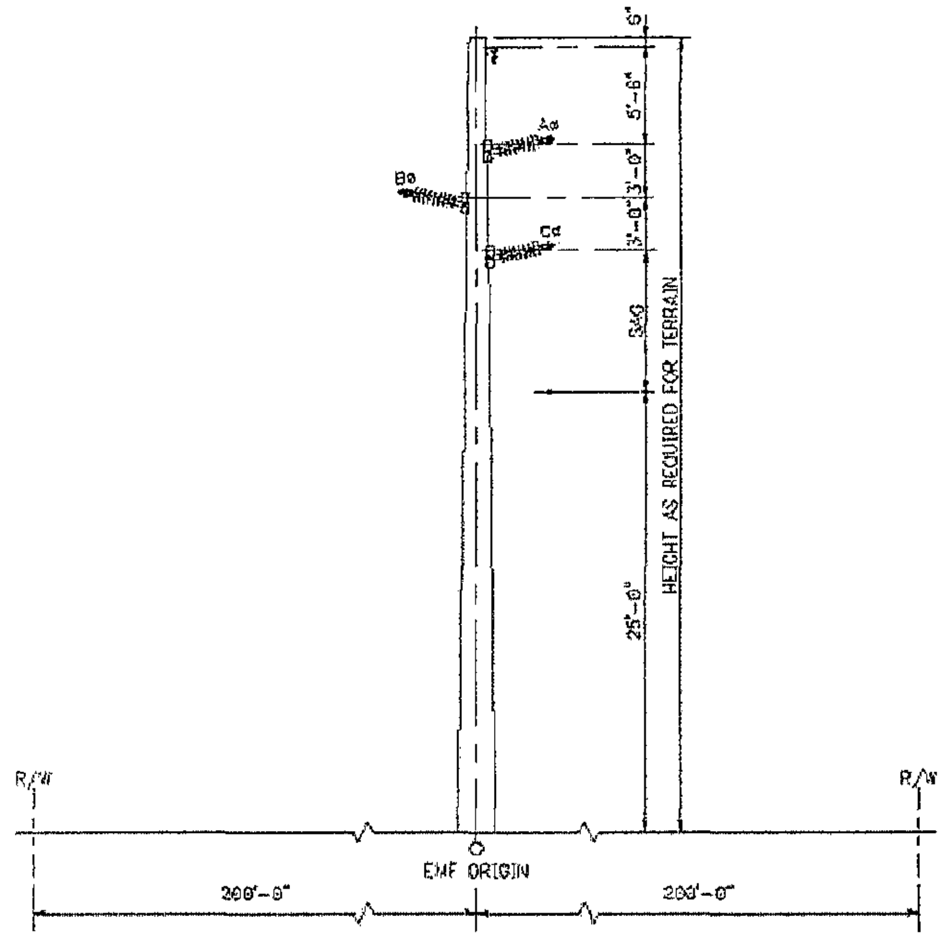
Component	Thickness		Diameter (Inches)			Diameter (mm)		
	Inches	mm	Minimum	Nominal	Maximum	Minimum	Nominal	Maximum
Conductor				1.117			28.371	
Cond. Shield *	0.020	0.508		1.175			29.845	
Insulation *	0.330	8.382	1.815	1.865	1.920	46.101	47.37	48.768
Insul. Shield *	0.055	1.397	1.925	1.984	2.070	48.895	50.393	52.578
Conc. Neutral	.1019	2.588		2.188			55.575	
Outer Jacket *	0.070	1.778		2.348			59.639	
* Minimum Point	Total Weight:		3032.52 lbs./kft			4512.99 kg/km		

Industry Standards: ICEA S-94-649 and AEIC CS8-07 As Applicable.

Customer Spec: 35KV URD FOR WIND FARMS Dated: 01/18/2007 No.:

Prepared By:	RP			Drawing No.: V - 15386
Approved By:	NV	E.A.:	PC No.: 189469	Date: 8/22/2007

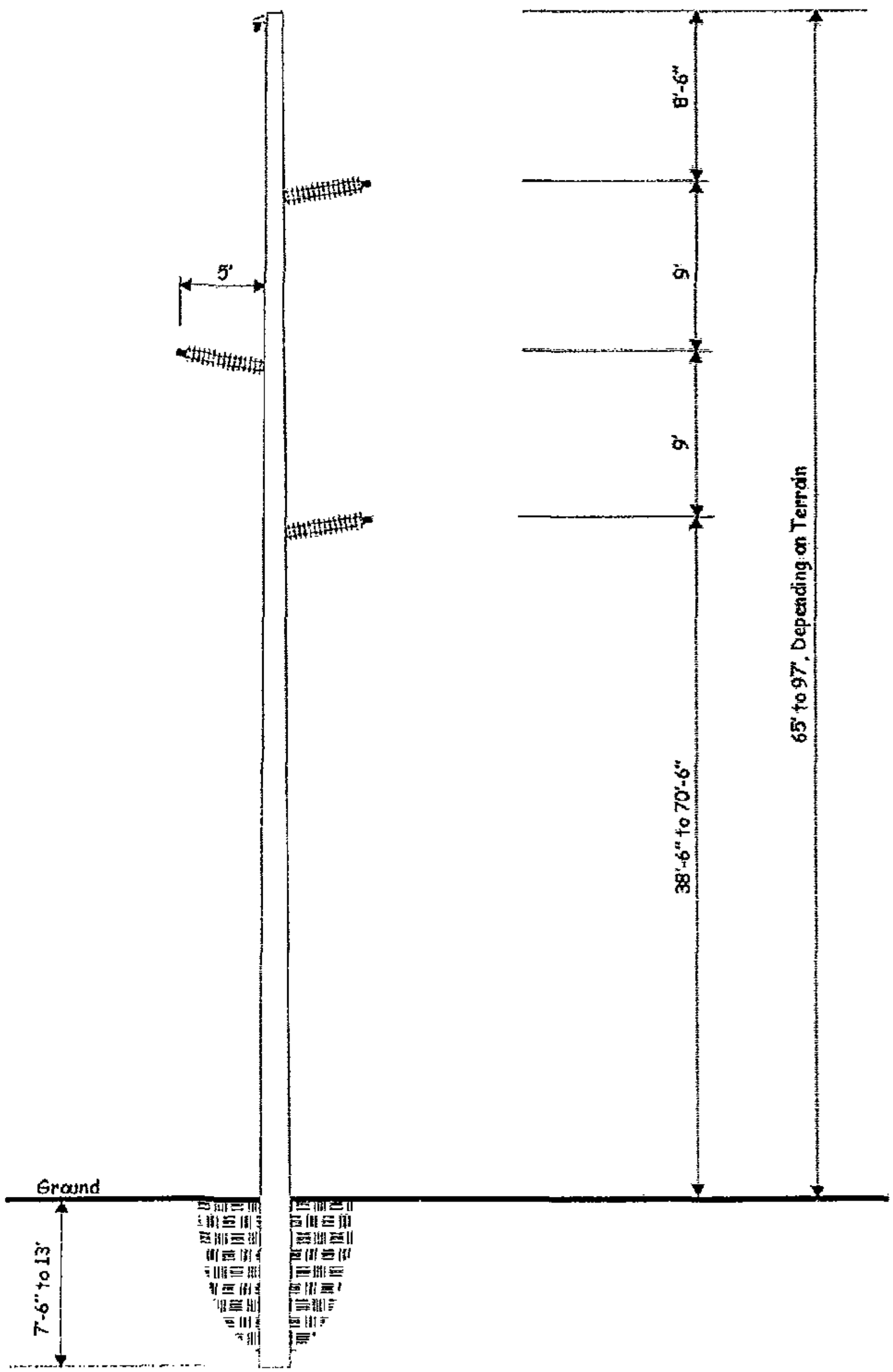
4 Executive Boulevard, Suffern, NY 10901
Phone: 845-369-6000 FAX: 845-357-7992



IBERDROLA RENEWABLES

Typical Overhead 34.5-kV Single-Circuit, Monopole Support Structure

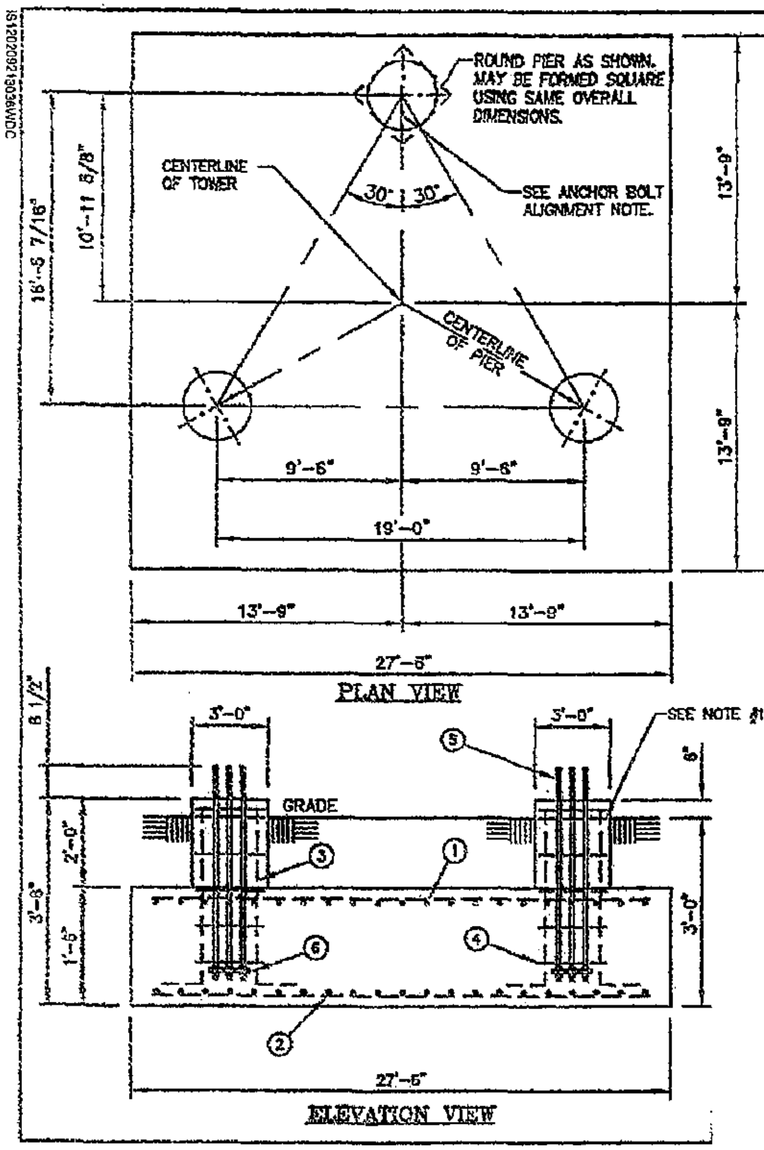
BLUE CREEK WIND FARM



IBERDROLA
RENEWABLES

Typical 115-kV Monopole Support Structure

BLUE CREEK WIND FARM

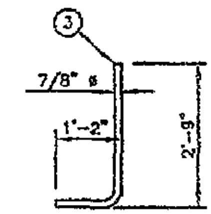


REINFORCING STEEL SCHEDULE								
ITEM	LOCATION	NO. REQ'D.	BAR SPC'G.	SIZE	CUT LGTH.	TOTAL LGTH.	TOTAL WT.	SHAPE
③	PAD TOP REINFORCING	76	EQUALLY SPACED	#8	27'-0"	2052'-0"	5479 LBS.	STRAIGHT
②	PAD BOTTOM REINFORCING	76	EQUALLY SPACED	#8	27'-0"	2052'-0"	5479 LBS.	STRAIGHT
③	PIER VERTICAL REINFORCING	42	EQUALLY SPACED	#7	3'-11"	164'-6"	336 LBS.	
④	PIER TIES	12	SPACED 12" C/C	#4	8'-9"	105'-0"	70 LBS.	
						TOTAL REBAR WT.	11364 LBS.	

ANCHOR BOLT SCHEDULE				
ITEM	PART NO.	NO. REQ'D.	ANCHOR BOLT SIZE	SPACING
⑤	C40041003	12	1 1/2 ø X 3'-4"	EQUALLY SPACED

TEMPLATE SCHEDULE			
ITEM	PART NO.	NO. REQ'D.	BOLT CIRCLE
⑥	C30139001	6	1'-8"

CONCRETE REQ'D	ROUND PIERS	SQUARE PIERS
PAD	42.01 CU. YDS.	42.01 CU. YDS.
PIERS	1.57 CU. YDS.	2.00 CU. YDS.
TOTAL	43.58 CU. YDS.	44.01 CU. YDS.



REBAR DETAIL
(PIER VERTICAL REBAR)

GENERAL NOTES

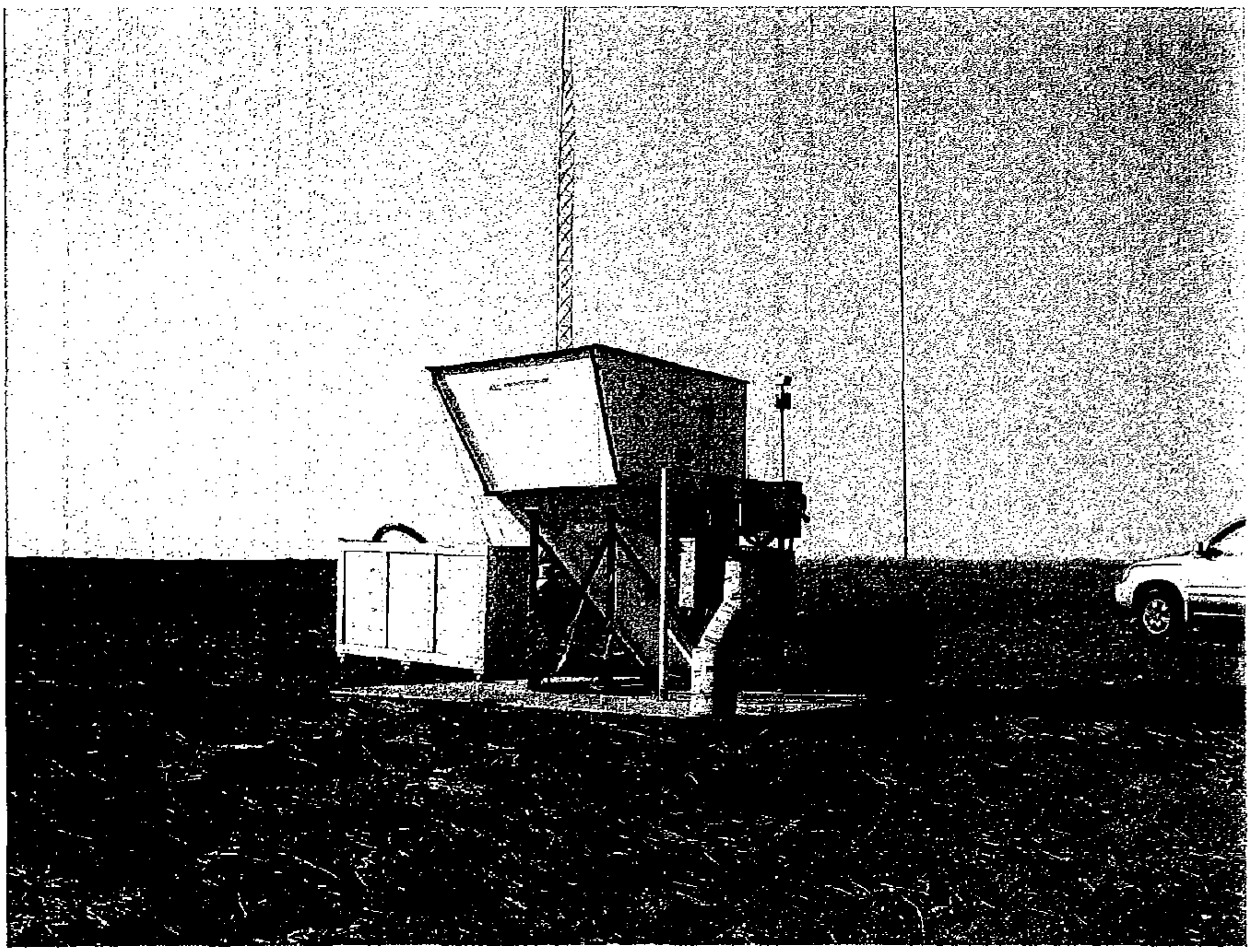
1. CONCRETE SHALL HAVE A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 3000 PSI, IN ACCORDANCE WITH ACI 318-02. (2 REBAR TIES REQ'D IN THE TOP 5")
2. REBAR TO CONFORM TO ASTM SPECIFICATION A615 GRADE 60.
3. ALL REBAR TO HAVE A MINIMUM OF 3" CONCRETE COVER.
4. ALL EXPOSED CONCRETE CORNERS TO BE CHAMFERED 3/4".
5. THE FOUNDATION DESIGN IS BASED ON THE GEOTECHNICAL BORING BY NORTHERN, INC., PROJECT NO. 205-569, NOVEMBER 14, 2005.
6. SEE THE GEOTECHNICAL REPORT FOR COMPACTION REQUIREMENTS, IF SPECIFIED.
7. ONE ANCHOR BOLT MUST BE ALIGNED DIRECTLY WITH THE CENTER OF THE TOWER (TYPICAL)

IBERDROLA RENEWABLES

Typical Meteorological Tower Foundation
BLUE CREEK WIND FARM

CH2MHILL

IS120209213036WDC



IBERDROLA RENEWABLES

Photo of a Typical SODAR Unit

BLUE CREEK WIND FARM

BEFORE
THE OHIO POWER SITING BOARD

In the Matter of the Application of **HEARTLAND WIND, LLC** for a Certificate to Site a Wind-Powered Electric Generation Facility in Van Wert County, Ohio and Paulding County, Ohio	Case No. 09-1066-EL-BGN

MOTION FOR WAIVERS

Applicant, Heartland Wind, LLC., pursuant to Ohio Administrative Code ("OAC") Rule 4906-01-03 and Rule 4906-7-12(C), respectfully moves the Ohio Power Siting Board ("Board") to grant the following waivers on an expedited basis:

(1) From the one-year notice period as set forth in Ohio Revised Code Section ("R.C.") 4906.06(A)(6);

(2) From providing an extensive site selection study to the extent that Applicant is not able to describe all the specific information listed in the site selection criteria as set forth in OAC Rule 4906-17-04(A);

(3) From providing map of vegetative cover as set forth OAC 4906-17-05(A)(3)(g), and instead allow the Applicant to provide a <u>general narrative description</u> of the vegetative cover that may be disturbed during construction; and

(4) From certain requirements relating to cross-sectional views and test borings set forth in OAC 4906-17-05(A)(4), and instead allow the Applicant to submit this information once it determines the final location of turbines and other structures.

Further support for these waiver requests is set forth in the Memorandum in Support below.

<u>MEMORANDUM IN SUPPORT</u>

I. BACKGROUND

Heartland Wind, LLC, ("Applicant" or "Heartland Wind") whose sole member and manager is Iberdrola Renewables, Inc., who in turn is a subsidiary of Iberdrola, S.A., the leading energy group in Spain and the fourth largest utility company in the world. With nearly 10,000 MW of renewable energy in operation globally, and more than 3,000 MW of that consisting of wind power in the United States, Iberdrola, S.A. currently is one of the world's leading providers of wind power. The Applicant's parent company is in the process of expanding its portfolio of clean and renewable energy projects in 23 countries (including the United States) by, among other measures, developing wind energy projects. In 2008 alone, the Applicant's parent company invested $2.2 billion in wind energy projects in the United States. Currently, Iberdrola Renewables, Inc. or its wholly owned companies, have successfully completed wind power projects in 13 states.

Expanding the Iberdrola Renewables, Inc. wind operations into Ohio, Heartland Wind, plans to submit an application to the Ohio Power Siting Board ("Board") in the near future for a Certificate to construct and operate a 350 megawatt wind generation facility to be located in portions of Van Wert County and Paulding County (known as the "Blue Creek Wind Farm"). The proposed Blue Creek Wind Farm will consist of 175, G87 turbines with a name-plate capacity of 2.0 MW manufactured by Gamesa, or other similar wind turbine models, and associated infrastructure (i.e. access roads, electrical collection system, construction staging area, operations and maintenance facilities and substations). The wind turbine array will be spread across 15,000 acres of leased land, located in portions of three (3) primarily agricultural townships in Van Wert County (Tully, Union and Hoaglin), and two (2) primarily agricultural townships in Paulding County (Blue Creek and Latty).

Based upon the unique nature of wind generation facilities, Heartland Wind. is seeking waivers from certain requirements of R.C. 4906.06 and the new OAC Chapter 4906-17 governing wind applications.

II. EXPEDITED RULING – OAC Rule 4906-7-12(C)

A ruling on this Motion is required in order for Applicant to complete an application in conformance with the applicable requirements in OAC Chapter 4906-17. Applicant plans to file its application approximately late December 2009. Meeting this filing date is necessary to allow

Applicant to begin construction by September 2010 so that the project can commence commercial operation of the first phase by no later than the end of 2011 and the second phase by no later than 2012.

As set forth in this waiver request, and as will be evident in the application itself, Applicant has conducted the requisite analyses and studies, and obtained the necessary site commitments, so that Applicant can meet its ambitious schedule. For these reasons, Applicant asks that the review of its waiver requests be undertaken on an expedited basis and urges the Board or Administrative Law Judge to decide this Motion on that basis.

III. WAIVER REQUESTS

A. RC 4906.06(A)(6): Waiver of the One Year Notice Period

Pursuant to RC 4906.06, an application for the siting of a wind generation facility must be filed "not less than one year nor more than five years prior to the planned date of commencement of construction." The statute also allows the Board to waive these time limits for "good cause" shown. Applicant requests the Board to waive the one-year requirement between the dates an application is filed and construction is commenced.

Applicant plans to submit an application for this project in mid to late December 2009. Through this waiver request, Applicant seeks the flexibility to begin construction-related activities prior to the commencement of the one-year milestone date contemplated by the statute. Applicant's desire to take full advantage of the longest period possible of construction weather, and shorten the construction period as much as possible so as not to inconvenience affected property owners for more than one construction season, appears to satisfy the good cause required by the statute.

Furthermore, a waiver from the one year period is authorized by statute and the Board has routinely granted the waiver for at least the last decade, including in a number of recent wind cases. See *In the Matter of Hardin Wind Energy LLC for a Certificate to Site a Wind-Powered*

Electric Generation Facility in Hardin County, Ohio, Case No. 09-479-EL-BGN, Entry (July 17,2009). See also *In the Matter of the Application of Black Fork Wind LLC for a Certificate of Environmental Compatibility and Public Need for the Siting of a Wind Powered Electric Generating Facility in Richland and Crawford Counties*, Case No. 09-546-EL-BGN, Entry (October 1, 2009).

B. OAC Rule 4906-17-04(A): Waiver of an Extensive Site Selection Study

As part of Applicant's application, it will be providing a significant amount of information regarding the company's selection of its site in both Van Wert County, Ohio and Paulding County, Ohio. Wind resource is extremely limited in Ohio; there are only a handful of project sites with the wind resource necessary to support a utility scale project. The convergence of sufficient wind resources, sufficient transmission capacity and interested landowners willing to lease their land – all are needed for a viable wind energy project. In order for Ohio utilities to meet the requirements for renewable energy mandated by the Ohio legislature, all viable Ohio wind sites must be considered as potential wind energy project sites. Each specific criterion set forth in OAC Rule 4906-17-04 may not apply even though the site is an appropriate one for a wind energy project. OAC Rule 4906-17-04 contemplates extensive detail in a site selection study. Applicant will be providing a description of the project boundary; the rationale for selecting the site; a map of the general project area; a list and description of qualitative siting criteria (i.e. constraints such as setbacks, noise, etc.); and a constraint map. Applicant is aware that there is no approved form for a site selection study used in Chapter 17 of the Board's rules. Moreover, as the Board recognized in promulgating the wind application rules, where an applicant limited its study to locations where there are potentially viable wind resources, it would be appropriate for the Board to grant a waiver from filing an extensive site selection study[1].

1 Opinion and Order in Case No. 08-1024-EL-ORD issued October 28, 2008 at paragraph 56.

Assuming that Heartland Wind files the site selection information indicated above, Applicant requests a waiver to the extent that each specific factor in OAC Rule 4906-17-04 (A) is not met.[2]

This waiver request is not novel: waivers from this subsection have been granted in a number of recent wind cases. *See In the Matter of Hardin Wind Energy LLC for a Certificate to Site a Wind-Powered Electric Generation Facility in Hardin County, Ohio*, Case No. 09-479-EL-BGN, Entry (July 17,2009); *In the Matter of the Application of Buckeye Wind LLC for a Certificate to Construct Wind Powered Electric Generating Facilities in Champaign County, Ohio*, Case No. 08-666-EL-BGN, Entry (July 31, 2009); and *In the Matter of the Application of Black Fork Wind LLC for a Certificate of Environmental Compatibility and Public Need for the Siting of a Wind Powered Electric Generating Facility in Richland and Crawford Counties*, Case No. 09-546-EL-BGN, Entry (October 1, 2009).

C. OAC 4906-17-05(A)(3)(g): Waiver to Allow Applicant to Provide a General Narrative Description of the Vegetative Cover that May be Disturbed During Construction, Rather than the Required Map.

OAC 4906-13-04(A)(3) requires Heartland Wind to submit a map showing, among other things, the vegetative cover that may be removed during construction. Given the large footprint of the project area, the Applicant's map does not portray the vegetative cover to be removed. Heartland Wind, however, will provide in its application a general narrative description of the vegetative cover that may be removed during construction, and will quantify the vegetation that may be disturbed during construction.

A similar waiver from this subsection was granted in a recent wind case, *In the Matter of the Application of Buckeye Wind LLC for a Certificate to Construct Wind Powered Electric Generating Facilities in Champaign County, Ohio*, Case No. 08-666-EL-BGN, Entry (July 31, 2009).

---

[2] Applicant is unsure of the quantitative factors referenced in paragraph (A) (1) (c) that requires a "comprehensive list and description of all. . . quantitative siting criteria."

D. OAC 4906-17-05(A)(4): Waiver to Allow Applicant to Submit Information Relating to Cross-Sectional Views and Test Borings Once it Determines the Final Location of Turbines and Other Structures.

Heartland Wind requests a waiver from the requirement that it provide a map and a corresponding cross-sectional view showing the location of test borings pursuant to Rule 4906-17- 05(A)(4). As part of its application, Heartland Wind will provide a geological desktop study aid and a generalized cross-sectional view based on available information. Applicant proposes to merely defer this requirement but later to supplement its filing by providing a cross-sectional view and the location of test borings once the final turbine sites are determined. This type of waiver with the proposed deferral was granted in *In the Matter of the Application of JW Great Lakes, LLC, for a Certificate to Construct a Wind Powered Electric Generating Facility in Hardin County, Ohio*, Case No. 08-666-EL-BGN, Entry (September 18, 2009).

WHEREFORE, Applicant respectfully requests that the Board waive the requirements set forth above and grant such other and further relief to which it may be entitled.

Respectfully submitted on behalf of
HEARTLAND WIND, LLC

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BEFORE
THE OHIO POWER SITING BOARD

RECEIVED-DOCKETING DIV 2009 NOV 24 PM 4:58 PUCO

In the Matter of the Application of **HEARTLAND WIND, LLC** for a Certificate to Site a Wind-Powered Electric Generation Facility in Van Wert County, Ohio and Paulding County, Ohio	)))))	Case No. 09-1066-EL-BGN

CLARIFICATION TO
MOTION FOR WAIVERS

On November 6, 2009, Applicant, Heartland Wind, LLC ("Heartland Wind" or "Applicant"), pursuant to Ohio Administrative Code ("OAC") Rule 4906-01-03 and Rule 4906-7-12(C), filed a motion for waiver with the Ohio Power Siting Board ("Board") to grant the following waivers on an expedited basis:

(1) From the one-year notice period as set forth in Ohio Revised Code Section ("R.C.") 4906.06(A)(6);

(2) From providing an extensive site selection study to the extent that Applicant is not able to describe all the specific information listed in the site selection criteria as set forth in OAC Rule 4906-17-04(A);

(3) From providing map of vegetative cover as set forth OAC Rule 4906-17-05(A)(3)(g), and instead allow the Applicant to provide a <u>general narrative description</u> of the vegetative cover that may be disturbed during construction; and

(4) From certain requirements relating to cross-sectional views and test borings set forth in OAC Rule 4906-17-05(A)(4), and instead allow the Applicant to submit this information once it determines the final location of turbines and other structures.

Representatives of Heartland Wind, having had discussions with Board Staff, believe that two of its waiver requests should be clarified by including additional information: the third and fourth request for waivers, pertaining to OAC Rule 4906-17-05 (A)(3)(g) vegetation cover information and OAC Rule 4906-17-05(A)(4) pertaining to cross sectional view and test borings.

With respect to the third waiver request, OAC Rule 4906-13-04(A)(3) requires Heartland Wind to submit a map showing, among other things, the vegetative cover that may be removed during construction. Applicant will also give a general description and provide a drawing of the vegetation that would be cleared in the Project area, (i.e., the disturbed area). However, an attempt to provide this detailed information for the massive acreage that comprises the Project area plus a five-mile buffer would be cost prohibitive. In light of the fact that Applicant will provide the vegetation information within the limited disturbance area, additional data would serve no useful purpose because the Board and Staff will have the relevant data for the impacted areas. Moreover, greater then 95% of the surface vegetation is agricultural land consisting predominantly of soybean, alfalfa and corn. Therefore Heartland Wind proposes to provide in its application a **general** narrative description of the vegetative cover within the Project area and will estimate the quantity of specific vegetation that may be disturbed or removed during construction.

A similar waiver from this subsection was granted in a recent wind case, *In the Matter of the Application of Buckeye Wind LLC for a Certificate to Construct Wind Powered Electric Generating Facilities in Champaign County, Ohio*, Case No. 08-666-EL-BGN, Entry (July 31, 2009).

The fourth waiver request pertained to cross-sectional views and test borings. In reviewing the application instructions for OAC Rule 4906-17-05 (A)(4), Heartland Wind representatives noted that "maps and corresponding cross-sectional view(s) showing geological features of the proposed project area and the location of test borings" are required. Heartland Wind has selected 18 sites which it believes to be representative of the type of areas where turbines, access roads and ancillary wind facilities will be located. It has chosen these sites where six borings were made and twelve Cone Penetration Tests were performed. Cross sectional views will be provided based upon the results of those tests.

Heartland Wind plans to perform geological tests (either bores or Cone Penetration Tests) at each of the final turbine location sites later in the process. As part of the final engineering design process, the results of the geological tests and cross sections will be provided to the Board

Staff at a reasonable time prior to construction in accordance with Finding No. 66 of the Opinion and Order in Case No. 08-1024-EL-ORD, issued October 28, 2008.

Heartland Wind requested a waiver of this requirement because its representatives were not certain of the scope of the geological tests and cross sectional views the Board Staff expected to be included in the application. As mentioned above, Heartland Wind has made 18 geological tests at locations representative of the wind facility locations and will provide cross sectional views based upon these.

If the 18 test locations and cross sectional views meet the requirements of the rule, Heartland Wind's waiver request on this requirement is unnecessary. However, to the extent that the rule requires more information and more cross sectional views than described above, Heartland Wind requests the waiver from Rule 4906-17- 05(A)(4). This type of boring and cross sectional view waiver with was granted in *In the Matter of the Application of JW Great Lakes, LLC, for a Certificate to Construct a Wind Powered Electric Generating Facility in Hardin County, Ohio*, Case No. 09-277-EL-BGN, Entry (September 18, 2009).

WHEREFORE, Applicant respectfully requests that the Board consider these clarifications to the four waiver requests filed on November 6, 2009 and waive the requirements set forth above and grant such other and further relief to which it may be entitled.

Respectfully submitted on behalf of
HEARTLAND WIND, LLC

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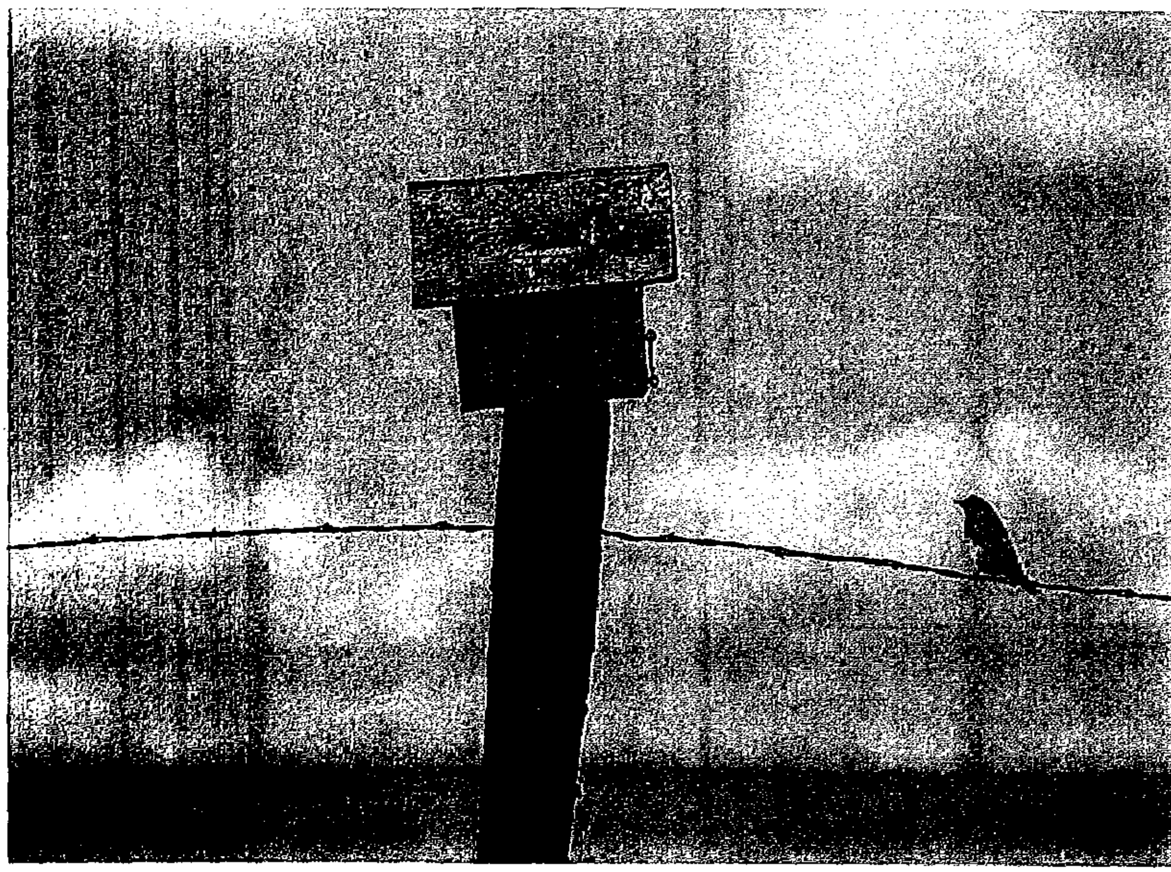
IBERDROLA RENEWABLES

Avian and Bat Protection Plan



October 10, 2008

IBERDROLA
RENEWABLES

IBERDROLA RENEWABLES			
DOCUMENT AMENDMENT RECORD			
Version	**Date Issued**	**Date Effective**	**Purpose of Issue and Description of Amendment**
A (draft—will become Version 1 upon final approval)	31- December 2007		Initial Issue
1	10-10-08	10-10-08	Final Approved Document

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Introduction

IBERDROLA RENEWABLES and its subsidiaries (collectively, Iberdrola) believes that conservation of the environment must be integral to the conduct of company activities. As an environmentally conscious company, Iberdrola is committed to promoting development of clean energy production, with its associated environmental benefits, while limiting the adverse environmental effects that can be associated with such clean energy production. Iberdrola is also committed to sustaining that obligation during facility operations. Iberdrola recognizes that the development and operation of wind energy projects may have direct and indirect impacts on birds, bats, and other wildlife resources and their habitats. Direct impacts include strike mortality from turbine blades, power lines and related infrastructure, electrocution from overhead collector and transmission lines, and loss of habitat from the footprint of the project. Indirect impacts may include displacement of birds and bats and other wildlife from their habitats, site avoidance, and behavioral modification. This Avian and Bat Protection Plan ("ABPP" or "Plan") supports practices and processes intended to minimize impacts to birds and bats from Iberdrola wind projects.

Iberdrola wind projects are subject to multiple Federal and state laws that protect birds and other wildlife and their habitats. Most birds in the United States are protected by the Migratory Bird Treaty Act (MBTA)[1]. In addition, bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (BGEPA), and some other species potentially found at wind project sites are protected by the Endangered Species Act. These laws provide for possible penalties for "take" of such species. "Take" under the MBTA is defined as to "pursue ,hunt, take, capture, kill...possess, offer for sale, sell...purchase...ship, export, import...transport or cause to be transported...any migratory bird, any part, nest, or eggs of any such bird...." The MBTA and BGEPA do not include language that provides for the issuance of "incidental" or "accidental "permits to take protected birds that are killed incidental to otherwise lawful activities, and thus any death of a protected bird at a wind project is a violation of these statutes. [2] Wildlife protection statutes in many states have similar provisions (e.g., California's "Fully Protected Species, Fish and Game Code").

The goal of this ABPP is to implement a series of best practices for all of Iberdrola's US wind activities, in order to operate in an environmentally sustainable manner to avoid or minimize and reduce risk to birds, bats and their habitats[3]. This ABPP is modeled on similar

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[1] Most avian species are protected; exceptions are non-native and nonmigratory species, which are the following: house sparrows, European starlings, rock doves (or common/feral pigeons), monk parakeets, and nonmigratory upland game birds.

[2] The USFWS is developing a final rule under BGEPA to establish a permit program to authorize "take" that is associated with otherwise lawful activities. The Service anticipates that permits issued under the regulation will usually authorize disturbance only; however, in some limited cases, a permit may authorize lethal take that results from but is not the purpose of the activity. Programmatic take (take that is recurring and not in a specific, identifiable timeframe and/or location) would be authorized only where it is unavoidable despite implementation of comprehensive measures developed in cooperation with the Service to reduce the take below current levels (see the Service's Draft Environmental Assessment released August 14, 2008, for additional details regarding "Programmatic permits"). This type of authorization could be extended to industries, such as electric utilities or some transportation industries, that currently take eagles without authorization but who can implement additional, exceptionally comprehensive measures to reduce take to the level where it is essentially unavoidable.

[3] Iberdrola recognizes that its obligations under the law as well as its wildlife stewardship responsibilities extend to trust wildlife resources other than birds and bats. Nothing in this plan is intended to overlook those responsibilities; however, because birds and bats are potentially issues at all sites, whereas other wildlife issues are typically site specific, the focus of this plan is on birds and bats. Other wildlife issues will be addressed in project-specific Avian and Bat Protection Plans.

Avian Protection Plans (APPs) that have been developed by U.S. electric utilities to protect birds and manage their risk under wildlife statutes—risk primarily associated with collisions and electrocution from overhead transmission and distribution lines and other utility equipment. Those plans were developed following the *Avian Protection Plan (APP) Guidelines* issued by the Edison Electric Institute's Avian Power Line Interaction Committee (APLIC) and the U.S. Fish and Wildlife Service (USFWS or Service) in April 2005. Iberdrola worked with the USFWS to "translate" the wires-oriented APP guidelines to apply to the particular issues faced by a wind energy generation company. Because habitat fragmentation and bat mortality have emerged as concerns at wind projects in a number of locations around the country, Iberdrola has expanded the scope of the Plan to address these issues as well.

This ABPP applies to all of Iberdrola's wind activities, including project development, construction, operations, and decommissioning, as well as any projects acquired from third parties. Iberdrola's development pipeline had numerous projects in various stages of development or acquisition before this ABPP was developed. Therefore, most portions of the Plan are effective on approval of this plan by Iberdrola management, but other sections will be implemented over time (see Section 6, Implementation).

For each wind project constructed after January 1, 2010, Iberdrola will implement a project-specific ABPP to address issues particular to the project site, and to outline how the corporate ABPP is applied to a specific project. The project-specific ABPP will summarize information about the project's species and habitats, development-stage surveys and studies, post-construction monitoring, mitigation commitments, and other variables specific to each site that could affect wildlife and their habitats. An outline of a project-specific ABPP is provided in Appendix A.

A key element of this corporate ABPP and each project-specific ABPP will be discussion with the USFWS and other relevant wildlife agencies early in the development process (within the constraints imposed by competition for land rights and other competitive aspects of the business). Early-stage consultation may include telephone conversations, in-person meetings, database requests, and other information sharing. In all cases, Iberdrola expects discussion with the USFWS to occur before irretrievable commitments are made to develop a project.

In 2007, USFWS appointed a Wind Turbine Guidelines Advisory Committee (including an Iberdrola representative) to advise the USFWS about "effective measures to avoid or minimize impacts to wildlife and their habitats related to land-based wind energy facilities." It is anticipated that once the USFWS has issued new guidelines, based in part on recommendations from the advisory committee, expected to be available in approximately two years, Iberdrola may revise the corporate ABPP as necessary. After that, the ABPP will be reviewed periodically and revised as necessarily to reflect new knowledge gained from current science as well as from Iberdrola experience with constructing and operating wind projects. All appropriate Iberdrola personnel involved in the development, operation, and oversight of Iberdrola wind projects will be trained in the development, implementation, and follow-up of this ABPP. Periodic audits will be conducted to confirm that Iberdrola's activities continue to comply with its provisions.

SECTION 1

Corporate Policy

Iberdrola policy is that wind projects shall be sited, designed, constructed, and operated in an environmentally sustainable manner to avoid or minimize adverse environmental impacts. Wind projects that comply with this principle will minimize potential impacts to birds, bats, and other wildlife and their habitats. However, it is recognized that wind turbines and associated overhead transmission and collector lines may cause injuries and deaths to birds and bats in spite of best efforts, including birds and bats protected by Federal and state laws and regulations. This ABPP is intended to support Iberdrola's compliance with key wildlife laws, by instituting clear and consistent procedures to minimize impacts to birds and bats and their habitats and to address impacts where they are identified.

To fulfill this commitment, Iberdrola will do the following:

- Implement and comply with its own comprehensive ABPP.
- Ensure its actions comply with all applicable state and Federal laws, regulations, permits, and ABPP procedures.
- Follow procedures described in this ABPP during the development of all new wind projects in order to understand avian and bat risk at each site and to incorporate features to avoid or minimize impacts to these species.
- For development or operational projects acquired from third parties in merger or acquisition transactions, ensure through the due diligence and acquisition process that preproject or operational practices employed by third parties prior to Iberdrola ownership are consistent with the ABPP, or if not consistent, document inconsistencies, develop a strategy for implementing ABPP practices, and implement ABPP practices as soon as practical.
- Document bird and bat mortalities and injuries at projects and/or structures in order to implement adaptive management actions as necessary.
- Provide information, training, and resources to improve staff knowledge and awareness of the requirements of the ABPP in order to support the ABPP's successful implementation at both the company level and as applied at specific projects.
- Participate with public and private organizations in programs and scientific research to identify causes and effective controls of detrimental effects of bird and bat interactions with wind projects.
- Continue to enhance the ABPP by applying lessons learned, research results, new technologies, and latest regulations and guidelines.

Through the proactive and innovative resolution of bird and bat interactions with our wind projects, this ABPP will support Iberdrola's regulatory compliance and leadership position in the wind industry, reduce risk to birds and bats and their habitats, enhance stakeholder acceptance of our wind projects, and support the responsible growth of the wind industry.

Signature: ____________________

Terry Hudgens, President and CEO, IBERDROLA RENEWABLES

Date: Oct. 15 2008

SECTION 2

Site Suitability Assessment and Project Design

Iberdrola will use the best available accepted science in its siting decisions, and will participate in industry/stakeholder research to continuously improve decisions about siting and designing wind projects and reducing environmental impacts.

