September 2009

PUBLIC SERVICE COMMISSION OF WISCONSIN

# Glacier Hills Wind Park Project Volume 1

## Final Environmental Impact Statement

PSC Docket 6630-CE-302

Date Issued: September 2009

PUBLIC SERVICE COMMISSION OF WISCONSIN

# Glacier Hills Wind Park Project

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This final Environmental Impact Statement for the proposed Glacier Hills Wind Park project is progress towards compliance with the Public Service Commission's requirement under Wis. Stat. § 1.11 and Wis. Admin. Code § PSC 4.30.

By: Kathleen J. Zuelsdorff — Sept. 28, 2009

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# To the Reader

This final Environmental Impact Statement (EIS) fulfills part of the requirements of the Wisconsin Environmental Policy Act (WEPA), Wis. Stat. § 1.11. WEPA requires state agencies to consider environmental factors when making major decisions. The purpose of this final EIS is to provide the decision makers, the public, and other stakeholders with an analysis of the economic, social, cultural, and environmental impacts that could result from the construction and operation of the new wind electric generation facility. This document has been prepared by the Public Service Commission of Wisconsin (Commission or PSC) with input from the Wisconsin Department of Natural Resources (DNR) and the Department of Agriculture, Trade, and Consumer Protection (DATCP).

You are encouraged to read this final EIS and attend the hearing for the project which will be held in the project area (see below). During the hearing the final EIS will be entered into the hearing record by Commission staff.

Comments on the draft EIS were reviewed and considered during preparation of the final EIS and resulted in a number of changes and additions to this document. A summary of the comments and a description of their final disposition are included in Table 7.1-1. These comments can be viewed by accessing the Electronic Regulatory Filing (ERF) system on the Commission's web page at http://psc.wi.gov/ and selecting the ERF button. On the ERF page select the *Search ERF* option and then enter the PSC reference numbers listed in Table 7-1 to view the comments.

This final EIS will be a subject of the hearing to be held for this project. The Commission's decision to approve, modify, or deny ATC's application for this project will be based on the record of the technical and public portions of the hearing. The public hearing will be held at 3:00 and 7:00 p.m. on November 4, 2009, at the Randolph Town Hall, 109 South Madison Street, Friesland, Wisconsin. A copy of the Notice of Hearing will be mailed to a list of known landowners in and near the proposed project area, and to local government officials. The Notice will also be published in the local newspaper.

At the hearing, members of the public may testify about the project or the final EIS. In addition, written comments may be submitted in any of the following ways:

- Written comments submitted at the public hearing.
- Written comments submitted *via* the Commission's ERF system by October 28, 2009. The form used to file comments electronically can be found on the Commission's web page, http://psc.wi.gov/, by selecting the *Public Comments* button, then selecting *Wisconsin Electric Power Company (WEPCO) Glacier Hills Wind Park*, docket 6630-CE-302 from the list provided.
- Written comments may be submitted by mail by October 28, 2009, addressed to:

  Docket 6630-CE-302 Comments
  Public Service Commission of Wisconsin
  P.O. Box 7854
  Madison, WI 53707-7854

Members of the public who submit comments should understand that those comments will be included in the record on which the Commission will base its decision to approve, modify, or deny Wisconsin Electric Power Company's application. As such, the comments are subject to objection during the hearing. If objected to, the comments might not be admitted into the hearing record. Members of the public who have doubts about the admissibility of their comments should plan to provide oral testimony at the public hearing. All comments and a transcript of oral testimony will be posted to the Commission's website as an open public record.

The public and technical portions of the hearing will satisfy the WEPA requirements of both the Commission and DNR. A Commission decision on the proposed project is expected in January 2009.

Specific questions on the final EIS should be addressed to:

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# Executive Summary

Wisconsin Electric Power Company (WEPCO) proposes to build a new wind electric generating facility in the townships of Randolph and Scott in northeast Columbia County. The proposed facility is referred to as the Glacier Hills Wind Park (Glacier Hills).

On October 30, 2008, WEPCO submitted an application to the Public Service Commission of Wisconsin (Commission or PSC) for a Certificate of Public Convenience and Necessity (CPCN), under Wis. Stat § 196.491(3) and Wis. Admin. Code § PSC 111.53, for authority to construct and operate a 90-turbine wind facility, with a capacity of up to 207 MW. The facility would consist of the turbines, access roads to the turbines, an underground 34.5 kilovolt (kV) cable system to collect the power produced at each turbine, a new interconnection substation to connect to the existing electric transmission system, and an operations and maintenance (O&M) building that would house a supervisory control and data acquisition (SCADA) system to monitor turbine operation.

## PROJECT AREA

The project area consists of about 17,350 acres of predominately agricultural land in the townships of Randolph and Scott in Columbia County. The village of Friesland lies within the project area, while the village of Cambria is just south and the village of Randolph just southeast of the project area.

The project area is an elevated, relatively flat upland, dropping off to the north and west towards the Fox River and towards Duck Creek to the south. It is dominated by agricultural lands, without exceptional topography or natural resources. The north and western portions of the project area are a mixture of agricultural and forested lands, while the south and east portions are almost entirely agricultural. Almost all project construction would occur on agricultural lands. Table ES-1 shows the land use patterns in the project area.

Table ES-1 Existing land use in the project area

| Agriculture | Woodland | Wetlands/Waterways | Developed (buildings and roads) | Total |
|---|---|---|---|---|
| 82% | 10% | 4% | 4% | 100% |
| 14,140 acres | 1,730 acres | 737 acres | 741 acres | 17,348 acres |

## DESCRIPTION OF FACILITIES

WEPCO has requested Commission approval for turbines sized from 1.5 to 2.3 MW. However, WEPCO recently entered into an agreement to purchase Vestas V90 (1.8 MW) turbines, pending Commission approval. The Vestas V90 has a tower height of 262.5 feet (80 meters), and a blade length of 147.6 feet (45 meters), for a total height of 410.1 feet (125 meters).

The proposed interconnection substation site would be located on the west side of County Trunk Highway (CTH) H, adjacent to an existing 138 kV line owned by American Transmission Company LLC (ATC) in the town of Scott. This existing 138 kV transmission line runs between the North Randolph and

Portage Substations. WEPCO would buy 20 acres of farmland on the north side of the 138 kV line. The substation would ultimately occupy 10 acres.

WEPCO would own and operate the turbines, electric collector system, O&M building, and SCADA system. It would also own the low-voltage (34.5 kV) portion of the substation, while ATC would own the transmission (138 kV) portion of the substation. WEPCO intends to use the power generated by this project to serve its customers.

The turbines would be available for operation 24 hours a day, seven days a week, unless a turbine is shut down for maintenance. Actual operation of the turbines would be determined by the wind speed and dispatch orders by WEPCO or the Midwest Independent Transmission System Operator, Inc. (MISO). Assuming appropriate maintenance, WEPCO expects the proposed project to have a lifespan of 30 years.

## PROJECT NEED AND COST

To comply with the Renewable Portfolio Standards (RPS) described in Wis. Stat. § 196.378, WEPCO must increase its renewable generation percentage to 8.27 percent by the year 2015. To accomplish this, the company must either purchase or construct and operate more renewable energy resources. This project is a means of complying with its renewable resource requirements.

Based on the Electric Generation Expansion and Analysis (EGEAS) modeling submitted by WEPCO, no additional capacity or energy is necessary to meet its projected demands or provide planning reserve margin until 2017.

WEPCO estimates the capital cost of the proposed Glacier Hills project, exclusive of an allowance for funds used during construction (AFUDC), to be between $335.2 million and $413.5 million depending primarily on the generating capacity of the turbine model selected.

## ALTERNATIVES CONSIDERED

### Technology alternatives

WEPCO considered other renewable energy technologies, such as biomass, hydro power, and solar power to meet its renewable portfolio requirements. It determined that the cost of alternative technologies was greater or that the technologies were less suitable for achieving its goals in the required time frame.

Purchasing renewable generation from an independent power producer (IPP) not affiliated with the utility or any of its affiliates was also considered but determined by the company to be not be cost-effective.

In April 16, 2009, Invenergy Wind LLC (Invenergy) filed testimony in which it offered its proposed 150 MW Ledge Wind project in Brown County as an alternative to WEPCO's project. Power from the Ledge Wind project would be delivered to WEPCO under a purchased power agreement (PPA). The Invenergy proposal has been evaluated by Commission staff in its EGEAS analysis and will be discussed at the technical hearings for this project.

### Site alternatives

WEPCO issued a request for proposals (RFP) seeking renewable energy generating facilities with a capacity up to 200 MW to help the company comply with the RPS mandate. Thirteen proposed projects were received from nine different parties, with each proposed project involving a discrete project area or site.

From these proposals WEPCO narrowed the options using a number of criteria discussed in Section 3.3.1 of this draft EIS. As a result of this evaluation, WEPCO concluded that the Glacier Hills project, located at the proposed site in Columbia County, offered the best opportunity for it to secure, in a timely and economical manner, the next increment of wind-powered capacity it needs in order to comply with the RPS mandate.

WEPCO proceeded to identify possible turbine sites within the project area based on many factors and characteristics which included, among others: willing landowners; avoidance of natural resource features; topography; airports; minimum setbacks to homes; roads and property boundaries; and efficient construction opportunities. In the end, WEPCO initially identified a total of 138 turbine sites, of which 90 are designated as preferred sites and 28 as alternative turbine locations. Some of the initial 138 sites were eliminated from consideration.

## ENVIRONMENTAL EFFECTS OF THE GLACIER HILLS WIND PARK

### Natural resource impacts

#### Birds

The potential for avian mortality and displacement from feeding and nesting habitat is a major environmental concern. Bird collisions with turbine blades and towers have been widely reported in this country and abroad. WEPCO conducted a pre-construction avian study of the project area between mid-June 2007 and mid-June 2008.[1] The methodology used and the timing of the survey was consistent with the Breeding Bird Survey methodology and provided a general assessment of bird use in the project area during the one-year study period.

The avian study did not identify any heavily used local flight paths or any locations in the project area where bird activity was heavily concentrated. The surveys recorded observations of 151 bird species. Three state-listed threatened species were recorded. An additional 20 species that are listed as species of greatest conservation need (SGCN) were observed in the project area.

Almost all project construction would occur on active agricultural lands. Only a small amount of habitat other than agricultural lands would be directly disturbed by the project. Active agricultural lands provide feeding areas for some bird species during migration and winter but provide only limited habitat for nesting birds. The impact to bird habitat from direct habitat removal and from fragmentation of existing habitat would be relatively low.

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[1] Noel J. Cutright, January 2009, Glacier Hills Wind Park Pre-construction Avian Study, Columbia/Dodge Counties, Wisconsin, Prepared for Wisconsin Electric Power Company, Application Appendix Z Supplement, PSC ERF #106556.

### Bats

Bat mortality has exceeded bird mortality at most wind farms where post-construction monitoring of both animal groups has been conducted. Many species of bats are long-lived and have low reproductive rates. Also, Bat Conservation International estimates that more than 50 percent of American bat species are in decline. These characteristics make bat populations more vulnerable to the cumulative impacts that could occur as the number of wind projects continues to increase.

Seven species of bats are known to occur in Wisconsin; five of these are state species of special concern exhibiting some evidence of decline. Very few bat studies have been conducted in Wisconsin and thus bat numbers and behavior are not well understood.

A pre-construction bat activity study was conducted in the Glacier Hills project area.[2] The study, based on acoustic surveys, focused on bat activity patterns during the post-breeding and fall migration periods. No species identifications were performed during the study.

It is certain there will be some level of bat mortality if the proposed wind farm is constructed. However, due to the lack of research on bat mortality at wind farms in the Midwest, it is not possible to make predictions about the magnitude of bat mortality for this project or whether that mortality would have a significant impact on bat populations.

Post-construction mortality studies are being conducted at three recently completed wind projects in Wisconsin, including WEPCO's Blue Sky Green Field (BSGF) project. These projects have land cover similar to that present within or adjacent to the Glacier Hills project boundary. In addition, the projected bat activity levels based on pre-construction surveys at BSGF are similar to the pre-construction estimates for the Glacier Hills project. The initial post-construction data from the BSGF project show a high level of bat mortality.[3] Thus, it is possible that bat mortality at Glacier Hills could also be high.

### Wetlands and waterways

The project area is crossed by a number of small, mostly intermittent tributary streams that flow into the Fox River and Duck Creek. Many of the project area's tributary streams are bordered by bands of wetland. Wetlands in the project area are primarily wet meadows, many of which are dominated by reed canary grass, along with areas of forested and scrub/shrub wetlands.

No wind turbines or turbine site access roads, other than temporary crane paths, would be constructed within waterways or wetlands. Electric collector cables and temporary crane paths would cross 14 waterways with wetland borders, six waterways without wetland borders, and one wetland-only area. Many of these crossing locations would take place along existing roadways.

Many of the cables would be installed beneath the waterways and wetlands using directional boring, with no resulting disturbance to streams or wetlands. Other cable crossings of waterways and wetlands would involve trenching using timber matting to support the construction equipment and reduce disturbance. Overall, the surface disturbance to wetlands would affect an area of approximately 1.69 acres.

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[2] Jeff Gruver, November 2008, Acoustic Surveys of Bat Activity at the Proposed Glacier Hills Wind Energy Project, Columbia County, Wisconsin, August 16–October 29, 2007. Prepared for Wisconsin Electric Power Company by Western EcoSystems Technology, Inc., Cheyenne, Wyoming. Application Appendix Z Supplement, PSC ERF #107526.

[3] Jeff Gruver, Kimberly Bay and Wallace Erickson, June 2009, Post-Construction Bat and Bird Fatality Study Blue Sky Green Field Wind Resource Area Fond du Lac County, Wisconsin, Interim Report, July 2008–October 2008. Prepared for We Energies by Western EcoSystems Technology, Inc., Cheyenne, Wyoming.

## Community and social impacts

### Aesthetics

The proposed Glacier Hills turbine sites are located in a rural project area of about 17,350 acres. The predominant land cover is agriculture, although there are some wooded areas, often associated with streams. Wetlands and waterways comprise 4 percent of the land cover, as do developed areas, including roads and buildings. State Highway (STH) 33 and a 138 kV transmission line run across the southern portion of the project area. An ethanol plant (owned by United Wisconsin Grain Producers) is located on STH 33, within the project area. The village of Friesland is located in the northeastern portion of the project area. Small rural residences and subdivisions are present in addition to farmhouses and "farmettes." The topography is mostly flat to gently rolling. The overall landscape is a visually pleasing one of farm fields and scattered woodlots, with farm houses, barns, and silos.

The large size and high-tech appearance of the wind turbines causes them to stand out against the backdrop of open, rural landscapes. Because of their approximate 400-foot height, they would be seen for long distances. Residents who live in close proximity to one or more turbines may perceive the turbines as an intrusion on the rural landscape. Conversely, someone who resides outside of the project area and is traveling past on a nearby roadway may find that the turbines provide interest in an otherwise typical Wisconsin landscape. Landowners that host one or more turbines may view the turbines in a positive light because they are providing income and ensuring some level of financial stability. Alternatively, landowners that live in close proximity to turbines sited on adjacent properties may feel a loss of control over their visual environment and a sense of helplessness to restore their former familiar surroundings.

Two public recreation areas are present in the project area: the Village Park in Friesland and Deer Creek Campground. WEPCO hired a consultant to prepare several photo simulations of how the wind turbines would appear from various public vantage points within the project area. Based on the photo simulations prepared, the view from the Friesland Village Park would include multiple turbines, but they do not appear to dominate the view given their distance from the park. From the entrance to the Deer Park Campground, turbines either cannot or cannot easily be seen.

Many factors determine how a wind energy facility is aesthetically perceived. These factors include different levels of visual sensitivity for individuals, different visual settings, different viewing conditions, and different individual ideas and experiences. The distance from a turbine and its location relative to the onlooker, the onlooker's activity, the number of turbines within a specific view, and the presence of any screening objects, such as hills or trees, can influence how the new wind turbines are perceived. Personal feelings about wind energy technology and the surrounding environment can also contribute to how wind energy facilities are visually perceived.

### Agriculture

The proposed Glacier Hills project is located primarily on agricultural land consisting of a mix of corn, alfalfa, and soybeans, interspersed with some dairy farms and vegetable production.

Long-term impacts caused by construction and operation of Glacier Hills would include permanent loss of agricultural land to energy facilities. In addition, lower crop yields may occur in areas used for temporary construction due to soil compaction, erosion, and mixing of soil horizons and disruption to existing drainage patterns. Direct loss of crops would occur in all areas of construction in the year of construction.

In addition, large-scale wind farms can limit or restrict the aerial application of pesticides and other plant protection products by creating a visual distraction to pilots, a physical barrier to flight patterns, and air turbulence that can increase the likelihood of pilot error or result in dangerous flying conditions.

WEPCO developed an Agricultural Mitigation Plan, which was reviewed and approved by the Department of Agriculture, Trade and Consumer Protection (DATCP) to avoid and minimize both construction impacts and long-term operational impacts. The company intends to restore all disturbed agricultural land not used for permanent facilities to a productive state.

### Airports and airstrips

No public use airports are located in the project area. Two private use airstrips are in the general project area.

The Swart Airstrip, located west of Sterk Road and about 0.75 mile north of STH 33, appears to consist of a grass or dirt runway through the middle of farm fields. The installation of turbines at two preferred sites could add a constraint to approaching and departing the Swart Airstrip from the west. No turbines would interfere with the approach east of the runway.

Slinger Field is grass strip located about 0.75 mile south of a preferred turbine site. The proposed wind farm is not expected to have any effect on use of the Slinger Field.

## LAND USE PLANS

Both Columbia County and the town of Randolph have 2030 Comprehensive Plans. By 2030, the town of Randolph expects to lose about 310 acres of agricultural land and gain about 291 acres of residential land, 6 acres of commercial land, and 13 acres of industrial land. The easements required for wind turbine sites restrict other construction on property that would interfere with operation of the wind facilities. This reduces economic and other pressures to convert farmland to other land uses, such as residential subdivisions, and thus could slow the loss of agricultural land in Randolph township.

Neither Columbia County nor the towns of Scott or Randolph have wind siting ordinances. WEPCO has been negotiating Joint Development Agreements (JDA) with both townships that would cover subjects such as facility lighting, tower color and height, signage, setbacks from residences, road repairs, and noise. These JDAs also may establish means for resolving disagreements between municipal authorities or landowners and the developer.

## SHADOW FLICKER

As wind turbine blades rotate, they cast a shadow upon the ground and objects below. A strobe effect can occur where the shadow of the rotating blades causes rapid changes in light intensity on a sensitive receptor, such as the windows of a residence. Obstacles such as trees or buildings between the wind turbine and a potential shadow flicker receptor can reduce or eliminate shadow flicker effects. Changes in elevation can either reduce or increase the effects.

WEPCO evaluated shadow impacts by using conservative inputs and two computer models, WindFarm and WindPRO. The computer modeling predicts that potential receptors to the north or south of the wind turbines are not likely to receive shadow flicker because the shadow is shorter in those directions. Receptors to the east and west of the turbine locations could experience shadow flicker in the morning and evening. The number of hours per year in which shadow flicker could occur lessens as distance from the turbine increases. Section 5.7.1.2 provides a detailed discussion and diagram of how many hours of shadow flicker can be expected to occur at specific distances and directions from a turbine.

## NOISE

Noise from an operating wind turbine is typically produced by both mechanical and aerodynamic sources. WEPCO hired a consultant to conduct a noise study as required by the PSC Noise Assessment Measurement Protocol (Noise Protocol). The study involves measuring ambient noise for ten-minute intervals at several agreed-upon locations in the project area during various time periods throughout the day. WEPCO's consultant conducted sound level measurements over a 13-day period from June 25 to July 8, 2008. These measurements were taken continuously in ten-minute intervals over the entire 13-day period. Due to an instrumentation error during the 2008 sampling period, additional noise sampling was conducted from July 12 to July 16, 2009. The Noise Protocol also requires the applicant to provide a sound level contour map showing the anticipated sound levels from the proposed project. The sound levels shown on the map, in conjunction with measurements of existing sound levels, are used to estimate the increase in sound levels in the project area.

Based on the noise study, turbine operation would be audible at a number of locations within the project area. Although the analysis performed by WEPCO's consultant demonstrated that the proposed project would meet a representative 50 decibel (A-weighted) (dBA) standard under worst-case conditions, wind turbine sounds would be perceptible outdoors during most hours of operation. There could be a few residences along East Friesland road near STH 33 where the modeled sound level would be 50.3 dBA, or slightly over the 50 dBA limit should the loudest turbine be installed. The consultant stated that the actual level is expected to be less due to the conservative assumptions used in the model.

Noise levels associated with wind turbines are difficult to assess because of the scattered nature of the turbines. In addition, impacts largely depend on the distance to and number of nearby turbines, the sensitivity of individuals (receptors), wind speed and direction, time of year, the type of structures or vegetation existing between the turbine and the receptor, and turbine design. Ambient sounds, including natural sounds, may also mask turbine noise to some degree.

## ROADS AND TRAFFIC CONGESTION

Major highways nearest to the project area are Interstate Highway 39 (I-39) to the west, U.S. Highway (USH) 151 running southwest to northeast, and USH 41 further to the east. Other major roads in the area include STH 33, which runs east-west in the project area and STH 146, which runs north-south a short distance into the project area. Numerous county and town roads also transect the project area.

Worker trips, involving construction employees traveling to and from the job site, would have the primary impact on local traffic. The construction workers would likely utilize a variety of routes, meaning that traffic would not concentrate on any specific road, with the exception of STH 33 which serves as a major east-west arterial crossing the project area. Between 120 and 150 workers in the project area could result in approximately 300 or more worker automobile trips per day (arriving and departing).

The second type of traffic associated with construction activities would involve trips by trucks delivering construction material, equipment, and supplies. WEPCO estimates that a total of 8,215 truck trips are expected for construction support items and another 630 to 900 truck trips for delivery of the large parts of the wind turbine. Most of the trucks hauling the turbine components and large cranes are over standard weight and/or over standard size.

The impacts on current traffic conditions during construction would be temporary, occurring only until all of the proposed facilities are installed. WEPCO would plan the delivery routes for turbine components and cranes needed for construction. Smaller road intersections along delivery routes and intersections with access roads would be widened during construction to allow for wide turns. Where the tree canopy overhangs the road, limbs may have to be trimmed. Owners of trees on private properties would be consulted and their wishes accommodated to the greatest extent possible.

All roads in the project area would be videotaped and reviewed by a consultant prior to and after construction to document conditions. WEPCO anticipates that damage to local roads would be minimal and localized and states that it would be responsible for the cost of making repairs to roads damaged as a result of construction.

## SHARED REVENUE AND EMPLOYMENT

If Glacier Hills is approved and constructed as proposed, Columbia County and each of the affected townships would receive shared revenue payments based on the number of wind turbines and residents in their jurisdiction. WEPCO currently proposes to locate 36 turbines (or 40 percent of the total) in Scott township and 54 turbines (or 60 percent of the total) in Randolph township. Based on use of the 1.8 MW Vestas V90 turbine, the county and townships would receive the approximate payments shown in Table ES-2 below.

Table ES-2 Total estimated annual payments to affected towns and county

| Turbine Size (MW) | Total MW for 90 turbines | Columbia County | Town of Scott | Town of Randolph |
|---|---|---|---|---|
| 1.8 | 162 | $378,000 | $108,000 | $162,000 |

In addition to shared revenue payments, the local economy could benefit from temporary project laborers (up to 150) staying in the area and about 15 permanent full-time employees that would maintain and operate the wind farm.

## TELEVISION, RADIO, AND TELECOMMUNICATIONS

WEPCO retained the consulting firm Comsearch to evaluate the impacts of the wind project on various telecommunications media, including microwave communication systems, television reception, AM/FM broadcast operations, and licensed land mobile radio operations.

No concerns were identified regarding blockage of government radio frequency transmissions. The possible impacts of the wind facility on 22 Doppler radar installations located within 250 kilometers of the project were also reviewed. Coverage of one Doppler radar set-up owned by WKOW Television Station would most likely be impacted. The loss of coverage would be limited to the northeast at very low elevation angles. No radio (FM or AM station) impacts are anticipated.

It is possible that the Glacier Hills project could affect television reception for some residents in the project area. This would take the form of “ghosting” for analog signals and pixilation for digital signals. WEPCO is committed to implementing mitigation methods to restore the television coverage that existed prior to the existence of the wind turbine facility.

CHAPTER

1

# 1. Project Overview and Regulatory Requirements

## 1.1. DESCRIPTION OF THE PROPOSED PROJECT

### 1.1.1. Proposed wind turbine facility

Wisconsin Electric Power Company (WEPCO) proposes to build a new wind electric generating facility in the townships of Randolph and Scott in northeast Columbia County. The proposed facility is referred to as the Glacier Hills Wind Park (Glacier Hills). Glacier Hills would consist of 90 turbines, access roads to the turbines, an underground 34.5 kilovolt (kV) cable system to collect the power produced at each turbine, a new substation to connect to the existing electric transmission system, and an operations and maintenance (O&M) building that would house a supervisory control and data acquisition (SCADA) system to monitor turbine operation. The O&M building would also include office and garage space.

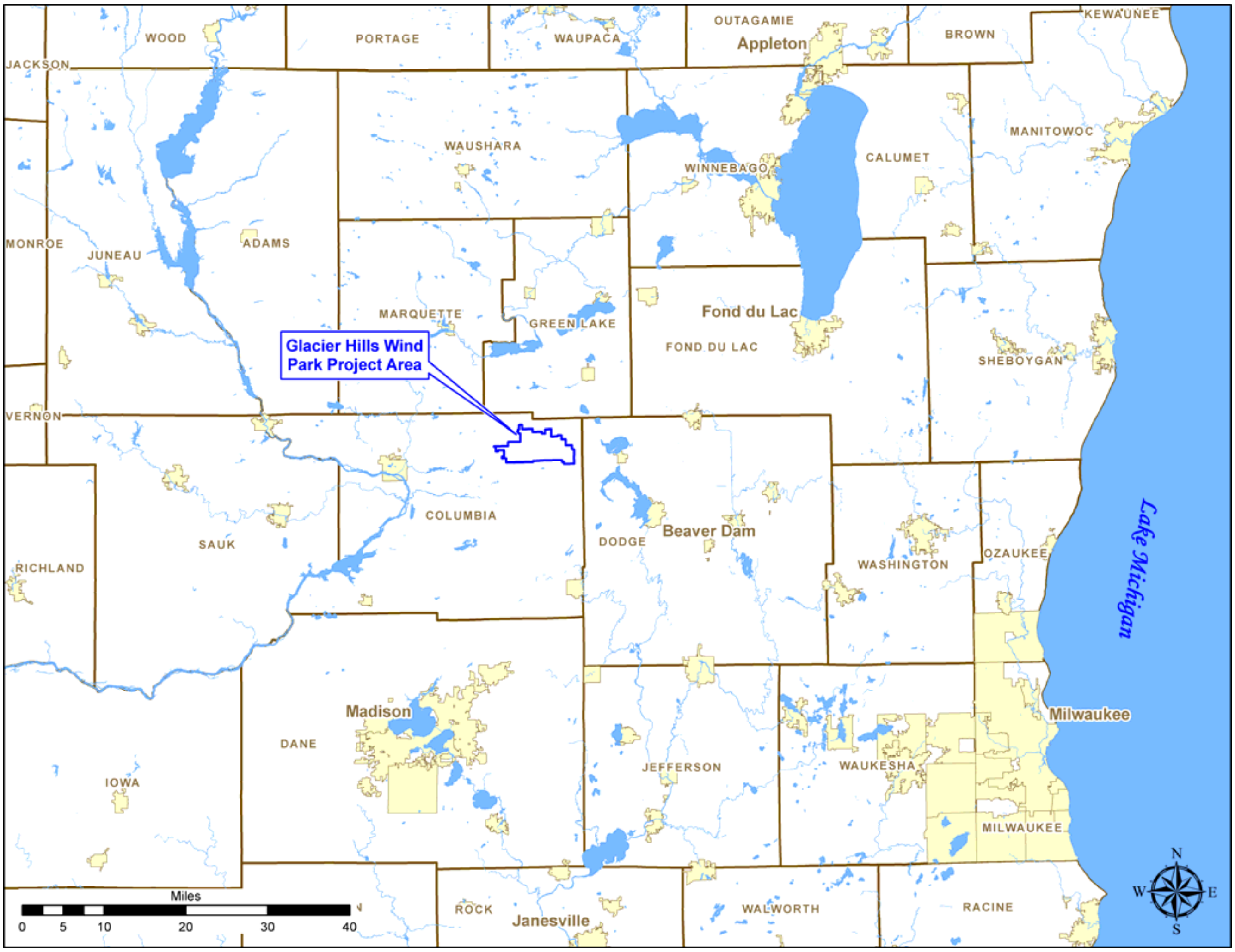
On October 30, 2008, WEPCO submitted an application to the Public Service Commission of Wisconsin (Commission or PSC) for a Certificate of Public Convenience and Necessity (CPCN), under Wis. Stat § 196.491(3) and Wis. Admin. Code § PSC 111.53, for authority to construct and operate a 90-turbine wind facility, with a capacity of up to 207 MW. WEPCO included information in the application for a range of turbine sizes from 1.5 to 2.3 MW, and has requested Commission approval for this range. However, WEPCO recently entered into an agreement to purchase Vestas V90 (1.8 MW) turbines, pending Commission approval. The Vestas V90 has a tower height of 262.5 feet (80 meters), and a blade length of 147.6 feet (45 meters), for a total height of 410.1 feet (125 meters).

WEPCO needs long-term easements for the land used by the wind turbines, access roads, and collector circuits. WEPCO has stated it intends to obtain easements from willing landowners. However, WEPCO could use the power of eminent domain if it is granted a CPCN by the Commission. Temporary easements are also needed for crane paths, construction areas (such as widened access roads and turbine sites), and construction laydown areas for storing equipment and supplies. WEPCO plans to buy land for the O&M building and the substation.

### 1.1.2. Proposed project area and turbine sites

Figure 1.1-1 is a map of the project area shown in a regional context. The proposed turbine sites within the project area are shown in Figure Vol. 2-1.

Figure 1.1-1 Map of the project area




The project area consists of about 17,350 acres of predominately agricultural land in the townships of Randolph and Scott in Columbia County. The village of Friesland lies within the project area, while the village of Randolph is just south of the project area. WEPCO has identified the approximate location of all facilities, although these locations are subject to change. WEPCO identified 118 viable turbine sites; 90 are designated as preferred sites and 28 are alternate sites. WEPCO has requested authority to build at any 90 of the 118 viable sites.

The proposed project was initially developed by Randolph Wind LLC, which was owned by Florida Power and Light Company (FPL). WEPCO acquired an option to purchase the project as part of the sale of the Point Beach Nuclear Plant to FPL Energy in 2007. WEPCO states that the Glacier Hills project was compared to nine project areas located in Iowa, Minnesota, southwestern Wisconsin, southeastern Wisconsin, and east central Wisconsin. These projects included responses to WEPCO's request for proposals for wind generation and the possible expansion of an existing, Wisconsin wind farm owned by WEPCO. WEPCO chose the Glacier Hills project based on schedule, cost, and financial risks.

### 1.1.3. Transmission interconnection facilities

Energy produced by each turbine is transformed to a voltage level of 34.5 kV by transformers located adjacent to each turbine; 34.5 kV collector circuits then carry this energy to a central substation that is connected to the area's existing transmission system. The substation converts the 34.5 kV voltage to the voltage of the nearest transmission line (a 138 kV line, in this case). Each collector circuit connects a "string" of turbines to the substation, and each turbine is connected to a string. For this reason, more than one circuit may be located within a collector right-of-way (ROW). For this project, the individual collector circuits converge along Vaughn Road. Fiber optic communication cables also connect each wind turbine to the substation.

WEPCO is currently proposing a substation site located on the west side of County Trunk Highway (CTH) H, adjacent to a 138 kV line owned by American Transmission Company LLC (ATC) in the town of Scott. This existing 138 kV transmission line runs between the North Randolph and Portage Substations. A more detailed discussion of the collector circuit system and the interconnection facilities is included in Chapter 2.

### 1.1.4. Ownership and operation of generation and transmission facilities

WEPCO would own and operate the turbines, electric collector system, O&M building, and SCADA system. WEPCO would own the low-voltage (34.5 kV) portion of the substation and ATC would own the transmission (138 kV) portion of the substation. Pending Commission approval of this proposed wind farm, ATC's portion of the substation is scheduled to be in service on October 1, 2010. WEPCO and ATC would likely enter into a Generator Interconnection Agreement in 2009.

WEPCO intends to use the power generated by this project to serve its customers.

### 1.1.5. Expected life of plant

The turbines would be available for operation 24 hours a day, seven days a week, unless a turbine is shut down for maintenance. Actual operation of the turbines would be determined by the wind speed. Assuming appropriate maintenance, WEPCO expects the proposed project to have a lifespan of 30 years. The average book life used in economic analyses is 26 years.

### 1.1.6. Decommissioning of plant

WEPCO states that when the useful life of the project has ended, the landscape and land use would be restored to pre-project conditions. All agreements with landowners hosting turbines include provisions for removing foundations (aboveground and belowground to a depth of four feet), turbines, and any other project structures from the property. The disturbed areas would be restored to a condition reasonably similar to their original condition. Reclamation would include leveling, terracing, mulching, seeding, and other activities, as appropriate.

# 1.2. REGULATORY BACKGROUND

## 1.2.1. Wisconsin Energy Priorities Statute

One of the goals listed in Wis. Stat. § 1.12, the State Energy Policy, is that all new installed capacity for electric generation in the state shall be based on renewable energy resources to the extent that it is cost effective and technically feasible. Wis. Stat. § 1.12(4) creates a priority list of methods for meeting future electricity demands. Energy conservation is ranked first. Noncombustible renewable resources (wind, solar, and hydro) are the second preference, and combustible renewable resources such as the various forms of biomass are the third preference. Commission decisions regarding new electric generating capacity must consider this statute.

## 1.2.2. Wisconsin's Renewable Portfolio Standard

In 1999 the Wisconsin legislature established a Renewable Portfolio Standard (RPS), outlined in Wis. Stat. § 196.378(2). This statute requires each electric provider in the state to obtain an increasing portion of the electricity that it sells to its retail customers (or members) from renewable resources. Electric providers include: investor-owned utilities (IOU), municipal utilities, and electric cooperatives. To meet the RPS requirement, WEPCO calculates that by 2010 it will need to provide 4.27 percent of its retail electric sales with renewable energy. By 2015, WEPCO will need to obtain 8.27 percent of the electricity sold to its Wisconsin customers from renewable sources. Wisconsin is one of 29 states, plus the District of Columbia, with a mandatory minimum renewable energy requirement.

# 1.3. REGULATORY REVIEW PROCESS

## 1.3.1. Certificate of Public Convenience and Necessity

Anyone proposing to build a power plant of 100 MW or more in Wisconsin must obtain approval from the PSC in the form of a CPCN before construction can begin. The Commission makes the final decisions about whether a power plant is built and where it is sited. The Commission consists of three members, appointed by the governor and approved by the Senate for six-year terms.

The Commission makes its decisions on a CPCN project application based on the hearing record (transcripts and exhibits). The hearing record is the product of a technical hearing and a public hearing conducted by an Administrative Law Judge.

Project developers must file a detailed application with the PSC. Application requirements for proposed wind turbines are posted on the PSC's web site. These requirements include information for Department of Natural Resources (DNR) permits. When an application is filed with the PSC and DNR, copies are also placed in libraries and provided to municipal clerks in the project area. The CPCN application is reviewed by Commission staff to see that it is complete. If it is not, additional information or a new application must be filed.

Once the PSC deems an application complete it must take final action on the project within 180 days. Court approval is needed to extend the review time to a maximum of 360 days. If the PSC does not obtain a court extension or issue a final decision within this period, the project is automatically approved as proposed by the applicant (refer to Wis. Stat. § 196.491(3)).

### 1.3.2. DNR permitting authority

To construct the proposed project, WEPCO would need several permits from the DNR Office of Energy. The DNR permits would govern construction in and over waterways and wetlands, and would require development of a soil erosion plan and hazardous materials management plan. DNR also reviews the project for the presence of endangered and threatened species, and species of special concern. DNR permits must be obtained before construction begins.

### 1.3.3. Wisconsin Environmental Policy Act requirements

The Wisconsin Environmental Policy Act (WEPA), Wis. Stat. § 1.11, requires all state agencies to consider the environmental impacts of major actions that could significantly affect the quality of the human environment. For projects that require approvals from both the PSC and DNR, a joint Environmental Impact Statement (EIS) is prepared, with the PSC functioning as the lead agency.

The purpose of an EIS is to inform the Commissioners and the public of the potential effects of the proposed project. The EIS describes the proposed project, discusses possible alternatives to the proposed action, and evaluates the project impacts on the natural and human environment. A draft EIS is issued, followed by a a 45-day comment period. Preparation of the final EIS is based on comments received on the draft EIS. After the final EIS is issued, there is at least a 30-day review period to allow individuals to read the final EIS and prepare for the public hearing, which is held in the project area. The EIS becomes part of the hearing record on which the Commission bases its decision.

### 1.3.4. Other state and federal agencies

The Wisconsin Department of Transportation (DOT) has issued permits to WEPCO for use of airspace. DOT would also need to issue permits for transport of turbine parts (oversize and overweight vehicles) on state roads, as well as placement of access roads (driveways) and collector lines on state highway ROW. The Department of Agriculture, Trade and Consumer Protection (DATCP) completed an Agricultural Impact Statement (AIS) for nine possible substation sites, and commented on WEPCO's proposed Agricultural Mitigation Plan (AMP). If WEPCO locates the 34.5 kV collectors for Glacier Hills as proposed relative to cemeteries, the Wisconsin Historical Society (WHS) has no further interest in the proposed project.

The Federal Aviation Administration (FAA) reviewed WEPCO's preferred turbine sites for airspace concerns and identified how the turbines would need to be marked and/or lighted. The U.S. Fish and Wildlife Service (USFWS) reviewed the project area and states that no federal threatened or endangered species are present. The U.S. Army Corps of Engineers permit to allow placement of fill in wetlands was issued on June 22, 2009. The U.S. Department of Commerce's National Telecommunication Information Agency (NTIA) has determined that Glacier Hills would not interfere with the communication links used by any federal agency.

### 1.3.5. County, town, and village requirements

Columbia County would have to issue permits for installing access roads (driveways) off county roads. The village of Friesland may need to approve a zoning change for the proposed operations and maintenance facility, and the village of Cambria may need to approve parcel subdivision for the substation site. Town governments would probably need to provide permits for road alterations such as driveways and placing collector circuits underground on road ROW.

### 1.3.6. Joint Development Agreements

The effects of wind farm construction, such as disruption to traffic, can affect a town as a whole, rather than isolated areas. In addition, few towns or counties have ordinances that address construction and operation of wind turbines. For these reasons, wind farm developers often enter into contractual agreements with town governments. These contracts are referred to as Joint Development Agreements (JDA). The JDA is a common tool used when an extensive area of land would be affected by a large utility project. Usually, the JDA would address some environmental parameters, methods for settling disagreements between the town and WEPCO, and compensation for town expenses associated with the project. For example, JDAs may set noise standards, determine the minimum distance between wind turbines and other features, such as roads or homes or property lines, and may address restoration of lands and roads damaged by construction. The JDA may also address methods of communication, or any other specific concerns of an individual township.

Both the Randolph and Scott townships are currently negotiating JDAs with WEPCO. These agreements are not required for Commission approval. In the absence of a JDA, many of the issues that it would address are determined by the Commission's decision and order. In addition, there are existing state laws that provide compensation for counties, towns, and villages that host wind turbines.

### 1.3.7. Glacier Hills Wind Park review to date

On October 30, 2008, WEPCO filed a CPCN application for Glacier Hills. Copies of the application were distributed to libraries and municipal clerks in the project area. On November 21, 2008, WEPCO was informed that its application was incomplete. WEPCO provided additional information, and the application was deemed complete on January 28, 2009. Copies of the application were updated.

On February 13, 2009, the PSC sent a notice to area residents, municipal clerks, and media informing them that the Commission was reviewing this project and setting the date for a prehearing conference to discuss issues to be addressed at hearing and schedules for discovery and testimony. The notice also stated that an Environmental Assessment (EA) would be prepared, requested comments, and provided contact information for Commission staff who are analyzing WEPCO's proposal.

On March 5, 2009, a "public notification letter" was sent to area residents and municipal clerks that briefly described the project, described ways to get information about the project, and solicited comments about the environmental aspects of the case. Six comments were received.

On May 7, 2009, the Commission issued a Notice of Hearing that was sent to area residents, municipal clerks, local media, and other interested persons.

At the end of May, WEPCO notified the Commission that it would file new testimony based on reduced contract costs for turbines. WEPCO filed its supplemental testimony on May 29 and June 5, 2009.

On May 28, 2009, the Commission approved a request to Dane County Circuit Court for an extension of the 180-day review deadline to 360 days. On June 3, the Court granted this request. The PSC must now take final action by January 25, 2010.

On June 1, 2009, the PSC's WEPA Coordinator sent a preliminary determination letter to area residents, municipal clerks, and media summarizing the environmental effects expected from the project, based on an EA prepared by Commission staff. The letter stated that the Commission did not intend to prepare an EIS, but solicited comments on this preliminary determination. Several comments were received throughout the 15-day comment period. Based on these comments and additional information made available to the Commission, this final EIS has been prepared.

On June 25, 2009, the Commission sent a letter to all affected landowners, government offices in the project area, media outlets, and other interested persons to inform them that a previously scheduled public hearing was cancelled and that the Commission would reschedule the hearings after the final EIS is issued.

The draft EIS was issued in July 2009 and a 45-day comment period on the draft EIS ended on September 4, 2009. Comments from the public and intervenors, which are acknowledged and summarized in Chapter 7, were used in the preparation of this final EIS.

### 1.3.8. Intervenors (Parties) in this case

A person, group or organization that has substantial interests that may be affected by the Commission's decision or whose participation will promote the proper disposition of the issues in the case may request to intervene in the case or become a "party." The PSC's Administrative Law Judge grants or denies party (intervenor) status. Intervenors have additional rights and responsibilities in the hearing process, such as providing expert witnesses, cross-examining or being cross-examined at the hearing, and filing "briefs" (written arguments made after the hearing is closed). An intervenor is usually represented by an attorney.

As the applicant, WEPCO is automatically considered a party. In addition, parties to this case include: the Citizens Utility Board (CUB), Clean Wisconsin Inc. (Clean Wisconsin), Coalition for Wisconsin Environmental Stewardship (CWESt), E Wind LLC, International Brotherhood of Electrical Workers Local 2150, Invenergy Wind LLC (Invenergy), the town of Randolph, and Renew Wisconsin.

On April 16, 2009, the Commission awarded CUB $90,000 and Clean Wisconsin $43,300 to analyze aspects of WEPCO's proposal and participate in the hearings. The money is awarded from a special intervenor compensation (IC) fund, that was established by the Wisconsin legislature. CUB proposes to analyze WEPCO's project from the perspective of the residential rate class, looking in particular at WEPCO's analysis of alternatives, and ways to minimize costs and rate effects. Clean Wisconsin proposes to analyze the proposed project from the perspective of its members and the environment. Both groups provided work plans, which include hiring consultants and lawyers. On June 23, 2009, CWESt filed an IC request to analyze the project from the perspective of individual property owners and Wisconsin residents. The Commission has not yet taken final action on this request.

Also on April 16, 2009, Invenergy submitted prefiled direct testimony describing the Ledge Wind Project, which it contends could provide energy to WEPCO as an alternative to the Glacier Hills Wind Park. The Ledge Wind Project is a 150 MW wind energy project consisting of approximately 100 wind turbines. Invenergy proposed to construct this project in Brown County, Wisconsin. The project site consists of approximately 13,000 acres, 11,000 acres of which are under long-term easement agreement with landowners. Invenergy would need to obtain a CPCN from the Commission before constructing its project, as would WEPCO for the Glacier Hills project. Invenergy has not yet filed its CPCN application with the Commission.

### 1.3.9 Project review going forward

The PSC will hold a public hearing in the project area at least 30 days after the final EIS is issued. A Notice of Hearing specifying the time, date, and location of the hearing will be sent to the entire project mailing list which includes area residents, municipal clerks, media and other interested parties.

The Notice of Hearing will also explain a format for submitting written testimony instead of appearing at the hearing.  Members of the public are encouraged to testify orally or in writing.  All testimony will become part of the hearing record on which the Commissioners base their final decisions about the project.

Before the hearing, the Commissioners do not discuss the issues of the proposed project with each other or any of the parties to the case.  After the hearing, the three Commissioners will independently review the hearing transcripts and exhibits.  The Commissioners will then meet to make a decision to approve, modify, or reject the proposed project based on information presented at the hearing.  That meeting will be open to public observation.  If the project is approved, the Commission will approve or modify WEPCO's proposal and add any conditions it determines necessary to include in the construction order.  After the Commission's decision is made, an order to the applicants will be prepared and issued.

CHAPTER

2

# 2. Engineering

## 2.1. TECHNICAL DESCRIPTION OF FACILITIES

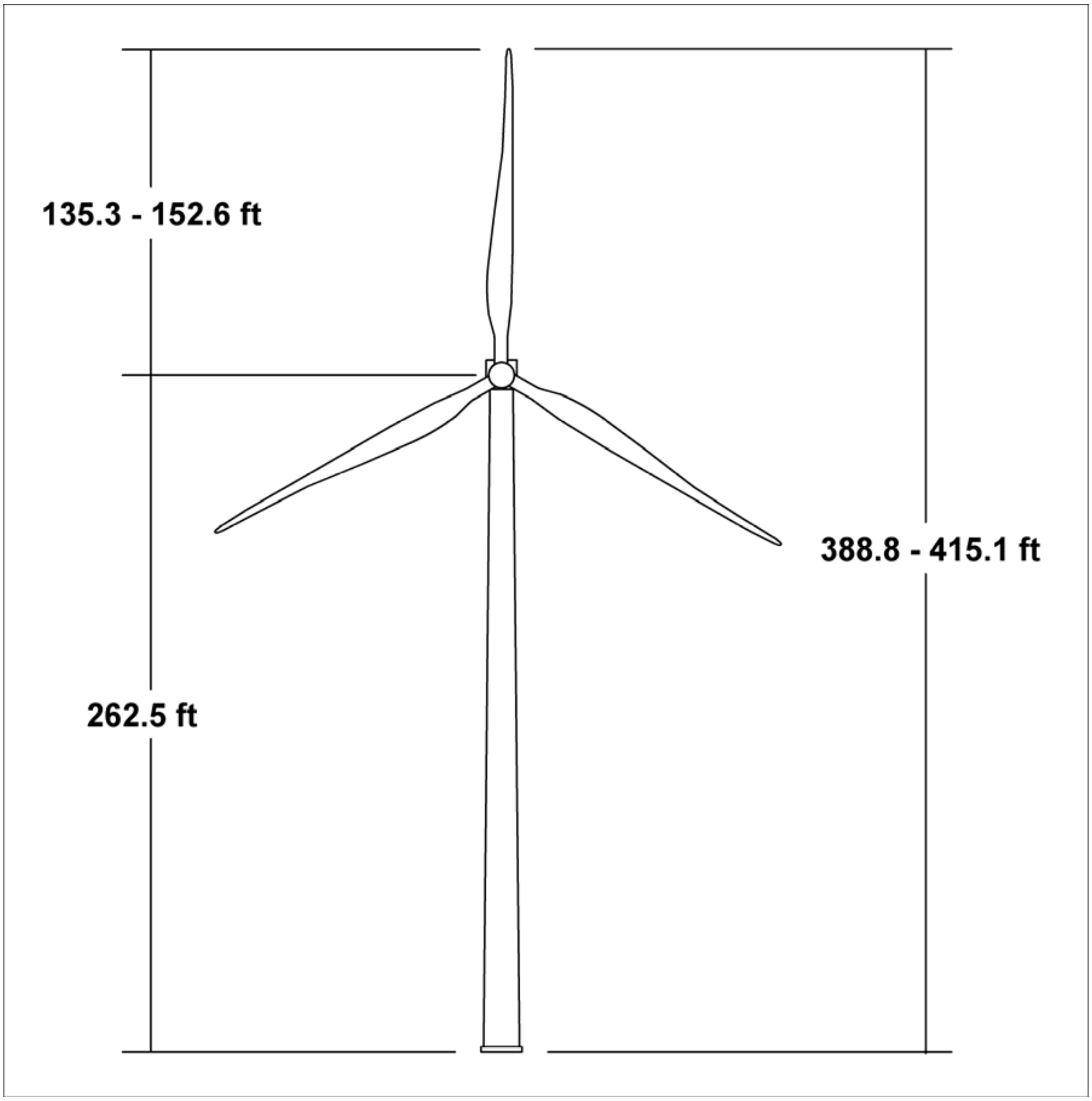
### 2.1.1. Wind turbines

The wind turbine models proposed for this project include structures manufactured by Vestas, Gamesa, General Electric, and Siemens. On May 26, 2009, WEPCO entered into an agreement with Vestas; however, WEPCO is requesting the flexibility to construct Glacier Hills with any of the turbines models listed in Table 2.1-1. Table 2.1-1 compares the technical characteristic of the turbines under consideration. The possible turbines have rated capacities that range from 1.5 to 2.3 MW. The total height of the wind turbines ranges from 389 to 415 feet. Figure 2.1-1 is a diagram of a typical wind turbine. All seven of the potential wind turbine models share a similar design. They are horizontal-axis, three-bladed turbines mounted on tubular steel towers. They all have full-span pitch control of the blades, three-stage gearboxes, three-phase generators, and hydraulic brake systems for use as a backup to the primary brake of feathering the blades out of the wind. Blade lengths range from 126 to 152 feet with an operational rotational speed of between six and 19 revolutions per minute (rpm).

#### 2.1.1.1. Turbine tower

Each wind turbine nacelle would be mounted on a 262.5-foot tubular, steel plate tower. The towers are manufactured and shipped in four sections. A lockable maintenance door is located at the base of each wind turbine tower. Access to the nacelle and turbine components is via a ladder with a fall arresting safety system on the inside of the tower. The outer portion of the tower is smooth and does not have any components or systems attached to it.

Figure 2.1-1 Diagram of typical wind turbine




### 2.1.1.2. Nacelle

The nacelle is the part of the wind turbine that sits on top of the tower and encloses the operating components of the wind turbine. The components include a gear box, low- and high-speed shafts, generator, controller, pitch system, brakes, and yaw system. A cutaway diagram showing the major components within a typical nacelle is included in Figure 2.1-2.