Normally, site assessment and design will parallel other project development activities and include the following:

- Preliminary site assessment: fatal flaw assessment and/or Phase 1 avian or bat risk assessment
- Site-specific avian and wildlife studies
- Incorporation of information from environmental studies in the layout and design of projects
- Where Iberdrola is expanding an existing wind project or developing a new wind project adjacent to a project for which abundant relevant environmental information is available, one or more of these steps may be modified based on the amount and value of previously collected environmental information.

As a standard practice, Iberdrola will meet with agencies and stakeholders, early in the process of evaluating the potential to develop a wind project at a particular site, and before permit applications are submitted or irretrievable commitments of resources are made. These stakeholder and agency discussions are a screening process for environmental issues at potential sites to help identify appropriate preproject environmental studies. Early discussions with agencies and nongovernmental organizations (NGOs) can also help identify areas or regions with known sensitive habitats and/or resources that should be avoided for wind project development. Furthermore, building key stakeholder relationships early in the process can improve the development process.

Figure 1 shows a preconstruction avian point count survey in progress.

Figure 1: Preconstruction Avian Point Count Survey (Photo courtesy of Karen Kronner)

"Fatal flaw assessments" and "Phase 1 Avian or Bat Risk Assessments" are both tools to identify risk early in the development process: the "Phase 1 Avian or Bat Risk Assessment" is focused on wildlife issues, while a "Fatal Flaw Assessment" may also address other issues, such as visual impacts. In most cases, they are internal documents used to guide Iberdrola decision-making, and will not normally be available for agency or public review. One or both types of assessment may be used.

2.1 Preliminary Site Assessment

Early in project development, the Iberdrola permitting team will prepare a "fatal flaw" or "key issues" report, which will identify key wildlife, important habitats, and other environmental issues at the site and identify likely permit requirements. The existence and adequacy of this report will be confirmed by Iberdrola's Wind Permitting Director or another designated person before significant or irreversible commitments are made to develop a site for wind energy. This report will identify species protected by the MBTA, BGEPA, ESA, and state wildlife laws that may be present in the project vicinity, and identify the likelihood of the species being present on the site. It will also identify the presence of any designated critical habitat for protected species, and summarize other available information on the presence of sensitive species (e.g., Birds of Conservation Concern, Breeding Bird Survey declining species, imperiled water birds, known migratory corridors, known migratory stop-over locations, and watchlist species). This report will be used in the decision about whether or not to proceed with next steps in project development, and to guide the appropriate level of formal or informal consultation with Federal and state wildlife agencies. This fatal flaw report may not be necessary in locations where Iberdrola is expanding an existing project or developing a project near an existing project where there is abundant relevant environmental information.

A Phase 1 Avian and Bat Risk Assessment is another preliminary site assessment tool that provides a level of information intermediate between a fatal flaw analysis and preconstruction surveys. It is typically used where additional wildlife information, beyond what would be provided by a fatal flaw study, is needed in order to identify key site-specific wildlife issues and refine the scope for preconstruction surveys. The goals of a Phase 1 Avian or Bat Risk Assessment are typically to:

- Collect information about the type, number and seasonality of use of birds and bats known or suspected to use a project site and the area surrounding the site
- Determine the degree and type of risk to birds and bats from wind power development at a particular site, and whether such risks are great enough to cease project development efforts
- Understand concerns of regulators and environmental organizations
- Identify options for avoiding or mitigating impacts
- Identify further research needed to assess specific risk or fill information gaps needed to assess risk

The data sources that are used for a Phase 1 Avian and Bat Risk Assessment will vary from site to site, but will include, as appropriate to the site:

- Agency consultation and review of databases, including USFWS, state natural heritage program, Breeding Bird Surveys, USGS Breeding Bird Atlas, Audubon Important Bird Area maps, and other relevant state or local information sources.
- Site reconnaissance visit by a wildlife biologist to observe site conditions and identify habitats present

Information from a project Fatal Flaw Assessment, Avian and Bat Risk Assessment, or both will be used internally by Iberdrola management in its assessment of whether to:

- Move ahead with the additional studies necessary to evaluate and mitigate avian and bat risks during project development; or
- Move ahead with additional wildlife studies but hold off decisions to develop a project pending the results of such additional studies; or
- Decide to terminate efforts to develop a site.

In all cases, consideration of wildlife issues will be integral to deciding whether a project should be developed or terminated.

2.2 Preconstruction Studies

Iberdrola will typically conduct at least 1 year of preconstruction avian surveys using statistically valid methods appropriate for the site, season, and species being studied (Anderson et al. 1999 and 2003). The determination of the appropriate survey design, including the number of seasons, will be documented in the project-specific ABPP and based on the characteristics of the site and the availability of information appropriate for extrapolation from nearby areas with similar habitats and topographical features. The need for new avian use surveys may be modified or reduced based on the availability of relevant information on avian use developed in connection with an existing wind project or otherwise pertinent to the proposed development site.

Where data review and agency consultation identify substantial displacement of resident birds as a potential impact of the project, preconstruction surveys should include bird use surveys. Displacement studies may require more intense study (e.g., a denser network of survey points or use of transects). Where there is a concern about substantial impacts to breeding birds, surveys will be conducted during the appropriate breeding season.

Iberdrola will conduct raptor nest surveys near all project facilities where raptors are expected to nest, and will develop appropriate buffer distances between active nests and (1) construction during nesting/fledging season and (2) turbine locations[4]. The survey area size and methodology will vary according to project terrain and cover (for example, aerial surveys may be appropriate in steep open terrain, while surveys on foot using taped calls may be more appropriate in forested areas).

Preconstruction study methods to assess risk to bats are less well developed than for birds. Iberdrola is participating in research through the Bat Wind Energy Cooperative (BWEC) at

[4] Guidelines on appropriate buffer distances vary by region and species, and appropriate state and Federal wildlife agency references should be consulted.

several Iberdrola project sites to develop better assessment methods. Iberdrola will install Anabat acoustic monitors on a sample of met towers at a range of prospective project locations across the country, reflecting a range of habitats and regions (Figure 2). Data will be collected at these sites using methodologies developed in consultation with the BWEC, and based on peer-reviewed protocols published in recent scientific journals. The goal of this data collection will be to contribute to the evaluation of bat risk assessment methodology being conducted by the BWEC, and, as the methodology is validated at multiple sites, to use the data to assess potential risk to bats. Anabat results will be analyzed by a qualified bat specialist to evaluate potential bat use of the sites.

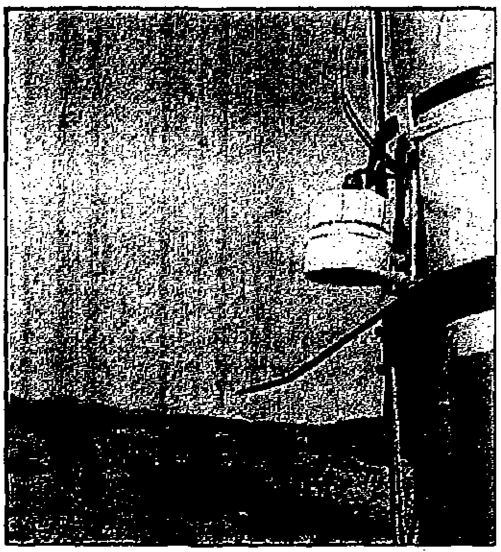

Figure 2: Anabat and "Bat Hat" Installed at Dillon Wind Project, CA

Preproject assessment will also include species-specific surveys for state and Federal sensitive species that are indicated to have the potential to occur on the project site.

The level and nature of other environmental studies (such as habitat mapping and wetlands studies) will be determined based on characteristics of the site and the information available about the site or nearby sites with similar characteristics. Iberdrola would normally expect to do more environmental studies at sites in regions that do not have existing wind projects than those where studies have been performed.

Preproject surveys will not typically include night radar monitoring, except in cases where there is evidence of the likelihood of especially high numbers and low flight altitudes of migratory birds, or particular concern with "fall out" conditions or migratory stop-over locations in the project vicinity. Nocturnal radar studies at a broad range of project areas have consistently shown the large majority of night migrants (birds and bats) fly at altitudes well above turbine height in normal weather conditions (Young et al. 2006). However, Iberdrola recognizes that at some locations (e.g., areas where there is evidence of substantial migratory movements in the project area, evidence of weather events that may cause bird "fallout," and little information about the altitude of migration), radar or other nocturnal measurement tools may be appropriate. An example of such a situation is wind development along the South Texas Coast, where Iberdrola has conducted 3 years of studies, including the use of radar and infrared sensors. All nocturnal investigations will follow the advice on design and methodology contained in the NWCC nocturnal methods and metrics guidance (Kunz et al. 2007).

Results of preconstruction studies will be used to evaluate the level of wildlife risk at each project and to influence project design to reduce wildlife risk. In some cases, these studies may lead Iberdrola to cease development of a project with undue wildlife risk, or in other cases to build wildlife avoidance and mitigation features into the project design and budget.

2.3 Site Design

Iberdrola project design will observe the following guidelines:

- Project turbine design/layout:
  - To the extent practicable and commercially reasonable, development should be maximized in cultivated or otherwise disturbed or fragmented habitats (e.g., the Klondike II Project in Oregon, located on land cultivated for wheat, or the Casselman Project in Pennsylvania, located on reclaimed strip mine) and minimized in contiguous high quality habitats.
  - Turbine towers should be set back an appropriate distance from defined canyon "breaks" or cliff edges where avian surveys indicate that such areas have high avian use (for example, the 300-foot setback from canyon rim used at the Big Horn Project in Washington; see Northwest Wildlife Consultants, 2008). The appropriate distance will be based on site-specific considerations of topography and avian use.
  - All permanent meteorological towers should be unguyed and unlit unless required to be lit by the FAA.
- Collector/Transmission system
  - There are two ways that overhead lines create potential risk to birds: risk of electrocution and risk of collision. *Suggested Practices for Avian Protection on Power Lines, the State of the Art in 2006* provides the current advice about electrocution avoidance; *Mitigating Bird Collisions with Power Lines: the State of the Art in 1994* is the most current sourcebook for designs to reduce the risk of collision (and is due to be updated over the next two years). Both documents are available from APLIC (http://www.aplic.org/) or in hard copy from the Edison Electric Institute).
  - To the extent commercially reasonable, collector lines should be placed underground and overhead lines minimized except as required to avoid wetlands, and canyon crossings, to otherwise to reduce environmental impacts, or because of geotechnical conditions. Where placing collector lines underground is not feasible, avian-safe designs must be employed.
  - Overhead lines should be designed per APLIC's current standards in *Suggested Practices for Avian Protection on Power Lines, the State of the Art in 2006* and *Mitigating Bird Collisions with Power Lines: the State of the Art in 1994* and updates) for avian-safe design contained in the two documents referenced above. All collector and transmission line design contracts must specify this design standard. Design includes the following and other standards:
    - Minimum separation of 150 cm (60 inches) between phase conductor and phase conductor and grounded hardware
    - Where such separation is not feasible, insulation should be used to prevent electrocution
    - Appropriate markers should be used in locations with elevated collision risk

- Other facilities:
  - Minimize lighting at O&M and substation facilities; motion-detector and/or (second choice) down-cast lights must be used. Where lighting must be used, it should have the minimum intensity while meeting safety and operational requirements.

Figure 3 illustrates a problem 69-kilovolt (kV) overhead transmission system pole. Figure 4 illustrates a raptor-safe 69-kV overhead transmission pole.

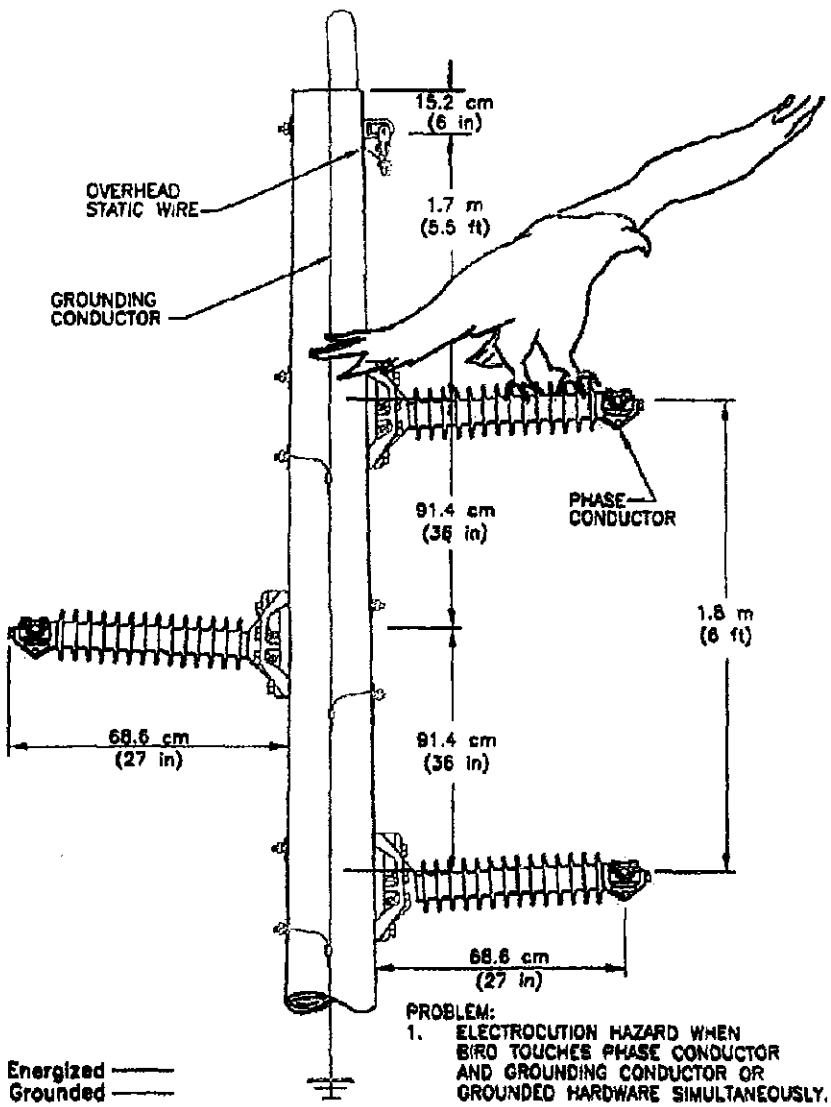

Figure 3: Example of Problem 69-kV Overhead Transmission System Pole

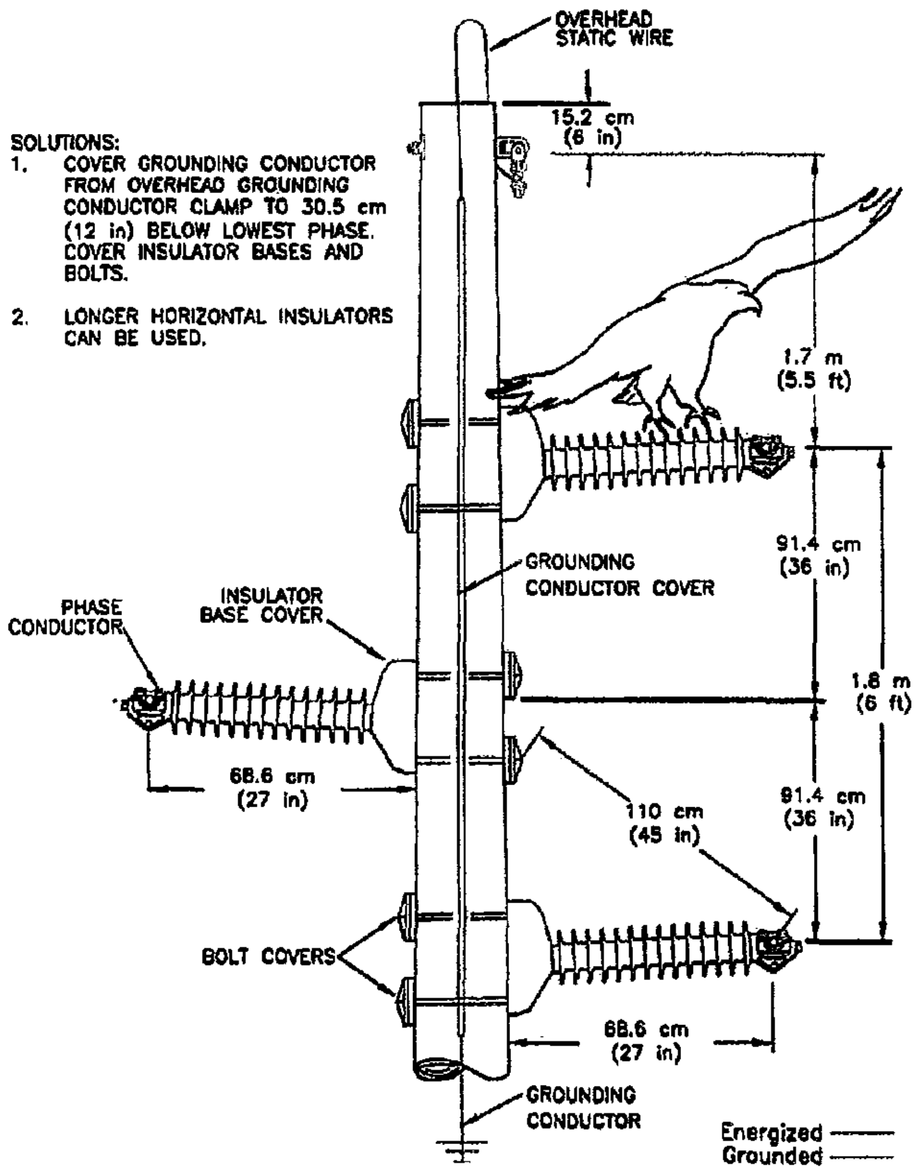

Figure 4: Example of Raptor-Safe 69-kV Overhead Transmission Pole

SECTION 3

Wildlife Considerations at Operating Projects

3.1 Post-Construction Monitoring

3.1.1 Formal Monitoring Programs

Formal post-construction avian and bat monitoring conducted by trained consultants will occur at most sites starting the first year of commercial operations, even if not required by permit. Post-construction monitoring, when not required by permit, will help Iberdrola identify and address any avian or bat issues, at existing and possibly at future sites. Exceptions are appropriate where there are already multiple years of monitoring at nearby sites with similar vegetation, topography, land use and wildlife species, or where little uncertainty exists regarding impacts (e.g., a new project proposed for an area like the Buffalo Ridge wind resource area of Minnesota/South Dakota, for which four years of monitoring were conducted by the State of Minnesota). Typically at least 1 year of post-construction mortality monitoring will occur—more where specified by permit or voluntary agreement, where the first years' monitoring suggests an extraordinary fatality rate and/or where weather conditions are highly variable, substantially affecting migration timing and intensity.

The type of monitoring that will be conducted at each site will be selected as appropriate to the site, and may include avian and bat mortality monitoring (conducted by trained biologists sometimes aided by search dogs), avian use surveys, raptor nest surveys, radar studies and/or thermal imaging. All monitoring programs will follow the guidance of Anderson et al., 1999, Kunz et al. 2007, and updates of these and other guidance documents. All monitoring programs will be reviewed by a qualified biostatistician, and will include corrections for searcher efficiency and carcass removal rates appropriate for the species of concern and the site, as well as estimates of the precision and variance of the survey results. Post-construction monitoring will typically consist of fatality studies. However, studies may be expanded to consider wildlife use or behavior if required by permits, or if deemed necessary to make comparisons with preconstruction data, when that is an objective of monitoring.

Figure 5 shows post-construction monitoring in action at the Big Horn Wind Project in Bickleton, Washington.

Figure 5: Post-Construction Monitoring at Big Horn Project, Bickleton, WA
(Photo courtesy of Karen Kronner)

The cost of post-construction monitoring varies greatly depending on the number of years, the percent of turbines sampled, and the sample interval. These factors will vary from project to project, depending on the following factors:

- **Purpose of the monitoring.** If the goal of monitoring is to confirm the general level of avian mortality predicted in preconstruction studies or to estimate the quantity of raptor fatalities, then a less frequent sampling interval may be suitable, assuming the sampling is relatively continuous within the project area. If the goal of monitoring is to quantify bat mortalities or to identify correlations between mortality and other factors such as weather, or impacts to specific species, more frequent monitoring may be necessary.
- **Carcass removal rates.** Sampling frequency may also be adjusted where scavenging is especially high, and more frequent sampling is necessary to provide accurate results.
- **Ground cover/visibility.** Where there is dense vegetation, mowing or clearing under the turbines to be sampled should be considered if feasible. In some cases, where visibility is low, the use of trained dogs may be a useful supplement to human searchers. Dogs have been shown to have high detection rates in some circumstances; however, they have the disadvantage of lower detection in very dry conditions, and they tend to tire more quickly than trained human searchers.
- **Availability of appropriate post-construction monitoring data from other projects in the area or from other sources of relevant available data.** Where such monitoring results are available, less intense or no formal monitoring may be needed at the new project to confirm the general level of avian and bat mortality.

A summary of the results of post-construction monitoring will typically be shared with wildlife agencies and the public once the monitoring report has been reviewed by Iberdrola, and consultants will be encouraged to publish data where appropriate.

When formal fatality monitoring is being conducted, any time plant operations staff or contractors find a dead bird or bat, the operator should photograph it, leave it in place, and inform the monitor, who will log the location and characteristics of the animal and as necessary inform Iberdrola environmental staff. If the Service has an operating mortality reporting system for wind projects similar to what is now being utilized by the electric utility industry (see Section 3.1.3, Reporting), Iberdrola staff will input that mortality information into the Service's reporting database. However, until that system is operating, Iberdrola staff will immediately report to the Service mortalities of any eagle, any sensitive species (including any listed birds and/orb bats), and more than five birds or bats found under a single turbine. If a bird or bat is alive but injured, the operator should notify the wildlife rehabilitation center that has been identified as appropriate to the project location.

3.1.2 Informal Monitoring

After formal monitoring is complete, all projects will implement a site-specific Wildlife Reporting and Handling System (WRHS). The operator who finds a dead bird or bat should leave it in place, photograph it, and record the finding (including the location, date, and species) on the WRHS reporting form (Appendix C). If the bird is a protected species, that fact should be reported to Iberdrola environmental staff, who will inform the appropriate state or Federal wildlife agencies. Any eagle carcass must ultimately be delivered to the National Eagle Repository in Denver following contact with the Service. If a bird or bat is alive but injured, the operator should notify the wildlife rehabilitation center that has been identified as appropriate to the project location. Posters will be prepared for each project to show species that are NOT protected; to specify reporting protocols; and to identify key contacts. Once the Service's on-line database can accept wind project data, any mortality of a protected bird should also be reported to the database.

3.1.3 Reporting

During both formal and informal monitoring, all avian and bat incidents (mortalities and injuries) will be entered into the Iberdrola WRHS database. USFWS currently maintains a database that electric utilities can use to record transmission/distribution system avian incidents. The Service is considering modifying that database to allow it to be used for recording wind project incidents. Iberdrola will work with the Service to pilot-test the use of the database for wind projects and, when it is functioning, to use it to report avian and bat incidents (in which case, the Service's database will be used instead of Iberdrola's database).

For each plant site, posters will be prepared showing reporting protocols, which birds must be reported, and key wildlife contacts.

Each year, avian and bat mortality statistics will be compiled into an annual Iberdrola summary report, plus other performance indicators about this ABPP and recommendations for improvement. This ABPP summary report will be reviewed by a team including identified Iberdrola Executive Management, Iberdrola Environment, Health, and Safety and Office of General Counsel and other appropriate personnel at Iberdrola. Once the review is complete, a summary of avian and bat mortality and any related observations or recommendations will be provided to the USFWS.

3.2 Impact Assessment

Sources of information about avian or bat impacts at operating projects include results of formal post-construction monitoring as well as operations reports of wildlife incidents.

Where results of formal monitoring indicate that either project-wide or per turbine mortality, whether for birds or bats, is higher than anticipated based on preproject evaluations, on comparisons with regional averages, and/or on discussions with wildlife agencies, that finding will be considered an action level to reexamine the scope and sources of the avian or bat risk (see Section 4.1, Impact Reduction and Mitigation Measures) and to discuss causes and mitigation with state wildlife agencies and the USFWS. Because variation in mortality could reflect annual variation in bird or bat use of the area and/or the survey's statistical methods, and because determination of the significance of the fatalities may require additional monitoring (e.g., estimation of use), monitoring may be an appropriate step.

If formal monitoring is not being conducted, a report by operating staff of any "incident" of unusual mortality event will be a trigger action to re-examine the scope and sources of the avian or bat risk. The need for additional study or action will depend on the species found—there will be less concern for non-native species such as pigeons that are not protected by the MBTA than for native species including species protected by the MBTA, with particular concern for more sensitive, declining, or imperiled species.

3.3 Nest Management

Some birds, including hawks and ravens, may use transmission and distribution poles, which provide substrate for nests. In some cases, bird nests can cause operational problems and may cause outages. For utilities with many miles of transmission and distribution lines and associated poles, managing nests is an important issue. Chapter 6 of APLIC's *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006* provides detailed instructions on handling problem nests and for creating safe nest structures, as well as requirements for permits, which may be required under both Federal and state wildlife statutes[5]. For wind power companies, nest management is rarely an issue that affects operations or avian safety because of the relatively limited amounts of overhead transmission. However, all affected staff should be aware of this potential.

In the following cases, operations staff must contact Iberdrola environmental staff for further guidance:

- Where birds have constructed nests in locations where they may affect operations or safety
- Where providing a nest platform or other substrate has been identified as a goal (e.g., as a mitigation action)

[5] Not all nests are of equal sensitivity: the USFWS is concerned about increasing densities of crows and ravens as a result of increased foraging and nesting opportunities associated with growing infrastructure in the arid west.

Operations staff will not remove or modify nests unless directed by Iberdrola environmental staff.

Figure 6 shows a ferruginous hawk nest in Sherman County, Oregon.

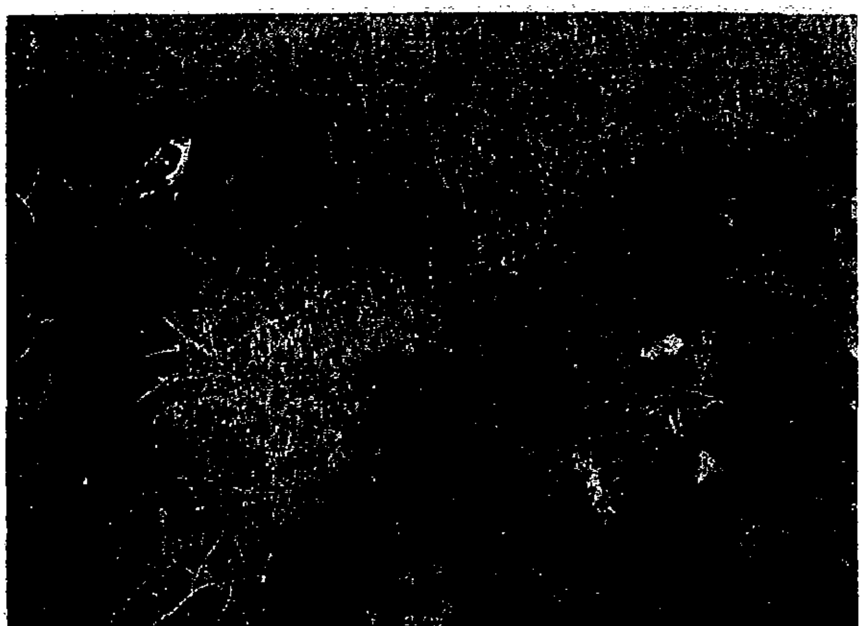

Figure 6: Ferruginous Hawk Nest in Sherman County, OR
(Photo courtesy of Karen Kronner)

SECTION 4

Mortality Reduction, Mitigation, Research, and Other Initiatives

4.1 Impact Reduction and Mitigation Measures

The tools identified in Section 2 are the primary methods to reduce potential avian and bat impacts at projects. However, where, despite the use of such methods, an operating project identifies unexpectedly high mortality or unexpected impacts to protected species or their habitats, the project will identify appropriate adaptive management mortality reduction or mitigation measures. Adaptive management measures must be tailored to the identified problem (e.g., a specific species, specific location, or specific season). Additional monitoring may be an appropriate first step if it is not clear why the risks to birds or bats were unusually high; however, monitoring alone will not be considered adequate mortality reduction or mitigation if that additional monitoring confirms elevated risk levels.

If additional monitoring confirms elevated risks to birds, then the following adaptive management measures may be considered:

- In extreme cases of documented mortality, Iberdrola recognizes that agencies will expect Iberdrola to consider operational changes to reduce mortality. Iberdrola may deploy technology to reduce risk to migrating birds. For example, Iberdrola is exploring the use of permanent onsite radar to detect major migration events and movements in the vicinity of turbines; movements of certain volumes or proximities to turbines might trigger short-term turbine curtailment to reduce the risk of mortality to migrating birds. Curtailments and/or relocation of turbines should be considered a "last resort" action, but Iberdrola understands that under the MBTA and other relevant wildlife laws, high levels of avian mortality may require that special actions be taken to reduce or avoid mortality.
- Modification of farmers' onsite land management, such as changes to hay mowing schedules to reduce loss of ground-nesting grassland birds or modification of grazing to improve habitat for ground-nesting birds, may be a useful mitigation measure at some wind projects, with landowner agreement.
- Installation of nest platforms may increase avian productivity where nesting structures limit populations (see the *2006 Suggested Practices* document).
- Offsite retrofitting of transmission and distribution lines with avian-safe design (i.e., at nonproject facilities) may reduce other sources of avian mortality. This kind of mitigation would generally require cooperation of other parties (i.e., the retail utility whose distribution and transmission lines would be modified).

For bats, adaptive management measures will likely include research actions, because the sources and parameters of bat mortality are less understood than for birds. The following measures may be considered:

- In extreme cases of documented bat mortality, Iberdrola recognizes that agencies and the public will expect Iberdrola to consider operational changes to reduce mortality. Management actions such as curtailments or relocation of turbines should be considered a "last resort" action, but may be appropriate actions, especially if additional experimentation with curtailment indicates that it can be done effectively and at relatively low cost in terms of lost power revenue
- Experimentation with seasonal curtailment to determine whether management actions such as changing turbine cut-in wind speed in certain combinations of wind speed, time of year, and time of night can significantly reduce bat mortality
- Expanded research in bat deterrent devices, to identify if bats can be conditioned to avoid wind turbines
- Expanded research in bat risk assessment, to develop more effective tools for identifying sites with varying levels of bat risk
- Habitat conservation, habitat enhancement or both may secure or protect habitat to replace the habitat effectively lost because of the bat mortality, although (because of the low reproduction rate and long life of bats) the primary focus for bats at wind projects should be on mortality reduction. This may be habitat acquired or conserved by the project or habitat acquired via a conservation bank.

Where direct loss of rare or sensitive wildlife habitats or indirect loss of habitat value through displacement of species are a substantial concern, Iberdrola will consider participating in regional conservation banks or acquiring conservation rights in appropriate habitats.

Figure 7 shows a long-billed curlew in flight at the Leaning Juniper II Wind Project. The long-billed curlew is classified by the USFWS as a bird of conservation concern.

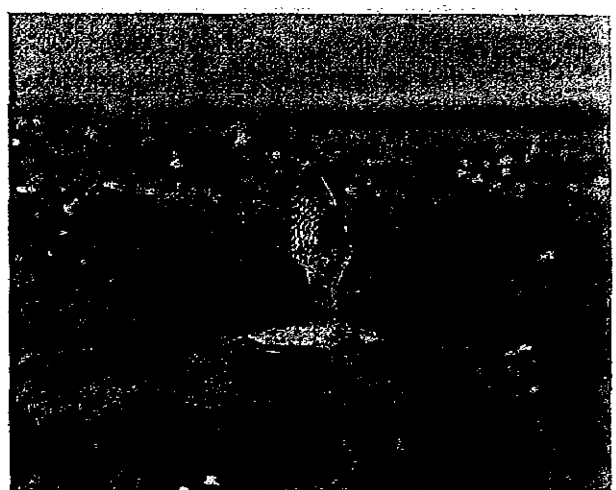

Figure 7: Long-Billed Curlew (USFWS Bird of Conservation Concern, USFWS 2002) at Leaning Juniper II Wind Project (Photo courtesy of Karen Kronner)

4.2 Research

Iberdrola will be an active participant in initiatives to increase our knowledge about wildlife interactions with wind energy. Current activities include the following:

- Since 2006, Iberdrola has participated in and assisted in funding research being conducted by Kansas State University on the "Effects of Wind Power Development on Greater Prairie-Chickens."

- In 2007, Iberdrola funded a study of lesser prairie chickens conducted by Texas Tech University and Texas Fish and Wildlife Department at two potential Iberdrola wind project sites in the panhandle of Texas.
- Iberdrola is a founding funder of the Bat Wind Energy Cooperative, and has made its Casselman, Hoosac, South Chestnut, Maple Ridge, and Dillon project sites available for research conducted by Bat Conservation International on ways to assess and reduce bat risk from wind projects.

Iberdrola is a founding member of the American Wind Wildlife Institute and supports the research and other initiatives of the AWWI. Iberdrola will continue to seek out other opportunities to contribute to knowledge and implementation of effective tools to reduce risk to birds and bats from wind power. Although decisions will be made on a case-by-case basis, Iberdrola's intends to continue to allow studies to progress, to develop and implement new research opportunities, and to continue to allow researchers access to sites to further advancement of understanding of ways to reduce impacts to wildlife.

4.3 Other Initiatives

Iberdrola will continue to look for opportunities to participate in local, regional, and national forums to further our understanding of wildlife interactions with wind turbines, help interpret those findings, and educate others about the effects of wind turbines on wildlife. The following are examples of initiatives that Iberdrola has been involved in:

- At the Big Horn Wind Project in Klickitat County, Washington, Iberdrola has provided funding and volunteers to install blue bird boxes in the Bickleton area, continuing a tradition that goes back several decades in that community.
- Iberdrola has been an active participant in efforts to develop effective guidelines for wind power projects guidelines to minimize their effects on wildlife in California, Texas, Pennsylvania, Oregon, Washington, and at the Federal level.
- Iberdrola is a founding member of the American Wind Wildlife Institute.

SECTION 5

Permit Compliance

Because Iberdrola operates in many states and environmental settings, the permits that apply to project development, construction, and operations vary considerably among project locations. In some cases, state requirements will require different or additional studies than those prescribed in this ABPP. For example, California has issued *California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development* (September 2007), which include detailed recommendations about pre- and post-construction measures. In other cases, permit conditions may impose additional provisions regarding birds or bats. In all cases, Iberdrola will comply with the more stringent of requirements of this ABPP or applicable statutory or permit requirements.

In addition to the permits required for wind project development, permits from the USFWS and/or state wildlife agencies are required for handling dead or injured birds protected by Federal and State wildlife laws[6]. In general, Iberdrola will not handle dead or injured birds; instead, these will be handled by contractors with the appropriate handling permits.

Permit compliance will occur in several stages of project development and operation.

1. <u>Internal Approvals</u>

Before a project is reviewed through Iberdrola's risk process, the Wind Permitting Director will confirm that a project-specific ABPP has been prepared as well as a plan for obtaining and complying with applicable permits.

2. <u>Construction</u>

Before project construction contractors are under contract, Iberdrola permitting staff or consultants will prepare an Environmental Permits Compliance Matrix for Construction and constraints maps that identify key environmental constraints such as sensitive habitats or locations to be avoided and that list applicable environmental permit compliance requirements. The construction environmental permits matrix will be cited in relevant construction contracts and all construction contractors will be responsible for compliance with all permit conditions. Environmental monitors will be used during construction at sites where there is elevated risk to species or habitats located near the construction activities.

3. <u>Operations</u>

Operations will be responsible for making sure that all operating projects maintain copies of applicable permits and permit conditions, including, where applicable, copies of take permits acquired per Federal or state Endangered Species Acts. Operations will also be responsible for maintaining all copies of annual permit reports to the USFWS and to any state agencies where required.

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[6] In the case of Federal permits, allowing the 'possession' of the bird/carcass requires the possession of a Rehabilitation, Special Purpose, Scientific Collecting, or related permit. The issuance and use of Federal Migratory Bird permits also require annual reporting to USFWS.

At each project, any project staff handling birds or bird carcasses will have appropriate Federal and/or state wildlife handling permits. Iberdrola will assure that wildlife rehabilitation centers and consulting staff will also have appropriate permits if they will be responsible for transporting dead or injured birds protected by those statutes.

Asset management will also be responsible for ensuring the project complies with permits as well as the ABPP.

SECTION 6

Implementation

6.1 Training

Iberdrola training will include the following components:

Development stage environmental training: Wind project development staff who are permitting and developing wind projects, including meteorological and engineering staff, will be trained in the requirements of the ABPP and in avian and bat issues that are of concern for sites that they are developing.

Construction stage environmental training: At each construction site, all construction staff will receive training on the environmental constraints and issues specific to the site, including sensitive habitats to be avoided (such as buffers around raptor nests or habitat of sensitive species) and how they are marked in the field, practices to minimize impacts to wildlife (such as project-specific speed limits), and procedures for handling injured or dead birds and other wildlife. Materials to support this training will include maps showing sensitive areas to be avoided.

Operations stage environmental training: Training in the key components of this ABPP and relevant elements of project-specific ABPPs will be part of the training provided to each new operations staff within 90 days of hire. In addition, all operations contractor staff who operate Iberdrola projects and Iberdrola Asset Management and remote Operations Staff will be trained as well. This training will include a general orientation to state and Federal wildlife laws and procedures for handling and reporting dead or injured birds (Figure 8). Materials to support this training will include a flowchart (Figure 9) showing how dead or injured birds and bats should be handled, as well as project-specific posters showing species that are of particular conservation concern or that have special status that may be present at the site.

External Training: APLIC training in ways to reduce collision mortality or risk of electrocutions may be required of certain staff. Valuable short courses and workshops on avian protection planning and practices are offered by the Avian Power Line Interaction Committee (www.aplic.org) and occasionally by state and Federal wildlife agencies. Similar training should be considered by Iberdrola staff who are implementing the ABPPs.

Figure 8: Raptor Identification Training for Wind Project Staff
(Photo courtesy of Karen Kronner)

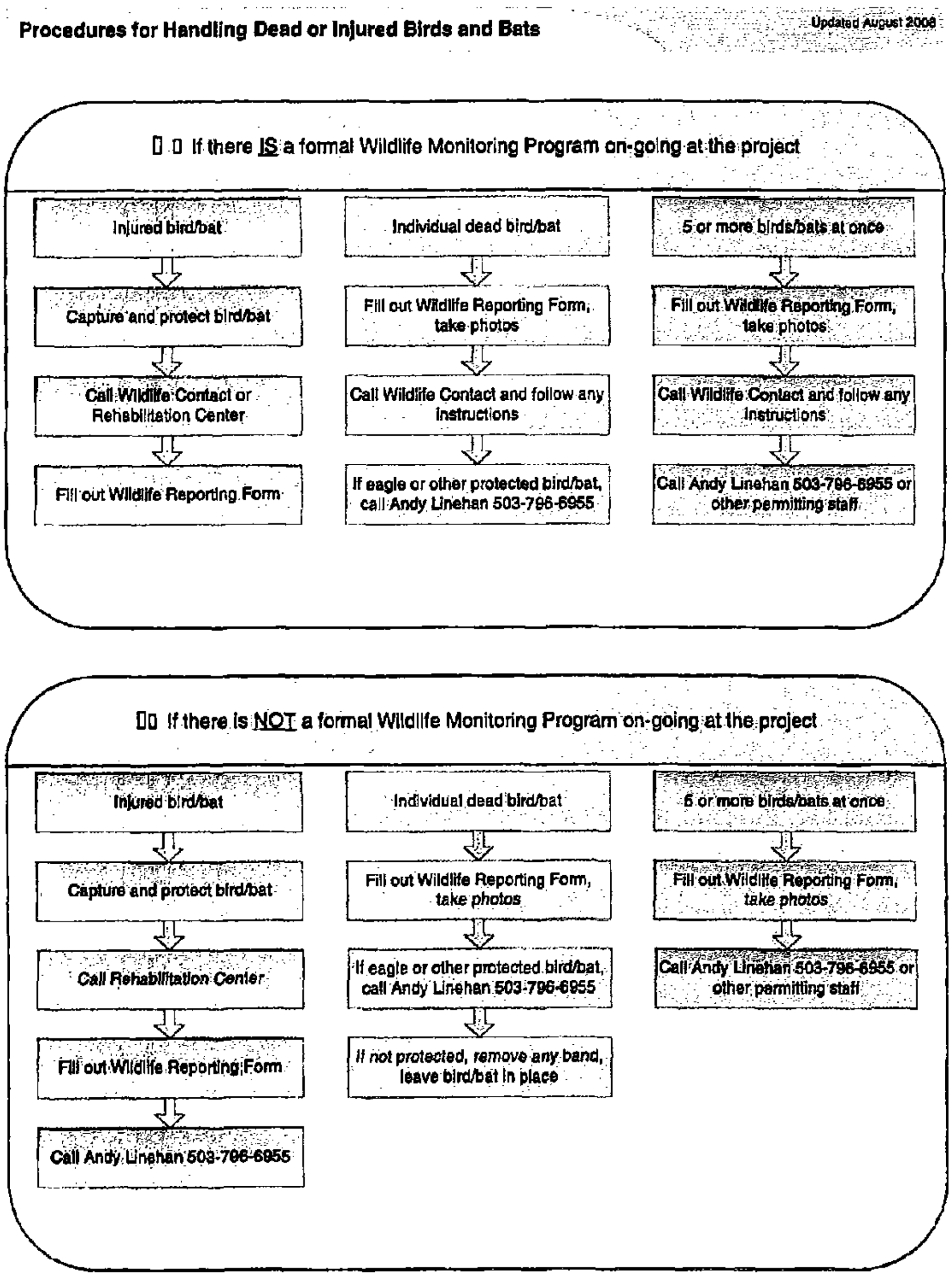

Figure 9: Procedures for Handling Dead or Injured Birds and Bats

Note: "Formal" monitoring refers to monitoring conducted according to a formal sampling plan by trained wildlife biologists, usually under contract, and typically during the first few years of a project's operation.

6.2 Quality Control

Compliance with the corporate ABPP and project-specific ABPPs will be integrated into the annual Environment, Health, and Safety (EHS) audit process. Any noted deficiencies and recommendations will be given corrective action plans, which will be implemented on a schedule that matches the urgency of the deficiency. Action plans will be followed up as part of the audit process. In addition, projects will be reviewed annually by Iberdrola audit or environmental staff to confirm that a project-specific ABPP is in place for each operating project and projects going through risk review; that operating project staff have adequate training and training materials, and that avian or bat mortality monitoring forms are being completed and provided to environmental staff on a regular basis.

Upon completion of the final USFWS wind turbine siting guidelines, anticipated by 2011, Iberdrola will revise the corporate ABPP as necessary. After that, the corporate ABPP will be reviewed as part of the ABPP annual reporting process and revised as recommended.

Once USFWS electronic mortality monitoring is in operation, Iberdrola will work with the Service to fine-tune the reporting procedures and responses.

6.2 Key Resources

Key resources include in-house permitting and environmental staff:

- Andy Linehan/Portland: 503-796-6955; andy.linehan@iberdrolausa.com
- Kristen Goland/Boston: 508-397-6130; kristen.goland@iberdrolausa.com
- Dave De Caro/Radnor, PA: 610-230-0333; ddecaro@iberdrolausa.com
- Max Musich/Portland: 503-796-7740; Michael.Musich@iberdrolausa.com
- Sarah Emery/Minneapolis: (612) 309-2713; Sarah.Emery@iberdrolausa.com

Each project, as part of its project-specific ABPP, will identify a list of local wildlife experts who can assist the project in addressing wildlife issues that evolve.

Other Iberdrola contacts are as follows:

- General Counsel—North American Renewables: W. Benjamin Lackey: 503-796-7127; Benjamin.Lackey@iberdrolausa.com
- Asset Management: Gerald Froese: 503-796-7196
- Operations: Stephanie Carey: EHS Manager: 503-796-7131; Stephanie.Carey@iberdrolausa.com
- Environment, Health, and Safety Director: Gary LeMoine: 503-796-7736; Gary.Lemoine@iberdrolausa.com

Key wildlife documents, such as copies of reporting forms, this ABPP, APLIC standards, permits with permit conditions, and permitting and legal references, are available to all Iberdrola staff at the following intranet folder: O:\PGC\PROJECTS\PERMITTING.