Figure 2.1-2 Nacelle cutaway (courtesy of Vestas Wind Systems A/S)

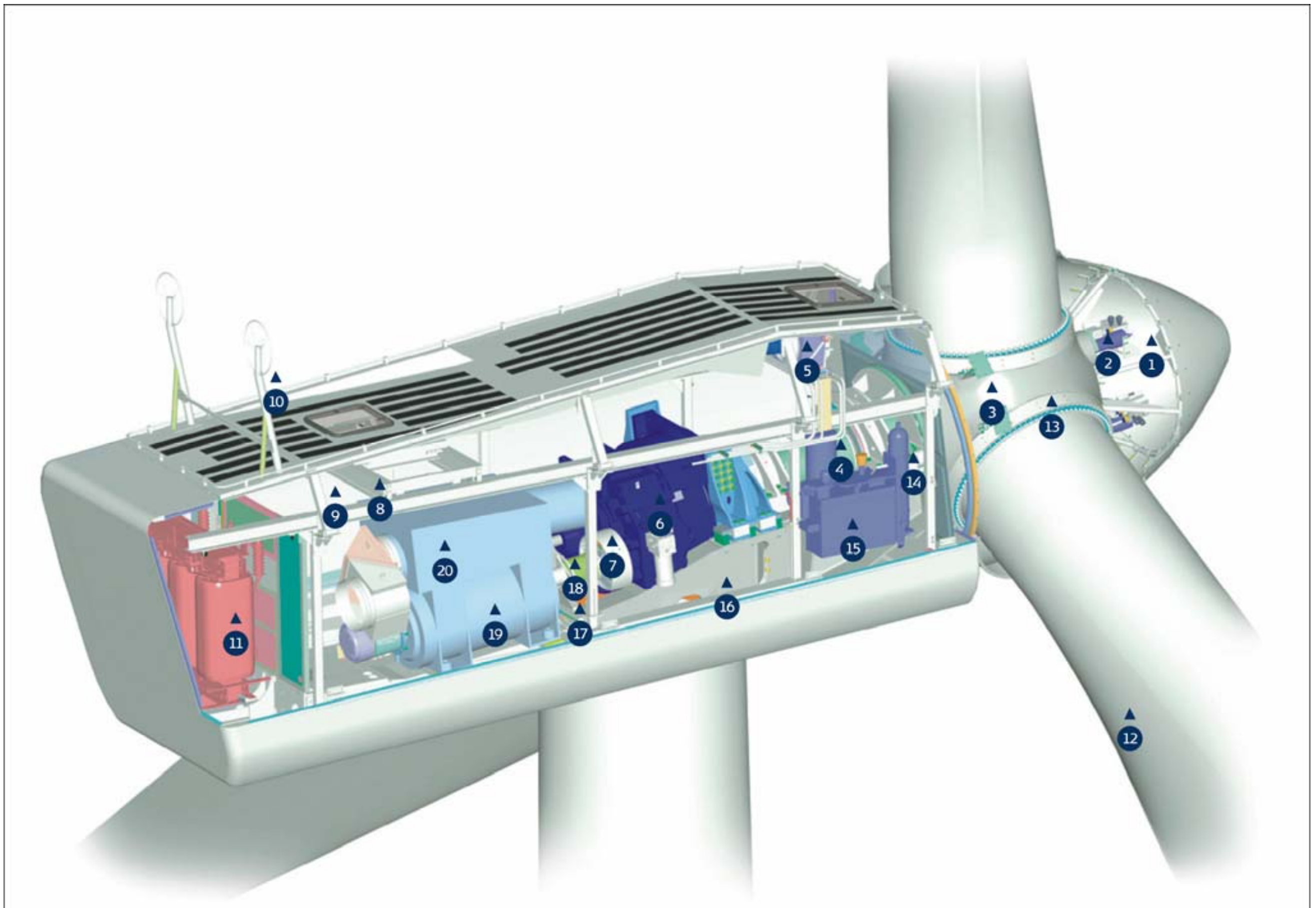



Table 2.1-1 Technical characteristics of turbine models

| Manufacturer | Gamesa | Gamesa | General Electric | General Electric | Siemens | Vestas | Vestas |
|---|---|---|---|---|---|---|---|
| Model | G87 | G90 | 1.5sle | 1.5xle | S2.3 | V90 | V82 |
| Rated capacity (MW) | 2.0 | 2.0 | 1.5 | 1.5 | 2.3 | 1.8 | 1.65 |
| Hub height (feet) | 262.5 | 262.5 | 262.5 | 262.5 | 262.5 | 262.5 | 262.5 |
| Blade length (feet) | 142.7 | 147.6 | 126.3 | 135.3 | 152.6 | 147.6 | 134.5 |
| Total Height (feet) | 402.8 | 410.1 | 388.8 | 397.8 | 415.1 | 410.1 | 397.0 |
| Swept Area (square feet) | 63,994 | 68,479 | 50,127 | 57,543 | 73,194 | 68,479 | 56,844 |
| Cut in wind speed (mph) | 8.9 | 6.7 | 7.8 | 7.8 | 8.9 | 7.8 | 7.8 |
| Cut out wind speed (mph) | 55.9 | 44.7 | 55.9 | 44.7 | 55.9 | 55.9 | 44.7 |
| Operational (rpm) | 9.0-19.0 | 9.0-19.0 | 10.1-18.7 | 10.1-18.7 | 6.0-16.0 | 9.0-14.5 | 14.4 |
| Rated wind speed (mph) | 29.0-31.3 | 31.3 | 31.3 | | 29.0-31.3 | 26.8 | |

#### 2.1.1.3. Gearbox

The gearbox converts the slow speed of rotation of the blades into the high speed rotation of the generator. For example, this conversion could be performed at a ratio of 1:100, which means that if the blades are rotating at a speed of 15 rpm, the generator would rotate at 1,500 rpm (depending on the type of turbine). Through this process, the generator converts mechanical energy into electrical energy. In order to reduce vibration and noise, the gearbox is attached to the nacelle bedplate with elastomeric elements.

#### 2.1.1.4. Generator

The wind turbines use an induction generator with wound rotor and slip rings. A variable frequency power converter, tied to the generator rotor, allows the generator to operate at a wide range of rotation rates. The generator is cooled by an air-to-air heat exchanger. Built-in temperature sensors signal the controller when to shut the generator down in case of overheating or prevent it from starting when the temperature is too low. Like the gearbox, the generator is isolated from the bedplate by elastomeric material to reduce vibration and noise.

#### 2.1.1.5. Transformer

Step-up transformers are located either in the nacelle or on a pad located at the base of the tower. The advantage of locating the transformer on the nacelle is that the transformer's weight can provide additional counter-balance for the nacelle. Transformers located on the ground are approximately six feet tall and attached to a pad that would be eight by nine feet. The transformer is likely to be rated in the range of 1,700 to 2,500 kilovolt amperes (kVA).

#### 2.1.1.6. Pitch system

The pitch system located within the hub adjusts the angle of the blades to maximize efficiency. Full blade pitch angle range is approximately 90 degrees, with the zero degree position being with the airfoil chord line flat to the prevailing wind. The blades, pitched to a full feather pitch angle of approximately 90 degrees, accomplish aerodynamic braking of the rotor. This causes the blades to "spill" the wind, thus limiting rotor speed.

Under partial load, the blade pitch angle is held constant and the rotor speed is controlled by the generator/converter control system. Once the rated wind speed is reached, the rotor blades operate in a "servo" mode, where turbine power output and rotor speed are controlled by varying the blade pitch angle in combination with the generator/torque converter/speed control system.

When wind speeds are above those rated for the turbine model, the blades would be pitched to feather (non-power). They would be allowed to rotate freely in this condition at very low rpm (less than 3 rpm). The generator would still be physically connected but would be off-line. This combination would result in the least stress to the system. When an emergency stop is necessary, such as if the connection to the electric grid is lost, the turbine blades will pitch to spill wind and reduce the rate of rotation of the blades. This brake mechanism would also be used when the machinery is being serviced.

#### 2.1.1.7. Yaw system

The yaw system consists of four yaw drives that turn the nacelle on top of the tower. The system automatically averages wind direction signals from a wind direction sensor mounted on top of the nacelle. Based on the input, the yaw system rotates the nacelle, hub, and blades into the direction of the wind. The yaw system includes brakes that can lock the turbine out of the wind when necessary.

#### 2.1.1.8. Control system

The wind turbine can be controlled automatically or manually from inside the nacelle or from a personal computer located in a control box at the bottom of the tower. It can also be controlled remotely using a SCADA System.

### 2.1.2. Turbine spacing

A wind turbine creates a wake in which the wind moves at a slower velocity and turbulence exists behind the turbine for a certain distance. This wake can impact the capacity of a downwind turbine to capture the best available wind velocity and produce the maximum amount of electricity. The wind turbines are, therefore, spaced far enough apart to minimize the wake that is experienced by the downwind turbines, considering the predominant wind directions. The wind turbines associated with the project would typically be sited approximately 1,200 to 2,000 feet apart.

### 2.1.3. Foundations

The foundation supports the entire wind turbine assembly. Foundations are constructed by excavating a hole; placing reinforcing steel, tower mounting system (anchor bolt cage) and concrete forms; and pouring concrete into the excavation. Some foundations are deep and relatively slender (pier foundation) while others are broad and relatively shallow (spread footing foundation).

Based on the site-specific soil and geotechnical conditions at each turbine site, the foundation would either be a pier foundation or spread footing foundation. Pier foundations are typically 25 by 25 feet in size and extend down to a depth of 30 feet. Typical spread footing foundations have an octagonal shape that spreads out to a diameter of approximately 50 to 55 feet with a depth of 8 feet below grade. Figures 2.1-3 and 2.1-4 provide diagrams of typical pier foundations and spread footing foundations, respectively.

Figure 2.1-3 Diagram of a typical pier foundation

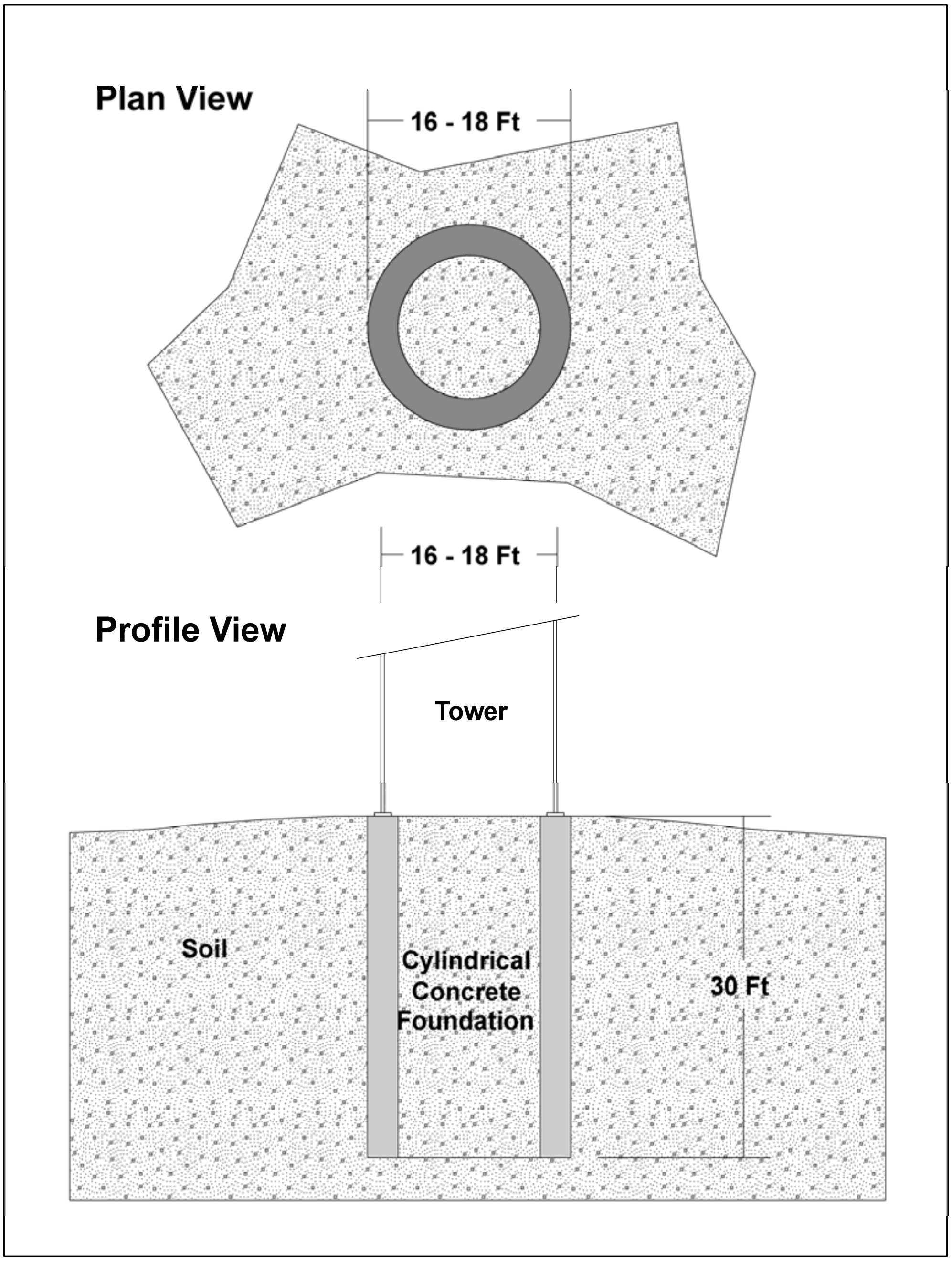
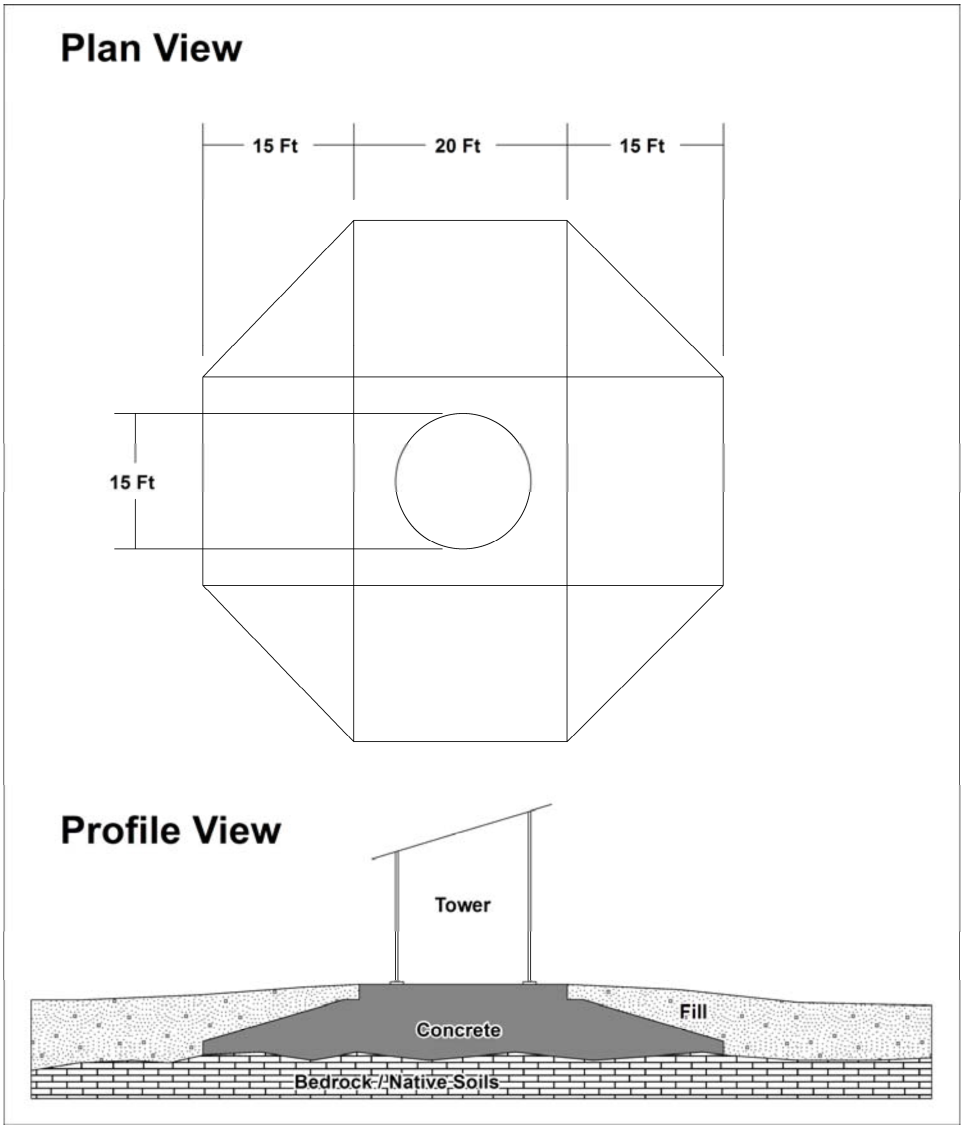


Figure 2.1-4 Diagram of a typical spread footing foundation




### 2.1.4. Underground/overhead collector system

Turbine generators produce three-phase electricity between 600 to 1,000 volts. At each turbine, a step-up transformer increases the voltage to the 34.5 kV used in the collector system circuits. Collector circuits originate at the turbines and connect at the substation which is interconnected to an existing transmission line. For this project, the substation would connect to the 138 kV line (X-6) that traverses the project area.

Underground collector systems would use jacketed, concentric neutral, aluminum conductors. Main branch circuits from the substation utilize 1000 MCM cable. As the cables are spliced for branches to turbine sub-circuits, the conductor sizes would be reduced to 500 MCM, 4/0 and 1/0 cable, depending on the ampacity requirements of the circuit branch. The typical collector circuit has between eight and 14 turbines connected. A fiber optic line would also be installed with each circuit to provide for SCADA and communications.

WEPCO originally proposed both overhead and underground collector circuits. In subsequent filings, WEPCO revised the application and all overhead circuits were replaced with underground circuits. The proposed collector circuits at Glacial Hills would be constructed underground. For greater detail on the potential environmental impacts of the construction of the collector system, see Chapter 4.

### 2.1.5. Substation and interconnection to the transmission grid

WEPCO is currently proposing to build a new substation on a site located on the west side of CTH H, adjacent to a 138 kV line owned by ATC in the town of Scott. This existing 138 kV transmission line runs between the North Randolph and Portage Substations. WEPCO would buy 20 acres of farmland adjacent to the north side of the existing 138 kV line. The substation would ultimately occupy 10 acres, including 60 feet of transmission line ROW to connect the substation to the existing transmission line. During construction, the entire 20-acre site would be used. WEPCO's proposed substation layout allows for future expansion.

The substation would include facilities owned by WEPCO and by ATC. Pending Commission approval of WEPCO's proposed wind farm, ATC's portion of the substation is scheduled to be in service on October 1, 2010. WEPCO and ATC would likely enter into a Generation Interconnection Agreement in 2009.

The Midwest Independent Transmission System Operator Inc. (MISO) has completed studies of the effect of WEPCO's proposed Glacier Hills project generation on the existing electric transmission system. To accommodate the proposed injection of power (at 20 percent capacity for on-peak demand hours and 100 percent for off-peak demand hours), several area lines would need new conductors and increased clearances, which could involve replacement of structures. Some area substations would also need improvements. These improvements are estimated to cost about $13 million. Some could require Commission approval. ATC's estimated timeline for completing these projects is 2015. The transmission system improvements identified in the MISO study are listed below.

- Rebuild ATC's 138 kV line from North Randolph Substation to Friesland Substation tap using larger conductor and new poles;
- Increase the 138 kV line clearances from Glacier Hills to Hamilton Street Substation tap;
- Replace circuit breakers at North Randolph Substation and a circuit switcher at Portage Substation;
- Construct a three-position ring bus at Glacier Hills.

These improvements assume FPL's original request for a 99 MW wind farm, an additional 150 MW for WEPCO's project, and an Iberdrola wind farm of 80 MW.

The latest system impact study determined that, with the addition of 99 MW and 150 MW from Glacier Hills and 80 MW from Iberdrola, the transmission system would be unable to perform as described in NERC requirements until the transmission system improvements listed above are completed. Until that time, ATC proposes a temporary Special Protection System (SPS). The SPS would curtail generation output from the wind farm down to 99 MW when loadings on certain transmission facilities exceeds pre-determined values. This solution would allow Glacier Hills to generate close to its maximum output for a majority of the time. The SPS would not require additional transmission facilities and instead would function using metering and telecommunications systems. The SPS would not be needed after the transmission upgrades are completed.

A diagram showing the project area and the existing transmission system is included in Figure Vol. 2-3.

## 2.2. PROPOSED CONSTRUCTION ACTIVITIES

### 2.2.1. Road construction and clearing

One of the first steps in the construction process would be site clearing and building gravel access roads to connect each turbine site to existing town and county roads. The width of the gravel access roads would be approximately 16 feet for the primary travel path, but may need to be as wide as 50 feet during the construction phase, to allow for passage of the large cranes needed to erect the turbines. All access roads would be restored to the 16-foot width after construction is completed. For the 90 preferred sites, approximately 20 miles of access roads would be needed. Access road construction begins by removing the organic materials from the site. These materials are then stockpiled for later use. The access roads would be finished with 8 to 12 inches of compacted aggregate road material on top of a poly geofabric material.

### 2.2.2. Crane paths

The cranes needed to assemble the wind turbines cannot use public roads, so they would use access roads constructed between turbine sites or travel cross-country. Crane paths would be cleared to a nominal width of 50 feet. After clearing, top soil and all unsuitable soils are removed, the path is graded so that drainage is directed away from the path, and the path is compacted. The crane path is checked to verify that it has a ground bearing capacity of at least 4,500 pounds per square foot. Because cranes cannot traverse a slope greater than 12 percent, temporary ramps may have to be built for any public road crossings or at other barriers. Crane paths that cross wetlands or waterways would meet DNR permit conditions and BMPs to avoid impacts to the resource. After construction, all crane paths would be restored to original condition and original use.

### 2.2.3. Foundation installation

The turbine foundation would be designed based on site-specific soil and geotechnical conditions. Based on the conditions at each site, the foundation would either be a pier foundation or a spread footing foundation.

### 2.2.4. Tower and turbine installation

Each turbine site would typically have a laydown area and crane pad area to facilitate construction. The laydown area is used for temporary storage and assembly of the wind turbine components, including the nacelle, hub, three blades, and the four tower sections. Additionally, the laydown area needs to be of sufficient size to allow for maneuvering and parking of construction vehicles. During construction, a clear area of about 1.6 acres (150-foot radius from the tower) would be established. The crane pad is a compacted area within the laydown area of approximately 55 to 85 feet where the crane would rest while lifting the turbine tower sections, the nacelle, blades and other equipment needed to assemble the wind turbine. Compaction of the crane pad is necessary so that settling does not cause the crane to become unstable. The laydown areas, excluding the crane pad, would be restored to their original condition upon completion of construction. The exact dimensions of the laydown and crane pad areas would be finalized as part of the final engineering of the project.

Three types of lattice boom crawler cranes are used in the construction and assembly of the wind turbines. The primary lift lattice boom crawler cranes used to erect the upper tower sections and to lift the heavy main wind turbine generator components to the top of the tower would have a minimum rated capacity of 400 tons. A second type of lattice boom crawler crane with a rated capacity of 200 to 300 tons would be used for base tower and mid-tower section installation. The third type of lattice boom crawler crane used for rotor assembly has a rated capacity of 100 to 200 tons. Solid boom rough terrain hydraulic cranes are used for unloading turbine equipment and assisting the primary lift crane. They are also used to support construction of turbine foundations, unloading, and placing and assembling components. These cranes have a rated capacity of 60 to 75 tons.

Below is a description of a typical construction sequence after the crane pad has been prepared, the foundation has been set, and the concrete has cured.

#### 2.2.4.1. Off-loading

The turbine components would be off-loaded from the delivery vehicles with a smaller crane and staged near the foundation in locations of appropriate proximity for the primary lift crane to be able to make the reach to pick up and set the components in place. The smaller crane would off-load the hub and blades, and would assemble the blades to the hub to complete the hub and three-blade assembly. Off-loading could take one to three days depending on the frequency of component delivery.

#### 2.2.4.2. Tower base

The components to be located in the base of the tower may consist of the controller cabinet, switchgear, and FAA lighting panel. These components would be set on the foundation. The base tower section would then be set over these components on the anchor bolts of the foundation. Setting the base tower section involves setting the shim packs and leveling the tower section prior to tightening the anchor bolts and grouting the tower section to the foundation. The grout typically requires a 24- to 48-hour cure period prior to installing the remaining components. Setting the tower base could take one to two days to complete.

#### 2.2.4.3. Turbine installation

The remaining erection sequence would begin once the primary crane arrived on the site, and could take one to two days to install the remaining components. The primary lift crane would set the second, third, and fourth sections of the tower. The nacelle would then be set on top of the tower. Once the nacelle is set, the hub and blade assembly would be lifted and secured in place. Upon completing the installation, the primary lift crane would move to the next turbine location.

Once the turbine is installed, the remaining work is internal to the tower and nacelle. It includes completing all electrical and mechanical connections. This is typically followed by an electrical and mechanical systems checkout.

### 2.2.5. Connection to underground collection systems

The next phase of construction would be installation of the underground electric collection system cables and communication lines to interconnect all the turbine generators to the substation and operations building. These lines would be installed in one continuous operation using a trenching machine. Once all systems were interconnected, each turbine would be started up and tested.

### 2.2.6. Restoration of all disturbed lands

The final construction phase would be reclamation and decompaction of all the land under temporary roads and laydown areas. All areas not needed for future operations would be restored to original use.

# 2.3. PLANT OPERATING CHARACTERISTICS

## 2.3.1. Plant operating schedule

The proposed wind generating facilities would operate whenever wind velocities are within the operating range of the turbines. Generally, the turbines require a minimum wind speed of about eight mph to begin generating electricity. If wind speeds exceed 45 to 56 mph, depending on the turbine model, the turbines utilize a blade pitch system to cut out of operation. The blade pitch system would reduce the amount of wind that the blade catches by rotating the blades at their base, thereby stopping the turbine from operating.

## 2.3.2. Plant capacity factor

Annual capacity factor for electric generating plants is calculated by dividing the actual energy produced by the facility by the total possible energy produced per year. Annual capacity factors for wind generating facilities in the Midwest range from approximately 25 to approximately 40 percent. The plant would not generate at rated capacity all of the time because wind velocities are not always sufficient to do so. Also, there would be some production time lost when the units are taken out of service for maintenance.

A map showing the wind resource in Wisconsin and the locations of the Glacier Hills project and other wind developments in the state is included in Figure Vol. 2-6. A map of the wind resource in the U.S. can be viewed at the National Renewable Energy Laboratory (NREL) website at http://www.windpoweringamerica.gov/pdfs/wind_maps/us_windmap.pdf. Note that Figure Vol. 2-6 is prepared using 70-meter data, while the NREL map is prepared using 50-meter data. The 70-meter data is used for the Wisconsin map because it more closely approximates the wind resource at the 80-meter hub height of utility-scale wind turbines, similar those proposed for this project. Wind project developments in areas with higher wind power classifications would be expected to have higher capacity factors.

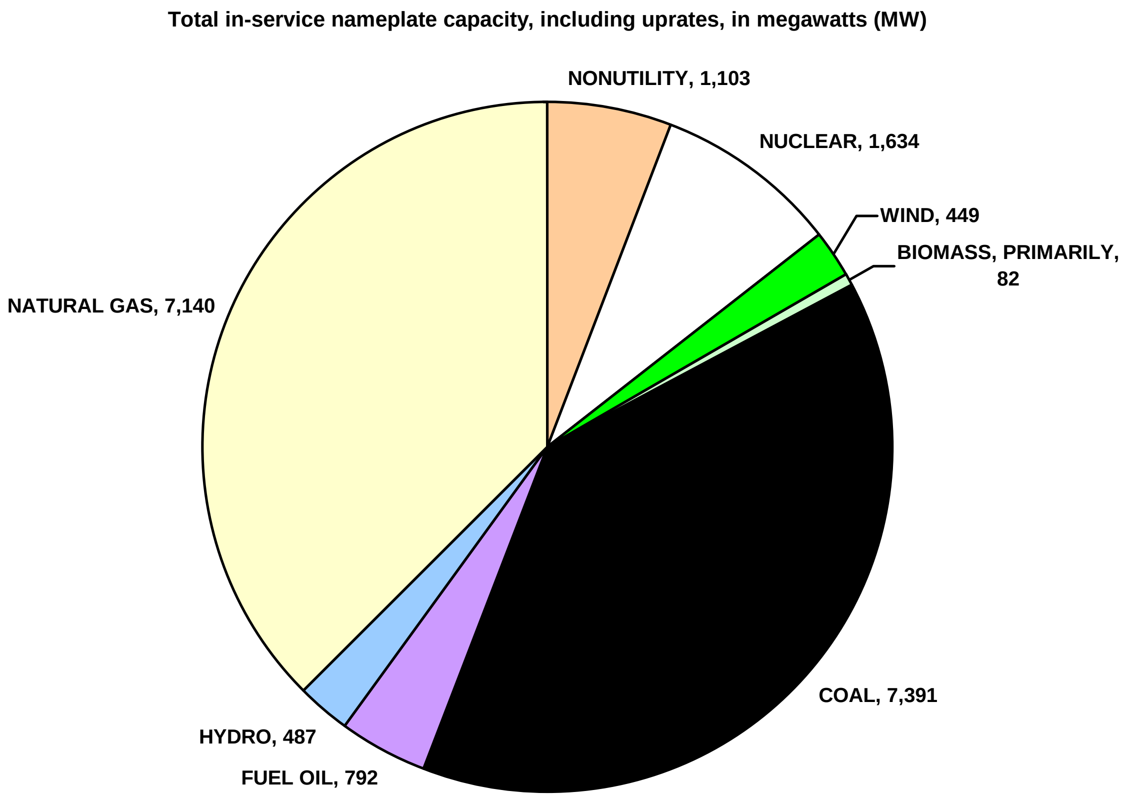
As described in Section 3.5, the anticipated energy production from the proposed project, which is a function of capacity factor, was used in evaluating the economics of the project. This anticipated energy production was calculated using actual wind speed data collected at five meteorological towers located at the project site. The towers were installed during 2003 and 2004, and data on the wind resource in the project area has been collected since they were installed.

## 2.3.3. Possible energy produced and existing Wisconsin generating capacity

The name plate generating capacity of the proposed project is in the range of 135 to 207 MW, which is the product of 90 turbines multiplied by the specific turbine rating. If the turbines generate at rated capacity for an entire month, they would produce approximately 97,200,000 to 149,040,000 kWh. However, if the plant operates at a capacity factor of 25 percent, the facility would produce approximately 24,300,000 to 37,260,000 kWh during the month.

During periods when the proposed wind facilities are not generating, the demand for electricity would be met by power produced by using other fuels. The existing in-service electric generating capacity located in Wisconsin is shown by fuel in Figure 2.3-1. The generating capacity shown as non-utility is owned by entities such as paper mills and other businesses, and includes plants using many different fuels. The non-utility capacity is shown separately because the power generated by those non-utility power plants would be needed if they did not exist, and would likely be produced by utility-owned generation.

Figure 2.3-1 Wisconsin in-service generating capacity by fuel, known capacity owned by utilities, cooperatives, merchants and non-utilities




## 2.4. PROPOSED CONSTRUCTION SCHEDULE

Typically, construction of a single turbine foundation can take approximately two to three days. When the foundation is completed, erection of the turbine can be expected to take four to five days. Depending upon the construction sequence at the project area, delivery of equipment and materials, and contractor preference, there could be a time lag between foundation completion and turbine assembly. Table 2.4-1 is WEPCO's estimate of the typical time needed for different construction activities at each turbine site and over the entire construction period.

Table 2.4-1 Typical length of construction activity

| Construction Activity | Days at a Site | Total Days for the Project |
|---|---|---|
| Access road construction | 1-2 | 135 |
| Collector cable installation | NA | 135 |
| Foundation and crane pad construction | 2-3 | 135 |
| Tower and turbine installation | 4-5 | 135 |
| Tower wiring | 3-5 | 120 |
| Turbine site restoration | 2 | 120 |

The schedule submitted by WEPCO has a proposed in-service date for this project in late 2011. Construction may begin as early as the second quarter of 2010. The time required for turbine manufacture and delivery would take almost 18 months. During the first six months of this period, ATC would begin work on the substation site, and WEPCO would refine the site design, execute construction contracts, and complete lease agreements. Construction of the turbines and WEPCO's portion of the substation would take about 18 months, with the last 6 months involving turbine delivery, set-up, and wiring. The first 12 months would involve preparing the construction staging areas, installing erosion controls, building access roads and crane paths, installing the collector system, and constructing the turbine foundations and crane pads at each site.

## 2.5. EASEMENT AGREEMENTS WITH LANDOWNERS

### 2.5.1. The basic easement agreement

To build and operate the wind turbines and related facilities on private land, WEPCO must obtain easements from the landowners. Long-term easements are needed for the land used by wind turbines, access roads, and collector circuits. Temporary easements are needed for crane paths, construction areas (such as widening access roads and turbine sites), and construction laydown areas for storing equipment and supplies. WEPCO has obtained easements from willing landowners that would allow construction and operation of turbines at all proposed and alternate sites. However, WEPCO may need or desire additional easements if the project design changes for any reason. WEPCO has stated that it intends to obtain any additional easements, if needed, from willing landowners. However, WEPCO could use the power of eminent domain if it is granted a CPCN by the Commission. WEPCO plans to buy land for the long-term uses of the O&M building and for the interconnection substation.

### 2.5.2. Payments to landowners

There are three documents that constitute "turbine site leases": a Wind Farm Easement Agreement (Agreement), a First Amendment to Wind Farm Easement Agreement (Amendment), and an Option Notice Letter (Letter). In addition to these overarching agreements, there is a specific Utility Easement Agreement solely addressing the collector system.

The Agreement is an option to acquire easements for the construction, operation, maintenance, and decommissioning of wind turbines and associated facilities. The Amendment extends the option's term. The option was exercised *via* the Letter, mailed to property owners between April and September 2007.

Having exercised the option, WEPCO possesses certain easement rights over the owner's property. The initial term of the easement commenced on the date specified in the Letter and ends 20 years after the date all wind turbines and improvements have been constructed and the wind project becomes commercially operational. The term may be extended two additional five-year successive periods, creating a 30-year easement term. Annual payments for wind turbines and compensation for other varied uses are provided to property owners. Costs associated with the Agreement are included in the cost estimates for this wind project.

Additionally, WEPCO has offered property owners an optional amendment, which includes an extension of the renewal terms by ten years and starts easement payments at the start of construction rather than the date of commercial operation. The property owners are not obligated to sign this optional amendment.

### 2.5.3. Taxes

Because the agreement is for an easement and not a fee simple purchase, the owner of the land would continue to pay taxes on the land as he or she did before the project. The company would pay the taxes or any other governmental charges or assessments that resulted from the turbines' presence or operation.

### 2.5.4. Impact mitigation

There are provisions in the easement agreement for WEPCO to reduce impacts or compensate the landowner for certain adverse impacts that might occur during construction or operation. WEPCO agrees to protect the landowner against liability for physical damage to property or injury to people resulting from wind facility construction or operation. Provisions in the easement agreements protect both the landowner and the company from potential hazardous materials violations that might occur. There are also provisions that protect the landowner from financial or regulatory problems that WEPCO might encounter. The easement protects WEPCO from direct or indirect interference by the landowner, as it exercises its rights to construct and operate the wind turbines. The key agreements, in this respect, are that the landowner would control the land and have a right to protect it, while WEPCO would have the right to construct, operate, maintain, repair, and protect its facilities.

The draft JDA between WEPCO and the towns of Randolph and Scott require WEPCO to operate and maintain the project consistent with "Good Utility Practice." This requires WEPCO to keep the wind towers and associated facilities in good repair and operating condition.

### 2.5.5. Removal of the facilities

The design life for the project is 30 years. WEPCO believes that a 30-year operational life can be reasonably achieved provided the turbines receive adequate maintenance. At the end or termination of the easement agreement, WEPCO would be responsible for removal of turbines and towers from the property and the removal of the concrete foundations to a depth of four feet below grade. WEPCO would be responsible for restoring the property to a condition reasonably similar to its original condition, including soil erosion control and crop yield restoration, if appropriate.

A general sequence of removal of a single turbine would include the following steps:

1. Decommission the turbine;
2. Disconnect electrical and mechanical systems;
3. Disconnect electric cable from the generator in the nacelle and the switchgear at the base;
4. Disconnect and lower the three blades;
5. Remove the nacelle and hub from the top of the tower;
6. Disassemble the tower sections;
7. Remove the equipment from the base of the tower;
8. Remove the base tower section, including grouting and anchor bolts;
9. Remove the concrete foundation;
10. Excavate the turbine foundation;
11. Clear the turbine area and restore it to a condition reasonably similar to the original condition.

Other features such as the O&M building may remain and be used for other purposes. Underground cables are left in place after being cut off well below grade. Access roads may be left intact at the landowner's request.

Removed turbine parts may be reconditioned and sold into the used wind turbine market, sold for scrap, or disposed of. If a secondary market for the used equipment is not available, it would be typical for the tower, frame, bearings, gearbox, and generator to be recycled as scrap metal and the fiberglass components such as blades and the nacelle cover to be cut down in size and hauled to a landfill.

Additional specifics for facility dismantling, removal, and site restoration are included in the draft JDA.

CHAPTER

3

# 3. Need, Alternatives, Project Cost, and Economics

Wisconsin statutes require the Commission to consider alternatives to the proposed project and to base its decisions on meeting energy demands for the state on a set of energy priorities listed in the statutes. Wis. Stat. § 1.11, WEPA, and Wis. Stat. § 196.491, commonly referred to as the Power Plant Siting Act, mandate an evaluation of alternatives to the proposed action, including a no action alternative. Wis. Stat. § 1.12 contains the energy priorities for the state of Wisconsin and Wis. Stat. § 196.378 contains the RPS requirements for Wisconsin electric utilities. This chapter provides a detailed discussion of Commission staff's analyses of the need for and reasonable alternatives to the project and how the proposed power plant technologies relate to the state's energy priorities and RPS requirements.

## 3.1. PROJECT NEED

Based on the Electric Generation Expansion and Analysis (EGEAS) modeling submitted by WEPCO, no additional capacity or energy is necessary to meet its projected demands or provide planning reserve margin until 2017 at the earliest.

However, in March 2006, Wisconsin revised its requirements for renewable energy generation under Wis. Stat. § 196.378 (Act 141). The Wisconsin renewable energy generation requirement is referred to as the RPS. For each "electric provider," which includes an electric utility such as WEPCO, Wis. Stat. § 196.378 defines "baseline renewable percentage" as the average of the energy provider's renewable energy percentage for 2001, 2002, and 2003. According to WEPCO's application, its baseline renewable percentage is 2.27 percent. Wis. Stat. § 196.378 provides that for the years 2006, 2007, 2008, and 2009, each energy provider may not decrease its renewable energy percentage below its baseline renewable percentage. Wis. Stat. § 196.378 further provides that by the year 2010, each electric provider must increase its renewable energy percentage so that it is at least 2 percentage points above the provider's baseline renewable percentage. For WEPCO, the renewable energy percentage required for 2010 is 4.27 percent. Additionally, Wis. Stat. § 196.378 states that by the year 2015, each electric provider must increase its renewable energy percentage at least 6 percentage points above the provider's baseline renewable percentage. For WEPCO, the renewable energy percentage required by 2015 is 8.27 percent. To meet the RPS, a phased approach is required to either purchase or construct and operate renewable energy resources.

Under Wis. Stat. § 196.49(3)(b), at its discretion, the Commission may refuse to authorize a construction project if the project will do any of the following:

- Substantially impair the efficiency of the service of the public utility.
- Provide facilities unreasonably in excess of the probable future requirements.
- When placed in operation, add to the cost of service without proportionately increasing the value or available quantity of service unless the public utility waives consideration by the commission, in the fixation of rates, of such consequent increase of cost of service.

Because of the RPS requirements, WEPCO needs more renewable resource generating facilities. This project is a means of complying with its renewable resource requirements and WEPCO believes that the project meets the criteria specified in Wis. Stat. § 196.49(3)(b).

The Energy Priorities Law establishes the preferred means of meeting Wisconsin's energy demands as listed in Wis. Stat. §§ 1.12 and 196.025(1). The Energy Priorities Law, Wis. Stat. § 1.12, creates the following priorities:

> **1.12 State energy policy.** (4) PRIORITIES. In meeting energy demands, the policy of the state is that, to the extent cost-effective and technically feasible, options be considered based on the following priorities, in the order listed:
> (a) Energy conservation and efficiency.
> (b) Noncombustible renewable energy resources.
> (c) Combustible renewable energy resources.
> (d) Nonrenewable combustible energy resources, in the order listed:
> 1. Natural gas.
> 2. Oil or coal with a sulphur content of less than 1%.
> 3. All other carbon-based fuels.

In addition, Wis. Stat. § 196.025(1) declares, "To the extent cost-effective, technically feasible and environmentally sound, the commission shall implement the priorities under s. 1.12(4) in making all energy-related decisions." Wind, as a noncombustible renewable resource, fits within the second-highest statutory priority.

While all of these statutes are applicable to the project at hand, there are some inconsistencies among them that must be reconciled by the Commission when it makes its final decisions for the Glacier Hills proposal.[4]

## 3.2. PROJECT ALTERNATIVES

### 3.2.1. No action

Taking no action on this application by denying the application would result in no change in the number of power plants in the state. WEPCO would have the same sources of electricity available as it has currently. Further, a no action alternative would not allow WEPCO to meet its RPS requirements.

[4] These statutes are discussed in the Final Decision and Order for dockets 6680-CE-171, 6680-CE-173, 6690-CE-194, and 6630-CE-294.

### 3.2.2. Other renewable resources as an alternative

Wis. Stat. § 196.378(1)(h) defines a renewable resource as a resource that derives electricity from biomass, wind power, solar thermal, photovoltaic (PV), tidal or wave action, or a fuel cell that uses a renewable fuel. As identified in Section 3.1. in this chapter, Wis. Stat. § 1.12(4) creates a priority list of preferred method for meeting future electricity demand. After conservation or energy efficiency, the next two priorities for electrical energy sources are renewable resources:

- Non-combustion renewables (wind, solar, hydro, etc.)
- Combustion renewables (biomass and biogas)

### 3.2.3. Hydroelectric power

Hydroelectric power is the largest source of renewable energy generation in Wisconsin, but it has limited potential for expansion. It is not considered to be a reasonable alternative to the proposed Glacier Hills project. Much of the potential for hydroelectric power is already being realized with existing dams. Hydroelectric power production comes from about 72 utility sites and about 50 privately-owned sites, and production is closely tied to annual rainfall. The total generating capacity of all the dams in Wisconsin is approximately 480 MW. While some upgrades might increase production at existing dams, no new hydroelectric developments are expected to be built in Wisconsin in the foreseeable future. Existing hydroelectric power plants are encouraged to operate with the run of the river, and dams that are not currently producing electricity are being removed to free river flow. A map showing current hydroelectric development in Wisconsin is included in Figure Vol. 2-7.

### 3.2.4. Solar power

PV cells convert sunlight directly into electricity without combustion or combustion emissions. PV panels, consisting of multiple PV cells, can be used in small groups on rooftops or as part of a substantial system for producing large amounts of electrical power. The amount of energy produced by a PV system depends on the amount of sunlight available. The intensity of sunlight varies by season of the year, time of day, and the degree of cloudiness.

Currently, PV generated power is less expensive than conventional power technologies where the load is small or the area is too difficult to serve by electric utilities. The cost of producing electricity with PV systems is 25 to 30 cents/kWh and, like all electrical generation technologies, the cost has increased recently because of demand. However, the greater demand is leading to more solar manufacturing facilities being built. Greater supply, along with continuing technological breakthroughs, may reduce the cost of producing electricity with PV systems. A map showing solar energy potential in the U.S. is included in Figure Vol. 2-9.

### 3.2.5. Biomass

Biomass energy is a combustible renewable energy resource, and is derived from plant materials or residue and biological waste. Combustible gases from landfills or anaerobic digestion of waste material is referred to as biogas.

Solid biomass can be burned like coal to produce steam. It can also be gasified and burned like natural gas. Biomass can include waste wood from construction or demolition projects or from wood product manufacturing. It can also include crops or other plantings, such as switchgrass or willows. Waste wood is the most available source of biomass in Wisconsin today. Waste wood is currently burned in several generating plants in Wisconsin, including plants owned by Northern States Power Company-Wisconsin (NSPW) at LaCrosse and Ashland, to produce steam for both electric energy and industrial processes. Table 3.2-1 shows estimates by Oak Ridge National Laboratory of the availability of different types of biomass fuels in Wisconsin. In addition, a map showing biomass resources available in the U.S. is included in Figure Vol. 2-8.

Table 3.2-1 Annual dry tons per year (8,500 Btu/lb.) available at $50 per ton delivered, based on Oak Ridge National Laboratory study, Biomass Feedstock Availability in the United States: 1999 State Level Analysis

| Biomass Source (8,500 Btu/lb) Capacity Output | Dry Tons Estimated Output |
|---|---|
| Forest residue | 1,138,400 |
| Mill wastes | 192,000 |
| Agricultural residue | 5,179,618 |
| Energy crops | 6,114,270 |
| Urban wastes | 639,110 |
| **Total biomass** | **13,263,398** |

Biomass fuel available in Wisconsin could total over 13 million dry tons annually. Considering the technologies available, this fuel could provide up to 3,028 MW of capacity. With an 85 percent capacity factor, the 3,028 MW would yield 22,547,000 MWh of energy per year.

Several technologies that utilize solid biomass fuels are in use today. There are power plants that burn chipped wood alone and others that co-fire wood products with fossil fuels. There are also numerous smaller plants, in Asia and Europe especially, that gasify biomass for combustion in boilers that can also burn natural gas. NSPW recently (February 2009) applied for authority to build and operate a larger gasifier that would provide fuel for about 22 MW of power at its Bay Front Power Plant in Ashland, Wisconsin. There is also a technology in the pilot-plant stage that involves harvesting and burning the whole above ground portion of trees.

Biogas (a form of biomass), an energy source consisting of methane and other combustible gases, can be used in a conventional engine or gas turbine to turn an electric generator. Biogas can be generated from on-farm anaerobic digestion (AD), landfill gas collection, and wastewater treatment plants. Electrical generation using on-farm digesters is the fastest growing use of biogas in Wisconsin. The primary application of AD is on dairy operations with 500 or more milk cows, but there is a potential for AD at poultry and hog confinement operations, as well as at smaller dairies. In Table 3.2-2, the number of dairy animals in the state is used to estimate potential. This number may overestimate the amount of potential dairy AD, but it could be low because it does not include poultry, hog, or food processing facilities. Landfill gas and wastewater treatment potentials are shown in Table 3.2-2.[5]

Table 3.2-2 Annual biogas potential in Wisconsin

| Biogas Source | Capacity | Estimated Output |
|---|---|---|
| Wastewater treatment plants | 6.65 MW | 52,000 MWh |
| Landfill gas | 27MW | 227,000 MWh |
| On-farm anaerobic digesters | 250 MW* | 1,994,100 MWh** |

* Based on number of dairy animals in Wisconsin.
** Assuming a capacity factor just over 92 percent.

[5] From Advance Plan 7 (AP7), Technical Support Document D21.

These supply options were modeled by WEPCO and Commission staff in their EGEAS analyses.

### 3.2.6. Independent power producer alternatives

As an alternative to the construction of Glacier Hills, WEPCO could rely on electric generation from an independent power producer (IPP) not affiliated with the utility or any of its affiliates. Such an alternative would require an IPP to construct a wholesale merchant power plant or sell electricity from one that is already operating and has available capacity for sale.

This alternative is being evaluated in this docket. On April 16, 2009, Invenergy Wind, LLC (Invenergy) filed testimony in which it offered its proposed 150 MW Ledge Wind project as an alternative to the WEPCO's project. Power from the Ledge Wind project would be delivered to WEPCO under a purchase power agreement (PPA). The Invenergy proposal is being evaluated by Commission staff in its EGEAS analysis.

## 3.3. PROJECT AREA ALTERNATIVES

Wis. Stat. § 196.491(3)(d)3. requires the Commission to consider alternative locations when determining whether a proposed generating plant is in the public interest. Wis. Admin. Code §§ PSC 111.53(1)(e) and (f), which implement this statutory provision, require a CPCN application to describe the siting process, to identify the factors considered in choosing the alternative sites, and to include specific site-related information for each site.

### 3.3.1. Selection of the project area

In determining the location for the proposed project, WEPCO issued a request for proposals (RFP) seeking renewable energy generating facilities with a capacity up to 200 MW to help WEPCO comply with the Act 141 mandate. Thirteen separate proposed projects were received from nine different parties, with each proposed project involving a discrete project area or site. From this list, eight of the 13 projects, all of which were wind farms, were short listed for further evaluation. In addition to these eight wind farm proposals, WEPCO also evaluated two additional possible projects that were already under WEPCO's control: the proposed Glacier Hills project site, and, a possible Blue Sky II wind farm (an expansion of the existing Blue Sky Green Field project). In all, ten separate wind projects located in Iowa, Minnesota, southwestern Wisconsin, southeastern Wisconsin, and in east-central Wisconsin were evaluated.

WEPCO conducted a multi-faceted evaluation of these ten projects and their corresponding sites. According to its application, WEPCO considered the following factors in its evaluation of the ten site alternatives:

- Project location and size;
- Wind capacity;
- Percent of required land under some form of control;
- Transmission interconnection/energy deliverability;
- Potential for expanding the number of turbines that can be constructed within the project area;
- Number of permit approvals and development agreements in hand versus the number yet to be obtained;
- Ease with which the project can be constructed, *i.e.,* local workforce options, proximity to nearest port and transportation infrastructure.

As a result of this evaluation, WEPCO concluded that the Glacier Hills project, located at the proposed site in Columbia County, offered the best opportunity for WEPCO to secure in a timely and economical fashion the next "increment" of wind-powered capacity it needs in order to comply with the Act 141 mandate.

### 3.3.2. Selection of proposed and alternative turbine sites

WEPCO identified possible individual turbine site alternatives considering the following factors and characteristics:

- Landowners willing to host one or more turbines;
- Minimum setbacks (which eliminate areas based on distances to existing land uses such as houses, roads, and property lines);
- Microwave communications (eliminate worst case Fresnel zone areas);
- Airports (eliminate cone of approach areas);
- Natural environment (avoid if possible areas including wetlands, waterways, threatened and endangered species/habitat, historical and archaeological resources, and forested lands);
- Resource preservation, including any lands under the Farmland and Ranch Preservation Program (FRPP), Managed Forest Law (MFL) and the Conservation Reserve Program (CRP);
- Compatibility of FRPP, MFL, and CRP areas with wind farm facilities;
- Wind profile (identify sites with acceptable access to the wind resource and taking into account land contour, elevation, prevailing wind direction, and one turbine's impact on other turbines (wake losses));
- Auxiliary facilities (cable routes, access roads, and crane routes considering least impact to the land; avoidance of wetlands, forests, and structures; minimum distance to the interconnection point; and efficient construction).

The result of the turbine site identification process was the identification of a total of 138 potential turbine sites, including a determination that cable routes and access roads could be constructed for those sites. Through an integrated, iterative, and multi-discipline process, WEPCO sought to optimize the initial turbine layout and define the final project proposal. Given the potential turbine sites, this process sought to:

- maximize the efficiency of the turbine array;
- minimize the actual or potential impact on the natural environment; and
- minimize the impact on residents.

The result of the optimization process is the proposed 90 proposed wind turbine locations and 28 alternative locations, as proposed in WEPCO's application. A map showing the locations of these proposed and alternative locations is included in Figure Vol. 2-1.

## 3.4. PROJECT COST

WEPCO estimates the capital cost of the proposed project, exclusive of an allowance for funds used during construction (AFUDC), to be between \$335.2 million and \$413.5 million depending primarily on the generating capacity of the turbine model selected. The estimate of costs by major plant account is shown in Table 3.4-1.

Table 3.4-1 Estimated project cost (millions)

| Capital | | |
|---|---|---|
| Description | Plant Account | Amount |
| Land and land rights | 340 | $3.3 |
| Structures and improvements | 341 | $8.4 |
| Generators | 344 | $340.0 |
| Accessory electrical equipment | 345 | $47.5 |
| Communication equipment | 397 | $1.2 |
| Allowance | | $13.1 |
| **Subtotal** | | $413.5 |
| AFUDC | | $20.6 |
| **Expense** | | |
| CPCN development costs | 344 | $1.5 |
| **Total Gross Project Cost** | | **$435.6** |

Notes:
1. The cost estimates are expressed in year-of-occurrence dollars.
2. The cost of the project will be met from internal sources and/or from the issuance and sale of securities.
3. Cost estimates are for 90 wind turbines rated at 2.3 MW each, which is the largest wind turbine under consideration. Cost estimates would be reduced accordingly if smaller wind turbines are installed.
4. Cost estimates do not include reimbursable ATC costs.

## 3.5. ECONOMICS - INTEGRATED RESOURCE ANALYSES, EGEAS RESULTS AND SENSITIVITIES

### 3.5.1. Scenarios and assumptions used for the model

Both WEPCO and Commission staff used the industry-accepted EGEAS model to compare a variety of alternatives and scenarios to the proposed Glacier Hills project. The EGEAS model is a modular, production-costing, generation expansion software tool used to find least-cost generation system expansion plans by comparing all combinations of multiple generation options to meet forecasted system load. Inputs into the EGEAS model include forecasted energy and demand, the economic and engineering characteristics of existing and possible new generation units, fuel price forecasts, known or expected energy purchases or sales, desired reserve margin, and the forecasted cost-of-emission allowances.