6.3 Public Awareness

Iberdrola will typically make summaries of avian and bat pre- and post-construction studies, when complete and reviewed by Iberdrola, available to NGOs, the agencies, and the general public, as a way of demonstrating to stakeholders the transparency of Iberdrola's avian and bat protection plan activities. Iberdrola environmental, operations, and development staff will provide Iberdrola's public affairs staff regular updates on accomplishments under the ABPP.

6.4 Cost Implications

Implementation of this ABPP will incur a number of new costs, beyond the costs of existing environmental due diligence/permitting currently incurred for most projects. These new costs include those associated with the following study/mitigation elements:

- Preconstruction avian surveys: For a 100-MW project, a year of preconstruction point count surveys and raptor nest surveys will typically cost in the range of $50,000 to $100,000.
- Preconstruction bat surveys: For a 100-MW project, a year of preconstruction anabat surveys will typically cost in the range of $50,000 to $75,000. A key constraint may be the availability of anabat monitors and consulting biologists experienced with analyzing bat call data.
- Underground collector lines: Underground collector lines typically cost one to three times the cost of overhead lines with the same capacity.
- Post-construction bird/bat mortality surveys: For a 100-MW project, a year of post-construction mortality surveys will typically cost in the range of range of $80,000 to $200,000.
- Habitat conservation areas: Habitat conservation area costs vary significantly, according to the local land market and the type of land transaction—costs per ace can range from a few hundred dollars to several thousand dollars.
- Avian radar used for operational monitoring and temporary curtailment costs approximately $275,000 (capital cost of equipment) plus the on-going cost of foregone power revenues.
- Post-construction mitigation: Post-construction mitigation costs can also vary substantially, from relatively minor cost items (such as installation of collision avoidance devices on transmission lines and artificial nest platforms) to potentially very expensive mitigation such as operational changes.

Long-term cost savings: In the long-term, compliance with this ABPP should reduce the costs of developing and operating wind projects. Permitting should become easier and less costly, as agencies become familiar with Iberdrola's ABPP and the reduced risk associated with Iberdrola projects. The ABPP should reduce the risk of expensive mitigation actions.

6.5 Implementation Schedule

The sections of this Plan are effective as indicated below:

- **Section 1, Corporate Policy**: Effective on signature.
- **Section 2, Site Suitability Assessment and Project Design:**

  Projects in Development—Effective on all projects, including those acquired from third parties through acquisitions and mergers, with construction beginning after January 1, 2010; good faith efforts will be made to apply to all projects with construction beginning before that date.

  Operating Projects—Effective on all projects with Commercial Operation Date (COD) after January 1, 2009.
- **Section 3, Wildlife Considerations at Operating Projects**: Effective as each project is COD after January 1, 2009.
- **Section 4, Mortality Reduction, Mitigation, Research, and Additional Measures**:

  Effective as post-construction monitoring data become available for each project COD after January 1, 2009.
- **Section 5, Permit Compliance**: Effective immediately for sites currently in development.
- **Section 6, Implementation:**

  Training: Construction training is effective as each new project with a COD after January 1, 2009, comes online; operations training is completed at each project within the first year of operation.

  Quality Control: First audit to be conducted no later than fourth quarter 2009. Subsequently, audits integrated with EHS audit schedule.

For each project, the corporate ABPP will be implemented by preparing a project-specific ABPP, which will outline how the corporate ABPP is being applied to each project. An outline of a project-specific ABPP is provided in Appendix A. The project-specific ABPP will be developed in stages, reviewed and approved by environmental permitting staff, and updated regularly. During project development, the project-specific ABPP will be developed in sufficient detail for Iberdrola environmental staff to review before the project goes through risk review. Before project construction is initiated, the ABPP should be revised to include construction phase monitoring/impact reduction methods. The project-specific ABPP should be maintained at each operating project and reviewed and updated as necessary annually.

SECTION 7

References

Anderson et al. 1999. *Studying Wind Energy/Bird Interactions: A Guidance Document Metrics and Methods for Determining or Monitoring Potential Impacts On Birds At Existing And Proposed Wind Energy Sites.* National Wind Coordinating Committee

Anderson et al. 2003. *The Proper Use of "Studying Wind Energy/Bird Interactions: A Guidance Document"* (addendum to the 1999 document). National Wind Coordinating Committee

Avian Power Line Interaction Committee and U.S. Fish and Wildlife. 2005. *Avian Protection Plan (APP) Guidelines.* April 2005. [Includes example APP sections from APPs prepared by PacifiCorp and Southern California Edison.]

Avian Power Line Interaction Committee. 2006. *Suggested Practices for Avian Protection on Power Lines, the State of the Art in 2006.*

California Department of Fish and Game and California Energy Commission. 2007. *California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development.*

Kunz et al. 2007. *Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document.* ***Journal Wildlife Management 71(8): 2249-2486.***

Northwest Wildlife Consultants, Inc. 2008. *Big Horn Wind Power Project Wildlife Fatality Monitoring Study 2006-2007.*

PPM Energy. 2005. "Wind Project Siting and Avian Policy," signed October 26, 2005.

U.S. Fish and Wildlife Service. 2002. Division of Migratory Bird Management, Arlington, Virginia. *Birds of Conservation Concern 2002.* [Online version available at http://www.fws.gov/migratorybirds/reports/bcc2002.pdf]

APPENDIX A

Outline of Project-Specific Avian and Bat Protection Plan

1. Project Environmental Setting
    a. Project location and scope
    b. Habitats present
    c. Results of Federal and state database queries
2. Development Stage Measures
    a. Avian monitoring scope and duration
    b. Bat monitoring scope and duration
    c. Special status species surveys (if applicable)
    d. Other applicable studies (e.g., habitat mapping, bird use surveys)
    e. Avian or bat impact reduction/mitigation measures
3. Operating Project Measures
    a. Summary of results of development stage measures
    b. Post-construction avian or bat mortality monitoring scope and duration
    c. Avian or bat mortality thresholds
    d. Other applicable studies (e.g., displacement studies, special status species studies)
    e. Any on-going impact reduction/mitigation measures

APPENDIX B

Key Federal Wildlife Statutes

The following discussion is quoted from the *Avian Protection Plan Guidelines* (APLIC, 2005).

> The **Migratory Bird Treaty Act** (16 U.S.C. 703-712; MBTA), which is administered by USFWS, is the cornerstone of migratory bird conservation and protection in the United States. The MBTA implements four treaties that provide for international protection of migratory birds. It is a strict liability statute wherein proof of intent is not an element of a taking violation. Wording is clear in that most actions that result in a "taking" or possession (permanent or temporary) of a protected species can be a violation.
>
> Specifically, the MBTA states: "Unless and except as permitted by regulations ...it shall be unlawful at any time, by any means, or in any manner to pursue, hunt, take, capture, kill ... possess, offer for sale, sell ... purchase ... ship, export, import ...transport or cause to be transported ... any migratory bird, any part, nest, or eggs of any such bird ... (The Act) prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior." The word "take" is defined as "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect."
>
> A 1972 amendment to the MBTA resulted in inclusion of bald eagles and other birds of prey in the definition of a migratory bird. The MBTA provides criminal penalties for persons who, by any means or in any manner, pursue, hunt, take, capture, kill, attempt to take, capture, or kill, possess, offer for sale, sell, offer to barter, barter, offer to purchase, purchase, deliver for shipment, ship, export, import, cause to be shipped, exported, or imported, deliver for transportation, transport or cause to be transported, carry or cause to be carried, or receive for shipment, transportation, carriage, or export, any migratory bird. The MBTA offers protection to 836 species of migratory birds, including waterfowl, shorebirds, seabirds, wading birds, raptors, and passerines.
>
> Generally speaking, the MBTA protects all birds occurring in the U.S. in the wild except for house (English) sparrows, European starlings, rock doves (pigeons), any recently listed unprotected species in the Federal Register and nonmigratory upland game birds.
>
> For a complete list of species protected under the MBTA see http://migratorybirds.fws.gov/intrnltr/mbta/mbtintro.html. A violation of the MBTA by an individual can result in a fine of up to $15,000 and/or imprisonment for up to six months for a misdemeanor, and up to $250,000 and/or imprisonment for up to two years for a felony. Fines may be doubled for organizations. Penalties increase greatly for offenses involving commercialization and/or the sale of migratory birds and/or their parts.

Under authority of the **Bald and Golden Eagle Protection Act** (16 U.S.C. 668-668d; BGEPA), bald and golden eagles are afforded additional legal protection. Penalties for the "take" of an eagle may result in a fine of up to $100,000 and/or imprisonment for up to one year. The BGEPA has additional provisions wherein the case of a second or subsequent conviction of the BGEPA, penalties may be imposed of up to $250,000 fine and/or two years imprisonment.[7]

The **Endangered Species Act** (16 U.S.C. 1531-1544; ESA) was passed by Congress in 1973 in recognition that many of our Nation's native plants and animals were in danger of becoming extinct. The purposes of the Act are to protect these endangered and threatened species and to provide a means to conserve their ecosystems. To this end,

Federal agencies are directed to utilize their authorities to conserve listed species, and make sure that their actions do not jeopardize the continued existence of these species.

Federal agencies are encouraged to do the same with respect to "candidate" species which may be listed in the near future. The law is administered by USFWS and the

Commerce Department's National Marine Fisheries Service (NMFS). USFWS has primary responsibility for terrestrial and freshwater organisms, while NMFS has responsibility for marine species such as whales and salmon. These two agencies work with other agencies to plan or modify Federal projects so that they will have minimal impact on listed species and their habitats. Protection of species is also achieved through partnerships with the States, with Federal financial assistance and a system of incentives available to encourage State participation. USFWS also works with private landowners, providing financial and technical assistance for management actions on their lands to benefit both listed and nonlisted species.

Section 9 of the ESA makes it unlawful for a person to "take" a listed species. Take is defined as "...to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." The Secretary of the Interior, through regulations, defined the term "harm" as "an act which actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering." However, permits for "incidental take" can be obtained from USFWS for take of endangered species which would occur as a result of an otherwise legal activity.

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[7] The Service is finalizing new regulations to permit "take" of bald eagles and golden eagles under BGEPA along with a draft environmental assessment.

In June of 2007, the Service proposed regulations (72 FR 31141, June 5, 2007) to accomplish the following three goals.

1. *Extend Eagle Act authorization to take previously authorized under the Endangered Species Act (ESA) as seamlessly as possible.*
2. Create a new permit type to authorize take of eagles that is associated with, but not the purpose of, the activity.
3. Create a second new permit type to authorize purposeful take of eagle nests that pose a threat to human or eagle safety.

USFWS split the "proposed rule" into two separate final rulemakings to expedite promulgation of the regulations that "grandfather" previously issued ESA take authorizations under the Eagle Act. Those regulations are categorically excluded from the National Environmental Policy Act (NEPA) requirement and have been finalized. The remainder of the rulemaking is undergoing review under NEPA.

Section 10 of the ESA allows for the development of "Habitat Conservation Plans" for endangered species on private lands or for the maintenance of facilities on private lands. This provision is designed to assist private landowners in incorporating conservation measures for listed species with their land and/or water development plans. Private landowners who develop and implement an approved habitat conservation plan can receive an incidental take permit that allows their development to proceed.

While the Service generally does not authorize incidental take under these Acts, USFWS realizes that some birds may be killed even if all reasonable measures to avoid the take are implemented. USFWS Office of Law Enforcement carries out its mission to protect migratory birds through investigations and enforcement, as well as by fostering relationships with individuals, companies, and industries who seek to minimize their impacts on migratory birds. Unless the take is authorized, it is not possible to absolve individuals, companies, or agencies from liability even if they implement avian mortality avoidance or similar conservation measures. However, 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.

State Regulations

Individual states may have regulations that protect avian species and Iberdrola must consult with respective State resource agency(s) to determine what regulations apply and if permits are required.

APPENDIX C

Wildlife Reporting and Handling System Form

Wildlife Incident Reporting Form

SECTION NO. 1 - DISCOVERY DATA

Report Date: ____________________________

(Date on which the animal(s) was found and the report completed)

Injury/Fatality

(Circle appropriate choice)

Complete/Dismembered/Feathers

(Circle appropriate description. Complete would indicate a complete and intact carcass or injured animal. Dismembered would indicate a missing or amputated wing or other appendage. Feathers would indicate that only feathers were found.)

Notification to __________________________________ **Date/Time** __________________

For Injured Animals, Notify Rehabilitation Center. If the injured animal is found after normal weekday office hours, protect the animal and report it the Rehabilitation Center on the next available working day.

For Fatalities, Notify Wildlife Consultant and/or IBERDROLA RENEWABLES Permitting Department

If during formal monitoring:

- Eagle or protected species carcass call → Wildlife Consultant and IBERDROLA RENEWABLES
- 5 carcasses or more call → Wildlife Consultant and IBERDROLA RENEWABLES
- Non-protected carcass call → Wildlife Consultant

If after formal monitoring:

- Eagle or protected species carcass call → IBERDROLA RENEWABLES
- 5 carcasses or more call → IBERDROLA RENEWABLES
- Non-protected carcass → No call necessary. Just fill out report.

SECTION NO. 2 - LOCATION OF FIND

Structure: ______________________________

(Include turbine number, Pole number, or other landmark feature if nothing is nearby)

Location Remarks: ______________________________

____

____

(Include closest turbine number, distance from turbine, and general direction [for ex, 50 feet south of turbine A-1]. Include any other details, such as –found on the road, power lines overhead, etc.)

SECTION NO. 3 - WILDLIFE IDENTIFICATION

Species: ______________________________

(If known, write the species. If not sure, write Unidentified.)

Field marks used: ______________________________

(Identification marks that helped you determine the species of the bird, if you are not sure and have an educated guess, put it here. For example, red tail and white chest)

Number of Photos Attached: ____________

(Print digital photos and attach to Wildlife Incident Reporting Form)

SECTION NO. 4 – OBSERVATIONAL DATA

Physical condition: ______________________________

____

____

(Describe the physical condition at the time of discovery, including broken wings, all appendages attached?, all pieces found?, skeleton visible?, infested with anything?, etc)

Estimated Time since Death or Injury (days): ____________ (<1, <4, <7, <14, <30, >30)

(Use your best judgment. Carcasses less than a few days old will have round, fluid filled eyes and will lack insect infestation. Carcasses with maggots are probably one to two weeks old. If bones are visible, the carcass is probably over 30 days old. Bones visible indicate over 30 days. Keep in mind that in cold weather carcasses will look fresh for much longer than in warmer weather.)

Other Field Notes: ______________________________

(Note anything else relevant to incident such as presence of other fatalities in the area, evidence of electrocution details, extreme weather conditions, or other details).

Ultimate Disposition of the Bird: ______________________________

(Taken to rehab center, Left in the field, or Placed in avian freezer)

SECTION NO. 5 - RESPONDENT

Respondent Name: ______________________________ Date ____________

Signature: ______________________________ Date ____________

All Wildlife Incident Reporting Forms should be sent to IBERDROLA RENEWABLES Permitting Department at the end of each calendar year.

APPENDIX D

U.S. Fish and Wildlife Service Regional Office Contacts

The following are USFWS regional permits offices:

Region 1
U.S. Fish and Wildlife Service
Migratory Bird Permit Office/ARW
Eastside Federal Complex
911 N.E. 11th Avenue
Portland, Oregon 97232
(503) 872-2715

Region 2
U.S. Fish and Wildlife Service
Migratory Bird Permit Office
Room 5504
P.O. Box 1306
Albuquerque, New Mexico 87103
(505) 248-7882

Region 3
U.S. Fish and Wildlife Service
Migratory Bird Permit Office
1 Federal Drive, Box 45
Ft. Snelling, Minnesota 55111
(612) 713-5436

Region 4
U.S. Fish and Wildlife Service
Permit Section
1875 Century Boulevard
Atlanta, Georgia 30345
(404) 679-7051

Region 5
U.S. Fish and Wildlife Service
Migratory Bird Permit Office
300 Westgate Center Drive
Hadley, Massachusetts 01035
(413) 253-8643

Region 6
U.S. Fish and Wildlife Service

Migratory Bird Permit Office
P.O. Box 25486, DFC (60130)
Denver, Colorado 80225
(303) 236-8145

Region 7
U.S. Fish and Wildlife Service
Migratory Bird Permit Office
1011 E. Tutor Road, Room 155
Anchorage, Alaska 99501
(907) 786-3693

AVIATION SYSTEMS INC.
Aviation Consultants

January 13, 2009

Mr. Max Musich
Iberdrola Renewables, Inc.
1125 NW Couch, Suite 700
Portland, OR 97209

Re: Blue Creek, 09-N-0521.OR.001

Dear Mr. Musich:

Pursuant to your request, Aviation Systems, Inc. (ASI), has performed an initial evaluation of the feasibility of the Blue Creek Wind Power Project. The purpose of the study is to determine the feasibility of erecting wind turbines with a tip height of up to 428 feet above ground level (AGL), from an aviation and airspace point of view. We have reviewed the above referenced project against aviation and airspace criteria set forth in Federal Aviation Regulation (FAR) Part 77 (14 CFR 77) *Obejcts Affecting the Navigable Airspace*; FAA Order 8260.3B, the *United States Standard for Terminal Instrument Procedures* (TERPs) and; FAA Order JO 7400.2G, *Procedures For Handling Airspace Matters*. The criteria in these documents comprise the factors the Federal Aviation Administration (FAA) will use in evaluating the aeronautical compatibility of the project when it is submitted for their official regulatory review. Our findings include the following:

- The project consists of proposed wind turbines to be located within an approximate area 16.6x 14.6 nautical miles (NM) in the State of Ohio.
- Ground elevations within the area range from 720 feet above mean sea level (AMSL) to 835 feet AMSL. With a proposed turbine height of 428 feet AGL, the highest point of the project could be 1263 feet AMSL. See attached map depicting the project and surrounding area. A 100-foot buffer is added for terrain variations and to establish the "Target Height" of 1363 feet AMSL.
- The nearest public airport is Van Wert County (VNW) Airport, located 9.65 NM, south of the project centerpoint. The project would impact airport operations as noted below. A total of two public use airports impact the project area.

APPENDIX E

Regional Wildlife Rehabilitation Centers

[To be added]

- The project would impact Minimum Vectoring Altitudes (MVA) as depicted on the chart. In Sector F, an MVA would be penetrated above 1200 feet AMSL. The FAA may limit structure heights within this area. If necessary, the FAA limitations imposed by the MVA (if any) would need to be evaluated by filing selected sites to determine feasibility.

- One Enroute Airway, V96, crosses the north section of the area, is 8 miles wide (broken green line is centerline) and has a Minimum Obstruction Clearance Altitude (MOCA) of 1200 feet AMSL. The FAA may initially issue Notices of Presumed Hazard. However, Obstruction Standards are not considered ultimate Operational Limitations and the FAA should issue Determinations of No Hazard after conducting an extended study.

- The project would be located outside the boundaries of Military Operations Areas or Restricted Areas.

- The La Grange Long Range Joint Use Radar Site (ARSR) is within 60 NM (49.35 NM northwest) of the search area centerpoint. Development is unlikely to impact Air Defense and Homeland Security radars. Further radar impact study is not necessary.

- Minimal to no impact to Weather Surveillance Radar-1988 Doppler (WSR-88D) weather radar operations. Further radar impact study is not necessary.

- The following list of Blue Creek Sectors indicates the vertical AMSL limits of each listed procedure:

    - Sector A – 1021' AMSL – VNW NDB Ruway 9 Primary Area
    - Sector B – 1021' AMSL to 1200' AMSL – NDB Runway 9 Secondary Area
    - Sector C – 1135' AMSL – VNW VFR CAT C Traffic Pattern
    - Sector D – 1136' AMSL to 1363' AMSL – VNW Runway 18 – 27 - 09 Outer Departure Area
    - Sector E – 1071' AMSL – Paulding Airport VFR CAT B Traffic Pattern
    - Sector F – 1200' AMSL – Fort Wayne Approach Control MVA
    - Sector G – 1363' AMSL – "Target Height"

- There are 3 Private Use Airports within the search area that are not protected by FAA criteria.

- Notwithstanding the 1200 feet AMSL MVA and MOCA which may limit structure height where the ground elevation exceeds 772 feet AMSL, there are many areas within the search area below the indicated Sector limits that would not cause any aviation operational impact and 428 feet AGL wind turbines should receive Determinations of No Hazard from the FAA.

Additionally, any structure over 200 feet AGL, in this case the turbines, requires notice to the FAA and also would require lighting in accordance with FAA Advisory Circular (AC) 70/7460-1K, change 2. After suitable locations are selected and at your request, ASI can handle the FAA filing process pursuant to the notice requirements of FAR Part 77 and follow-up until the No Hazard Determinations are issued by the FAA. We will be able to negotiate selective lighting so that not all of the turbines would require the extra expense of installing and maintaining lights.

FAA makes changes to the National Aviation System everyday. New approaches are published, departure procedures are changed, new runways are planned, MVAs are modified, etc. Therefore, it is possible for the study findings to become obsolete in a relatively short time period. We recommend that prior to filing specific sites within the study area, the study findings be reviewed for currency. Studies greater than 12 months old should automatically be re-visited and their findings confirmed.

Our findings are intended as a planning tool, in conjunction with the resolution of other pertinent issues. Actual construction activities are not advisable until the FAA Determinations of No Hazard are issued.

Sincerely,

Jerry Chavkin
Vice President, Airspace Operations

Attachments

Visual Impact Assessment Report

Blue Creek Wind Farm

Paulding and Van Wert Counties, Ohio

Prepared for

Heartland Wind, LLC

201 King of Prussia Road
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December 2009

Prepared by

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4 Visual Impact Assessment Results 4-1
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Appendices

A Viewpoint Assessment Locations
B Photosimulations

SECTION 1

Introduction

Heartland Wind, LLC (the Applicant), a limited liability company whose sole member and manager is Iberdrola Renewables, Inc. (IBR), is proposing to construct, own and operate up to 350 megawatts (MW) in nameplate capacity of wind-powered electric generation located in Van Wert and Paulding Counties, Ohio (the Blue Creek Wind Farm or the Facility[1]).The proposed Facility is located within an approximate 40,500-acre area (Project area) in Benton, Blue Creek, and Latty townships in Paulding County and Tully, Union, and Hoaglin townships in Van Wert County, Ohio. The Applicant selected the Project area based primarily upon the wind resource, transmission access, land availability, community support, site accessibility, and minimal environmental, ecological, and agricultural impact risk.

This Visual Impact Assessment Report (Report) summarizes the methodology and results of the visual assessments conducted in the Project area. The Applicant completed this assessment to provide an understanding of the Facility's appearance and its potential visual effects.

This assessment supports the Applicant's submittal to the Ohio Power Siting Board (OPSB) for a Certificate of Environmental Compatibility and Public Need ("Certificate"), in accordance with Chapter 4906-17 of the Ohio Administrative Code, Application Filing Requirements for Wind-Powered Electric Generating Facilities.

Appendix A contains an overview map of the visual impact assessment locations. Appendix B contains eight photosimulations from eight representative viewpoints in the Project area.

[1] According to OPSB regulations at OAC Rule 4906-17-01, the term Facility is defined as "all the turbines, collection lines, any associated substations, and all other associated equipment."

SECTION 2

Project Description

The Project area is located within Paulding and Van Wert Counties, Ohio and encompasses approximately 40,500 acres in the Townships of Benton, Blue Creek, and Latty in Paulding County and the Townships of Hoaglin, Tully, and Union in Van Wert County. The Facility lies in the north-central portion of Van Wert County, approximately 3.0 miles north of the City of Van Wert, and in south-central portion of Paulding County, approximately 8.0 miles south of the Village of Paulding. The Project area stretches generally in a southwesterly to northeasterly direction from State Route 30 just northeast of the Village of Convoy.
The Facility would consist of the following:

- Up to 175 wind turbine generators[2];
- Electrical collection system using underground and aboveground 34.5 kilovolt (kV) collection lines and aboveground 115 kV collection lines;
- Three intra-project collection substations;
- One interconnection substation;
- Gravel access roads;
- A temporary staging and construction laydown area;
- Up to two permanent meteorological facilities consisting of up to two permanent meteorological towers (met towers) and a sonic detection and ranging (SODAR) facility;
- A temporary concrete batch plant; and
- An operation and maintenance (O&M) building.

The Applicant has not yet selected the wind turbine model for the Facility ; however, for purposes of the visual impact assessment, the Gamesa G90-2.0 MW wind turbine (G-90) on a 100-meter wind turbine tower was used. The G-90 is the most likely turbine to be used because of the Applicant's experience with this machine at other Midwestern sites and large-scale purchase commitment with Gamesa for the next few years.

---

[2] The proposed Facility will have up to 175 turbines for a maximum potential output of 350 MW. Within the Application, specific locations for 167 turbines and other related Facility infrastructure are identified. An additional eight turbines will be located in an area along the eastern portion of the Project area boundary. The Applicant will provide the locations of the eight turbines on an updated map by March 15, 2010 and appropriate site-specific information by April 1, 2010 in sufficient time for the OPSB staff to consider the information in the staff report.

SECTION 3

Visual Impact Assessment Methodology

To provide an understanding of the Facility's appearance and its potential effects on representative views in the Project area, photosimulations were prepared for views from eight viewpoints. Figure A-1 (Simulation Viewpoints) in Appendix A of this Report, shows the location of the viewpoints selected for this evaluation. The Applicant selected these viewpoints through a process that included review of area maps on which the proposed locations of the turbines and other Facility features, review of Google Earth© air photos, and field investigations. The Applicant selected eight viewpoints to provide for a range of views at different viewing distances and in a range of representative viewing contexts.

Figures B-1 through B-8 contained in Appendix B present the existing view from each viewpoint, along with a photosimulation that depicts the view, as it would appear with the Facility in place. These images were prepared through a process that entailed photo documentation of the views from each of the viewpoints using a single lens reflex digital camera set to take photos equivalent to those taken with a 35 mm camera using a 50 mm focal length. For two of the views, single frame images were used, but from six locations where wider viewing angles were required, two individual 50 mm frames were spliced together to create a panoramic view. The Applicant used computer modeling and rendering techniques for each view to produce the simulated images. Existing topographic and site data provided the basis for developing an initial digital model. Facility engineers provided site plans and digital data for the proposed facilities. Three-dimensional (3-D) digital models of the turbines and ancillary facilities were then developed. The Applicant then combined these models with the digital site model to produce a complete computer model of the Facility.

For each simulation viewpoint, the Applicant digitized each viewer location from topographic maps and scaled from aerial photographs using 5 feet as the assumed viewer eye level. Computer "wire frame" perspective plots were then overlaid on the photographs of the views from the simulation viewpoints to verify scale and viewpoint location. Digital visual simulation images were produced as a next step based on computer renderings of the 3-D model combined with high-resolution digital versions of the base photographs. The final hardcopy visual simulation images that appear in Appendix B of this report were produced from the digital image files using a color printer. The results provide an accurate and realistic depiction of how the turbines and other Facility features would appear in the view.

SECTION 4

Visual Impact Assessment Results

Review of the figures presenting the Facility simulations of Viewpoints 1 through 3, which are all located approximately 5 miles from the edge of the Project area, indicates the range of potential turbine visibility in these more distant views. At Viewpoint 3 (Figure B-3), intervening trees and other landscape elements would completely hide the turbines. At Viewpoint 2 (Figure B-2), the turbines would be visible as small, distant elements that are visible in some of the breaks in the tree line. At Viewpoint 1, where there is an entirely open view toward a portion of the Project area (Figure B-1), many of the turbines would be visible as relatively small features along the distant horizon. In mid-range views, such as Viewpoint 4 located along U.S. Highway 30 just west of U.S. Highway 127 in the area immediately north of Van Wert, approximately 3 miles from the closest turbine (Figure B-4), the turbines would be visible along the horizon in places where they partially extend above the tree line located in the middle ground.

In closer views, the turbines would become more visually prominent, and would have more of an effect on the character and composition of the landscape. In Viewpoint 8 (Figure B-8), where the turbines that would be visible in the view would be located approximately 0.7 mile from the viewpoint, the turbines would be readily visible, but would appear to be in scale with the trees in the foreground of the view. In Viewpoint 7 (Figure B-7), which is a view from Bressler Park in Scott, the closest turbines seen in this view would be located approximately 0.45 mile away. In this view, although the turbines would be readily visible and large in scale, they would be partially hidden and appear to be generally in scale with the foreground elements in the view. In Viewpoint 6 (Figure B-6), the closest turbines would be located approximately 0.5 mile from the viewpoint. Because the foreground zone of this view is completely open, the turbines would be fully visible, and would become important elements in the overall landscape composition. In Viewpoint 5 (Figure B-5), a view from eastbound U.S. Highway 30 at Colwell Road, the closest turbines would be located approximately 0.3 mile from the viewpoint. Because the foreground zone of this view is completely open and because the turbines are so close to the viewpoint, the nearby turbines would dominate the view.

Summary of Viewpoints (Presented in increasing visible prominence)

View pe	Viewpoint Fi ure	I u Ion
Distant	Viewpoint 1 (Figure B-1)	Entirely open view toward a portion of the Project area. Many of the turbines would be visible as relatively small features along the distant horizon.
	Viewpoint 2 (Figure B-2)	Turbines would be visible as small, distant elements that are visible in some of the breaks in the tree line.
	Viewpoint 3 (Figure B-3)	Intervening trees and other landscape elements would completely hide the turbines.
Mid-Range	Viewpoint 4 (Figure B-4)	Turbines would be visible along the horizon in places where they partially extend above the tree line located in the middle ground.

Summary of Viewpoints (Presented in increasing visible prominence)

View pe	**Viewpoint Fi ure**	**I u ion**
Close Range	Viewpoint 5 (Figure B-5)	Closest turbines would be located approximately 0.3 mile from the viewpoint. Because the foreground zone of this view is completely open and because the turbines are so close to the viewpoint, the nearby turbines would dominate the view.
	Viewpoint 6 (Figure B-6)	Closest turbines would be located approximately 0.5 mile from the viewpoint. Because the foreground zone of this view is completely open, the turbines would be fully visible, and would become important elements in the overall landscape composition
	Viewpoint 7 (Figure B-7)	View from Bressler Park in Scott. Closest turbines seen in this view would be located approximately 0.45 mile away. Although the turbines would be readily visible and large in scale, they would be partially hidden and appear to be generally in scale with the foreground elements in the view.
	Viewpoint 8 (Figure B-8)	Turbines that would be visible in the view would be located approximately 0.7 mile from the viewpoint, and would be readily visible, but would appear to be in scale with the trees in the foreground of the view.

SECTION 5

Conclusions and Recommendations

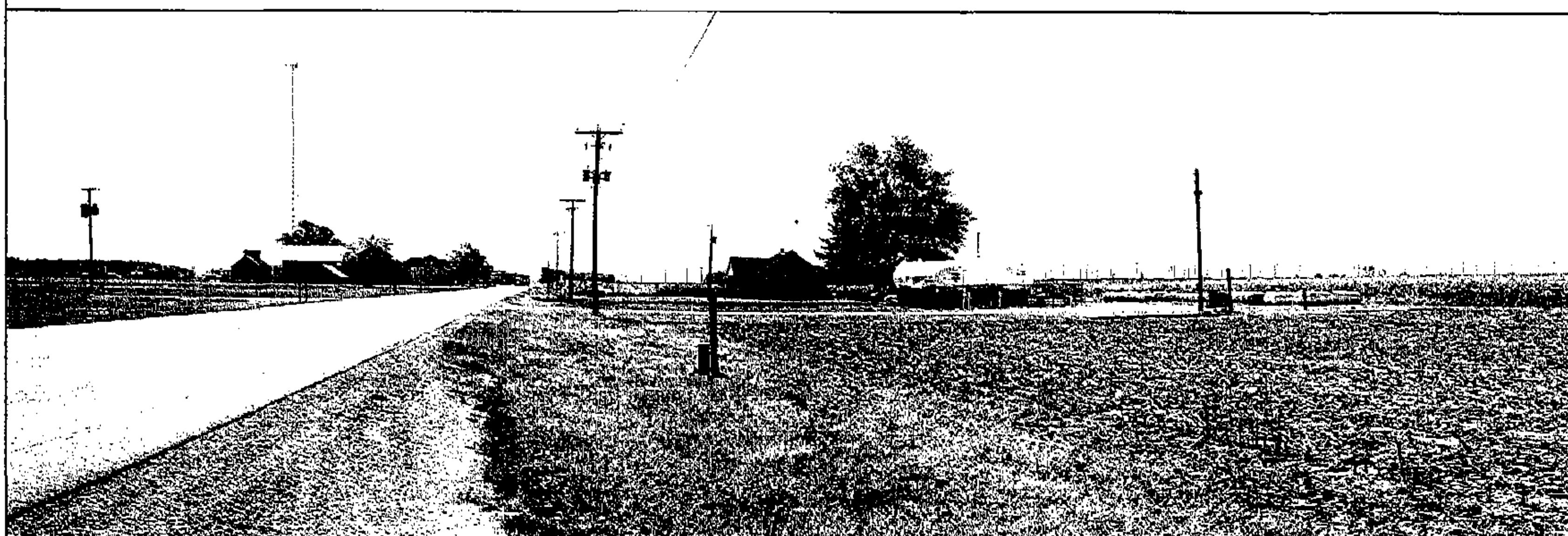
To maximize the visual integration of the proposed Facility into the overall pattern of the Project area landscape, Heartland would incorporate best management practices related to Facility appearance. The Applicant would incorporate the following measures into Facility design to ensure an attractive appearance and good integration into its landscape setting:

- Wind turbine towers, nacelles, and rotors are locally uniform and conform to high standards of industrial design to present a trim, uncluttered, aesthetic appearance.
- The Applicant would not use the proposed turbines as structures for mounting commercial advertising, and conspicuous lettering or corporate logos identifying the Facility owner or the equipment manufacturer would not appear on the sides of the nacelles.
- Low-reflectivity, neutral gray, white, or off-white finishes for the towers, nacelles, and rotors to minimize contrast with the sky backdrop, the reflections that can call attention to structures in the landscape, and Federal Aviation Administration (FAA) lighting requirements.
- Neutral gray, white, off-white, or earth tone finishes for the small cabinets containing pad-mounted equipment that might be located at the base of each turbine, to help the cabinets blend into the surrounding ground plane.
- Restriction of exterior lighting on the turbines to the aviation warning lights required by FAA, which would be kept to the minimum required number and intensity to meet FAA standards.
- Placement of as much of the Facility's electrical collection system underground, as practicable, minimizing the system's visual impacts.
- A low-reflectivity finish would be applied for the exterior of the O&M building to maximize its visual integration into the surrounding landscape.
- Restriction of outdoor night lighting at the O&M building and the substation to the minimum required for safety and security; sensors and switches would be used to keep lighting turned off when not required, and all lights would be hooded and directed to minimize backscatter and offsite light trespass.
- Low-reflectivity finishes for substation equipment to minimize their visual prominence.
- Dull gray porcelain insulators in the substation to reduce insulator visibility.

Appendix A

Viewpoint Assessment Locations

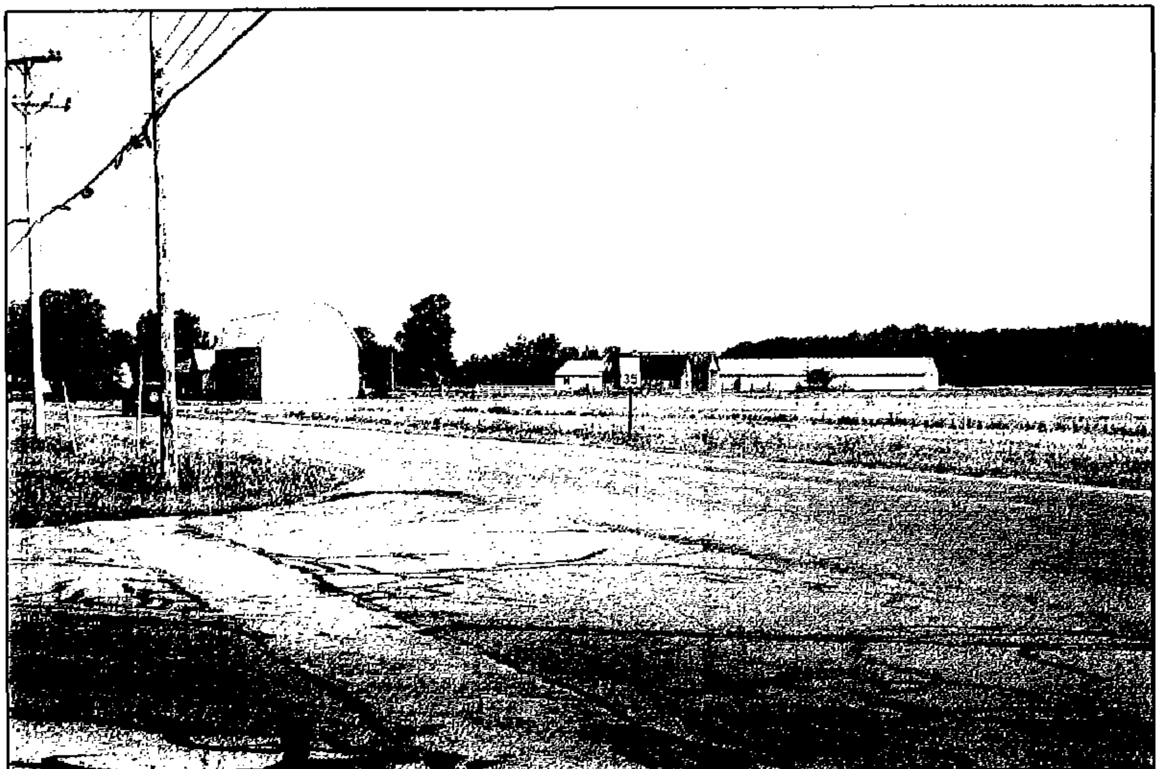
Appendix B
Photosimulations

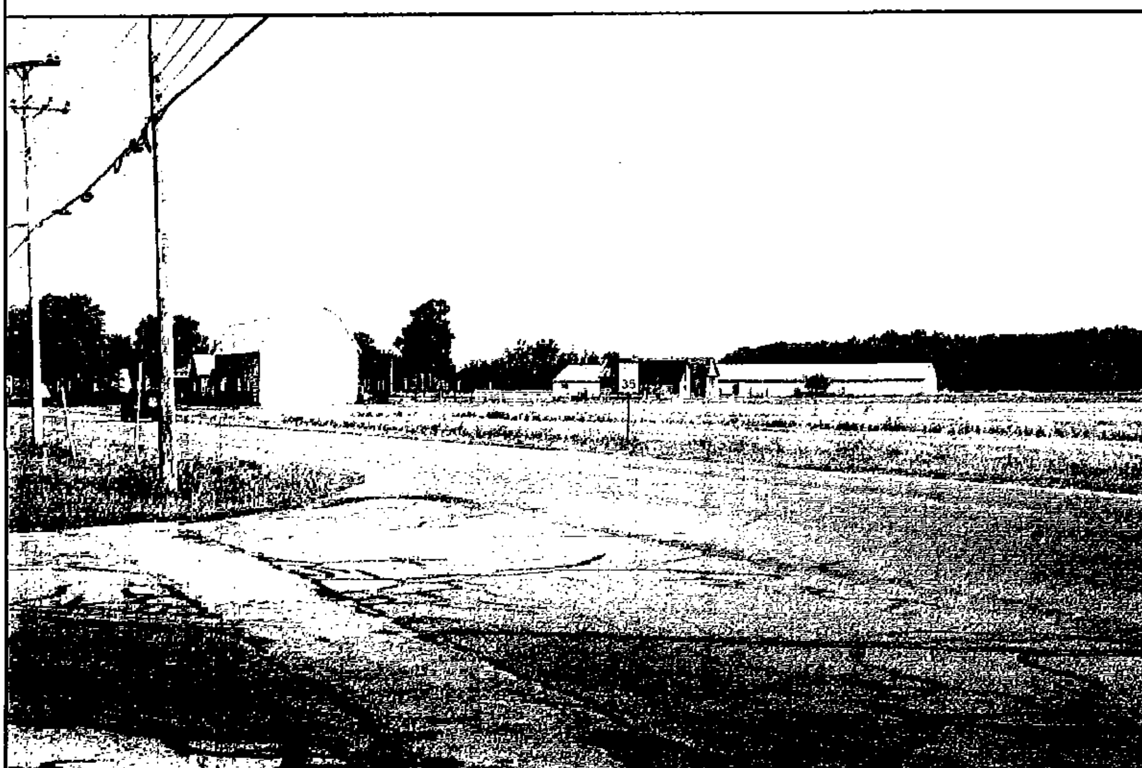


Blue Creek Wind Farm
Viewpoint 1
Highway 127 south of Latty.
Existing and with-project
simulated views looking
south and southwest.

Blue Creek Wind Farm
Viewpoint 2
US 224 at
Middle Point-Wetzel Road,
Existing and with-project
simulated views
looking west along US 224.

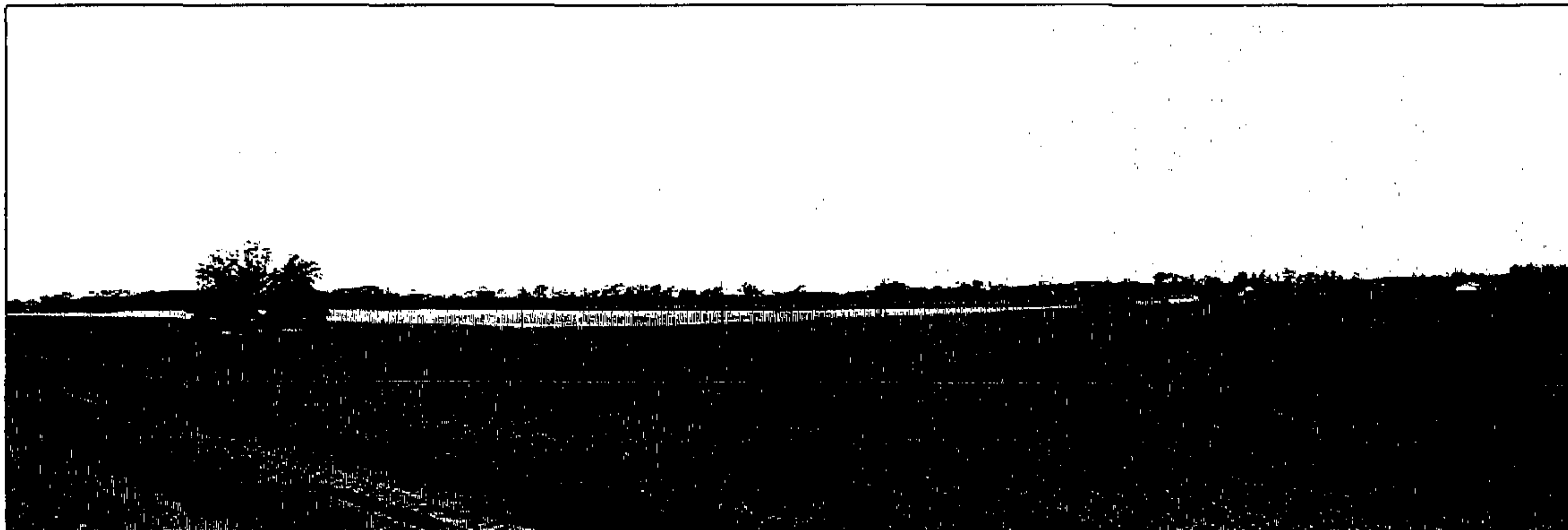
IBERDROLA
RENEWABLES

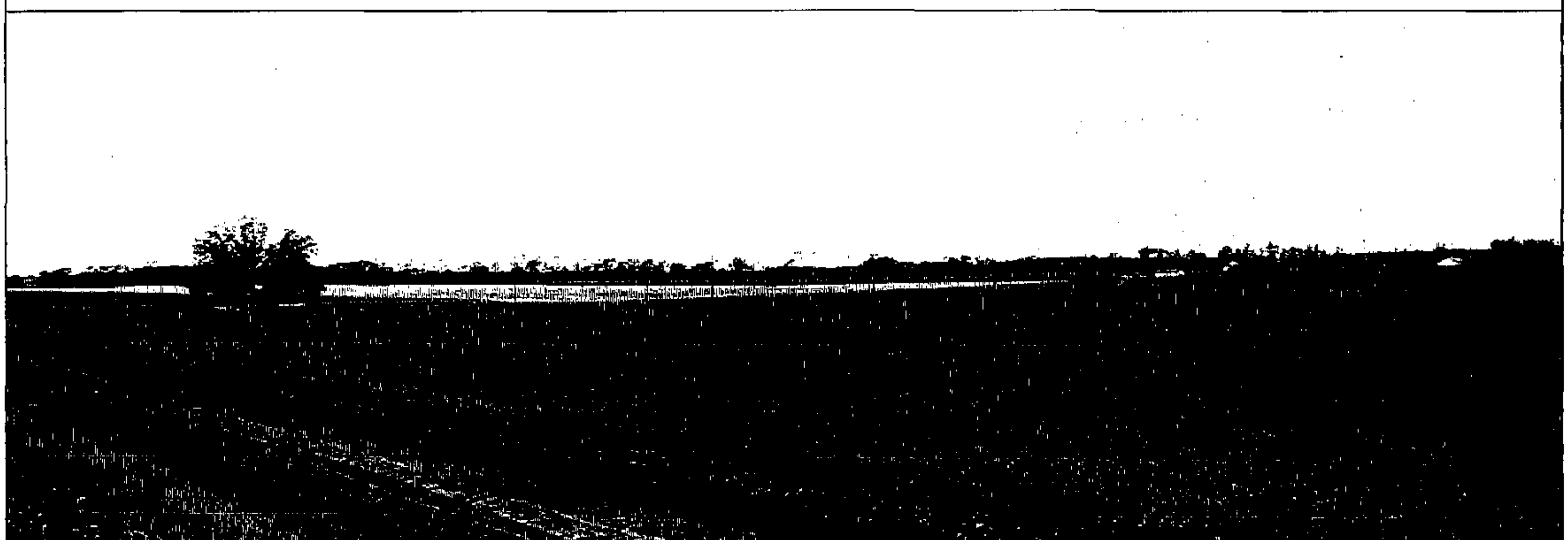




Note: This viewpoint is 5 miles from the closest turbine, and from this area,
views toward the turbines will be screened by vegetation and structures in the foreground and middleground.
As a consequence, the turbines will not be visible.