In addition to the Glacier Hills project, the EGEAS model was allowed to choose from the following types of proxy plants to meet future generation requirements:

- Combustion gas turbines (CT)
- Combined-cycle gas units (CC)
- Coal
- Biomass
- Solar (certain scenarios only)
- Generic wind
- Purchases
- Nuclear (certain scenarios only)

In general, CTs, which are typically used for peak load (running less than 10 percent of the time), have a low capital cost but expensive fuel costs. CC units are used for intermediate load needs (running between

10 and 70 percent of the time) and are cheaper to operate (due to higher unit efficiencies) than CTs, but more expensive to operate than coal-fired or nuclear powered baseload (which run more than 70 percent of the time). Baseload generation (typically coal and nuclear) has high capital costs but lower fuel costs. Dispatchable renewable technologies, such as biomass, currently have high capital costs and fuel costs. The cost of electric generation from non-dispatchable renewable technologies, such as wind and solar, varies depending on the technology and site selection. Currently, it has high capital costs but no fuel costs.

EGEAS modeling matches the required load and durations to the most efficient form of generation. The units with the lower operating fuel cost are usually chosen by EGEAS if available. Since newer units are typically more efficient, EGEAS typically predicts higher capacity factors, given the same fuel, than those for the less efficient older units. The capacity factor and energy production of the wind units modeled in EGEAS are derived from the use of hourly wind curves. The hourly wind curves for the Glacier Hills and Ledge Wind projects are based on actual site data.

### 3.5.2. EGEAS modeling description

WEPCO and Commission staff produced EGEAS modeling for two cases (with and without carbon dioxide ($CO_2$) emissions monetized) and several scenarios.

For the case without $CO_2$ monitized, WEPCO modeled the following scenarios:

1. Optimal base
2. Base with Glacier Hills Wind Park (GHWP) forced in 2012
3. No production tax credit for wind generation
4. Low load forecast optimal
5. Low load forecast with GHWP forced in 2012
6. High load forecast optimal
7. High load forecast with GHWP forced in 2012
8. Low fuel forecast optimal
9. Low fuel forecast with GHWP forced in 2012
10. High fuel forecast optimal
11. High fuel forecast with GHWP forced in 2012
12. 10 percent planning reserve credit for GHWP
13. 20 percent planning reserve credit for GHWP
14. High operating and maintenance cost for GHWP
15. Low operating and maintenance cost for GHWP
16. High GHWP project cost with GHWP forced in 2012
17. RPS compliant

For the $CO_2$ monetization case, WEPCO modeled the following scenarios:

1. Optimal base
2. Base with GHWP not allowed
3. Optimal with nuclear
4. Nuclear with GHWP forced in 2012
5. No RPS
6. RPS compliant

Based on prior Commission decisions that directed Commission staff to include $CO_2$ monetization as a base assumption in its EGEAS modeling, all Commission staff scenarios, except one, are variants of WEPCO's $CO_2$ monetization case scenarios. For the $CO_2$ monetization case scenarios, the only major change made by Commission staff was to allow additional biomass units. The single no $CO_2$ case scenario performed by Commission staff is a variant on WEPCO's RPS-compliant scenario. Commission staff replaced the biomass and solar units used by WEPCO to meet its RPS requirement with a single 200 MW wind facility. This was done to determine if there was a cost premium for solar and biomass versus wind.

As stated above, some of the Commission staff scenarios include the Ledge Wind project as an alternative to Glacier Hills. For scenarios 12, 13, 19, and 20 listed below and shown in Table 3.5.1, Ledge Wind is modeled as offered by Invenergy (proposed PPA begins in 2011 and runs for 20 years). For the other scenarios, Ledge Wind is modeled as noted.

Commission staff performed the following scenarios:

1. RPS compliant-wind only (no $CO_2$)
2. Staff base-optimal (more biomass allowed than WEPCO base)
3. Low $CO_2$ cost-optimal
4. Low $CO_2$ cost-GHWP not allowed
5. Low natural gas cost
6. Low natural gas cost-GHWP not allowed
7. Low $CO_2$ and natural gas cost-optimal
8. Low $CO_2$ and natural gas cost-GHWP not allowed
9. Low load forecast-optimal (forecast from docket 5-UR-104)
10. Low load forecast-GHWP not allowed
11. Ledge Wind-optimal (both Ledge Wind and GHWP offered)
12. Ledge Wind-GHWP not allowed
13. Ledge wind in 2012-optimal
14. Ledge wind in 2012-GHWP not allowed
15. Ledge wind 30-year PPA-optimal
16. Ledge wind 30-year PPA-GHWP not allowed
17. Ledge wind in 2012 with a 30-year PPA-optimal
18. Ledge wind in 2012 with a 30-year PPA-GHWP not allowed
19. Ledge wind with a 10 percent increase in GHWP capital cost-optimal
20. Ledge wind with a 25 percent increase in GHWP O&M cost-optimal

Table 3.5-1 EGEAS results in present value revenue requirement (PVRR) for alternative scenarios (in $ millions)

| $CO_2$ Cost Included | EGEAS Plan Description | PVRR ($ Millions) | Difference from Commission Staff Optimal Base ($ Millions) | Difference from Comparable Optimal Scenario ($ Millions) |
|---|---|---|---|---|
| No | WEPCO RPS compliant | $37,720.7 | | |
| No | RPS compliant-wind only | $37,673.8 | | -$46.9 |
| Yes | WEPCO Base | $47,235.8 | $511.2 | |
| Yes | Commission Staff Base | $46,724.6 | | |
| Yes | Low $CO_2$-opt | $42,825.0 | -$3,899.6 | |
| Yes | Low $CO_2$-GHWP not allowed | $42,835.6 | -$3,889.0 | $10.6 |
| Yes | Low natural gas-opt | $45,636.6 | -$1,088.0 | |
| Yes | Low natural gas- GHWP not allowed | $45,625.8 | -$1,098.8 | -$10.8 |
| Yes | Low $CO_2$ and natural gas-opt | $42,246.2 | -$4,478.4 | |
| Yes | Low $CO_2$ and natural gas- GHWP not allowed | $42,247.1 | -$4,477.5 | $0.9 |
| Yes | Low load-opt | $43,797.8 | -$2,926.8 | |
| Yes | Low load-GHWP not allowed | $43,874.6 | -$2,850.0 | $76.8 |
| Yes | Ledge wind-opt | $46,724.6 | $0 | |
| Yes | Ledge wind- GHWP not allowed | $46,885.4 | $160.8 | $160.8 |
| Yes | Ledge wind 20-year PPA starting in 2012-opt | $46,724.6 | $0 | |
| Yes | Ledge wind 20-year PPA starting in 2012-GHWP not allowed | $46,873.8 | $149.2 | $149.2 |
| Yes | Ledge wind 30-year PPA starting in 2011-opt | $46,680.5 | -$44.1 | |
| Yes | Ledge wind 30-year PPA starting in 2011-GHWP not allowed | $46,674.4 | -$50.2 | $6.1 |
| Yes | Ledge wind 30-year PPA starting in 2012-opt | $46,672.5 | -$52.1 | |
| Yes | Ledge wind 30-year PPA starting in 2012-GHWP not allowed | $46,666.4 | -$58.2 | $6.1 |
| Yes | Ledge wind & 10% increase in GHWP capital cost-opt | $46,767.2 | $42.6 | |
| Yes | Ledge wind & 25% increase in GHWP O&M expense-opt | $46,751.2 | $26.6 | |

### 3.5.3. EGEAS analyses summary

- Replacing the biomass and solar generating facilities with a 200 MW wind plant results in a PVRR savings of approximately $47 million.
- At its currently estimated cost, Glacier Hills is chosen as part of the optimal solution in all $CO_2$ monetization sensitivities modeled by Commission staff.
- In the Ledge Wind-Optimal (20-year PPA beginning in 2011) sensitivity, both Glacier Hills and Ledge Wind are offered, but only Glacier Hills is chosen as part of the optimal plan. Glacier Hills is chosen as part of the optimal plan even under the low load, plus 10 percent capital cost and plus 25 percent O&M sensitivities. When modeled as a 20-year PPA, Ledge Wind is not optimally chosen in any sensitivity.
- Removing Glacier Hills from the options available in the Ledge Wind (as offered) sensitivity and forcing in Ledge Wind in its place results in an additional PVRR cost of approximately $161 million.
- If modeled as a 30-year PPA, Ledge Wind is chosen as part of the optimal plan along with Glacier Hills.
- In the two "GHWP not allowed" sensitivities where Ledge Wind is modeled as a 30-year PPA, it is lower cost than the Ledge Wind-opt (20-year PPA starting in 2011, GHWP only chosen) by approximately $50 to $60 million.

CHAPTER

4

# 4. Natural Environment – Potential Impacts and Mitigation

## 4.1. AIR QUALITY

This section focuses on two aspects of potential air quality impacts:

- The avoidance of air pollution emissions from an operating wind energy plant.
- The potential for air quality impacts during construction.

### 4.1.1. Air emissions avoided by using wind energy

The physical impacts of the Glacier Hills project are expected to be fairly localized. This is in contrast to some impacts of constructing and operating coal or natural gas-fired power plants, which are more regional or possibly global in scale. Air quality impacts, for example, have a very broad area of effect. Adverse air quality impacts would be avoided to the extent that the wind project provides electricity that would otherwise be generated by combustion of fossil fuels.

The proposed wind project would generate electric power from turbines moved by naturally-blowing wind. Coal-fired, oil-fired, or natural gas-fired generators use combustion to drive turbine-generators with either hot air or steam, producing air pollutant emissions that have adverse impacts on health, welfare, and the environment. Liquid and gaseous fuels also can vaporize and escape into the surrounding air. In addition, coal (or other solid fuel) handling requires particulate controls. All of these impact risks would be avoided during operation of the proposed wind project.

The U.S. Environmental Protection Agency (EPA) currently sets National Ambient Air Quality Standards (NAAQS) to regulate the emissions of six “criteria” air pollutants:

- carbon monoxide (CO)
- nitrogen oxide ($NO_2$)
- ozone ($O_3$)
- lead (Pb)
- particulates ($PM_{10}$ and $PM_{2.5}$)
- sulfur dioxide ($SO_2$)

CO, $NO_2$, and $SO_2$ are common products of combustion of fossil fuels, such as coal. Pb was commonly a product of combustion of gasoline in vehicles before its use as a gasoline additive was discontinued.

Particulates can be emitted by combustion, created by chemical processes in the atmosphere after emission and, in coarser forms, distributed as dust stirred up during the construction process. $SO_2$ and nitrogen oxides ($NO_x$) can combine to form fine particulates. They can also combine with moisture in the atmosphere and return to the earth as acid precipitation. $NO_x$ and volatile organic compounds (VOC) can combine in sunlight to form ozone ($O_3$).

In addition, fossil fuel combustion processes emit pollutants classified as "hazardous air pollutants" (HAP) such as inorganic solids (like arsenic), inorganic acid-gases (like hydrochloric acid), organic compounds (like formaldehyde), or metallic compounds (like compounds of mercury). They also emit "greenhouse gases" (GHG), such as $CO_2$, methane, and nitrous oxide, which contribute to global warming and climate change. Methane is also a component of natural gas, which can be released in the course of production, transport, and use of that compound.

With regard to $CO_2$ specifically, based on the EGEAS analyses for this project, the $CO_2$ "savings" from running the base case model with the Glacier Hills project included *versus* without it is approximately 1.1 million tons per year over the 26-year period of 2012 through 2037, or approximately 28 million tons total over this period.

Except for dust due to earth moving and emissions from diesel-powered construction equipment, air pollution emissions would not occur as a result of the wind energy project.

### 4.1.2. Air quality and odor during construction

During project construction, air emissions resulting from site preparation activities could include fugitive dust generated by construction equipment moving over the ground, wind-blown fugitive dust, and fuel combustion emissions of trucks and construction equipment. Particulates would likely constitute the majority of the air emissions during the construction phase. Most of the total suspended particulates would be fugitive dust emissions from grading activities and from excavation, hauling, loading, and dumping of soil or rock material. Minor emissions of $SO_2$, $NO_x$, and CO would come from mobile equipment exhausts.

Dust from construction activities and truck traffic can be controlled using standard construction practices like watering of exposed surfaces, covering of disturbed areas, or reduced speed limits on the site.

Dust and combustion emissions during the construction phase would be generally limited to the project area and would be similar to the construction of other kinds of large scale outdoor construction activities, such as road work and erection of buildings. The project "area" includes many individual turbine construction "sites" where construction dust and combustion emission impacts would occur.

After construction was completed and operations began, air and dust emissions related to vehicular traffic would be reduced because all traffic between turbines would be along graveled access roads, and traffic would only consist of routine maintenance and repairs.

The principle odor source during construction would be diesel exhaust from construction equipment or trucks. No other objectionable odors are expected as a result of construction or operation.

# 4.2. BIRDS

## 4.2.1. Introduction

The potential for avian mortality and displacement from feeding and nesting habitat are major environmental concerns. Bird collisions with turbine blades and towers have been widely reported in this country and abroad. Avian mortality studies associated with wind turbines are ongoing in California and in other U.S. states, and in Europe. In the Midwest, mortality studies have been conducted in Minnesota, Illinois, Iowa, and Wisconsin. Mortality rates estimated from these studies vary, but are generally lower in the Midwest when compared to older wind farm installations in the west.

It is difficult to compare studies from different types of wind farms. Various types, heights, and configurations of wind turbines may impact birds differently. Older, shorter turbines with higher rotation speeds, supported by guy wires or on metal lattice towers, appear to pose greater avian risks than newer turbines that are taller, have lower rotation speeds, and are supported on tubular towers. Bird impacts will also vary at different times of the year, from year to year, and in different locations due to meteorological factors that influence migration patterns, land use, and habitat resources. In addition, not all bird studies are designed with the same scientific rigor. These factors make it difficult to rely solely on the results from existing studies to predict the potential bird impacts from the proposed Glacier Hills project.

Potential wind farm impacts to birds include collision mortality, habitat loss, and habitat fragmentation. Bird mortality rates at proposed wind farms can be related to the overall abundance of species that occur in the project area, the type and abundance of birds that spend time at altitudes that would bring them within the blade-swept area, and particular behaviors that might increase a species' chances for encountering turbine blades.

Species that inhabit a project area in large numbers and for long periods of time may be more likely to be affected by the wind turbines. Rare and declining bird species may not be frequent users of a project area but their population may be more sensitive to impacts if mortality numbers relate to a high percentage of the population. Some bird behaviors put a particular species at greater risk. For example, raptors focused on searching for prey may be more susceptible to striking or being struck by turbine blades than birds simply traveling through a project area. The visual acuity of some bird species may not be sufficient to determine proximity to wind turbines at close range.[6] Avian mortality may be the product of a small number of fatalities that occur over many days/nights at many structures, or a single large-scale event. Though large-scale events can be widely reported in the press, to date they have been mostly associated with tall structures, such as radio and television towers, and have not occurred at wind farms.

Another factor that may affect avian mortality is regional migration and movement patterns that result in large numbers of birds migrating through the project area and crossing between areas of significant natural resources.

## 4.2.2. Project area specifics

The data and conclusions available from existing modern wind projects are insufficient to understand the interaction of birds, environmental factors, and wind turbines. Well-designed pre-construction and post-construction studies are essential to understanding the nature of the impact and what mitigation, if

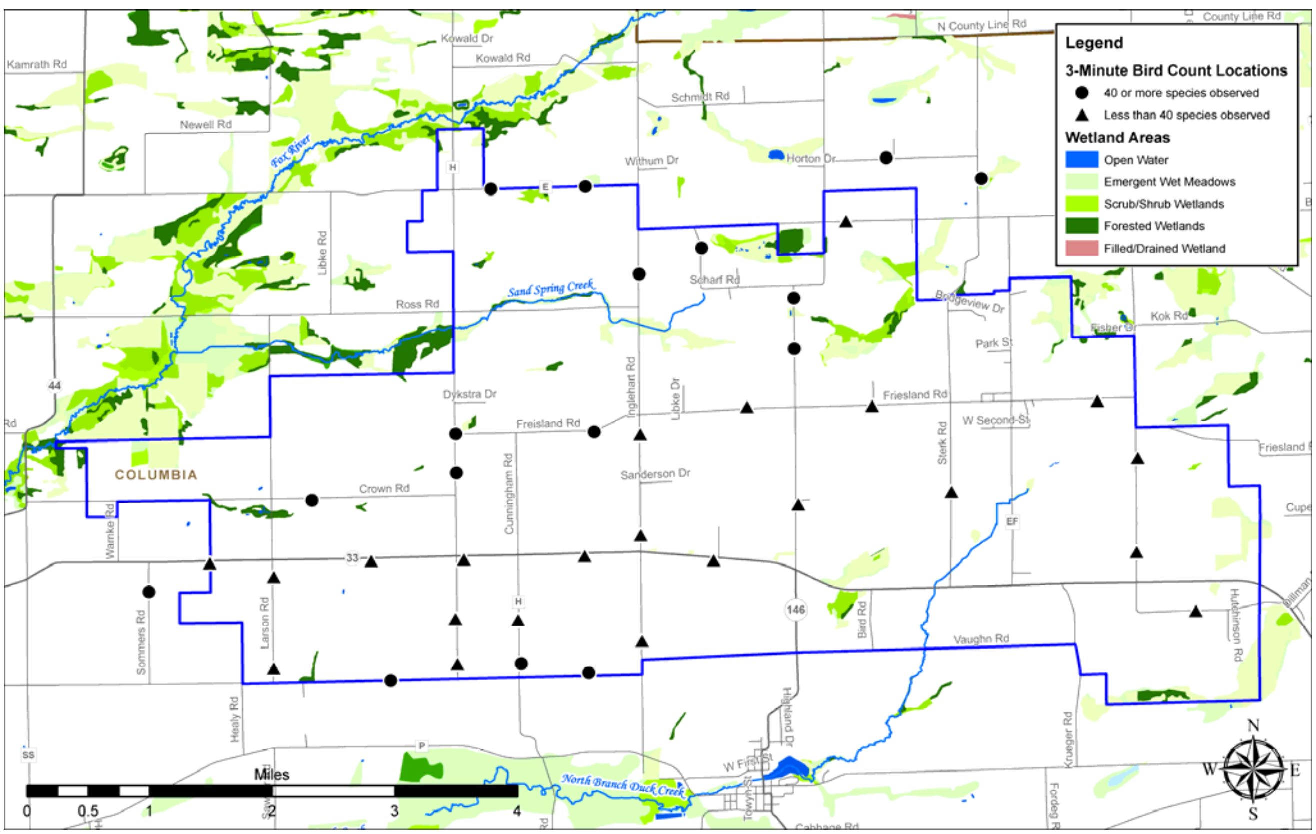
[6] McIsaac, H. 2000. Raptor Acuity and Wind Turbine Blade Conspicuity. Proceedings of the National Avian Wind Power Planning Meeting IV. Carmel, CA.

any, might be effective. At the time this final EIS is being prepared, Wisconsin has limited experience with three wind farm projects where *both* pre- and post-construction studies have been conducted. The data from these other projects, while providing important information on bird and bat mortality, are insufficient to predict the potential bird impacts from the Glacier Hills project.

Bird mortality rates evaluated at several other upper Midwest wind farm projects suggest that losses in the range from one to eight birds per turbine per year might be expected. Preliminary numbers from wind farm sites in Wisconsin are at the upper end of this range. Losses at these levels are not likely to be significant to populations of most common bird species. A wind farm project proposed in an area harboring endangered, threatened, or other rare species would raise a greater concern. Likewise, construction of wind turbines near areas with concentrated bird use, or along heavily used local flight paths, would also be a greater potential concern. Indirect affects to birds through removal and fragmentation of habitat can be a concern depending on the types of habitat present in a project area.

WEPCO conducted a pre-construction avian study of the project area between mid-June 2007 and mid-June 2008.[7] The methodology used and the timing of the survey was consistent with the Breeding Bird Survey methodology and provides a general assessment of bird use in the project area during the one-year study period.

Figure 4.2-1 Bird count locations




[7] Noel J. Cutright, January 2009, Glacier Hills Wind Park Pre-construction Avian Study, Columbia/Dodge Counties, Wisconsin, Prepared for Wisconsin Electric Power Company, Application Appendix Z Supplement, PSC ERF #106556.

Almost all project construction would occur on active agricultural lands. Only a small amount of habitat other than agricultural lands would be directly disturbed by the project. Active agricultural lands provide feeding areas for some bird species during migration and winter but provide only limited habitat for nesting birds. The impact to bird habitat from direct habitat removal and from fragmentation of existing habitat would be relatively low (see Section 4.6 Woodlands). Construction activities to install the proposed wind turbines would likely temporarily disturb birds using areas near the active construction sites.

The avian study did not identify any heavily used local flight paths or any locations in the project area where bird activity was heavily concentrated. A portion of the project area, generally the north and western portion of the project area, is a mixture of farm fields, wetlands, and wooded areas with a somewhat greater number of species and overall numbers of birds than the predominantly agricultural landscape found in the southern and eastern portion of the project area. (See Figure Vol. 2-4.)

The surveys recorded observations of 151 bird species. Three state-listed threatened species were recorded (great egret, osprey, and red-shouldered hawk). An additional 20 species that are listed as species of greatest conservation need (SGCN)[8] were observed in the project area.

There were six sightings of the state-listed threatened great egret (*Ardea alba*) during the avian study. Five sightings were birds flying through the study area and the other was an egret on the ground at a small pond. All sightings occurred during spring and summer. There was one sighting of the state-listed threatened osprey (*Pandion haliaetus*) flying through the project area. There was one fall observation of two state-listed threatened red-shouldered hawks (*Buteo lineatus*) soaring together near one of the avian study count locations. The observations of these three state-listed threatened birds suggest that they only occasionally make use of the project area. There were no observations in the avian study that would suggest any nesting activity by these three species in the project area.

The 20 SGCN species observed during the avian study (in addition to the three state-listed threatened species discussed above) are listed in Appendix A. Five SGCN songbird species are summer residents in the project area and inhabit grasslands and agricultural fields—the field sparrow, vesper sparrow, dickcissel, bobolink, and eastern Meadowlark. In addition, the northern harrier is a raptor species that inhabits grasslands and wetlands and likely breeds in the project area. Construction of the proposed wind turbines should not result in any significant change in the field and grassland nesting habitat used by these six species. The brown thrasher is another SGCN songbird species that was observed at two locations in the project area during the nesting season. The brown thrasher nests in hedgerows and along the shrubby edges of fields, farmsteads, and deciduous forests. Red-headed woodpeckers, which primarily inhabit savanna-like woodlands or open oak woodlands, were observed at a number of locations during the spring and fall migration periods. Three wood thrushes, which inhabit blocks of woodland, were noted in the avian survey. No substantial changes to woodland or shrubby edge habitats of the brown thrasher, red-headed woodpecker, or wood thrush are expected from the proposed project. The observations of the remaining SGCN bird species suggest they occasionally pass through the project area in low numbers during migration and are thus unlikely to be significantly impacted from the proposed wind turbines.

Aside from the results of the pre-construction avian study conducted in the project area, Commission staff has received several reports from citizens that bald eagles (*Haliaeetus leucocephalus*) are occasionally sighted in the project area during the winter months feeding on carrion or loafing in trees adjacent to fields.

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[8] SGCN species, identified in the Wisconsin Wildlife Action Plan developed by DNR, have low and/or declining populations and are in need of conservation action. SGCN species are listed to ensure priority treatment when conservation actions or programs are developed.

## 4.3. BATS

Bat mortality has exceeded bird mortality at most wind farms where post-construction monitoring of both animal groups has been conducted. Many species of bats are long-lived and have low reproductive rates. This is particularly worrisome because even if the mortality rates for birds and bats from wind turbines were similar, wind turbines can have a more significant impact on bat populations than bird populations, with the exception of rare bird species. Bat Conservation International estimates that more than 50 percent of American bat species are in decline. As the number of wind projects continues to increase, the cumulative impact on bat populations could be serious. Wind turbines may be more deadly for bats than other structures, such as towers or buildings, on a per structure basis.

Very few bat studies have been conducted in Wisconsin and thus bat numbers and behavior are not well understood. Wisconsin's landscape of farmland, wetlands, and forests makes the presence of bats ubiquitous, but not necessarily abundant. Seven species of bats are known to occur in Wisconsin; five of these are state species of special concern exhibiting some evidence of decline (see Table 4.3-1).

Table 4.3-1 Potential bat species in the project area

| Common Name | *Scientific Name* | State Designation | Type |
|---|---|---|---|
| Big brown bat | *Eptesicus fuscus* | None | Cave |
| Little brown bat | *Myotis lucifugus* | None | Cave |
| Northern long-eared bat | *Myotis septentrionalis* | State special concern | Cave |
| Eastern pipistrelle | *Pipistrellus subflavus* | State special concern | Cave |
| Eastern red bat | *Lasiurus borealis* | State special concern | Tree |
| Hoary bat | *Lasiurus cinereus* | State special concern | Tree |
| Silver-haired bat | *Lasionycteris noctivagans* | State special concern | Tree |

Bats are categorized as either cave bats or tree bats depending on their strategy for overwintering. Cave bats mostly congregate in large hibernacula such as caves or abandoned mines. Tree bats, on the other hand, are generally solitary and do not congregate for hibernation but migrate in early spring and late fall. Tree bats are more difficult to study and, in general, less is known about tree bats than about cave bats. In previous Midwestern wind farm studies, tree bats had represented the majority of bats that collide with wind turbines. However, preliminary results from recent Wisconsin mortality studies have shown a more even split between tree and cave bat fatalities, which may be due to proximity to cave hibernacula.

The Neda Mine, one of the largest hibernacula for bats in the Midwest, is located about 25 miles east-southeast of the project site. Neda is an abandoned iron ore mine providing cave-like habitat used by bats for roosting and hibernation. Over 100,000 bats are estimated to overwinter in the mine.[9] It is not known whether bats roosting in the Neda Mine travel as far as the project area to feed.

Bat fatalities have been recorded at wind facilities worldwide. Small numbers of bats were first recorded in the U.S. at wind energy projects in California during avian fatality searches. Bat fatalities at North American wind energy facilities generally received little attention until high numbers of bat fatalities occurred in 2003 and 2004 at two eastern wind power projects—Mountaineer Wind Project in West Virginia and the Meyersdale Wind Project in Pennsylvania. Annual mortality was estimated at 47.5 bats/turbine for Mountaineer and 25 bats/turbine at Meyersdale.[10] At the Buffalo Mountain Wind

[9] Redell, D. 2005. Behavioral Ecology of Bats Using the Neda Mine Hibernaculum. Thesis, University of Wisconsin-Madison, Madison, Wisconsin.
[10] Arnett, Edward B., *et al.* 2008. Patterns of Bat Fatalities at Wind Energy Facilities in North America. Journal of Wildlife Management 72(1):61–78. Kerns and Kerlinger, 2003.

Project in Tennessee bat mortality rates over a three-year period were 20.8 bats/turbine.[11] These three sites are in very different ecological settings from the proposed Glacier Hills site.

Estimated bat mortalities rates for Midwestern wind farms have been lower than the estimates for the eastern wind projects. Annual mortality rates were estimated at 7.8 bats/turbine at the Top of Iowa project in Iowa, 4.3 bats/turbine at the Kewaunee County Wind Project in Wisconsin, and 2.0 bats/turbine at the Buffalo Ridge Project in Minnesota.[12] Preliminary mortality data at two recently constructed Wisconsin wind projects, however, indicate bat mortality rates above the national average.

It is possible that some of the earlier bat mortality studies may have underestimated bat fatalities due to inadequate sample size, sample area or search interval, insufficient methods to correct for searcher efficiency, or scavenging rates. Carcass recovery can differ depending on vegetative cover, search frequency, and the condition of the carcass.

A pre-construction bat activity study was conducted in the Glacier Hills project area.[13] The study was based on acoustic surveys and focused on bat activity patterns during the post-breeding and fall migration periods. No species identifications, however, were performed during the study. The study report indicated that the mean number of bat passes per night was higher than similar data collected at Buffalo Ridge, Minnesota and Foote Creek Rim, Wyoming and lower than sites in West Virginia, Iowa, and Tennessee.

It is certain that there will be some level of bat mortality if the proposed wind farm is constructed. However, due to the lack of research on bat mortality at wind farms in the Midwest, it is not possible to make any predictions about the magnitude of bat mortality for this particular project or whether that mortality would have any significant impacts on bat populations.

Post-construction mortality studies are being conducted at three recently completed wind projects in Wisconsin. These projects have land cover (*i.e.,* wooded areas, wetlands, and fallow fields within an agricultural matrix) similar to that present within or adjacent to the Glacier Hills project boundary. In addition, the projected bat activity levels based on pre-construction surveys at one of WEPCO's recently constructed wind farm projects (Blue Sky Green Field) were similar to the pre-construction estimates for the Glacier Hills project. The initial post-construction field data from the Blue Sky Green Field project show a high level of bat mortality.[14] Thus, it is possible that bat mortality at Glacier Hills could also be high.

Attempts are underway to develop mitigation techniques to reduce bat mortality from wind turbines. The Bat and Wind Energy Cooperative is currently investigating two possible approaches to minimize fatalities: slowing the blade rotation rates at low wind speeds during times when bats are most active and using acoustical devices to discourage bat activity near the turbines. The research is not far enough along to determine whether either approach would be a practical mitigation technique for all or even some wind projects. However, results from their first curtailment study (in Pennsylvania)[15] where the "cut-in speed"

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11 *Ibid.*
12 *Ibid.*
13 Jeff Gruver, November 2008, Acoustic Surveys of Bat Activity at the Proposed Glacier Hills Wind Energy Project, Columbia County, Wisconsin, August 16–October 29, 2007. Prepared for Wisconsin Electric Power Company by Western EcoSystems Technology, Inc., Cheyenne, Wyoming. Application Appendix Z Supplement, PSC ERF #107526.
14 Jeff Gruver, Kimberly Bay and Wallace Erickson, June 2009, Post-Construction Bat and Bird Fatality Study Blue Sky Green Field Wind Resource Area Fond du Lac County, Wisconsin, Interim Report, July 2008–October 2008. Prepared for We Energies by Western EcoSystems Technology, Inc., Cheyenne, Wyoming.
15 Edward Arnett, Michael Schirmacher, Manuela Huso, and John Hayes, April 2009, Effectiveness of Changing Wind Turbine Cut-in Speed to Reduce Bat Fatalities at Wind Facilities, 2008 Annual Report, Prepared for the Bats and Wind Energy Cooperative and the Pennsylvania Game Commission. (http://www.batsandwind.org/pdf/Curtailment_2008_Final_Report.pdf)

of the turbines was increased to 5.0 meters per second or 6.5 meters per second indicated a significant reduction in bat mortality. Typical turbine cut-in speeds at which the hub and blades are oriented to capture the wind and begin producing energy are 3.5 to 4.0 meters/second. It is estimated that at these low wind speeds bats are still very active, and therefore at risk from turbines. If the cut-in speed is increased to a speed where bats are less active, as was done in the Pennsylvania study, then mortality will likely be less than for normal operation. The Pennsylvania study is the first such study completed in the U.S. The Bat and Wind Energy Cooperative is continuing research at this site in 2009 to further evaluate this mitigation technique.

## 4.4. OTHER WILDLIFE

The project area is dominated by agricultural lands without exceptional topography or natural resources. The north and western portion of the project area is a mixture of agricultural and forested lands, while the south and east portions are almost entirely agricultural. Almost all project construction would occur on agricultural lands.

A variety of common wildlife species are likely present in the project area. These species include, among others: white-tailed deer, squirrels, rabbits, beavers, coyotes, foxes, raccoons, muskrats, skunks, opossums, woodchucks, mice, chipmunks, voles, and other small mammals. Very little impact to wildlife, with the exception of birds and bats, is expected from the construction or operation of the proposed Glacier Hills project.

The Natural Heritage Inventory (NHI) data maintained by DNR was reviewed to identify any known records of threatened and endangered species or areas having high quality natural plant and animal communities. The NHI database indicated occurrences of three herptile (reptile or amphibian) species within two miles of the project boundary. The project area, however, does not appear to include habitat suitable for these species and it is unlikely that they would be present within the project boundary. The Birds section addresses rare bird species.

## 4.5. WATERWAYS AND WETLANDS

### 4.5.1. Streams and wetlands in the project area

The project area is an elevated, relatively flat upland, dropping off to the north and west towards the Fox River and towards Duck Creek to the south. The project area is crossed by a number of small, mostly intermittent tributary streams that flow into the Fox River and Duck Creek. Many of the streams are intermittent. Many of the project area's tributary streams are bordered by bands of wetland. No DNR-designated Outstanding Resource Waterways (ORW) or Exceptional Resource Waterways (ERW) are located in the project area. Two of the streams are designated by DNR as Areas of Special Natural Resource Interest (ASNRI) because they provide habitat for rare species; however, this rare species habitat is outside the project area.

Wetlands in the project area are primarily wet meadows, many of which are dominated by reed canary grass, along with areas of forested and scrub/shrub wetlands.

### 4.5.2. Construction impacts

No wind turbines or turbine site access roads, other than temporary crane paths, would be constructed within waterways or wetlands.

Electric collector cables and temporary crane paths would cross 14 waterways with wetland borders, six waterways without wetland borders, and one wetland-only area. Many of these crossing locations would take place along existing roadways.

Collector cables would be installed beneath six of the waterways and their wetland borders using directional boring, with no resulting disturbance to the stream or wetland.

The other cable crossings of waterways and wetlands would involve trenching. Timber matting would be used to help support the construction equipment and reduce disturbance. When water is present in the waterway, a dam and pump construction method would be used to divert the water around the construction area.

Overall, the surface disturbance to wetlands would affect an area of approximately 1.69 acres. About 1.27 acres are wet meadows and approximately 0.42 acre is wooded or shrub/scrub wetlands. The estimated affected area is based on 50-foot-wide construction work zones for cables or crane paths through the wetlands. Table 4.5-1 lists the wetland and waterway crossings

Temporary roadways constructed from timber mats, covering about 0.7 acres, would be used to allow cranes to cross three wetland areas and two associated streams. The timber mats would be removed when no longer needed. In addition, one crane path would be constructed across an intermittent stream using a temporary timber mat bridge.

Table 4.5-1 Waterways and wetlands

| Crossing Code | Waterway Name (1) | Cable Crossing | Crane Path | Direction. Bore | Crossing located in Road ROW | Width of Stream at Top of Bank (ft) | Section | Town, Range | Wetland Impacts | | WWI Class. (if done) | Comm. Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Acres (2) | Lineal Feet | | |
| **Waterway Alone** | | | | | | | | | | | | |
| D4-1b | UNT Cambria Creek | X | | | Yes | No channel | 26 | 13N, 11E | | | | Farmed Channel |
| D10-1 | UNT Cambria Creek | | X | | | 14 | 23 | 13N, 12E | | | | |
| E5-1a | UNT Duck Creek | X | | | | 16 | 36 | 13N, 11E | | | | |
| E5-1b | UNT Duck Creek | X | | | Yes | 15 | 36 | 13N, 11E | | | | |
| E6-2 | UNT Duck Creek | X | | | Yes | 22 | 30 | 13N, 12E | | | | |
| E8-2 | UNT Duck Creek | X | | | Yes | No channel | 28 | 13N, 12E | | | | |
| **Waterway and Wetland Border** | | | | | | | | | | | | |
| B4-2 | UNT* Fox River | X | | X | Yes | 13 | 14 | 13N, 11E | None - bore | None - bore | | Wooded, Shrub/scrub |
| B7-1 | UNT Fox River | X | | | | 18 | 8 | 13N, 12E | 0.11 | 100 | | Wooded Shrub/scrub |
| C4-1 | UNT Fox River | X | | | Yes | 5 | 23 | 13N, 11E | 0.14 | 120 | | *(11) |
| C4-2 | UNT Sand Spring Creek | X | | X | Yes | 38 | 23 | 13N, 11E | None - bore | None - bore | | Wet Meadow Shrub/scrub |
| C4-3 | Sand Spring Creek | X | | X | Yes | 13 | 23 | 13N, 11E | None - bore | None - bore | T3/E1K | Wooded Shrub/scrub |
| C5-1 | UNT Sand Spring Creek | X | | | Yes | 9 | 24 | 13N, 11E | 0.41 | 360 | | Wet Meadow |
| C5-2 | Sand Spring Creek | X | | X | Yes | 19 | 24 | 13N, 11E | None - bore | None - bore | E1Hg / E1K | Wet Meadow |
| D4-1a | UNT Fox River | X | | | Yes | 20 | 26 | 13N, 11 E | 0.12 | 110 | | Wooded Shrub/scrub |
| D4-2 | UNT Cambria Creek | X | | | Yes | 8 | 26 | 13N, 11E | 0.05 | 40 | | Wooded Shrub/scrub |
| D10-3 | UNT Cambria Creek | X | X | | | No channel | 23 | 13N, 12E | 0.20 | 170 | | Wet Meadow |
| E3-1 | UNT Duck Creek | X | | | | No channel | 34 | 13N, 11E | 0.16 | 140 | | Wet Meadow |
| E6-1 | UNT Duck Creek | X | | X | Yes | 17 | 30 | 13N, 12E | None - bore | None - bore | | Wooded Shrub/scrub |
| E8-1 | UNT Duck Creek | X | | X | Yes | 12 Vert. | 28 | 13N, 12E | None - bore | None - bore | | Wooded Shrub/scrub |
| E10-4 | UNT Cambria Creek | | X | | | 15 | 26 | 13N, 12E | 0.04 | 35 | | Wet Meadow |
| **Wetland Alone** | | | | | | | | | | | | |
| F9-2 | UNT Cambria Creek | X | X | | | | 34 | 13N, 12E | 0.46 | 400 | | Wet Meadow |
| | | | | | | | | TOTAL | 1.69 | 1475 | | |

(1) Unnamed tributary to - (UNT)
(2) Area calculation estimated using a corridor width of approximately 50 feet.

WEPCO has filed a Chapter 30 permit application with DNR. The DNR Chapter 30 permit would dictate the specific construction method for each waterway. WEPCO would conduct waterbody crossings in accordance with DNR-approved site-specific, typical or contingency plans. These plans generally include crossing method, timing of construction, erosion control measures, setbacks, additional temporary work space locations, in-stream sediment control where appropriate, equipment bridges where applicable, and substrate backfill specifications. Impacts on surface waters would be limited primarily to the period of construction and are dependent on the time, duration, and method of cable or crane path installation. The evaluation of potential impacts from crossing waterways using any of the open trench methods assumes that the DNR waterway permit would require use of appropriate erosion control practices along with the restoration of the streambed contours to preconstruction conditions. DNR's permit reviews would specify any additional requirements to protect water bodies and fisheries.

Many of the project's waterway crossings are intermittent streams, with periods of the year when no water flow occurs. DNR permits for similar projects have often allowed open cut trench construction across intermittent waterways only at times of no flow. Crossing intermittent streams during no-flow periods with open cut trenching would not alter the streams' water quality or have any direct affect on aquatic life. With simple restoration efforts, there would not be any substantial change to streambed configuration or flow characteristics as a result of open trenching of intermittent streams under no-flow conditions. It is also expected that cable crossings of perennial waterways would need to be installed using dam and pump methods. These methods are designed to greatly reduce potential impacts to water quality. Impacts on biota present in the stream are also expected to be minor, with these impacts primarily related to inhibiting movement of fish and other aquatic organisms through the construction zone.

Construction activities in wetlands generally involve ROW and workspace clearing, installation of erosion control measures, topsoil stripping, trench excavation and cable installation and backfilling, and site restoration. Potential impacts of constructing through wetlands include: compaction of soils and alterations of important microtopography that could potentially alter the hydrology; changes to plant composition including the introduction of invasive species; and soil mixing within the excavated areas. The DNR wetland Water Quality Certification would contain many requirements designed to reduce construction impacts to the wetlands.

Overall, the potential impacts of the proposed project on waterways and wetlands are expected to be minor. The waterways that would be crossed are generally small, and many are intermittent. They show extensive modifications from agricultural practices, or would be crossed at locations already affected by existing road crossings. The total area of affected wetland is small. Most of the wetlands are degraded from past establishment of reed canary grass, and no rare wetland species are known to be present.

## 4.6. WOODLANDS

Woods cover about 10 percent of the project area, and consist primarily of maple, oak, and pine. While wind turbine construction would occur primarily in open areas, a small amount of woodland would be affected.

The crane walk and collector route between turbine sites 78 and 93 would likely require removing up to about one acre of open woods. The access road to turbine site 81 could remove up to about 0.5 acre of woods, depending on its final alignment.

Two wooded areas would be crossed by collector cables that would be installed by directional boring. This technique installs the cables under a land feature without disturbing the surface. The bore would start and end in drill pits excavated on either side of the surface feature. The wooded areas that WEPCO proposes to bore under are between turbine sites 47 and 69 and between sites 7 and 31.

Construction might also require some tree trimming along the edge of woodlands and the removal of trees along roads and field lines for temporary access. For example, where turbine access roads intersect with existing roads, a large turn-out area for the entry of oversize trucks would require the removal of trees located on both sides of the existing road. Stands of trees or trees on the edge of woodlots may need to be removed or trimmed for construction-width access roads and cross-country crane paths.

CHAPTER

5

# 5. Community and Social Environment – Impacts and Mitigation

## 5.1. AFFECTED MUNICIPALITIES

The Glacier Hills project area is located entirely within Columbia County, within the towns of Randolph and Scott. The village of Friesland is located within the project area and the villages of Cambria and Randolph are located south of the project area. The location of the project area is shown in Figure Vol. 2-1.

WEPCO currently proposes to locate 54 turbines (60 percent of the total) within the town of Randolph and 36 turbines (40 percent of the total) in the town of Scott. No turbines would be located inside village boundaries.

### 5.1.1. Demographics

The Wisconsin Demographic Services Center estimates the population of counties and towns, based on the 2000 U.S. census. The January 2008 estimate for Columbia County is 56,130 persons. The January 2008 estimate for the town of Randolph is 762 persons, a 9 percent increase over the 2000 census. The January 2008 estimate for the town of Scott is 868 persons, an increase of 9.7 percent from the 2000 U.S. census.

Amish live in and near the project area. WEPCO estimates there are two Amish farms in the project area and another seven farms within 1.0 mile of the project area boundary. WEPCO has easements with two Amish property owners, one for a collector circuit and another for wind turbines. Another Amish person has acquired a property on which there are easement restrictions. In addition, an Amish school is under construction about 1,500 feet from three turbines.

The Amish generally do not use electricity and do not involve themselves with state or other government processes. Due to these factors, it's difficult to assess what, if any, are the potential effects of a proposed electric facility on their community. Concerns have been expressed about the effect of construction traffic on Amish farm families, who generally use horses and buggies rather than automobiles for transportation. WEPCO has discussed the issue of increased traffic with an Amish bishop and landowner participants, who have expressed no concern. WEPCO has stated that it "…will continue discussions with Amish community to resolve any emerging concerns and minimize any impact to the community." WEPCO has also discussed the location of the school with Amish property owners.

### 5.1.2. Existing land use

Figure Vol. 2-10 shows land use and land cover in and around the project area. The predominant land use is farmland. Woods are concentrated on the northern and western portions of the project area and residential properties are scattered throughout the project area. WEPCO calculated existing land uses in the project area as a whole. Table 5.1-1 lists the major land uses and their approximate percentage. The predominant use is farmland. Both temporary and permanent changes to land use are expected to occur primarily on farmland.

Table 5.1-1 Existing land use in the project area

| Agriculture | Woodland | Wetlands/Waterways | Developed (buildings and roads) | Total |
|---|---|---|---|---|
| 82% | 10% | 4% | 4% | 100% |
| 14,140 acres | 1,730 acres | 737 acres | 741 acres | 17,348 acres |

Table 5.1-2 is an estimate of the amount of land that would be used by the proposed wind farm, either temporarily or permanently. Affected acreages designated as being temporarily impacted would be disturbed during construction but restored following construction. Acreages designated as being permanently affected would support wind turbines, access roads, or related facilities for at least 20 to 30 years. The amount of land temporarily disturbed by construction could amount to about one square mile. The acreage permanently replaced by wind farm facilities would amount to 60 to 80 acres and would be almost entirely agricultural land.

Table 5.1-2 Approximate acreage used by or lost to turbine facilities in the project area

| Facility | Temporary | Permanent | Assumptions |
|---|---|---|---|
| Turbine sites | 144-180 acres | 13.5 acres | 90 turbine sites; 1.6-2.0 acres per turbine site (temporary); 0.15 acres per turbine site (permanent) |
| Access roads | 121 acres | 39-48 acres | 20 miles of access road; 50 feet wide (temporary); 16-20 feet wide (permanent) |
| Crane paths | 52 acres | NA | Does not include paths on access roads; 8.57 miles in total length; 50 feet wide (temporary); 0 feet wide (permanent) |
| Collectors | 203-237 acres | NA | 56 circuit-miles; All underground; 30-35 feet wide (temporary); 0 feet wide (permanent) |
| Substation | 20 acres | 10-20 acres | 20 acres used during construction; 10 acres fenced + other facilities |
| O&M building/ laydown area/ parking/storage | 20 acres | 5 acres | 20 acres temporary (15 leased); 5 acres permanent for the operation and maintenance building |
| **Total Acres** | **Approximation** | | **Duration** |
| **Temporary** | 560-630 acres | | During construction |
| **Permanent** | | 68-86 acres | 20-30+ years |

In addition to agricultural land, construction of the wind farm would remove individual trees and stands of trees. Collector circuits and crane paths would cross some wetlands and waterways, requiring permits and special construction techniques. For the most part collector circuits follow access roads and public road ROW, occasionally requiring easements from adjoining residential landowners. Collector circuit easements would require a maximum width of 50 feet in road ROW and a maximum of 70 feet in farmland. WEPCO's attempts to restore temporarily disturbed land could include: storing soil horizons separately and then replacing soil, chisel-plowing to reduce compaction, repairing damaged drainage tiles, removing rocks uncovered by digging, and reseeding.

### 5.1.3. Publicly-owned lands

There are no publicly owned lands within the project area, except for property in the village of Friesland.

### 5.1.4. Schools, hospitals, daycare facilities, and residences

Because the most vulnerable members of the population are generally the young, the old, and the infirm, the PSC requires information on the locations of hospitals, nursing homes, schools, or daycare facilities within the general area of any large, proposed energy facility. Concerns usually focus on air emissions related to fossil-fuel combustion, coal handling, or natural gas safety. None of these concerns applies to the Glacier Hills project. However, other health-related concerns have been expressed regarding shadow flicker and noise.

There are no hospitals or nursing homes within the project area. There is one known daycare center on Sterk Road, and one immediately outside the project area, south of Vaughn Road. Turbine sites 27 and 74 are about 0.75 mile from the daycare on Sterk Road. Turbine 92 is about 0.5 mile from the daycare on Vaughn Road.

A new parochial school is under construction just south of CTH E on the property of a participating landowner. The closest turbine (51) would be about 1,140 feet from the edge of the school building. In addition, turbine 50 would be about 1,635 feet distant; turbine 135 about 1,760 feet distant, and turbine 78 about 2,030 feet distant.

A discussion of sensitive communities might also include a discussion about local residences in the project area. Most residences in the project area are not located on parcels that would host turbines; however, many would have turbines located nearby. There are 47 residences owned by non-participating landowners within 1,500 feet of a turbine and 101 within 2,500 feet of a turbine. Although the area is zoned largely Prime Agricultural, there are many exurban, non-farm, rural residences in the area, and the number of these dwellings is increasing.

## 5.2. ZONING AND LOCAL ORDINANCES

### 5.2.1. Existing Zoning

The towns of Randolph and Scott are not zoned. The only zoning within the project area is that of the village of Friesland in the northeastern corner of the project area. WEPCO does not propose to locate any turbines within the village. The closest site to Friesland is alternate turbine site 75, which is located about 0.25 mile north of an area zoned for conservancy. Nearby, alternate turbine site 134 is about 0.33 mile from an area in Friesland that is zoned residential. There are proposed turbine sites west of the village (where it is zoned agriculture) and southeast of the village (where it is zoned manufacturing). The proposed operations and maintenance building may require zoning approval if it is located within the village of Friesland.

In August 2009, the village of Friesland established an extraterritorial zoning district that extends about 1.5 miles from the village boundaries. A Joint Committee of town and village representatives is now working to develop zoning ordinances for that area. The Friesland Village Planning Commission sent a comment letter, dated September 1, 2009, to the Commission, opposing any wind turbines within 1.5 miles of the village boundaries.

The town of Springvale lies outside the project area. The northeastern corner of Springvale is adjacent to the southern boundary of the Glacier Hill's project area. That portion of Springvale is zoned for agriculture. The village of Cambria is south of the project area and the closest turbine site is about one mile from the Cambria village limits. The electric transmission substation might require a conditional use permit from Cambria, due to extraterritorial zoning.

### 5.2.2. Local authority over wind energy systems

There are limitations on local authorities described in Wis. Stat. § 66.0401(1), which says that no county, city, town, or village may place any restrictions on the installation or use of a wind energy system unless the restriction satisfies one of the following conditions:

- It serves to preserve or protect the public health or safety.
- It does not significantly increase the cost of the system or significantly decrease its efficiency.
- It allows for an alternative system of comparable cost and efficiency.

Wis. Stat. § 196.491(3)(i), the power plant siting law, indicates that if a project has been granted a CPCN by the Commission, and if that project is precluded or inhibited by a local ordinance, "the installation and utilization of the facility may nevertheless proceed." This means that a local government body, such as a county or town, may not stop or hinder a project by local ordinance if the project developer has received a CPCN from the Commission.

However, before the Commission can grant a CPCN, it must determine that the proposed project "will not unreasonably interfere with the orderly land use and development plans for the area involved." Thus, the CPCN application review must include an examination of relevant zoning and land use, and local plans for the future in order to aid the Commission in making this determination.

Columbia County and the towns of Randolph and Scott have no specific regulations for wind energy systems. The village of Friesland has regulations for small wind turbines built within the village.

### 5.2.3. Land use plans

Both Columbia County and the town of Randolph have 2030 Comprehensive Plans. In its plan, the town of Randolph recognizes future pressures for residential and renewable resource development. The plan recommends that Columbia County develop a wind ordinance.

By 2030, the town of Randolph expects to lose about 310 acres of agricultural land and gain about 291 acres of residential land, 6 acres of commercial land, and 13 acres of industrial land. The following table is from the town's land use plan. An excerpt from the plan states:

> The amount of land utilized by other land use categories such as agricultural, commercial and industrial will also change over the planning period. For example, agricultural land will continue to be converted to other uses thereby reducing the overall amount of agricultural lands. Commercial and industrial lands will likely continue to be developed at current rates, however these uses will most likely take place in nearby cities and villages as has been the case in the past. As a result, the Town of Randolph will not require large amounts of commercial and industrial future land uses.

Table 5.2-1 illustrates the projected demand for residential, commercial, industrial, and agricultural land uses in the town of Randolph.

Table 5.2-1 Projected future land use demand in five-year increments for the town of Randolph, 2005-2030

| Year | Residential* | Commercial | Industrial | Agriculture |
|---|---|---|---|---|
| 2005 | 528 | 24 | 53 | 21,286 |
| 2010 | 586 | 25 | 56 | 21,224 |
| 2015 | 644 | 27 | 58 | 21,162 |
| 2020 | 703 | 28 | 61 | 21,099 |
| 2025 | 761 | 29 | 64 | 21,037 |
| 2030 | 819 | 30 | 66 | 20,976 |
| Projected changes in acres | +291 | +6 | +13 | -310 |

*Includes single-family and multi-family.
Source: Columbia County Planning and Zoning

## 5.3. AESTHETICS AND VISUAL RESOURCES

The large size and high-tech appearance of wind turbines causes them to stand out against the backdrop of the open, rural landscapes in which they are sited, and because of their approximately 400-foot height, they can be seen for long distances. Glacier Hills, like other proposed wind farms, raises concerns about aesthetics, or changes in the visual environment. This section discusses visual changes, except for shadow effects, which are addressed in Section 5.7. The visual nature of the project area would change if the proposed project is built. However, no overall measure of the visual changes or a conclusion about the relative desirability or undesirability of visual change can be provided. This is due to the differences between people, their individual perceptions, and their unique, specific locations in the environment.

Many factors determine how a wind energy facility is aesthetically perceived. These factors include different levels of visual sensitivity for individuals, different visual settings, different viewing conditions, and different individual ideas and experiences. The distance from a turbine and its location relative to the onlooker, the onlooker's activity, the number of turbines within a specific view, and the presence of any screening objects, such as hills or trees, can influence how the new wind turbines are perceived. Personal feelings about wind energy technology and the surrounding environment can also contribute to how wind energy facilities are visually perceived.

Like other modern wind turbines, the proposed three-blade turbines are large. Hub height is 262.5 feet above the ground and the blade length is almost 150 feet, for a total height of about 410 feet (Vestas V90 turbine). The V90 turbines would have the same paint color and finish as those used in the Blue Sky Green Field Wind Farm. (A diagram of the proposed turbine is shown in Chapter 2, Figure 2.1-1.)

### 5.3.1. Existing visual environment

The proposed turbines are located in a rural project area of about 17,350 acres. The predominant land cover is agriculture (82 percent), although there are some wooded areas (10 percent), often associated with streams. Wetlands and waterways comprise 4 percent of the land cover. Developed areas, *i.e.* roads and buildings, also comprise 4 percent. STH 33 runs across the southern portion of the project area, as does a 138 kV transmission line. An ethanol plant is located on STH 33, within the project area. The village of Friesland is located in the northeastern portion of the project area. Although primarily farmland, there are rural residences in addition to farmhouses, and "farmettes" in addition to farms. The topography is mostly flat to gently rolling. The overall landscape is a visually pleasing one of farm fields, and scattered woodlots, with farm houses, barns, and silos. No specific features (such as waterfalls or overlooks) are identified as scenic attractions. There are two public recreation areas: the Village Park in Friesland lies within the eastern portion of the project area and Deer Creek Campground lies within the western portion. There is also a private church park near the center of the village of Friesland.

### 5.3.2. Photo simulations

WEPCO hired a consultant to prepare several photo simulations of how the wind turbines would appear from various public vantage points within the project area. The simulations assume use of the largest turbine under consideration (only slightly larger than the currently proposed V90 turbine), and that the turbine is facing in the direction of prevailing winds.

The consultant's photo-simulation report focused on nine locations from which to gauge the change in scenery. (The consultant later added the entrance to the Deer Creek Campground). Most of these locations are public roads or parks at the edge of turbine clusters. The report does not address the change in view at individual residences in the project area.

Locations from which pictures were taken include the ethanol plant entrance, Randolph Cemetery, the Friesland barbecue area, Rosedale Presbyterian Church, CTH E, H, M, and STH 33. The simulations are meant to give a general impression of the potential change in views, not an exact picture.

Eight examples showing an existing view and a photo simulation of the same view after project construction are shown in Figures Vol. 2-12 through 2-19.

### 5.3.3. Potential visual impacts during construction

Construction activities would occur over a relatively short period of time (18 months). The first 12 months, involving preparation for the delivery and construction of the turbines, would affect the general project area. The last six months would focus construction activities at successive turbine sites. The number and size of delivery trucks in the project area would increase substantially during the construction period, along with other equipment such as backhoes. When the turbines are installed, large cranes and oversize truck deliveries would occur. The construction activities associated with the wind generation project would add a new dimension to the rural landscape and temporarily alter the visual environment as trucks, heavy machinery, and construction workers enter the project area to install the turbines in a relatively short time frame.

For the duration of the construction period, the rural landscape within the project area would take on a more industrial character as the heavier truck traffic moves about and the profile of backhoes, cranes, and tower components become a common sight.

Most construction is expected to occur during daylight hours. Supplemental nighttime lighting, however, may be required if work at night is necessary to meet project schedules. If work does occur after dark, mobile trailer lighting systems and generators would likely be required to ensure safe work conditions.

### 5.3.4. Potential impacts during operation

The visibility and the aesthetic effects of a particular wind energy project depends on many factors, including proximity to residences and roadways, local terrain, tree coverage near residences, and lighting requirements. Also, as mentioned above, the type of viewer and the viewing conditions can influence how the turbines are perceived visually.

Residents who live in close proximity to one or more turbines may perceive the turbines as an intrusion on the rural landscape. Conversely, someone who resides outside of the project area and is traveling past on a nearby roadway may find that the turbines provide interest in an otherwise typical Wisconsin landscape. Landowners that host one or more turbines may view the turbines in a positive light because they are providing income and ensuring some level of financial stability; alternatively, landowners that live in close proximity to turbines sited on adjacent properties may feel a loss of control over their visual environment and a sense of helplessness to restore their former familiar surroundings. Because of the size of the structures, it may not be possible for adjacent landowners to mitigate the visual changes that would occur.

Changes in the view from one location may depend on the direction of view; turbines appearing in one direction, but not another—or closer in one direction, but farther in another. Sky conditions can affect the visibility of the turbines. An overcast sky can reduce the visibility and prominence of a group of turbines on the horizon, as compared to viewing them against a bright blue sky.

Volume 2 includes eight photo simulations that show portions of the study area with and without the proposed project. Figure Vol. 2-12 was taken from the Randolph Cemetery, looking west-northwest. This figure shows how turbines can be seen from a long distance in a relatively flat area. Figure Vol. 2-13 is a photo taken from the Friesland barbecue area, the one recreational area from which the turbines could be plainly seen. Figure Vol. 2-14 provides an impression of the size and proportions of the turbines. Figure Vol. 2-15, a view from the Rosedale Presbyterian Church cemetery, looking southeast indicates the potential for mitigating views in some instances. The photo shows turbines in the context of a cornfield and evergreen tree. One tree branch blocks the view of part of a turbine. The photos in Figures Vol. 2-16, 2-17, and 2-18 were chosen because of their different locations within the project area. The photo in Figure Vol. 2-16 is taken looking east from Larson Road, north of Crown Road. It shows turbines from more of a side than front viewpoint. The photo in Figure Vol. 2-17 is taken looking south-southeast from the corner of CTH E and Inglehart Road. This photo includes an existing electric distribution line. The photo in Figure Vol. 2-18 is taken looking south-southeast from CTH M, south of Friesland Road. Figure Vol. 2-19 is taken at the entrance to the ethanol plant looking east, and indicates the size and proportion of the proposed turbines.

The view from the Friesland village park would include multiple turbines, but they do not appear to dominate the view given their distance from the park. From the entrance to the Deer Creek Campground, turbines either cannot or cannot easily be seen. Due to distance, screening, and/or topography, the proposed wind turbines should not dominate the view from the few public recreation areas in the project area.

The FAA has standards for marking and lighting wind turbines. The FAA reviewed the proposed locations of the 90 turbine sites identified as WEPCO's preferred array. The FAA indicated that all 90 turbines would need to be white and 48 of them would also need synchronized flashing red lights after dark. The turbines that would have to be both white and have red lights installed are generally located on the outer edge of a cluster of turbines, while inner turbines in a cluster generally only need to white. No daytime lighting would be needed under the FAA standards if the turbines are white. The flashing red lights would be very conspicuous at night in the open rural setting of the project area.

### 5.3.5. Mitigation of visual impacts

The design of wind turbines and their uniform size and appearance can mitigate visual effects. Placing the electric collector system underground as WEPCO proposes would also mitigate some visual impact of the wind farm. Turbines may be screened from view by planting trees, especially conifers, or installing a fence, garage, or other structure. The effectiveness of screening depends primarily on the distance between the turbine(s) and the viewer. It may also depend on the viewer's activity or exact location (for example a view from a particular window) and the precise location or closeness of the screening material.

## 5.4. AGRICULTURAL IMPACTS

The proposed Glacier Hills project is located primarily on agricultural land. The project area is mostly a mix of corn, alfalfa, and soybeans, interspersed with some dairy farms and vegetable production. The proposed turbine sites, new electric substation, and the operations and maintenance building would all be on currently farmed land. Also, over 95 percent of the land that would be used for permanent access roads is located on agricultural land.

Temporary laydown areas at the substation site and near the operations and maintenance building would be located on agricultural land, as well as most of the temporary access roads and cross-country crane paths and about two-thirds of the land used for collector circuits. WEPCO intends to restore all lands used for temporary purposes, and lands on which collector circuits are located.

### 5.4.1. Direct impacts

Long-term impacts caused by construction and operation of Glacier Hills would include permanent loss of agricultural land for energy facilities, and possibly lower crop yields in construction areas due to loss of productivity through the possible mixing of soil horizons, soil compaction, erosion, and disruption to existing drainage patterns. Construction impacts could be reduced through appropriate construction techniques and post-construction land restoration. WEPCO has stated that it is "committed to ensuring that all agricultural lands that are not used for permanent structures (the turbines and access roads) are restored to pre-construction conditions for future agricultural use."

The company developed an Agricultural Mitigation Plan that was reviewed and approved by DATCP. This plan was included as part of WEPCO's CPCN application and is Appendix B in this final EIS.

### 5.4.2. Indirect impacts

#### 5.4.2.1. Farmland Preservation and Conservation Reserve Program lands

A few turbines are located on land enrolled in the Farmland Preservation Program. Because neither township has zoning, the preservation agreements are directly between individual farmers and DATCP. Under state statute, lands used for wind facilities that require PSC authorization would be released by DATCP from the farmland preservation program. While farmers would no longer receive benefits under preservation agreements, they would not be required to repay past benefits.

Wind turbine construction can affect the eligibility of lands enrolled in the federal CRP. WEPCO currently does not propose to site any turbines on CRP lands.

#### 5.4.2.2. Aerial application practices

Large-scale wind farms can limit or restrict the aerial application of pesticides and other plant products by creating a visual distraction to pilots, a physical barrier to flight patterns, and air turbulence that can increase the likelihood of pilot error or result in dangerous flying conditions. Pilots who perform aerial applications must divide their attention between aircraft systems, treatment volumes, swath spacing, weather, and obstruction avoidance. Wind turbines sited in areas that routinely or occasionally receive aerial applications create a hazard for aerial applicators and could result in a need to change agricultural practices or crop selection. Wind turbines are substantially taller than other obstructions commonly encountered by aerial applicators. The planes that perform this work would not normally fly at an altitude above the tower heights where the pilots could have a "safe zone" to check aircraft systems and treatment volumes.

In addition, the wake turbulence caused by the turning blades of the turbines could result in loss of control of the aircraft. Because this turbulence is invisible and thus hard to avoid, it is difficult to perform the tasks necessary for safe application of pesticides and other plant products.

In response to concerns about the increasing number of individual turbines and large-scale wind farms in the state, the Wisconsin Agricultural Aviation Association passed a resolution on May 11, 2009, that states:

> WE HEREBY RESOLVE to refuse any aerial crop protection application inside a grouping of wind generators. We also resolve to refuse an aerial crop protection application, which the pilot deems dangerous, due to its proximity to a wind generator.

The amount of agricultural land that would no longer be suitable for aerial applications, assuming specific no-fly buffer areas around the turbines, was estimated. Approximately 11,402 acres of agricultural lands lie within buffer areas extending one-half mile from each turbine, while buffer areas of one mile cover about 20,074 agricultural acres. The one-mile buffers include most of the agricultural lands within the boundary of the project area and would extend over large areas beyond the project area boundary. These estimates are based on the lands identified as agricultural in the land use information included in WEPCO's CPCN application.

Most aerial applications of crop protection products take place on vegetable and potato crops because they are particularly susceptible to a wide range of plant pests. These crops, especially potatoes, may require several applications of plant protection products each year.[16] Aerial applications to corn, soybeans, and alfalfa take place less frequently. The decision whether to treat pests often is based on field monitoring and the treatment a particular field receives can vary substantially from year to year based on the conditions during that growing season.

Aerial application allows producers to apply plant protection products to large acreages in a timely manner and treat diseases before they reach epidemic proportion. Potato and vegetable crops directly

[16] Potato fields can require treatment at 5-10 day intervals for diseases such as late blight, a highly destructive condition which is endangering the 2009 potato crop.

contribute an estimated $380 million to Wisconsin's economy each year and twice this amount when an economic multiplier is applied.

The project area for Glacier Hills primarily has a mix of corn, alfalfa, and soybeans, interspersed with some vegetable production. Some cropland within the project area has plant protection products applied aerially. In general, aerial applications to vegetable and potato crops are made to maintain crop quality. Aerial applications to corn and soybeans normally are made to increase or maintain crop yields.

There may be ways to allow continued aerial applications near wind turbines. For example, it has been reported that some wind farm operators have agreed to stop specific turbines for short periods of time to allow aerial treatment of nearby fields. To date, the identification and evaluation of useful mitigation approaches is limited.

#### 5.4.2.3. Foreclosure of future opportunities

The easements required for wind turbine sites restrict other construction on that property that would interfere with operation of the wind facilities. This reduces economic and other pressures to convert farmland to other land uses, such as residential subdivisions. Some people may consider this aspect a project benefit.

## 5.5. AIRPORTS AND AIRSTRIPS

### 5.5.1. Reporting requirements for high structures

FAA Regulations regarding obstructions to navigable airspace (14 CFR 77, or "FAA Part 77") require notification to the FAA Administrator of any proposed construction "of facilities more than 200 feet in height above the ground level at its site (Section 77.13(a)(1))." The tallest turbines proposed for this project have a maximum height of 415 feet, exceeding the FAA notice threshold of 200 feet. The landscape is gently rolling, so there would be slight variations in the above sea level elevations of different wind turbines. In addition, construction of the wind turbines would require the installation and movement of cranes that would extend to the turbine hub height or beyond. The primary lift crane used to erect the towers would be in the 400- to 500-ton size range. The crane height would typically have a 200-foot main boom and a 120-foot luffing jib.

### 5.5.2. Private airports

No public use airports are located in the project area. Two private use airstrips are in the general project area.

The Swart Airstrip is located west of Sterk Road and about 0.75 mile north of STH 33. It appears to consist of a grass or dirt runway through the middle of farm fields.

The FAA does not have oversight of airspace around private use airports. The Commission has, in recent dockets, looked at potential impacts to private use airports using the FAA's "end of runway" standards for public use airports, which examines potential obstacles in an airport's final approach paths. This process uses a trapezoidal zone, 250 feet wide at the near end of the runway and extending outward from the runway end for a distance of 5,000 feet, at which point the trapezoid is 1,250 feet wide. Applying this trapezoidal zone to the western approach to the Swart Airfield shows that one alternate turbine site (103) is within this zone and two preferred turbine sites (28 and 112) straddle the approach zone, one on either side. Installing turbines 28 and 112 may add a constraint to approaching and departing the Swart Airfield from the west. No turbines are within or near the approach trapezoid extending east from the runway.

The Slinger Field is located about 0.75 mile south of preferred turbine site 81. Slinger Field is a grass strip in farmland. No preferred or alternate turbine sites are located in or near the runway approach zones. The proposed wind farm is not expected to have any effect on use of the Slinger Field.

### 5.5.3. Federal Aviation Administration safety requirements

The FAA has standards for marking and lighting wind turbines. The FAA has reviewed the proposed locations of the 90 turbine sites identified as WEPCO's preferred array. The FAA indicated that all 90 turbines would have to be white and 48 of them would also need synchronized flashing red lights. The turbines that would have to be both white and have red lights installed are generally located on the outer edge of a cluster of turbines, while the inner turbines in a cluster generally only need to be white. No daytime lighting would be needed under the FAA standards if the turbines are white.

### 5.5.4. Medical helicopters

The proposed project would reduce the number of locations that could be used by emergency medical helicopters, which is discussed further in Section 5.7.7.

## 5.6. ARCHEOLOGICAL AND HISTORIC RESOURCES

The Wisconsin Historic Preservation Database of the Wisconsin Historical Society (WHS) has been reviewed to identify if there is the potential for the proposed project to affect known burial, archeological, cultural, or other historic resources.

WHS records show two archeological sites within one mile of the project area. The closest archeological site, a prehistoric village/campsite, is located about 1,000 feet from some of WEPCO's proposed facilities. WEPCO had an archeological consultant conduct a Phase 1 survey on and around the location of these proposed facilities.[17] No archeological or historic materials were found in this survey.

Five cemeteries are located in or adjacent to the project area: (1) St. Mary's Catholic Cemetery; (2) the Randolph Center at Friesland Cemetery; (3) the Portage Prairie Cemetery; (4) an unnamed gravesite; and (5) the Rosedale Cemetery. WEPCO proposes a 100-foot setback from any burial site and if a site is located near a road, WEPCO proposes no construction between the site and the near edge of the road.

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[17] Great Lakes Archaeological Research Center, November 2008, Archaeological Investigations for the Randolph Wind Farm, Columbia County, Wisconsin, GLARC Technical Document 2008-22. Prepared by Katherine E. Shillinglaw and Jennifer B. Harvey.

WEPCO proposes no facilities near St. Mary's Catholic Cemetery or the Randolph Center at Friesland Cemetery. However, the company proposes to place collector lines along Inglehart Road, which is adjacent to the Portage Prairie Cemetery. If the collectors are located on the east side of Inglehart Road, construction activities would not affect this cemetery.

An unnamed gravesite is located about 500 feet north of Vaughn Road, east of Inglehart Road. WEPCO also proposes to place collector lines along Vaughn Road. If these lines are located south of the road, they would not affect the gravesite. Or if the lines are located north of the road, in or immediately adjacent to the road ROW, they would also not affect the unnamed grave site.

Rosedale Cemetery is located on State Highway (STH) 33, between Larson and Dodge Roads. WEPCO proposes a collector line in agricultural fields near the cemetery. If a 100-foot buffer is maintained, WEPCO's proposal would not affect this cemetery.

WHS records show two historic houses within the project area. One is a clapboard Italianate on STH 33 near a cluster of turbines. The other, a brick Italianate, is on the south side of Friesland Road and 0.2 miles west of Inglehart Road. Neither home would be directly affected by the proposed wind farm, although views from these homes may change.

## 5.7. HEALTH AND SAFETY

### 5.7.1. Shadow flicker

#### 5.7.1.1. Description of shadow flicker

As wind turbine blades rotate, they cast a shadow upon the ground and objects below. A strobe effect can occur where the shadow of the rotating blades cause rapid changes in light intensity in the area of the shadow. Shadow flicker occurs when rotating wind turbine blades cast shadows on a sensitive receptor. These rapid changes in light intensity are troublesome when they affect a sensitive receptor, such as the windows of residences. Shadow flicker can occur if a turbine is located near a home and the home is in a position where the shadow of the moving blade is cast upon the residence. Obstacles such as trees or buildings between the wind turbine and a potential shadow flicker receptor can reduce or eliminate shadow flicker effects. Changes in elevation can either reduce or increase the effects.

No shadow flicker would occur when the turbine blades are not rotating as when winds are calm. However, when winds are low, the blades continue to rotate slowly and would still cast a shadow. Shadow flicker occurs only during hours of sunshine, as no discernable shadow is cast on overcast days. Because the wind turbine is designed to turn and face into the wind, shadow flicker is less pronounced when the wind direction is perpendicular to the direction of the wind turbine, as viewed from the receptor. By contrast, the shadow flicker is more pronounced during sunlight hours when the wind blows from a direction near parallel with a line between the wind turbine and the receptor.

The rate of changes in light intensity is a function of the rotational speed and the three blades on the rotor. This rate, or "blade pass frequency," is measured in cycles per second, or hertz (Hz). Each complete change in light intensity, from the beginning of one shadow to the beginning of the next shadow, is considered one cycle.

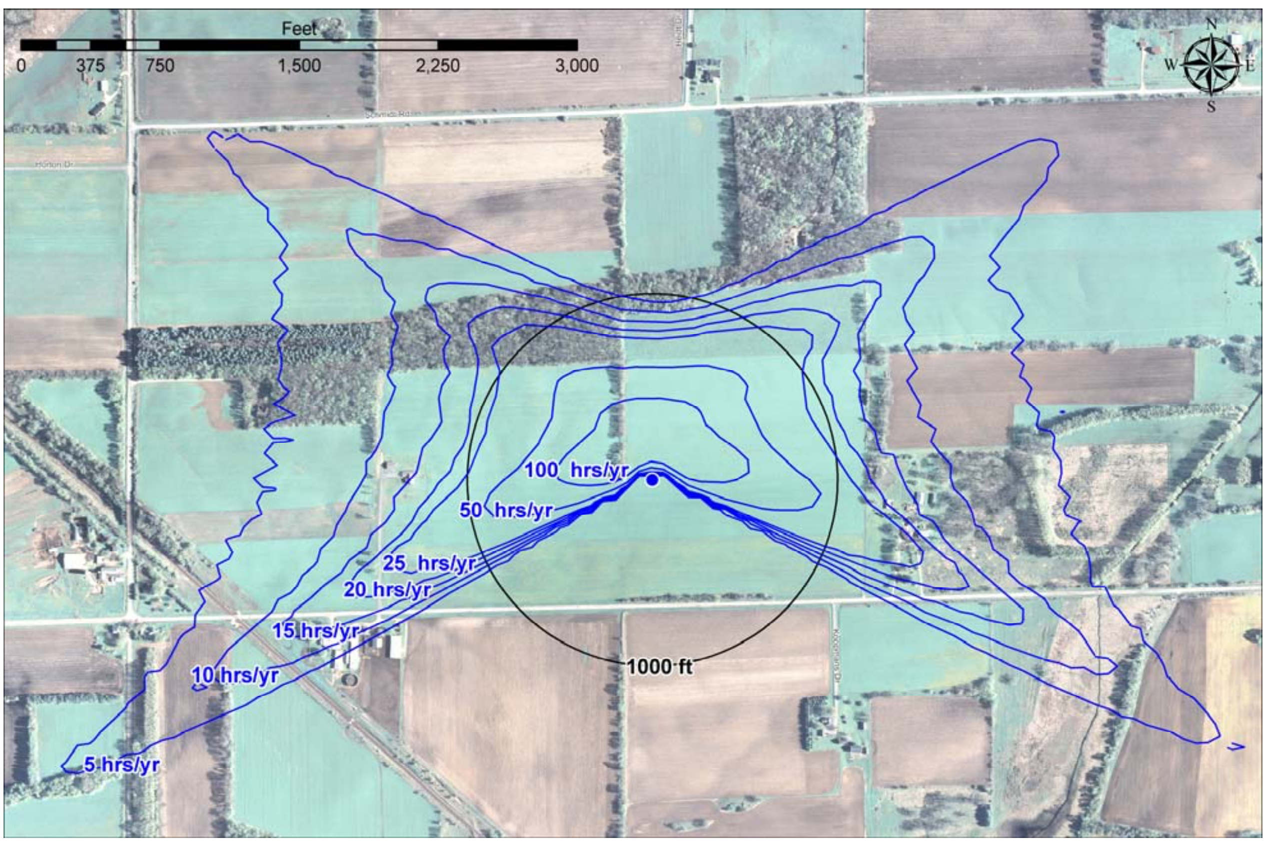
WEPCO proposes to use wind turbines that rotate between 6 and 19 rpm. For this range of rotational speeds, the blade pass frequency would range from 0.3 to about 1.0 cycle per second.

#### 5.7.1.2. Potential for shadow flicker in the project area

WEPCO evaluated shadow impacts by using conservative inputs and two computer models, WindFarm and WindPRO. These models are capable of predicting the likelihood of shadow flicker effects in the area of the proposed wind turbine installation. The predictions are based on the physical dimensions of the selected turbine, local topography, turbine location, local annual wind speed and direction data, the sun's path across the sky based on latitude and longitude, and the monthly average hours of sunshine. These model inputs are specific to the location in which the turbine installation is proposed. The two models used by WEPCO yielded similar results.

Figure 5.7-1 shows the likely shadow flicker modeling results from 5 to 100 hours per year for a typical turbine location. The circle identifies the non-participating landowner minimum setback of 1,000 feet from a turbine. Homes located 600 or more feet from the turbine (the participating landowner set-back) would most likely experience less than 100 hours per year of shadow flicker. Beyond 1,000 feet from a turbine, homes would most likely experience a shadow flicker of less than 50 hours per year. However, homes located south of the turbine would experience no shadow flicker.

Figure 5.7-1 Likely hours per year of shadow flicker



The computer modeling predicts that potential receptors to the north or south of the wind turbines are not likely to receive shadow flicker, because the shadow is shorter in those directions. Receptors to the east and west of the turbine locations could experience shadow flicker in the morning and evening.

Tables 5.7-1 and 5.7-2 provide a summary of shadow flicker impacts for houses at 600 feet from a turbine (representing the minimum setback distance to a participating residence) and 1,000 feet (representing the minimum setback distance to a non-participating residence). Even though these results have been reduced by 50 percent to account for cloud cover in the project area, they are still conservatively high values.

Generally, the results show that a house to the south of a turbine would not be impacted and that houses farther away from a turbine would have fewer hours of impact. Also, with the exception of short midday impacts in the winter due to low sun angles, the results show that impacts on houses 1,000 feet away from a turbine would be limited to early and late in the day, when the sun angle is low and shadows tend to be more diffuse.

Additional shadow flicker calculations were conducted for a representative turbine site in the project area, taking into account topography. This calculation included average monthly cloud data, average hours of operation and the average amount of time per year the turbine is yawed in various directions.

Table 5.7-1 Potential shadow durations at 600 feet from a turbine

| Direction from Turbine | Days of Potential Impact per Year[1] | Max Hours per Day[2] | Mean Hours per Day[2,3] |
|---|---|---|---|
| North | 66 | 1.8 | 1.6 |
| Northeast | 97 | 1.8 | 1.2 |
| East | 86 | 1.8 | 1.5 |
| Southeast | 0 | 0 | 0 |
| South | 0 | 0 | 0 |
| Southwest | 0 | 0 | 0 |
| West | 90 | 1.8 | 1.5 |
| Northwest | 95 | 1.8 | 1.3 |

1. Reduced by 50 percent from theoretical maximum to account for cloud cover. Results would be twice this amount if skies were assumed to be always clear. Not adjusted for yaw position or still winds.
2. Not reduced to account for cloud cover; assumes sky is always clear.
3. Mean hours per day calculated only on days with potential impact. Days without impact are not factored into the average. Mean hours per day would be much lower if days with no potential impact were factored in.

Table 5.7-2 Potential shadow durations at 1,000 feet from a turbine

| Direction from Turbine | Days of Potential Impact per Year[1] | Max Hours per Day[2] | Mean Hours per Day[2,3] |
|---|---|---|---|
| North | 12 | 0.4 | 0.3 |
| Northeast | 65 | 1.1 | 1.0 |
| East | 52 | 1.2 | 0.9 |
| Southeast | 0 | 0 | 0 |
| South | 0 | 0 | 0 |
| Southwest | 0 | 0 | 0 |
| West | 49 | 1.2 | 0.9 |
| Northwest | 62 | 1.1 | 1.0 |

1. Reduced by 50 percent from theoretical maximum to account for cloud cover. Results would be twice this amount if skies were assumed to be always clear. Not adjusted for yaw position or still winds.
2. Not reduced to account for cloud cover; assumes sky is always clear.
3. Mean hours per day calculated only on days with potential impact. Days without impact are not factored into the average. Mean hours per day would be much lower if days with no potential impact were factored in.

Figures 5.7-2 through 5.7-4 show traces of the rotating turbine blade shadows on three days: the winter solstice, equinox, and the summer solstice. For each shadow trace, the position of the shadow is shown at various times of day, from 30 minutes after sunrise to 30 minutes before sunset. The turbine is assumed to be oriented perpendicular to the sun, thereby casting the largest shadow. As the days of the year pass from the winter to summer, the shadow trace also moves from the winter solstice trace through the equinox trace to the summer trace.

Figures 5.7-2 through 5.7-4 also show that the areas most likely to experience shadow flicker occur to the east and west of the turbine tower locations. However, the number of hours per year during which shadow flicker could occur lessens as distance from the turbine increases. There are three reasons why this is so:

- As the season passes from winter to summer, the shadow angles at sunrise and sunset move from north to south. Because this angle changes, a residence further from the turbine would most likely experience shadow flicker only during a few days per year.

- As the sun rises or sets, the turbine shadow length changes rapidly, so that a residence further way from the turbine location would experience shadow flicker for only a short time during the day.

- A discernable shadow forms or dissipates within 15 to 45 minutes of sunrise or sunset, depending on sky conditions.

Figure 5.7-2 Shadow traces at winter solstice

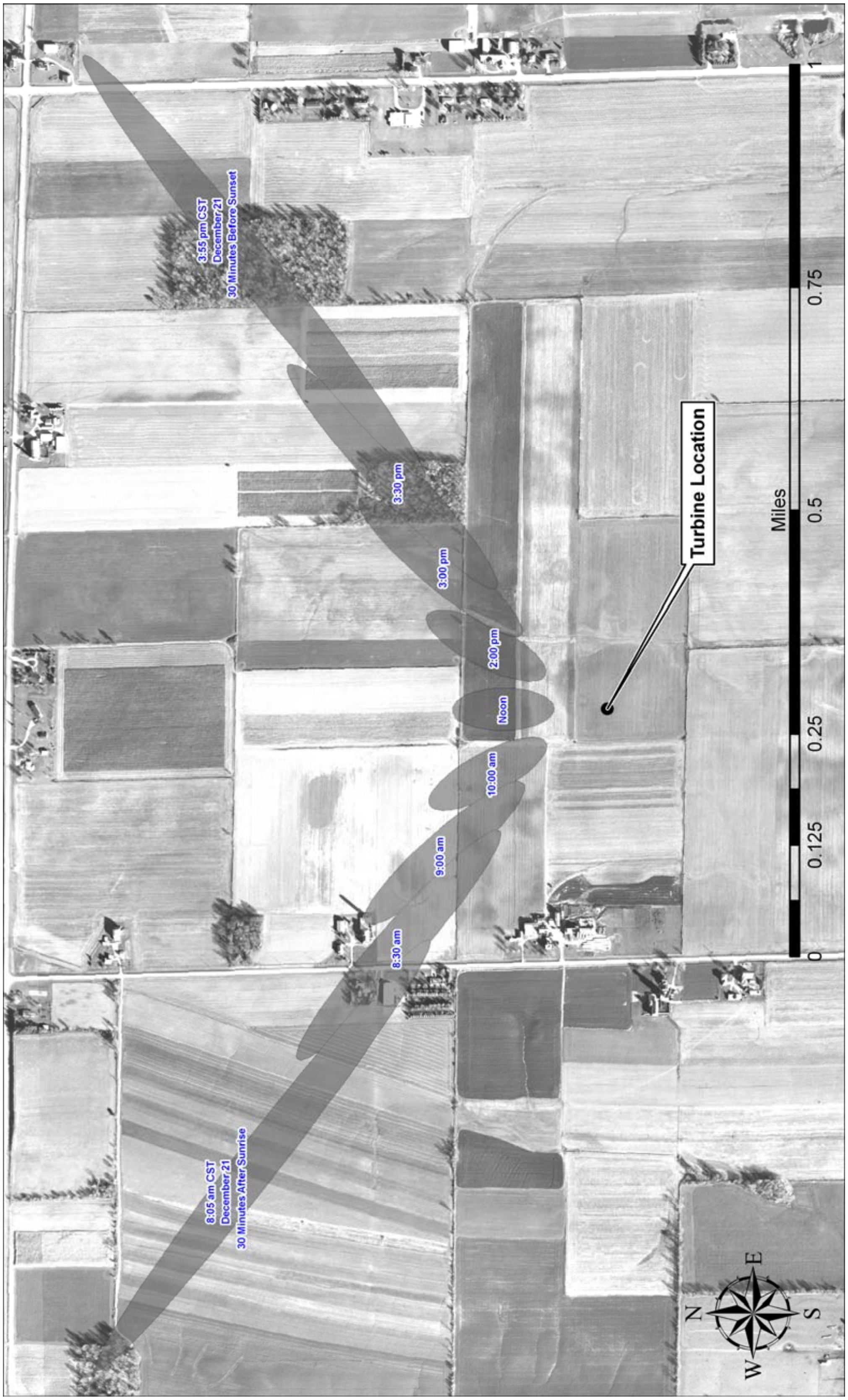


Figure 5.7-3 Shadow traces at equinox

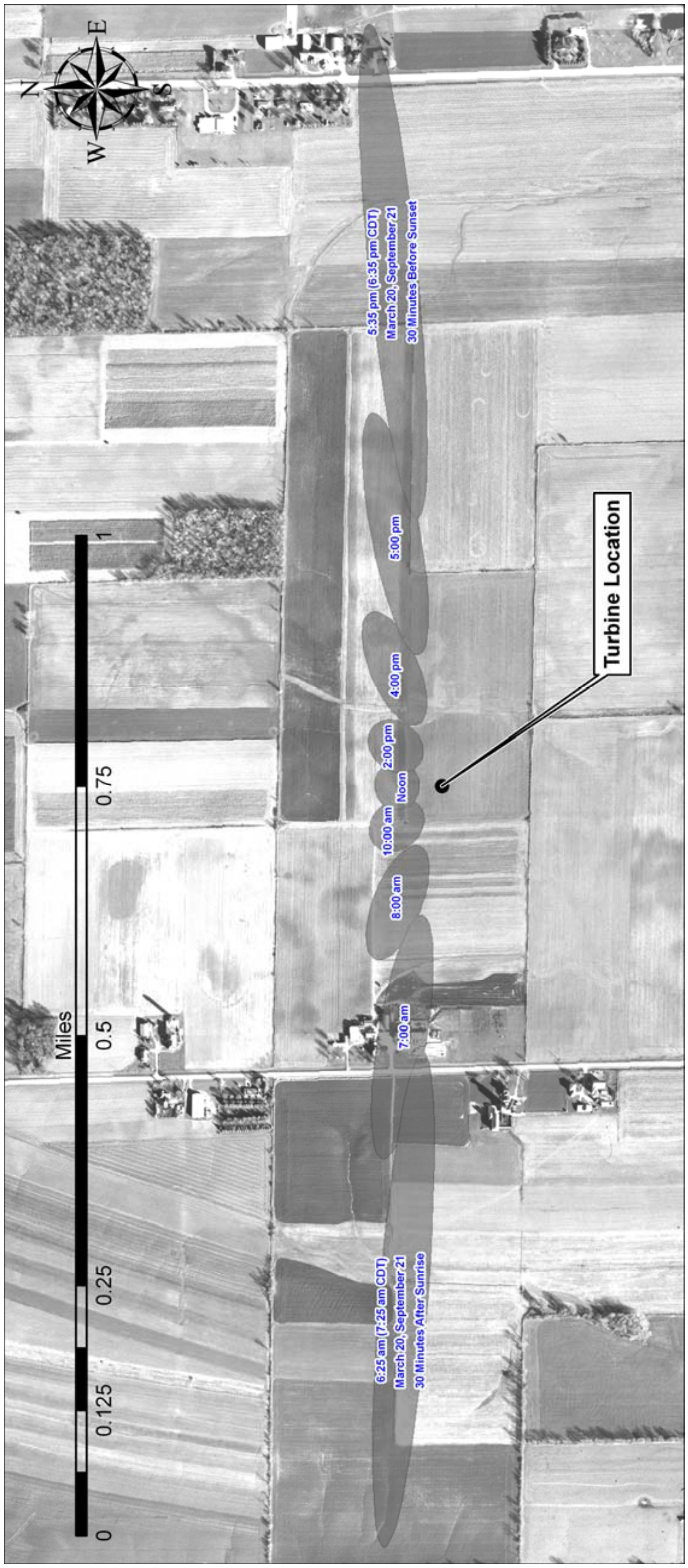
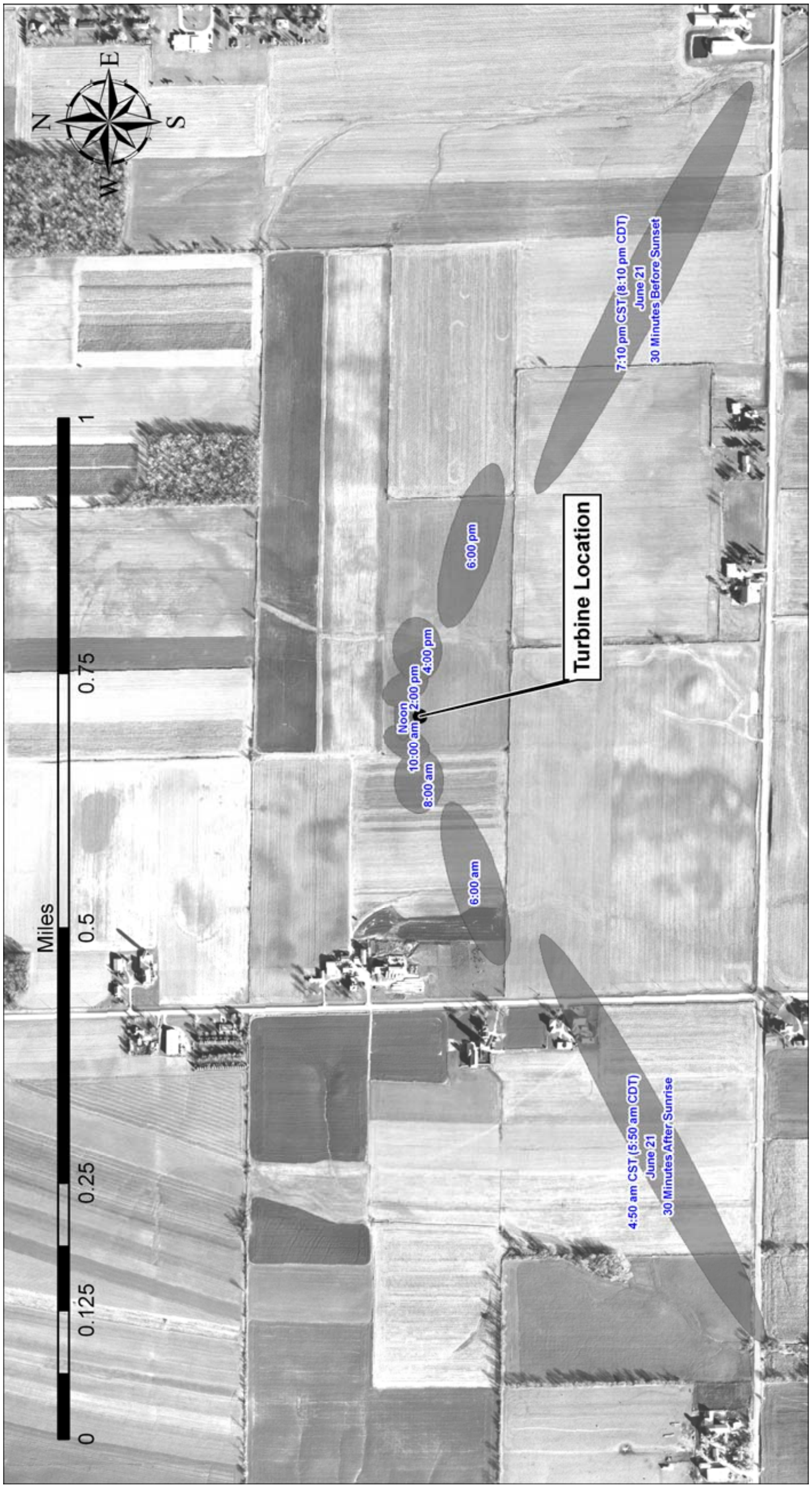


Figure 5.7-4 Shadow traces at summer solstice



#### 5.7.1.3. Possible effects of shadow flicker

Shadow flicker from a wind turbine may cause an annoyance and health concerns for project area residents. According to WEPCO's modeling, many residences in the project area would experience some shadow flicker. Residences that are greater than 1,000 feet from a wind turbine could experience shadow flicker for shorter periods, but most likely only for a few days per year as the sun's path changes with the seasons.

Two types of concerns have been raised regarding shadow flicker: (1) annoyance and (2) possible epileptic seizures. Epileptic seizures can sometimes be triggered by certain frequencies of flashing or flickering light sources. This is a fairly rare condition known as photosensitive epilepsy. By 20 years of age, studies show that approximately one percent of the population may develop epilepsy. About 3 percent of those with epilepsy have photosensitive epilepsy. Photosensitivity is more common in children and adolescents and becomes less common from the mid-twenties onward. The frequency of flicker that could trigger the epileptic seizure varies from person to person; however, it is frequencies from 5 to 30 Hz that are most likely to cause the seizure. While some epileptic patients are sensitive at higher frequencies, the triggering of photosensitive epileptic seizures by flicker below 3 Hz is uncommon. None of the proposed wind turbines would produce a shadow flicker above 1 Hz.

#### 5.7.1.4. Possible mitigation of shadow flicker

Prior to the operation of the wind turbines and upon the request of a landowner, WEPCO would provide site-specific shadow flicker evaluations for the residence. Factors considered would include land contour, orientation of the residence, existing visual barriers, and location of all nearby turbines. Details provided by WEPCO would include an estimate of the anticipated total hours a year of shadow flicker, as well as a summary of their duration, time of year, and time of day. A graphical calendar detailing the shadow on the residence by time of day and month of the year for each turbine could also be generated.

After the wind turbines are operating, WEPCO would work expeditiously with homeowners who complain about shadow flicker impacts to implement reasonable and appropriate mitigation. Mitigation could include room-darkening shades or blinds in the windows affected by the turbine shadow or appropriately located vegetative barriers. One commenter suggested stopping the rotation of the blades whenever shadow flicker adversely affects a homeowner.

### 5.7.2. Mechanical hazards

#### 5.7.2.1. Turbine collapse and blade throw

There are few incidents of utility-scale wind turbine blades breaking loose from their hub or turbines collapsing. However, they have occasionally occurred in Europe and the U.S. The incidents have been a result of lightning strikes, improper assembly, or improper manufacture of the turbine components.

#### 5.7.2.2. Ice shedding and ice throw

Ice throw from wind turbines has been studied in a number of European cold climates.[18,19] "Rime ice" or "glace ice" can form on a wind turbine given the right combination of temperature and moisture. Rime ice occurs when objects such as trees or wind turbines are exposed to low temperatures in combination with fog. Depending on the duration of the ice conditions, significant amounts of rime ice can collect on the turbines, and increase static and dynamic loads. Glace ice can occur when a warm front drifts above cold air. The falling rain can cool down to temperatures below the freezing point without actually freezing into solid ice. If the super-cooled rain hits the surface or objects with temperatures below 32°F, it will instantly turn to a layer of solid ice. Ice accretion can be collected by all parts of the turbine structure.

Studies show the majority of the ice throws are small (less than 50 grams), though larger ice fragments can occur. Furthermore, the majority of the ices thrown from turbines are within 80 meters (262 feet) of the turbine base.

When rime ice or glace ice would occur, the turbine would shut down if the blades became unbalanced and the vibration sensor stops the turbine. The turbine would restart when the ice had been shed.

It is expected that there would be little danger to public safety from wind turbine ice throw because the setbacks typically required for other safety issues would also work to minimize the likelihood of impacts from ice throw. No impacts from wind turbine ice throws have ever been documented in Minnesota where hundreds of wind turbines have been installed and have operated for many years.

### 5.7.3. Lightning protection and grounding

To protect the wind turbines from damage caused by lightning strikes and to provide grounding for electrical components of the wind turbine, an electrical grounding system would be installed at each turbine location. Parts of the grounding system would be built into the wind turbine blades, nacelle, and tower. In addition, a buried grounding system would be constructed as part of the wind turbine foundation pad. Design of the buried grounding system would consider local soil electrical conductivity conditions to ensure that electricity from lightning strikes would be dissipated into the ground. The design of the grounding system would also consider local electrical codes. A schematic of a typical turbine grounding system is included in Figure 5.7-5.

A lightning receptor would be built into each wind turbine blade tip, and would function similar to a lightning rod. The lightning receptor would be connected to the main turbine bed plate in the nacelle by a copper grounding conductor that would run the length of each blade. The electrical generator would be mounted on and electrically connected to the main turbine bed plate.

The nacelle would be fitted with a lightning rod to protect it from direct lightning strikes. Like the blade tip lightning receptors, the nacelle lightning rod is connected to the main turbine bed plate by a copper grounding conductor. The main turbine bed plate would be connected by at least two copper conductors that would run down to the base of the turbine tower, where they would connect to the

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18 Cattlin, R., S. Kunz, A. Heimo, G. Russi, and M. Tiefgraber, Wind Turbine Ice Throw Studies in the Swiss Alps, 2007 proceedings, The European Wind Energy Association (EWWA), [http://www.ewec2007proceedings.info/allfiles2/272_Ewec2007fullpaper.pdf].

19 Durstewitz, M.; On-site Cold Climate Problems- presented at BOREAS VI; April 2003, Pyhatunturi, Finland [http://web1.msue.msu.edu/cdnr/icethrowseifertb.pdf].

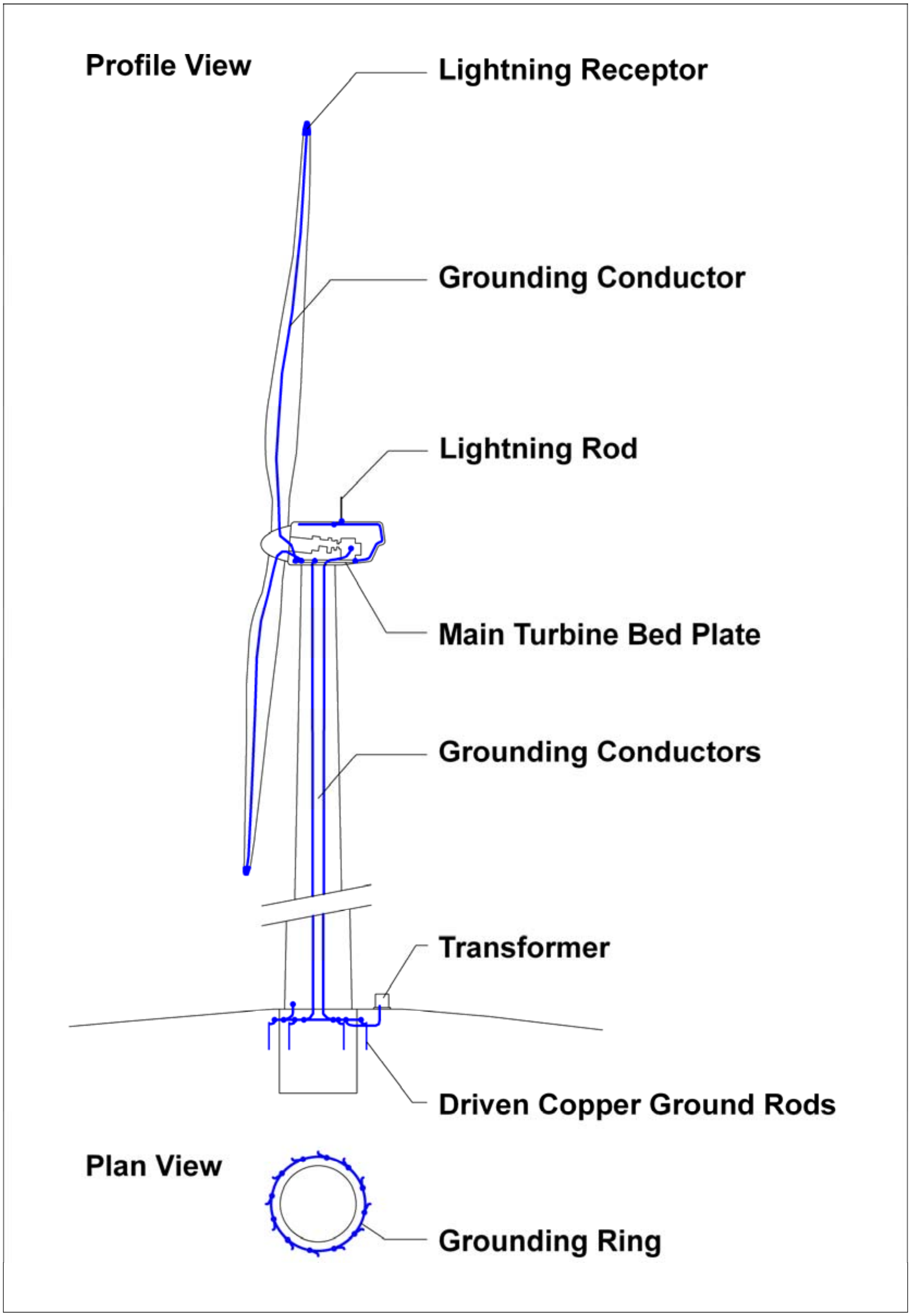
buried grounding ring. In addition, the steel turbine tower and the turbine transformer would be connected to the grounding ring.

The grounding ring would be constructed of a ring of buried copper conductor that would encircle the turbine foundation. The ring of copper conductor would be connected to copper grounding rods that would extend down into the soil. The number of ground rods would depend on soil conditions. If the soil conditions were such that electricity is easily conducted into the soil, fewer ground rods would be used. Conversely, if soil conditions did not readily allow for the flow of electricity off of the grounding ring, it would be necessary to use more copper ground rods.

The grounding system is usually constructed from a material like 250 kCM bare copper wire and eight-foot long, 5/8-inch diameter rods driven into the ground. The conductor comprising the grounding ring would be installed at least 30 inches below ground level and approximately 18 inches from the tower foundation. Ground rods would be equally spaced along the grounding ring, approximately 24 inches from the grounding ring conductor. The ground conductor would be extended to the transformer.

Wind turbines proposed for the WEPCO project would come from the manufacturer with lightning protection and grounding hardware. The grounding ring and connections of the turbine and transformer to the grounding ring would be WEPCO's responsibility.

Figure 5.7-5 A typical schematic of proposed wind turbine grounding system



### 5.7.4. Induced and stray voltages

Stray voltage is a term used to describe a physical phenomenon that may affect confined livestock. Stray voltage is a special case of voltage where a current flow is present across two animal contact points. These contact points can include any two conductive points which the animal may simultaneously contact to complete a circuit (the path) which allows current to flow. Stray voltages are low-level voltages and should be distinguished from painful shocks felt by humans.

Stray voltage can be present whenever electrical systems are in operation. There are several potential contributors to stray voltage including unbalanced loading, improper or damaged grounding systems, improperly installed electrical equipment, or naturally occurring influences. Utility systems need to be "grounded" in order to provide a return path for electricity when a "fault" condition or lightning strike occurs. The proper grounding of a utility system is the core of electrical safety. Removing the grounding from a utility system jeopardizes the safety of everyone. The occurrence of neutral-to-earth voltage and current flow on neutral and grounding conductors is an unavoidable consequence of the use of electrical power. Complete elimination of these phenomena is unrealistic.

The state of Wisconsin has the most extensive stray voltage program of any state in the nation and was the first state to establish stray voltage regulations, which have been modeled by other states. Studies on the effects of stray voltage on livestock began more than four decades ago. These studies, conducted by hundreds of independent researchers, have provided a solid understanding of the way electricity affects animals and what levels can cause problems.

Buried cable, as proposed for the collector circuits for this wind project, is one of the effective methods to mitigate the potential for impacts to confined livestock from stray voltage.

In areas where transmission and distribution systems are in close proximity, transmission lines can induce voltages and currents on the distribution system through high electric and magnetic fields (EMF). An extensive length of underbuilt distribution beneath a high-voltage transmission line could allow such an induction process to occur. The coupling between the two is primarily caused by the magnetic field that surrounds the transmission line conductors. Inductive coupling of voltages and currents into the distribution system is minimized with proper arrangement of the conductors in relation to each other and the ground.

No overhead collector circuits or new overhead transmission lines, other than those associated with the interconnection substation, are proposed for this wind project.

### 5.7.5. Electric and magnetic fields

#### 5.7.5.1. EMF basics

Concerns regarding exposure to EMF are often raised during power plant and transmission line construction cases. Magnetic fields are created when an electric current flows through a conductor. Magnetic fields vary in intensity depending on how much electric current is flowing at any given time; the higher the electric current, the larger the magnetic field. There is no relationship between magnetic field and voltage of the line. The intensity of magnetic fields also decreases with distance from the source. Magnetic fields can be reduced by decreasing the current flow, increasing the distance from the source, or by bringing individual conductors closer together. Power lines and the structures that support them can be designed to reduce the resulting magnetic fields. This is accomplished by properly arranging the individual conductors so that their respective magnetic fields interact and partially cancel one another.