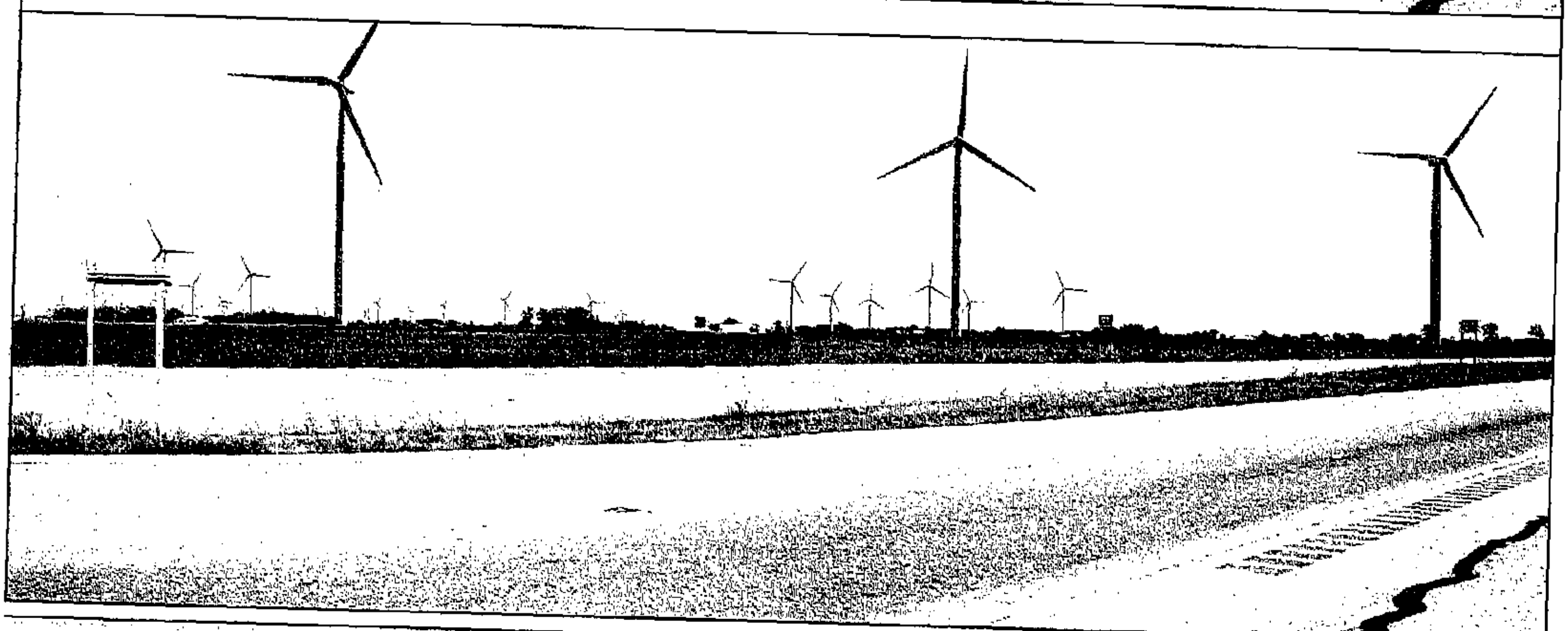
Blue Creek Wind Farm
Viewpoint 3
Jennings at Ervin at the eastern edge of Van Wert.
Existing and with-project simulated views
looking north toward project.



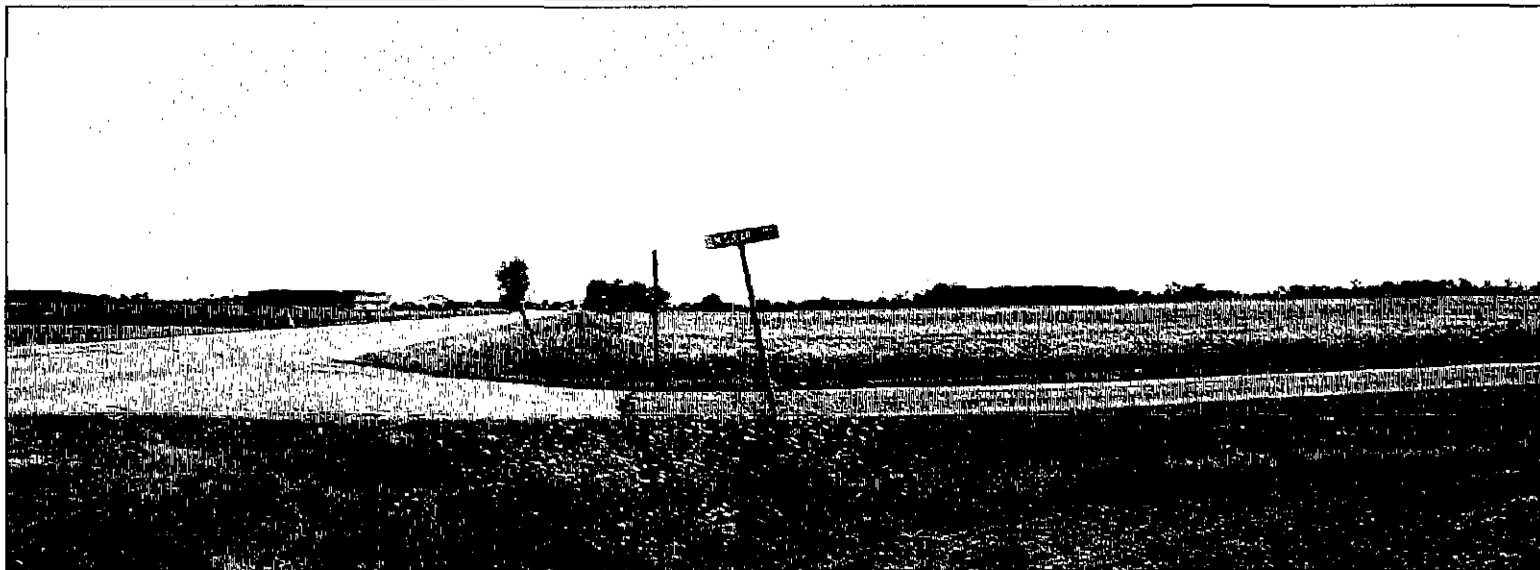


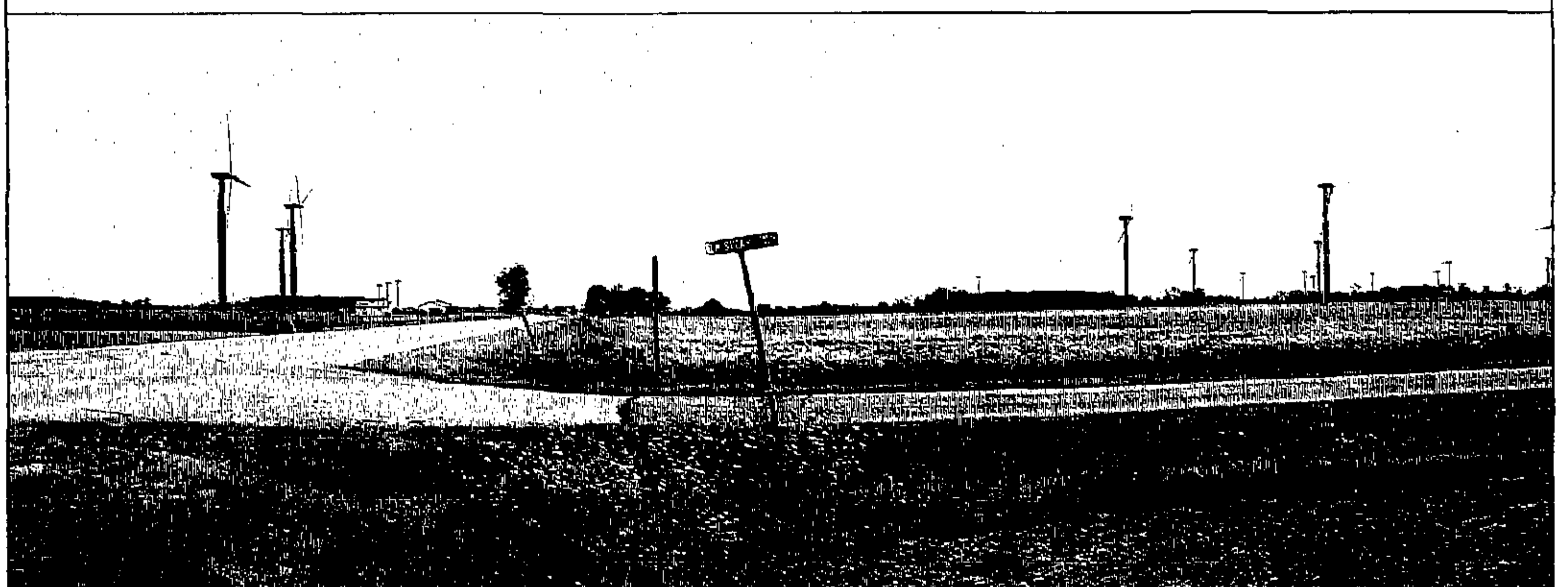
Blue Creek Wind Farm
Viewpoint 4
US 30 just west of US 127.
Existing and with-project simulated views looking northwest.

IBERDROLA RENEWABLES



Blue Creek Wind Farm
Viewpoint 6
US 30 at Colwall Road.
Existing and with-project simulated views looking northeast.





Blue Creek Wind Farm
Viewpoint 6
US 127 at Elm Sugar Road.
Existing and with-project simulated views looking south and southwest.

Blue Creek Wind Farm
Viewpoint 7
Bresler park in Scott
Existing and with-project
simulated views looking west.

Blue Creek Wind Farm
Viewpoint 6
Van Wert - Paulding County Line Road at
Dulch John Road.
Existing and with-project
simulated views looking southwest.

Shadow Flicker Analysis for the Blue Creek Wind Project

Prepared for

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December 2009

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Table

1 Predicted Shadow Flicker

Figure

1 Location of Residences with Predicted Shadow Flicker over 30 hours per year

SECTION 1

Introduction

Heartland Wind, LLC (Heartland Wind), a limited liability company whose sole member and manager is Iberdrola Renewables, Inc. (IBR), is proposing to construct, own, and operate a facility with up to 350 megawatts (MW) in nameplate capacity of wind-powered electric generation in Van Wert and Paulding counties, Ohio (the Blue Creek Wind Farm, or the Facility). The Blue Creek Wind Farm is located within Paulding and Van Wert counties, Ohio in the townships of Benton, Blue Creek, and Latty in Paulding County and the townships of Hoaglin, Tully, and Union in Van Wert County. The Facility lies in the north-central portion of Van Wert County, approximately 3.0 miles north of the city of Van Wert, and in south-central portion of Paulding County, approximately 8.0 miles south of the village of Paulding. The Project area stretches generally in a southwesterly to northeasterly direction from State Route 30 just northeast of the village of Convoy.

The Facility would include the following:

- Up to 175 wind turbine generators[1]
- Electrical collection system using underground and aboveground 34.5 kilovolt (kV) collection lines and aboveground 115 kV collection lines
- Three intra-project collection substations
- One interconnection substation
- Gravel access roads
- A temporary staging and construction laydown area
- Up to two permanent meteorological facilities consisting of up to two permanent meteorological towers (met towers) and a sonic detection and ranging (SODAR) facility
- A temporary concrete batch plant
- An operation and maintenance (O&M) building

Heartland Wind performed a shadow flicker analysis for 167 Gamesa G90 2.0 MW wind turbines (G-90) on 328-foot (100-meter) -tall towers to evaluate the extent of potential shadow flicker experienced at each residence and primary transportation corridor in the Project area. The G-90 is the most likely turbine to be used because of Heartland Wind's

[1] The proposed Facility will have up to 175 turbines, for a maximum potential output of 350 MW. Figure 1 within this report identifies the specific locations for 167 turbines and other related Facility infrastructure. An additional eight turbines will be located in an area along the eastern portion of the Project area boundary. The Applicant will provide the locations of these eight turbines and appropriate site-specific information by April 1, 2010 in sufficient time for the OPSB staff to consider the information in the staff report.

experience with this machine in other Midwestern sites and large-scale purchase commitment with Gamesa for the next few years.

Shadow flicker is the term used to refer to the alternating changes in light intensity that can occur at times when the rotating blades of wind turbines cast moving shadows on the ground or on structures. Shadow flicker occurs only when the wind turbines are operating during sunny conditions, and is most likely to occur early and late in the day when the sun is at a low angle in the sky. The intensity of shadow flicker is "...defined as the difference or variation in brightness at a given location in the presence or absence of a shadow" (National Research Council, 2007). The frequency of shadow flicker is a function of the number of blades making up the wind turbine rotor and rotor speed. Shadow flicker frequency is measured in terms of alternations per second, or hertz (Hz). The intensity of the shadows cast by the moving blades of wind turbines and thus the perceived intensity of the flickering effect is determined by the distance of the affected area from the turbine, with the most intense, distinct, and focused shadows occurring closest to the turbine (Department of Energy & Climate Change [DECC], 2009). In general, for the size wind turbines constructed today, the shadow flicker effects are most evident within the first 820 feet (250 meters) of the turbine and fade with distance, so that by 3,281 feet (1,000 meters), the shadow contrasts are no longer readily evident (Osten and Pahlke, 1998).

There are two primary concerns about shadow flicker. The first is that shadow flicker could potentially trigger epileptic seizures and the second is that shadow flicker could become a source of annoyance to residents living in close proximity to wind turbines.

The Epilepsy Foundation of America notes that for a small minority (about 3 percent) of the three million people in the United States who are affected by epilepsy, there is a potential for epileptic seizures to be triggered by flashing light. These seizures have the potential to be triggered when the light flashes are in the range of from 5 to 30 Hz. Because the frequency of the shadow flicker created by modern wind turbines is in the range of 0.6 to 1.0 Hz, the shadow flicker effects created by wind turbines do not have the potential to trigger epileptic seizures. (Epilepsy Foundation of America, 2008)

The issue of annoyance is more subjective. There could be cases in which shadow flicker cast on dwellings in very close proximity to wind turbines could be enough of a source of distraction to residents to be considered a nuisance. The National Research Council has observed that shadow flicker is more likely to be a concern in the higher latitude regions of Northern Europe, where the sun is likely to be at a low angle particularly in winter, than in the continental United States, where "...shadow flicker has not been identified as causing even a mild annoyance" (2007).

There are currently no federal or state standards regulating frequency or duration of shadow flicker for wind turbines. International studies and guidelines from Europe and Australia, including the *Best Practice Guidelines for the Irish Wind Energy Industry* (Irish Wind Energy Association [IWEA], 2008), have suggested 30 hours of shadow flicker per year as the threshold of significant impact, or the point at which shadow flicker can be considered a nuisance. Heartland Wind used a threshold of 30 hours per year for this analysis to identify affected residences. The threshold of 30 hours per year represents approximately 0.3 percent of the total hours (8,760) in a year, so three times this number represents shadow flicker of less than one percent of the year.

SECTION 2

Methods Used to Predict Shadow Flicker Effects

CH2M HILL conducted the shadow flicker analysis using the shadow flicker module of WindFarm 4.1.1.2, a comprehensive software package developed to aid in designing wind farm projects and in evaluating their environmental effects. To calculate shadow flicker levels at a residence, WindFarm takes into account the location of the residence, the orientations of each of the residence's sides, the location of each wind turbine, turbine hub height, turbine rotor width, latitude and longitude, and data on the sun's path through the sky on each day of the year.

The model domain included all proposed turbines and nearby residences. USGS digital elevation model files with 33-foot (10-meter) resolution were used by the program to account for elevation differences and topographic features in the distance in the line of sight when viewed from a window. As the sun approaches the horizon, it is less intense; therefore, the shadow influence is reduced. An angle of 3 degrees above the horizon was specified in the model, below which shadow influence was not calculated.

For the Project, the WindFarm model evaluated the shadow flicker effects of 167 G-90 wind turbines, which have a hub height of 328 feet (100 meters) and a rotor diameter of 295 feet (90 meters). Heartland Wind evaluated all residences within 2,950 feet (900 meters) of a turbine site for potential shadow flicker impacts. The 2,950 feet (900 meters) figure represents ten times the rotor diameter of a turbine (295 feet [90 meters]). The IWEA guidelines suggest this distance (IWEA, 2008), and several government sources suggest that shadow flicker effects become relatively insignificant beyond 10 rotor diameters (U.S. Department of Interior, 2005; DECC, 2008).

The shadow flicker analysis involved a three-step process. The first step was to make an initial model run to identify all residential structures located within 2,950 feet (900 meters) of the nearest wind turbine that would have the potential to be exposed to 30 or more hours of shadow flicker per year. Once those residences were identified, the second step included a structure-specific field survey was undertaken to determine the actual orientation of windows on each of these houses. In addition, the survey identified any potential obstructions in the line of sight between the residence and the turbine blades such as trees and other structures, and the presence of existing window treatments such as awnings that would reduce the visibility of the blade shadows at the residence.

The third step was a second modeling analysis performed to determine the shadow flicker effects at discrete points using specific house coordinates and structure specific data. At residences where detailed data on fenestration was not available, the WindFarm model was run assuming windows face all directions. Because of this, it is likely that at these residences, the model results over predict shadow flicker if these residences do not have windows facing a turbine that could cause shadow effects. The results of this modeling are presented in Table 1, which identifies 39 residences located within 2,950 feet (900 meters) of the proposed turbines that would potentially be exposed to 30 or more hours of shadow flicker a year.

The shadow flicker data generated by WindFarm provides a worst-case assessment that overestimates the daily minutes and total annual hours of shadow flicker. Factors that the model does not account for in generating the shadow flicker data include the following:

1. There is likely to be times when the rotors will not be turning because of insufficient wind.
2. The direction of the wind may sometimes be such that the turbine blades are turned in a direction that decreases the creation of blade shadow effects.
3. The presence of haze in the air that can have the effect of reducing the intensity of light and reducing the distances at which shadows can be cast.
4. Shadows created by the portions of the rotor closest to the hub are more intense and can be perceived at a longer distance than the shadows created by the tips of the blades. The model treats the shadows created by all parts of the blade as if they were the shadows created by the portions closest to the hub. As a result, the model may overstate the distances at which shadows can be seen and may overstate their effects.
5. The potential for structures and vegetation lying between the residence and the turbines to block shadows created by the rotating turbine blades, thus preventing shadow flicker from occurring at the residence.

In addition, the WindFarm shadow flicker program does not account for the occurrence of clouds and fog, the effect of these sunless conditions on limiting the number of days on which shadow flicker can occur, and the annual number of hours that shadow flicker is likely to be experienced. To consider weather conditions, the output of the WindFarm shadow flicker program was adjusted using percent sky cover from historical climate data from Fort Wayne, Indiana.

SECTION 3

Analysis Results

The information presented in Table 1 includes

- The distance of each residence from the closest flicker-generating turbine;
- The number of hours of shadow flicker the model predicts the residence would be exposed to over the course of a year;
- An identification of the turbines that would contribute to shadow flicker at that residence; and
- Any features noted during the site visit with the potential to prevent the shadow flickering from being visible at the residence.

The long-term effect of each obstruction identified could not be predicted because none of them is necessarily permanent. Figure 1 identifies the locations of the 39 residences predicted to be exposed to 30 hours or more per year of shadow flicker.

TABLE 1
Predicted Shadow Flicker

Residence ID	Predicted Shadow Flicker (hours/year)[a]	Turbines Contributing to Shadow Flicker	Distance to Closest Contributing Turbine (m)	Noteworthy Obstructions
41	41:59	47, 42	430	Row of evergreen tress to north and west
44	40:19	40, 41, 42, 47	465	Large deciduous trees surrounding house
45	43:27	41, 42, 46, 47	461	Structures west of house, mixed trees north and east
96	44:03	59, 60	381	Barns west of house
98	36:08	59, 60	404	Evergreen fence surrounding house
107	33:39	26, 37, 38	424	Garage and barn east of house
114	39:55	139, 140, 141	453	Structures north of house and deciduous trees west of house
116	42:26	139, 140, 141	461	Garage southeast of house, deciduous trees south of house
117	35:33	117, 118, 119	520	Row of evergreens southwest of house
124	40:44	120, 121, 122	379	Garage north of house and barns south of house
126	42:54	117, 118, 119	424	Large deciduous trees on property

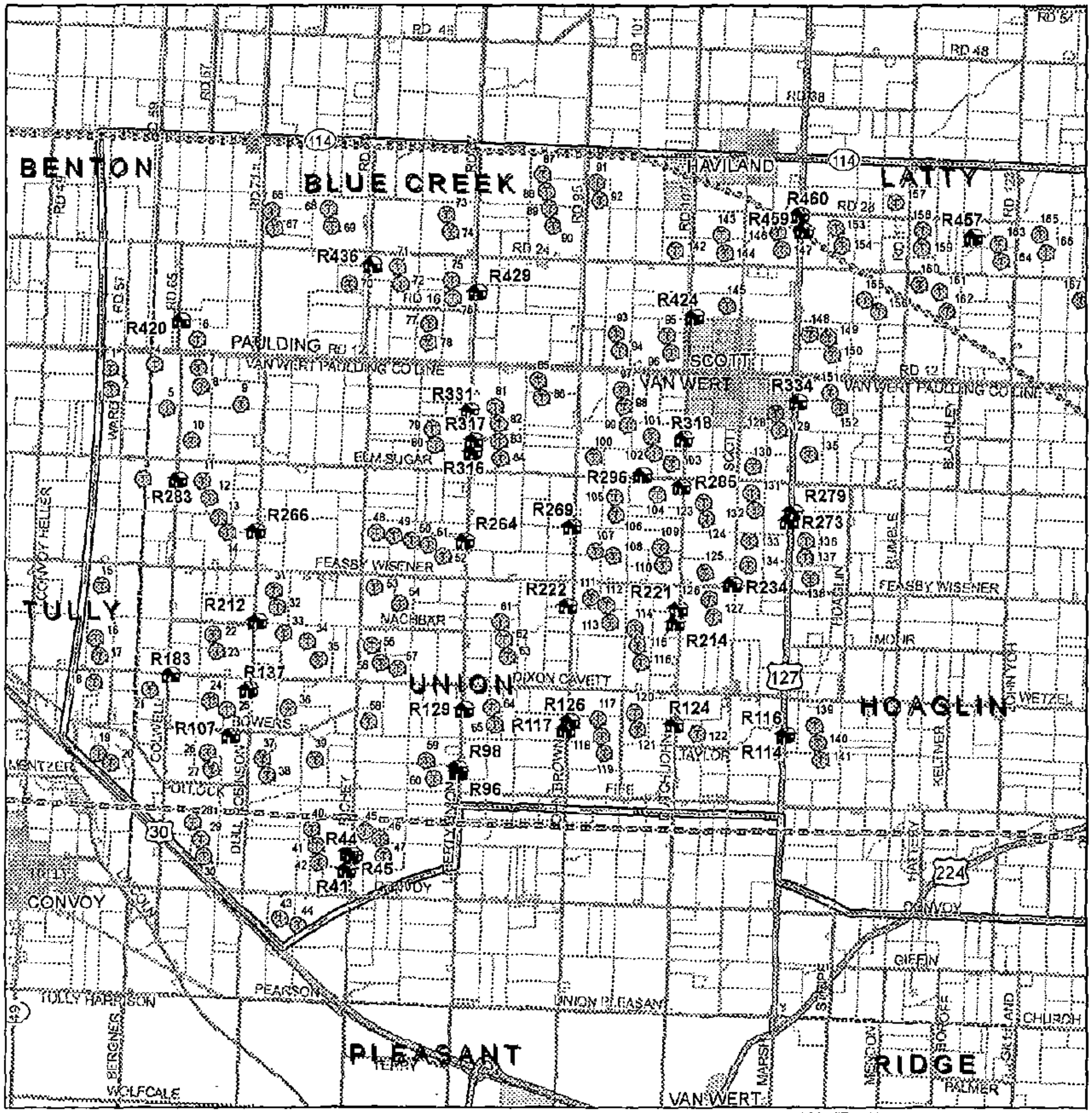
TABLE 1
Predicted Shadow Flicker

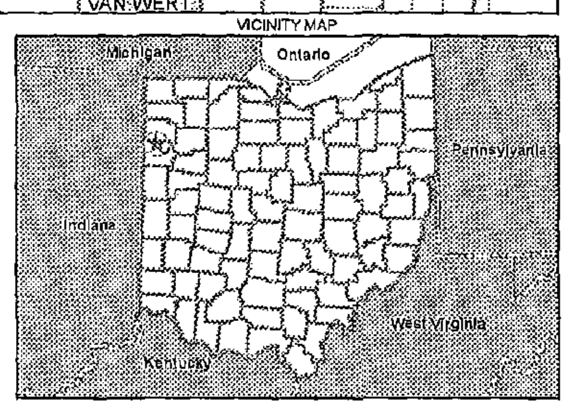
Residence ID	Predicted Shadow Flicker (hours/year)[a]	Turbines Contributing to Shadow Flicker	Distance to Closest Contributing Turbine (m)	Noteworthy Obstructions
129	34:25	64, 65	415	Structures south of house
137	32:27	24, 25, 36	446	Barns north of house
183	33:11	21, 24	383	Evergreens east and west of house
212	32:35	22, 23, 33, 34	442	Property surrounded by evergreen fence
214	32:05	114, 115, 127	589	Garage south of house
221	38:43	114, 126, 127	502	Barns and garage north of house, mixed trees on property
222	34:42	111, 112, 113	378	Deciduous trees east of house
234	47:28	125, 126	396	
264	41:01	50, 51, 52	403	Garage southwest of house, deciduous tree north of house
266	32:38	13, 14	421	Garage south of house and row of evergreens east of house
269	34:55	106, 107, 108	523	Structures west of house, mixed trees north and east of house
273	51:31	132, 133, 136	387	Buildings west of house
279	32:38	131, 132, 133	580	Garage northeast of house
283	52:32	3, 11, 12, 13	552	Barns and garages north of house and mixed trees south of house
285	41:34	104, 123, 124	413	House surrounded by many evergreen and deciduous trees
296	56:21	100, 103, 104, 105	377	Large barn north of house and deciduous trees south of house
316	43:38	79, 80, 83, 84	426	Structures east of house, row of evergreens north of house
317	56:26	79, 80, 83, 84	374	Structures east of house, deciduous trees south and west of house
318	35:24	99, 101, 102	482	Mixed trees on property
331	67:18	79, 81, 82, 83	391	Garage west of house, evergreens north of house, mixed trees on property
334	52:31	128, 151, 152	375	Multiple structures west and south of house
420	30:09	6	380	Large deciduous tree east of house
424	38:48	95, 145	497	

TABLE 1
Predicted Shadow Flicker

Residence ID	Predicted Shadow Flicker (hours/year)[a]	Turbines Contributing to Shadow Flicker	Distance to Closest Contributing Turbine (m)	Noteworthy Obstructions
429	50:05	75, 76, 77	380	Structures east of house, many trees on property
436	51:24	70, 71, 72	384	Row of evergreens north of house, mixed trees throughout property
457	44:04	158, 159, 163, 164	388	Barn east of house
459	61:45	146, 147, 153, 154	390	Structures northeast of house, deciduous trees south and west of house
460	37:22	146, 153, 154	421	Deciduous tree southwest of house

a Model results adjusted by mean monthly sky cover from Fort Wayne, Indiana.





LEGEND

- Homes Over 30 Hours per Year of Shadow Flicker
- Proposed Turbine and Turbine ID Number
- Existing 138 kV Transmission Line
- Existing 345 kV Transmission Line
- Taxlot Boundary
- Project Area Boundary
- City Boundary
- Township Boundary
- County Boundary

Notes:

1. Base data sources:
ESRI Data and Maps (2008)
(airports, counties outside Ohio, states)
Ohio Department of Transportation (2004)
(counties, townships, roads, active railroads, cities)
Ohio Geographically Referenced Information Program (2005)
(local roads)

2. Taxlots:
Taxlot information is preliminary. Spatial accuracy and attibutes validation is ongoing.

N

0 0.5 1 2
Miles
1 in = 1.5 mile

FIGURE 1
Homes With Shadow Flicker Over 30 Days Per Year
Blue Creek Wind Farm Area
Created: December 11, 2009

IBERDROLA RENOVABLES

\\LAKEFRONT\PROJ\BR_BLUECREEK_394265\MAPFILES\APPENDIX\FLICKER\FIGURE1_FLICKER_LETTER.MXD PGRONLI 12/11/2009 16:33:45

CH2MHILL

SECTION 4

Mitigation Measures

There are currently no federal or state standards regulating frequency or duration of shadow flicker for wind turbines. International studies and guidelines from Europe and Australia have suggested 30 hours of shadow flicker per year as the threshold of significant impact, or the point at which shadow flicker can be considered a nuisance. Heartland Wind used a threshold of 30 hours per year for this analysis to identify affected residences.

The results presented here are representative of the maximum Facility shadow flicker impacts and an overall reduction in Facility shadow flicker impacts is expected to be realized through the micrositing process. Heartland Wind plans to use a number of mitigation measures to reduce projected shadow flicker impacts to 30 hours or less per year for affected residences. Mitigation measures may include:

- Turbine micro-siting to minimize projected impacts
- Good Neighbor Agreements to offer compensation to affected residents
- Window blinds, window awnings, and vegetative plantings to be offered to affected residents, including those with and without Good Neighbor Agreements.

SECTION 5

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Preliminary Investigation Report

Blue Creek Wind Project
Van Wert & Paulding Counties, Ohio

Prepared for
Iberdrola Renewables, Inc.

December 2009

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Preliminary Investigation Report

Blue Creek Wind Project
Van Wert & Paulding Counties, Ohio

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Certification

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Ohio.

STATE OF OHIO
MATTHEW B. JOHNSON
E-74181
REGISTERED
PROFESSIONAL ENGINEER

Matthew Johnson, P.E.

December 4, 2009
Date

74181
License #

Executive Summary

BARR under contract with IBERDROLA completed a preliminary geotechnical investigation of the proposed Blue Creek Wind Project in Paulding and Van Wert Counties, Ohio. The proposed Blue Creek Wind Project will consist of up to 175 Gamesa G87 wind turbines. This report summarizes the preliminary geotechnical investigation at 18 proposed turbine sites spread across the project site. The major findings are:

1. A desktop study for this site was completed in February 2009. The desktop study identified potential geotechnical risks due to: shrink/swell potential, high groundwater, compressible soils, low strength soils, and karst (voids, sinkholes) potential. This preliminary investigation evaluated these risks to determine their potential impact on project costs and feasibility.

2. A conventional spread footing appears to be feasible and cost effective.

3. Of the potential geotechnical risks, only high groundwater and high shrink/swell soils appear to be significant issues. The karst risk appears to be low.

4. Topsoil is about 12- to 24-inches across the entire site and the glacial soil overburden ranges from 5- to 25-feet thick over the bedrock. High shrink/swell clay (i.e., "fat" clay) is present in the upper 3 feet of the overburden cover, and the remainder consists of lean clay with traces of course sand and gravel. At the sites explored, the test results indicate shrink/swell potential was low for the soils at anticipated turbine foundation embedment depths, soils exhibited a low compressibility and, therefore, a low potential for intolerable settlements, and the extent of low strength soils across the site was minimal.

5. The piezometer results to date indicated groundwater is 7.5- to 11.7-feet below the ground surface. The water table is typically highest in the spring and the results so far are from the fall. This suggests that a buoyant foundation design will be required for at least some of the proposed turbine sites. A buoyant design would likely be required at any proposed turbine site lacking detailed site-specific data. A buoyant design could increase turbine foundation construction costs by as much as 30 percent. Additional evaluation at most, if not all, proposed turbine locations are recommended since it could reduce the number of sites requiring a buoyant design. This additional investigation will cost approximately $40,000 to $50,000. This work should be completed well in advance of final investigation since water levels can vary over time and are typically highest in the spring, but this requires early determination of the near-final array coordinates.

6. The near surface fat clays will significantly affect the costs of roads and shallow foundations. The fat clay soils will be susceptible to changes in moisture content and subsequent softening, shrinking, and swelling. The feasibility of stabilizing the soil subgrades using lime should be evaluated during the design phase of the project to determine if lime will significantly improve

the roadway performance and or lessen the aggregate thickness required. Effects of fat clays on the roads may also be mitigated by constructing ditches.

7. Spread footings for turbines are typically imbedded about 7 feet below grade. At proposed turbine site 53 the bedrock was found as shallow as 5.5 feet below grade. At this depth, the typical approach is to place additional fill around the turbine to achieve the necessary embedment and blasting should not be necessary. However, should a proposed final turbine location be found to have very thin soils, such that adding backfill is not practical and blasting is not feasible, Iberdrola may want to have alternative sites available.

8. The final turbine array may have a relatively small number of sites with bearing capacity significantly lower than the mean. Designing to a small number of the weakest sites would mean that most of the turbine foundations are much larger than necessary. In some cases, the weak soil is relatively thin and can be subcut and replaced with engineered backfill. In cases of thicker or deeper weak soils, cost savings may be possible by setting up alternate turbine locations so that sites with weak soils can be eliminated without reducing the total number of turbines, or using two foundation designs—one for weak soil sites and one for other sites.

9. Other issues posing lesser risks or imposing minimal cost were also evaluated, including soil electrical resistivity, soil thermal resistivity, and soil corrosivity. None of these appear to pose significant cost or feasibility issues for the project, and this work has generated parameters appropriate for designs suitable for cost estimation and bidding. Preliminary electrical designs are not included in the scope of this report.

10. Sufficient design parameters were developed for completing a foundation design suitable for cost estimation and bidding. That design is provided separate from this report.

1.0 Introduction

Barr Engineering Company (BARR) under contract with Iberdrola Renewables, Inc. completed a preliminary geotechnical investigation of the proposed Blue Creek Wind Project in Van Wert, County, Ohio. The Blue Creek Wind Project is proposed to contain up to 175 Gamesa G87 wind turbines. This report addresses geologic and geotechnical risks identified in the desktop study completed by Barr February 2009 (Reference 1) and summarizes the preliminary geotechnical investigation consisting of 18 proposed wind turbine locations spread across the project site. This report describes the investigation and testing performed, presents the results of this work, and provides geotechnical analyses and recommendations for foundations.

1.1 Site Location

The proposed Blue Creek Wind Project is located in Paulding & Van Wert Counties, Ohio as indicated in Figure 1. Figure 2 shows the proposed turbine layout. The latitude/longitude coordinates of the sounding locations and corresponding turbine locations are included in Appendix A.

1.2 Site Geology

The Blue Creek site is in west-central Ohio. This region is in a glaciated area and underlain by:

- Alluvial deposits in present day stream beds.
- Clayey soils originated from Wisconsin-age glacial sediments; primarily glacial lake deposits and older glacial till (Figure 3).
- Limestone/dolomite and evaporite bedrock (Figure 4).

Figure 5 is a conceptual geologic cross section of the project site.

The project site is located within a geomorphic region known as the Maumee Lake Plain. During the end of the last ice age (10,000 to 15,000 years ago), this area was covered by Glacial Lake Maumee, a predecessor of modern-day Lake Erie. During the time of Glacial Lake Maumee, there was slow deposition of clay and silt particles through the lake waters, with associated wave action leveling and creating the present flat topography in the region. During fluctuations in the elevation of Lake Maumee, near-shore deposits of sand and silt bars formed throughout the region. Highway 30 on the south side of the proposed site, is built on or is almost parallel to some of these beach deposits. Ground and end moraine deposits consisting of primarily a clay matrix with interlayered sand, silt, and some gravel likely underlay some areas of the glacial lake sediments (Reference 2 and 3). Figure 3 shows high plasticity clay (CH or fat clay) covering much of the proposed project site (Reference 4).

Water wells across the site indicate a static water level of 5-feet to about 25-feet below ground surface. These wells produce from bedrock aquifers, so the static water levels represent a potentiometric surface, and not a water table. The glacial overburden probably represents a confining layer to the underlying bedrock aquifers and contains several confined aquifers within. Overburden thickness is likely less than 25 feet through the entire project (Figure 4). The uppermost water table is likely to be shallow, 5- to 20-feet below ground surface, across the entire project site.

Prior to European settlement much of the project area was densely forested, poorly drained swamp land, commonly referred to as the "Black Swamp". It was not uncommon for water to remain at the surface for weeks after rain events. Peat deposits or highly organic soils, which are commonly found in old swamp land, do not appear to be present in the project area (Reference 4).

Bedrock topography ranges from 700 feet to 750 feet above mean sea level (MSL). Ground surface elevations ranges from 730 feet to 800 feet MSL, indicating overburden thickness ranges from 2-feet to 70-feet thick through the project area. These values are consistent with water well logs. The Silurian-aged Salina group, consisting of dolomite, anhydrite, gypsum, and shale, underlies most of the site. In the northern portion of the site, the Devonian-aged Detroit River Group overlies the Salina Group. The Detroit River Group consists mostly of dolomite, sandstone, and shale (References 6, 7, 8).

1.3 Previous Investigation

BARR completed a desktop study of this project area in February 2009 (Reference 1).

2.0 Geotechnical Investigation Methods

The preliminary geotechnical investigation for the Blue Creek Wind Project consisted of cone penetration test (CPT) soundings performed at 12 proposed turbine locations and soil boring/rock coring performed at six proposed turbine locations. Figures 6 and 7 show the plan location of all sounding and boring locations performed for the project, as well as the proposed turbine layout. The site investigation was conducted during a period from October 19, 2009 through October 23, 2009, with laboratory testing and analysis completed in November 2009.

Preliminary turbine locations were staked in the field by Iberdrola. During the preliminary geotechnical investigation, each investigated location was verified with handheld GPS units. Surveyed coordinates of the investigated preliminary turbines, substations and a list of tests performed at each location are provided in Appendix A.

2.1 Geotechnical Investigation

2.2.1 CPT Soundings

A total of 12 CPT soundings were performed in accordance with ASTM D5778, "Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils" at locations selected by Barr (Figure 6). Refusal was met at all soundings; subsequently no CPT soundings went deeper than about 2 feet. One CPT sounding at preliminary turbine location 53 met refusal at 6-feet below ground surface. A second attempt confirmed the initial refusal depth. Logs of CPT soundings are included in Appendix B.

CPT soundings were conducted by ConeTec Inc, of West Berlin, New Jersey. CPT testing was performed with a 20-ton all-terrain mounted rig and an enclosed work space. All equipment was in accordance with ASTM D-5778. For the CPT test, a cylindrical cone is pushed vertically into the ground at a constant rate of penetration of 20 mm/sec. During penetration, measurements are made of the cone tip resistance (q_c), the side friction of the cylindrical shaft (f_s) just above the tip, and pore water pressure generated by cone penetration (u_2).

The cones used in the investigation have a 15 cm^2 base area and a 60 degree apex angle. The sleeve area of the cones is 300 cm^2. The fluid used for saturation of the filter was glycerin. The CPT contractors provided BARR with complete records of tip resistance, sleeve friction, pore pressure, and friction ratio of all CPT soundings. These records included a hard copy showing the graphical variations of all readings with depth. Copies of the data plots and analyzed data are included in Appendix B.

The following describes the procedures used to interpret the CPT data and the interpreted lithology.

The CPT data interpretation was performed using an in-house program designed by Barr specifically for use on wind turbine projects. The in-house program has been cross-checked with CPTINT version 5.2 for quality assurance and has been found to be compliant. The program uses the soil behavior type classification system from CPT data proposed by Robertson et al. (1986). The classification system is based on the corrected tip resistance (q_t), the friction ratio (R_f), and pore-water pressure parameter (B_q), and includes a total of 12 soil behavior types. These cone parameters are defined as follows:

$$q_t = q_c + (1 - a) \cdot u_2$$ (Reference 9, page 25)

$$R_f = \frac{f_s}{q_t} \cdot 100\%$$ (Reference 9, page xiv)

$$B_q = \frac{u_2 - u_0}{q_t - \sigma_{vo}}$$ (Reference 9, page 51)

where,

q_c = *tip resistance measured by the cone*, load per area

a = the area ratio of the cone

u_2 = measured pore-water pressure during cone penetration, load per area

f_s = unit sleeve friction resistance, load per area

σ_{vo} = total overburden stress, load per area

u_o = in-situ pore water pressure, load per area

The cone was also equipped with a seismometer that measured arrival time of shear and compression waves generated at the ground surface. Shear waves were generated at the ground surface, by the CPT rig, at ten locations, and arrival times were measured at depth intervals of approximately 1 meter (~3 feet), to determine the interval shear wave velocity. Compression waves were generated at the ground surface at the two test locations, and arrival times were measured at depth intervals of approximately 1 meter (~3 feet), to determine the interval compression wave velocity. Preliminary geotechnical investigation locations were selected to provide spatial coverage over the project site and are indicated on Figure 6. The results of shear and compression wave testing can be found in Appendix C.

2.1.2 DMT Soundings

One DMT sounding was performed at preliminary turbine location 87 (Figure 7) to develop a settlement profile for the site soils. The DMT sounding performed during this investigation is included in Appendix D.

The Marchetti Dilatometer consists of a 95-mm stainless steel blade with a thin, flat, expandable steel membrane (60-mm diameter) on the side. Performing a DMT test consists of pushing the dilatometer blade into the ground vertically to a desired test depth, measuring the thrust necessary to accomplish this penetration, and then using gas pressure to expand the circular steel membrane against the soil. The test operator obtains three readings: the A-pressure required to initiate movement of the membrane against the soil; the B-pressure required to move its center 1 mm into the soil; and the C-pressure during deflation of the membrane, which is related to the in-situ pore-water pressure in sands and penetration pore-water pressure in clays. The operator then pushes the blade to the next depth and repeats the test. A dilatometer sounding log consists of results from all the measured and correlated parameters with depth.