Magnetic fields occur whenever and wherever electricity is used. Common sources of magnetic fields include electric blankets, fluorescent lights, electric appliances (computers, microwaves, televisions, washing machines, etc.), electric baseboard heating, and power lines. Because there are so many common sources of EMF, we are exposed to a wide variety of magnetic fields every day. Magnetic fields are measured or estimated in units of Gauss (G) or milligauss (mG) (a milligauss is equal to 1/1000th of a Gauss). Measurements of power line EMF are always reported in mG.

#### 5.7.5.2. EMF and human health

Scientists have found only weak and inconsistent epidemiological associations between exposure to power-frequency EMF (the kind created by power lines) and human health. Several epidemiological studies have shown a statistical association between the risk of childhood leukemia and the kind of electric wires outside the home. However, many epidemiological studies have found no link to leukemia. Cellular studies and studies exposing test animals to EMF have shown no link between EMF and disease. Taken as a whole, the biological studies conducted over the last 25 years have not been able to establish a cause-and-effect relationship between exposure to EMF and human health effects. In addition, there have been no plausible biological mechanisms discovered to explain how exposure to power-frequency EMF might cause human disease.

For more information on EMF and human health, a free publication, entitled EMF – Electric and Magnetic Fields is available on the PSCW web site (http://psc.wi.gov).

#### 5.7.5.3. Sources of EMF

The only source of EMF from this project would be the collector circuits constructed between the turbines and connecting them to the substations. WEPCO had an analysis of the electric and magnetic fields that would be generated by both single-circuit and double-circuit configurations overhead and underground at distances of 0, 25, 50, and 100 feet from the circuit centerline. Table 5.7-3 shows the result of the analysis. (WEPCO initially proposed a short overhead collector circuit, but that line is now proposed to be constructed using an underground configuration.)

Table 5.7-3 Calculated magnetic field levels (mG) for the possible buried cables and overhead line near the substation

| Distance from Centerline | Centerline | 25 feet | 50 feet | 100 feet |
|---|---|---|---|---|
| Double-circuit overhead | 56.0 | 36.1 | 17.5 | 5.7 |
| Single-circuit underground | 15.3 | 1.2 | 0.3 | 0.1 |
| Double-circuit underground | 27.5 | 2.4 | 0.6 | 0.2 |
| Quad-circuit underground | 21.2 | 5.4 | 1.3 | 0.3 |

Note: WEPCO initially proposed a short overhead collector circuit, but that line is now proposed to be constructed using an underground configuration.

The estimated electrical fields would be negligible. The estimated magnetic fields are within the range of values generally anticipated for such a project. They do not exceed the maximum recommendations for pacemaker devices and the values are on the same order of magnitude as those generated by electric appliances used in most homes. WEPCO currently proposes to construct all cable underground which typically generates lower magnetic field levels than overhead lines.

### 5.7.6. Potential electric distribution service interruptions

Local overhead electric distribution lines are located throughout the project area. The lines in the area are about 16 feet above the traveled surface. These lines might interfere with construction equipment and trucks hauling turbine components. For these deliveries, pole stands that lift the line above the truck may be employed eliminating the need for line disconnection. In other locations, "line drops" may be used. For a line drop, the local electrical service is disrupted for a brief time and the line is temporary rerouted underground for a short distance. Where line drops or pole stands are not practical, the expected outage for a material delivery would be 10 to 15 minutes.

Some distribution lines may also intersect with cross-country crane paths. These distribution lines would most likely need to be disconnected for approximately 20 to 30 minutes for the passage of the crane. However, wherever possible, WEPCO plans to use line drops to minimize disruptions to the electrical service.

In the event that distribution service needs to be interrupted, WEPCO would coordinate the interruption with the local distribution company and municipal officials. Potentially affected residents would be notified by telephone, mailer, door cards, and/or house to house contacts.

### 5.7.7. Medical helicopters

Medical helicopters are part of the emergency response system in southern Wisconsin. Wind turbines can limit potential landing sites for the helicopters, both because of the physical presence of the turbines and the dangers related to flying through the disturbed air (wake turbulence) extending away from an operating turbine.

UW Med Flight is the responding air ambulance service closest to the Glacier Hills project area. UW Med Flight and the other responding agencies plan to develop safe landing sites or locations within the project area to which medical helicopters could be dispatched. Establishing alternate landing zones in an area is a common tool employed by medical helicopter services where terrain, vegetation, or structures restrict landing sites.

The reduction in potential landing areas within the project area could result in persons needing to endure additional (or longer) ambulance rides to reach the helicopter, which in turn increases the overall travel time to the hospital. Generally, the quicker a patient reaches a hospital for treatment, the better the chance that the patient will survive.

In some instances, alternate landing sites may not be required; a medical helicopter can land in proximity to a wind turbine if it is safe and prudent to do so. There do not appear to be any UW Med Flight rules or policies that would preclude landing within the wind project area if it is safe to do so. The decision about where to land is the pilot's and is based on a variety of site factors that present themselves upon arrival at an emergency scene. For example, closer landings to a turbine might be possible if the winds are calm and the wind turbine rotors are not rotating.

### 5.7.8. Emergency shutdown options for turbines

There are basically three mechanisms through which one or more turbines could be powered off in an emergency situation. These mechanisms are described below.

- Automatic Response—Emergency conditions such as ice buildup or power outages would be detected by the turbines' extensive instrumentation and result in automatic shutdown. The turbines are highly computerized with over two hundred sensors in each unit that monitor weather, temperatures, pressures, safety interlocks, and other operating conditions. If any of these sensors either fail or pick up an alarm condition, the turbine computer would shut the unit down automatically.

- Operator Intervention—Manual responses by operators could also be utilized. The entire wind park would be monitored by a SCADA (Supervisory Control and Data Acquisition) system that allows operators to monitor the operation of the units, and also remotely shut down individual units or the entire wind park if emergency conditions dictate the need to do so. The WEPCO System Control Center would monitor the wind park output and conditions at the substation. If an emergency condition occurred, the controllers at the Control Center could shut down the entire substation or individual circuit breakers within the station.

- Emergency Response Personnel—This situation includes conditions that require emergency response personnel, such as fire or medical response. If the Automatic Response has not shut down the subject turbine, the operators would take action to do so by calling 9-1-1, securing the surrounding area, accounting for all personnel, and preventing public access. Authorized personnel would direct the emergency responders to the appropriate location.

# 5.8. NOISE

## 5.8.1. Background

The decision to prepare an EIS in this docket was based, in part, on comments submitted to the Commission on the EA it prepared for the project. Comments received on the EA included those submitted by CWESt. CWESt's comments focused on the noise section of the EA, and those comments were considered as the following sections of the EIS were prepared.

### 5.8.1.1. Descriptions of operating wind turbine and construction noise

Noise from an operating wind turbine is typically produced by both mechanical and aerodynamic sources. Mechanical noise is created by bearings, gear housings, cooling fans, yaw drives, and the generator itself. The tower and nacelles may also conduct or transmit mechanical noise. Methods for reducing mechanical noise in wind turbines include using low-speed cooling fans, special finishing of gear teeth, adding baffles and acoustic insulation to the nacelle, and using vibration isolators and soft mounts for major components. The mechanical noises are generally emitted at tonal frequencies associated with the rotating machinery.

Aerodynamic noise is created when the turbine blades cut through the air. Noise generated by wind turbines depends on the wind speed and the design of the turbine. The flow of air over the rotating turbine blades is not smooth, resulting in turbulence and noise. Aerodynamic noise is broadband in character, meaning that the noise occurs over a wide frequency range.

Noise is also generated during construction of the wind turbines. Construction noise would come from a series of intermittent sources, most of which would be diesel engine drive systems that power most construction equipment. Because of the unique nature of large-scale wind projects, the construction phase would be spread over a large area rather than confined to a relatively small, fenced-in plant site. Construction noise impacts would vary significantly with time of day, stage of construction, and turbine location. Construction of access roads and foundations, and turbine component and crane deliveries, are likely to be the loudest sources of construction noise. Construction would occur primarily during daytime hours, so there would be little or no construction noise impact at night.

The types of noise generated by construction of the wind farm are not expected to be significantly different from noises associated with other common outdoor construction activities. Thus, the remainder of this section focuses on turbine aerodynamic and mechanical noises.

#### 5.8.1.2. Noise measurements

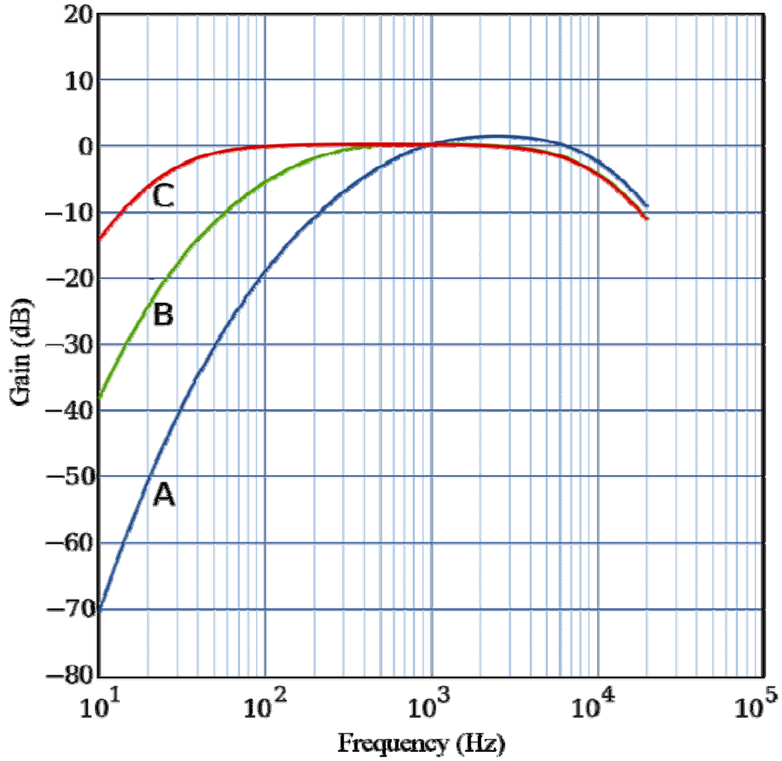
Everyday sounds are comprised of sound waves of many different frequencies. The frequency of a sound wave is measured in Hz, with one Hz equal to one sound wave cycle per second. Sound levels are measured with a device called a sound level meter in units known as decibels (dB).

While the frequency range of human hearing is generally accepted to be between 20 to 20,000 Hz, the human ear is not equally sensitive to sounds through that entire range. Accordingly, when sound level measurements are taken, it is customary to use weighting curves in conjunction with the sound level meter to approximate the frequency sensitivity of human hearing. Three internationally standardized weighting characteristic curves exist for sound measurements: characteristic A for sound levels below about 55 dB, characteristic B for sound levels between about 55 and 85 dB, and characteristic C for sound levels above about 85 dB.[20] In practice, the B weighting characteristic curve is rarely used. A graphical representation of these weighting curves is included in Figure 5.8-1. When sound levels are measured using a weighting characteristic, the measurements are designated by adding the characteristic curve letter after the abbreviation for decibels, such as 58 dBA.

In some instances, sound level measurements are taken without weighting. Those sound levels are typically expressed in dB, and are referred to as unweighted sound levels.

[20] Beckwith and Buck, Mechanical Measurements, Second Edition, 1969.

Figure 5.8-1 Sound level frequency weighting curves




#### 5.8.1.3. Common sound levels

Sound levels above 140 dBA can cause immediate damage to hearing. At the other end of the spectrum, normal breathing generates a sound of about 10 dBA while a soft whisper registers at around 30 dBA. Normal conversation would be about 60 dBA at a distance of three feet. People are exposed to a wide variety of noise levels in their living environment. Typical ambient noise levels in an urban environment can range from 58 dBA for a quiet urban area to as much as 72 dBA or more for very noisy neighborhoods. For small towns and quiet suburbs, ambient noise levels typically range from 47 to 53 dBA. Rural areas are even quieter, with noise levels during the daytime hours of around 45 dBA. In the workplace, a medium-sized office would exhibit, on average, a noise environment of around 63 dBA. Inside a typical residence, daytime noise levels can vary from 40 to 45 dBA with no television or radio playing, to between 50 and 70 dBA while listening to television or stereo music.[21,22]

#### 5.8.1.4. Sound level calculations and human perception of sound

In order to determine the likely impact of a new sound source it is important to understand how new sources of sound add to the ambient environment. Sound levels (as measured in dB) are logarithmic rather than linear. This means that the decibel levels emitted by two different sound sources cannot simply be arithmetically added together to determine the combined effect of those sound sources. As a generally accepted rule of thumb, two noise sources emitting sound at the same dB level would have

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[21] Environmental Protection Agency, 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety.
[22] Talbott, E.O. and G.F Craun, 1995. Introduction to Environmental Epidemiology. Lewis Publishers.

a combined total sound level of 3 dB greater than either source alone. The same rule can be applied to weighted sound levels.

As a point of reference, sound experts generally agree that the human ear can detect changes in dBA roughly as follows:

- A change of 3 dBA or less is barely perceptible.
- A change of 5 dBA is perceptible.
- A change of 10 dBA is perceived as either twice or half as loud.

Sound levels decrease with distance from the source. Assuming there are no obstructions between the sound source and receptor, the sound from a single point source decreases by approximately 6 dBA for every doubling of the distance. For a sound source that is a continuous line, such as a highway, the sound levels will generally decrease by about 3 dBA with a doubling of the distance from the source. In addition to distance, sound levels can be affected by intervening structures or objects such as buildings, trees, and shrubs.

#### 5.8.1.5. Sound level reporting

When sound level measurements are taken over a period of time, the overall sound level is expressed as $L_{eq}$. This quantity can be thought of as the equivalent or average sound level over the period of the measurement, and may be expressed in dBA, dBC, or unweighted dB.

In addition to $L_{eq}$, a number of statistical sound level measures are commonly used to characterize noise environments. One of the more important of these statistical measures is $L_{90}$ noise levels in both dBA and dBC. The $L_{90}$ is the sound level that is exceeded 90 percent of the time, and is generally accepted to represent the sound that is nearly always present in a given noise environment, as it reduces the influence on the measurements of short-duration, transient noises such as automobile drive-bys and aircraft fly-overs. Some other statistical measures commonly used include $L_{10}$ and $L_{50}$, which represent the sound levels exceeded 10 and 50 percent of the time, respectively.

Octave band measurements are often used to characterize sounds over the frequency range. These measurements quantify the sound level in specific frequency ranges, which are typically centered at 16, 32, 63, 125, 250, 500, 1000, 2000, 4000, and 8000 Hz. One-third octave band measurements are sometimes used, where there would be three measurements in each octave at various center frequencies. Octave band measurements can be reported in dBA, dBC, or dB, and in any of the statistical measures.

Because of the differences in the A-weighted and C-weighted characteristic curves, subtracting the dBA measurement from the dBC measurement yields a rough estimate of the low-frequency component of the sound. Referring to Figure 5.8-1, the difference between the $L_{eq}$ in dBA and the $L_{eq}$ in dBC would result in a numerical representation of the area under the C-weighting curve that does not also lie under the A-weighting curve.

### 5.8.2. Noise level standards

Acceptability standards for noise vary by nation, state, and locality. In the U.S., the EPA only provides noise guidelines, not standards. Some state governments issue their own regulations and local governments often enact noise ordinances. There are no statewide noise standards for wind turbines in Wisconsin nor do the towns of Randolph or Scott have noise standards. WEPCO's easement contracts set distance limits for noise relative to participating landowners, using 50 dBA as the maximum allowable noise level. The JDAs being negotiated may set distance limits for noise relative to non-participating landowners, but these levels have not yet been agreed upon.

### 5.8.3. PSC Noise Measurement Protocol requirements

WEPCO hired a consultant to conduct a noise study as required by the PSC Noise Assessment Measurement Protocol (Noise Protocol).[23] This protocol is part of the PSC's application requirements for wind project developers.[24] In summary, the Noise Protocol requires the applicant or its consultant to take a series of ten-minute sound level measurements in the project area prior to construction to establish the nature of the pre-construction noise environment. These measurements are required to be taken during various periods during the day, at each of several measurement point (MP) locations agreed upon between Commission staff and the applicant. The required measurement periods are as follows:

Table 5.8-1 Required noise measurement periods

| Measurement period | Military time | Time period |
|---|---|---|
| Morning | 0600-0800 | 6:00 a.m. to 8:00 a.m. |
| Afternoon | 1200-1400 | Noon to 2:00 p.m. |
| Evening | 1800-2000 | 6:00 p.m. to 8:00 p.m. |
| Night | 2200-2400 | 10:00 p.m. to Midnight |

MP locations are selected to provide information on the range of noise environments in a project area. Some examples of areas commonly selected for measurements include: areas with residences, areas with industrial noises (such as near the United Wisconsin Grain Producer's ethanol plant), quiet areas, and public areas.

Required pre-construction measurements at all locations include $L_{eq}$, and statistical measures of $L_{10}$, $L_{50}$, and $L_{90}$, all in both dBA and dBC. In addition, unweighted octave band measurements are required at each MP during each time period, down to center frequencies of at least 16 Hz. The applicant is required to provide estimates of the increase in sound levels during each measurement period and at each location using sound data provided by the wind turbine manufacturers.

Finally, the applicant is required to provide a sound level contour map showing the anticipated sound levels from the proposed project. The sound levels shown on this map, in conjunction with measurements of existing sound levels, are used to estimate the increase in sound levels in the project area.

If the project is approved, the applicant is usually required by the Commission's order to collect post-construction noise measurements in accordance with the Noise Protocol. These measurements are taken at the same MPs and during the same time periods as the pre-construction measurements.

[23] http://psc.wi.gov/utilityinfo/electric/construction/documents/noiseprotocol.pdf
[24] http://psc.wi.gov/utilityinfo/electric/construction/documents/V45_Wind%20Farm.pdf

Two sets of measurements are required: one with the turbines operating; and one with the turbines not operating.

## 5.8.4. Pre-construction noise study results

After the draft EIS was issued, WEPCO's consultant identified an incorrect instrumentation setting that affected the sound level measurements collected during its initial noise study, which was conducted over a 13-day period from June 25 to July 8, 2008. The incorrect instrumentation setting caused noise measurements to be limited to no lower than about 33 dBA. Measurements recorded during periods when sound levels were above about 33 dBA were not affected. To correct this error, noise measurements in the project area were again collected over a four-day period from July 12 to July 16, 2009.

New sample measurements collected in 2009 were taken at the same locations and during the same measurement periods used for the 2008 noise study.

Continuous measurements, which are not required by the PSC's Noise Protocol, were collected only at location MPC in 2009, as shown in Figure 5.8-2. Based on useful data from the 2008 measurements, WEPCO's consultant states that ambient sound levels are similar throughout the project area, with the exception of the area near the United Wisconsin Grain Producer's Ethanol plant, located north of STH 33 on Tessman Road. For this reason, WEPCO's consultant concluded that sound levels at MPC represent typical ambient sound levels for the project area as a whole, and that continuous measurements at the other two locations were not necessary. Continuous measurements were used primarily to correlate ambient sound levels to wind speed, and to predict the maximum increase in sound levels.

The original consultant's report showing the 2008 measurement results, its update showing the 2009 measurement results, a Commission staff data request, and WEPCO's responses to that data request are included in Appendix C. The balance of Section 5.8.4 and all of Section 5.8.5 have been revised to show the results of the 2009 measurements.

### 5.8.4.1. Measured sound levels

A summary of dBA and dBC sound level measurements taken in the project area in 2009 is included in Table 5.8-2. Measurements of ambient sound levels, $L_{eq}$, in the project area range from 23.9 to 64.7 dBA, and 39.8 to 78.4 dBC. Measured $L_{90}$ levels range from 20.4 to 40.9 dBA, and 36.3 to 58.2 dBC.

In addition to the pre-construction ten-minute sample measurements the PSC requires as part of its Noise Protocol, WEPCO's consultant also collected $L_{90}$ sound level measurements in dBA over a four-day period from July 12 to July 16, 2009, at measurement point MPC. These measurements were taken continuously in ten-minute intervals over the entire four-day period. The location where this continuous monitor was placed is shown in Figure 5.8-2. The results of the continuous measurements are included in the consultant's report, Appendix C.

As mentioned previously, dBC measurements, in conjunction with dBA measurements, can be used to calculate an estimate of the low-frequency component of the noise environment. Based on this calculation, the difference between the existing $L_{90}$ dBC and dBA levels in the existing ambient noise environment ranges from 8.0 to 26.4 dBC. Of the three highest differences, the two of the three highest are calculated from measurements taken during "windy" conditions as described by the consultant's field notes. Those two differences are also influenced by traffic sounds, according to the consultant's field notes. The third highest, at 24.4 dBC, occurs at MP1, which is influenced by the United Wisconsin Grain Producer's Ethanol plant. According to the consultant's field notes, the ethanol plant and a high-altitude plane are audible during the measurement. It is generally accepted that collection of dBC measurements is complicated by higher wind conditions, and those measurements tend to be higher than expected. A map showing the locations where the existing ambient noise measurements were taken is also included in Figure 5.8-2.

WEPCO's consultant recommends that the turbine noise be limited to a maximum of about 60 to 65 dBC in order to avoid annoyance from low frequency sounds. The consultant calculated that dBC noise levels would range from 58 to 62 dBC (depending on turbine model) at the closest potential non-participating residence.

#### 5.8.4.2. Predicted post-construction noise level from turbines

As required by the PSC's Noise Protocol, WEPCO's consultant prepared an estimate of the noise emissions from the proposed project. This estimate was prepared in two ways:

1. By manual calculation using turbine manufacturer's octave band sound level data for the worst-case (loudest) turbine model option; and,
2. By computer modeling using CadNA (Computer Aided Design for Noise Abatement) published by Datakustik, GmbH in Germany, a dedicated computer sound propagation model expressly developed for power plant applications.

Using method one, the range of noise emissions from the proposed project is expected to be 45 to 49 dBA, depending on the turbine model selected. Based on these calculations, WEPCO's consultant concluded that the project would meet a noise limit of 50 dBA.

Using method two, a sound level contour map showing constant sound levels is generated by the computer program. This contour map for the worst-case (loudest) turbine model is included in Figure 5.8-2. From this computer model, the consultant concluded that there could be a few residences along East Friesland road near STH 33 where the modeled level would be 50.3 dBA, or slightly over a 50 dBA limit for the loudest turbine under consideration. The consultant stated that the actual level is expected to be less due to the conservative assumptions used in the model.

#### 5.8.4.3. Predicted post-construction ambient sound level increases

The estimated increase in sound levels with the turbines operating in a four meters per second (about nine mph) wind at a height of ten meters is calculated to be up to 16 dBA. This increase is calculated assuming the worst-case conditions of four nearby operating turbines at 1,000 feet, and represents the expected increase over the average ten-minute $L_{90}$ at a four meters per second wind speed. A four meters per second wind speed was used because it represents the anticipated worst-case condition where turbine noise is near maximum, but wind speed near the ground is still low and sounds caused by wind are minimal. The estimate of the average $L_{90}$ was calculated from data collected during the 2009 pre-construction noise study for the project, from both the sample and continuous measurements. A general rule of thumb is that the human ear can perceive a change of five or more dBA. Thus, it could be expected that noise from the operating turbines would be audible at a number of locations within the project area.

Figure 5.8-2 Sound level measurement locations for the pre-construction noise study and results of computer modeling of the post-construction noise level from turbines in 1 dBA increments

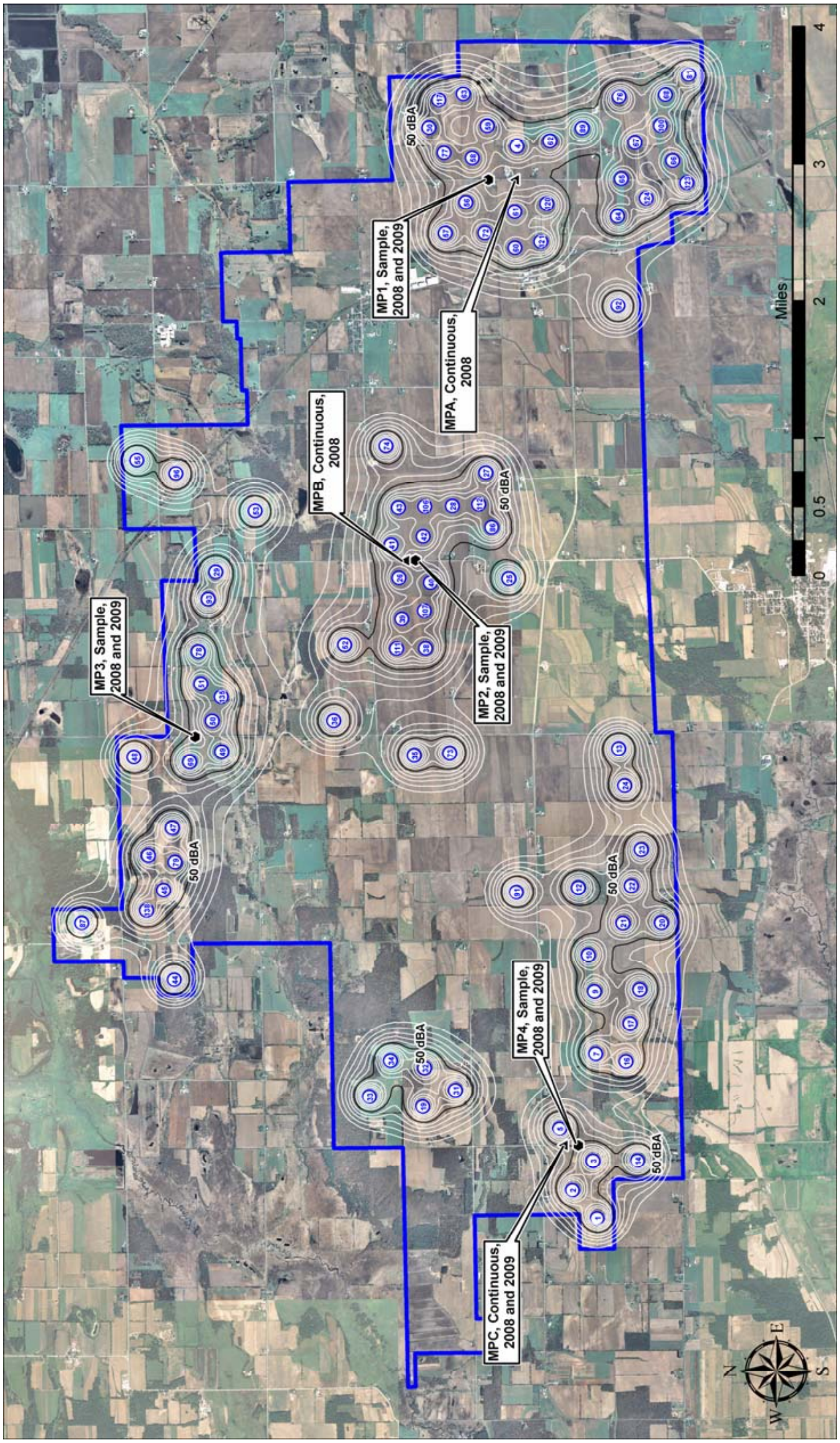

Table 5.8-2 2009 measured ambient sound levels in the Glacier Hills project area

| Measurement Point | Measurement Date | Measurement Period | Measured Ambient Sound Levels | | | | Estimate of Existing Ambient Low Frquency Sound Levels |
|---|---|---|---|---|---|---|---|
| | | | LAeq (dBA) | LA90 (dBA) | LCeq (dBC) | LC90 (dBC) | LC90 minus LA90 (dBC) |
| MP1 | 7/13/2009 | 0600-0800 | 58.8 | 33.8 | 62.6 | 51.4 | 17.6 |
| | 7/14/2009 | 0600-0800 | 58.2 | 40.1 | 65.2 | 56.1 | 16.0 |
| | 7/13/2009 | 1200-1400 | 37.6 | 29.5 | 58.4 | 53.9 | 24.4 |
| | 7/14/2009 | 1200-1400 | 64.7 | 40.9 | 77.9 | 56.9 | 16.0 |
| | 7/13/2009 | 1800-2000 | 45.9 | 27.6 | 55.9 | 49.9 | 22.3 |
| | 7/15/2009 | 1800-2000 | 58.1 | 37.8 | 71.3 | 58.0 | 20.2 |
| | 7/13/2009 | 2200-2400 | 50.3 | 28.7 | 57.7 | 48.8 | 20.1 |
| | 7/15/2009 | 2200-2400 | 50.2 | 40.2 | 61.7 | 57.6 | 17.4 |
| MP2 | 7/13/2009 | 0600-0800 | 46.9 | 35.0 | 52.4 | 47.8 | 12.8 |
| | 7/14/2009 | 0600-0800 | 56.6 | 31.4 | 66.8 | 50.5 | 19.1 |
| | 7/13/2009 | 1200-1400 | 52.1 | 28.6 | 60.2 | 46.4 | 17.8 |
| | 7/14/2009 | 1200-1400 | 54.7 | 33.8 | 67.3 | 58.2 | 24.4 |
| | 7/13/2009 | 1800-2000 | 57.5 | 20.4 | 63.8 | 40.5 | 20.1 |
| | 7/15/2009 | 1800-2000 | 51.6 | 33.1 | 68.5 | 53.7 | 20.6 |
| | 7/13/2009 | 2200-2400 | 43.4 | 22.2 | 56.0 | 40.5 | 18.3 |
| | 7/15/2009 | 2200-2400 | 48.3 | 22.3 | 58.2 | 39.1 | 16.8 |
| MP3 | 7/13/2009 | 0600-0800 | 56.8 | 30.5 | 61.5 | 45.4 | 14.9 |
| | 7/14/2009 | 0600-0800 | 59.5 | 32.4 | 66.6 | 46.3 | 13.9 |
| | 7/13/2009 | 1200-1400 | 39.0 | 30.6 | 56.9 | 50.8 | 20.2 |
| | 7/14/2009 | 1200-1400 | 45.4 | 39.3 | 51.5 | 47.3 | 8.0 |
| | 7/13/2009 | 1800-2000 | 54.1 | 24.2 | 57.8 | 42.2 | 18.0 |
| | 7/15/2009 | 1800-2000 | 44.5 | 37.4 | 59.4 | 49.0 | 11.6 |
| | 7/13/2009 | 2200-2400 | 23.9 | 21.0 | 39.8 | 36.3 | 15.3 |
| | 7/15/2009 | 2200-2400 | 54.1 | 26.3 | 61.5 | 39.8 | 13.5 |
| MP4 | 7/13/2009 | 0600-0800 | 52.9 | 37.9 | 56.8 | 46.0 | 8.1 |
| | 7/14/2009 | 0600-0800 | 33.4 | 28.3 | 55.0 | 50.4 | 22.1 |
| | 7/13/2009 | 1200-1400 | 35.5 | 30.4 | 58.8 | 48.8 | 18.4 |
| | 7/14/2009 | 1200-1400 | 34.6 | 31.1 | 67.5 | 57.5 | 26.4 |
| | 7/13/2009 | 1800-2000 | 63.5 | 27.0 | 78.4 | 42.7 | 15.7 |
| | 7/15/2009 | 1800-2000 | 38.7 | 31.2 | 62.5 | 53.3 | 22.1 |
| | 7/13/2009 | 2200-2400 | 28.9 | 20.6 | 44.3 | 38.3 | 17.7 |
| | 7/15/2009 | 2200-2400 | 38.3 | 22.1 | 54.1 | 40.1 | 18.0 |

#### 5.8.4.4. Octave band measurements

WEPCO's consultant collected one/third octave band unweighted $L_{90}$ measurements concurrently with the 2008 sample measurements. While the detailed results of these measurements are included in Appendix C, it noteworthy to mention that the United Wisconsin Grain Producer's Ethanol plant located north of STH 33 on Tessman Road appears to have a distinct influence on the noise environment at MP1. This influence appears in approximately the 80 to 400 Hz range.

### 5.8.5. Pre- and post-construction noise measurement results at operating Wisconsin wind developments

As mentioned previously, the PSC requires that a noise study be prepared for projects that require PSC review and approval. Typically, the Commission also requires that a post-construction noise study be prepared as a condition of approval of the project. To date, studies have been prepared and filed for three operating wind projects: the Blue Sky Green Field project; the Forward Wind project; and the Cedar Ridge Wind Farm. For the proposed project, WEPCO submitted a pre-construction study as part of its application for this project. Tables 5.8-3 and 5.8-4 summarize the results of the $L_{90}$ measurements in both dBA and dBC from the pre- and post-construction studies at these recently constructed wind farms and the 2009 pre-construction noise data for this project.

While the data in Tables 5.8-3 and 5.8-4 are limited, a few general conclusions can be drawn:

- Pre-construction sound levels in the Glacier Hills project area appear similar to pre-construction sound levels in other wind project areas in Wisconsin.
- The incremental increase in sound levels when wind turbines are operating versus when they are not has been observed to be up to 14 dBA and 11 dBC. The increase in dBA would generally be acknowledged to be very noticeable.
- The incremental increase in low frequency sound levels, calculated by subtracting the $L_{90}$ measurement in dBA from the $L_{90}$ measurement in dBC, has been estimated, using actual sound level measurements, to be up to 24 dBC, although it is not likely that all of this increment is attributable to wind turbines. In fact, the test engineer's field notes filed as part of the report indicate that there was "howling" wind at the time of the measurement. It is generally accepted that collection of dBC measurements is complicated by higher wind conditions. The next highest estimated increase in low frequency sound levels is estimated to be 21 dBC.

Table 5.8-3 Summary of pre-construction noise studies at existing wind project developments in Wisconsin

| Measurement Period | Preconstruction Noise Measurements (1) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0600-0800 | | 1200-1400 | | 1800-2000 | | 2200-2400 | |
| | LA90 (dBA) | LC90 (dBC) | LA90 (dBA) | LC90 (dBC) | LA90 (dBA) | LC90 (dBC) | LA90 (dBA) | LC90 (dBC) |
| **Blue Sky Green Field Wind Project, Docket 6630-CE-294 (for full report, see PSC ERF REF# 50884)** | | | | | | | | |
| Measurement Date | 1/17/2006 | | | | | | | |
| MP1 | | | 41 | | 35 | | | |
| MP2 | | | 39 | | 45 | | | |
| MP3 | | | 32 | | 41 | | | |
| MP4 | | | 37 | | 44 | | | |
| MP5 | | | 42 | | 42 | | | |
| Measurement Date | 1/18/2006 | | | | | | | |
| MP1 | 46 | | | | | | 51 | |
| MP2 | 48 | | | | | | 51 | |
| MP3 | 45 | | | | | | 48 | |
| MP4 | 47 | | | | | | 50 | |
| MP5 | 52 | | | | | | 49 | |
| Measurement Date | 1/19/2006 | | | | | | | |
| MP1 | | | | | | | 35 | |
| MP2 | | | | | | | 41 | |
| MP3 | | | | | | | 36 | |
| MP4 | | | | | | | 34 | |
| MP5 | | | | | | | 34 | |
| **Cedar Ridge Wind Farm, Docket 6680-CE-171 (for full report, see PSC ERF REF# 111682 and 117845)** | | | | | | | | |
| Measurement Date | 2/22/2007 | | | | | | | |
| MP1 | | | 45 | 58 | 28 | 46 | 27 | 49 |
| MP2 | | | 41 | 56 | 30 | 48 | 29 | 50 |
| MP3 | | | 41 | 56 | 27 | 48 | 29 | 49 |
| MP4 | | | 49 | 61 | 35 | 53 | 25 | 46 |
| MP5 | | | 39 | 54 | 27 | 46 | 28 | 48 |
| Measurement Date | 2/23/2007 | | | | | | | |
| MP1 | 35 | 55 | | | | | | |
| MP2 | 36 | 57 | | | | | | |
| MP3 | 35 | 57 | | | | | | |
| MP4 | 34 | 56 | | | | | | |
| MP5 | 35 | 58 | | | | | | |
| **Forward Wind Project, Docket 9300-CE-100 (for full report, see PSC ERF REF# 22302 through 22317)** | | | | | | | | |
| Measurement Date | 7/1/2004 | | | | | | | |
| MP1 | 33 | 46 | 28 | 43 | 32 | 43 | 29 | 42 |
| MP2 | 33 | 44 | 27 | 41 | 38 | 48 | 30 | 42 |
| MP3 | 38 | 52 | 27 | 41 | 36 | 44 | 28 | 44 |
| MP4 | 32 | 42 | 33 | 41 | 39 | 44 | 25 | 38 |
| MP5 | 54 | 57 | 42 | 52 | 47 | 57 | 46 | 56 |
| MP6 | 40 | 50 | 35 | 46 | 43 | 53 | 33 | 44 |
| **Proposed Glacier Hills Wind Park, Docket 6630-CE-302 (for full report, see Appendix C)** | | | | | | | | |
| Measurement Date | 7/13/2009 | | | | | | | |
| MP1 | 34 | 51 | 30 | 54 | 28 | 50 | 29 | 49 |
| MP2 | 35 | 48 | 29 | 46 | 20 | 41 | 22 | 41 |
| MP3 | 31 | 45 | 31 | 51 | 24 | 42 | 21 | 36 |
| MP4 | 38 | 46 | 30 | 49 | 27 | 43 | 21 | 38 |
| Measurement Date | 7/14/2009 | | | | | | | |
| MP1 | 40 | 56 | 41 | 57 | | | | |
| MP2 | 31 | 51 | 34 | 58 | | | | |
| MP3 | 32 | 46 | 39 | 47 | | | | |
| MP4 | 28 | 50 | 31 | 58 | | | | |
| Measurement Date | 7/15/2009 | | | | | | | |
| MP1 | | | | | 38 | 58 | 40 | 58 |
| MP2 | | | | | 33 | 54 | 22 | 39 |
| MP3 | | | | | 37 | 49 | 26 | 40 |
| MP4 | | | | | 31 | 53 | 22 | 40 |

(1) If more than one measurement exists on the same day for a measurement period, values shown are the arithmatic average of the measurements.

Table 5.8-4 Summary of post-construction noise studies at existing wind project developments in Wisconsin

| | Measurements With Wind Turbines OFF | | | | | | | | Measurements With Wind Turbines ON (1) | | | | | | | | Incremental Increase | | | | | | | | Estimate of Low Frequency Component (4) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Measurement Period | 0600-0800 | | 1200-1400 | | 1800-2000 | | 2200-2400 | | 0600-0800 | | 1200-1400 | | 1800-2000 | | 2200-2400 | | 0600-0800 | | 1200-1400 | | 1800-2000 | | 2200-2400 | | 0600-0800 | 1200-1400 | 1800-2000 | 2200-2400 |
| | LA90 (dBA) | LC90 (dBC) | LA90 (dBA) | LC90 (dBC) | LA90 (dBA) | LC90 (dBC) | LA90 (dBA) | LC90 (dBC) | LA90 (dBA) | LC90 (dBC) | LA90 (dBA) | LC90 (dBC) | LA90 (dBA) | LC90 (dBC) | LA90 (dBA) | LC90 (dBC) | LA90 (dBA) | LC90 (dBC) | LA90 (dBA) | LC90 (dBC) | LA90 (dBA) | LC90 (dBC) | LA90 (dBA) | LC90 (dBC) | (dBC) | (dBC) | (dBC) | (dBC) |
| **Blue Sky Green Field Wind Project, Docket 6630-CE-294** (for full reports, see PSC ERF REF# 50884, 102715, 102964) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Measurement Date | 5/20/2008 | | | | | | | | 5/20/2008 | | | | | | | | | | | | | | | | | | | |
| MP1 | 37 | 53 | 39 | 56 | 34 | 48 | 34 | 53 | 40 | 55 | 42 | 58 | 39 | 55 | 41 | 58 | 3 | 2 | 4 | 2 | 5 | 6 | 7 | 6 | 15 | 16 | 16 | 17 |
| MP2 | 38 | 58 | 39 | 64 | 34 | 58 | 35 | 55 | 44 | 61 | 43 | 63 | 41 | 60 | 44 | 62 | 7 | 3 | 4 | | 7 | 3 | 9 | 6 | 17 | 19 | 19 | 18 |
| MP3 | 37 | 52 | 38 | 51 | 44 | 53 | 30 | 49 | 40 | 55 | 42 | 56 | 41 | 55 | 39 | 54 | 3 | 3 | 4 | 5 | | 2 | 10 | 5 | 15 | 14 | 14 | 15 |
| MP4 | 36 | 56 | 38 | 63 | 37 | 59 | 31 | 51 | 42 | 57 | 41 | 62 | 40 | 60 | 38 | 54 | 5 | 1 | 3 | | 3 | 2 | 7 | 4 | 15 | 21 | 20 | 16 |
| MP5 | 42 | 58 | 40 | 54 | 37 | 51 | 35 | 52 | 44 | 58 | 42 | 57 | 42 | 56 | 44 | 58 | 2 | | 3 | 3 | 5 | 5 | 9 | 6 | 14 | 14 | 14 | 14 |
| Measurement Date | 5/21/2008 | | | | | | | | 5/21/2008 | | | | | | | | | | | | | | | | | | | |
| MP1 | 39 | 58 | 38 | 58 | 33 | 50 | 30 | 58 | 43 | 60 | 40 | 58 | 40 | 56 | 41 | 65 | 5 | 2 | 2 | 1 | 6 | 6 | 11 | 7 | 17 | 18 | 16 | 24 |
| MP2 | 37 | 56 | 32 | 53 | 35 | 57 | 36 | 51 | 43 | 61 | 41 | 59 | 42 | 59 | 43 | 56 | 6 | 5 | 10 | 5 | 8 | 3 | 8 | 6 | 18 | 17 | 17 | 13 |
| MP3 | 36 | 49 | 35 | 48 | 36 | 50 | 32 | 45 | 42 | 56 | 39 | 54 | 42 | 55 | 39 | 54 | 7 | 7 | 4 | 6 | 6 | 5 | 7 | 9 | 14 | 15 | 13 | 14 |
| MP4 | 31 | 50 | 37 | 58 | 36 | 58 | 33 | 45 | 38 | 53 | 43 | 59 | 41 | 59 | 40 | 52 | 6 | 4 | 6 | 2 | 6 | 1 | 7 | 7 | 16 | 17 | 18 | 12 |
| MP5 | 35 | 52 | 39 | 52 | 39 | 50 | 34 | 50 | 43 | 56 | 42 | 55 | 42 | 57 | | | 8 | 5 | 3 | 3 | 4 | 7 | | | 14 | 13 | 15 | |
| Measurement Date | 5/22/2008 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MP1 | 38 | 53 | 36 | 50 | 38 | 54 | 37 | 54 | | | | | | | | | | | | | | | | | | | | |
| MP2 | 39 | 52 | 33 | 51 | 40 | 59 | | | | | | | | | | | | | | | | | | | | | | |
| MP3 | 37 | 46 | 37 | 50 | 35 | 50 | | | | | | | | | | | | | | | | | | | | | | |
| MP4 | 34 | 47 | 31 | 49 | 36 | 52 | 44 | 56 | | | | | | | | | | | | | | | | | | | | |
| MP5 | 37 | 50 | 39 | 55 | 35 | 50 | | | | | | | | | | | | | | | | | | | | | | |
| **Cedar Ridge Wind Farm, Docket 6680-CE-171** (3) (for full report, see PSC ERF REF# 111682, 117845) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Measurement Dates (2) | 2/22/2007, 2/23/2007 | | | | | | | | 2/25/2009 | | | | | | | | | | | | | | | | | | | |
| MP1 | 35 | 55 | 45 | 58 | 28 | 46 | 27 | 49 | 37 | | 35 | | 34 | | 36 | | 2 | | | | 6 | | 9 | | | | | |
| MP2 | 36 | 57 | 41 | 56 | 30 | 48 | 29 | 50 | 41 | | 41 | | 40 | | 41 | | 5 | | | | 10 | | 12 | | | | | |
| MP3 | 35 | 57 | 41 | 56 | 27 | 48 | 29 | 49 | 39 | | 38 | | 37 | | 35 | | 4 | | | | 10 | | 6 | | | | | |
| MP4 | 34 | 56 | 49 | 61 | 35 | 53 | 25 | 46 | 40 | | 37 | | 34 | | 37 | | 6 | | | | | | 12 | | | | | |
| MP5 | 35 | 58 | 39 | 54 | 27 | 46 | 28 | 48 | 43 | | 37 | | 40 | | 42 | | 8 | | | | 13 | | 14 | | | | | |
| **Forward Wind Project, Docket 9300-CE-100** (for full reports, see PSC ERF REF# 22302 through 22317, 100610) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Measurement Date | 6/26/2008 | | | | | | | | 6/24/2008 | | | | | | | | | | | | | | | | | | | |
| MP1 | 28 | 48 | 30 | 43 | | | 26 | 43 | 36 | 50 | 38 | 47 | | | 28 | 45 | 8 | 2 | 8 | 4 | | | 2 | 2 | 14 | 9 | | 17 |
| MP2 | 29 | 51 | 29 | 47 | | | 24 | 47 | 36 | 54 | 38 | 54 | | | 36 | 53 | 7 | 3 | 9 | 7 | | | 12 | 6 | 18 | 16 | | 17 |
| MP3 | 31 | 48 | 35 | 46 | | | 29 | 43 | 40 | 52 | 45 | 56 | | | 38 | 54 | 9 | 4 | 10 | 10 | | | 9 | 11 | 12 | 11 | | 16 |
| MP4 | 29 | 47 | 38 | 46 | | | 28 | 44 | 35 | 48 | 40 | 52 | | | 36 | 51 | 6 | 1 | 2 | 6 | | | 8 | 7 | 13 | 12 | | 15 |

(1) If more than one measurement exists on the same day for a measurement period, values shown are the arithmatic average of the measurements.
(2) The pre-construction noise measurements for the Cedar Ridge project were used as a proxy for measurements with the turbines OFF.
(3) The post-construction noise study filed for the Cedar Ridge project was not conducted as required by the Commission's Noise Measurement Protocol.
(4) Estimate calculated by subtracting the LA90 from the LC90 measurements taken with the turbines ON.

### 5.8.6. Human reaction to noise

Turbine operation would be audible at a number of locations within the project area. Noise levels associated with wind turbines are difficult to assess because of the scattered nature of the turbines. In addition, impacts largely depend on the distance to and number of nearby turbines, the sensitivity of individuals (receptors), wind speed and direction, time of year, the type of structures or vegetation existing between the turbine and the receptor, and turbine design. Ambient sounds, including natural sounds, may also mask turbine noise to some degree.

Although the analysis performed by WEPCO's consultant as part of the utility CPCN application demonstrates that the proposed project would meet a representative 50 dBA standard under worst-case conditions, wind turbine sounds would be perceptible outdoors during most hours of operation.

There has been an increasing level of concern raised for wind turbine projects regarding the potential effects of noise on people living in the project area.

The number of non-participating residences located between 1,000 and 1,500 feet from the proposed turbine locations is estimated to be 47 with an additional 54 residences between 1,500 and 2,500 feet from the proposed turbines.

Noise can be a significant annoyance to people, as noted by complaints from residents living near recently constructed wind projects in Wisconsin. Sleep disturbance appears to be a common concern.

The current level of knowledge, however, regarding potential health effects from turbine noise is limited. For example, a review of the environmental impacts of wind turbines by the National Research Council in 2007 included the following comments on potential health effects from wind turbine noise:

> Low-frequency vibration and its effects on humans are not well understood. Sensitivity to such vibration resulting from wind-turbine noise is highly variable among humans…More needs to be understood regarding the effects of low-frequency noise on humans.[25]

The Minnesota Department of Health (MDH) recently reviewed the limited literature on wind turbine noise effects.[26] The MDH review considered results from two epidemiological studies in Sweden,[27] a study in the United Kingdom,[28] and a study in the Netherlands.[29] The MDH also considered four case report surveys that catalogued complaints near wind farms.[30] Overall, the MDH study concluded that:

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[25] National Research Council, 2007, Environmental Impacts of Wind-Energy Projects. Committee on Environmental Impacts of Wind Energy Projects, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies. 346 pp.

[26] Minnesota Department of Health, Environmental Health Division, 2009, Public Health Impacts of Wind Turbines, 29 pp.

[27] Pedersen, E. and K.P. Waye (2004). Perception and annoyance due to wind turbine noise—a dose–response relationship. The Journal of the Acoustical Society of America 116: 3460; Pedersen, E. (2007). Human response to wind turbine noise. The Sahlgrenska Academy, Göteborg University, Göteborg ISBN. 88 pg.; Pedersen, E. and W.K. Persson (2007). Wind turbine noise, annoyance and self-reported health and well-being in different living environments. Occup Environ Med 64(7): 480-6.

[28] U.K. Department for Business Enterprise and Regulatory Reform (2007) Research into Aerodynamic Modulation of Wind Turbine Noise: Final report. Report by: University of Salford. Authors: A. Moorhouse, M.H., S. von Hünerbein, B. Piper, M. Adams

[29] van den Berg, F., E. Pedersen, J. Bouma and R. Bakker (2008). Project WINDFARMperception: Visual and acoustic impact of wind turbine farms on residents. Final report, FP6-2005-Science-and-Society-20, Specific Support Action project no. 044628. June 3, 2008, 99 pg.

[30] Harry, A. (2007). Wind turbines, noise, and health. February 2007, 62 pg.; Phipps, Robyn (2007) In the Matter of Moturimu Wind Farm Application. Evidence to the Joint Commissioners, Palmerston North. March 8-26, 2007; Large Wind Turbine Citizens Committee: Town of Union (2008). Setback Recommendations Report. Union, Rock County, Wisconsin. January 6, 2008, 318 pg.; Pierpoint, N. (2009). Wind Turbine Syndrome: A Report on a Natural Experiment (Pre-publication Draft). Santa Fe, NM, K-selected Books.

> The most common complaint in various studies of wind turbine effects on people is annoyance or an impact on quality of life. Sleeplessness and headache are the most common health complaints and are highly correlated (but not perfectly correlated) with annoyance complaints. Complaints are more likely when turbines are visible or when shadow flicker occurs. Most available evidence suggests that reported health effects are related to audible low frequency noise. Complaints appear to rise with increasing outside noise levels above 35 dBA.

The studies done to date suggest that there is a wide variability in how people react to wind turbine noise and that many people do not appear to be affected. The studies do, however, support the concern that some people do react negatively to wind turbine noise, primarily through annoyance and sleep disturbance. It is widely accepted that disruption of sleep can lead to other physiological and psychological problems.

Dr. Nina Pierpoint has hypothesized that in addition to annoyance and disturbance, wind turbine noise can result in direct activation of the vestibular and autonomic nervous system leading to other health problems.[31] This validity of this suggestion has been questioned. The MDH study concluded that "evidence is scant" for this hypothesis.

In summary, it is important to recognize that turbine noise can be problematic for some people. Although specific sound levels or distances from turbines cannot be directly correlated with these disturbance or annoyance problems, project design and siting should take potential impacts of turbine noise into account.

## 5.9. LOCAL ECONOMIES

### 5.9.1. Shared revenue

Under Wis. Stat. § 79.04(06), local municipalities are paid annually for generation that is located within their boundaries. (This payment occurs if the generation is 1 MW or more in capacity.) The current payment, set by statute, is $2,000 per MW. The total amount is shared between the county and towns. The county receives two-thirds of the total payment, and the towns share one-third of the total payment. An individual town's share depends on the percentage of total generation within its boundaries. WEPCO currently proposes to locate 36 turbines (or 40 percent of the total) in Scott township and 54 turbines (or 60 percent of the total) in Randolph township.

In addition to the payment for generation, there is an additional, annual incentive payment for renewable generation. That payment is currently $1,000 per MW for the county and $1,000 per MW for the town(s). The towns would share the $1,000 per MW payment according to the percentage of total generation within their boundaries.

Table 5.9-1 estimates total annual payments to the county and the townships of Scott and Randolph. Because WEPCO has not yet formally chosen a turbine size, the table shows payments associated with turbine sizes of 1.5 MW (the minimum size proposed), 1.8 MW (the size assumed in all computer modeling), and 2.0 MW (the largest size likely to be installed).