The DMT parameter generally includes the measured material index I_d, dilatometer modulus E_d, horizontal stress index K_d, constrained modulus of soil compressibility M, and undrained shear strength s_u. The main objective for performing the DMT soundings was to determine the constrained modulus of soil compressibility in order to evaluate settlements. The DMT has the advantage of providing quasi-continuous soil compressibility information as part of the field investigation. Traditionally, the compressibility soil parameters are obtained by performing a soil boring, taking an undisturbed Shelby tube sample, and performing a consolidation test in the laboratory. The use of the DMT obtains required compressibility parameters much more quickly and comprehensively. The DMT test also is an in-situ test method which does not require sampling and transportation of soils to a testing laboratory.

2.1.3 Soil Borings/Rock Coring

A total of six borings were performed at preliminary turbine locations 22, 42, 71, 103, 120, and 148. Borings were performed using hollow stem auger (HSA) and rock coring methods (Figure 7). Soil borings and rock coring was performed by GEOCON Testing Services of Oak Forest, Illinois using an ATV-mounted drill rig.

HSA refusal was encountered at all investigated boring locations at depths ranging from 11- to 22-feet below ground surface. Rock coring was used to advance the borehole 10 additional feet after HSA refusal at each site to verify bedrock, its characteristics, and to identify potential karst features. Soil samples were collected using standard penetration testing (SPT) and Shelby tubes. Soil samples were collected for laboratory testing and transported to the laboratory testing subcontractor by Barr. Logs of HSA borings and rock core pictures are included in Appendix E.

2.1.4 Piezometers

Piezometers were installed by GEOCON Testing Services at all six soil boring locations shown on Figure 8 to depths of approximately 15 feet. This depth was selected to monitor groundwater levels at the anticipated depth of the foundation and based on observations or apparent groundwater levels encountered during drilling. Groundwater monitoring is discussed in Section 3.3 of this report.

2.2 Soil Testing

The following tests were performed by GEOCON Engineering of Illinois:

- Thin-wall tube sampling in accordance with ASTM D1587, "Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes"
- Standard Penetration Tests (SPT) in accordance with ASTM D1586, "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils"

The following tests were performed or coordinated by Soil Engineering Testing of Minnesota:

- Moisture content tests were performed in accordance with ASTM D2216, "Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass"
- Unconfined compressive strength in accordance with ASTM D2166, "Standard Test Method for Unconfined Compressive Strength of Cohesive Soil"
- Mechanical Grain Size analysis (only) in accordance with ASTM D6913, "Standard test Methods for Particle Size Distribution (Gradation) of Soils Using Sieve Analysis"
- Grain Size with Hydrometer analysis in accordance with ASTM D422-63, "Standard Test Method for Particle Size Analysis of Soils"
- Percent Fines (silt and clay) in accordance with ASTM D1140-00, "Standard Test Method for Amount of Material in Soils Finer Than the No. 200 Sieve"
- Atterberg Limit determinations in accordance with ASTM D4318, "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils"
- Unit weight testing
- Standard proctor density test in accordance with ASTM D698, "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))."
- Thermal Resistivity tests in accordance with ASTM D5334, "Standard Test Method for Determination of Thermal Conductivity of Soil and Soft Rock by Thermal Needle Probe Procedure"
- Soluble chloride, soluble sulfate, and pH of soils

2.3 Electrical Resistivity Testing

Electrical resistivity testing was completed at proposed turbine locations east and west substations locations as directed by the electrical designer (not Barr) through Iberdrola. Testing was completed using the "Four Point Method", per IEEE Standard 81. At each location, measurements were taken to yield average soil resistivity at 'A' spacings of 2, 5, 10, 20 and 40 feet. Figure 9 shows the locations of those tests performed as a part of this investigation. Electrical resistivity test results are included in Appendix G.

2.4 Thermal Resistivity Testing

Bulk soil samples were collected at proposed turbine locations 22, 42, 103, 120 and near the west substation as directed Iberdrola. The samples were obtained from a depth of about 3- to 5-feet below the surface and placed in sealed 5-gallon buckets. The samples were delivered to SET in Minneapolis, Minnesota. SET performed the testing in accordance with ANSI/IEEE Standard 442 "Guide to Soil Thermal Resistivity Measurements". Figure 9 show the locations of those tests performed as a part of this investigation. Thermal resistivity test results are included in Appendix G.

2.5 CBR Testing

Bulk soil samples were collected at proposed turbine locations 22, 42, 71, 103, and 148 as directed by Iberdrola. The samples obtained were from a depth of about 1- to 2-feet below the ground surface and placed in sealed 5-gallon buckets. The samples were delivered to SET in Minneapolis, Minnesota. SET performed the testing in accordance with ASTM D1883 " CBR (California Bearing Ratio) of Laboratory Compacted Soils". Figure 9 show the locations of those tests performed as a part of this investigation. At the time of this report, the thermal resistivity testing is being performed. CBR test results are included in Appendix H upon completion of testing.

3.0 Results

The desktop study completed by Barr identified several potential geotechnical. These risks included: shrink/swell potential, high groundwater, compressible soils, low strength soils, and karst (voids and sinkholes) potential. Section 2.0 described the field investigation procedures. Section 3.0 presents data from the investigation and provides further analysis of these results.

3.1 Geological Hazards

Of the potential geotechnical risks, only high groundwater and high shrink/swell soils appear to be significant issues. These are addressed in detail in later sections of this report. The karst risk appears to be low. Appendix F is a stand-alone report on the karst evaluation; following is a brief summary of karst risk. Table 1 is an updated summary of site geologic hazards.

The desktop study (Reference 1) identified that the proposed wind project site is underlain by carbonate and evaporite bedrock. These rock types are susceptible to dissolution by weakly acidic groundwater. The dissolution can cause voids to form in the bedrock, thereby creating conditions where sinkholes could form at the surface. Surface subsidence can occur rapidly or gradually, where movement is undetectable by simple observation. Risk to turbines could range from tilting out of specification to catastrophic failure.

Assessing the karst risk potential is difficult. While some physical evidence of karst features may be at the surface, most of the risk is hidden underground. The presence of soluble bedrock is the key factor in determining that that some risk is present, and thereafter that risk level cannot be completely eliminated. However, there are many steps available to evaluate the situation and thereby better qualify the level of risk and reduce the risk. As part of the geotechnical investigation, a supplementary karst evaluation was completed to assess the karst risk potential to the proposed project site. The methods and results of this investigation are included in Appendix F.

In summary, the karst risk potential is likely low. Rock coring at six turbine locations and an inspection of a local quarry suggest the entire project site is likely underlain predominantly by dolomite, which is less soluble than evaporite rocks or limestone. The quarry inspection revealed no significant cavities in the bedrock. No known karst features (i.e., sinkholes) exist in the project area based on information gathered from local experts (Ohio Geological Survey, County Engineer, and quarry operators). Due to the flat surface topography and bedrock surface topography, it is likely groundwater conditions that would favor sinkhole development do not exist within the project area.

3.2 Soil Lithology

The results of the, CPT soundings (Appendix B), DMT soundings (Appendix D), and HSA boreholes (Appendix E) from this preliminary investigation were compiled to obtain an understanding of the lithology of the study area. Figure 3 shows USCS soils classifications based on NRCS soil survey information (Reference 5). The existing conditions, as determined from field data and Figure 4, generally confirm to the conditions indicated in the geologic history described in Section 1.2. Specific subsurface conditions vary from site to site. The following are detail descriptions of the predominant soil layers.

3.2.1 Topsoil

Topsoil, typically about 24-inches thick, was encountered across the project site. The topsoil consisted of silty soils with varying organic content. The depth of the topsoil likely will vary across the site and be affected by the farming activities in the area. One soil shallow sample from turbine site 71 plotted as a Fat Clay, based on the USCS system.

3.2.2 Glacial Till Soils

Glacial till was encountered below the topsoil, extending then entire overburden thickness above bedrock. The till consisted primarily of brown silty clay overlying gray silty clay with trace amounts of sand and gravel. As indicated on Figure 4, the thickness of the glacial till (drift) ranges from 5- to 25-feet thick. The overburden (glacial till) is thinnest near the rock quarry (turbine site 53).

The silty clay glacial till soil exhibited general Atterberg limit ranges (all in percent moisture content) for plastic limits ranging from 18 to 26, for liquid limits ranging from 26 to 38, and for plasticity indices ranging from 12 to 27. According to the Plasticity Chart (Reference 10, pg 7.1-18), these soils generally plot as CL soils according to the USCS Classification System. Natural moisture contents of the silty clay glacial till ranged from 6 to 29 percent, and tend to decrease with increasing depth. Moist unit weights ranged from approximately 120 to 140 pcf and dry densities ranged from approximately 118 to 125 pcf.

3.2.3 Sand Seams

During drilling at T-120, sand seams or layers, greater than a few inches, were encountered only between the depths of 9 and 13 feet. The SPT *N* value was 29 bpf, indicating dense to very dense conditions. At all remaining borehole locations (T-22, T-42, T-71, T-103, T-120, and T-144), sand seams were only encountered directly above bedrock. These sand seams tended to be poorly graded, fine to coarse-grained sand with small gravel and all seams were water bearing.

3.2.4 Glacial Lake Deposits and Swamp Deposits

The desktop study completed by Barr identified that much of the project site likely could contain soils of glacial lake origin. These lake sediments tend to be lower strength and less consolidated than glacial till soils found throughout the Midwest. Data obtained from the NRCS indicated the liquid limit and plasticity index values of these lake sediments could have moderate potential for shrink/swell conditions. Liquid limit and plasticity index values were obtained for one surface sample at T-71, which confirmed these conditions. However, as discussed in Section 3.1 soil conditions below the surface do not indicate shrink/swell conditions.

As summarized in Section 1.2, organic soil layers (swamp deposits or peat deposits) were not encountered at sites tested in this investigation phase.

3.2.5 Bedrock

Rock coring was completed at all borehole locations for approximately 10 feet into the uppermost portion of the bedrock. Dolomite bedrock was encountered at all borehole locations (T-22, T-42, T-71, T-103, T-120, and T-144) at depths ranging from 11 to 22 feet. The dolomite is nearly fresh with weathering limited to areas along fractures. There is little to moderate fracturing, with most RQD values ranging from about 50 percent to 100 percent.

3.2.6 Depth to Bedrock

Based on refusal depths by CPT soundings and HSA boreholes, depth to bedrock is likely less than 10 feet below ground surface in portions of the project site. Figure 4 shows refusal depths of the CPT soundings and HSA boreholes which are both interpreted to be bedrock depth. If bedrock is encountered above the proposed foundation embedment depth, rock removal may be required to facilitate foundation construction. Depending on the depth to bedrock, the requirements of the foundation, and the site constraints, consideration could be given to raising the base of the turbine foundation in conjunction with raising the local site grades to provide the required amount of foundation covering fill.

3.3 Groundwater Conditions

Groundwater was encountered in all of the borings performed at depths ranging from 10- to 22-feet below ground surface while drilling. Groundwater levels were measured in the piezometers several times in the fall of 2009 (Table 2). Water levels at the time of this monitoring event ranged from about 6.6-feet to 12.5-feet below ground surface. A follow-up groundwater monitoring event was performed on November 17, 2009. Water levels at the time of this monitoring event ranged from 7.2-feet to 11.7-feet below ground surface. Based on these observations, it is likely that shallow ground water will be encountered at least at a portion of the turbine locations.

Overall, groundwater may be a factor in the construction or long-term performance of the wind turbines, especially where sand seams are present close to the ground surface. A buoyant foundation design appears likely for at least a portion of the turbine sites. Depending on the rate at which groundwater levels stabilize, it may be possible to excavate to the proposed foundation subgrade elevations and place protective mud mat coverings over the soils prior to significant seepage, but at sites with sandy or silty soils or significant sand/silt seams, dewatering may be required. Depending on the rate of seepage and the final water level elevations, a cut-off trench with sump points may allow for dewatering of the site, but multiple well points may be required with highly permeable (sandy) soils or static water levels significantly above the foundation bearing elevations.

It is common for periodic flooding of the fields and low-lying areas due to heavy rainfall or rainfall in combination with melting of the snow cover. Roadway construction at lower elevations may encounter difficulty due to the presence of water in the soil and increased road aggregate thicknesses may be required for stability. In addition, roadways or turbine foundations in areas particularly prone to flooding may require erosion protection to limit removal of aggregate or foundation covering soils. Ideally, relocation of roadways or turbines from areas prone to flooding may simplify design of these project elements.

3.4 Shear Strength

3.4.1 Undrained Shear Strength—Cohesive Soils

The undrained shear strength of the clayey soils at various depths is calculated based on CPT data using the following equation:

$$s_u = \frac{q_t - \sigma_{vo}}{N_{kt}}$$ (Reference 9, pg. 64)

where:

s_u = undrained shear strength

N_{kt} = empirical cone factor (16 was used for this project based upon previous experience at similar sites)

σ_{vo} = total in-situ vertical stress = varies (from CPT data)

q_t = corrected cone tip resistance = varies (from CPT data)

Table 3 summarizes the average undrained shear strength calculated from CPT data for each investigated preliminary wind turbine location. The values reported in Table 3 correspond to the average undrained shear strength from a depth of 7 feet to the bottom of the sounding. A start depth of 7 feet was selected as the minimum anticipated foundation embedment depth provided a spread footing is utilized for turbine support. Figure 10 shows the undrained shear strength as determined from the results of the CPT investigation and can be used for reference if a deeper foundation system is selected for the project. The predominant soil types at the investigated preliminary turbine locations were cohesive based on interpretations of the results from CPT.

The average undrained shear strength data ranged from approximately 2,850 to 7,850 psf. Review of the undrained shear strength, determined from CPT soundings indicates that the undrained shear strength values at all of the turbine locations except turbine 87 exceeded 2,000 pounds per square foot (psf). At turbine location 87, a zone of lower strength soils was identified between the depths of approximately 6.5- to 7.5-feet below ground surface. Considering that lower undrained shear strength values at other isolated turbine locations across the site may be encountered, for this preliminary geotechnical investigation, the recommended undrained shear strength design value (for use in preliminary wind turbine foundation design assuming a spread footing foundation system is selected) will be 1,500 psf. This design value was chosen based on data in Figure 10.

Unconfined compressive strength test results performed on Shelby tube samples indicated the soils had unconfined compressive strengths ranging from 3.1 to 9.4 tons per square foot (tsf). The unconfined compressive strength is typically considered to be twice the undrained shear strength. Therefore, the undrained shear strength of the soils ranged from 3,100 to 9,400 psf, which exceeds the 1,500 psf recommended preliminary design value.

3.5 Shear and Compression Wave Velocities

The results of the shear and compression wave velocities are in Appendix C. Shear wave velocity (interval average) results measured by a seismic cone penetrometer are summarized in Table 4. The interval shear wave velocities were measured from the bearing elevation of the proposed foundation (7 feet) to the depth of the sounding. The interval shear wave velocities (V_s) were used to compute the average shear velocity from the assumed base of the foundation to the end of the sounding.

The average shear wave velocity (V_s) of the underlying soil varied from 727 ft/sec to 1064 ft/sec (Table 4). It is recommended that the minimum average shear wave velocity (investigated preliminary turbine location 84) of 727 ft/sec be used in soil stiffness calculations as part of the structural foundation design and this value will be used in the remainder of the calculations in this report for consistency.

The compression wave velocity was also measured during this preliminary investigation at four locations selected to provide spatial coverage across the project site. Table 4 summarizes the compression wave velocity (interval average) results measured by the seismic cone penetrometer at selected locations. The average compression wave velocity (V_p) at the tested sites were 3,377 ft/sec to 8,117 ft/sec.

The compression and shear wave velocity information was used to compute the Poisson's ratio (υ). The following equation relates shear and compression waves with Poisson's ratio:

$$\nu = \left(\frac{Vp^2}{2Vs^2} - 1\right) \Big/ \left(\frac{Vp^2}{Vs^2} - 1\right)$$

(Reference 10, page 1108)

Table 4 summarizes the computed Poisson's ratio at the four investigated preliminary locations where shear and compression wave velocities were both measured and the calculated Poisson's ratio of the soils at these locations. Poisson's ratio from the tested locations ranged from 0.45 to 0.49. A value of 0.44 is recommended for preliminary design. For a complete geotechnical investigation, additional turbine locations will need to be investigated which may affect the preliminary design seismic velocities and Poisson's ratio.

3.6 Compressibility

3.6.1 Compressibility Characteristics from DMT

The DMT data was used to obtain the one-dimensional constrained modulus *M*. The M-values indicate that the soil is of low compressibility.

The one-dimensional constrained modulus *M* is related to the one-dimensional coefficient of volume compressibility m_v by the following equation:

$$M = \frac{1}{m_v}$$

The data are used to compute the settlement of the proposed wind turbine foundations in a later section of this report.

3.7 Compaction and CBR Testing

A total of nine laboratory compaction tests were conducted on five bulk surface soil samples (1- to 2-feet below grade) and from four borehole sampling (4-feet below grade) collected across the site. Standard Proctor testing performed as a part of this geotechnical evaluation indicated the soil maximum dry density ranges from 92.2 to 98.6 pcf for fat clay soils (surface soils) and 100.7 to 111.1 pcf for silty lean clay and lean clay (glacial till). The corresponding optimum moisture content varied from 22.4 to 25.3 percent for the fat clay and was 17.3 to 22.1 percent for the glacial till. In-situ moisture contents of the bulk samples obtained for CBR testing on cohesive soils ranged from 24.6 to 28.8 percent. Based on these results, the in-situ unit weight of 110 pcf (100 pcf maximum dry density at 10 percent moisture content) is recommended for backfill. The results of the compaction testing can be found in Table 6.

Design for roads and working areas is based in part on the strength of the subgrade that can be reasonably achieved. California Bearing Ratio (CBR) tests were completed on soil samples from the site to determine the field strength of the subgrade.

A total of five CBR samples were collected from the site. The bulk samples were collected from soil immediately below the existing topsoil or at depths on the order of 1 to 3 feet below the surface. The soil samples were prepared to approximate three densities: 90, 95, and 98 percent of the maximum standard Proctor density at the optimum moisture content. The results of the CBR testing can be found in Table 5.

Results from the samples collected below the topsoil indicate that corrected CBR values at 0.1 inch under a surcharge of 50 psf range from 1.0 to 1.3 percent for the fat clay when compacted to 95 percent of the standard Proctor unit weight at optimum moisture. A CBR value of 1.1 percent is recommended for road design.

4.0 Analysis and Recommendations

Results of the preliminary field investigation have been presented in Section 3.0. Based on these results, this Section 4.0 provides analysis, conclusions, and recommendations for the preliminary design and construction of wind turbine foundations and general construction considerations. For foundations, the preliminary design factors addressed include bearing capacity, footing stiffness, foundation settlement, and sliding friction.

4.1 Roadway Design

Roadway design covers preparation of surface, preparation of subgrade, and materials necessary for roadway construction. The high shrink/swell soils have a significant impact on road design and construction costs.

4.1.1 Surface Preparation for Roadways

Site preparation for roadways should be initiated by removing all surface vegetation, root zones, the upper layer of organic topsoil, and loose, soft or otherwise unsuitable materials. The organic-rich topsoil thickness generally was 24 inches thick. Actual stripping depths will likely vary and should be evaluated by a geotechnical engineer at the time of construction. Topsoil removed during site stripping should be graded into existing site topography or used as fill materials in non-critical areas. Incorporation of topsoil in compacted fill which will support turbines, roadways, pavement, equipment pads, or other site structures is not recommended. The surficial soils shall be graded to prevent accumulation of surface water and to allow for proper drainage in the vicinity of the proposed roadways. Compaction of this material is required to achieve a minimum of 95 percent of the laboratory maximum dry density measured according to Standard Proctor.

4.1.2 Subgrade Preparation

After stripping or excavating to rough grade is complete, the exposed subsurface along the entire roadway should be proof-rolled. Proof-rolling should be performed with a fully loaded tandem axle dump truck having a minimum gross weight of 25 tons. Proof-rolling will aid in identifying areas of unstable subgrade. Proof-rolling should be performed in the presence of a geotechnical engineer. Typical standards for proof-rolling should include no rutting greater than 1 to 1-½ inch, and no "pumping" of the soil behind the proof-roll. Proof-rolling is not an indication that the subgrade strength is adequate or that it meets design requirements, but simply highlights potentially unsuitable subgrade conditions. If the compacted subgrade soil conditions do not meet the required compaction test results, per the construction specifications, the deficient materials shall be removed and replaced with the required thickness of additional road base material according to Table 6 (for 1.5-inch design rut depth). Areas which fail proof-rolling tests should be sub-cut and replaced with suitable fill.

The silty clay to clayey silt glacial till soils likely may be easily disturbed by construction traffic or become unstable during proof-rolling and/or subsequent construction operations and some means of subgrade stabilization may be required to facilitate construction. Use of a vibratory roller is not recommended for cohesive soil subgrades.

Alternatives for roadway subgrade stabilization include the following:

- **Removal and Replacement**—The inadequate materials can be removed and replaced with granular structural fill consisting of well-graded sand and gravel materials (similar to typical roadway base course materials). Compaction of this material is required to achieve a minimum of 95 percent of the laboratory maximum dry density measured according to Standard Proctor. The granular structural fill can be used in conjunction with a geotextile fabric or geo-grid to potentially reduce depth of over-excavation or to reduce the amount of granular materials required.

- **Scarification and Re-compaction**—It may be feasible to scarify, dry, and re-compact the exposed soils. The success of this procedure would depend primarily upon favorable weather and sufficient time to dry the soils. Even with adequate time and weather, however, stable subgrades may not be achievable if the thickness of the soft soil is greater than 1 to 1-½ feet.

- ***Soil Stabilization***—The use of cement, lime, or fly-ash as a soil stabilizing agent can be considered in lieu of removal and replacement or scarification and recompaction. The type and quantity of materials used to stabilize the soils will be dependant upon soil type. Typically lime stabilization is used for higher moisture content silty clay to clayey silt soils similar to those encountered at the site. Use of lime will also reduce the Liquid Limit of the soil and reduce the shrink/swell potential of fat clay soils. Design of a soil stabilization program should be performed by a geotechnical engineer in conjunction with laboratory testing to provide the proper stabilizing agent, application rate, and depth of soils stabilized.

Placed fill for subgrade stabilization shall be compacted with a sheepsfoot or pad-foot compactor at sites on cohesive material and a smooth drum roller for granular and gravel fill material. Native silty clay to clayey silt materials present across the site indicate the use of the sheepsfoot or pad-foot compactors. Vibratory versions of these compactors are acceptable, although not required for cohesive soils. Vibratory rollers may disturb the cohesive soils, especially in the presence of higher moisture contents. The number of passes required will vary depending upon the equipment used, fill material type, and moisture condition of the fill.

Imported fill material may consist of sand, silty sand, clayey sand, sandy lean clay or lean clay, although the liquid limit of these materials should not exceed 45 and the plastic index should not exceed 20. Note that imported fine-grained fill soils may be particularly difficult to compact if wet or allowed to become wet, or if spread and compacted over wet or marginally stable subgrades. The majority of the on-site glacial till soils likely will be suitable as fill materials, however, Liquid Limit test results on shallow soils exceeded 45 percent and/or Plasticity Indicies exceeded 20 percent.

After completion of proof-rolling, but prior to placement and compaction of granular fill, any soils loosened during the excavation activities should be recompacted as noted in this section of the report.

The roadway surfaces should be crowned or sloped to prevent water ponding on or around the roadway surfaces. The roadway crowns and slopes should have a 2 percent slope to promote drainage. Culverts should be used where needed to allow drainage underneath the roadways and to prevent ponding either over or on the side of the roadways. If rain occurs during roadway construction, the subgrade should be allowed to dry prior to continuing work.

4.1.3 Road Base Design Considerations

The design thickness of placed granular fill is determined using CBR values. Based upon Section 3.7, a CBR value of 1.1 percent will be used for the non-modified roadway subgrade compacted to 95 percent of a Standard Proctor maximum dry density. The required aggregate thickness was determined by using the Giroud-Han iterative equation:

$$h = \frac{0.868 + \left(0.661 - 1.006J^2\right)\left(\frac{r}{h}\right)^{1.5} \log N}{\left[1 + 0.204\left(\frac{3.48CBR_{bc}^{0.3}}{CBR_{sg}} - 1\right)\right]} \left(\sqrt{\frac{\frac{P}{\pi r^2}}{\frac{s}{f_s}\left[1 - 0.9e^{-\left\{\frac{r}{h}\right\}^2}\right] N_c f_c CBR_{sg}}} - 1 \right) r$$

where;

h = required thickness (meters)

J = aperture stability modulus (m-N/degree)

P = wheel load = axle load/2

r = radius of tire print

N = number of axle passes

CBR_{sg} = Subgrade CBR = 1.1 %

CBR_{bc} = Aggregate CBR = (~5 x CBR_{sg})

f_s = rut depth factor = 75 mm (~ 3 inches)

s = maximum rut depth = 1.5 inches and 3 inches

N_c = bearing capacity factor (5.14 for geotextile reinforced pavements)

f_c = factor relating CBR of subgrade to equivalent c_u value = 30

Two traffic conditions were evaluated and analyzed for use of the road: (1) conditions during construction of the project, and (2) maintenance traffic (during wind farm operation) consisting of light duty trucks.

The construction condition assumes: a subgrade CBR value of 1.1 percent; an aggregate CBR value of 5.5 percent; a maximum axle load of 25 kips; a tire pressure of 80 psi; 800 axle passes; and maximum allowable rut depths of 1.5 and 3.0 inches. The required aggregate thickness for the construction condition varies from 6 to 25 inches, depending on the level of soil compaction, geotextile reinforcement, and maximum allowable rut depth (Table 6).

The maintenance condition assumes: a subgrade CBR value of 1.1 percent; a aggregate CBR value of 5.5 percent; a maximum axle load of 3.5 kips; a tire pressure of 65 psi; 2000 axle passes; and maximum allowable rut depths of 1.5 and 3.0 inches. The required aggregate thickness for the maintenance condition varies from 6 to 10 inches, depending on the level of aggregate reinforcement and maximum allowable rut depth (Table 6).

It is recommended that a minimum of 6 inches of aggregate base be placed to compensate for partial topsoil stripping, provided the topsoil is stable and capable of proper roadway support. About 24 inches of gravel would be required if complete topsoil stripping were to be performed.

Please note that axle loads and/or axle passes in excess of the design values noted above may decrease the overall life of the road because of premature road deterioration. In the event of heavy traffic leading to excessive rutting or surface deterioration during construction, it is recommended that 2 inches of gravel be added and re-graded to reestablish the road surface.

It is recommended that granular roadway material be placed on the roadways. The granular roadway surface should consist of crushed limestone gravel. To facilitate local purchase, this aggregate should meet the requirements of Ohio Department of Transportation standards for typical roadway base course materials. Alternative road surface materials may be used depending upon availability and suitability. A smooth drum vibratory compactor should be used to compact the gravel roadway. This material should be compacted in a single lift. The gravel roadway should be compacted to 95 percent of maximum standard proctor dry density, as determined by ASTM D 698.

4.2 General Excavation and Fill

The following sub-sections present general recommendations for site clearing, grading, and compaction for the preliminary investigated wind turbine foundations.

4.2.1 Clearing and Grubbing

The project site is predominantly farmland, and clearing and grubbing will generally be restricted to the removal of planted agricultural crops or remains of crops, grass, topsoil and boulders. Based on the field investigation, the thickness of this organic material or topsoil is about 24 inches.

The topsoil and organic material is usually mixed during the excavation process, and thus, should not be used for structural fill. This material should be placed separately away from the rest of the excavated material to avoid contamination. Topsoil removed during site stripping should be graded into existing site topography or used as fill in non-critical areas. This material could be used in grading non-structural fill such as fields, or service areas in which compressibility of the material does not have an impact on overlying structures or roadways.

4.2.2 Site Grading

Results of the preliminary geotechnical exploration indicate that cut and fill of the subsoil in the area can be achieved with conventional machinery.

4.2.3 Grading in Cut

Grading in cut should be able to remove all boulders, topsoil and organic. The soils in the upper 7 to 10 feet can be classified primarily as Type B from OSHA soil classifications (29 CFR 1926 Subpart P-Excavations). Soils likely will vary significantly across the sites and it is the responsibility of the competent field person to verify the in-situ soil classification at each excavation and verify that the benching or slopes are adequate during construction (29 CFR 1926 Subpart P-Excavations).

4.2.4 Grading in Fill

Based on soil conditions encountered at the anticipated foundation depth of 7 to 10 feet, all preliminary investigated foundations will be placed on natural ground, and the use of compacted fill beneath the base of the foundation will not be required.

4.3 Dewatering

Based on this preliminary investigation and the discussion presented in Section 3.3, groundwater is anticipated to be encountered within 7 feet of the ground surface. During turbine foundation excavation, dewatering may be required.

At the turbine locations with groundwater at or below the foundation bearing elevation, a system of connected trenches and sump pits likely will be adequate to control groundwater seepage. At locations with shallower groundwater or in deeper excavations, more comprehensive dewatering methods, such as dewatering wells or cut-off trenches may be required

In the event of heavy rainfall, the impermeable nature of the clay soils could limit water outflow from the excavation, and typical dewatering can be achieved by use of sump pit and small pump. Other drainage elements such as sub-drains are not required. Water should not be allowed to pond in the base of the excavations.

4.4 Wind Turbine Tower Foundation

Based on the preliminary geotechnical investigation of the investigated turbine locations, the proposed foundations will be supported by predominantly cohesive soils and undrained (cohesive soil) bearing capacity will be evaluated for preliminary foundation design.

4.4.1 Foundation Type

Investigation of the preliminary turbine locations found the presence of a predominantly cohesive soil. The extreme frost penetration depth for this project location is 4 feet (Reference 16 NAVFAC 7.1, p. 43). Based on these conditions and the analysis presented below, a conventional spread footing bearing on soil approximately 7 feet below grade is a feasible and cost effective foundation system to utilize at all of the turbine sites included in this investigation.

4.4.2 Bearing Capacity

The spread footings should bear on suitable natural soils generally consisting of silty clay and clayey silt soils. The following sections discuss, in detail, the determination of the preliminary allowable bearing capacity for the proposed turbine foundations.

4.4.3 Bearing Capacity—Cohesive Soil

Allowable soil bearing pressure for a spread footing resting on a cohesive material (i.e., clay) is based on the undrained shear strength obtained from testing and investigation. A brief discussion of the undrained shear strength was provided in Section 3.4.1. The recommended preliminary design undrained shear strength for this project is 1,500 psf.

The following is a more detailed description of the procedure used to determine the allowable bearing capacity for a cohesive material.

The ultimate bearing capacity of the soil supporting a spread footing can be determined using the Terzaghi-Meyerhoff equation as follows:

$$q_{ult} = \frac{1}{2}\gamma' b_{eff} N_\gamma S_\gamma i_\gamma + qN_q S_q i_q + s_u N_c S_c i_c$$ (Reference 13, p. 192)

where:

q_{ult} = ultimate bearing pressure, psf

γ = unit weight of the soil, pcf

B_{eff} = average effective footing width

q = surcharge at foundation level, psf

s_u = design undrained shear strength of the soil

N_γ = bearing capacity factor

N_q = bearing capacity factor

N_c = bearing capacity factor

S_γ = shape factor

S_q = shape factor

S_c = shape factor

i_γ = inclination factor

i_q = inclination factor

i_c = inclination factor

The first and second terms of the above equation are associated with granular soils which typically exhibit drained modes of failure (except under earthquake loading) and where excess pore pressures cannot build up in the soil when sheared. These terms represent the ultimate drained bearing capacity.

The third term of the equation is associated with fine-grained/clayey soils which typically exhibit an undrained mode of failure and where excess pore pressures can build up in the soil when sheared. The first and second terms are dropped from the equation, and the third term remains, with an overburden pressure, representing the ultimate undrained bearing capacity shown as follows:

$$q_{ult} = s_u N_c S_c i_c \qquad \text{(Reference 13, p. 192)}$$

The following are formulas for the dimensionless bearing capacity (N_c), shape (s_c), and inclination (i_c) factors above (Reference 13, page 192-193):

$$i_c = 0.5 + .05\sqrt{1 - \frac{H_d}{A_{eff} S_u}} \qquad S_c = 1 + 0.2\frac{B_{eff}}{L_{eff}} \qquad N_c = \pi + 2$$

Based upon the concurrent foundation design:

D_f = depth of foundation measured from the final ground surface = 7 ft

ϕ = internal friction angle = 0 deg (undrained case)

S_u = design undrained shear strength of the soil = 1,500 psf

N_q = bearing capacity factor = 1 (Reference 12, page 395)

N_c = bearing capacity factor = 5.14 (Reference 12, page 395)

where :

B_{eff} = effective footing width from normal and extreme wind load conditions

L_{eff} = effective footing length from normal and extreme wind load conditions

H_d = design horizontal load from normal and extreme wind load conditions

A_{eff} = effective area as a result of a wind load causing a moment on the foundation from normal and extreme wind load conditions

Based on the preliminary foundation design parameters for the with Gamesa G87 turbines, the limiting ultimate undrained bearing capacity is 9,350 psf for normal operation loads and 8,750 psf for extreme wind load.

The allowable soil bearing pressure is then obtained by dividing the ultimate bearing capacity by an appropriate factor of safety (FOS). The recommended factors of safety for normal and extreme loading are 3 and 2.25, respectively (Reference 11, page 36).

Therefore, the allowable soil bearing pressures for the undrained case are 3,100 and 3,850 psf for the normal and extreme load cases, respectively.

4.4.4 Bearing Capacity—Bedrock

Laboratory testing was not performed on the bedrock, the bearing capacity of sound, intact rock typically exceeds the bearing capacity of the soil and should not govern the foundation design.

4.5 Foundation Stiffness

Elastic theory relates shear wave velocity with the shear modulus at small strain using the following equation:

$$G_o = \rho V_s^2$$ (Reference 12, pg. 155)

where

G_o = shear modulus at small strain

V_s = shear wave velocity using CPT seismic data

ρ = mass density of the soil. The mass density is the ratio of the unit weight (γ) and the acceleration of gravity, g (32.2 ft/s^2 or 9.81 m/s^2).

To estimate the minimum shear modulus, the minimum average shear wave velocity of 727 ft/sec was selected as the design value (Section 3.4). All test locations either met or exceeded this value. Based on laboratory testing, a moist unit weight of 136 lbs/ft^3, the shear modulus at small strain is computed to be 2,235 kips per square foot (ksf). This value is the preliminary small strain shear modulus. For preliminary foundation design, the structural engineer should reduce the shear modulus based upon the estimated level of soil stress caused by the foundation.

4.6 Sliding Friction

The friction coefficients between the soil of the sites and concrete should be taken as 0.4, in accordance with recommendations provided by Reference 14, assuming a smooth concrete surface. These values are based on the limiting, clay, soils.

4.7 Foundation Settlement

Immediate, long-term and differential settlements of the foundation were computed based on results of the preliminary geotechnical investigation and testing described here. The established limit for Gamesa 87 foundation rotation is 0.17 degrees (or 3 mm/m) (Reference 15). A total settlement limit is not stipulated.

4.7.1 Immediate Settlement

The immediate or elastic settlement can be computed based on the application of the extreme wind load, using the following equation based on elastic theory:

$$S = \frac{B_{eff} q_o}{E_s}\left(1-\upsilon^2\right) I$$ (Reference 17, page 7.17)

where:

S = elastic settlement

q_o = contact pressure

B_{eff} = effective foundation width

υ = Poisson's ratio = 0.45 (from Section 3.5)

E_s = elastic soil modulus = $2G_o(1+\upsilon)b$ = 1,944 ksf (G_o = 2,235 ksf from Section 4.5) and b = 0.3, typical reduction factor from small strain to 1 percent strain)

I = shape factor = 1.12 (Reference 17, page 7.17)

The immediate settlement is estimated to be on the order of approximately 0.5 inches based on the application of assumed extreme wind loading based on the preliminary spread footing foundation system.

4.7.2 Long-Term Settlement from DMT Results

The long term settlement can be estimated using the data collected from the DMT. The procedure proposed by Schmertmann (Reference 18) was used to calculate the settlement using the one-dimensional constraint modulus M. In this procedure, the soil strata under the proposed foundation are subdivided into several layers. Then the stress increment induced by the foundation load is calculated at the mid-point of each layer. The compression of each layer can be computed using the following equation:

$$s_t = \sum_i \Delta\sigma' \frac{\Delta H_i}{M_i}$$

where:

> $\Delta\sigma'$ is the change in effective stress at the mid-point of the soil layer due to the foundation load,
>
> ΔH_i is the thickness of layer i, and
>
> M_i is the average one-dimensional constraint modulus of the layer i.

Using this formula, settlement from the DMT results is based on the application of the normal operating load. To calculate the consolidation settlement, the soil is split into several layers, with the total settlement calculated as the sum of the individual layer settlements. The depth of calculation is typically taken as twice the approximate width of the foundation plus embedment, however, the bedrock encountered across the site will be non-compressible under the foundation loads and does not need to be factored into turbine settlement.

4.7.3 Differential Settlement

To calculate the differential settlement across the turbine foundation, the maximum and edge settlements should be calculated. In order to calculate the average pressure increase at the center and edge of the foundation ($\Delta\sigma'$ from Section 4.7.2 above), the appropriate influence factor can be applied through the following equation:

$$\Delta\sigma = I * q$$

where:

$\Delta\sigma$ = applied foundation load at midpoint of soil layer (variable with depth and location)

I = Influence factor varying with depth and location beneath foundation

q = foundation bearing pressure for mean operating load condition

The influence factor used in the above equation for the center of the effective bearing area can be calculated using the following equation:

$$I_{center} = 1 - \frac{1}{\left[\left(\frac{r_{eff}}{z_{mid} - d_f}\right)^2 + 1\right]^{3/2}}$$ (Reference 12, page 132)

where:

$r_{eff} = \sqrt{\dfrac{B_{eff} \cdot L_{eff}}{\pi}}$ = effective radius of loaded area

z_{mid} = depth to midpoint of soil layer

d_f = bearing depth of foundation

The influence factor used in the above equation for the edge of the foundation can be calculated using Figure 4.10 of Reference 17, page 4.31, with a curve value of 1.0, which represents the edge of the effective foundation bearing area.

The following equation should be used to calculate the differential settlement:

$$\Delta S = \frac{S_{\max} - S_{edge}}{B_{eff}/2 + e}$$

where:

ΔS = differential settlement

S_{max} = maximum settlement beneath the turbine foundation

S_{edge} = settlement at the edge of the turbine foundation

B_{eff} = equivalent ellipse soil width in bearing

e = eccentricity of bearing pressure

Preliminary estimates of the long-term settlement on the order of less than 0.15 inches (edge) to 0.25 inches (center/max) based on the results of the DMT and the application of the assumed mean operating load. This indicates a potential differential settlement on the order of 0.1 inches over the effective area of the turbine foundation. The corresponding maximum estimated differential settlement is within the range of 0.35 mm/m.

4.8 Soil Chemical Content and Cement Type

The results of the chemical testing from four samples indicate that the soils have pH ranging from 7.6 to 7.8. The analytical laboratory testing results indicate that the soils contain less than 10 to 17 ppm of Chlorides and less than 50 ppm soluble sulfates (detection limit). The laboratory test results are included in Table 8 and Appendix H. As a result, Type I Cement is considered appropriate for use on this site because soluble sulfate levels in the soil are well below 1,000 ppm which constitutes the dividing line between negligible and moderate sulfate exposure. (Reference 17, page 79).

4.9 Weak Soils and Shallow Bedrock

The proposed turbine locations investigated during this preliminary investigation appear suitable for support of the anticipated turbine foundations. However, weak soils and shallow bedrock have the potential to add significant cost to the project. There are options for mitigation.

One of the 12 sites investigated by CPT had bearing capacity significantly below the mean, site 53. In this case, the soil is less than 7-feet thick so the turbine would bear directly on bedrock and the soil strength is immaterial. However, it raises the possibility that a few proposed turbine sites may have weak soils and bearing capacities significantly below the mean. Designing a single foundation based on these outlier locations would mean most foundations would be significantly over-designed. Several options exist:

- Iberdrola may want to consider moving those turbines, which suggests pre-arranging some alternate sites.
- Iberdrola may consider using two foundation designs.
- Iberdrola can consider soil improvement for lower strength sites (likely removal and replacement or stone column/geopier foundations).

The final decisions will need to be based on the results of the final investigation.

Proposed turbine site 87 had relatively weak soils at approximately 7- to 8-feet below grade. This may end up being just below the base of the foundation. In such cases, it is recommended to subcut and remove the weak soils and add engineered backfill to establish the proper embedment depth.

Due to natural variations in the subsurface soil profile, it is possible that unsuitable soils may be encountered during foundation excavation. A geotechnical engineer should inspect the excavations for unsuitable soils prior to foundation construction. If unsuitable soils are encountered during the course of the foundation excavation, the foundation designer should be notified and methods for subgrade stabilization presented in Section 4.1.2 should be implemented.

At proposed site 53 the soil is about 5.5-feet thick. In this case, the turbine foundation can be constructed to bear on the bedrock, and additional fill can be imported to raise the grade to the design embedment. However, this raises the possibility that some yet-to-be-investigated sites may have even thinner soil. Iberdrola has indicated (personal communication, Jeromy Miceli, 2 December 2009 that Ohio regulations make blasting onerous. Iberdrola should consider moving those turbines where soil is very thin over hard rock, which suggests pre-arranging some alternate sites.

5.0 Limitations of Analysis

The preliminary analysis and conclusions provided are based on the results of fieldwork which focused on investigation of ten preliminary wind turbine locations. Using generally accepted engineering methods and practices, the preliminary investigation performed has made every reasonable effort to characterize the investigated turbine locations. However, the likelihood that conditions may vary from any specific location tested is possible, and following completion of the final geotechnical investigation careful attention to soil conditions should still be undertaken during the time of construction by qualified personnel.

The soil conditions at the remainder of the proposed wind turbine sites will need to be evaluated to determine their support characteristics for the proposed wind turbine foundations. The test results and recommendations provided herein cannot be applied to any turbine sites not explored as part of preliminary geotechnical investigation without testing and verification.

Prior to the final foundation design, a geotechnical investigation must be conducted at each proposed turbine location and should consist of:

- Site reconnaissance focused on identifying geological hazards at proposed turbine locations and proposed road alignments.
- A geotechnical drilling program consisting :
    - Cone penetration testing at all proposed turbine locations to determine soil lithology and soil strength.
    - Hollow-stem auger borings at 10 percent of the proposed turbine locations and at proposed turbine locations where CPT encountered refusal in order to collect soil samples for laboratory testing, and to determine soil strength. Rock coring should be performed at a number of sites where relatively shallow bedrock is encountered.
    - Perform seismic testing at a minimum of 10 percent of the proposed turbine locations to determine foundation design parameters.
    - Perform dilatometer soundings at a minimum of 10 percent of the proposed turbine locations to determine soil compressibility.
- Explorations at 20 percent of the proposed turbine locations and along proposed access road alignments scattered across the site to determine overlying soil thicknesses and to collect soil samples for thermal resistivity testing and road subgrade strength testing.
- Summarize final geotechnical investigation with a report addressing geotechnical hazard evaluation, geotechnical recommendations, and geotechnical design parameters for foundation design.

- Perform electrical resistivity testing at 10 percent of the sites and at the proposed substation location for electrical design purposes.

In addition to the field investigation, a laboratory testing program should be completed and should include:

- Grain size analyses with hydrometer as required to adequately classify each soil type encountered in the borings.
- Atterberg limit tests as required to adequately classify each soil type encountered in borings and test pits.
- Unconsolidated-undrained strength testing on soil samples collected from hollow-stem auger borings.
- California Bearing Ratio testing on soil samples collected from shallow test pits for use in access road design.