[31] Pierpoint, N. (2009). Wind Turbine Syndrome: A Report on a Natural Experiment (Pre-publication Draft). Santa Fe, NM, K-selected Books.

There is a per person payment limit for the generation payment, but not for the incentive payment. The county limit for all generation-related payments is $100 per person (this project contributes about $4/person). The township limit for all generation-related payments is $200 per person (this project contributes about $50/person for Scott and $85/person for Randolph). The towns and county would receive the first shared revenue payments the year after the project becomes operational.

Table 5.9-1 Total estimated annual payments to affected towns and county

| Turbine Size (MW) | Total MW for 90 turbines | Columbia County | Town of Scott | Town of Randolph |
|---|---|---|---|---|
| 1.5 | 135 | $315,000 | $90,000 | $135,000 |
| 1.8 | 162 | $378,000 | $108,000 | $162,000 |
| 2.0 | 180 | $420,000 | $120,000 | $180,000 |

### 5.9.2. Jobs and service-related benefits

In addition to shared revenue, there would be an economic benefit to businesses in the county due to construction and operation of the wind farm. WEPCO states that:

> Local construction and maintenance service providers will be identified and informed on how to submit proposals to Wisconsin Electric.

In addition, local restaurants and motels may benefit from project laborers staying in the area.

During the course of construction, up to 150 workers would be employed. WEPCO estimates that nearly half of these would come from central Wisconsin. About 15 permanent full-time employees would maintain and operate the wind farm. Finally, the local economy would be improved over the life of the project by the money paid to property owners that host a wind turbine or provide other easements.

## 5.10. PROPERTY VALUES

The potential impact of wind farms on property values has been a subject of discussion in a number of Wisconsin communities since large-scale wind projects were first proposed in Wisconsin; however, there are few scientific studies that can be relied on to accurately assess these impacts. Because a wind farm's turbines are dispersed over a large area, there are differences in the aesthetic effect of the turbines across the viewshed and thus differences in the potential impact for different property owners. The perceived impacts of wind farms may differ, depending on whether the property owner hosts a wind turbine or not, whether views are partially blocked by topography or trees, and whether an individual's primary use of their land is agricultural or residential.

Determining the impact on property values can be further complicated by the fact that many property transfers conducted in rural areas are between family members (rather than at "arm's length") and may not be at fair market value. A study of property values that includes these kinds of property transfers might not accurately reflect adverse impacts related to the wind farm. Finally, changes in property values can only be tabulated when a property actually changes hands. Most property value studies do not capture impacts on the marketability of a property which includes the length of time a property on the market remains unsold or properties taken off of the market because they have become unsellable.

### 5.10.1. Literature review

Numerous studies have inventoried public opinions towards wind power in the U.S., Europe, Australia, and New Zealand. Most identify a widely held belief that proximity to a wind farm will cause a decline in property values. However, surveys of the public or even individuals with knowledge of regional property values, such as assessors or realtors, cannot be used as proof of impacts on property values. This survey method of study is highly subjective and has no controls for other factors that may affect property values.

Only a few studies have attempted to statistically determine whether the proximity of wind turbines affects property values and to quantify those impacts. Fewer still are published in peer-reviewed journals. Available studies include a 1996 study from Denmark,[32] a 2003 Renewable Energy Policy Project (REPP),[33] a critique of the REPP study by the Energy Center of Wisconsin on behalf of the Wisconsin Department of Administration (DOA),[34] a 2006 thesis by Ben Hoen,[35] and a 2009 study from Appraisal Group One.[36] In addition, a study from Lawrence Berkeley National Laboratory by Ben Hoen and Ryan Wiser has been recently presented at conferences, but not yet published. The conclusions of these studies have ranged from no impact to thousands of dollars of impact.

The Denmark 1996 study concluded that homes near a single wind turbine averaged DKK 16,200 ($2,314 U.S.) less in value and homes located near groups of 12 wind turbines averaged DKK 94,000 ($13,429 U.S.) less in value. However, the study did not define what constituted homes "near" turbines versus those "further away."

The REPP study plotted the sales data near ten large wind projects scattered throughout the U.S. Comparable areas with and without a wind farm were analyzed over a period of several years before and after the wind project developments. Sale price trends were compared for properties within the view shed before the wind project developments and those properties after the developments. Third, comparable areas with and without wind farms for the period after the wind project developments were assessed. The results of this study showed little evidence of adverse impacts by the wind farms on local property values. The REPP study flaws identified in the DOA report included the definition of "viewshed". REPP defined viewshed as a five-mile radius surrounding the outermost wind turbines in a wind farm. The study did not take into account that properties closest to the wind turbines may be subject to greater impacts than those one or more miles away from the turbines. The REPP study was also flawed by small sample size; it included too few properties to support statistical analysis. Additionally, the REPP study did not distinguish between agricultural properties and residential properties that would likely be affected to a greater extent.

A more current study of two recently completed Wisconsin wind farms was completed by Appraisal Group One. This study also contained similar problems of small sample size and weak statistical analyses. While the study was limited to residential vacant land sales, other potential factors that might influence sale prices were not analyzed. The study did not verify that all properties sold within the wind farm areas actually had views of wind turbines, whether the properties were sold prior to the proposal of a wind

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[32] Munksgaard, J. and A. Larsen, "Social Assessment of Wind Power", The Institute of Local Government Studies (AKF), Copenhagen, Denmark, 1996.
[33] Sterzinger, G., F. Beck, D. Kostiuk, "The Effect of Wind Development on Local Property Values", Renewable Energy Policy Project, Washington D.C., 2003 (available electronically at www.repp.org/wind/index.html).
[34] State of Wisconsin, Dept. of Admin., Div. of Energy, "A Study of Wind Energy Development in Wisconsin," Energy Center of Wisconsin, 2004 (available electronically at www.ecw.org/prod/231-1.pdf).
[35] Hoen, Ben, "Impacts of Windmill Visibility on Property Values in Madison County, New York," Bard Center for Environmental Policy, Bard College, 2006.
[36] Kielisch, K., "Wind Turbine Impact Study," Appraisal Group One, 2009.

facility versus after the wind facilities were constructed and operating, and it did not differentiate between vacant lots with infrastructure potential such as streets, sewer, and water as opposed to farmland with no infrastructure.

Additional studies have been conducted by Ben Hoen in 2006 (master's thesis) and the Lawrence Berkeley National Laboratory in 2009 (Ben Hoen and Ryan Wiser). The Hoen thesis analyzed the impact of one wind farm in Madison County, New York on property values for residences located between one and five miles from a wind turbine. The Lawrence study analyzed 10 study areas within the U.S. for properties located between 3,000 feet to more than five miles from a turbine. Both studies statistically tested for a large number of variables that might affect property values and concluded that there was no significant variation in property values for properties with viewsheds of wind turbines compared with those without. However, neither study was able to tease out the impacts to properties directly adjacent to wind turbines.

### 5.10.2. Conclusions from property value studies

Based on the existing literature, it is difficult to draw specific conclusions about the potential impacts of a wind farm on property values. However, it is reasonable to expect that the value of agricultural lands that host wind turbines would increase due to the guaranteed annual source of income. It is also reasonable to expect that residential properties located adjacent to properties hosting wind turbines could be adversely impacted. For non-agricultural properties, the value of the property is likely related to the aesthetics of living in a rural setting, and the presence of turbines could reduce property values or cause a lengthier market time. Possible remedies include use of manmade and natural screening, sufficient turbine setbacks from adjacent residences, or a property value protection plan.

The use of visual screening such as trees would most likely not be effective in blocking out the proposed turbines from nearby residences due to the height of the proposed turbines. Additionally, visual screening that still allows for some scenic views by residents may not be effective in reducing other wind turbine impacts such as noise and shadow flicker. Visual screening may be more effective for residences at a greater distance from turbines and could lessen potential property value impacts.

Another method that could mitigate potential impacts to non-host residences is a property value protection plan. This type of a plan provides property owners with certain assurance that they will receive "fair market value" for their eligible properties upon sale. Since 1997, this type of agreement has been implemented between the Onyx Glacier Ridge Landfill and the town of Williamstown, city of Mayville, and Dodge County. Fair market value is determined by a state-licensed appraiser. The plan identifies the properties covered by the agreement, the party responsible for paying for the property appraisals, and the method for compensating affected property owners.

## 5.11. RECREATION

The Village Park in Friesland lies within the eastern portion of the project area and Deer Creek Campground lies within the western portion. There is also a private church park near the center of the village of Friesland. None of these areas would have turbines built in their immediate vicinity. WEPCO's consultant prepared photo simulations for views from the Village Park and Deer Creek Campground. The view from the Friesland Village Park would include multiple turbines, but they do not appear to dominate the view given their distance from the park. From the entrance to the Deer Creek Campground, turbines either cannot or cannot easily be seen. Due to distance, screening, and/or topography, the proposed wind turbines would not dominate the view from any public recreation areas that are located in the project area.

# 5.12. ROADS

## 5.12.1. Existing road network

The federal, state, county, and town roads in the project area are illustrated in the various map figures, particularly Figures Vol. 2-1, 2-10, and 2-11. Major highways nearest to the project area are I-39 to the west, U.S. Highway (USH) 151 running southwest to northeast, and USH 41 further to the east. These roads are part of the connection between the Madison area and cities north of the project area, Madison and the city of Fond du Lac, and the Milwaukee area and other points north such as Fond du Lac, Oshkosh, and Appleton. Other major roads in the area include:

- STH 33, which runs east-west in the project area;
- STH 146, which runs north-south a short distance into the project area;
- Numerous county and town roads that transect the project area.

## 5.12.2. Potential construction traffic related to the project

Traffic associated with construction activity would include both workers traveling to the project site (worker trips) and equipment or supply delivery trips.

### 5.12.2.1. Worker trips and personal vehicles

Worker trips, involving construction employees traveling to and from the job site, would have the primary impact on local traffic. The location of the project would result in construction workers likely coming from a variety of surrounding areas including Montello (from the northwest), Portage (from the west), Waupun and Beaver Dam (from the east), and Columbus (from the south). Construction workers could also be driving from major metropolitan areas such as Madison (from the southwest), Fond du Lac (from the northeast), or Milwaukee (from the southeast). Some workers may also come from other, smaller communities in or near the project area, such as the villages of Friesland, Randolph, Cambria, and Pardeeville. WEPCO estimates that approximately 40 percent of the construction workforce would come from the central Wisconsin area.

The construction workers would likely utilize a variety of routes, meaning that traffic would not concentrate on any specific road, with the exception of STH 33 which serves as a major east-west arterial crossing the project area.

The largest typical number of construction workers in the project area, at any one time, is expected to be between 120 and 150 workers. This could result in approximately 300 or more worker automobile trips (arriving and departing).

### 5.12.2.2. Construction equipment, parts, and supplies

The second type of traffic associated with construction activities would involve trips by trucks delivering construction material, equipment, and supplies. All construction materials, bulk materials, and equipment would be delivered by truck, including concrete and gravel, trenching machinery, and other construction needs. Construction vehicles would make multiple trips to the project area daily, especially those vehicles that provide materials such as concrete. WEPCO estimates that a total of 8,215 truck trips are expected for construction support items and another 630 to 900 truck trips for delivery of the large parts of the wind turbine. Each turbine requires seven to ten of these oversized trucks. The large cranes are delivered disassembled to the project area on low-boy and flat bed semis. Each large crane requires 19 trucks.

Turbine components are sourced from multiple locations, nationally and internationally. For deliveries from northern Lake Michigan ports, WEPCO expects the trucks to travel on USH 41, STH 26, STH 49, CTH AW, and STH 73 to the project area, passing through the cities of Oshkosh and Waupun. For turbine components delivered from southern Lake Michigan ports, the trucks would travel through or around Milwaukee, along one of two routes which include USH 41, STH 33, CTH E, CTH A, I-94, STH 26, STH 60, and STH 73. The routes would pass near or through the communities of Allenton, Beaver Dam, Fox Lake, Watertown, Columbus, and Randolph.

The truck configurations would be designed and assembled specifically for the dimensions and weights of the tower or blade parts to be hauled, and for the specific haul routes that would be used. Figures 5.12-1 and 5.12-2 illustrate types of truck configurations that might transport the various components of the wind turbine over public roads. Trucks for the nacelle, blades, or tower sections could range from 83 to 177 feet long. Most of the trucks hauling the turbine components and large cranes are over standard weight and/or over standard size. Table 5.12-1 lists the approximate dimensions and hauling weights of the trucks delivering major turbine components.

Figure 5.12-1 Truck configurations for transporting the nacelle, hub, blade, and top tower section for a typical 1.65 MW turbine

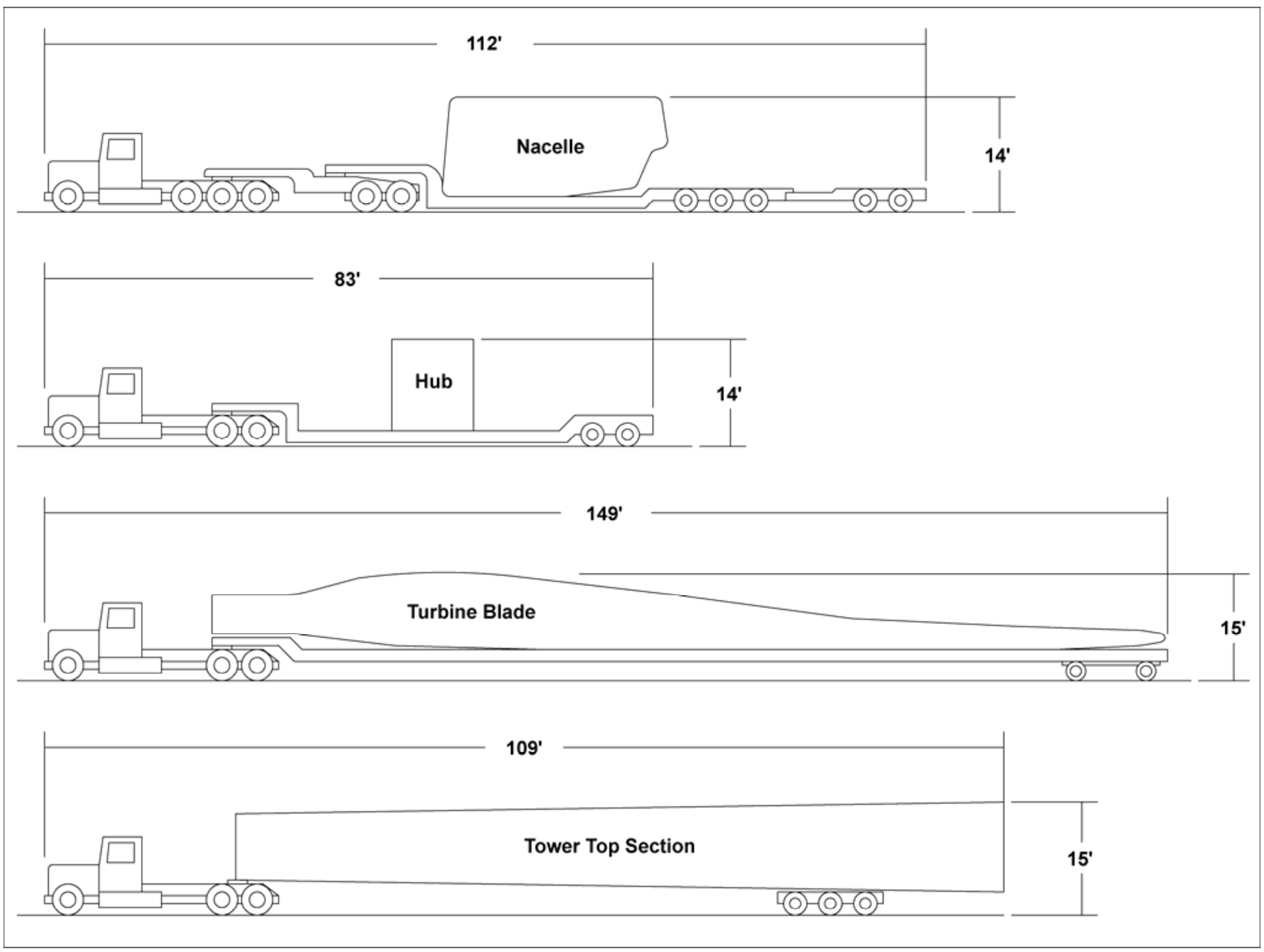
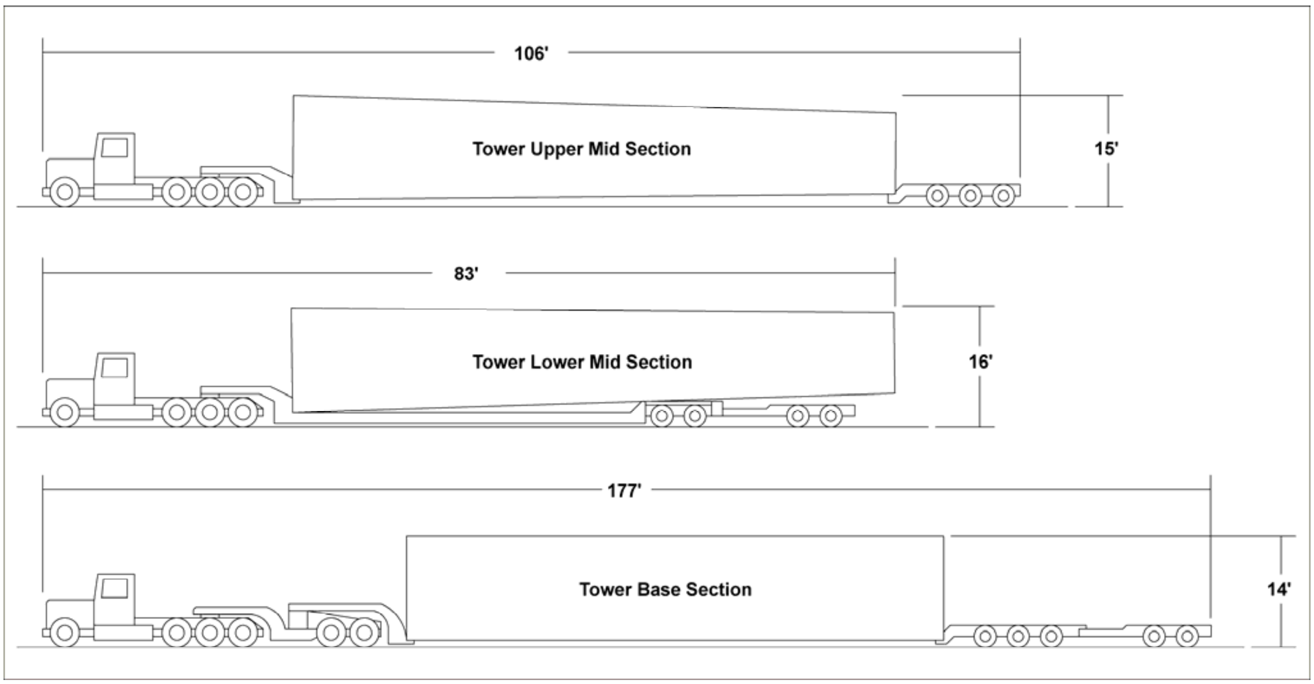


Table 5.12-1 Approximate dimensions and hauling weight of trucks delivering major turbine components (as shown in Figures 5.11-1 and 5.11-2)

| Part | Total Gross Weight (pounds) | Minimum Ground Clearance (inches) | Length (feet) | Height (feet) |
|---|---|---|---|---|
| Nacelle | 190,000 | 6 | 112 | 14 |
| Blade | 74,000 | 24 | 149 | 15 |
| Tower Base Section | 232,000 | 6 | 177 | 15 |
| Tower Lower Mid Section | 112,000 | 6 | 83 | 16 |
| Tower Upper Mid Section | 137,000 | 6 | 106 | 15 |
| Tower Upper Section | 112,000 | 6 | 109 | 15 |
| Hub | | 6 | 83 | 14 |
| Crane Delivery | 100,000 | 6 or 24 | 70 | |

Figure 5.12-2 Truck configurations for transporting the mid and base tower sections for a typical 1.65 MW turbine




### 5.12.2.3. Cable construction in roadways

Utility cables would be buried under portions of state and county highways (STH 33, STH 146, CTH EF, CTH E, and other local roads). During construction, it may be necessary to close one lane of traffic. Wherever possible, these cables would be installed using directional boring to minimize impacts to the traveling public.

## 5.12.3. Potential impacts on traffic and road conditions during construction

Heavy construction equipment, including mobile cranes, earth moving equipment, cement trucks, and dump trucks, would be delivered to the project area as described above.

The impacts on current traffic conditions during construction would be temporary, occurring only until all of the proposed facilities are installed. Levels of truck traffic in the area would vary depending on the phase of construction. Truck deliveries would typically occur between 6 a.m. and 6 p.m., Monday through

Saturday. Extended delivery hours may be necessary, including nighttime deliveries, due to travel permits, weather, and/or schedule limitations. Construction traffic would utilize roadways that have enough capacity to handle the expected number and size of vehicles, but congestion could occur at certain times from vehicles entering and exiting the project area. Some local roads are narrow (16 to 24 feet wide). There may be some minor traffic disturbance associated with wide loads and oncoming traffic. Avoidance of peak travel times and traffic control actions can be used to minimize this impact. Similarly, oversize loads conducting turning movements may slow traffic for a short period at specific locations.

Table 5.12-1 shows some of the weights, lengths, widths, and heights of the turbine part transport trucks and loads. The basic designs and numbers of axles in Figures 5.12-1 and 5.12-2 also illustrate how the companies might control the weight distribution of the turbine tower parts so that axle loads are kept below the thresholds allowed by various road authorities across the country. Deliveries would be coordinated with local officials. Depending on the time of day and how many trucks arrived at one time, police services might be required to assist in temporary traffic diversion during delivery of the large equipment to the site.

### 5.12.4. Mitigation of potential road and traffic impacts during construction

WEPCO hired a consultant to conduct a preliminary review of the status of area roads, bridges, and culverts to verify that the local roads could support the anticipated number and weight of the anticipated construction traffic. The consultant advised against the use of timber bridges on Sterk Road, CTH M, and Inglehart Road, and suggested further analysis was needed at other locations. WEPCO would plan the delivery routes in advance. Smaller road intersections along delivery routes and intersections with access roads would be widened during construction, in order to allow for wide turns. Some existing public roadways have areas where the tree canopy overhangs the road. In areas where the tree limbs might interfere with the delivery of turbine components, tree limbs would be trimmed prior to the delivery. Trees would be trimmed by experts using accepted utility practices so that the trees are not harmed. Owners of trees on private properties would be consulted and their wishes accommodated to the greatest extent possible.

All roads in the project area would be videotaped and reviewed by a consultant prior to and after construction to document conditions. WEPCO would be responsible for the cost of making repairs to roads damaged as a result of construction. A road plan would be included as part of the JDA that stipulates local road use limitations, coordination, pre- and post-construction surveys, and repair details. WEPCO anticipates that damage to local roads would be minimal and localized. The company would repair all damage caused during construction.

Additionally, WEPCO has initiated discussions with DOT about all oversized deliveries and schedules. Final routes for the oversized deliveries would be approved by DOT and be specified in the permit issued by the shipper.

Any necessary permits or approvals required to transport large or oversized equipment or materials to the project area would be obtained by the hauler. The hauler would be responsible for knowing and complying with the clearances and restrictions for all routes along which they would travel to reach the project area, including through states other than Wisconsin. The haulers would be licensed. During this permitting process, the transportation company would work with the road permitting authority to select the final delivery route and address any clearance, weight, or time restriction issues that could affect the delivery. Trailer dimensions would be determined, including clearance from the ground, overhead clearance, side-to-side clearance, the method of fastening the equipment, and the trailer axle configuration.

With these protections in place, no permanent impacts or damage to the area roadways would be expected from the transport of turbine parts or from heavy construction equipment. With the exception of the addition of access roads on the properties hosting wind turbines, there would be no anticipated permanent changes to the condition of area roadways.

### 5.12.5. Potential impacts on traffic during plant operation

It is anticipated that the Glacier Hills Wind Park would employ approximately 10 to 15 permanent employees. These employees would include a site manager, inventory manager, and a receptionist/office manager. All these permanent workers would likely come from the central Wisconsin area. Additional specialized personnel may work at the project for limited periods. Routine maintenance on a turbine is usually performed by a crew of two or three technicians dispatched from the O&M building to the turbine site. A small number of vehicles would deliver supplies and equipment, as needed.

## 5.13. TELEVISION, RADIO, AND TELECOMMUNICATIONS INTERFERENCE

WEPCO retained the consulting firm Comsearch to evaluate the impacts of the wind project on various telecommunications media, including microwave communication systems, television reception, AM/FM broadcast operations, and licensed land mobile radio operations.

### 5.13.1. Microwave paths

Wind turbines can interfere with microwave paths by blocking or partially blocking the line-of-sight path between microwave transmitters and receivers. Using WindPower GeoPlanner software, Comsearch made a geographical representation of registered fixed microwave paths. Because microwave communication is a line-of-sight technology, potential interference of microwave telecom signals can be avoided by locating the wind turbines outside of the microwave communications profile. The wind turbine sites were selected by WEPCO to avoid obstructing any commercial microwave beam paths in the area.

The federal government has a large number of departments and agencies that operate a separate set of communication systems that are not part of any public databases. Because of this, WEPCO submitted a notification of the wind project to NTIA which is the coordinator of the government communication systems for all departments and agencies. Upon review of the project, NTIA stated in a letter that no concerns were identified regarding blockage of government radio frequency transmissions.

### 5.13.2. Radar

Line-of-sight interference can also occur between wind turbines and radar installations. There are two types of radar installations, the National Weather Service (NWS) NEXRAD Doppler radar and Doppler radar installations operated by broadcast television stations. There is no anticipated interference with the NWS operations due to the distance of the project from the Milwaukee/Sullivan installation. NWS confirmed that any impacts would be minimal or negligible.

WEPCO reviewed the possible impacts of the wind facility on 22 Doppler radar installations located within 250 kilometers of the project. The analysis indicated that the coverage of one Doppler radar set-up, which is owned by WKOW Television Station and located approximately 40 miles from the wind project, would most likely be impacted. The loss of coverage would be limited to the northeast at very low elevation angles. Radar data would still be available for altitudes approximately 1,000 feet above the wind turbines in the affected sector. WEPCO informed the station manager of the potential impact.

### 5.13.3. Television

The off-air television stations within 40 miles of the project area include two full-power analog and three digital channels. There are also two translators available but they are low power stations with limited coverage and programming. Broadcasts from Madison, Milwaukee/Kenosha, Maysville, Green Bay, and Fond du Lac can currently be received in the project area; however, many of the signals are of marginal level because the stations are over 40 miles away. These weak signals may be become weaker when the wind turbines are installed. Project area subscribers to cable and direct satellite broadcasts would be unaffected by the presence of the wind turbine facility.

The turbine towers are metal and block all electromagnetic field signals at close range. Turbine blades are reinforced fiberglass with epoxy resins and reflect electric fields, allowing magnetic fields to pass through. Finally, the rotating blades of a turbine can produce a reflected television video signal for televisions that use an antenna to receive over-the-air signals and are located in close proximity to the wind turbine. Wind turbines can also block or cause unwanted reflections of broadcast signals.

It is possible that the WEPCO project could affect television reception for some residents in the project area. This would take the form of "ghosting" for analog signals and pixilation for digital signals.

After construction of the project is completed, WEPCO is committed to implement the following mitigation methods, either singly or in combination to restore the television coverage that existed prior to the existence of the wind turbine facility. WEPCO would expeditiously work with residents to implement reasonable and appropriate mitigation measures. This commitment is further reinforced in the proposed JDAs.

- Installing high-gain TV antenna on towers with rotors with pre-amplifier to boost the received signal level;
- Where cable television exists, providing cable hookups;
- Installing a cable system;
- Installing a wireless television distribution system to provide television channels to a cluster of affected homes;
- Providing satellite television service;
- Providing a satellite head end reception point with a cable distribution system to a cluster of homes near the head end.

### 5.13.4. Cellular and two-way radio

There is no convincing evidence that wind turbines interfere with individual cell phones or two-way radios. In fact, turbine maintenance personnel often use cell and radio equipment to perform their work. In some areas cell phone antennae have been installed on the turbine towers.

### 5.13.5. Wireless Internet

A recent development is a broadband wireless Internet service. This usually involves a 2 GHz antenna array sending and receiving signals from a local tower to a wide area of customers. The local tower would have a narrow microwave "backhaul" path to the office network connection point. The customer would have a small dish or panel antenna at the home or office to send and receive signals to the local tower. The home or office customer may have a reception issue if they are very close to a wind tower that is in line with the local area antenna. This may be resolved in a manner similar to the television issue.

Some of the new wireless Internet providers choose not to register with the Federal Communications Commission (FCC) and they may be at risk. Non-FCC registered service providers may want to provide some additional information about their microwave network to WEPCO to minimize potential interference with their backhaul paths.

### 5.13.6. AM/FM broadcast operations

Potential problems with AM broadcast operations occur when AM stations with directive antennas are within two miles of turbine towers and AM stations with non-directive antennas are within 0.5 miles. All AM stations in the project region are more than two miles from the proposed turbine tower sites. Furthermore, no impacts to FM stations are anticipated because they are more than 7.5 miles from the center of the project area.

### 5.13.7. Land mobile radio operations

There are 268 land mobile radio operations (LMR) frequencies in the region of the proposed wind farm, 32 of which are within the project area. The frequencies of operation of the LMR repeaters are generally unaffected by the presence of wind turbines. Additionally, very little, if any, change in the coverage of the repeaters is anticipated. In the unlikely event that coverage is affected on a LMR network, it can be rectified by the addition of a repeater on a structure in the project area, such as a building, meteorological tower, utility tower, or the lower part of a wind turbine.

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CHAPTER

6

# 6. Cumulative Impacts

There are currently 306 utility-scale wind turbines in Wisconsin with a total generating capacity of approximately 448 MW. These turbines are part of the wind facilities listed in Table 6-1. The total existing electric generating capacity in Wisconsin is about 19,078 MW. Thus, the existing wind generating capacity is about 2.4 percent of the state's total in-service generating capacity of 19,078 MW. With the addition of the proposed project, the portion of generation capacity powered by wind would increase to a little more than 3 percent.

Table 6-1 Existing utility-scale wind projects in Wisconsin

| Wind Project | Town | County | Number of Turbines | Capacity (MW) |
|---|---|---|---|---|
| Rosiere | Lincoln and Red River | Kewaunee | 17 | 11 |
| Lincoln | Lincoln | Kewaunee | 14 | 9 |
| Glenmore | Glenmore | Brown | 2 | 1 |
| Blue Sky Green Field | Calumet and Marshfield | Fond du Lac | 88 | 145 |
| Cedar Ridge | Eden and Empire | Fond du Lac | 41 | 68 |
| Forward | Byron, LeRoy, Lomira, and Oakfield | Dodge and Fond du Lac | 86 | 129 |
| Byron | Byron | Fond du Lac | 2 | 1 |
| Butler Ridge | Herman | Dodge | 36 | 54 |
| Montfort | Eden | Iowa | 20 | 30 |

## 6.1. GENERAL IMPACTS

Wind turbines have effects on natural resources, the social environment, community resources, and on the people living in a project area. This chapter looks at whether the proposed project's potential impacts become more significant when considered in combination with the state's existing wind projects.

Construction of the proposed project would occur primarily in open agricultural areas, with only minor impacts to woodlands, wetlands and waterways. Thus, it is not contributing to any long-term cumulative impacts on these resources.

The proposed project avoids any adverse effects on air and water quality, two important natural resources affected by most other, combustion-based, generation projects. The overall significance of these positive benefits, especially on greenhouse gas emissions, may be magnified as multiple wind projects are constructed, allowing more combustion-based generation to be avoided. For example, a new 600 MW coal unit running 80 percent of the time using western coal would emit approximately 4.1 million tons of $CO_2$ per year (based on assumptions from the Department of Energy/Energy Information Administration Annual Energy Outlook 2009).

Based on the EGEAS analyses, over a 26-year period beginning in 2012, the $CO_2$ "savings" from running the base case model with the Glacier Hills project included versus without it is approximately 1.1 million tons of $CO_2$ per year or approximately 28 million tons total over this period.

## 6.2. BIRD AND BAT IMPACTS

Potential wind farm impacts to birds and bats include collision mortality, habitat loss, and habitat fragmentation. The severity of the impact can be greater for rare and declining species. No heavily used local flight paths or areas where bird activity is heavily concentrated are located in the project area, nor is it expected that any rare birds would be affected. It is difficult to predict wind farm bird mortality rates or their significance. Bird mortality data evaluated at several other upper Midwest wind farm projects suggest that losses in the range from one to eight birds per turbine per year might be expected. Preliminary numbers from wind farm sites in Wisconsin are at the upper end of this range. Losses at these levels, however, are not likely to be significant to populations of most common bird species, even when considered in combination with the other wind farms in Wisconsin.

Bat mortality has exceeded bird mortality at most wind farms where post-construction monitoring of both has been conducted. Preliminary mortality data at two Wisconsin wind projects indicate mortality levels above the national average. Compared to many species of birds, bats are long-lived and have low reproductive rates, which may make their populations more vulnerable to wind turbine mortality than is the case for birds. Many American bat species are in decline. Overall, very few bat studies have been conducted in Wisconsin and thus bat numbers and behavior are not well understood. The pre-construction bat activity study conducted in the project area focused on bat activity patterns based on acoustic surveys during the post-breeding and fall migration periods. The acoustic sampling showed that the project area has an active bat population.

There will be some level of bat mortality if the proposed project is constructed. Because of the lack of research on bat mortality at wind farms in the Midwest, it may not be possible to make any predictions about the magnitude of bat mortality for this particular project, but preliminary data on bat mortality from two recently constructed Wisconsin wind projects suggests that the mortality levels at Glacier Hills could also be higher than the national average. It is unknown whether these mortality rates would have any significant impacts on bat populations.

The overall decline in bat populations in North America, combined with the expanding number of new wind farm projects being developed, may justify an increased concern about bat mortality from wind farms. The cumulative effect of any individual project on bat populations may be underestimated if only the local circumstances are considered.

Other recent wind farm projects were located along a landscape feature known as the Niagara Escarpment. The concern was expressed that construction of numerous large wind farms on the escarpment may have a negative cumulative effect on bird and bat populations, as the escarpment is thought to be a migratory pathway for some species of birds and possibly for bats. The proposed Glacier Hills project, however, is not located along the escarpment and should not contribute to the cumulative effects of multiple wind projects being sited along the escarpment.

## 6.3. LANDSCAPE AESTHETICS

Southern and east-central Wisconsin, unlike some areas where large-scale wind farms have been built, is fairly densely populated. The growing interest by developers and utilities in siting and building wind turbine facilities in Wisconsin and the trend toward increasingly larger projects and taller turbines with higher capacities suggests that the aesthetic impacts associated with wind farms will have an increasing effect on the Wisconsin landscape. The construction of multiple wind farm projects is resulting in a major change in the overall visual appearance and aesthetic quality of some areas of east-central and southern Wisconsin.

Ironically, while the presence of the turbines guarantees that the landscape remains open crop land or grassland, the presence of the turbines may result in a more "industrial" looking landscape. During the day, the large groupings of wind towers and spinning blades contrast with the backdrop of barns, farmsteads and fields that currently dominate these regions of the state. At night, the red flashing lights required for air traffic safety alter the view of the night sky for those living within and near the project areas.

## 6.4. LAND USE IMPACTS

Due to the engineering and design requirements for wind generation, the projects are often sited in areas where the primary land use is agriculture. In general, wind farms are a compatible use of farm land. On an acreage basis, very little land is removed from production and the negotiated easement agreements with farm operators that allow facilities to be sited on their land can provide some financial stability to a business that is subject to many risks. The presence of multiple wind projects in east-central and southern Wisconsin could preserve agricultural land use in these areas, if it results in slowing residential growth and suburban development in the rural landscape. It is possible that wind farms could restrict the expansion of some communities if turbines are located too close; this may become more likely as the number of wind farm projects increases.

## 6.5. PUBLIC CONCERN

The pattern of land ownership and population density common in rural areas of southern and east-central Wisconsin can lead to concerns when building new wind farms. There are few large land parcels held by single owners. Instead, land is generally divided into medium and small parcels. It is common practice for small pockets of land to be carved out of active agricultural lands for residential properties or subdivisions consisting of small parcels. Wind farm projects, such as the current proposal and others recently constructed in the state, cover large areas that include participating landowners who have contracted to host one or more turbines, along with nearby non-participating landowners who receive no direct benefit from the project.

Based on experience with recently constructed wind farms, there is a wide range in how non-participating landowners react to nearby new turbines. To some, the turbines are an inconsequential change on the landscape; others believe that the turbines greatly degrade their lives. Many have feelings that range somewhere in between. The potential adverse effects that raise the most concern include shadow flicker, noise, and landscape aesthetics. An increasing number of landowners are becoming aware of these potential effects as more wind projects are built. Acknowledgement of these possible impacts and an open discussion regarding appropriate setbacks and siting guidelines to minimize the impacts of large utility-scale wind projects is needed.

CHAPTER

7

# 7. Summary of Comments and Changes to the EIS

## 7.1. SUMMARY OF COMMENTS

The applicants, parties to the case, a state agency, and many individuals provided written comments to the Commission between July and early September 2009. Most of the public comments received during this time period did not address the content or format of the draft EIS, but rather raised general issues or concerns or expressed opinions about the project itself. These comments will become part of the project record, but are not discussed here. Only the public comments that specifically mentioned the draft EIS are listed in Table 7.1-1 below. The comments from the applicants and intervenors in the case addressing the draft EIS are also listed in the table.

All comments on the draft EIS posted or received by September 8, 2009, were considered in the development of this final EIS. In general, the comments from the applicants, other agencies, parties, and the public provided new information, constructive criticisms, and recommendations regarding the content and format of the final EIS.

The comments have not been reproduced in the final EIS due to cost or production problems.

A summary of significant changes to the EIS by chapter and general topics appears after Table 7.1-1.

Commission and DNR staffs are appreciative of the time and effort that interested persons or parties invested in reading the draft EIS and giving thoughtful consideration to the project and its potential effects in their comments. Individuals are encouraged to attend the public hearings in the project area to be held on November 4, 2009, and express their views about the project and its potential impacts in testimony.

Table 7.1-1 Summary of comments to the EIS

| ERF REF# | Entity | Comment Content Summary | Action Taken |
|---|---|---|---|
| 117579 | Steinich, G. | Section 2.3.3, commentor states that expected annual energy output is overstated | Considered as the final EIS was prepared |
| | | Section 5.7, commentor states that health and safety issues need further investigation | Considered as the final EIS was prepared |
| | | Section 5.5, aerial application of herbicides, fungicides, and pesticides will be jeopordized | A discussion of this issue is found in Section 5.4.2.2 |
| | | Section 5.2, village of Friesland has begun to implement extraterritorial rights to restrict turbine placement within 1.5 miles of village | Acknowledged in the final EIS |
| | | Volume 2, photo simulations are not accurate | Considered as the final EIS was prepared |
| | | Chapter 4, needs to be more study of bird and bat mortality | Considered as the final EIS was prepared |
| | | Section 5.10, needs to be more study of property values effects | A discussion of some additional property value studies has been added to this section |
| | | Chapter 3, purchase of renewable energy needs to be considered as an alternative | Considered as the final EIS was prepared |
| | | Public opposition not properly addressed or acknowleged | Public comments received will be part of the record on which the Commission's final decision is based |
| 119717 | De Jager, T and P. | Section 5.5, aerial application of herbicides, fungicides, and pesticides will be jeopordized | A discussion of this issue is found in Section 5.4.2.2 |
| 119717 | Tamminga, E. | General comment supporting the project | Considered as the final EIS was prepared |
| 119717 | Sommers, P. | General comment supporting the project | Considered as the final EIS was prepared |
| 118423 | Zweizig, D. | Comment supporting an increased setback of 0.5 mile | Considered as the final EIS was prepared |
| 118436 | Bembinster, C. | Section 5.8, suggests review of the noise study prepared for the EIS for Coyote Wind Farm in Montana | Considered as the final EIS was prepared |
| 119717 | Steffen, G. | General comment supporting the project | Considered as the final EIS was prepared |
| 119124 | Congdon, J. | Chapter 5, EIS does not adequately address shadow flicker, noise, health effects | Considered as the final EIS was prepared |
| | | Section 4.3, potential for significant bat mortality | New information from two existing Wisconsin wind farm post-construction studies was added |
| | | Section 5.10, property values reduced | A discussion of some additional property value studies has been added to this section |
| | | Section 5.13, television and radio reception problems | Considered as the final EIS was prepared |
| | | Section 5.3, aesthetic impacts | Considered as the final EIS was prepared |

| ERF REF# | Entity | Comment Content Summary | Action Taken |
|---|---|---|---|
| 119717 | Koopmans, S. | Section 3.3.1, wind resource in project area not compared to alternate sites in Wisconsin and other states | Discussion of wind resource added to Section 3.3.1 |
| | | Section 3.3.1, consideration of population density and wind resource in selecting project area | This issue is discussed in Section 6.5 |
| 119456 | CWESt | Section 5.8, draft EIS does not mention comments on the EA submitted by CWESt | Mention of CWESt's comments added to Section 5.8.1 |
| 119550 | IBEW Local Union 21 | General comment supporting the project | Considered as the final EIS was prepared |
| 119717 | Wilkinson, S. | Section 5.9.2, effects on jobs | Considered as the final EIS was prepared |
| | | Section 2.1.4, no overhead collector circuits shown in draft EIS | After its CPCN application was filed at the PSC, WEPCO altered its project design to eliminate overhead collector circuits. This has been clarified in the final EIS |
| | | Section 2.5, easement agreement conditions | Considered as the final EIS was prepared |
| | | Chapter 5, noise and shadow flicker studies and mitigation techniques | Considered as the final EIS was prepared |
| | | Section 5.11, restriction of recreation activities | Considered as the final EIS was prepared |
| | | Section 5.3, aesthetic impacts | Considered as the final EIS was prepared |
| 119493 | Clean Wisconsin | Section 4.1.1, avoided CO2 emissions achieved by the proposed project | An estimation of the avoided CO2, based on the EGEAS analyses, has been added |
| | | Draft EIS does not address environmental benefits of the project | Considered as the final EIS was prepared |
| | | Section 3.5, results of EGEAS runs estimates of air pollutants not reported | Considered as the final EIS was prepared |
| | | Section 3.5, implications of MISO generation resource dispatch not discussed | Considered as the final EIS was prepared |
| | | Section 4.1, final EIS should address the implications of MISO dispatch on the avoided environmental impacts of fossil fuel combustion | Considered as the final EIS was prepared |
| | | Section 4.1, final EIS should consider retirement of a coal plant to ensure that the proposed project would reduce air emissions | Considered as the final EIS was prepared |
| | | Section 6.1, EIS should quantify the cumulative reduction in combustion-based generation based on compliance with the Renewable Portfolio Standards | Considered as the final EIS was prepared |
| | | Executive Summary, final EIS should reflect that the proposed project may not be allowed to operate by MISO under circumstances where supply exceed load | Considered as the final EIS was prepared |

| ERF REF# | Entity | Comment Content Summary | Action Taken |
|---|---|---|---|
| 119498 | WEPCO | Executive Summary, page XIV, minor suggested revisions | Considered as the final EIS was prepared |
| | | Executive Summary, page XVI, suggestions regarding bats discussion | Considered as the final EIS was prepared |
| | | Executive Summary, page XIX, suggestion regarding compliance with 50 dBA threshold | Considered as the final EIS was prepared |
| | | Section 1.1.1, additional easements may be required | Considered as the final EIS was prepared |
| | | Section 1.1.4, minor suggested revision | Considered as the final EIS was prepared |
| | | Section 1.3.2, suggested wording change regarding DNR permitting authority | Considered as the final EIS was prepared |
| | | Section 1.3.4, U.S. Army Corps of Engineers permit issued | Issuance of this permit was acknowledged in the final EIS |
| | | Section 2.1.5, description of required transmission upgrades has changed | Revisions to this section were made to reflect the latest MISO transmission impact studies |
| | | Section 2.2.4, crane pad area not restored after construction | EIS was revised to reflect this comment |
| | | Section 2.5.1, additional easements may be required | Considered as the final EIS was prepared |
| | | Section 4.3, suggestions regarding bats discussion | Considered as the final EIS was prepared |
| | | Section 5.7.1.2 and 5.7.1.3, suggested wording changes regarding shadow flicker discussion | Some changes to these sections were made to more accurately reflect Figure 5.7-1 |
| | | Sections 5.8.1.5, 5.8.4.2, and 5.8.4.3, suggested wording changes reagrding noise discussion | Considered as the final EIS was prepared |
| | | Section 5.8.6, suggestions regarding human reaction to noise | This section was revised to include some clarifications about the MDH paper and other studies |
| | | Section 5.10, suggestion regarding additional information on property values | Section 5.10 was expanded to include a discussion of some new property value studies that have become available |
| 119518 | Invenergy Wind LLC | Section 3.5, EGEAS modelling for project appears erroneous due to incorrect or improper assumptions | Considered as the final EIS was prepared |
| 119717 | Bump, J. | Chapter 5, Amish community impacts not addressed | Information about the Amish community present within and near the project area was added |
| 119717 | Bump, J. | Section 5.7, solutions for health and safety issues not included in draft EIS | Considered as the final EIS was prepared |
| | | Section 5.2, Suggestions regarding Joint Development Agreement (JDA) process | Considered as the final EIS was prepared |
| | | Section 5.10, property value protection plan needed | Considered as the final EIS was prepared |
| | Department of Agriculture, Trade and Consumer Protection | Section 5.4, observations about the potential effect of the project on aerial applications, possible mitigation strategies and general information about the economic value of the potato and vegetable crop to Wisconsin | Section 5.4.2.2. was expanded. |
| | | Section 5.4, the terminology for describing various types of impacts could be altered to reflect project phases such as construction, project operation, and post-decommissioning | Considered as the final EIS was prepared |
| | | General concerns that the Agricultural Mitigation Plan for the project may not include decommisioning activities. | Considered as the final EIS was prepared |

## 7.2. SUMMARY OF SIGNIFICANT CHANGES TO THE EIS

In response to some comments from intervenors and the general public on the draft EIS, several sections of the draft EIS have been expanded or altered.

The following discussion summarizes these changes. The information is presented chapter by chapter. The sections or subsections (shown in bold) under each chapter heading indicate where the text changes occur.

There were also some changes made that are not listed in the summaries below. The overwhelming majority of those changes were made to improve the readability of the text and correct minor errors.

### Chapter 1 Project Overview and Regulatory Requirements

**1.3.8. Intervenors:** A new subsection was added to update the information regarding participation by intervenors in this docket.

### Chapter 2 Engineering

**2.1.5. Substation and interconnection to the transmission grid:** Updates were made to this section to reflect the completion of MISO's most recent transmission system impact study.

**2.3.2. Plant capacity factor:** Two paragraphs providing background information about wind resources in Wisconsin and the project area have been added to this section.

### Chapter 3 Need, Alternatives, Project Cost and Economics

**3.5.2. EGEAS modeling description:** The list of scenarios that were modeled has been expanded. Table 3.5-1 reflects the results of these additional analyses.

**3.5.3. EGEAS analyses summary:** The results summary has been expanded to include the new scenarios.

### Chapter 4 Natural Environment - Potential Impacts and Mitigation

**4.1.1. Air emissions avoided by using wind energy:** An estimate of the $CO_2$ emissions that could be avoided by building and operating the Glacier Hills Wind project has been added to this section.

**4.2.2. Birds:** Information received in comments regarding the possible presence of bald eagles in the project area during winter has been added.

**4.3. Bats:** Changes in this section reflect updates in on-going post-construction studies at existing wind farms in Wisconsin and new research being conducted on reducing bat mortality.

### Chapter 5 Community and Social Environment - Impacts and Mitigation

**5.1.1. Demographics:** Some information about the Amish families living within or near the project area has been added.

**5.2.1. Existing zoning:** This section was expanded to include information about actions the village of Friesland has taken since the draft EIS was issued.

**5.4.2.2. Aerial application practices:** Some information about how the project could limit aerial application of plant products, such as pesticides, fertilizers, etc. near the proposed turbine sites was added.

**5.7.1.2. Potential for shadow flicker in the project area:** Portions of this section were re-written so that the text more accurately describes Figure 5.7-1.

Total annual hours columns were removed from Tables 5.7-1 and 5.7-2.

**5.7.7. Medical helicopter flights:** This is a new section that was added based on new information.

**5.7.8. Emergency shutdown options for turbines:** This is a new section that discusses how one or more turbines in the wind park could be powered off if an emergency occurs.

**5.8. Noise:** An explanation about an instrumentation problem in the applicant's first pre-construction noise study and the results of a repeated study are provided. Also, some additional information about existing studies on possible health effects from wind turbine noise is discussed in Section 5.8.6.

**5.10. Property Values:** This section has been expanded to include a discussion of several additional studies that examine the effect of wind turbines on property values.

## Chapter 6 Cumulative Impacts

**6.1. General Impacts:** Additional information about avoided $CO_2$ emissions has been added.

**6.2. Bird and Bat Impacts:** Information has been updated to reflect new data received from on-going post-construction mortality studies at two Wisconsin wind farms.

## Chapter 7 Summary of Comments and Changes to the EIS

This is a new chapter that was added to address the comments on the draft EIS.

## Executive Summary

The Executive Summary has been revised to reflect the important changes described above.

## Volume 2

A new photo simulation (Figure Vol. 2-19) has been added to illustrate a view of the turbines from the UWGP ethanol plant entrance looking east.