6.0 References

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Tables

Table 1

Geologic and Geotechnical Hazards Summary

Hazard	Present at Site?	Comment
Flooding/High groundwater	Yes	The site is relatively flat and poorly drained soils exist throughout much of the site and could be prone to localized flooding. Groundwater is less than 10 feet below ground surface over much of the site.
Slope failure	No	The site is relatively flat.
Subsidence – Pumping	Unlikely	Project site is underlain by bedrock with a framework capable of resisting subsidence due to production of oil, gas or water.
Subsidence – Mining	No	Mining activity is limited to limestone quarry operation and no coal mining
Subsidence – Caves/Karst	Possible but unlikely	Bedrock is susceptible to dissolution, but no current karst hazards areas are presently known in the project area.
Earthquake/Seismicity	No	The site is in a moderately low seismic area. Turbine load factoring allows for using the higher of the wind load or the seismic load, and wind load is larger.
Swelling/shrinking soil	Yes	Lake origin (fat) clay soil is present throughout the site at the surface. Shrink/swell potential will need to be addressed in road designs and shallow foundations.
Corrosive soil	No	Clay soils exist throughout the project area, which are potentially corrosive to steel. However, lab testing indicates that Type 1 cement can be used and the soil pH is near neutral .
Made ground	Unlikely	No coal mining exists in the region and there does not appear to be any significant relief associated with raised grades. There is a small potential for filled areas associated with the low-lying swamp areas.
Collapsible soil	No	Collapsible soils are not known or likely to be present.
Volcanic activity	No	No current volcanic activity exists in the region.
Quick clay	No	Quick clay conditions are not known or likely to be present.

Table 2

Summary of Depth to Groundwater from Auger Borings

Proposed Turbine Site	Groundwater Depth While *Drilling [ft]*	Groundwater Depth Upon Completion of Drilling [ft]	Groundwater Depth on *10/20/09 [ft]*	Groundwater Depth on *11/3/09 [ft]*	Groundwater Depth on *11/17/09 [ft]*
T-22	10	8.6	8.6	8.2	8.4
T-42	13.3	10.8	10.8	11.5	11.7
T-71	22	NE	NE	6.6	7.2
T-103	16	NE	NE	12.5	11.1
T-120	21	NE	NE	10.8	11.1
T-148	16	10.5	10.5	7.3	7.5

NE – Not encountered

Table 3

Average Undrained Shear Strength and Friction Angle from CPT

Turbine ID	ϕ' [deg]	No. of granular layers	s_u [psf]	No. of cohesive layers	Depth of Refusal [ft]	Comment
T-7	42	14	7,886	56	22.5	-
T-27	40	19	5,600	26	~8	-
T-53	37	2	2,858	15	5.5	Turbine will bear on rock so soil strength is immaterial
T-60	44	11	7,535	39	16	-
T-84	41	7	5,624	21	9	-
T-87	39	25	5,693	53	25.5	-
T-94	39	4	7,218	43	14.5	-
T-111	40	15	7,619	34	15.5	-
T-130	40	14	7,571	53	22	-
T-139	40	17	8,657	42	19	-
T-144	39	14	6,486	49	20.5	-
T-160	37	15	5,198	56	23	-

Table 4

Summary of Seismic Testing From CPT

Proposed Turbine ID	Average Interval Shear Wave Velocity [ft/s]	Shear Modulus [ksf]	Average Interval Compression Wave Velocity [ft/s]	Poisson Ratio
T-7	991	4148	3377	0.45
T-27	791	2644	--	--
T-60	989	4128	--	--
T-84	727	2235	--	--
T-87	881	3280	--	--
T-94	888	3334	--	--
T-111	835	2948	8117	0.49
T-130	838	2696	--	--
T-139	1064	4779	5942	0.48
T-144	959	3888	--	--
T-160	819	2836	5479	0.49
Average	889	3356	5729	0.48
Stand Dev	101	786	1944	0.02
Minimum	727	2235	3377	0.45
Maximum	1064	4779	8117	0.49
Design Value	**727**	**2235**	**3377**	**0.45**

Table 5

Summary of Standard Proctor Test Results

Turbine ID / Thermal Test Location	Depth [ft]	Standard Proctor Data					CBR Value (%)		
		Maximum Dry Density (pcf)	Optimum Moisture (%)	95% Compaction Moist Unit Wt. at Opt. Moisture (pcf)	In-situ Moisture (%)	95% Compaction Moist Unit Wt. at in-situ Moisture (pcf)	90% Compaction	95% Compaction	98% Compaction
T-22	1	98.6	23	115.2	24.6	116.7	1.0	1.1	2.2
T-22	4	100.7	22.1	116.8	22.6	117.3	--	--	--
T-42	2	96.9	23.6	113.8	26.3	116.3	1.0	1.1	1.6
T-42	4	105.4	19.2	119.4	20.2	120.4	--	--	--
T-71	1	95.8	24.9	113.7	28.7	117.1	0.9	1.1	1.6
T-103	1	92.2	25.3	109.8	28.8	112.8	1.0	1.0	2.2
T-103	4	104.4	21.1	120.1	21.0	120.0	--	--	--
T-120	4	111.1	17.3	123.8	19.8	126.4	--	--	--
T-148	1	99.2	22.4	115.3	25.5	118.3	0.7	1.3	2.6
Sub	4	101.7	22.1	118.0	27.4	123.1	--	--	--
Mean				116.6		118.8			
St. Dev.				4.0		3.8			
Min.				109.8		112.8			
Max				123.8		126.4			

Table 6

Subgrade Compaction and Aggregate Thickness

1.5 Max Rut Depth		Compaction (% of Standard Proctor Unit Weight)											
		95 or Greater		94 to 94.99		93 to 93.99		92 to 92.99		91 to 91.99		90 to 90.99	
Traffic Condition		Maint. Traffic	Const. Traffic	Maint. Traffic	Const. Traffic	Maint. Traffic	Const. Traffic	Maint. Traffic	Const. Traffic	Maint. Traffic	Const. Traffic	Maint. Traffic	Const. Traffic
Unreinforced		8	22	8	23	9	23	9	24	9	25	10	25
Reinforced	Geotextile	6	11	6	12	6	13	6	14	6	15	6	16
Reinforced	BX 1100	6	6	6	6	6	6	6	9	6	10	6	11
Reinforced	BX 1200	6	6	6	6	6	6	6	6	6	6	6	6

3.0 Max Rut Depth		Compaction (% of Standard Proctor Unit Weight)											
		95 or Greater		94 to 94.99		93 to 93.99		92 to 92.99		91 to 91.99		90 to 90.99	
Traffic Condition		Maint. Traffic	Const. Traffic	Maint. Traffic	Const. Traffic	Maint. Traffic	Const. Traffic	Maint. Traffic	Const. Traffic	Maint. Traffic	Const. Traffic	Maint. Traffic	Const. Traffic
Unreinforced		6	6	6	6	6	6	6	6	6	9	6	11
Reinforced	Geotextile	6	6	6	6	6	6	6	6	6	6	6	6
Reinforced	BX 1100	6	6	6	6	6	6	6	6	6	6	6	6
Reinforced	BX 1200	6	6	6	6	6	6	6	6	6	6	6	6

*Note that a minimum of 12 inches of aggregate base is recommended for road design to compensate for topsoil stripping.

Assumed Traffic Loading Conditions

Construction		Maintenance	
Axle Load [kips]	25	Axle Load [kips]	3.5
Tire Pressure [psi]	80	Tire Pressure [psi]	65
Axle Passes [each]	800	Axle Passes [each]	2000
Max Rut Depth [in]	1.5, 3	Max Rut Depth [in]	1.5, 3

Table 7

Summary of Geotechnical Parameters for Foundation Designs

Parameter	Value	Units
Undrained Soil Shear Strength (cohesive soil)	1,500	lb/ft^2
Soil Friction Angle (granular soil)	37	degrees
Min. Allowable Bearing Capacity, Normal Operating Load	3,100	lb/ft^2
Min. Allowable Bearing Capacity, Extreme Load	3,850	lb/ft^2
Min. Average Shear Wave Velocity	727	ft/s
Min. Design Small Strain Shear Modulus	2,235	kips/ft^2
Poisson Ratio	0.45	
Min. Foundation/Soil Friction Factor	0.4	
Backfill Density over Foundation (dry density = 95 pcf @ moisture content = 12 % min.)	110	lb/ft^3
Frost Depth	40	inches

Table 8

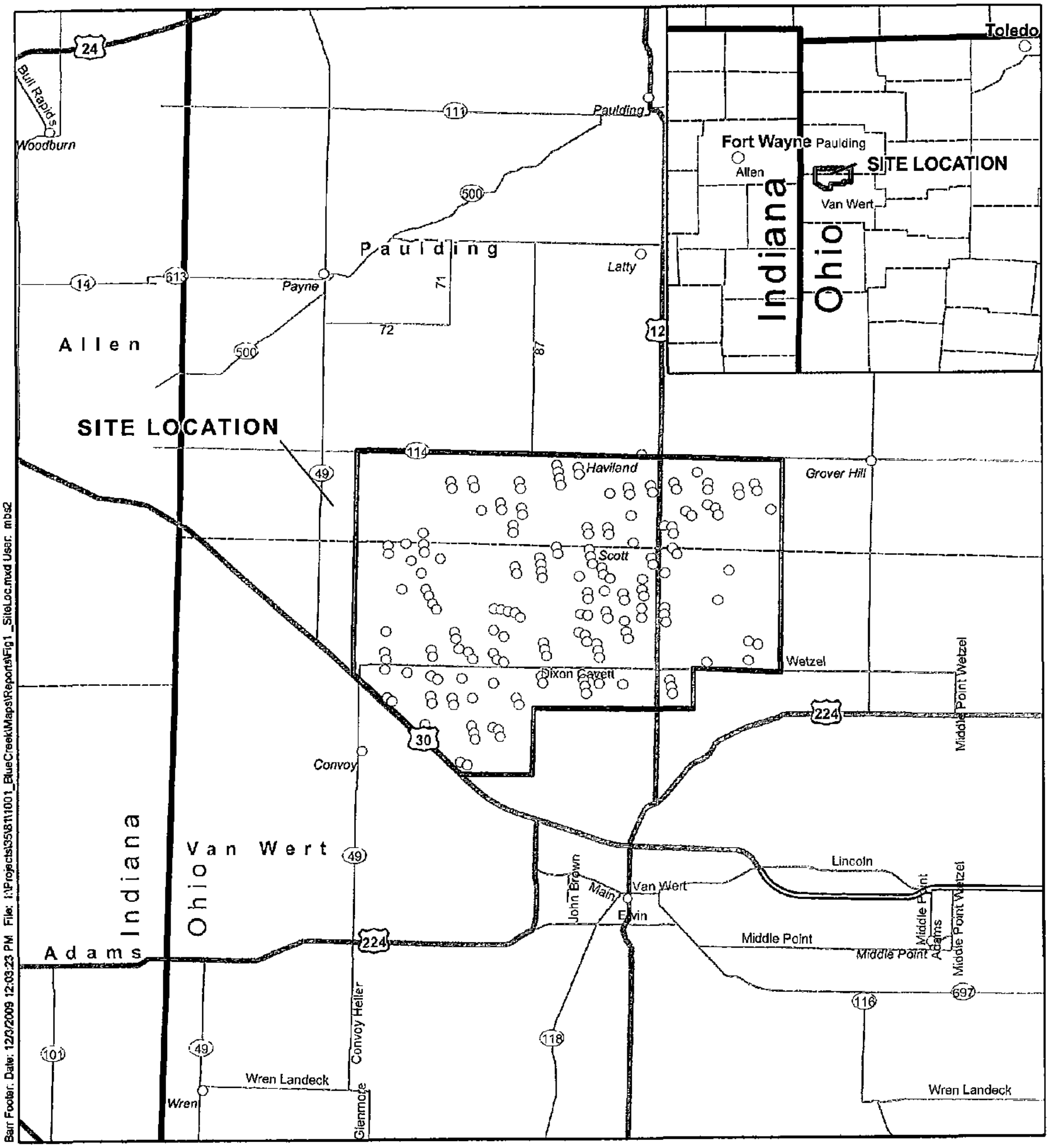
Chemical Test Results on Soil Samples

Turbine Number	Depth	pH	Chloride [mg/kg]	Sulfate [mg/kg]
T-22	5	7.6	15.0	50.0
T-71	5	7.7	12.0	50.0
T-120	5	7.8	10.0	50.0
T-148	5	7.6	17.0	50.0
Mean		7.7	13.5	50.0
St. Dev.		0.10	3.1	0.0
Min.		7.6	10.0	50.0
Max		7.8	17.0	50.0

* Chloride test result for sample obtained from several test locations was below the detection limit of 10 mg/kg. A value of 10 mg/kg will be used for analysis at this location.

* Sulfate test result for sample obtained from several test locations was below the detection limit of 50 mg/kg. A value of 50 mg/kg will be used for analysis at this location.

Figures



Barr Footer: Date: 12/3/2009 12:03:23 PM File: I:\Projects\35\81\1001_BlueCreek\Maps\Reports\Fig1_SiteLoc.mxd User: mbs2

○ Turbine Locations (coords. 9/04/2009)

▭ Project Extents

N

Miles

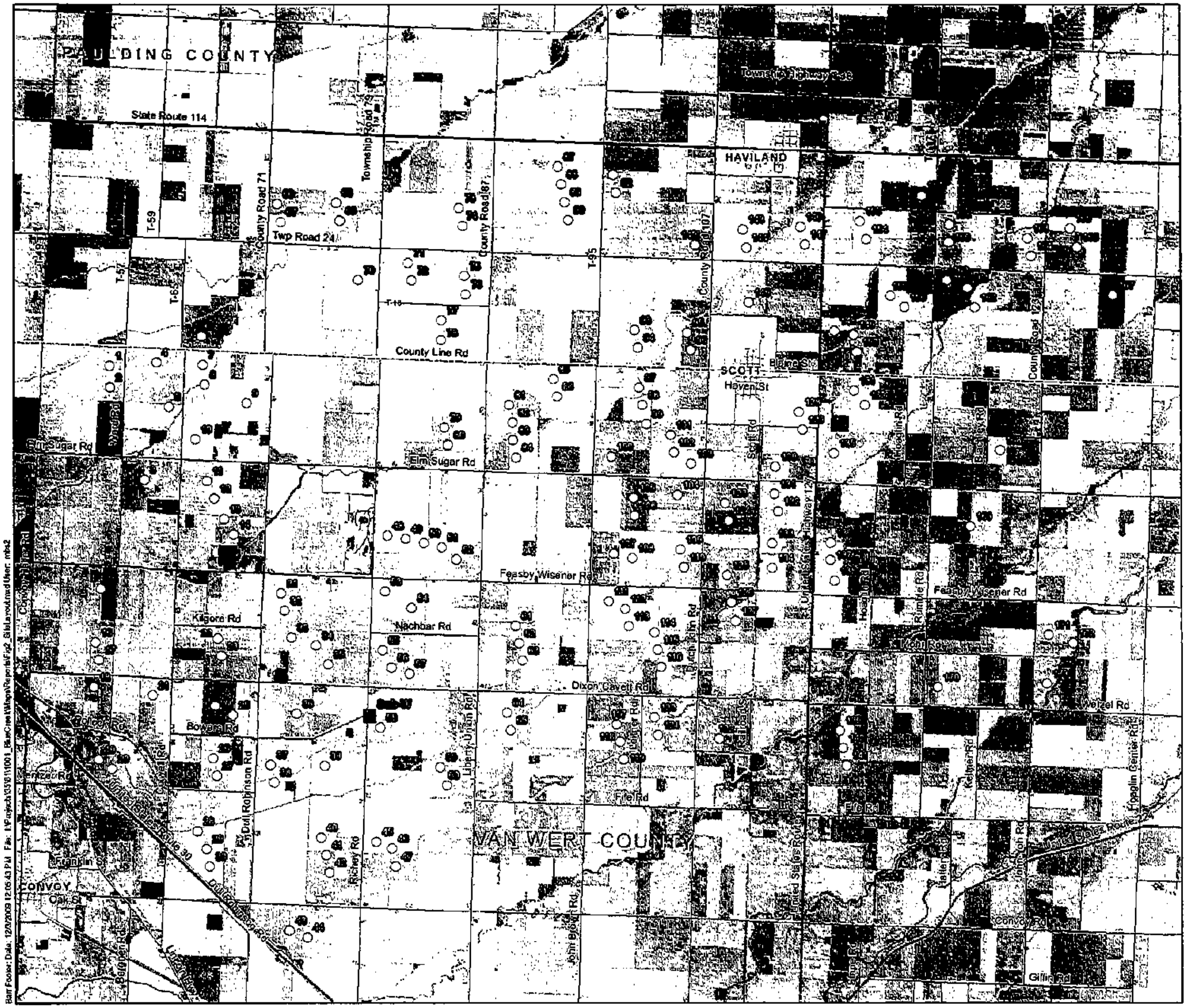
4 0 4

Kilometers

5 0 5 10

Figure 1

SITE LOCATION
Blue Creek Wind Project
Iberdrola Renewables, Inc.
Paulding & Van Wert Counties, Ohio



Current Turbine Location (9/4/2009 Coord.)

Ancillary Structure Locations

Image Source: NAIP, 2006

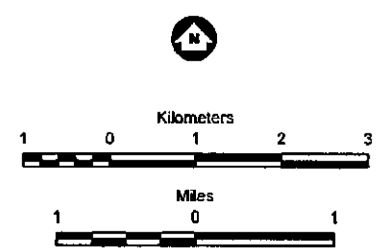
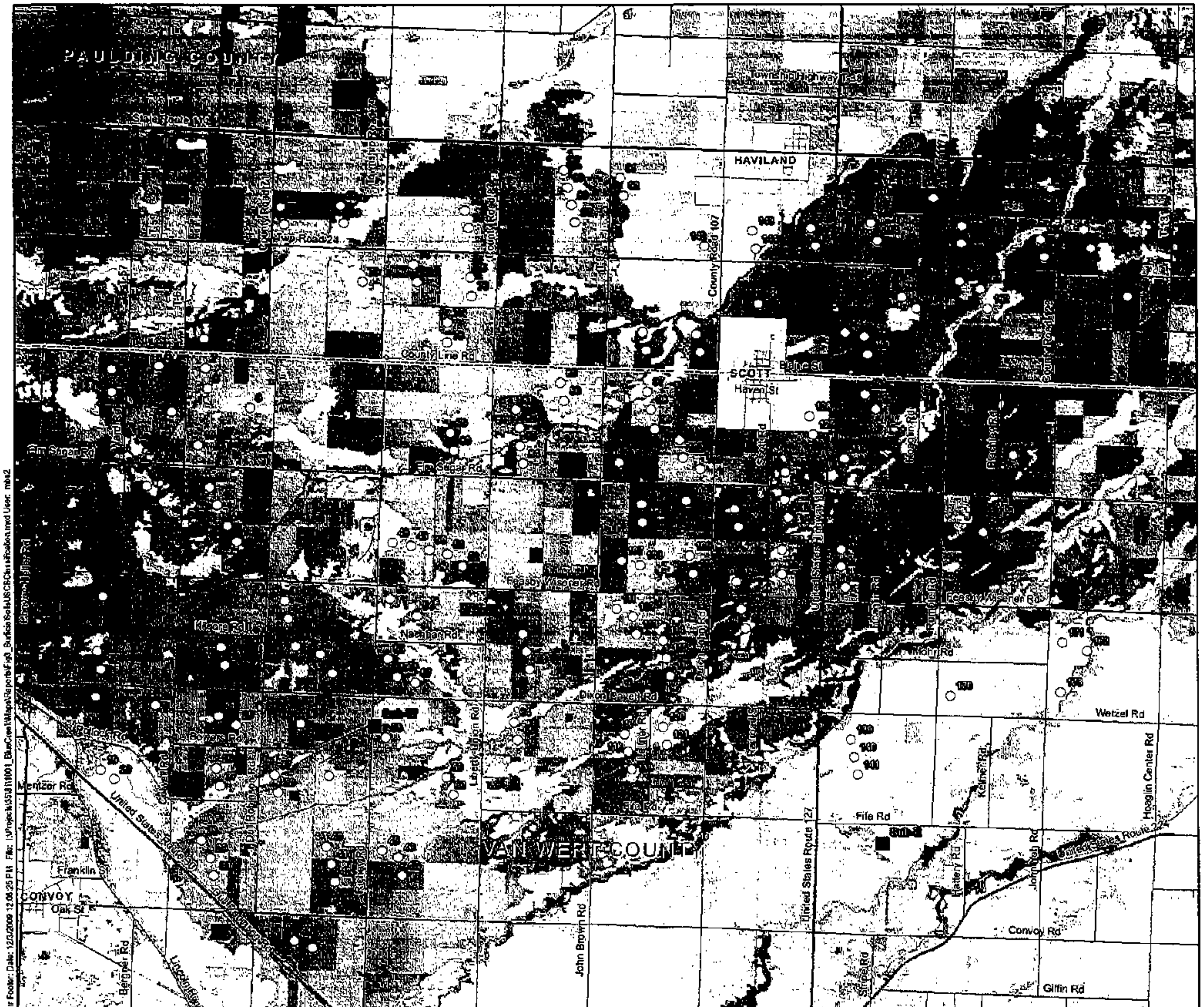


Figure 2

SITE LAYOUT
Blue Creek Wind Project
Iberdrola Renewables, Inc.
Paulding & Van Wert Counties, Ohio



Current Turbine Location (9/4/2009 Coord.)

Ancillary Structure Locations

Non-Clayey Soils

USCS Soils

CH

CL

MH

Imagery Source: NAIP, 2006
Soils Data: USDA NRCS SSURGO Database

Kilometers: 1 0 1 2 3

Miles: 1 0 1

Figure 3

SURFICIAL SOILS USCS CLASSIFICATION
Blue Creek Wind Project
Iberdrola Renewables, Inc.
Paulding & Van Wert Counties, Ohio

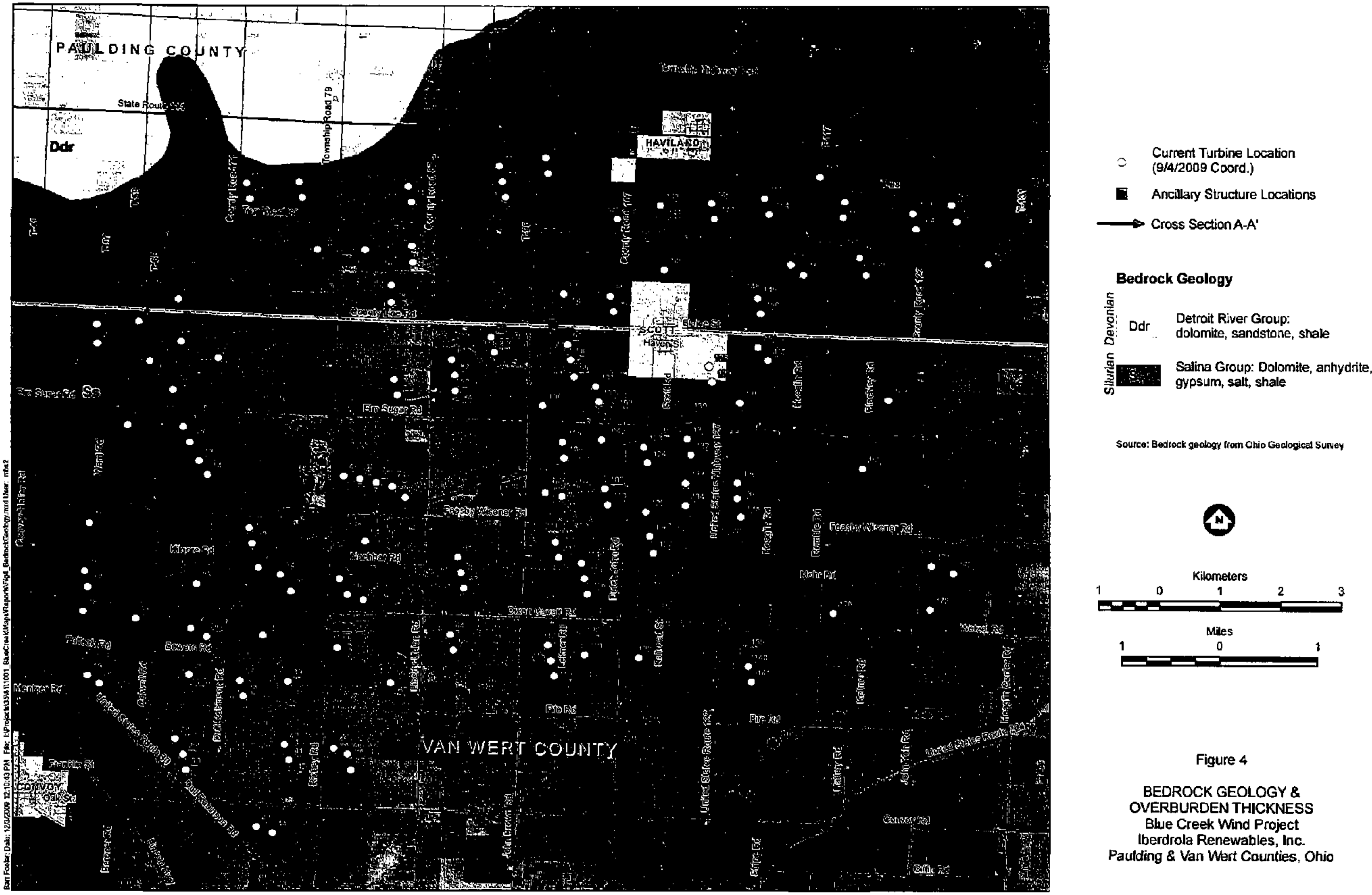


Figure 4

BEDROCK GEOLOGY &
OVERBURDEN THICKNESS
Blue Creek Wind Project
Iberdrola Renewables, Inc.
Paulding & Van Wert Counties, Ohio

P:\Mpls\35 OH\81\35811001\WorkFiles\Geotech\Report\Draft Figures\Karst\Conceptual Geologic Cross Section A-A'.CDR RLG 11-20-09

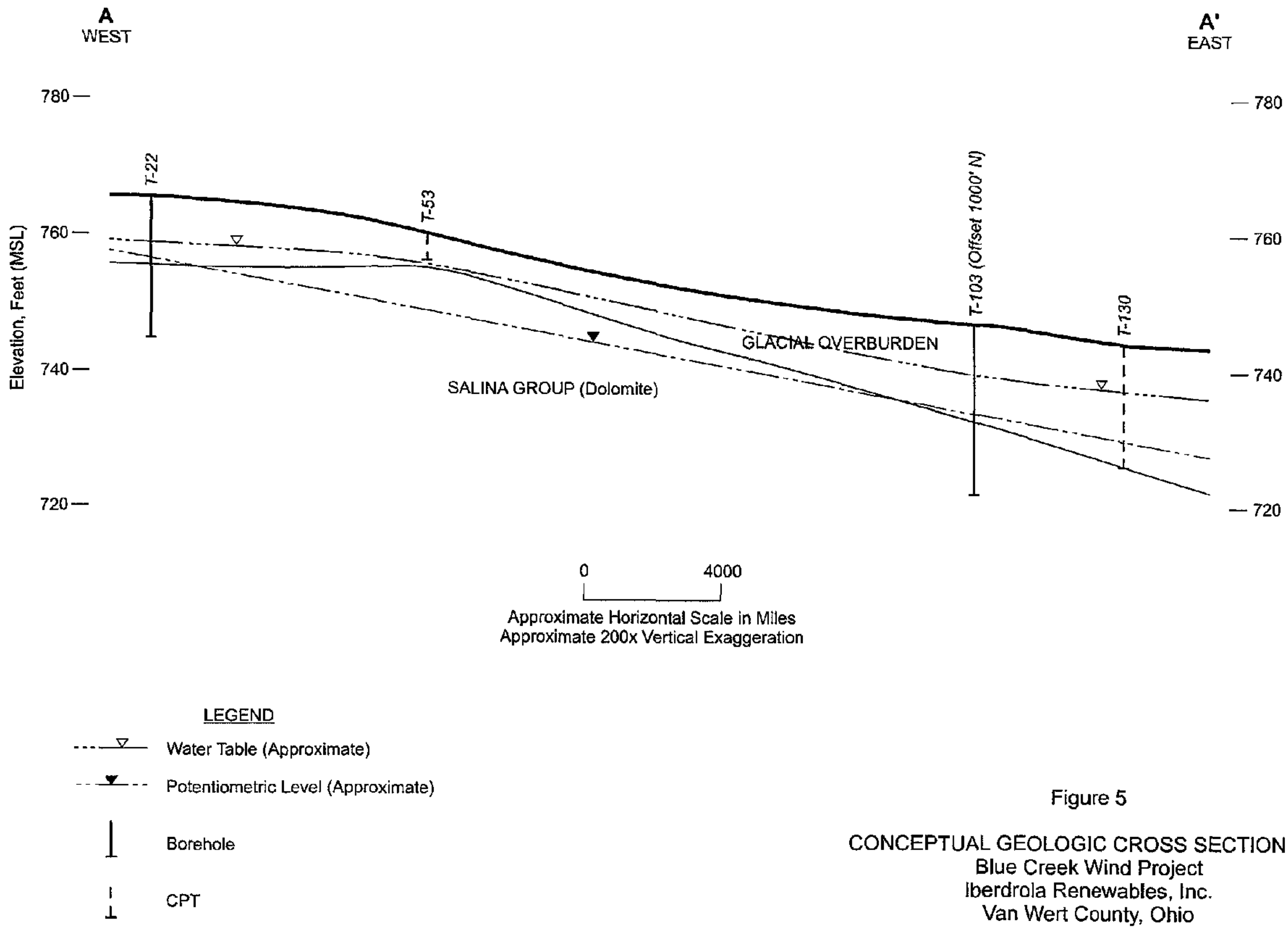


Figure 5

CONCEPTUAL GEOLOGIC CROSS SECTION A-A'
Blue Creek Wind Project
Iberdrola Renewables, Inc.
Van Wert County, Ohio

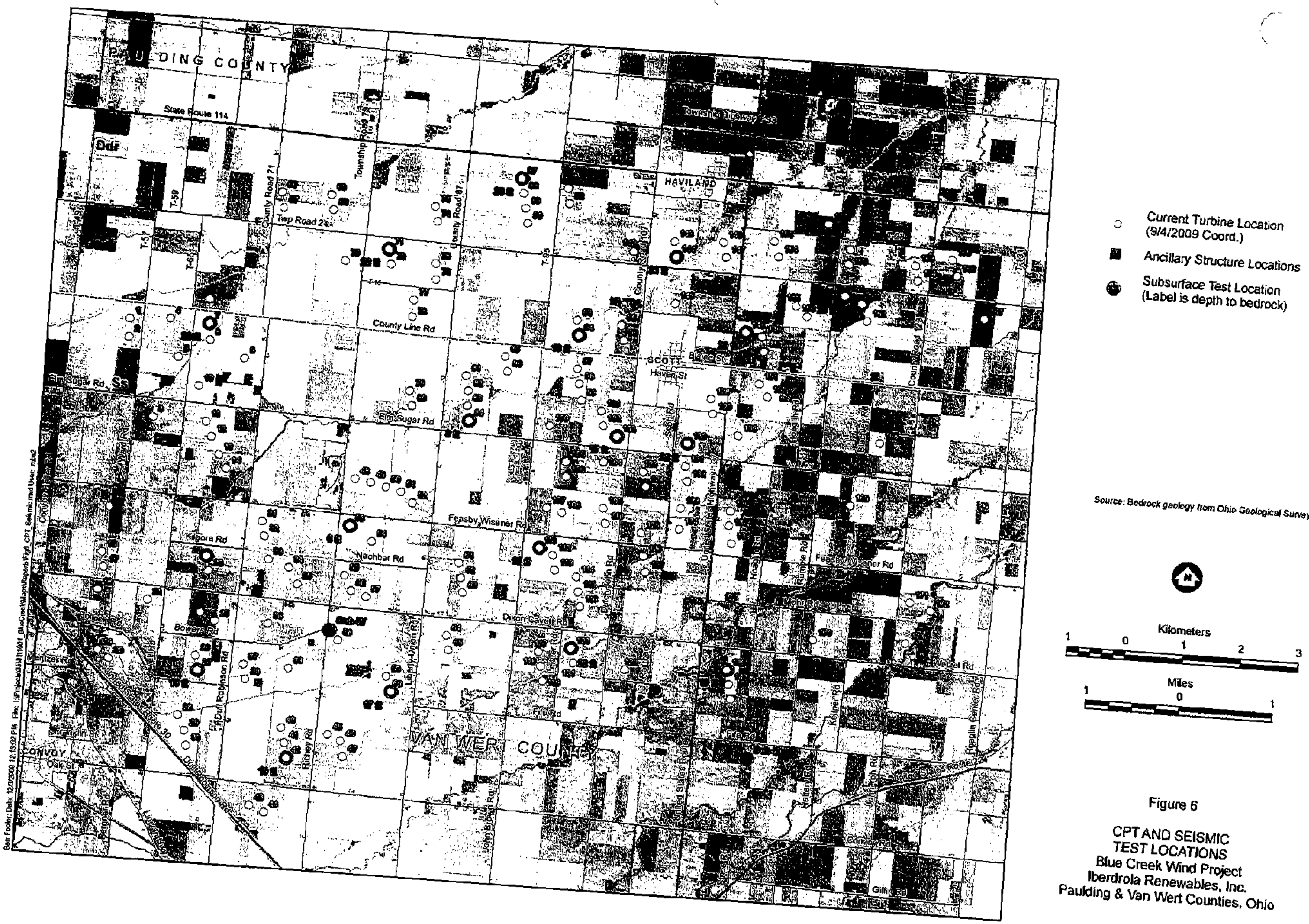


Figure 6

CPT AND SEISMIC
TEST LOCATIONS
Blue Creek Wind Project
Iberdrola Renewables, Inc.
Paulding & Van Wert Counties, Ohio

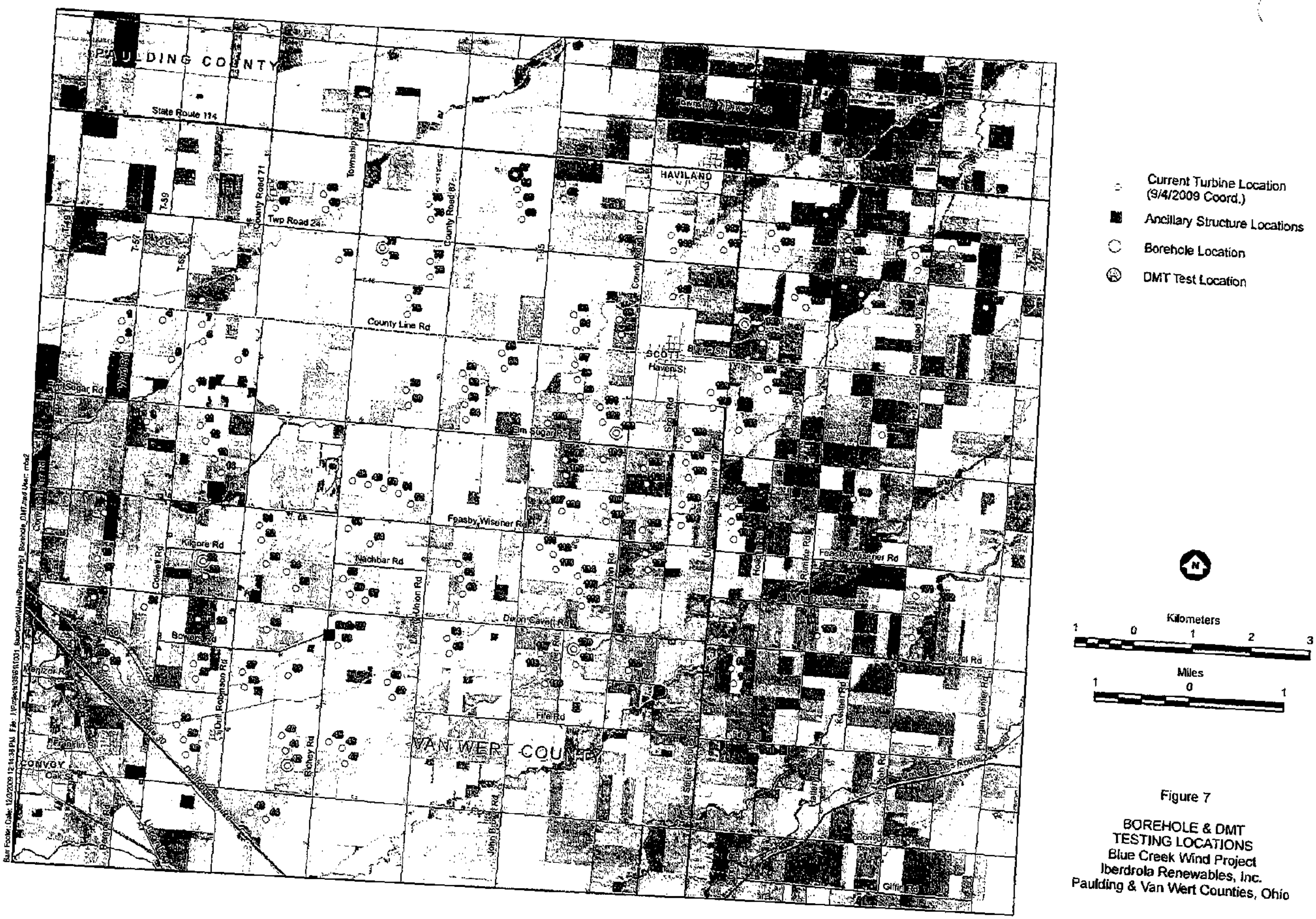
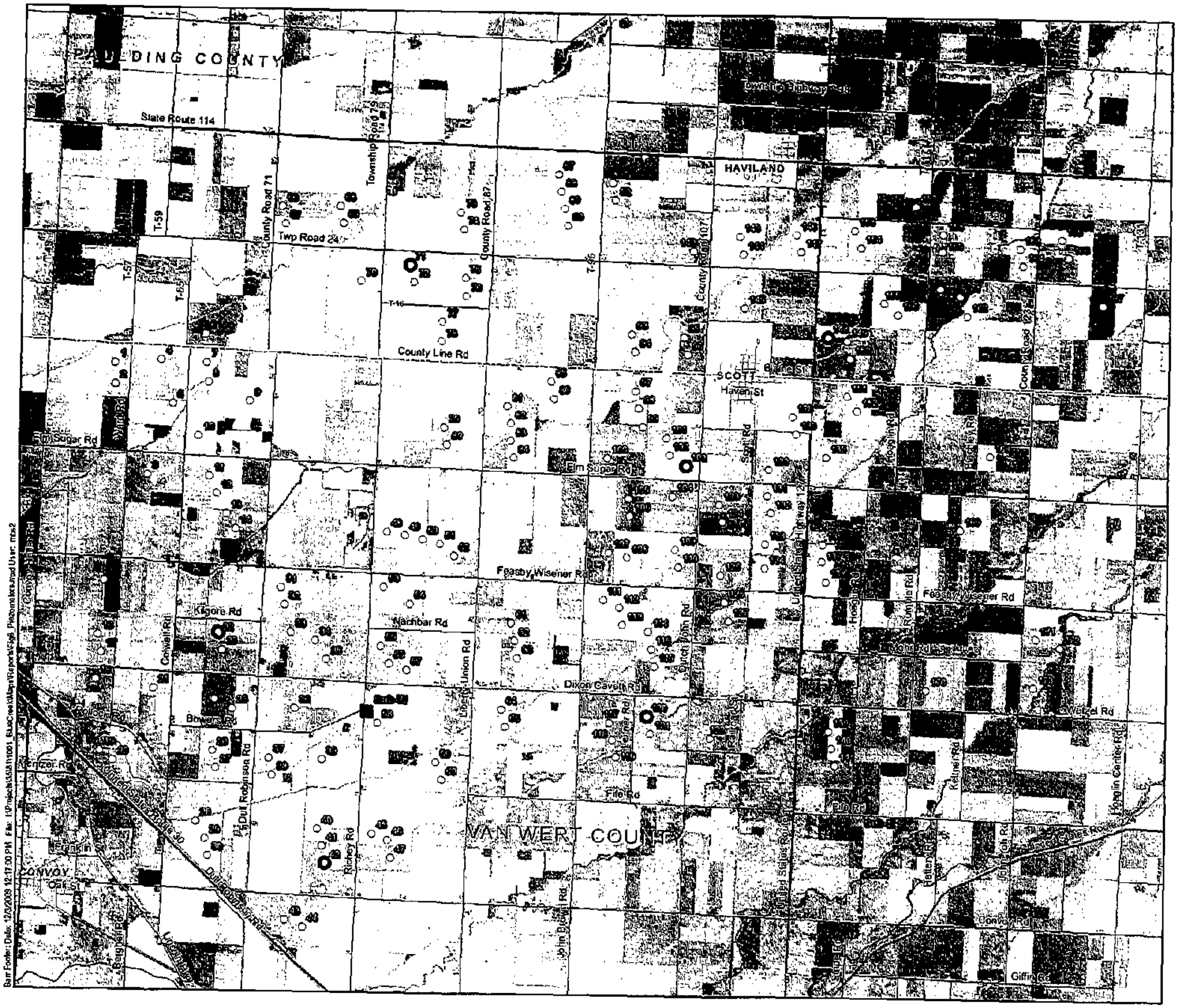


Figure 7

BOREHOLE & DMT
TESTING LOCATIONS
Blue Creek Wind Project
Iberdrola Renewables, Inc.
Paulding & Van Wert Counties, Ohio



Current Turbine Location (9/4/2009 Coord.)

Ancillary Structure Locations

Piezometer Location

Kilometers: 1 0 1 2 3

Miles: 1 0 1

Figure 8

PIEZOMETER LOCATIONS
Blue Creek Wind Project
Iberdrola Renewables, Inc.
Paulding & Van Wert Counties, Ohio

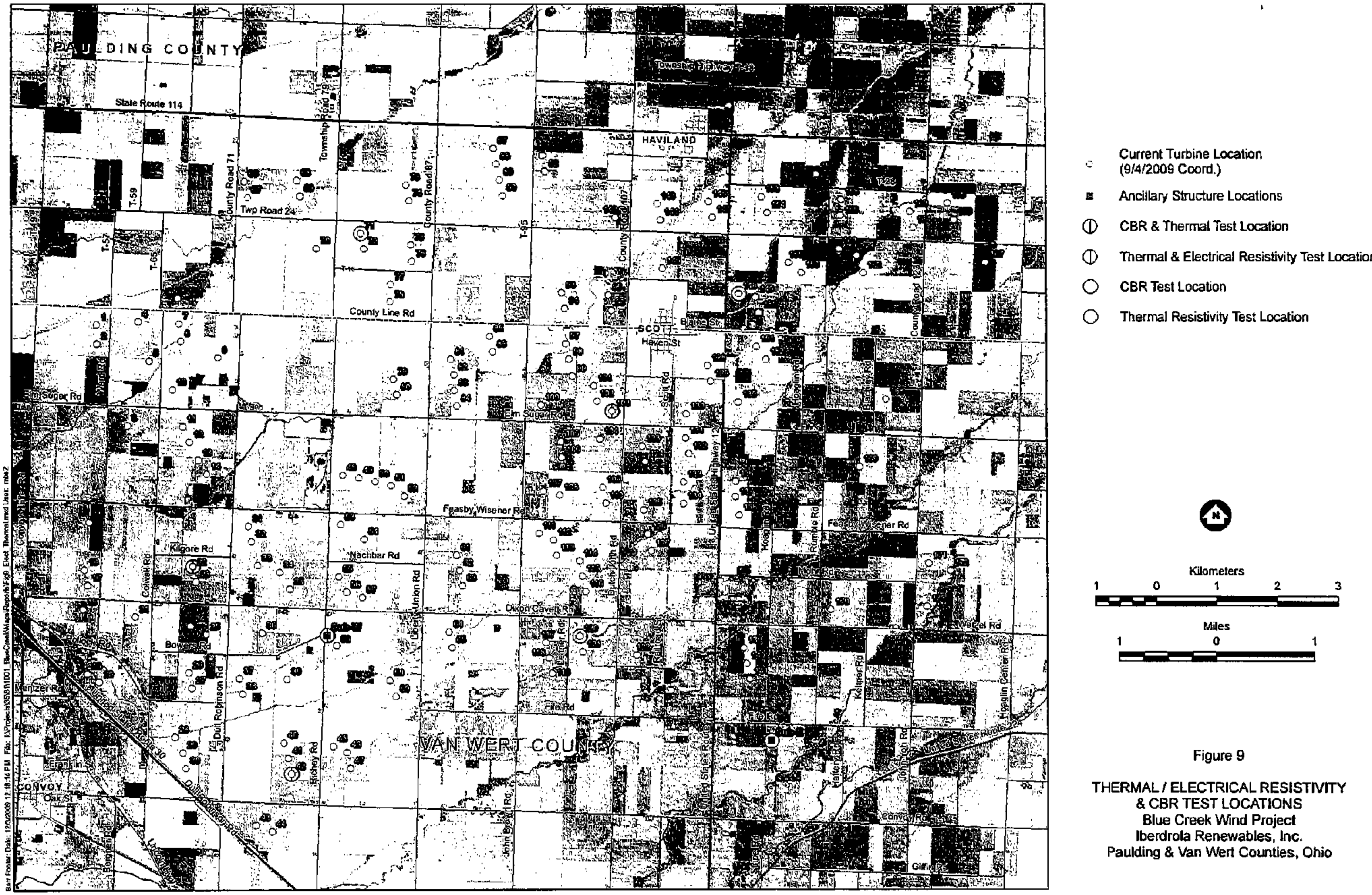


Figure 9

THERMAL / ELECTRICAL RESISTIVITY
& CBR TEST LOCATIONS
Blue Creek Wind Project
Iberdrola Renewables, Inc.
Paulding & Van Wert Counties, Ohio

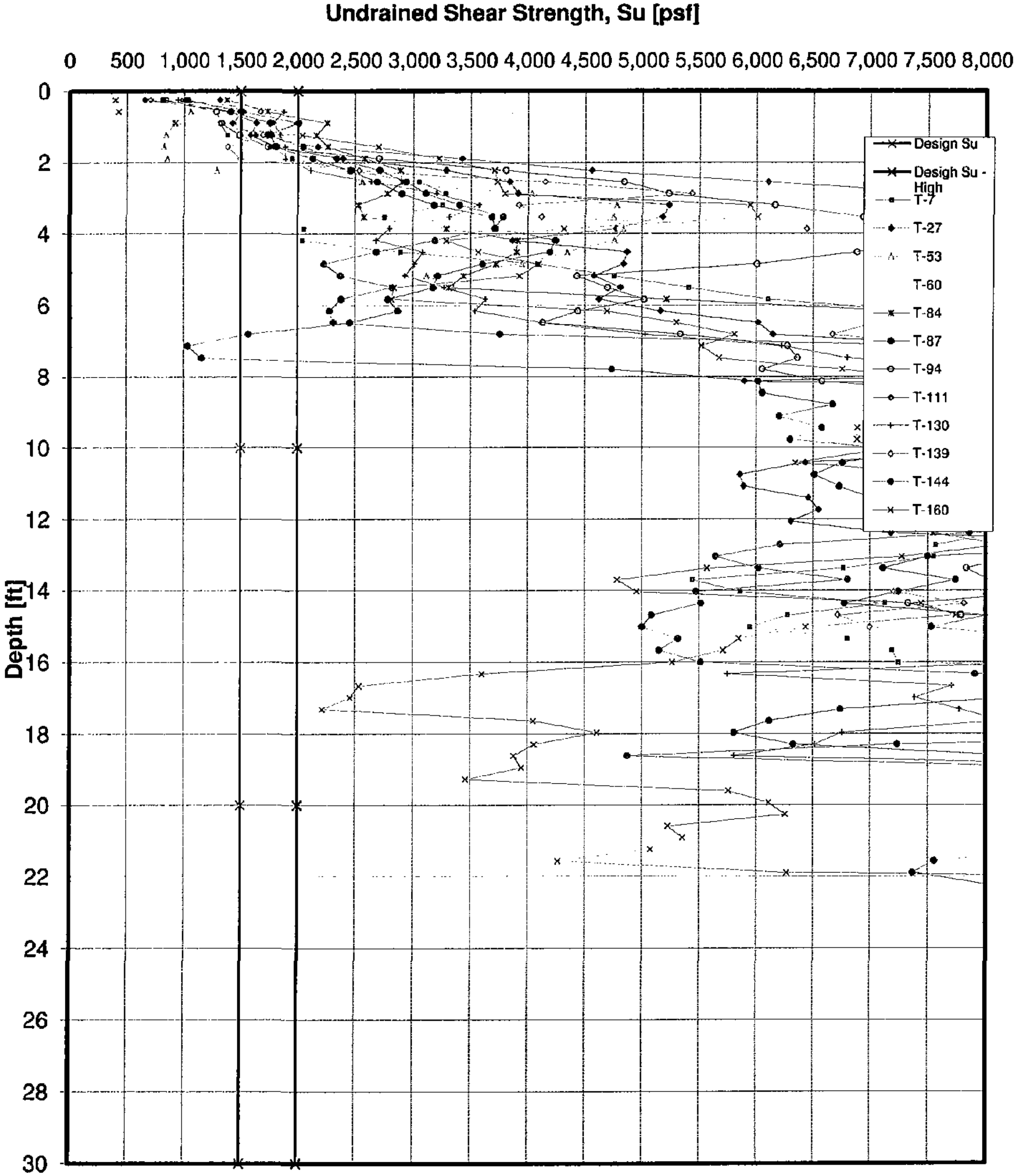


Figure 10. Su from CPT vs. Depth (All turbine sites)

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Appendices

Appendix A

Turbine Coordinates and Testing Summary

Appendix A
Turbine Site Coordinates and Investigation Summary

Turbine ID/ Test ID	UTM Zone 16 NAD 83 (meters)		CPT Testing	Soil Boring & Lab Soil Testing	Seismic Testing		DMT	CBR Test	Chemical Analysis	Electrical Resistivity Testing	Thermal Resistivity Testing
	Northing	Easting			V_s	V_p					
Sub-W	697947	4534983								X	X
Sub-E	705398	4533731								X	
22	695701.0467	4535958.66		X				X	X		X
42	697537.8238	4532646.54		X				X			X
71	698093.0879	4541667.13		X				X	X		
103	702413.5276	4539001.6		X				X			X
120	702121.8296	4535227.64		X					X		X
148	704367.7655	4541094.41		X				X	X		
1	693862.8326	4539859.32									
2	693890.8567	4539544.3									
3	694476.5896	4538219.94									
4	694536.0464	4539957.49									
5	694763.976	4539313.34									
6	695168.3929	4540385.95									
7	695212.5881	4539962.46	X		X	X					
8	695259.4749	4539676.71									
9	695887.1088	4539448.77									
10	695176.8935	4538860.78									
11	695385.5162	4538265.85									
12	695510.2065	4538015.29									
13	695673.714	4537724.75									
14	695826.6344	4537508.3									
15	693953.485	4536580.01									
16	693928.1771	4535779.98									
17	693998.2544	4535524.98									
18	693947.282	4535119.33									
19	694089.7666	4534059.79									
20	694289.2378	4533938.03									
21	694804.1999	4535058.14									
23	695768.304	4535705.69									
24	695727.0062	4534961.31									
25	695988.6524	4534847.32									
26	695745.1382	4534194.5									
27	695812.4975	4533940.62	X		X						
28	695585.0359	4533122.48									
29	695732.5143	4532873.54									
30	695798.8398	4532622.21									
31	696569.7612	4536689.24									
32	696637.2257	4536437.16									
33	696762.9433	4536047.93									
34	697128.4909	4535955.51									
35	697315.72	4535688.91									
36	696907.9903	4534928.74									
37	696583.2391	4534154.43									
38	696650.5453	4533902.83									
39	697363.6743	4534192.88									
40	697378.4397	4533149.05									
41	697470.0633	4532898.98									
43	697013.6452	4531759.14									
44	697278.8813	4531675.51									
45	698187.0019	4533146.82									
46	698422.52	4533063.25									
47	698493.6466	4532802.12									
48	698053.6481	4537643.51									
49	698325.0324	4537614.88									
50	698592.9786	4537570.22									
51	698858.6385	4537525.57									
52	699084.218	4537360.68									
53	698076.6322	4536824.02	X		X						
54	698477.432	4536602.66									
55	698098.2179	4535951.85									
56	698246.7659	4535698.27									
57	698508.998	4535630									
58	698140.4149	4534805.57									
59	699047.3616	4534285.98									
60	699160.2945	4534031.88	X		X						
61	700007.9187	4536441.16									
62	700075.1004	4536189.85									
63	700143.4133	4535938.8									
64	699966.5164	4535151.81									
65	700033.9644	4534899.28									
66	696132.9536	4542378.23									
67	696201.1791	4542123.71									
68	696988.7679	4542458.05									
69	697056.9927	4542203.53									
70	697380.7893	4541362.39									
72	698161.3131	4541412.6									
73	698782.0865	4542503.79									
74	698848.8748	4542251.03									
75	698919.6089	4541528.6									

Turbine ID/ Test ID	UTM Zone 16 NAD 83 [meters]		CPT Testing	Soil Boring & Lab Soil Testing	Seismic Testing		DMT	CBR Test	Chemical Analysis	Electrical Resistivity Testing	Thermal Resistivity Testing
	Northing	Easting			V_s	V_p					
76	698959.0128	4541263.03									
77	698631.0124	4540856.31									
78	698646.7534	4540567.67									
79	698781.4544	4539281.51									
80	698849.5277	4539029.37									
81	699703.2556	4539679.89									
82	699771.3292	4539427.07									
83	699795.3007	4539165.37									
84	699851.2752	4538910.81	X		X						
85	700320.3714	4540106.62									
86	700388.4456	4539854.48									
87	700181.5927	4543200.73	X				X				
88	700248.5143	4542948.58									
89	700316.6322	4542695.22									
90	700383.5528	4542443.06									
91	700997.8164	4543136.2									
92	701055.1822	4542880.46									
93	701458.8681	4540906.41									
94	701526.2495	4540652.51	X		X						
95	702227.9903	4540925.31									
96	702295.3726	4540671.4									
97	701580.5164	4540068.41									
98	701646.8958	4539814.96									
99	701724.3374	4539536.36									
100	701241.344	4539021.54									
101	702086.9574	4539399.04									
102	702153.862	4539146									
104	702243.8457	4538527.22									
105	701607.1628	4538443									
106	701637.8383	4538180.09									
107	701368.3503	4537601.68									
108	701644.4089	4537557.86									
109	702339.4409	4537731.29									
110	702409.0527	4537476.79									
111	701345.2947	4536897.68	X		X	X					
112	701588.1639	4536802.98									
113	701656.6899	4536551.35									
114	702038.4697	4536484.61									
115	702105.2946	4536232.65									
116	702173.2096	4535979.59									
117	701577.8243	4535089.9									
118	701644.8312	4534835.79									
119	701713.0952	4534584.21									
121	702189.5521	4534974.68									
122	703084.5144	4534981.42									
123	702943.3525	4538453.9									

Turbine ID/ Test ID	UTM Zone 16 NAD 83 (meters)		CPT Testing	Soil Boring & Lab Soil Testing	Seismic Testing		DMT	CBR Test	Chemical Analysis	Electrical Resistivity Testing	Thermal Resistivity Testing
	Northing	Easting			V_s	V_p					
124	703010.7259	4538202.23									
125	703037.8537	4537402.3									
126	703134.2557	4537007.93									
127	703210.9374	4536734.06									
128	703930.3941	4539863.33									
129	703996.6792	4539609.7									
130	703636.4173	4539037.6	X		X						
131	703649.2369	4538638.52									
132	703716.6121	4538386.85									
133	703664.4675	4537910.6									
134	703686.2974	4537553.93									
135	704476.5517	4539289.78									
136	704515.2378	4537979.71									
137	704527.0407	4537729.45									
138	704609.0217	4537424.14									
139	704831.207	4535218.23	X		X	X					
140	704898.1914	4534966.36									
141	704966.0743	4534714.49									
142	702261.0816	4542213.89									
143	702934.2918	4542481.72									
144	703003.2963	4542223.32	X		X						
145	703090.0978	4541425.19									
146	703769.8237	4542579.37									
147	703855.081	4542328.24									
149	704647.6523	4541056.24									
150	704713.0789	4540805.44									
151	704712.887	4540238									
152	704885.8144	4540031.93									
153	704632.377	4542714.94									
154	704746.3156	4542463.62									
155	705154.6006	4541666.91									
156	705367.8777	4541511.28									
157	705511.9854	4543148.32									
158	705944.3017	4542759.23									
159	705955.8278	4542505.61									
160	705964.4738	4541949.36	X		X	X					
161	706269.9804	4541857.13									
162	706396.9661	4541577.57									
163	707096.7329	4542640.22									
164	707163.9161	4542387.36									
165	707709.7611	4542824.04									
166	707830.0358	4542558.51									
167	708398.8169	4541895.03									
168	706904.362	4539506.72									
169	706540.8135	4538358.96									
170	706221.5966	4535955.75									
171	707788.7049	4536835									
172	708155.0695	4536739.69									
173	707812.5368	4536114.19									

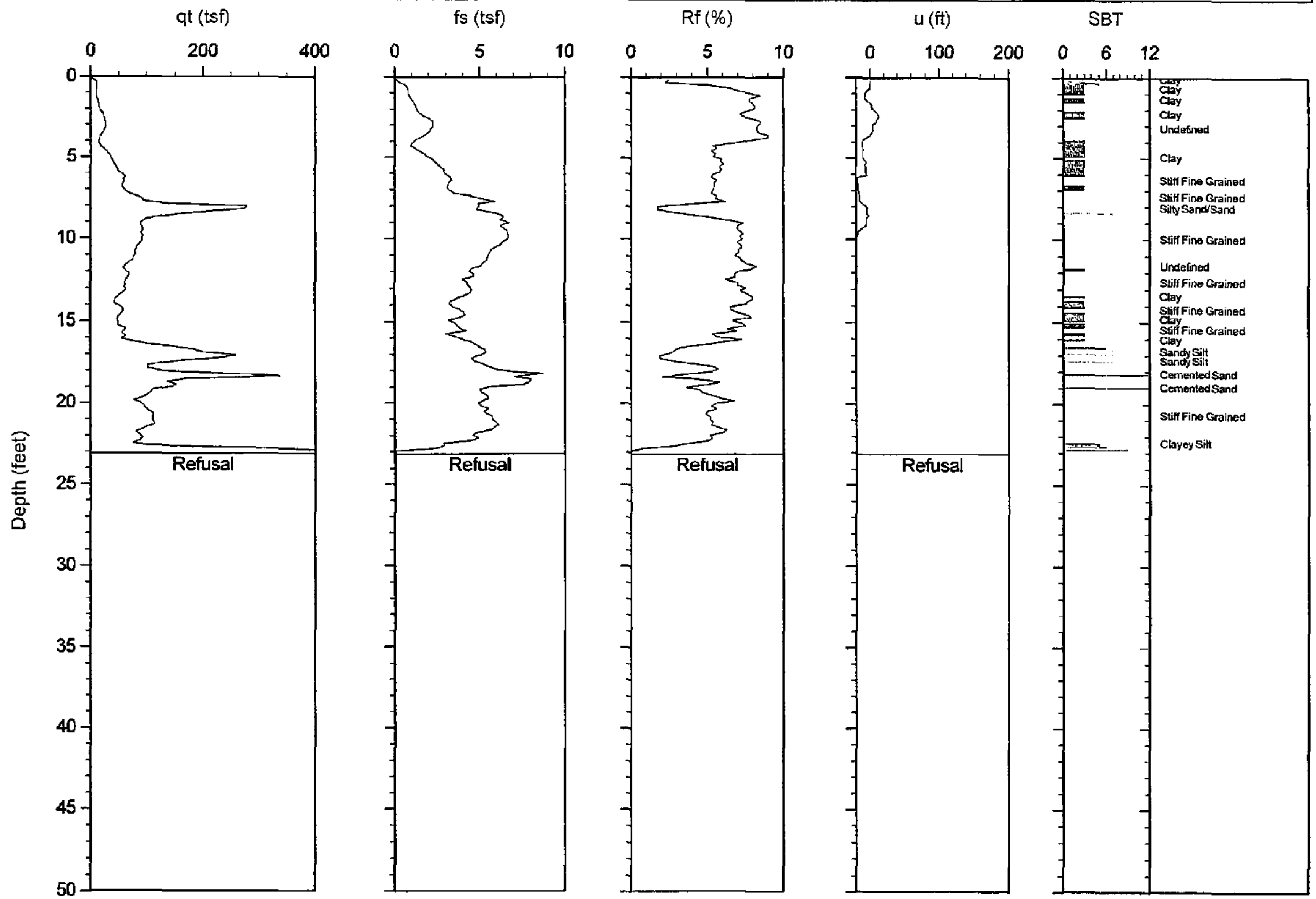
Appendix B

CPT Sounding Logs

CONETEC | Barr Engineering

Job No: 09-771
Date: 10:22:09 08:38
Site: Van Wert, OH

Sounding: CPT-7
Cone: 268:T1500F15U500



Max Depth: 7.050 m / 23.13 ft
Depth Inc: 0.050 m / 0.164 ft

File: 771C007.COR

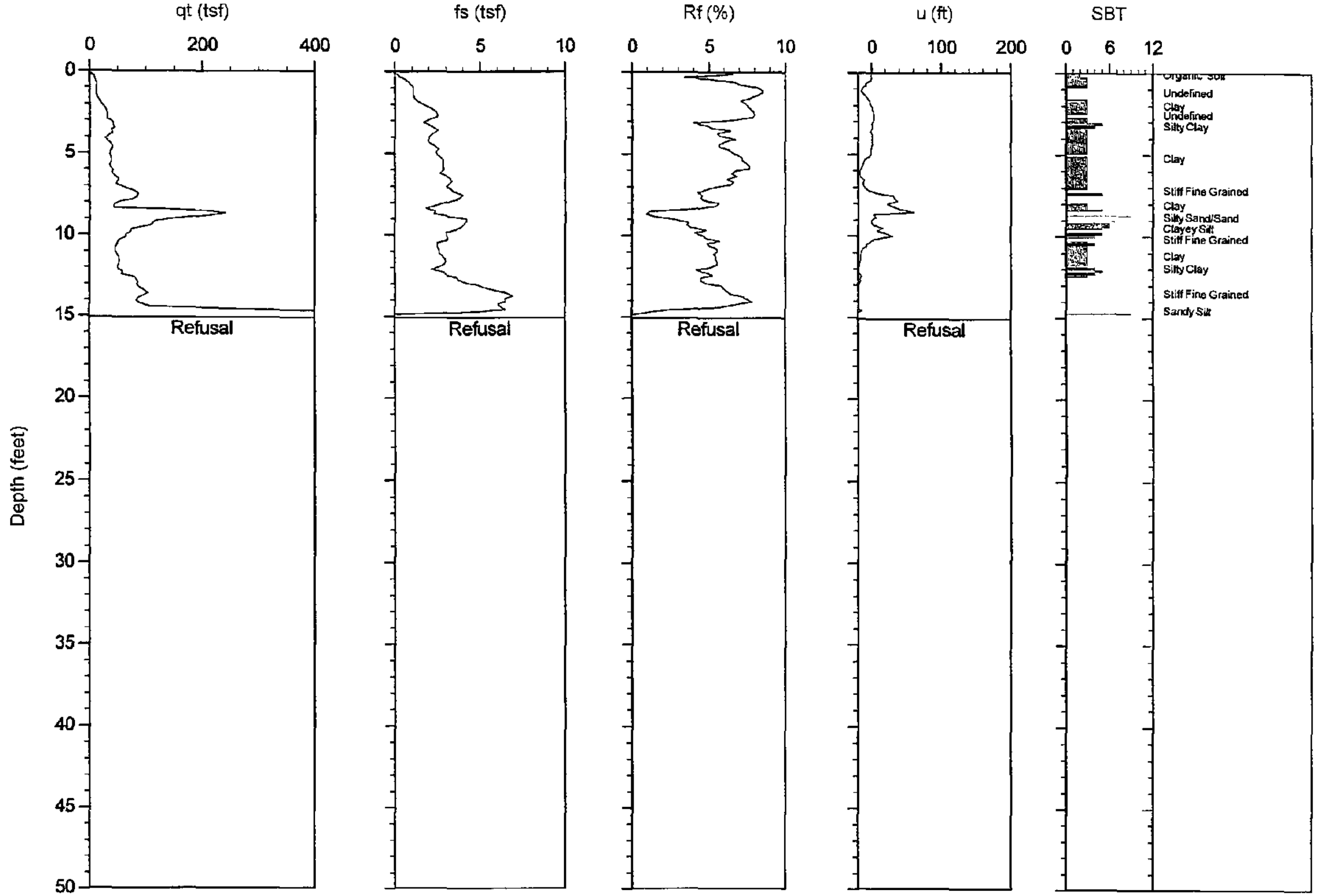
SBT: Lunne, Robertson and Powell, 1997
Coords: N: 4539961.863 E: 695215.206 Elev: N/A

ConeTec

Barr Engineering

Job No: 09-771
Date: 10:21:09 11:42
Site: Van Wert, OH

Sounding: CPT-27
Cone: 268:T1500F15U500



Max Depth: 4.600 m / 15.09 ft
Depth Inc: 0.050 m / 0.164 ft

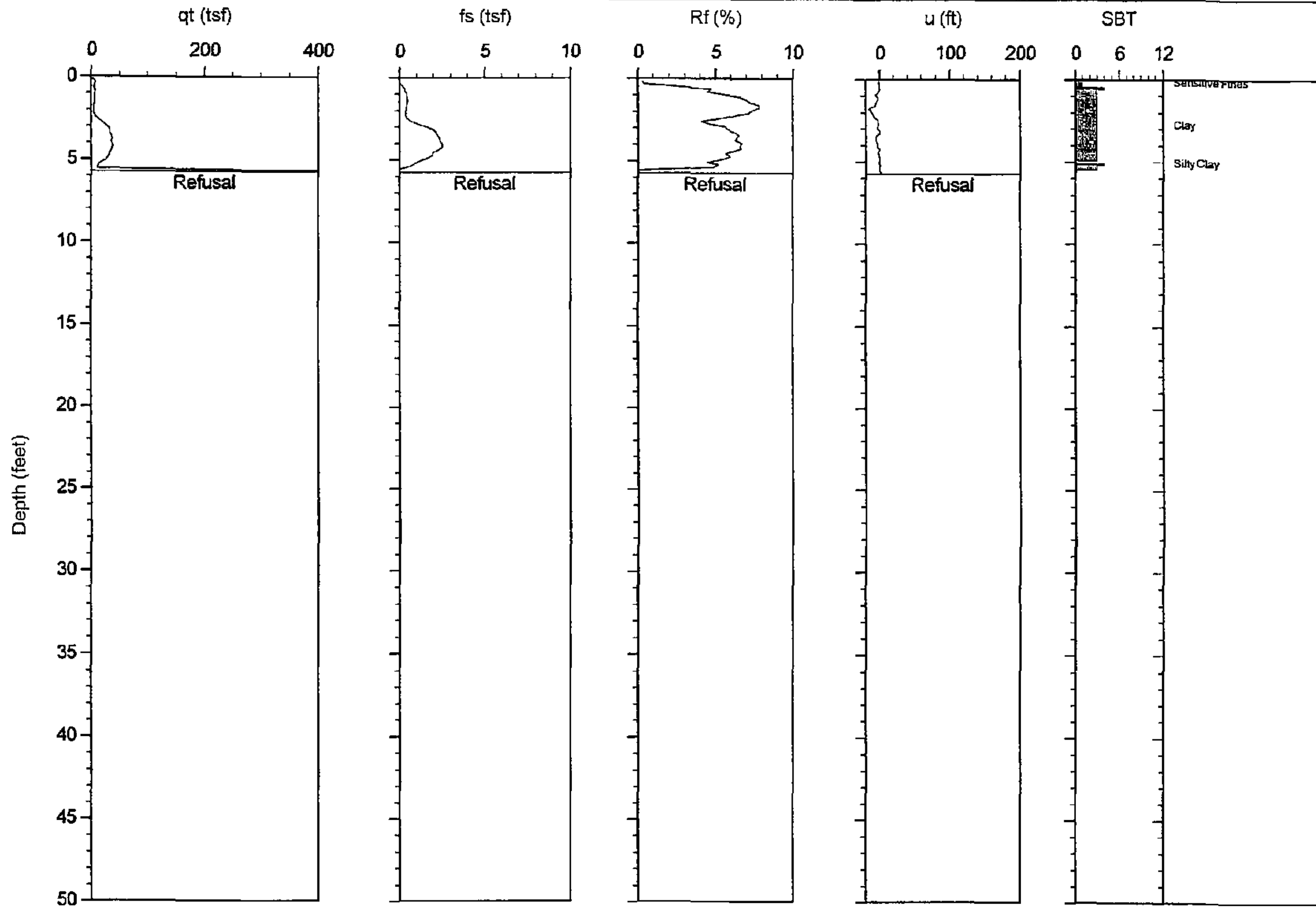
File: 771C027.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: N: 4533941.360 E: 695814.680 Elev: N/A

ConeTec | Barr Engineering

Job No: 09-771
Date: 10:21:09 13:51
Site: Van Wert, OH

Sounding: CPT-53A
Cone: 268:T1500F15U500



Max Depth: 1.750 m / 5.74 ft
Depth Inc: 0.050 m / 0.164 ft

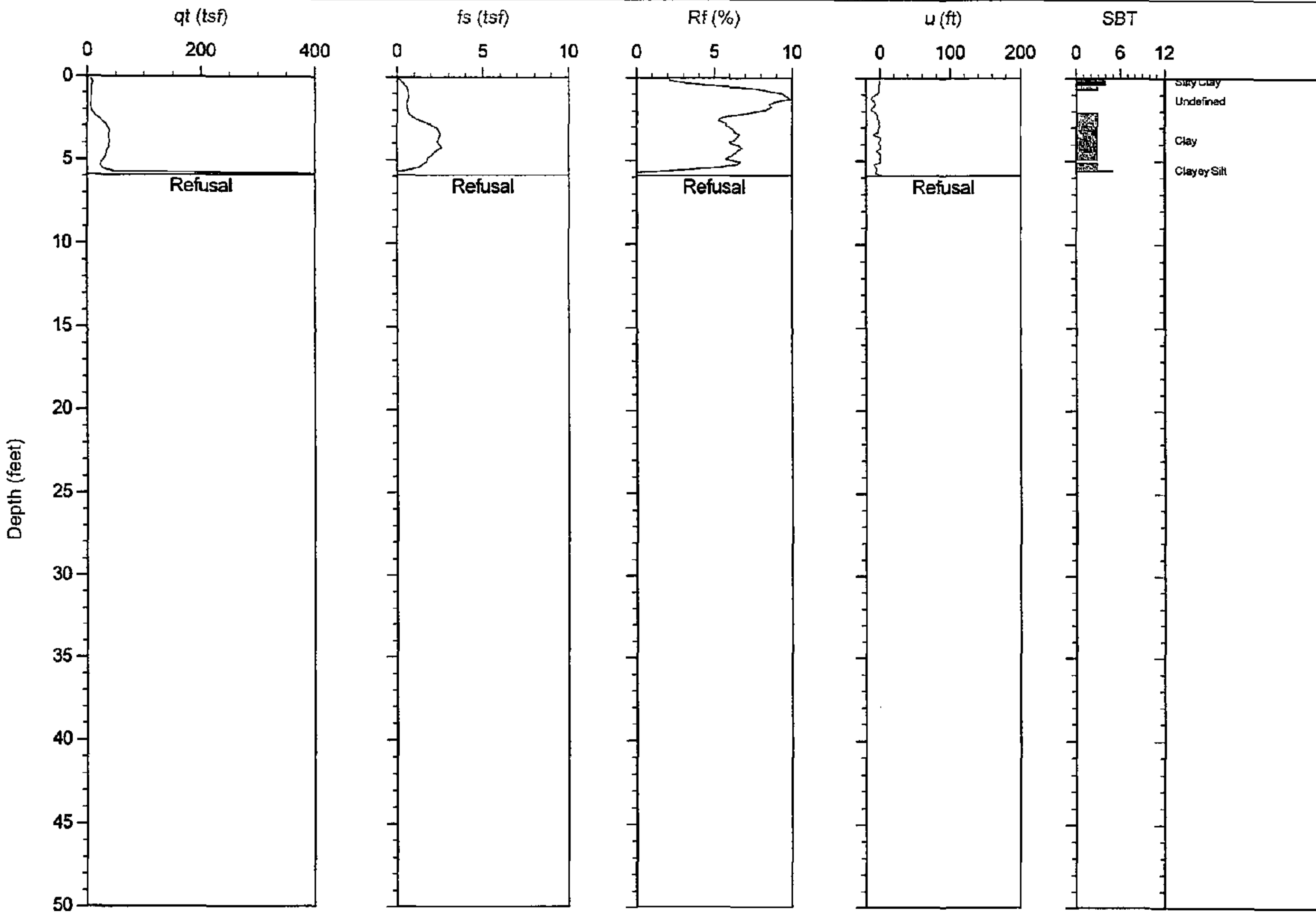
File: 771C053A.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: N: 4536822.162 E: 698080.837 Elev: N/A

ConeTec | Barr Engineering

Job No: 09-771
Date: 10:21:09 13:35
Site: Van Wert, OH

Sounding: CPT-53
Cone: 268:T1500F15U500



Max Depth: 1.800 m / 5.91 ft
Depth Inc: 0.050 m / 0.164 ft

File: 771C053.COR

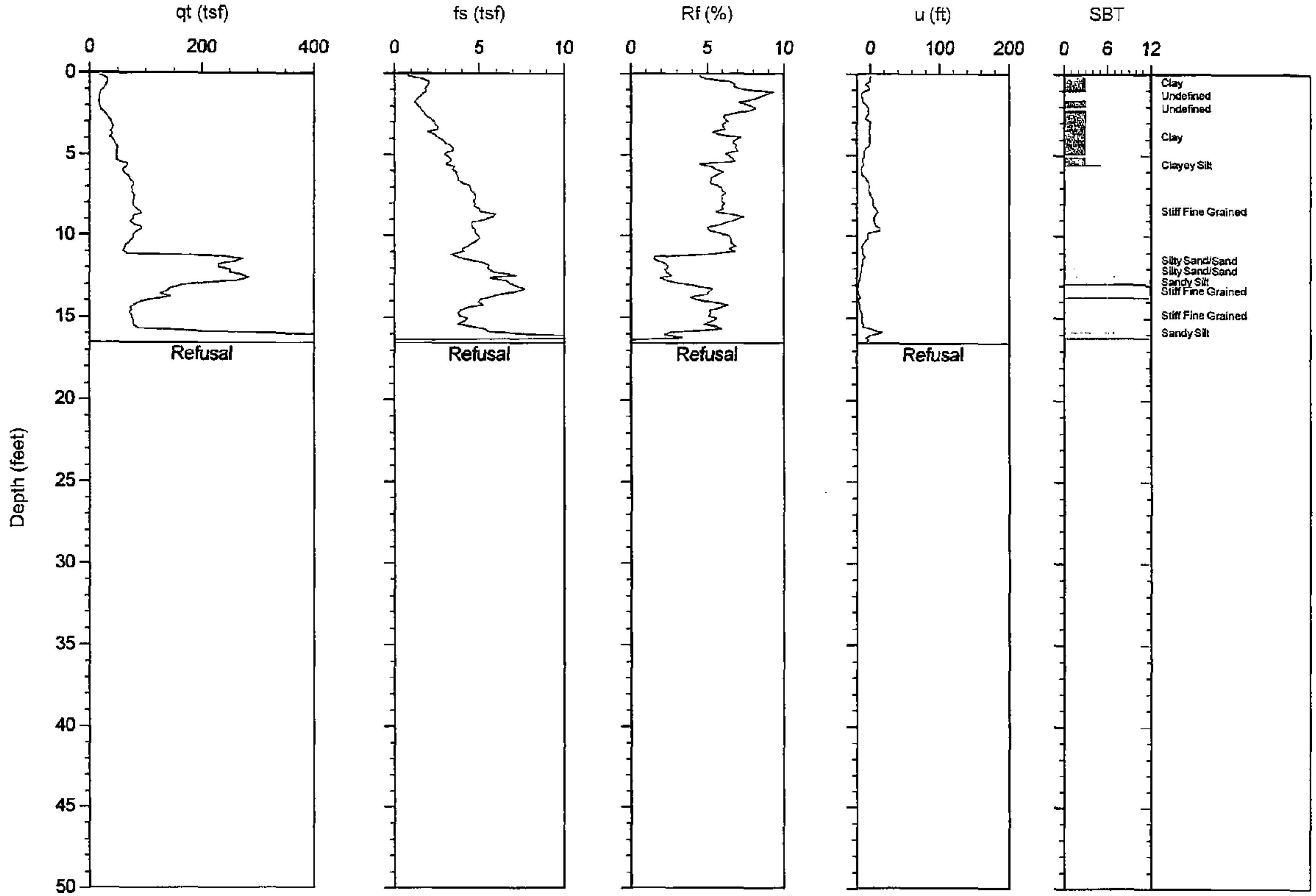
SBT: Lunne, Robertson and Powell, 1997
Coords: N: 4536825.863 E: 698080.737 Elev: N/A

CONETEC

Barr Engineering

Job No: 09-771
Date: 10:21:09 10:14
Site: Van Wert, OH

Sounding: CPT-60
Cone: 268:T1500F15U500



Max Depth: 5.050 m / 16.57 ft
Depth Inc: 0.050 m / 0.164 ft

File: 771C060.COR

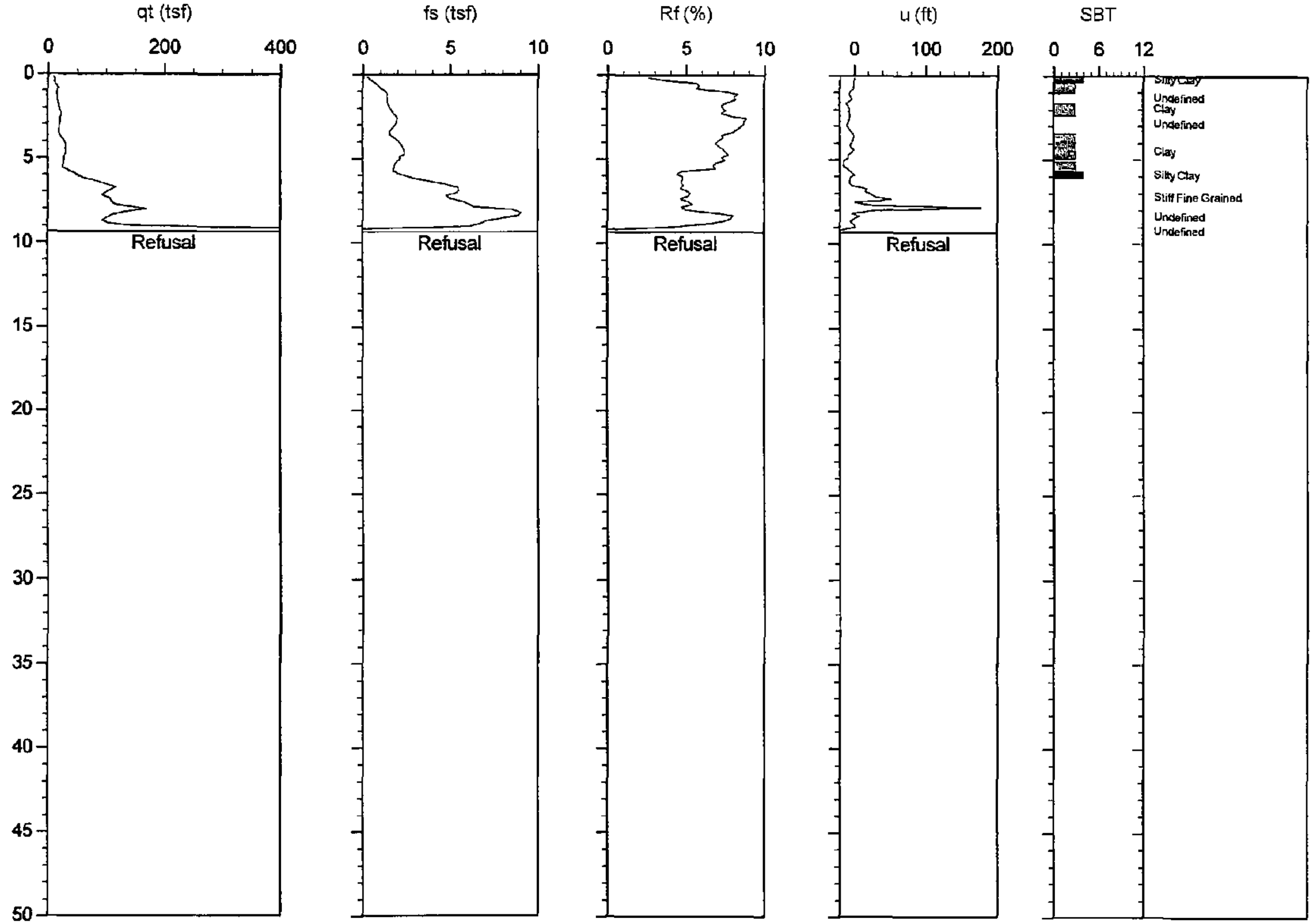
SBT: Lunne, Robertson and Powell, 1997
Coords: N: 4534031.146 E: 699160.091 Elev: N/A

ConeTec

Barr Engineering

Job No: 09-771
Date: 10:21:09 16:55
Site: Van Wert, OH

Sounding: CPT-84
Cone: 268:T1500F15U500



Max Depth: 2.850 m / 9.35 ft
Depth Inc: 0.050 m / 0.164 ft

File: 771C084.COR

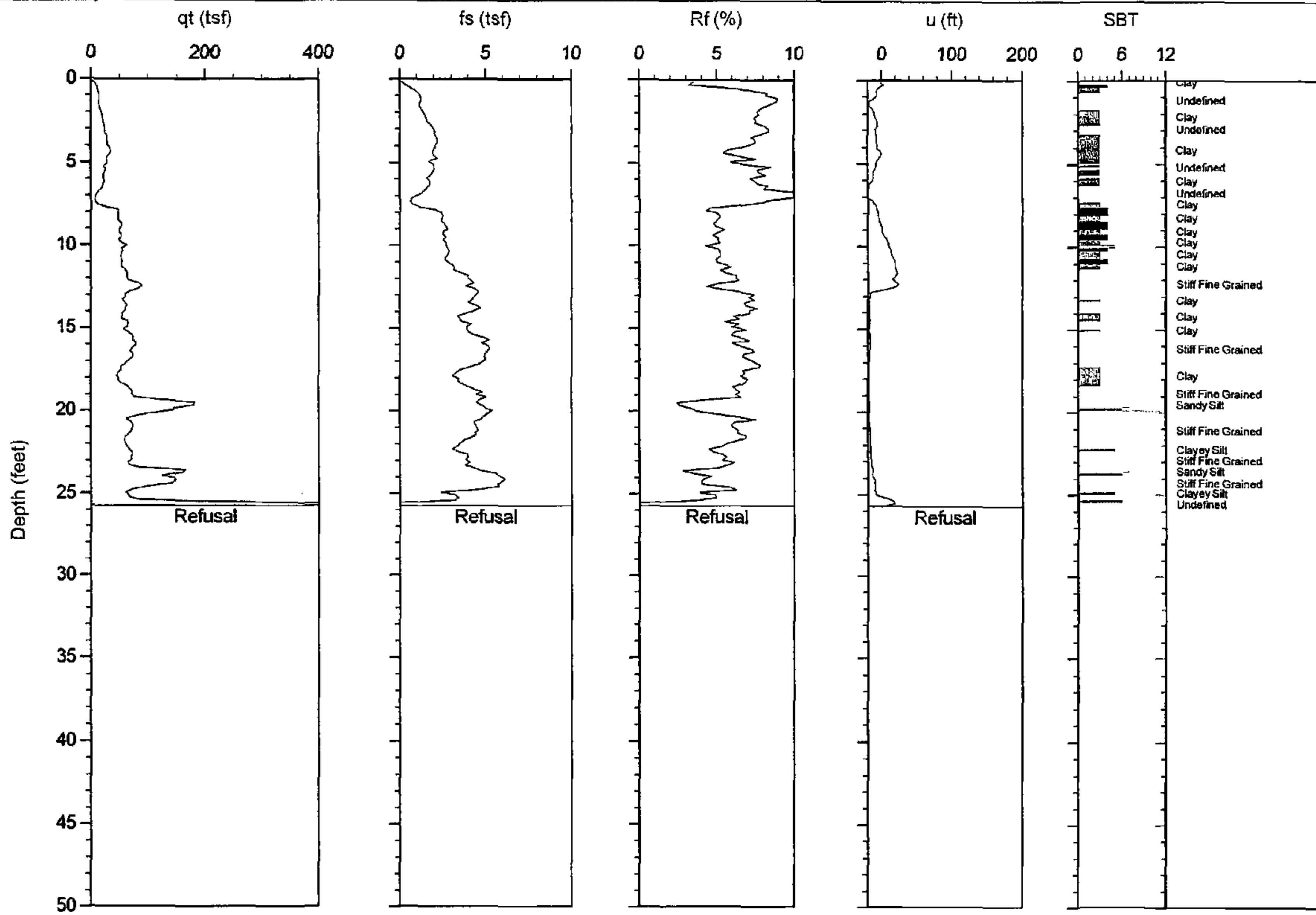
SBT: Lunne, Robertson and Powell, 1997
Coords: N: 4538910.748 E: 699853.150 Elev: N/A

ConeTec

Barr Engineering

Job No: 09-771
Date: 10:20:09 14:27
Site: Van Wert, OH

Sounding: CPT-87
Cone: 268:T1500F15U500



Max Depth: 7.850 m / 25.75 ft
Depth Inc: 0.050 m / 0.164 ft

File: 771C087.COR

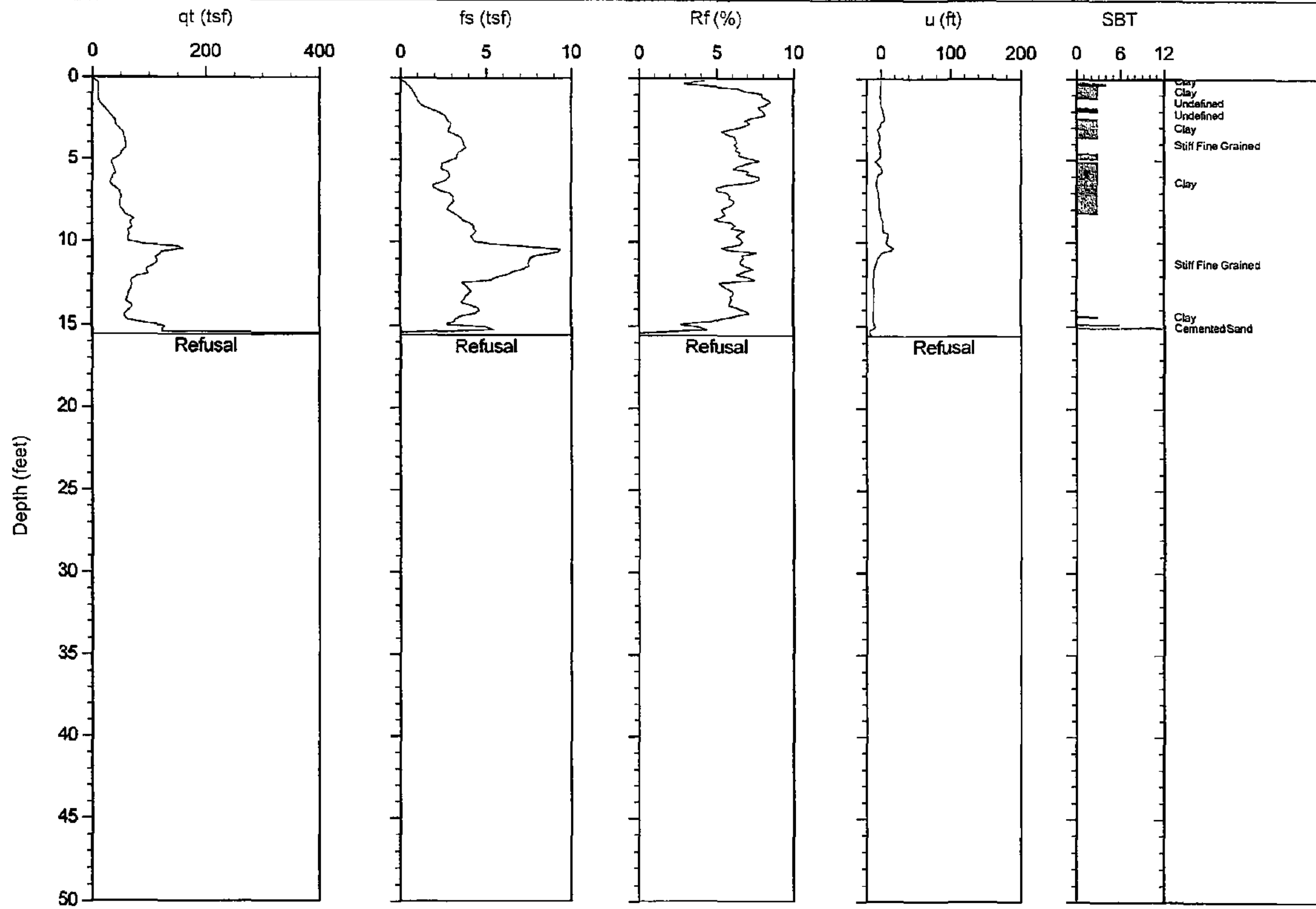
SBT: Lunne, Robertson and Powell, 1997
Coords: N: 4543204.715 E: 700183.720 Elev: N/A