# 8. Acronyms

| Abbreviation or Acronym | Definition |
|---|---|
| ºC | Degrees Centigrade |
| ºF | Degrees Fahrenheit |
| % | Percent |
| § | Section |
| AD | Anaerobic digestion |
| AFUDC | Allowance for funds used during construction |
| AIS | Agricultural Impact Statement |
| AMP | Agricultural Mitigation Plan |
| ASNRI | Areas of special natural resource interest |
| ATC | American Transmission Company LLC |
| BACI | Before-after-control-impact |
| BACT | Best available control technology |
| BCI | Bat Conservation International |
| BMP | Best management practices |
| BOA | Bureau of Aeronautics |
| BSGF | Blue Sky Green Field wind farm |
| CadNA | Computer Aided Design for Noise Abatement |
| CC | Combined-cycle |
| CFR | Code of Federal Regulations |
| cfs | Cubic feet per second |
| ch. | Chapter |
| Clean Wisconsin | Clean Wisconsin Inc. |
| CO | Carbon monoxide |
| $CO_2$ | Carbon dioxide |
| Commerce | Wisconsin Department of Commerce |
| Commission or PSC | Public Service Commission of Wisconsin |
| CPCN | Certificate of Public Convenience and Necessity |
| CRP | Conservation Reserve Program |
| CT | Combustion turbine |
| CTH | County trunk highway |
| CUB | Citizens' Utility Board |
| cu. ft. | Cubic feet |
| CWESt | Coalition for Wisconsin Environmental Stewardship |
| DATCP | Wisconsin Department of Agriculture, Trade and Consumer Protection |
| dB | Decibels |
| dBA | Decibels A-weighted |
| dBC | Decibels C-weighted |
| DNR | Wisconsin Department of Natural Resources |
| DOA | Wisconsin Department of Administration |
| DOE | U.S. Department of Energy |
| DOT | Wisconsin Department of Transportation |

| Abbreviation or Acronym | Definition |
|---|---|
| DSM | Demand-side management |
| EA | Environmental Assessment |
| EAA | Experimental Aircraft Association |
| EGEAS | Electric Generation Expansion and Analysis |
| EIS | Environmental impact statement |
| EMF | Electric and magnetic field |
| EPA | U.S. Environmental Protection Agency |
| ERW | Exceptional Resource Waterway |
| ESA | Endangered Species Act |
| FAA | Federal Aviation Administration |
| FCC | Federal Communications Commission |
| FERC | Federal Energy Regulatory Commission |
| FPL | Florida Power and Light Company |
| FRPP | Farmland and Ranch Preservation Program |
| G | Gauss |
| gal | Gallon |
| GHG | Greenhouse gas |
| GHz | Gigahertz |
| Glacier Hills | Glacier Hills Wind Park |
| GWh | Gigawatt hour |
| $H_2SO_4$ | Sulfuric acid |
| HAP | Hazardous air pollutants |
| hr. | Hour |
| Hz | Hertz |
| I-39 | Interstate Highway 39 |
| IC | Intervenor compensation |
| Invenergy | Invenergy Wind LLC |
| IOU | Investor-owned utility |
| IPP | Independent power producer |
| JDA | Joint Development Agreements |
| kV | Kilovolt – 1,000 volts |
| kVA | Kilovolt ampere |
| kW | Kilowatt |
| kWh | Kilowatt-hour |
| lb. | Pound |
| LDC | Local distribution company |
| LLC | Limited liability company |
| LVRT | Low Voltage Ride Through |
| MAIN | Mid-America Interconnected Network |
| MAPP | Mid-Continent Area Power Pool |
| MBTA | Migratory Bird Treaty Act |
| MDH | Minnesota Department of Health |
| MFL | Managed Forest Law |
| mG | Milligauss (equal to $1/1000^{th}$ of a gauss) |
| MISO | Midwest Independent Transmission System Operator Inc. |
| MP | Measuring point |

| Abbreviation or Acronym | Definition |
|---|---|
| mph | Miles per hour |
| msl. | Mean sea level |
| MVA | Megavolt amperes |
| MW | Megawatt |
| MWh | Megawatt hour |
| N/A | Not available or not applicable |
| NAAQS | National Ambient Air Quality Standards |
| NERC | North American Electric Reliability Council |
| NEV | Neutral-to-earth voltage |
| NHI | Natural Heritage Inventory |
| $NO_2$ | Nitrogen oxide |
| $NO_x$ | Nitrogen oxides |
| NOI | Notice of Intent |
| NRCS | Natural Resource Conservation Service |
| NRHP | National Register of Historic Places |
| NREL | DOE's National Renewable Energy Laboratory |
| NSPW | Northern States Power Company-Wisconsin |
| NTIA | National Telecommunication Information Agency |
| NWCC | National Wind Coordinating Committee |
| NWS | National Weather Service |
| $O_3$ | Ozone |
| O&M | Operations and maintenance |
| ORW | Outstanding Resource Waterway |
| Pb | Lead |
| $PM_{10}$ | Particles of 10 micrometers or less |
| $PM_{2.5}$ | Particles less than 2.5 micrometers |
| PPA | Purchased power agreement |
| PSC or Commission | Public Service Commission |
| PSD | Prevention of significant deterioration |
| PTC | Production Tax Credit |
| Pv | Photovoltaic |
| REPP | Renewable Energy Policy Project |
| RFP | Request for Proposals |
| ROW | Right-of-way |
| rpm | Revolutions per minute |
| RPS | Renewable Portfolio Standard |
| RRC | Renewable credits |
| SCADA | Supervisory control and data acquisition |
| SEA | Strategic Energy Assessment |
| SGCN | Species of greatest conservation need |
| spp. | Species (plural) |
| SPS | Special Protection System |
| STH | State trunk highway |
| TMDL | Total maximum daily load |
| tpy | Tons per year |
| USDA | U.S. Department of Agriculture |

| Abbreviation or Acronym | Definition |
|---|---|
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| USH | U.S. Highway |
| VOC | Volatile organic compounds |
| WEPA | Wisconsin Environmental Policy Act |
| WEPCO | Wisconsin Electric Power Company |
| WES | Wind Energy Systems |
| WHS | Wisconsin Historical Society |
| Wis. Admin. Code | Wisconsin Administrative Code |
| WisAHRD | Wisconsin Archaeological and Historic Resources Database |
| Wis. Stat. | Wisconsin Statute |

# Appendix A – Bird Species of Greatest Conservation Need Observed during Pre-construction Avian Study

APPENDIX A

Bird Species of Greatest Conservation Need Observed during Pre-construction Avian Study (comments quoted directly from the study report[1])

**American Black Duck** (*Anas rubripes*) **–** “One black duck was in a mixed flock of ducks flying medium to high over point 15-8 on 23 October.”

**Blue-winged Teal** (*Anas discors*) **–** “Twelve of the 26 blue-wingeds were observed at point 3-37. Only 3 of the 26 blue-wingeds observed were flying, 2 in the low category and the other in the high category. The other 11 teal were on water at points 3-11, 3-31, and 3-33.”

**Lesser Scaup** (*Aythya affinis*) **–** “The only scaup observed was in a mixed flock of ducks flying medium to high over point 15-8 on 23 October.”

**Bald Eagle** (*Haliaeetus leucocephalus*) **–** “Three eagles were sighted flying north at a medium to high height at point 15-11 on 5 May. In 2007 there were 5 active eagle nesting territories in Columbia County.”

**Northern Harrier** (*Circus cyaneus*) **–** “Harriers were sighted on 16 occasions during all 3 seasons. Typical of the species, all were flying at a low altitude, most of them actively hunting for small mammals.”

**American Golden-Plover** (*Pluvialis dominica*) **–** “On 24 September a flock of 30 birds flew low over point 3-9. A flock of 19 birds flew low past point 3-8 and landed in a harvested agricultural field that was greening. On 8 October flocks of 6 at 15-4 and 36 at 15-2 appeared to be migrants heading south.”

**Solitary Sandpiper** (*Tringa solitaria*) **–** “One solitary was seen at point 3-7 in a small flooded ditch in a yard on 20 August, and another was seen on the same date at point 15-6 feeding in shallow water on a manure pile. On 5 May one was heard at point 3-17.”

**Upland Sandpiper** (*Barramia longicauda*) **–** “All of the 8 uplands tallied were giving their characteristic “wolf-whistles” from very open agricultural habitat south of Hwy 33 during May migration.”

**Black-billed Cuckoo** (*Coccyzus erythropthalmus*) **–** “One cuckoo was singing in a woodland south of point 3-39 on 17 June 2008.”

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[1] Noel J. Cutright, January 2009, Glacier Hills Wind Park Pre-construction Avian Study, Columbia/Dodge Counties, Wisconsin, Prepared for Wisconsin Electric Power Company, Application Appendix Z Supplement, PSC ERF #106556

**Red-headed Woodpecker** (*Melanerpes erthrocephalus*) **–** "Seventeen red-headeds were either heard or seen flying low during spring and fall surveys. Multiple sightings were recorded at 4 of the 10 points where they were tallied, with 4 heard at point 3-16 and 3 observed at point 15-8."

**Willow Flycatcher** (*Empidonax traillii*) **–** "One willow was heard at point 3-38 on 17 June 2008."

**Veery** (*Catharus fuscenscens*) **–** "One Veery was observed at point 15-10 on 12 May."

**Wood Thrush** (*Hylocichla mustelina*) **–** "Three Wood Thrushes were heard during the breeding season at points 3-11, 3-30, and 3-33."

**Brown Thrasher** (*Toxostoma rufum*) **–** "All 24 thrashers were tallied either during spring migration or the breeding season. The observations in June were at points 3-20 and 3-32."

**Field Sparrow** (*Spizella pusilla*) **–** "Twenty-one of the 22 Field Sparrows recorded came from 3-minute stops, with 2 points accounting for 15 individuals – 10 at point 3-34 and 5 at point 3-30."

**Vesper Sparrow** (*Pooecetes gramineus*) **–** "This was the 4th most abundant sparrow, following song, chipping, and savannah. For the 11 surveys from 15 April through 15 July, vesper numbers were in double-digits."

**Dickcissel** (*Spiza Americana*) **–** "All 15 Dickcissels were observed during summer, with 11 of the 15 observed at 5 adjacent points: 15-10 (1), 3-35 (2), 3-36 (1), 3-37 (5), and 3-40 (2)."

**Bobolink** (*Dolichonyx oryzivorus*) **–** "Twenty-five Bobolinks were observed at 11 points on 7 surveys between early May and mid-June."

**Eastern Meadowlark** (*Sturnella magna*) **–** "Of the 26 meadowlarks observed at point 3-35, 20 were in a loose flock moving across and along the road on 31 July. Three of the 9 other locations where meadowlarks were tallied had multiple sightings, 2 at point 15-11, 2 at 3-40, and 3 at 3-37."

**Rusty Blackbird** (*Euphagus carolinus*) **–** "Of the 45 rusties tallied during the study, 30 were observed at point 15-10 on 15 April."

# Appendix B – Agricultural Mitigation Plan

# WE ENERGIES
# AGRICULTURAL MITIGATION PLAN
# RANDOLPH WIND FARM

June 2008

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# 1. INTRODUCTION

We Energies, a utility company based and operating in the State of Wisconsin, proposes to construct a wind farm located in Columbia County of Wisconsin, tentatively named the Randolph wind project ("Randolph"). We Energies has a longstanding commitment to working with landowners who may be affected by construction of various utility projects throughout the State of Wisconsin. We Energies has a vested interest in working with landowners within the project to ensure their satisfaction with utility project construction and post-construction restoration. We will have a continuous working relationship with landowners throughout the 30-40 year life span of the wind farm.

We Energies continues to be committed to restoring construction areas to pre-construction conditions with all our construction projects. We believe this Agricultural Mitigation Plan (AMP), will help to assure this outcome within agricultural areas in the proposed wind farm project area. We Energies has prepared this AMP specifically to prevent or mitigate potential adverse impacts of the project on agricultural productivity, using construction and restoration procedures from other We Energies projects and modifying them as necessary. We Energies requires its qualified contractors to possess a high level of proficiency to implement the practices described within this AMP.

# 2. PURPOSE

The purpose of this AMP is to:

- establish personalized communications with agricultural landowners to ensure their unique concerns are addressed
- provide agricultural landowners and tenants with a hotline for convenient access to the Company Representative to contact;
- present a concise informational process for agricultural landowners regarding the various Project phases;
- describe the job duties of the We Energies Environmental Inspector (EI);
- provide additional assurance of effective agricultural construction mitigation and restoration; and
- demonstrate a comprehensive agricultural mitigation program satisfactory to Wisconsin Department of Agriculture, Trade and Consumer Protection (WDATCP).

# 3. PROJECT DESCRIPTION

### 3.1 General Project Description

The Randolph wind farm is located in northeast ColumbiaCounty, in the Towns of Randolph and Scott. This project site was identified based on the availability of wind resources, transmission access and availability, and other relevant siting factors. The project site for Randolph is an area of approximately 17,500 acres, composed primarily of agricultural land.

A regional location map of the general project area (Attachment A) and a map showing the approximate project boundary (Attachment B) is attached. We Energies has begun to gather field data such as wetland, waterway and woodland locations and topsoil depths among other items. This will allow us to develop preliminary plans for structure locations. We will then meet with landowners to discuss the proposed locations and gain their feedback.. . We currently anticipate construction of between 70 and 100 turbines, which, depending on the turbine model chosen, may generate between 100 and 250 megawatts (MW) of electric generation.

Agricultural land will be impacted both temporarily and permanently (for the estimated 30-40 year life of the project). Each wind turbine will require a permanent concrete foundation, a gravel access road, and underground collector system (electrical cable system). These structures will remain in place for the 30-40 year life of the project. Upon expiration of the easement with each landowner, the turbine and access roads will be removed from each site and the soils restored for agricultural use. Underground cables will be severed and left in place so as to minimize future land distubance. The concrete foundation will be removed to a depth of four feet and covered with soil. The remaining underground concrete foundation will be abandoned in place.

Temporary impacts include laydown areas adjacent to each turbine for temporary storage of construction materials and construction operations to construct the turbine. Paths between each turbine will be compacted to allow a large crane safe access and operation between turbines. Section 3.3 below outlines other construction activities and structures that may be required for this project. We will not have a definitive determination of locations or construction specifications for these activities or structures until easements have been signed and site-specific planning has been completed.

There is no existing electrical substation in the area of the proposed wind farm with the capacity or potential to be expanded. We anticipate that we will purchase approximately 15-20 acres of land from a willing landowner that currently has a wind farm easement with We Energies. Several landowners have expressed an interest in selling land to We Energies for this purpose.

**Major Construction Activities for Facility Installation**

We Energies has not purchased turbines for this project. National and international demand for turbine equipment has grown substantially and is anticipated to continue for several years to come as demand substantially outstrips supply. These market conditions have also provided turbine manufacturers with significant negotiating leverage. Ultimately, this means that turbine availability is scarce, equipment prices have increased substantially, and the ability to hold equipment delivery times without a substantial financial commitment is extremely limited. To minimize uncertainty and aggressively manage costs for rate payers and customers, we anticipate issuing a request for proposals for the wind turbines in early 2009 to maximize the Project's economic negotiating position and operation fit of the equipment, although the date is subject to change based on market conditions at that time. The successful proposal will provide the turbine specifications.

The wind turbines under consideration for use at the Project share a similar design: horizontal-axis, three-bladed turbines mounted on tubular steel towers. Turbine specifications for size and details such as blade length may vary. We expect turbine specifications to be close to the follow specifications: hub height of 80 meters (262 feet) and blade lengths of 42 meters (137 feet), with a total tip height of 125 meters (400 feet). A figure showing a typical wind turbine structure is attached (Attachment C).

### 3.2.1 Turbine Foundation

The foundation supports the entire wind turbine assembly. Foundations are typically constructed by excavating a hole, placing reinforcing steel, and pouring concrete into the excavation. Foundations vary depending on the soil and geotechnical conditions at each turbine site. A "deep" foundation is comprised of a hollow reinforced concrete cylinder approximately 16-18 feet in diameter with a depth of approximately 30 feet. A "shallow" foundation requires the installation of a mat foundation below grade which is approximately 50 ft by 50 ft in size (0.06 acres) and approximately 8 eight feet deep. A typical deep and shallow foundation drawing is attached (Attachment D).

At this time we do not know whether deep or shallow foundations will be needed for each turbine. For purposes of this plan we will use the scenario that would impact the greatest amount of agricultural acreage. Using the assumption that all turbines may require the shallow subsurface mat foundation, and that this subsurface structure may inhibit the use of the foundation site for agricultural practices, the 50 ft by 50 ft area is a 0.06 acre area, which would total 3.0 acres for 50 turbines and 4.8 acres for 80 turbines. The least agricultural impact scenario would use the assumption that all turbines would use the deep foundation, resulting in an approximately 18 ft by 18 ft impact of 0.007 acres, totaling 0.35 acres for 50 turbines and 0.56 acres for 80 turbines. The specific foundations will be designed based on the soil and geotechnical conditions that are determined from the soil borings taken at each turbine location prior to construction.

A gravel pad for use by the crane will be constructed adjacent to each turbine, and is typically 50 by 80 feet in size (0.09 acres). This gravel pad will be left intact after construction to allow construction equipment access/laydown for future maintenance and repair needs. This results in a total of 4.5 acres of impact for 50 turbine sites and 7.2 acres for 80 turbines. A permanent padmount transformer (approximately 6 feet by 10 feet in size) is installed directly adjacent to each turbine.

A laydown area adjacent to each turbine foundation will be needed for construction laydown and equipment operation. A photo of a typical laydown site is attached (photo is the BSGF I laydown area) (Attachment E). If agricultural fields are used for laydown during the winter, excess snow will be pushed from the laydown site and a layer of snow will cover the frozen ground during laydown and construction activities. Upon completion of construction, the laydown area will be decompacted as necessary to restore the area to pre-construction conditions.

If laydown and construction activities occur during the growing season, topsoil will be stripped from the laydown site. Upon completion of construction the subsoil will be decompacted as needed to restore the area to pre-construction conditions, and the topsoil replaced.

Semi trailers will be used to bring turbine parts to the site, and a crane will be used to install the turbine sections and blades. These turbine construction and laydown areas will be a temporary impact of approximately 2.0 acres at each turbine site. The laydown dimensions and configuration at each turbine site will vary slightly depending on site specific conditions. Agricultural activities will not take place in the construction area while the turbine is being installed. Each laydown area will be restored to agricultural use upon completion of turbine construction. A site of up to twenty five or thirty additional acres may be obtained via easement to be used for temporary construction laydown/storage, and will be restored to agricultural use upon completion of the project. A site has not been identified for this additional laydown area at this time.

### 3.2.2 Access Roads

Access roads will be constructed from existing roadways to each turbine site to provide access for equipment necessary for construction, and to facilitate access to the turbine for ongoing operation and maintenance. Temporary access roads will be approximately 40 feet wide. Generally, the end of the access road that intersects with the public road will be up to 150 feet wide. The purpose of this expanded access road entrance is to allow the oversized trailer carrying turbine parts to safely turn into the driveway.

In places where access roads are constructed over agricultural land, topsoil will be stripped and stockpiled separately. Geo-textile construction fabric will be placed on the subsoil surface (below the imported rock material for the road surface) for additional stability and to provide a distinct barrier between the imported rock material and the subsoil surface. Acccess roads are approximately thirty five feet wide to allow construction equipment access. Upon completion of turbine construction, access roads will then reduced to a width of approximately sixteen feet for permanent access roads to each turbine. Upon completion of the easements (30 - 40 years), access roads will be completely removed. When the road, or portion of a road is removed, all gravel and geotextile fabric will be removed from the site, the subsoils decompacted and topsoil replaced. In the event the Landowner wants a road left intact, a written mutual agreement between the Landowner and the Company will be established. A typical access road design is attached (Attachment F).

### 3.2.3 Crane Routes

Construction of the wind farm will require cranes to erect the turbines. A large crane will be used to install the upper two sections of the turbine tower, the nacelle, and rotor (blades). The Blue Sky Green Field I Project utilized a Manitowoc 16000, with specifications of 315 feet tall, 29.5 feet wide, 500 tons and moved at approximately 1 ½ miles per hour. A photo is enclosed (Attachment G). We anticipate a similar crane to be used on this project. The crane will drive from one turbine site to the next. The route taken by the turbine are selected to be the shortest practical distance between the turbines and are generally on agricultural lands.

Due to the size and weight of the crane, when it is mobile or "walking", it has a limited range of accessibility over uneven terrain. When designing the crane routes, the route attempts to avoid steep slopes, woodlands, wetlands, and waterways as much as possible. In addition, We Energies prefers to avoid driving the cranes on public roads as much as reasonably possible. The slow speed may create a traffic issue on narrow roads and the weight of the crane may damage the road surface. It is possible to partially or completely dissasemble the crane into its 14 component parts, place the parts onto 10 or more trailers and truck them to the next turbine site where the crane would be reassembled. This typically will cause up to a one week delay in use of the crane due to the disassembly and reassembly, as well as an added cost of between $15,000 to $70,000 dollars, depending on the level of dissasembly required; therefore, this is avoided as much as possible.

Upon completion of the project, all crane routes on agricultural lands will be inspected to determine if decompacted is needed. If crane routes are completed during winter months when the soils are adequately frozen, the soil may or may not need decompaction. The crane routes will be inspected post-construction during the growing season (ideally in spring or after rain events) to determine if soil compaction may have caused compression of underground drainage tiles. Compression of drain tiles may result in ponded water on or near the crane routes. Any damaged tiles on or adjacent to the crane routes will be repaired or replaced.

### 3.2.4 Collector System/ Underground and Aboveground Cables

Each wind turbine will be connected to the Substation via an underground electrical collection system consisting of 2 inch to 3 inch diameter cables. The cables will be installed approximately 4 feet under ground. The temporary construction corridor for the installation of the electric cables will be up to approximately 25 feet wide. The disturbed area along cable runs will vary, depending primarily on the type of equipment used to install the cables. Agricultural use of the area will be temporarily impacted during installation, and returned to agricultural use when cable installation is complete. Installation of the cables may be completed by open-cut trench, in which case the topsoil and subsoils are removed and stockpiled separately and replaced in the correct soil horizons in the trench. The “plow” method may also be used; the machine slices open the soil, holds it open while the cable is installed, and drops the soil directly back into place. In this installation method, the soil horizons are not disturbed. Cable may also be installed via underground directional bore; a tunnel is augered underground into which the cables are pulled. The only soil disturbance with this method is at the entry and exit holes for the tunnel (which are less than a foot wide).

Installation of aboveground cables (on utility poles) may be utilized in some areas, especially if access to land is limited. Utility poles supporting overhead cables may be installed in road right-of-way or on private land if the landowner has voluntarily signed an easement allowing the installation. Future agricultural use of land under a utility line is allowed, with the exception that trees or tall woody shrubs may not be planted directly under the utility line. If aboveground cables are installed, a “switching station” may be necessary; this station would collect the aboveground cables at one location, from which the cables would be rerouted underground. Less than one acre would be needed for this station.

A SCADA (Supervisory Control and Data Acquisition) System, which provides for centralized monitoring and control of the wind turbines, will also be installed underground. The SCADA system collects data related to real-time generation output, tracks operating and maintenance statistics, and generates safety alarms that protect the turbine components. Typically, fiber optic cable is used for SCADA communication lines between individual wind turbines, wind monitoring towers, the project substation, and the operations/ maintenance building. SCADA cabling is usually buried in the same trenches as the underground electric cables that run between the wind turbines.

## 3.3 Accessory structures and construction activities that may be required for the project

### 3.3.1 O&M Building

Utility-scale wind power projects typically include an operations and maintenance building (O&M Building) where offices, control room, locker rooms, spare parts storage and employee and equipment parking are provided.

### 3.3.2 Temporary Laydown area

The temporary laydown area will be twenty five to thirty acres in size. It may be located immediately adjacent to the O&M Building as that would simplify on-site coordination, but the laydown area could be located anywhere in the project area. Topsoil will be stripped from the laydown area and stockpiled. A geotextile fabric will be placed on the subsoil surface prior to placing gravel. Stormwater and erosion control measures will be used as needed.

The area will be used to store turbine parts, construction equipment, construction vehicles, construction trailers and employee parking. Upon completion of the project, the site will be decompacted and topsoil replaced. The laydown area will be placed on land that is under easement for the project. Crop compensation will also be provided to the landowner.

### 3.3.3 Public Road Improvements

The trailers that will bring the turbine parts to the site are oversized trailers that require approval from the Department of Transportation. Some local roads may have intersections that are too narrow or too tight of a corner for the trailer to safely turn. At these intersections, the road will be improved by adding compacted gravel to increase the turning radius of the intersection. At the end of the project construction, all the gravel is removed from the site and the intersection returned to pre-construction condition. In general, we expect that these road improvements will occur entirely within DOT road right-of-way. However, depending on the width of the road right-of-way, it is theoretically possible that at some intersections, some of the road improvement fill will be on private lands, potentially agricultural lands. An easement or lease agreement will be obtained from the property owner as needed. If this is the case, a geotextile fabric will be placed between the soil surface and the gravel, crop compensation will be provided to the landowner, and upon completion of the project, the gravel and geotextile fabric will be removed and the site decompacted and restored.

### 3.3.4 Transmission Interconnect Facilities/ Substation expansion

An electrical substation will be required for the project, to connect the wind farm to an American Transmission Company (ATC) transmission line. Typically, a substation for a project this size will require 15-20 acres. A typical substation design drawing is attached (Attachment H).

#### 3.3.5 Meterological towers

Meterological ("met") towers are installed prior to construction of a wind farm to determine whether local wind speeds meet the criteria for successful operation of a wind farm. These towers may be up to 50 meters tall and held in place with three or four sets of guy wires and a base that is bolted into the ground. A photo of a typical met tower is attached (Attachment I). These towers are typically sited on less than one acre of land within the project area. While the met towers are in place, farming activities may continue around the met tower, and to within a few feet of the base of the guy wires. Often, additional met towers may be installed after construction of the wind turbines, immediately adjacent to a few turbines, to confirm wind readings and operation of those turbines. While some met towers are temporary and removed from the site within two years of the start of operation, some met towers will remain at the project site throughout the life of the project. The total number of temporary and permanent met towers varies with each wind farm. An easement for the laydown area would be obtained from landowners that are interested in voluntarily signing an easement.

### 3.4 Construction Sequencing

Construction consists of three general stages; access road, foundation construction and collector system construction, turbine erection and crane walks, and restoration. There is some overlap of these construction stages and some construction activities are weather dependent.

#### 3.4.1 Access Road, Foundation Construction and Collector System Installation

The first phase of construction includes the majority of soil disturbing activities. The first activities are to survey and stake construction areas and install erosion control measures as needed. Construction of access roads begins; at the same time excavation of the turbine foundations begin as each access road is completed. The laydown area adjacent to each turbine is prepared. Concurrently, the underground electrical collector system is being installed via open cut trench, plow installation, or directional drills. Since the installation includes tens of miles of cable that connect each turbine with the electrical substation, there are often multiple crews installing the collector system at different locations throughout the project site.

The centerline of access roads, turbine foundation and collector system locations are GPSed throughout construction. This allows accurate mapping of all above and below ground structures. This mapping can be used for locating structures for replacement or repair as well as determination of construction zones for determining crop damage payments.

Other activities that occur at the beginning of the project construction include grading and preparation of the main laydown area where the turbine parts and equipment is stored, construction of the permanent O&M building and the construction or expansion of an electrical substation to connect the project to electrical transmission lines. Once construction of the main laydown area is completed, delivery of the turbine parts commences and parts are stored at the main laydown area.

#### 3.4.2 Turbine Erection and Crane Operation (Crane Routes)

This phase of construction may begin any time after a majority of the foundations and access roads have been completed. The turbine parts will be moved from the main laydown area and trucked to each turbine foundation in preparation for erection. The turbine is erected in two separate operations. First, a crane will erect the bottom two parts of the turbine tower. This is an average sized crane of the size typically used on construction sites.

The large crane(s) will be delivered to the project site; depending on the size and type of crane, anywhere from 10 to 20 semi trailers of crane sections will be delivered. The large crane is assembled at a turbine site. Crane routes between turbines will be prepared by removal of topsoil and subsoil compaction as needed for safe operation of the crane. When the crane(s) have been assembled, it will begin installation of the turbine by erecting and connecting the upper two turbine tower components, then installing the nacelle, and finally installing the hub with attached blades. When the assembly is complete, the crane will use the crane route to arrive at the next turbine site that is ready for installation.

Construction of the electrical collectory system and construction of the substation is generally completed by this time. During turbine installation, there are other construction activities occurring on site that do not include soil disturbance such as checking to ensure that construction meets industry standards, testing equipment and energizing collector systems and the substation.

#### 3.4.3 Restoration

When construction activities are complete, then restoration of the project site will begin. This will include removal of the fill adjacent to roads that were used by oversized trucks as “turning radii” ; removal of portions of access roads to ensure that all access roads are no more than 16 feet wide; decompaction and soil restoration of crane routes and other soil disturbance areas. Upon completion of restoration, the only above ground structures will be the turbines, access roads, electrical substation and O&M Building. All disturbed lands will be restored to their pre-construction condition unless otherwise requested by the landowner.

## 4. SOILS

The soils in the project area are dominated by two associations: the Plano-Griswold-Saybrook association in the lower two-thirds of the project area and the Grellton-Gilford-Firesland association which crosses diagonally through the project area. The Plano-Griswold-Saybrook association have well drained and moderately well drained silty soils that have a silty or loamy subsoil and are underlain by sandy loam glacial till. The Grellton-Gilford-Friesland association has well drained, moderately well drained and poorly drained loamy soils that have a dominately loamy subsoil, and are underlain by sandy loam glacial till, stratified slit and sand, or silty sediment. In general, these soils have moderate permeability and moderate to high fertility. Most construction activities will occur in these areas.

Two additional associations are within the project boundary, but are less extensive; the Houghton-Adrian-Palms association in the northeast and adjacent to the Fox River in the west, and the Lapeer-Wyocena association along the northern portion of the project area. The Houghton-Adrian-Palms association are very poorly drained organic soils and underlain in places by sandy or loamy sediment. These soils have moderate to rapid permeability, but are typically saturated. Drainage systems may create soil conditions suitable for cropping, although fertility is low. The Lapeer-Wyocena association are well drained loamy and sandy soils that have a loamy subsoils and are underlain by sandy loam or loamy sand glacial till. The Lapeer series are on moraines, drumlins and till plains, and often inclue slopes. These soils have medium permeability and fertility, and while cropped, the sloped areas are often in pasture or woodlots. The Wyocena series has moderately rapid permeability and may be seasonally droughty. These soils have medium fertility and are generally cultivated.

## 5. SCOPE OF AGRICULTURAL MITIGATION

This AMP applies to those activities occurring on privately owned Agricultural Land. Agricultural Land as used here is understood to include rotated pastureland (except permanent pasture), all presently cultivated land including cropland, haylands, truck gardens, specialty crops, and land in government agricultural set-aside programs. “Permanent pasture” as used here includes land devoted exclusively to pasture use, and not suited to tillage or crop rotation, as determined by the lack of any sustained crop history. “Construction area(s)” as used here includes all permanent or temporary workspace areas to be used by We Energies for the purpose of constructing and operating the project, as well as lands on which aboveground facilities or other appurtenances related to the project will be located. The AMP may not apply to organic muckland soils, and the interests of Landowners whose property consists of such soils will be addressed separately in a manner that deals with the mitigation of anticipated impacts on such lands that may result from the construction of the project.

This AMP is binding on We Energies and all of their subsidiaries and holding companies, successors and assigns.

## 6. ENVIRONMENTAL INSPECTOR ROLE AND QUALIFICATIONS

We Energies will have a Company Project Construction Manager and a Company Environmental Manager for the project. To assist with on-site inspection and monitoring, We Energies will hire an Environmental Inspector (“EI”) for the Project. The EI will be a qualified individual to monitor and enforce implementation of the AMP. The EI will have experience with agricultural operations, familiarity with construction, and knowledge in regard to agronomy and soil conservation. The EI will report directly to the We Energies Environmental Manager and the We Energies Project Construction Manager. Generally, the EI will begin work prior after environmental permits have been issued, but prior to the commencement of construction activities.

The EI will be thoroughly familiar with the following:

- The Wind Farm Project Agricultural Mitigation Plan;
- typical wind farmconstruction sequences and processes;

They also will:

- be trained in techniques of soil conservation;
- be familiar with agricultural operations;
- possess good oral and written communication skills; and
- be able to work closely with the agricultural landowners, tenants and applicable agencies.

For a detailed EI job description, see Appendix A.

Contractors will be required to structure their construction activity to be consistent with the AMP.

# 7. AGRICULTURAL MITIGATION: PLANNING AND PRE-CONSTRUCTION PHASE

The planning phase consists of contacting interested agricultural landowners to determine if they are willing to discuss hosting a wind turbine, resulting with landowners voluntarily signing an easement with the Company to host one or more wind turbines and associated structures (cables, access roads, etc) on their land. These activities begin upon completion of the Agricultural Impact Statement process. A copy of the Agricultural Impact Statement will be provided to each landowner to further their understanding of the construction and restoration techniques that We Energies is committed to using on the Project.

A generic easement document is attached (Attachment J). This generic easement is usually modified, as each landowner's agricultural organization and lands are unique. The easement also commits the Company to provide compensation for crop damages/loss that may occur due to construction on their land, as well as annual payments for each wind turbine constructed on their property. A payment amount is not included in the generic document, as it is a private term of the easement and the amount is agreed upon by the Company and landowner prior to the landowner voluntarily signing the easement.

During the planning phase, We Energies will:

- Contact all landowners who have indicated a possible interest in the Project;
- Meet with those landowners interested in the project and determine if each landowner is interested in signing a easement, and if so, negotiate with willing landowners to sign a mutually agreeable easement;
- Oversee collection and analysis of baseline agricultural information in general gathered during development of the project;
- Be directly involved in ensuring agricultural interests are representated during the bid preparation phase by providing review comments on the bid documents, and by attending the pre-bid job showing, bid meeting and contractor award process;

We Energies will begin pre-construction planning after easements are signed. Upon signing the easement, the We Energies Property Management Right of Way Agent will work with the landowner to ascertain existing agricultural operations that may require special attention, such as conservation practices, location of above and below ground structures (drain tiles), muck soils, certified organic lands and ensure that these are noted in construction documents. The Property Management Agent will also ensure that other relevant agricultural issues are included in the construction line list such as plans for new drainage systems, irrigation systems or other farm technology. This information will be used by the Company to develop a Construction Plan that will specify the location of turbines and associated structures for the entire project area.

- During the pre-construction phase, We Energies and/or the EI will:
- Meet with each landowner to obtain property specific information (such as drain tiles, conservation practices, etc) to ensure these structures/ operation practices are noted on construction plans;
- review agricultural related project documents such as descriptions or maps of leased lands, permits, draft construction alignment sheets, and relevant plans prior to construction; and
- review information supplied by affected farm operators, conservation districts, agricultural extension agents, and others;

- participate in design of and lead the environmental training program for inspection and construction crews, to ensure they are familiar with AMP, agricultural concerns and issues that may come up.
- Negotiate with the farmland owner/operators to avoid the spreading manure over all areas within the proposed construction area prior to construction. If construction equipment comes in contact with manure on a parcel, the equipment will be cleaned prior to entering a parcel under separate ownership.
- Generally, excess soils from turbine base will be removed and disposed of off-site. If excess soil is to be disposed of on site, We Energies will meet with the landowner to determine the location to dispose of the excavated material displaced from the hole created by the turbine base. Materials may not be placed in wetlands, waterways or floodplains.

If any construction activities may occur on a Certified Organic Farm, We Energies will work with the landowner or tenant, the landowner or tenant's certifying agent, and/or a mutually acceptable 3rd party organic certifier as consultant to identify site-specific construction practices that will minimize the potential for decertification as a result of construction activities. Possible practices may include: equipment cleaning, use of drop cloths during welding and coating activities; removal and storage of additional topsoil; planting a deep-rooted cover crop in lieu of mechanical decompaction; applications of composted manure; or similar measures. We Energies recognizes that Organic System Plans are proprietary in nature and will respect the need for confidentiality.

We Energies will communicate with affected landowners of agricultural land to keep them informed of overall progress, explain the AMP and construction activities, and to learn of any additional issues or concerns noted by landowners. The landowner or EI will communicate all issues and concerns to the Company. No later than 30 days prior to the start of construction, We Energies will provide landowners with a telephone number and address that can be used to contact the Company. The phone number will include provisions for taking calls on evenings and weekends by use of an answering machine or voice mail system. We Energies will respond promptly to calls or correspondence from landowners or tenants. Where the Company needs to consult or obtain concurrence from both the landowner and tenant of a property, they will make a good faith effort to do so. In the event, there is a disagreement between landowner and tenant with regard to a decision, the Company's obligation will be satisfied by securing agreement of the landowner.

We Energies or the EI will develop and provide training for contractors prior to construction so they are aware of the AMP and implementation plans prior to construction.

At least 7 days prior to construction, We Energies will provide WDATCP with the current available information collected for the Project:

- Total acreage of cropland, pasture and specialty crops, including orchards, organic mucklands and fields with irrigation systems that will be impacted by permanent structures.
- Location of permanent aboveground facilities.
- Location of any known temporary storage areas, proposed crane paths and underground cables.
- This information will be provided with the understanding that locations of some facilities may be altered at a later date based on site specific conditions or due to the specifications of construction equipment used at the site. Proposed relocations of structures will be completed after consultation with the landowner about the relocation.

# 8. AGRICULTURAL MITIGATION: CONSTRUCTION AND RESTORATION PHASES

During construction and restoration, the EI's role is to monitor and enforce implementation of the We Energies AMP to avoid negative impacts to agricultural lands by advising the Company and construction contractor personnel in the event incorrect construction methods are being used. The EI will generally be present on-site during construction, and will have access to all work areas in agricultural lands. The EI will travel between various construction activities in agricultural lands, spot-checking construction operations. If the EI discovers actions that do not appear to meet the AMP requirements, he may stop-work at that location if necessary and will immediately contact the appropriate Company Representative (either the We Energies Environmental Manager or the We Energies Construction Manager). The EI and Company Represenative will determine if site-specific restoration action is necessary. They will also ensure that the erring construction crew is trained in the appropriate construction methods. The EI will also be available to communicate with landowners whenever problems or concerns arise and will ensure that the Company addresses those issues with the landowner.

In the event adverse weather conditions cause soil conditions to become unfavorable for construction or restoration activities at a given site, the EI will consult with the Company to temporarily halt activity at that location. The EI will confer with the Company as to when activities should be resumed at the site.

# 9. AGRICULTURAL MITIGATION: CROP COMPENSATION

We Energies will compensate the landowner for crop loss. The easement signed by each landowner will include language requiring the Company to adequately compensate landowners based on crop prices at the time of construction. Crop loss will occur during the construction of the project, which, depending on the timing of construction activitiies, may include one or two growing seasons. If post-construction bird or bat mortality studies are required by Federal or State permits, crop compensation will be provided if the study requires an area of agricultural lands immediately around a turbine to be mowed.

At the end of each growing season, the Company will provide each landowner with an aerial photo/map outlining the areas of their property that were impacted by construction, with a calculation of the total acres impacted by the construction as shown on the map. Upon agreement by both the Company and Landowner on the areas impacted, this map and calculation will be used to determine financial compensation for crops lost due to construction activities.

# 10. BEST CONSTRUCTION MANAGEMENT PRACTICES

We Energies require those working on the project to research, plan, implement, monitor, and assure the required results are obtained. We Energies relies on these methods to identify agricultural concerns and implement measures to maintain agricultural productivity throughout construction and restoration.

Appropriate use of these measures are assured by key field personnel such as the EI and Property Management Right of Way Agents. Additionally, We Energies seeks to only use contractors with a consistent favorable history of installing and maintaining measures described in the AMP. Thus, permit conditions, landowner satisfaction, and natural resources are preserved. We Energies will incorporate the applicable provisions of this AMP into all bid documents and contracts with each contractor retained on this project by the Company for construction and restoration. Each contractor retained by the Company for the project must also incorporate the applicable provisions of the AMP into their contracts with each subcontractor on the project.

We Energies utilizes construction techniques within agricultural areas that will insure future agricultural productivity. The following construction methods are to be utilized in agricultural areas:

## 10.1 TOPSOIL SEGREGATION

As described above, various construction activities will take place on the project site. During construction of access roads, foundation excavation, and laydown area construction area, topsoil will be removed from the construction area and stockpiled separately from any other excavated soils. This will preserve the topsoil resource by eliminating the potential for topsoil / subsoil mixing. The collector system will be installed via open cut trench, “plow”method and directional boring. As described in section 3.2.4 above, the plow and bore method do not disturb the soil horizons. Open cut trenching will require separation of top and sub soils during excavation. For all excavations, top and sub soils will be replaced in their original soil horizons when backfilling. Landowners will be asked to refrain from manure spreading prior to topsoil removal. Erosion control measures will be used as necessary.

The topsoil is defined to include the upper most portion of the soil commonly referred to as the plow layer, the A horizon, or its equivalent in uncultivated soils. It is the surface layer of the soil that has the darkest color or the highest content of organic matter. All of the topsoil to a depth of 12 inches, or the entire original topsoil depth if it is less than 12 inches, will be removed from excavated areas; however, topsoil will not be removed from under the topsoil storage piles. We Energies has the option to remove amounts of topsoil in excess of 12” at its discretion.

## 10.2 CLEARING OF BRUSH AND TREES FROM THE EASEMENT

The Company will attempt to avoid crossing wooded areas for construction purposes. If it is not possible to avoid wooded areas, the Company’s Property Management Right of Way agents will negotiate compensation with each landowner as outlined in the easement agreement with each landowner. Methods of disposal of trees, brush and stumps may include off-site burning, burial, chipping, or removal. Vegetation from cherry and walnut trees can be toxic to livestock. All debris from these trees will be removed from site such that it will not be allowed to come into contact with livestock and may not be stockpiled on site.

## 10.3 FENCING

Prior to construction the Property Management Right of Way agents will work with landowners to determine if fences will need to be removed or accessed by construction equipment. If necessary, temporary fencing will be installed. Wire tension on temporary fences must be adequate to prevent sagging. Bracing of fences to trees or vegetation is prohibited. Fence materials, such as paint, must not be toxic to livestock.

Where livestock graze adjacent lands to construction areas, arrangements will be made with the landowner prior to construction to determine if temporary fences are necessary. The Company's contractors will be responsible to close any gates as used throughout the workday.

Existing fence crossings severed by construction activities will be repaired. Following construction, any temporary gates and fences installed for use by construction crews must be removed, unless the landowner approves otherwise. Permanent fences will be restored to their pre-construction condition at the commencement of construction using new posts and new wire.

## 10.4 IRRIGATION SYSTEMS

If project construction intersects an operational irrigation system on agricultural land, the Company and the landowner will establish a mutually acceptable amount of time that the affected irrigation systems may be taken out of service during construction. Water flow in irrigation systems on agricultural land is not to be disrupted by construction without first notifying affected landowners. Any damage to an irrigation system caused by construction will be repaired as soon as reasonably possible.

### 10.5 EROSION CONTROL AND DEWATERING

Erosion controls such as silt fence, staked hay bales, and erosion matting will be used to prevent surface runoff from carrying sediment laden water onto adjacent lands. Dewatering may be required to remove standing water from turbine foundation excavation areas or trench areas. Typical erosion control and dewatering techniques are outlined on the Wisconsin Department of Natural Resources website ( http://dnr.wi.gov/runoff/stormwater/techstds.htm ). These standards will be met or exceeded at all times. It is not permissible to allow soil or water runoff to occur from non-organically farmed fields onto organically farmed fields at any time even if both fields are owned by the same landowner.

### 10.6 DRAIN TILE

We Energies will work with each Landowner through the pre-construction process to determine location of known drain tiles. If a drain tile is damaged or severed in the course of construction, the tile will be repaired. A temporary repair with solid tubing to allow drainage while construction activities are completed may be used, or a permanent repair immediately installed.

Prior to backfilling soils at that location, the drain tile will be permanently repaired. Repairs may include support of the tile to maintain proper drainage gradient, replacement of tile and placement of subsoils free of large rocks and clumps around the tile to cushion it, and/or placement of filter cloths. Each repair will be documented to show proper actions have been taken to ensure future drainage and GPS coordinates of the repair location recorded.

## 10.7 WEED CONTROL

Where the EI sees evidence that weed growth on stockpiled topsoil could present a problem to adjacent cultivated fields the EI will consult with the Company to have the weeds removed prior to topsoil replacement. If the Company chooses to spray the topsoil pile with herbicide, the landowner will be consulted in regard to the choice of herbicide to be used, taking into account their preference for cover crop and plans for the next year's crop. If any herbicide spraying is completed, it will be done by a state licensed applicator.

## 10.8 REPAIR OF EXISTING AGRICULTURAL EROSION CONTROL FACILITIES

Existing agricultural facilities such as diversion terraces, grassed or lined waterways, outlet ditches, water and sediment control basins, vegetated filter strips, etc. damaged due to construction activities will be restored to pre-construction conditions. Photographs and elevational surveys will be taken as necessary prior to construction activities at the site to ensure final restoration is satisfactory.

### 10.9 SOIL RESTORATION

The purpose of soil restoration is to ensure that soil strata are replaced in the proper order, decompacted, and that rock content of the upper 24 inches of soil is not increased. The Company will discuss rock and excess soil disposal with the landowner to determine acceptable disposal location(s) on the property. Heavy equipment will not be allowed to cross those agricultural areas that have been decompacted and restored.

De-compacting the Subsoil

De-compaction of the subsoil will only be done when the subsoil condition is friable/tillable in the top 18 inches of the subsoil profile, using the Atterberg Field Test as guidance (see Attachment K). The EI may recommend to the Company specific locations for the decompaction of the subsoil in locations where soils appear to be either predominantly wet or in low lying areas where water ponding has occurred due to the "trench effect" as a result of topsoil removal. In these cases the Company may consult with the landowner to determine the appropriate decompaction needs.

Ripping equipment to be used will be a v-ripper, chisel plow, paraplow, or equivalent. Typical spacing of the shanks varies with equipment but is typically in the 8 - 24 inch range. The normal depth of tillage is 18 inches. The depth of rip may be adjusted as appropriate for different soil types or for a deeply and severely compacted area.

Subsoil compaction will normally be alleviated with three passes of the decompaction equipment. Multiple passes refers to the implement passing over the same soil band. That is, three passes of a 10 foot wide implement will treat a 10 foot wide band of soil, not a 30 foot wide band. Passes must be made in multiple directions. This can be achieved in the narrow areas by having the implement weave back and forth across the area being ripped.

De-compaction Testing

After three passes of deep tilling the subsoil, the success of the decompaction effort will be measured using a penetrometer ( see Attachment L). Decompaction success will be measured by comparing the compaction level on the agricultural area disturbed by construction activity and outside the disturbed or afffected agricultural land. If soil compaction on the affected agricultural land is 20% or less than the compaction off of the right-of-way, soil decompaction will be considered achieved. The sample for the non-affected area (not disturbed by construction) should be taken adjacent to the disturbed area sample. If the test shows decompaction has succeeded, the restoration process can proceed to rock removal from the subsoil. If decompaction was not successful, the decompaction effort will continue. The contractor is required to make as many passes as necessary to alleviate compaction. Should testing show that the decompaction effort is not successful after additional passes, a change in the decompaction equipment used would be appropriate. The Environmental Inspector will use the Atterberg Field Test (attached) to recommend when further attempts at decompaction should be postponed due to moisture levels.

Topsoil Replacement

The topsoil will be replaced to its original depth across the spoil storage, trench, work, and traffic areas. The layer of replaced topsoil should be uniform across the right-of-way width, including any crowning. Topsoil should be replaced with wide tracked machinery or equivalent light loaded equipment to avoid compaction of the topsoil and subsoil layers. Rubber tired motor graders may be used to spread and level topsoil to address unevenness in the field. In areas where minimal tillage, no-till, or level land farming practices are employed, a tracked machine will be required to establish final grades.

De-compacting Through the Topsoil

De-compaction through the topsoil may be necessary, if the subsoil and/or topsoil are compacted during topsoil replacement activities. A penetrometer will be used to determine if additional decompaction is necessary through the topsoil.

Final Rock Removal

Replacing the topsoil (or de-compacting through the topsoil) may free some rocks and bring them to the surface. The size, density and distribution of rock remaining on the construction work area should be the same as adjacent areas not disturbed by construction.

Final Cleanup

All previously restored construction area should not be traversed by unnecessary equipment traffic. All construction-related debris, including litter generated by the construction crews, will be removed from the landowner's property and disposed of appropriately. Final clean-up begins immediately after all the other above-mentioned sequence of restoration activities operations are completed, and not before. Final clean-up includes installation of permanent erosion control measures if necessary and disposal of construction debris and will be completed as soon as practicably possible (weather permitting), or as soon as possible thereafter. If final clean-up is delayed, temporary erosion controls will be installed as necessary.

## 10.10 WINTERIZATION

It is likely that construction activities will occur during winter months. If construction activities include installation of turbine towers, nacelles and/or rotors, it is likely that de-icing activities will occur. These construction activities require the use of a crane to lift and install the components. High precision is required when lifting, fitting and connecting these components. The presence of ice on a component can cause the component to shift, making connections difficult. In addition, the ice might drop from the component during the lift, causing a safety hazard for construction personnel.

De-icing the components will occur when components are at the turbine site, just prior to the lift and installation. The de-icing method used will depend on the weather and temperatures. No toxic materials, such as anti-freeze will be used for de-icing. All materials used for de-icing will be non-toxic, and may consist of methods such as high-pressure steam cleaning, or using a mix of warm water and non-toxic cleansers (such as isopropyl alcohol, or “Simple Green” © cleanser).

Site restoration, including activities such as topsoil replacement or restoration, decompaction and planting will occur as soon as reasonably possible in the spring as appropriate.

## APPENDIX A

### Detailed Job Description for Environmental Consultant

The EI will be involved in all construction phases of the Project to assure construction and mitigation provisions in agricultural areas achieve the anticipated results. The EI reports directly to the Company Environmental Manager and the Company Project Construction Manager.

Prior to Conmencment of Construction the EI will:

- review agricultural related project documents such as ROW descriptions, permits, alignment sheets, and relevant plans prior to construction;
- review information supplied by affected farm operators, conservation districts, agricultural extension agents, and others;
- participate in design of training program for inspection and construction crews, to ensure they are familiar with agricultural concerns and problems that may come up;
- become thoroughly familiar with the Company's construction and restoration implementation plans;
- photo-document agricultural areas of concern (access roads, drainage and irrigation systems, agricultural best management practices, etc.) prior to construction and otherwise document pre-construction conditions related to agricultural practices as necessary;
- ensure known drain tile locations within the construction area are identified;
- verify that the construction contractors are segregating topsoil;
- be aware of any topsoil or subsoil removal procedures negotiated by landowners in easement agreements with the Company.

During construction, the EI will:

- photo-document agricultural areas of concern (access roads, drainage and irrigation systems, agricultural best management practices, etc.) during construction as needed;
- monitor appropriate clearing, grading and stump and tree removal;
- assure on-site training of the AMP practices is conducted for all new employees at the site;
- communicate on a regular basis with the Company noting any day-to-day issues that require further evaluation;
- coordinate with the Company to keep landowners/tenants informed as needed on overall construction progress;
- will work with the Company to ensure that landowners/tenants are informed in a timely manner on any problems caused by construction or restoration actions affecting them directly and explain mitigation actions being taken;
- monitor trench dewatering activities to prevent deposition of sediment, soil erosion or flooding in agricultural areas;
- identify potential problems of non-compliance with the AMP and work with the Company to initiate appropriate preventative actions prior to occurrence where feasible;
- ensure appropriate markings of encountered surface and sub-surface drainage systems, irrigation systems and other agricultural facilities;
- submit timely reports to the Company;
- ensure construction activities within agricultural areas are confined to authorized work areas;
- monitor and assure adequate agricultural topsoil and subsoil stripping, segregation, and preservation;
- advise the Company when conditions such as wet soil should restrict construction activities at a particular agricultural job site;
- ensure adequate repairs of surface and subsurface drainage systems, and necessary modifications or reconfiguration of these systems; ensure adequate repairs to irrigation systems, fencing, erosion control structures, and other agricultural facilities;

- monitor triple trenching protocols where these are necessary;

During restoration, the EI will**:**

- monitor backfilling operations to ensure the subsoil and topsoil are decompacted properly to minimize future trench settling;
- ensure proper backfilling occurs to accommodate future settling;
- photo-document agricultural areas of concern (access roads, backfilling and decompaction, agricultural best management practices, etc.) during restoration as needed;
- ensure subsoil and topsoil profiles are restored to original pre-construction conditions including importation or replacement of topsoil where necessary;
- ensure proper surface rock removal, if any, and its proper disposal;
- perform compaction testing and ensure appropriate actions are taken to de-compact compacted soils in the proper sequence with the proper equipment under appropriate conditions;
- ensure proper clean-up activities occur.

# Appendix C – Noise Assessment

Application of Wisconsin Electric Power Company
For the Glacier Hills Wind Park
Docket No. 6630-CE-302

**Data Request PSC 22.01**

**Request:**

22.01 *(Supplemental response to Data Request 21.01, PSC ERF REF #118553)* In Figure 1, on page 1 of the technical memo, the dates of the measurements on the X-axis are inconsistent. The dates start at 6/26/08 through 7/1/08, then there are two labeled 6/26/08, then 7/4/08 through 7/8/08. This inconsistency also appears in the original report, Figure 4.2.1, for all three monitor locations. Provide an explanation for this apparent inconsistency.

**Response:**

There was a typographical error for the 2 dates labeled 6/26/08. The dates should be labeled consecutively from 6/26/08 through 7/8/08.

**Prepared by: Richard O'Conor**

**Date: September 10, 2009**

Application of Wisconsin Electric Power Company
For the Glacier Hills Wind Park
Docket No. 6630-CE-302

**Data Request PSC 22.02**

**Request:**

22.02 *(Supplemental response to Data Request 21.01, PSC ERF REF #118553)* In reading the technical memo, it appears that the instrument setting problem affected the continuous measurements taken in 2008 for Monitor C. However, in 2009 both the continuous measurements at Monitor C and the sample measurements at Sites 1 through 4 were retaken. Table 1 in the technical memo implies that the sample measurements from 2008 were somehow affected by the instrument setting problem at Monitor C in 2008. Explain how this could be so.

**Response:**

All monitors used in the original measurements in 2008 had the same setting problem. Therefore, the sample measurements at sites 1 through 4 were retaken in 2009.