CONETEC

Barr Engineering

Job No: 09-771
Date: 10:22:09 10:18
Site: Van Wert, OH

Sounding: CPT-94
Cone: 268:T1500F15U500



Max Depth: 4.750 m / 15.58 ft
Depth Inc: 0.050 m / 0.164 ft

File: 771C094.COR

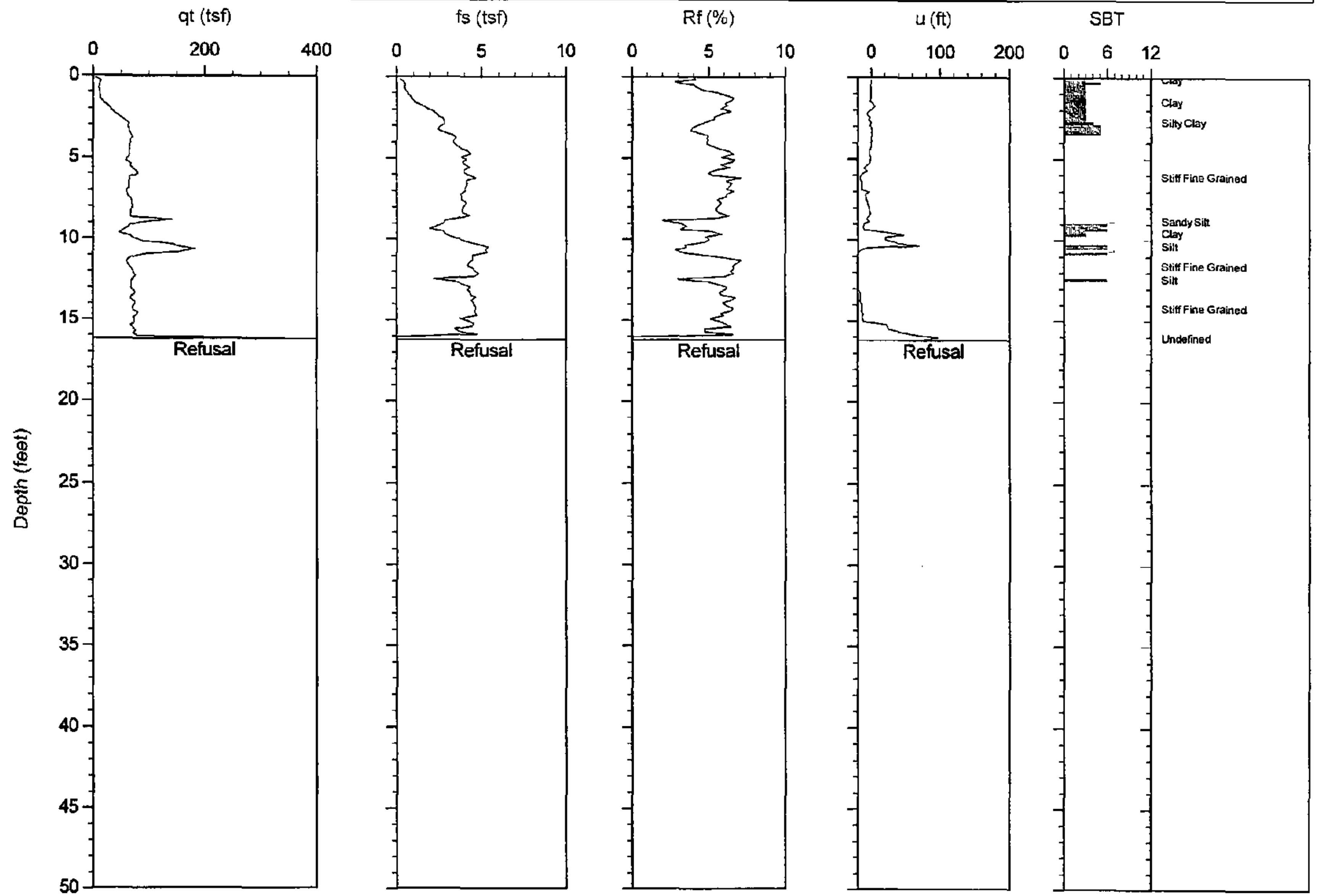
SBT: Lunne, Robertson and Powell, 1997
Coords: N: 4540650.817 E: 701525.976 Elev: N/A

ConeTec

Barr Engineering

Job No: 09-771
Date: 10:21:09 15:12
Site: Van Wert, OH

Sounding: CPT-111
Cone: 268:T1500F15U500



Max Depth: 4.950 m / 16.24 ft
Depth Inc: 0.050 m / 0.164 ft

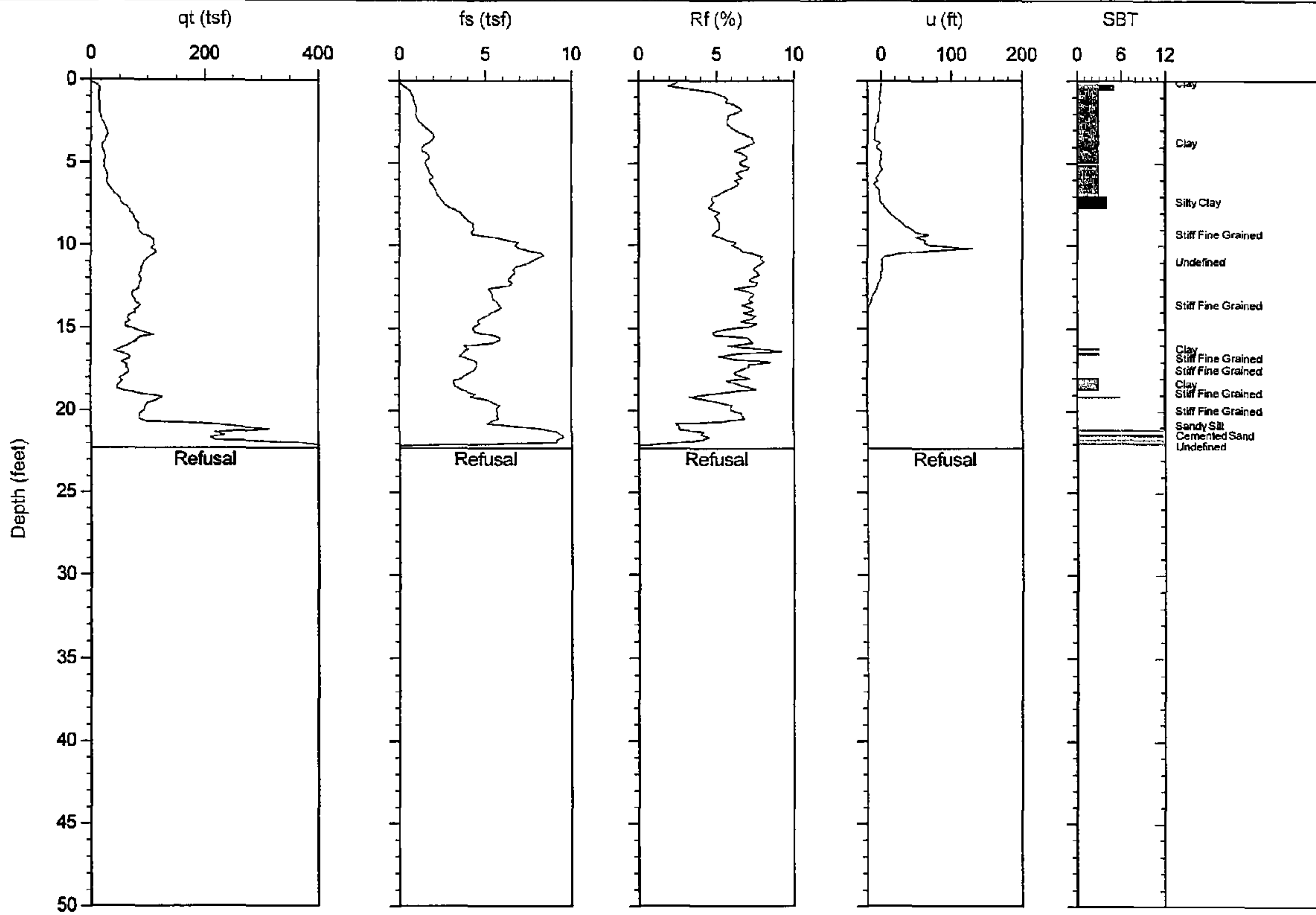
File: 771C111.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: N: 4536899.810 E: 701348.127 Elev: N/A

ConeTec | Barr Engineering

Job No: 09-771
Date: 10:20:09 15:52
Site: Van Wert, OH

Sounding: CPT-130
Cone: 268:T1500F15U500



Max Depth: 6.800 m / 22.31 ft
Depth Inc: 0.050 m / 0.164 ft

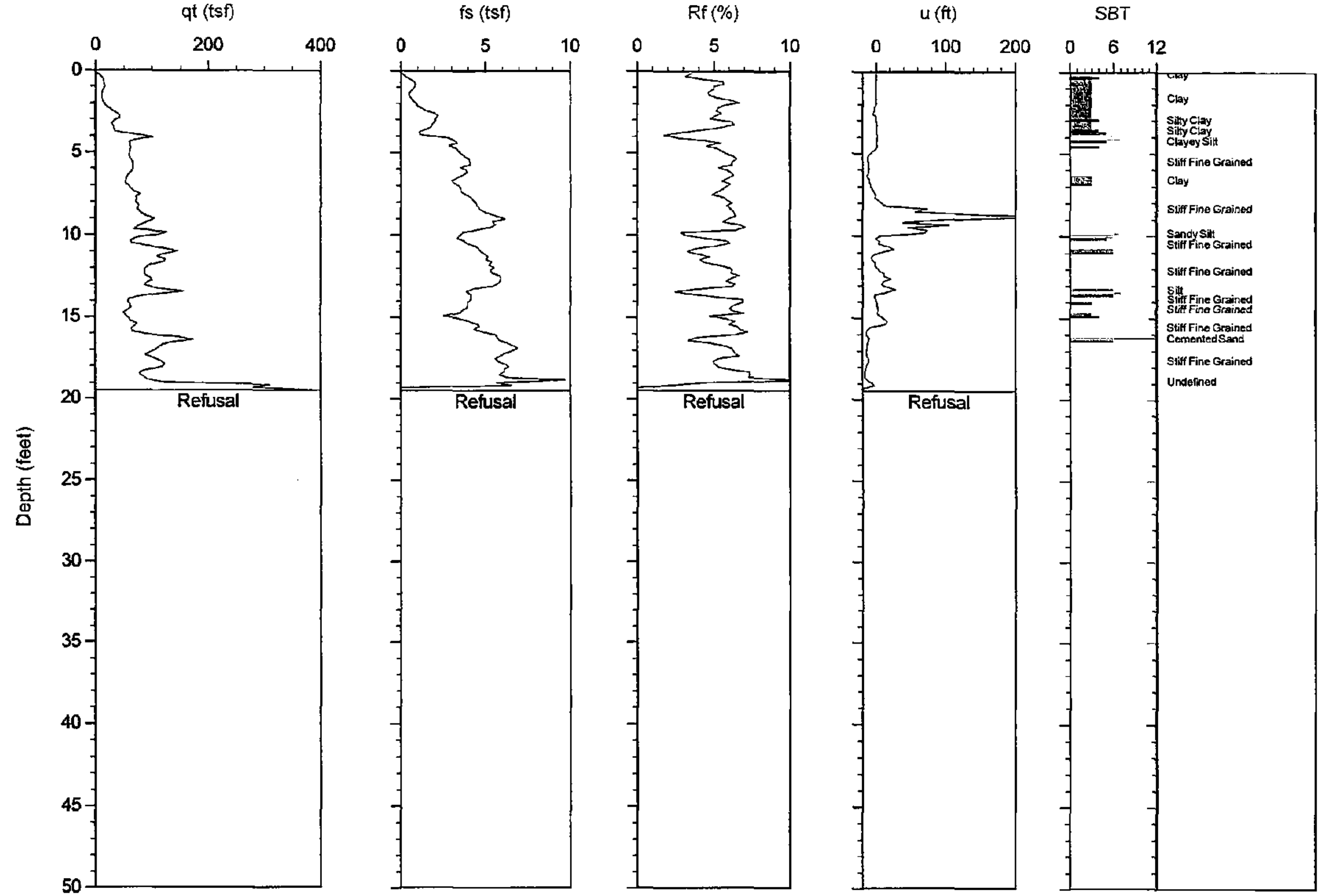
File: 771C130.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: N: 4539035.037 E: 703637.545 Elev: N/A

ConeTec | Barr Engineering

Job No: 09-771
Date: 10:20:09 17:12
Site: Van Wert, OH

Sounding: CPT-139
Cone: 268:T1500F15U500



Max Depth: 5.950 m / 19.52 ft
Depth Inc: 0.050 m / 0.164 ft

File: 771C139.COR

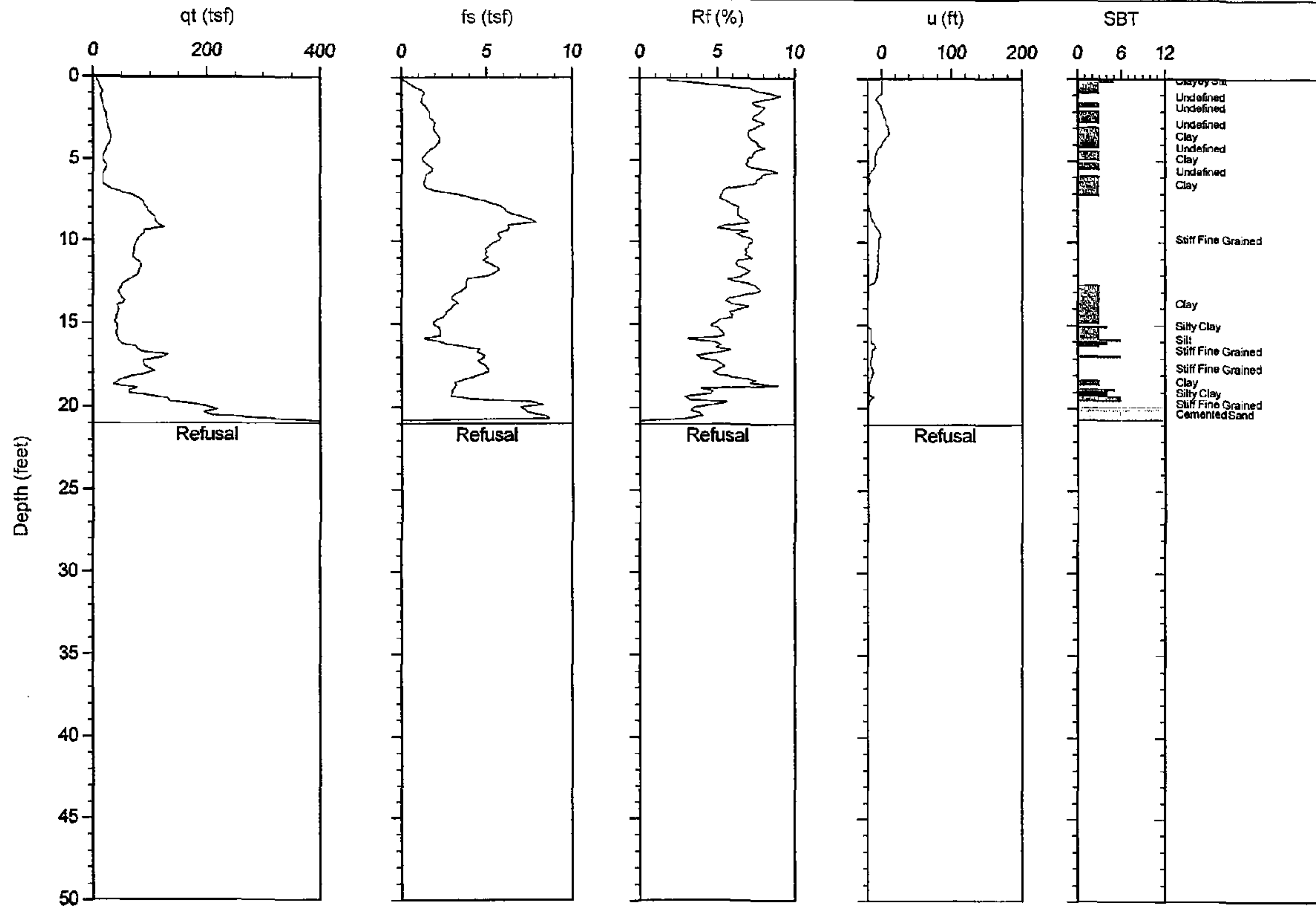
SBT: Lunne, Robertson and Powell, 1997
Coords: N: 4535218.375 E: 704834.340 Elev: N/A

CONETEC

Barr Engineering

Job No: 09-771
Date: 10:21:09 08:25
Site: Van Wert, OH

Sounding: CPT-144
Cone: 268:T1500F15U500



Max Depth: 6.400 m / 21.00 ft
Depth Inc: 0.050 m / 0.164 ft

File: 771C144.COR

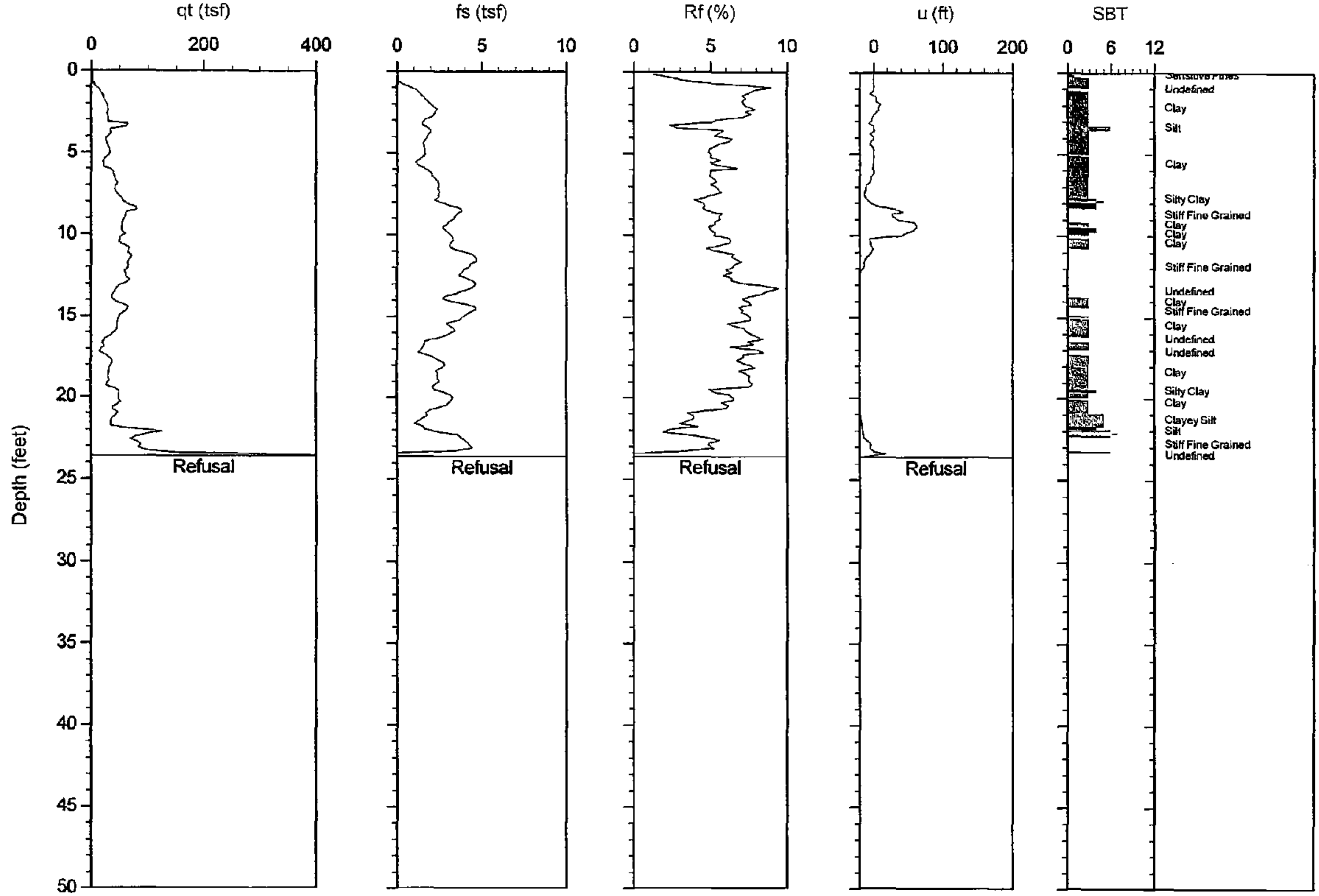
SBT: Lunne, Robertson and Powell, 1997
Coords: N: 4542221.185 E: 703006.314 Elev: N/A

CONETEC

Barr Engineering

Job No: 09-771
Date: 10:20:09 12:02
Site: Van Wert, OH

Sounding: CPT-160
Cone: 268:T1500F15U500



Max Depth: 7.200 m / 23.62 ft
Depth Inc: 0.050 m / 0.164 ft

File: 771C160.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: N: 4541951.741 E: 705964.050 Elev: N/A

Appendix C

Shear and Compression Wave Velocity Test Results

ConeTec

Job No 09-771
Client Barr Engineering
Project Title Blue Creek Wind Project
Hole CPT-07
Site Van Wert, Ohio
Date 10/22/2009

Seismic Source: Plate
Source Offset: 7.60 (ft)
Source Depth: 0.08 (ft)
Geophone Offset: 0.66 (ft)

SEISMIC TEST RESULTS - Vp

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vp Interval Velocity (ft/s)
5.08	4.42	8.75				
15.09	14.43	16.24	7.49	2.60	9.43	2880
23.13	22.47	23.65	7.41	1.93	18.45	3838

CONETEC

Job No	09-771
Client	Barr Engineering
Project Title	Blue Creek Wind project
Hole	CPT-07
Site	Van Wert, Ohio
Date	10/22/2009

Seismic Source:	Beam	
Source Offset:	2.00	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
5.08	4.42	4.85				
15.09	14.43	14.57	9.72	13.29	9.43	731
23.13	22.47	22.56	7.99	6.49	18.45	1231

CONETEC

Job No	09-771
Client	Barr Engineering
Project Title	Blue Creek Wind project
Hole	CPT-27
Site	Van Wert, Ohio
Date	10/21/2009

Seismic Source:	Beam	
Source Offset:	2.00	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
5.08	4.42	4.85				
15.09	14.43	14.57	9.72	12.28	9.43	791

CONETEC

Job No	09-771
Client	Barr Engineering
Project Title	*Blue Creek Wind project*
Hole	CPT-53A
Site	Van Wert, Ohio
Date	10/21/2009

Seismic Source:	Beam	
Source Offset:	2.00	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
0.66	0.00	2.00				
5.08	4.42	4.85	2.85	5.18	2.21	551

CONETEC

Job No	09-771
Client	Barr Engineering
Project Title	Blue Creek Wind project
Hole	CPT-53
Site	Van Wert, Ohio
Date	10/21/2009

Seismic Source:	Beam	
Source Offset:	2.00	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
0.66	0.00	2.00				
5.08	4.42	4.85	2.85	4.63	2.21	617

CONETEC

Job No	09-771
Client	Barr Engineering
Project Title	Blue Creek Wind project
Hole	CPT-60
Site	Van Wert, Ohio
Date	10/21/2009

Seismic Source:	Beam	
Source Offset:	2.00	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
5.08	4.42	4.85				
15.58	14.92	15.06	10.20	10.32	9.67	989

CONETEC

Job No	09-771
Client	Barr Engineering
Project Title	Blue Creek Wind project
Hole	CPT-84
Site	Van Wert, Ohio
Date	10/21/2009

Seismic Source:	Beam	
Source Offset:	2.00	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
5.08	4.42	4.85				
9.35	8.69	8.92	4.07	5.59	6.56	727

CONETEC

Job No	09-771
Client	Barr Engineering
Project Title	Blue Creek Wind project
Hole	CPT-87
Site	Van Wert, Ohio
Date	10/20/2009

Seismic Source:	Beam	
Source Offset:	2.00	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
5.08	4.42	4.85				
15.09	14.43	14.57	9.72	10.98	9.43	885
25.10	24.44	24.53	9.95	11.33	19.44	879

CONETEC

Job No	09-771
Client	Barr Engineering
Project Title	Blue Creek Wind project
Hole	CPT-94
Site	Van Wert, Ohio
Date	10/22/2009

Seismic Source:	Beam	
Source Offset:	2.00	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
5.58	4.92	5.31				
15.09	14.43	14.57	9.26	10.42	9.68	888

CONETEC

Job No	09-771
Client	Barr Engineering
Project Title	Blue Creek Wind Project
Hole	CPT-111
Site	Van Wert, Ohio
Date	10/21/2009

Seismic Source:	Plate	
Source Offset:	6.58	(ft)
Source Depth:	0.17	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vp

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vp Interval Velocity (ft/s)
5.08	4.42	7.84				
15.09	14.43	15.71	7.87	0.97	9.43	8117

CONETEC

Job No	09-771
Client	Barr Engineering
Project Title	Blue Creek Wind project
Hole	CPT-111
Site	Van Wert, Ohio
Date	10/21/2009

Seismic Source:	Beam	
Source Offset:	2.00	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
5.08	4.42	4.85				
15.09	14.43	14.57	9.72	11.63	9.43	835

CONETEC

Job No	09-771
Client	Barr Engineering
Project Title	Blue Creek Wind project
Hole	CPT-130
Site	Van Wert, Ohio
Date	10/20/2009

Seismic Source:	Beam	
Source Offset:	2.00	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
5.08	4.42	4.85				
15.42	14.76	14.90	10.04	14.39	9.59	698
22.31	21.65	21.75	6.85	6.87	18.21	997

CONETEC

Job No	09-771
Client	Barr Engineering
Project Title	Blue Creek Wind Project
Hole	CPT-139
Site	Van Wert, Ohio
Date	10/20/2009

Seismic Source:	Plate	
Source Offset:	7.42	(ft)
Source Depth:	0.08	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vp

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vp Interval Velocity (ft/s)
5.08	4.42	8.60				
15.09	14.43	16.16	7.56	1.12	9.43	6749
19.52	18.86	20.19	4.04	0.88	16.65	4589

CONETEC

Job No	09-771
Client	Barr Engineering
Project Title	Blue Creek Wind project
Hole	CPT-139
Site	Van Wert, Ohio
Date	10/20/2009

Seismic Source:	Beam	
Source Offset:	2.00	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
5.08	4.42	4.85				
15.09	14.43	14.57	9.72	11.33	9.43	858
19.52	18.86	18.97	4.40	3.12	16.65	1410

CONETEC

Job No	09-771
Client	Barr Engineering
Project Title	Blue Creek Wind project
Hole	CPT-144
Site	Van Wert, Ohio
Date	10/21/2009

Seismic Source:	Beam	
Source Offset:	2.00	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
5.08	4.42	4.85				
15.09	14.43	14.57	9.72	14.04	9.43	692
21.00	20.34	20.44	5.87	4.53	17.39	1296

ConeTec

Job No	09-771
Client	Barr Engineering
Project Title	Blue Creek Wind Project
Hole	CPT-160
Site	Van Wert, Ohio
Date	10/20/2009

Seismic Source:	Plate	
Source Offset:	7.33	(ft)
Source Depth:	0.17	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vp

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vp Interval Velocity (ft/s)
5.08	4.42	8.47				
15.58	14.92	16.47	8.00	1.64	9.67	4878
23.62	22.96	23.94	7.47	1.23	18.94	6072

ConeTec

Job No	09-771
Client	Barr Engineering
Project Title	Blue Creek Wind project
Hole	CPT-160
Site	Van Wert, Ohio
Date	10/20/2009

Seismic Source:	Beam	
Source Offset:	2.00	(ft)
Source Depth:	0.00	(ft)
Geophone Offset:	0.66	(ft)

SEISMIC TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Depth Interval (ft)	Time Interval (ms)	Mid-layer Depth (ft)	Vs Interval Velocity (ft/s)
5.08	4.42	4.85				
15.58	14.92	15.06	10.20	13.74	9.67	743
23.62	22.96	23.05	7.99	8.93	18.94	895

Appendix D

Dilatometer (DMT) Test Results

Job No: 09-771
Job Name: Blue Creek Wind Project
Job Location: Van Wert, Ohio
Date: 10/22/09
Sounding No: DMT-87
Ground Water Depth (ft): 30

[1] Depth Below Existing Ground Surface
[2] Mayne, 1995
[3] Marchetti, 1980
[4] Marchetti, 1997
[5] Campanella and Robertson, 1991
[6] Marchetti, 1980
[7] Schmertman, 1981

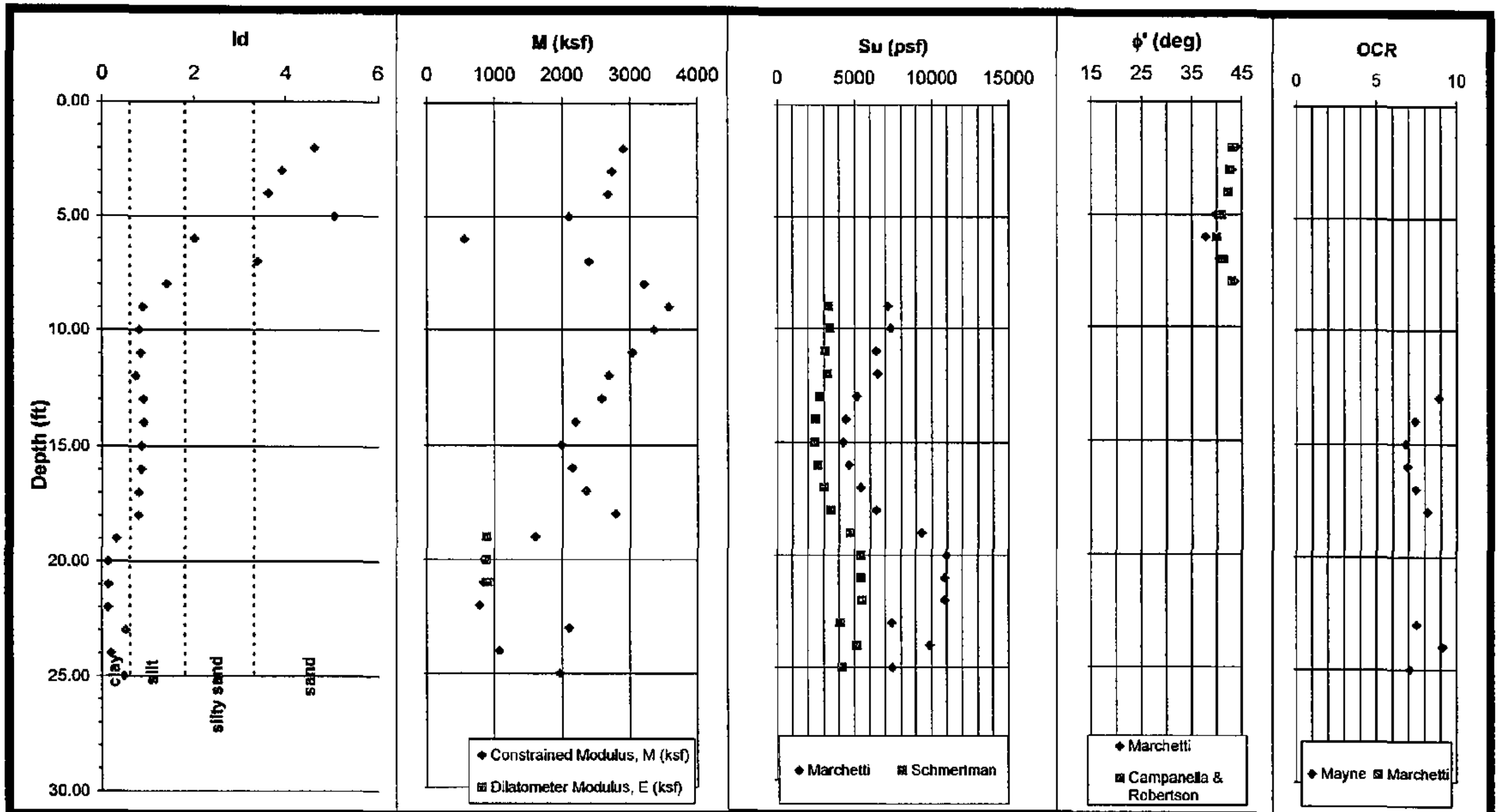
CONETEC

Depth[1] (ft)	A (bar)	B (bar)	C (bar)	po	p1	u_o (psf)	σ_{vo} (psf)	σ_{vo}' (psf)	Id	K_D	E_D (bar)	K_o	OCR[2]	OCR[3]	ϕ'^4 (deg)	ϕ'^5 (deg)	R_M	E_D (ksf)	s_u^6 (psf)	s_u^7 (psf)	M (ksf)
2.00	3	15.2	0	2.6	14.85	0	240	240	4.62	23.0	424	3.0			44.0	43.1	3	885			2909
3.00	3.5	15.8	0	3.1	15.45	0	360	360	3.92	18.2	427	2.6			43.1	42.6	3	892			2737
4.00	3.9	16.6	0	3.5	16.25	0	480	480	3.62	15.3	442	2.4			42.4	42.2	3	923			2679
5.00	2.8	15.1	0	2.4	14.75	0	600	600	5.05	8.5	427	1.7			39.7	41.0	2	892			2104
6.00	1.9	6.2	0	1.9	5.85	0	720	720	2.02	5.6	136	1.3			37.8	40.0	2	283			556
7.00	4.35	17.6	0	3.9	17.25	0	840	840	3.38	9.8	462	1.8			40.4	41.3	2	965			2394
8.00	10.2	23.9	0	9.8	23.55	0	960	960	1.41	21.3	478	2.9			43.7	42.9	3	999			3210
9.00	16.2	30	0	15.8	29.65	0	1080	1080	0.88	30.5	482	3.5	15.5	70.1			4	1006	7156	3292	3578
10.00	16.8	30	0	16.4	29.65	0	1200	1200	0.81	28.5	460	3.4	14.5	63.2			3	961	7320	3424	3355
11.00	15.4	28	0	15.0	27.65	0	1320	1320	0.84	23.8	438	3.1	12.1	47.5			3	915	6409	3138	3038
12.00	15.8	27.2	0	15.5	26.85	0	1440	1440	0.73	22.5	394	3.0	11.4	43.5			3	824	6512	3234	2690
13.00	13.4	25.2	0	13.1	24.85	0	1560	1560	0.90	17.5	409	2.6	8.9	29.5			3	854	5161	2728	2588
14.00	12	22.7	0	11.7	22.35	0	1680	1680	0.91	14.6	369	2.3	7.4	22.1			3	770	4423	2448	2201
15.00	11.8	21.8	0	11.6	21.45	0	1800	1800	0.86	13.4	343	2.2	6.8	19.5			3	717	4271	2413	1992
16.00	12.8	23.5	0	12.5	23.15	0	1920	1920	0.85	13.6	369	2.2	6.9	19.9			3	770	4646	2615	2151
17.00	14.6	26	0	14.3	25.65	0	2040	2040	0.80	14.6	394	2.3	7.4	22.3			3	824	5396	2983	2356
18.00	17	30	0	16.6	29.65	0	2160	2160	0.79	16.1	453	2.4	8.2	25.8			3	945	6421	3468	2787
19.00	22.8	30	0	22.7	29.65	0	2280	2280	0.31	20.8	241	2.8	10.6	38.6			3	504	9361	4740	1610
20.00	26	30	0	26.1	29.65	0	2400	2400	0.14	22.7	125	3.0	11.5	44.2			3	261	10983	5441	854
21.00	26	30	0	26.1	29.65	0	2520	2520	0.14	21.6	125	2.9	11.0	40.9			3	261	10850	5441	842
22.00	26.2	30	0	26.3	29.65	0	2640	2640	0.13	20.8	118	2.8	10.6	38.5			3	245	10833	5485	783
23.00	19.8	30	0	19.5	29.65	0	2760	2760	0.52	14.8	351	2.3	7.5	22.7			3	732	7404	4082	2102
24.00	24.8	30	0	24.8	29.65	0	2880	2880	0.20	18.0	169	2.6	9.2	30.8			3	352	9863	5178	1075
25.00	20.2	30	0	20.0	29.65	0	3000	3000	0.49	13.9	336	2.2	7.1	20.6			3	702	7447	4170	1974

CONETEC

DILATOMETER TEST RESULTS

Test ID: DMT-87
Site: *Blue Creek Wind Project*
Location: Van Wert, Ohio
Project No.: 09-771



Appendix E

HSA Boring Logs & Rock Core Photos

BARR

Barr Engineering Company
4700 W 77th St. Suite 200
Edina, MN 55435

LOG OF BORING T-103

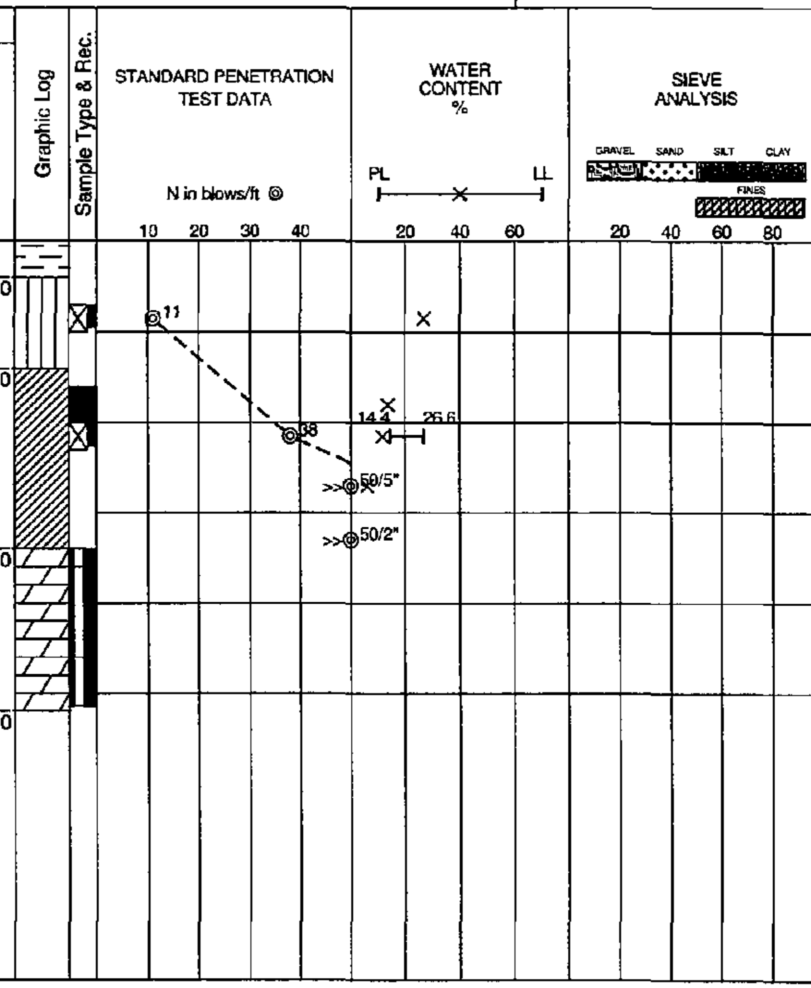
Sheet 1 of 1

Project: Blue Creek Wind Project | Location: Van Wert County, Ohio | Client: Iberdrola Renewables, Inc

Barr Project Number: 35/81-1001

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Bottom depth
0	SILTY TOPSOIL (OL), black, moist	2.0
2.0	CLAY (CL), brown, moist, very stiff	7.0
7.0	CLAY (CL), gray, little gravel (small), hard. 2-inch poorly graded sand with gravel layer (above bedrock) at 17 feet	17.0
17.0	DOLOMITE and DOLOMITIC LIMESTONE, gray, slightly to moderately fractured, slight or no decomposition, strong, isolated vugs (up to 2-inch diameter)	26.0
	End of borehole @ 26 feet	



Physical Properties

Depth (approx.), feet	WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
4.5	26.9				3		
9	13.8	121.9		5.3			
11	11.8				4.5		
14	6.1						
17							0
20							80
24							78

Completion Depth: 26.0
Date Boring Started: 10/21/09
Date Boring Completed: 10/21/09
Logged By: LAJ
Drilling Contractor: GeoCon
Drilling Method: HSA
Ground Surface Elevation:
Coordinates:-84.5941, 40.977 Datum: NAD 83

Remarks:

SAMPLE TYPES

Split Spoon | Shelby Tube | Rock Core

WATER LEVELS

While Drilling: 16
End of Drilling:
hrs After Drilling: Dry

LEGEND

MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Q_u Unconfined Compression
Q_p Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

BARR

Barr Engineering Company
4700 W 77th St. Suite 200
Edina, MN 55435

LOG OF BORING T-120

Project: Blue Creek Wind Project | **Location:** Van Wert County, Ohio | **Client:** Iberdrola Renewables, Inc

Barr Project Number: 35/81-1001

MATERIAL DESCRIPTION (ASTM D2488)

Surface Elev.:

Depth, feet	Material Description
0 – 2.0	SILTY TOPSOIL (OL), black, moist
2.0 – 6.0	SILT (ML), brown, moist, stiff
6.0 – 10.5	CLAY (CL), gray, with interlayered silty-sand (SM), moist, very stiff.
10.5 – 11.5	SILTY SAND (SM)
11.5 – 22.0	CLAY (CL), gray, little gravel (small), hard. 2-inch poorly graded sand with gravel layer(above bedrock) at 22 feet
22.0 – 34.5	DOLOMITE and DOLOMITIC LIMESTONE, gray, slightly to moderately fractured, slight or no decomposition, strong.
34.5	End of borehole @ 34.5 feet

Test Data

Approx. Depth, feet	Sample Type	SPT N (blows/ft)	Water Content (PL / LL)	Sieve Analysis	WC %	γ pcf	φ °	Q_u tsf	Q_p tsf	Gs	RQD %
4.5	Split Spoon	16		1.2 / 89	20.1				0		
9.5	Shelby Tube		14.6 / 31.7		13.5	122.5		9			
11	Split Spoon	26			18				0		
14.5	Split Spoon	16			13.5				4		
19	Shelby Tube				12.6	124.9		8.09			
20.5	Split Spoon	>>55			13.8				4.5		
27 – 34.5	Rock Core										67
											57
											82

Completion Depth:	34.5
Date Boring Started:	10/20/09
Date Boring Completed:	10/20/09
Logged By:	LAJ
Drilling Contractor:	GeoCon
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	-84.5988, 40.9431
Datum:	NAD 83

Remarks:

SAMPLE TYPES: Split Spoon; Shelby Tube; Rock Core

WATER LEVELS:
- While Drilling: 21
- End of Drilling:
- hrs After Drilling: Dry

LEGEND:
- MC Moisture Content
- γ Dry Unit Weight
- φ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.