**Prepared by: Richard O'Conor**

**Date: September 10, 2009**

Application of Wisconsin Electric Power Company
For the Glacier Hills Wind Park
Docket No. 6630-CE-302

## Data Request PSC 22.03

**Request:**

22.03 *(Supplemental response to Data Request 21.01, PSC ERF REF #118553)* In Table 1 of the technical memo, it appears that the measurements were taken as follows: 7/13, morning, midday, evening, night 7/14, morning, midday 7/15, evening, night. I would not expect that there would be a full day, including the afternoon of 7/14 and morning of 7/15, when no measurements were taken. As such, verify that the dates and times of measurements shown in Table 1 of the technical memo are correct.

**Response:**

There was a full day when no measurements were taken due to rain storms in the area during that period.

The dates and times of measurements shown in Table 1 of the technical memo are correct.

**Prepared by: Richard O'Conor**

**Date: September 10, 2009**

Application of Wisconsin Electric Power Company
For the Glacier Hills Wind Park
Docket No. 6630-CE-302

**Data Request PSC 22.04**

**Request:**

22.04 *(Supplemental response to Data Request 21.01, PSC ERF REF #118553)* Table 2 in the technical memo correlates the LA90 ambient to wind speed. This data appears to be based only on the continuous measurements taken in 2009 at Monitor C. Explain if and how the continuous measurements from 2008 are used in the underlying calculations for Table 2 in the technical memo. If the 2008 continuous measurements are not used in Table 2 of the technical memo, explain why not.

**Response:**

The 2008 measurements were not used in Table 2 for the technical memo. *Only* the new data at Monitor C was used for estimating the level vs. wind speed since the original data was flawed. Since the area is a macro area ambient, one monitor out of the three original locations (Monitor A was not used due to contamination from sound generated by the Ethanol plant) is sufficient for the purpose of estimating the level vs. wind speed.

**Prepared by: Richard O'Conor**

**Date: September 10, 2009**

Application of Wisconsin Electric Power Company
For the Glacier Hills Wind Park
Docket No. 6630-CE-302

## Data Request PSC 22.05

**Request:**

22.05 (S*upplemental response to Data Request 21.01, PSC ERF REF #118553)* Provide any updated noise contour GIS shapefiles that have been prepared reflecting the corrected ambient sound level measurements.

**Response:**

The updated noise contour GIS shapefiles reflecting the turbine locations (rev 6) for the loudest turbine under consideration were transmitted to PSC Staff on 9/15/09.

**Prepared by: Richard O'Conor**

**Date: September 15, 2009**

Application of Wisconsin Electric Power Company
For the Glacier Hills Wind Park
Docket No. 6630-CE-302

## Data Request PSC 22.06

**Request:**

22.06 Provide updated cost estimates for the transmission interconnection facilities. In your response, distinguish between reimbursable and non- reimbursable costs.

**Response:**

Based on ATC studies completed to date, the estimate of the G706 and H012 transmission interconnection costs are as follows:

| | Reimbursable Costs | Non-Reimbursable Costs | Total |
|---|---|---|---|
| G706 | $3,306,111 | $561,266 | $3,867,377 |
| H012 | $12,660,443 | $0 | $12,660,443 |
| Total | $15,966,554 | $561,266 | $16,527,820 |

The assumptions for these costs are:

a. The use of Vestas V90 turbines
b. G706 is built to its full 99 MW capacity. Please note that the G706 costs are based on refined project costs developed during the Detail Design Phase of the project.
c. H012 is built to its full 150 MW capacity. Please note that the H012 costs are high level as portrayed in the System Impact Study. ATC will develop more refined costs during the development of the Facility Study and then again (further) when H012 enters the Detail Design Phase.
d. The Iberdrola G366 project is built to its full 80 MW capacity
e. The Alliant 300 MW Columbia coal project is not built

**Prepared by: Terry Carroll**

**Date: September 15, 2009**

# Public Service Commission of Wisconsin

**Eric Callisto, Chairperson**
**Mark Meyer, Commissioner**
**Lauren Azar, Commissioner**

**610 North Whitney Way**
**P.O. Box 7854**
**Madison, WI 53707-7854**



September 2, 2009

**VIA ELECTRONIC MAIL**

Mr. Roman Draba, Vice President Regulatory Affairs and Policy
Wisconsin Electric Power Company
231 West Michigan Street
Milwaukee, WI 53203

Re: Application of Wisconsin Electric Power Company for a Certificate of Public Convenience and Necessity to Construct a Wind Electric Generation Facility and Associated Electric Facilities, to be Located in the Towns of Randolph and Scott, Columbia County, Wisconsin — 6630-CE-302

Dear Mr. Draba:

Public Service Commission (Commission) staff has the following data requests regarding Wisconsin Electric Power Company's October 30, 2008, application in the docket listed above:

22.01 *(Supplemental response to Data Request 21.01, PSC ERF REF #118553)* In Figure 1, on page 1 of the technical memo, the dates of the measurements on the X-axis are inconsistent. The dates start at 6/26/08 through 7/1/08, then there are two labeled 6/26/08, then 7/4/08 through 7/8/08. This inconsistency also appears in the original report, Figure 4.2.1, for all three monitor locations. Provide an explanation for this apparent inconsistency.

22.02 *(Supplemental response to Data Request 21.01, PSC ERF REF #118553)* In reading the technical memo, it appears that the instrument setting problem affected the continuous measurements taken in 2008 for Monitor C. However, in 2009 both the continuous measurements at Monitor C and the sample measurements at Sites 1 through 4 were retaken. Table 1 in the technical memo implies that the sample measurements from 2008 were somehow affected by the instrument setting problem at Monitor C in 2008. Explain how this could be so.

22.03 *(Supplemental response to Data Request 21.01, PSC ERF REF #118553)* In Table 1 of the technical memo, it appears that the measurements were taken as follows:

- 7/13, morning, midday, evening, night
- 7/14, morning, midday
- 7/15, evening, night

I would not expect that there would be a full day, including the afternoon of 7/14 and morning of 7/15, when no measurements were taken. As such, verify that the dates and times of measurements shown in Table 1 of the technical memo are correct.

22.04 *(Supplemental response to Data Request 21.01, PSC ERF REF #118553)* Table 2 in the technical memo correlates the LA90 ambient to wind speed. This data appears to be based only on the continuous measurements taken in 2009 at Monitor C. Explain if and how the continuous measurements from 2008 are used in the underlying calculations for Table 2 in the technical memo. If the 2008 continuous measurements are not used in Table 2 of the technical memo, explain why not.

22.05 *(Supplemental response to Data Request 21.01, PSC ERF REF #118553)* Provide any updated noise contour GIS shapefiles that have been prepared reflecting the corrected ambient sound level measurements.

22.06 Provide updated cost estimates for the transmission interconnection facilities. In your response, distinguish between reimbursable and non- reimbursable costs.

Please post your responses to this request to the Commission's Electronic Regulatory Filing system. If you have any questions regarding this request, please contact me at (608) 266-0478.

Sincerely,

Jim Lepinski, P.E.
Docket Coordinator
Gas and Energy Division

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Application of Wisconsin Electric Power Company
For the Glacier Hills Wind Park
Docket No. 6630-CE-302

**Data Request PSC-21.01**

**Request:**

21.01 *(Application TSD, Appendix R)* It appears that the test engineer's field notes for the only 6:00 a.m. to 8:00 a.m. measurement period are included with this report. Provide the engineer's field notes for the remaining measurement periods. If appropriate, file a complete, revised report as your response to this request, rather than just the additional pages.

**Supplemental Response:**

The revised report including the full set of field notes was filed in the original response to PSC Data Request 21.01 (PSC Ref # 116497).

The attached Technical Memorandum titled *Newly Measured Ambient Sound Levels* is an addendum to the report filed in the original response to PSC Data Request 21.01 (PSC Ref # 116497).

The purpose of the addendum is to correct for an instrumentation setting error that was detected that affects the ambient sound measurements presented in our original report number 092408-4, *Noise Assessment, Glacier Hills Wind Park*, October 2008. In preparing the addendum, the data collection was completely repeated during a four day period from July 12 through July 16, 2009, almost one year exactly from the original survey.

It should be noted the corrected ambient data has no effect on the predicted sound emissions of the turbines, no effect on compliance with the 50 dBA limit and no effect on the conclusions of Report 092408-4.

**Prepared by: Richard O'Conor**

**Date: August 17, 2009**

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# TECHNICAL MEMORANDUM

| | |
|---|---|
| Title: | **NEWLY MEASURED AMBIENT SOUND LEVELS** |
| Project: | **GLACIER HILLS WIND PARK** |
| Location: | RANDOLPH, WI |
| Prepared For: | **We Energies** |
| Prepared By: | **George F. Hessler, P.E.** |
| Revision: | **0** |
| Issue Date: | **August 9, 2009** |
| Reference No: | **TM-080909-1, Addendum to Report 092408-4** |
| Attachments: | |

**Attn. Mr. Richard O'Conor**

## Introduction

An instrumentation setting error has been detected that effects the ambient sound measurements presented in our original report number 092408-4, *Noise Assessment, Glacier Hills Wind Park*, October 2008. The firmware instrument setting unknowingly changes the measurable dynamic range of the analyzer when frequency dependent data is selected in addition to overall A and C levels. This creates an electronic noise floor of about 33 dBA. There is a gain setting in the firmware that must be set to lower the noise floor when measuring in quiet environments that was not set. As a result, the measurement, system without the proper gain setting, could not measure levels lower than 33 dBA. This effect is clearly shown below:

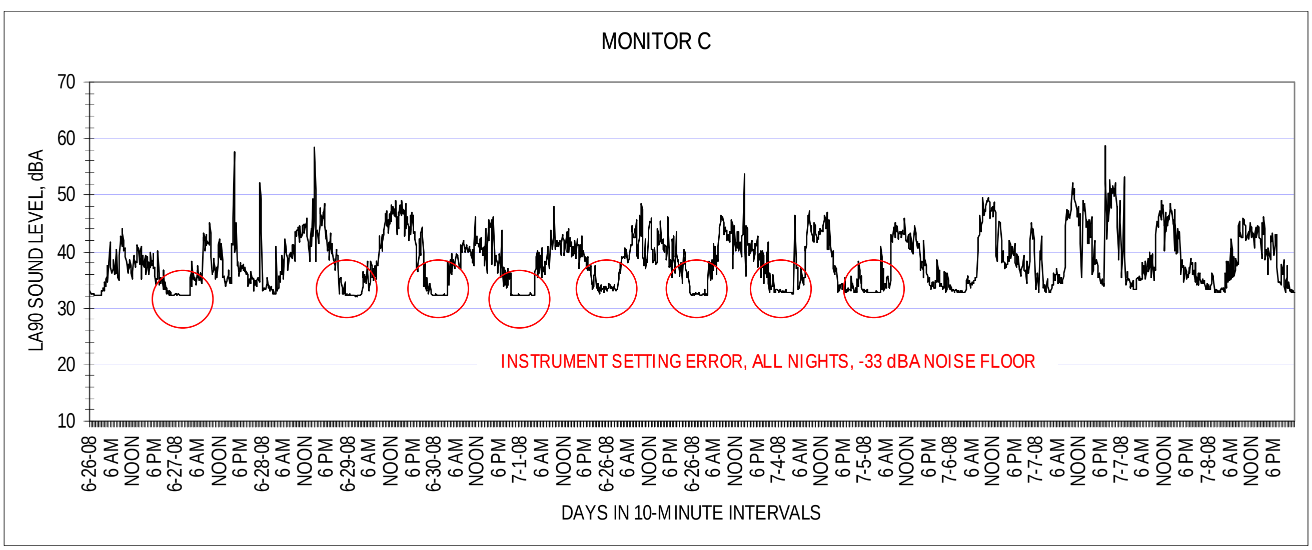


***Figure 1:*** *Continuous LA90 sound level over a 14-day sampling period at Monitor C, Site 4.*

Consequently, the data collection has been completely repeated during a four day period from July 12 thru July 16, 2009, almost one year exactly from the original survey and the new data is reported herein.

It should be noted the corrected ambient data has no effect on the predicted sound emissions of the turbines and compliance with the 50 dBA limit and conclusions of Report 092408-4 remain unchanged.

## Repeated Monitor Data at Location C

The graphic below plots a rerun of continuous 10-minute sampling data where it can be seen that levels during late night and early morning hours fall below 20 dBA.

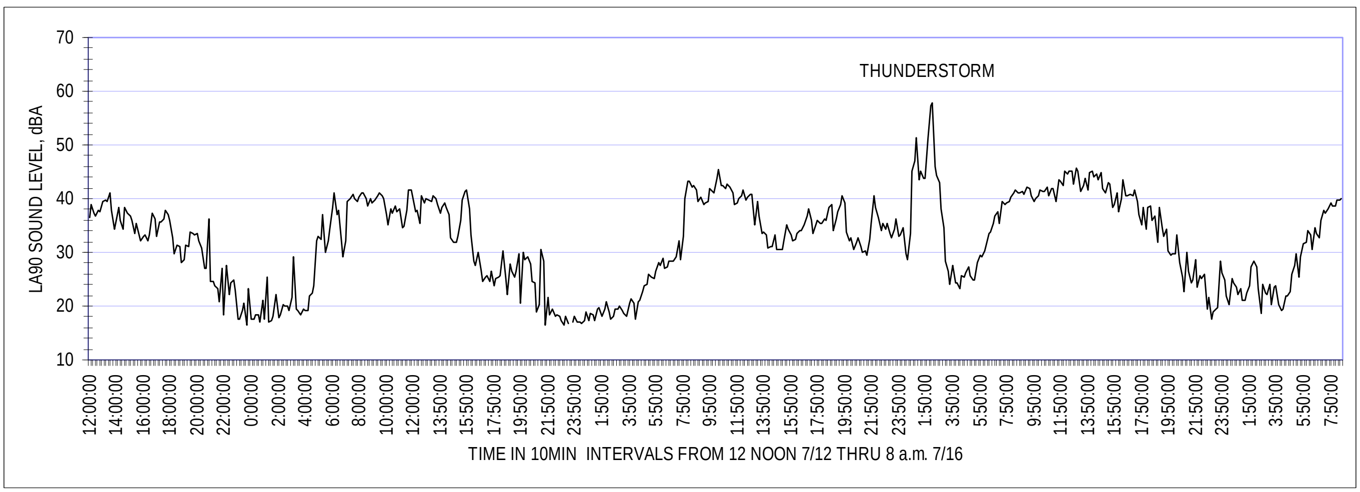


***Figure 2:*** *Continuous LA90 sound level over a 4-day sampling period at Monitor C, Site 4 with correct gain setting.*

## Repeated PSC Procedure Manual Data at All Locations

The following tabulates the repeated manual measurements over a 2-night period with calm and still winds for both the A- and C-weighted sound level during the prescribed PSC daily intervals. For ease, the data is presented in the same format as the original report and the blue numerals from the original report are shown to observe the change in measurement results. Observer comments for the new testing are included as Appendix A of this Memo.

The first observation is that the A-weighted level results are lower than the July 08 survey which is expected since late night and early morning levels are no longer controlled by the instrument system electronic noise floor. Conversely, the C-weighted levels are not significantly different between the surveys because the C-weighted level is unaffected by the artificial lowest level capability of the system.

The second observation is that the LA90 residual data is less uniform over the project area. This occurs because Site 1 near the Ethanol plant includes this plant noise and results in the highest measured levels, while levels at the other three locations are very uniform resulting in a macro-area residual ambient of approximately LA90 = 29 dBA.

| A-WEIGHTED LEVELS | | SITE 1 | | | | | SITE 2 | | | | | SITE 3 | | | | | SITE 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | PSC PERIOD | LAeq | LA01 | LA10 | LA50 | LA90 | LAeq | LA01 | LA10 | LA50 | LA90 | LAeq | LA01 | LA10 | LA50 | LA90 | LAeq | LA01 | LA10 | LA50 | LA90 |
| 13-Jul-09 | 6AM to 8AM | 58.8 | 72.7 | 58.1 | 37.4 | 33.8 | 46.9 | 54.8 | 51.4 | 43.1 | 35.0 | 56.8 | 70.3 | 45.3 | 35.8 | 30.5 | 52.9 | 61.3 | 47.8 | 42.7 | 37.9 |
| 14-Jul-09 | | 58.2 | 70.9 | 50.3 | 43.0 | 40.1 | 56.6 | 71.4 | 49.4 | 37.9 | 31.4 | 59.5 | 73.9 | 52.3 | 38.1 | 32.4 | 33.4 | 43.4 | 35.1 | 30.6 | 28.3 |
| 13-Jul-09 | 12PM to 2PM | 37.6 | 48.7 | 40.9 | 32.0 | 29.5 | 52.1 | 67.1 | 40.9 | 31.1 | 28.6 | 39.0 | 46.8 | 43.3 | 35.9 | 30.6 | 35.5 | 42.4 | 38.9 | 33.7 | 30.4 |
| 14-Jul-09 | | 64.7 | 79.6 | 52.1 | 44.3 | 40.9 | 54.7 | 69.5 | 49.3 | 37.6 | 33.8 | 45.4 | 54.3 | 47.9 | 44.0 | 39.3 | 34.6 | 41.8 | 37.1 | 33.1 | 31.1 |
| 13-Jul-09 | 6PM to 8PM | 45.9 | 60.2 | 34.8 | 30.6 | 27.6 | 57.5 | 72.6 | 50.2 | 28.2 | 20.4 | 54.1 | 66.3 | 35.4 | 26.7 | 24.2 | 63.5 | 78.5 | 51.1 | 34.2 | 27.0 |
| 15-Jul-09 | | 58.1 | 72.0 | 44.9 | 41.2 | 37.8 | 51.6 | 66.0 | 40.3 | 35.4 | 33.1 | 44.5 | 50.3 | 47.4 | 43.8 | 37.4 | 38.7 | 47.1 | 42.1 | 36.5 | 31.2 |
| 13-Jul-09 | 10PM to 12AM | 50.3 | 64.2 | 44.2 | 34.1 | 28.7 | 43.4 | 55.8 | 32.7 | 24.4 | 22.2 | 23.9 | 28.8 | 26.0 | 23.2 | 21.0 | 28.9 | 36.9 | 31.8 | 25.2 | 20.6 |
| 15-Jul-09 | | 50.2 | 63.7 | 45.3 | 41.8 | 40.2 | 48.3 | 62.0 | 41.6 | 26.3 | 22.3 | 54.1 | 65.402 | 42.0 | 29.9 | 26.3 | 38.3 | 49.1 | 42.6 | 31.1 | 22.1 |
| | MINIMUM ANY SURVEY | | | | 30.6 | 27.6 | | | | 24.4 | 20.4 | | | | 23.2 | 21.0 | | | | 25.2 | 20.6 |
| | LOG AVERAGE | | | | 40.3 | 37.4 | | | | 36.8 | 31.0 | | | | 39.1 | 33.7 | | | | 36.1 | 31.5 |
| | ARITH. AVERAGE | | | | 38.1 | 34.8 | | | | 33.0 | 28.3 | | | | 34.7 | 30.2 | | | | 33.4 | 28.6 |
| | STD DEV | | | | 5.3 | 5.6 | | | | 6.5 | 5.9 | | | | 7.6 | 6.3 | | | | 5.0 | 5.5 |
| | ARITH. AVERAGE IN JULY 08 WAS | | | | 40.3 | 38.3 | | | | 36.7 | 35.1 | | | | 41.6 | 38.9 | | | | 38.6 | 36.4 |
| | DIFFERENCE | | | | -2.2 | -3.5 | | | | -3.7 | -6.8 | | | | -6.9 | -8.7 | | | | -5.2 | -7.8 |

| C-WEIGHTED LEVELS | | SITE 1 | | | | SITE 2 | | | | SITE 3 | | | | SITE 4 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | PSC PERIOD | LCeq | LC10 | LC50 | LC90 | LCeq | LC10 | LC50 | LC90 | LCeq | LC10 | LC50 | LC90 | LCeq | LC10 | LC50 | LC90 |
| 13-Jul-09 | 6AM to 8AM | 62.6 | 60.8 | 53.5 | 51.4 | 52.4 | 55.4 | 49.7 | 47.8 | 61.5 | 50.9 | 47.6 | 45.4 | 56.8 | 56.1 | 49.6 | 46.0 |
| 14-Jul-09 | | 65.2 | 61.9 | 58.4 | 56.1 | 66.8 | 58.6 | 53.4 | 50.5 | 66.6 | 60.2 | 51.4 | 46.3 | 55.0 | 57.2 | 52.8 | 50.4 |
| 13-Jul-09 | 12PM to 2PM | 58.4 | 61.8 | 56.6 | 53.9 | 60.2 | 57.7 | 50.0 | 46.4 | 56.9 | 59.7 | 55.9 | 50.8 | 58.8 | 62.4 | 55.9 | 48.8 |
| 14-Jul-09 | | 77.9 | 70.4 | 62.2 | 56.9 | 67.3 | 70.8 | 64.7 | 58.2 | 51.5 | 53.2 | 50.2 | 47.3 | 67.5 | 71.0 | 64.3 | 57.5 |
| 13-Jul-09 | 6PM to 8PM | 55.9 | 53.5 | 51.3 | 49.9 | 63.8 | 55.8 | 45.2 | 40.5 | 57.8 | 52.2 | 45.4 | 42.2 | 78.4 | 62.2 | 50.5 | 42.7 |
| 15-Jul-09 | | 71.3 | 71.3 | 63.9 | 58.0 | 68.5 | 72.8 | 62.7 | 53.7 | 59.4 | 62.9 | 55.0 | 49.0 | 62.5 | 65.5 | 59.6 | 53.3 |
| 13-Jul-09 | 10PM to 12AM | 57.7 | 54.0 | 50.6 | 48.8 | 56.0 | 47.1 | 42.5 | 40.5 | 39.8 | 42.6 | 38.6 | 36.3 | 44.3 | 46.9 | 41.1 | 38.3 |
| 15-Jul-09 | | 61.7 | 61.3 | 59.4 | 57.6 | 58.2 | 48.6 | 42.9 | 39.1 | 61.5 | 54.0 | 44.4 | 39.8 | 54.1 | 58.3 | 47.3 | 40.1 |
| | LOG AVERAGE | | | 59.2 | 55.2 | | | 58.2 | 51.5 | | | 51.3 | 46.5 | | | 57.5 | 51.1 |
| | ARITH. AVERAGE | | | 57.0 | 54.1 | | | 51.4 | 47.1 | | | 48.6 | 44.6 | | | 52.6 | 47.1 |
| | STD DEV | | | 4.9 | 3.6 | | | 8.5 | 6.9 | | | 5.8 | 4.9 | | | 7.3 | 6.6 |
| | ARITH. AVERAGE IN JULY 08 WAS | | | 54.8 | 52.4 | | | 52.6 | 49.1 | | | 47.9 | 44.5 | | | 51.7 | 48.3 |
| | DIFFERENCE | | | 2.2 | 1.7 | | | -1.2 | -2.0 | | | 0.7 | 0.1 | | | 0.9 | -1.2 |

***Table 1:*** *Amended Table 4.1.1 from report 090408-4*

## Ramifications of New Data

The purpose of the PSC ambient noise measurement procedure is to document baseline ambient sound levels for periods throughout the day and night. The procedure was developed long before wind turbines became a source of generation, and the parameter of interest was the quietest ambient levels for comparison to conventional power plant noise emissions to assess impact by the incremental increase to the baseline ambient. Quietest ambient levels *always* occur during calm and still wind conditions.

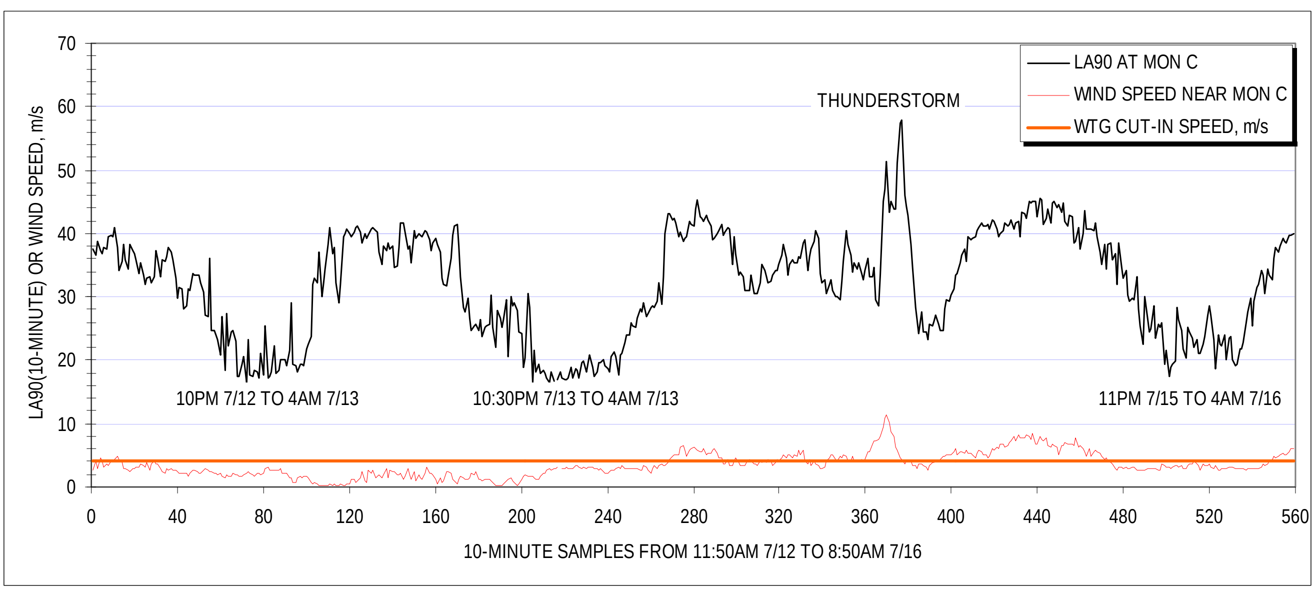


***Figure 3:*** *Continuous LA90 sound level over a 4-day sampling period at Monitor C, Site 4 compared to measured wind speed at a height of 10 meters.*

One feature of wind turbines is that they do not operate during these minimum level time periods. This is evidenced by Figure 3 above that shows the new data was acquired during light winds at an elevation of 10 meters. Notice the wind speed is below the cut-in speed of the turbines during the quietest level periods.

Nevertheless, experience indicates the worst case for potential noise annoyance occurs when winds are light at ground level but sufficiently high to operate the wind turbines. It is unduly conservative to estimate the increase in level due to turbine operation based on minimum ambient levels when the turbines will not operate. It remains to establish a reasonable baseline ambient level at the start of wind turbine operation at a 10m high wind speed of 3 to 4 m/s. This can be done by regression analysis of the newly measured data with wind speed.

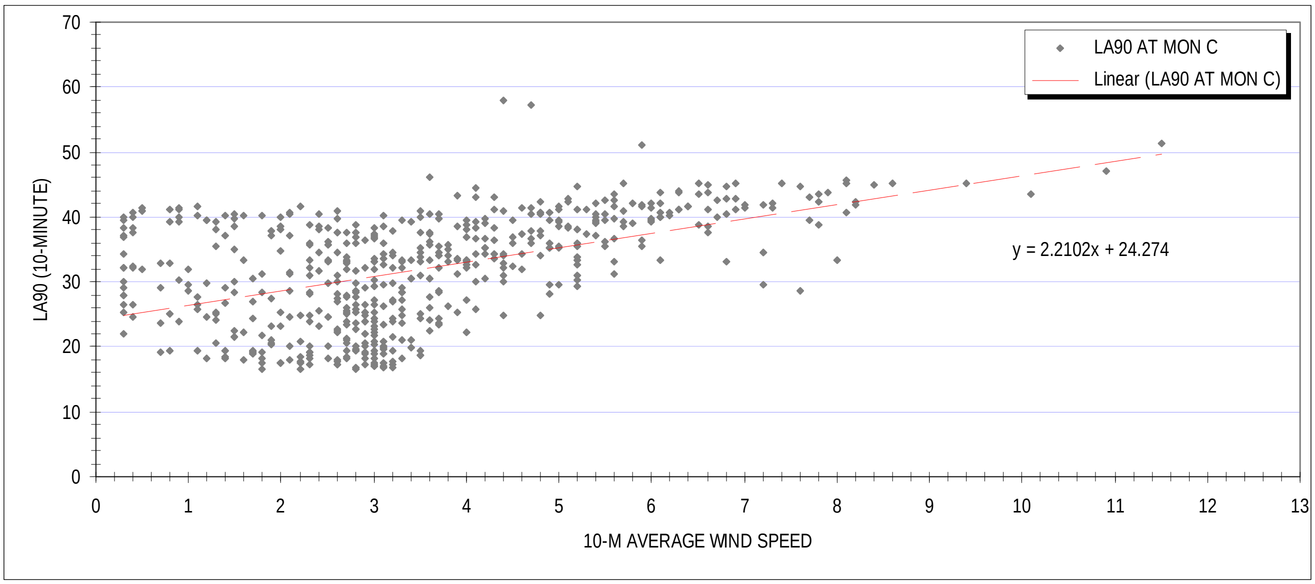


***Figure 4:*** *Regression analysis using all measured data.*

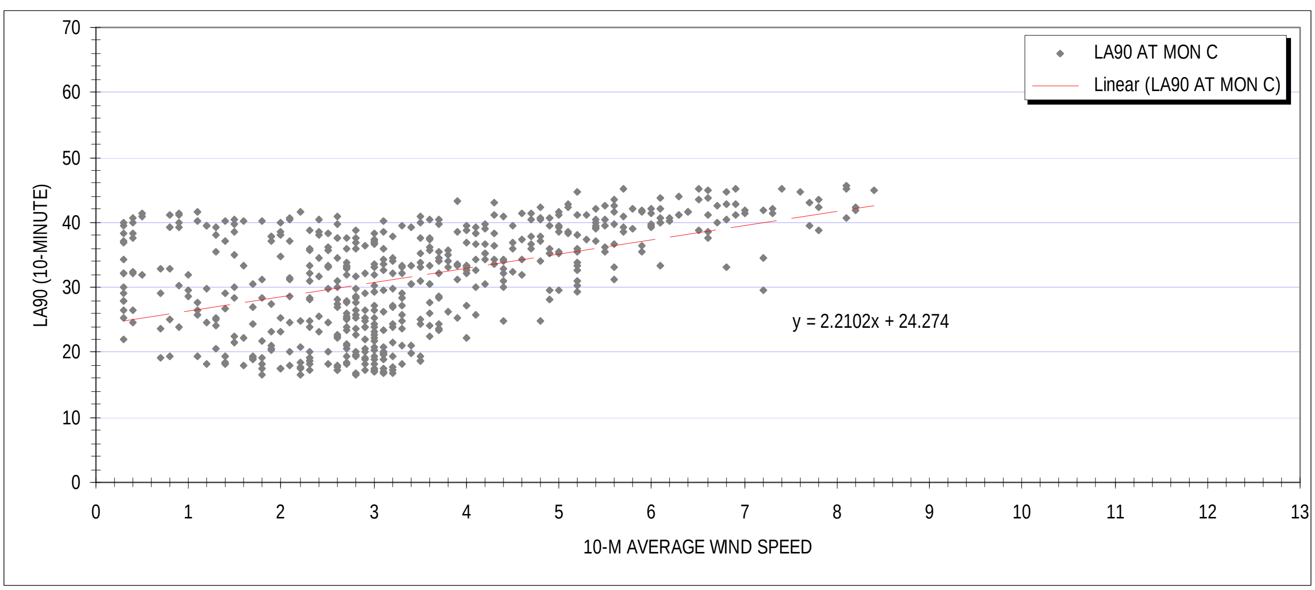


***Figure 5:*** *Regression analysis with thunderstorm period removed from the measured data.*

Figures 4 and 5 above show a regression analysis for LA90 sound level and wind speed. The only difference is that the thunderstorm data is removed from Figure 5, but the answer is essentially unchanged. This gradual increase in ambient level with wind speed is very typical of countless measurement sites in similar topography.

The resultant table of LA90 with wind speed is given below. The LA90 baseline level is seen to be 33 dBA when wind turbine operation begins. This result is still somewhat conservative to use as a baseline because the wind turbines do not emit maximum noise levels at the start of operation. However, we recommend the baseline of 33 dBA because it offsets the wide variance of measured results in the low wind ambient measurements.

For reference, the measured ambient at 4 m/s at the BSGF project was 35 dBA, so a result of 33 dBA fits well with an environment here that is more remote from interstate and heavier traffic sources.

| | LA90 VS. WTG OPERATIONAL SPEEDS | | | | | | |
|---|---|---|---|---|---|---|---|
| WIND SPEED AT 10M HEIGHT, m/s | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| LA90 AMBIENT, dBA | 33.1 | 35.3 | 37.5 | 39.7 | 42.0 | 44.2 | 46.4 |

***Table 2:*** *Correlation of LA90 ambient sound level and wind speed*

## Revised Increase to Ambient Calculations

The Table below revises the estimated "worst-case" level increases. The OFF level was 37 dBA so the worst-case increases have gone up by 4 dBA.

| | A-WEIGHTED SOUND LEVEL, dBA | | |
|---|---|---|---|
| TURBINE MODEL | ON (NOTE 1) | OFF (NOTE 2) | INCREASE (ON-OFF) |
| MODEL A | 45 | 33 | 12 |
| MODEL B | 47 | 33 | 14 |
| MODEL C | 45 | 33 | 12 |
| MODEL D | 45 | 33 | 12 |
| MODEL E | 49 | 33 | 16 |

Note 1: Worst-case calculations for a 4-unit turbine array at full speed operation at 1000 feet from closest turbine

Note 2: Average 10-minute LA90 at 4 m/s wind speed (10 m height) from continuous measurements

***Table 3:*** *Amended Table 2.0.3 from report 090408-4*

The calculated increases shown above are based on a 4 dBA cumulative addition for surrounding turbines and the turbines emitting maximum emissions (about 6 m/s and higher in most cases) to represent the "worst-case" scenario for increase calculations. The corrected ambient data has no effect on the predicted sound emissions of the turbines and compliance with the 50 dBA limit and conclusions of Report 092408-4 remain unchanged.

Please call on me with any questions or comments.

George F. Hessler Jr., Bd. Cert. INCE

*George F. Hessler Jr.*

# APPENDIX A-1 6AM-8AM

**Site 1 - E. Freisland Rd**

7/13/2009 Little to no wind

| Time | Event |
|---|---|
| 7:37:00 | Birds and Traffic on 33 |
| 7:37:50 | Car passed |
| 7:38:20 | Birds |
| 7:38:48 | Truck at Nearby Farm |
| 7:39:11 | Birds, Traffic on 33 and Ethanol Plant |
| 7:39:52 | High Altitude Plane |
| 7:39:59 | Car passed |
| 7:40:39 | High Altitude Plane |
| 7:40:56 | Truck Idling at Nearby Farm, Birds, Traffic on 33 |
| 7:42:06 | Truck passed |
| 7:42:40 | Car passed |
| 7:42:53 | Truck Idling at Nearby Farm |
| 7:43:38 | Car passed |
| 7:44:19 | Birds and Traffic on 33 |
| 7:44:35 | Loud Truck on 33 |
| 7:45:03 | Birds and Traffic on 33 |
| 7:46:14 | Loud Truck on 33 |
| 7:46:47 | High Altitude Plane |

**Site 1 - E. Freisland Rd**

7/14/2009 Little to no wind

| Time | Event |
|---|---|
| 6:08:45 | Ethanol Plant and Birds |
| 6:10:46 | Ethanol Plant, Birds and Traffic on 33 |
| 6:12:36 | Car passed |
| 6:13:22 | Ethanol Plant, Birds and Traffic on 33 |
| 6:13:44 | Car passed |
| 6:14:10 | Ethanol Plant, Birds and Traffic on 33 |
| 6:16:58 | Truck passed |
| 6:17:42 | Car passed |
| 6:17:58 | Ethanol Plant, Birds and Traffic on 33 |
| 6:18:45 | Stop |

**Site 2 - County Highway M**

7/13/2009 Little to no wind

| Time | Event |
|---|---|
| 7:14:45 | Birds and Traffic on 33 |
| 7:17:50 | Traffic on 33 Picks Up - Louder |
| 7:18:37 | High Altitude Plane |
| 7:19:24 | Traffic on 33, Birds (Three birds are sitting on nearby bushes and are loud) |
| 7:24:13 | High Altitude Plane |
| 7:24:33 | Car passed |

**Site 2 - County Highway M**

7/14/2009 Little to no wind

| Time | Event |
|---|---|
| 6:28:45 | Birds and Traffic on 33 |
| 6:30:41 | Car passed |
| 6:31:15 | Birds and Traffic on 33 |
| 6:34:33 | Car passed |
| 6:34:59 | (2nd) Car passed |
| 6:35:35 | Birds and Traffic on 33 |
| 6:36:29 | 2 Cars passed |
| 6:37:41 | Birds and Traffic on 33 |

**Site 3 - Inglehart Rd**

7/13/2009 Little to no wind

| Time | Event |
|---|---|
| 6:51:00 | Birds and Horse Trotting at Farm |
| 6:52:44 | High Altitude Plane |
| 6:53:16 | Car passed |
| 6:54:10 | High Altitude Plane |
| 6:54:56 | Car passed |
| 6:55:22 | Birds |
| 6:57:00 | Truck passed |
| 6:58:44 | Birds |
| 6:59:24 | Car on Inglehart (in distance) |
| 6:59:41 | Birds |
| 7:00:18 | Horse Trotting |
| 7:00:55 | Birds |

**Site 3 - Inglehart Rd**

7/14/2009 Little to no wind

| Time | Event |
|---|---|
| 6:47:45 | Truck passed |
| 6:49:02 | Birds and Cows |
| 6:49:51 | Car on Cty E |
| 6:50:03 | Birds and Cows |
| 6:50:54 | High Altitude Plane |
| 6:53:53 | Truck Leaving Farm |
| 6:54:28 | Car passed |
| 6:55:14 | Birds and Cows |
| 6:56:04 | Truck passed |
| 6:57:00 | Birds |
| 6:57:20 | Truck passed |

**Site 4 - Larson Rd**

7/13/2009 Little to no wind

| Time | Event |
|---|---|
| 6:19:59 | Traffic on 33 and Birds |
| 6:20:45 | Louder Truck on 33 |
| 6:21:02 | Traffic on 33 and Birds |
| 6:26:05 | Traffic Noise Dies Down |
| 6:26:27 | Traffic on 33 and Birds |
| 6:27:30 | Truck passed |
| 6:28:17 | Traffic on 33 and Birds |

**Site 4 - Larson Rd**

7/14/2009 Little to no wind

| Time | Event |
|---|---|
| 7:20:00 | High Altitude Plane |
| 7:21:08 | Traffic on 33 and Birds |
| 7:27:46 | High Altitude Plane |
| 7:28:38 | Traffic on 33 and Birds |

# APPENDIX A-2 12PM-2PM

**Site 1 - E. Freisland Rd**

7/13/2009 Light wind

| Time | Event |
|---|---|
| 12:07:15 | Ethanol Plant |
| 12:09:30 | Birds - Loud |
| 12:11:09 | Birds (Quieter) |
| 12:13:37 | High Altitude Plane |
| 12:14:35 | Birds - Loud |
| 12:14:43 | High Altitude Plane |
| 12:15:10 | Birds (Quieter) |

**Site 1 - E. Freisland Rd**

7/14/2009 Windy

| Time | Event |
|---|---|
| 12:02:15 | High Altitude Plane, Wind in Leaves and Traffic on 33 |
| 12:04:04 | (2) Motorcycles |
| 12:04:33 | Truck passed |
| 12:05:09 | Traffic on 33 and Wind |
| 12:07:19 | High Altitude Plane |
| 12:08:30 | Car passed |
| 12:08:44 | High Altitude Plane and Wind |
| 12:09:56 | Truck passed |
| 12:10:46 | Traffic on 33 and Wind |

**Site 2 - County Highway M**

7/13/2009 Windy

| Time | Event |
|---|---|
| 12:27:15 | Birds and Bugs |
| 12:28:39 | High Altitude Plane |
| 12:29:18 | Birds and Bugs |
| 12:29:51 | Car passed |
| 12:30:23 | Birds and Bugs |
| 12:31:08 | High Altitude Plane |
| 12:33:10 | Birds and Bugs |
| 12:34:01 | Car passed |
| 12:34:33 | Bugs |
| 12:35:54 | Car passed |
| 12:36:19 | Bugs |

**Site 2 - County Highway M**

7/14/2009 Windy

| Time | Event |
|---|---|
| 12:21:00 | Wind and Traffic on 33 |
| 12:21:06 | Car passed |
| 12:21:21 | Wind in Leaves and Traffic on 33 |
| 12:24:00 | Car passed |
| 12:24:33 | Wind in Leaves and Traffic on 33 |
| 12:27:04 | Car passed |
| 12:27:33 | (2nd) Car passed |
| 12:28:10 | (3rd) Car passed |
| 12:28:41 | Wind in Leaves and Traffic on 33 |
| 12:28:55 | High Altitude Plane and Wind in Leaves |

**Site 3 - Inglehart Rd**

7/13/2009 Windy

| Time | Event |
|---|---|
| 12:46:00 | Wind in Trees and Birds |
| 12:48:00 | High Altitude Plane |
| 12:49:00 | Wind in Trees and Birds |
| 12:49:51 | Back up Alarms and High Altitude Plane |
| 12:50:54 | Birds |
| 12:52:06 | Wind in Trees and Birds |
| 12:55:50 | Car in Distance |

**Site 3 - Inglehart Rd**

7/14/2009 Windy

| Time | Event |
|---|---|
| 12:38:45 | Truck passed |
| 12:39:30 | Wind in Trees |
| 12:43:55 | Wind in Trees and Birds |
| 12:46:03 | High Altitude Plane and Wind |

**Site 4 - Larson Rd**

7/13/2009 Windy

| Time | Event |
|---|---|
| 13:10:00 | Bugs |
| 13:11:00 | Traffic on 33 |
| 13:12:00 | Bugs and Birds |
| 13:12:57 | Traffic on 33 |
| 13:17:57 | Wind in Leaves |
| 13:18:33 | Traffic on 33 |

**Site 4 - Larson Rd**

7/14/2009 Windy

| Time | Event |
|---|---|
| 13:10:00 | Wind in Leaves and Faint Traffic on 33 |
| 13:15:40 | Car in Distance |
| 13:16:00 | Wind in Leaves and Faint Traffic on 33 |
| 13:19:16 | High Altitude Plane |

# APPENDIX A-3 6PM-8PM

**Site 1 - E. Freisland Rd**

| 7/13/2009 | Little to No Wind |
|---|---|
| Time | Event |
| 19:23:00 | Birds and Ethanol Plant |
| 19:29:19 | Car passed |
| 19:30:03 | Birds, Ethanol Plant and Traffic on 33 |
| 19:31:32 | Car passed |
| 19:32:09 | Birds and Ethanol Plant |

**Site 1 - E. Freisland Rd**

| 7/14/2009 | Windy |
|---|---|
| 18:01:00 | Wind in Leaves and Ethanol Plant |
| 18:02:22 | Car passed |
| 18:02:36 | Wind in Leaves and Ethanol Plant |
| 18:05:27 | Loud Truck on 33, Wind in Leaves and Ethanol Plant |
| 18:06:08 | Truck passed |
| 18:08:39 | Car passed |
| 18:09:07 | Wind in Leaves and Ethanol Plant |

**Site 2 - County Highway M**

| 7/13/2009 | Little to No Wind |
|---|---|
| Time | Event |
| 18:17:15 | Birds and Bugs |
| 18:17:45 | Truck passed |
| 18:18:25 | Birds and Bugs |
| 18:19:30 | Car passed |
| 18:20:06 | Birds and Bugs |
| 18:20:44 | Van passed |
| 18:21:18 | Birds |
| 18:22:17 | Car passed |
| 18:22:40 | Birds |
| 18:24:36 | Car passed |
| 18:25:02 | Very Quiet - No Birds |
| 18:27:11 | Truck passed |

**Site 2 - County Highway M**

| 7/14/2009 | Windy |
|---|---|
| Time | Event |
| 18:20:45 | Wind in Leaves |
| 18:22:03 | Car passed |
| 18:22:28 | (2nd) Car passed |
| 18:23:01 | Wind in Leaves |
| 18:24:10 | Wind in Leaves and High Altitude Planes |
| 18:26:10 | Wind in Leaves |

**Site 3 - Inglehart Rd**

| 7/13/2009 | Little to Moderate Wind |
|---|---|
| Time | Event |
| 18:34:45 | Birds |
| 18:35:50 | High Altitude Plane |
| 18:36:14 | Wind in Trees and Birds |
| 18:37:05 | Wind Picks Up |
| 18:37:24 | Truck passed |
| 18:38:14 | Wind in Trees and Birds |

**Site 3 - Inglehart Rd**

| 7/15/2009 | Windy |
|---|---|
| Time | Event |
| 18:38:15 | Wind in Trees |
| 18:44:45 | Truck in Distance |
| 18:44:55 | Wind in Trees |

**Site 4 - Larson Rd**

| 7/13/2009 | Little to No Wind |
|---|---|
| Time | Event |
| 19:00:00 | Traffic on 33 |
| 19:03:30 | High Altitude Plane |
| 19:04:57 | Motorcycle passed |
| 19:06:10 | Motorcycle passed (Second Time) |
| 19:06:40 | No Traffic - Very Quiet |
| 19:07:02 | Traffic on 33 |

**Site 4 - Larson Rd**

| 7/15/2009 | Windy |
|---|---|
| Time | Event |
| 19:00:00 | Wind in Leaves and Faint Traffic on 33 |
| 19:03:33 | High Altitude Plane |
| 19:05:30 | Wind in Leaves and Faint Traffic on 33 |

# APPENDIX A-4 10PM-12AM

**Site 1 - E. Freisland Rd**

7/13/2009 Little to no wind

| Time | Event |
|---|---|
| 22:00:00 | Ethanol Plant |
| 22:03:41 | Car passed |
| 22:04:34 | Ethanol Plant |
| 22:04:52 | Trucks on 33 |
| 22:06:33 | Ethanol Plant and Traffic on 33 |
| 22:08:31 | Car passed |
| 22:09:14 | Ethanol Plant |
| 22:09:52 | Car passed |

**Site 1 - E. Freisland Rd**

7/14/2009 Little to Moderate Wind

| Time | Event |
|---|---|
| 22:03:00 | Ethanol Plant and Wind in Leaves |
| 22:07:04 | Car passed |
| 22:07:30 | Ethanol Plant and Wind in Leaves |
| 22:08:45 | Car passed |
| 22:08:04 | Ethanol Plant and Wind in Leaves |
| 22:12:45 | Truck on 33 and Ethanol Plant |

**Site 2 - County Highway M**

7/13/2009 Little to no wind

| Time | Event |
|---|---|
| 22:22:15 | Very Quiet - Little noise |
| 22:22:54 | Car on Friesland |
| 22:24:12 | Truck on 33 |
| 22:25:02 | Very Quiet - Little noise |
| 22:26:42 | Car passed |
| 22:28:04 | Truck on 33 - Faint |
| 22:28:30 | Very Quiet - Little noise |
| 22:29:30 | Car passed |
| 22:30:02 | Very Quiet - Little noise |

**Site 2 - County Highway M**

7/14/2009 Little to Moderate Wind

| Time | Event |
|---|---|
| 22:24:30 | Very Quiet - Faint Traffic on 33 |
| 22:25:07 | High Altitude Plane |
| 22:27:18 | Car passed |
| 22:28:06 | Traffic on 33 |
| 22:31:05 | Car passed |
| 22:32:17 | Very Quiet - Faint Traffic on 33 |

**Site 3 - Inglehart Rd**

7/13/2009 Little to no wind

| Time | Event |
|---|---|
| 22:41:30 | Barking Dog in Distance |
| | Very Quiet |

**Site 3 - Inglehart Rd**

7/15/2008 Windy

| Time | Event |
|---|---|
| 22:43:00 | Wind in Leaves - Very Quiet |
| 22:46:21 | Car in Distance |
| 22:46:57 | Wind in Leaves - Very Quiet |
| 22:47:59 | Holly Coughing |
| 22:48:03 | Wind in Leaves - Very Quiet |
| 22:50:11 | High Altitude Plane |
| 22:50:30 | Amish Buggy |

**Site 4 - Larson Rd**

7/13/2009 Little to no wind

| Time | Event |
|---|---|
| 23:10:00 | Faint Traffic on 33 |
| 23:15:09 | Very Quiet |
| 23:15:28 | Faint Traffic on 33 |
| 23:16:05 | Very Quiet |
| 23:18:40 | Truck on 33 |
| 23:19:10 | Traffic on 33 |

**Site 4 - Larson Rd**

7/15/2009 Little to No Wind

| Time | Event |
|---|---|
| 23:10:00 | High Altitude Plane (Very Quiet) |
| 23:10:52 | Traffic on 33 (Faint - Can Hear Trucks Clearly but Still Very Quiet) |
| 23:14:00 | No Traffic - Very Quiet |
| 23:17:09 | Traffic on 33 (Faint) |

Application of Wisconsin Electric Power Company
For the Glacier Hills Wind Park
Docket No. 6630-CE-302

**Data Request PSC 21.01**

**Request:**

21.01 *(Application TSD, Appendix R)* It appears that the test engineer's field notes for the only 6:00 a.m. to 8:00 a.m. measurement period are included with this report. Provide the engineer's filed notes for the remaining measurement periods. If appropriate, file a complete, revised report as your response to this request, rather than just the additional pages.

**Response:**

The revised report is attached. The additional engineer's field notes for the remaining measurement periods have been added.

**Prepared by: Richard O'Conor**

**Date: July 8, 2009**

Hessler Associates, Inc.
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**Report Number 092408-4**
**Noise Assessment**
**Glacier Hills Wind Park**
October 2008

Prepared For:

**We Energies**
Milwaukee, WI

Prepared By:
Hessler Associates, Inc.
*Consultants in Engineering Acoustics*

Principal Consultant:
George F. Hessler Jr., P.E., Bd. Cert. INCE

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## Report 092408-3



## List of Figures and Tables

**Tables**



**Figures**

## 1.0_Introduction

Hessler Associates has been contracted by We Energies to conduct a study of potential noise impact associated with their planned Glacier Hills Wind Project in Columbia County, Wisconsin. The project contains approximately 90 wind turbines to be installed near the townships of Randolph and Scott. At this time there are five wind turbine models under consideration for the project rated from 1.5 MW up to 2.3 MW.

Existing environmental community noise levels were measured to provide a baseline of existing conditions for comparison to predicted sound emission levels from the planned wind turbines. Measurement of existing ambient sound levels was done in accordance with the Public Service Commission of Wisconsin (PSCW) protocol[1]. In addition, continuous sound level measurements were made to establish a trend and relationship between ambient sound levels and wind speeds. Noise impact from the turbines, if any, would occur during warm weather and the transition months when the outdoor environment is used for enjoyment and ambient measurements were collected in June during such conditions.

Increases to existing levels caused by the installation of the wind turbines were calculated in accordance with reference 1 under a worst case operational scenario for all five turbines under consideration. The site is shown on Figure 1.0.1 located at the end of the text portion of this report for maximum size.

## 2.0_ Executive Summary and Conclusions

*Ambient Measurements*

Attended and continuous unattended baseline sound measurements were carried out from June 25th through July 8th, 2008 at the Glacier Hills Park site. The derived site area residual ambient level as a function of wind speed is tabulated below.

| WIND SPEED (m/s) AT 10m HEIGHT | | | | |
|---|---|---|---|---|
| 4 | 5 | 6 | 7 | 8 |
| RESIDUAL LA90 SOUND LEVEL (NOTE 1) | | | | |
| 37 | 38 | 39 | 40 | 41 |

***Table 2.0.1:*** *Macro-area Residual LA90 Ambient Level for Project*

*Project Noise Requirements*

There are three main noise requirements to evaluate for the project

- Proposed Randolph & Scott Townships Agreement: 50 dBA limit at non-participating residences[2]
- Assessment of ambient level increases as calculated by the PSCW Protocol, ref. 1
- Lease requirement that the sound level at 200 feet from participating residences not exceed 50 dBA.

---

[1] "Measurement protocol for sound and vibration assessment of proposed and existing electric power plants", Public Service Commission of Wisconsin, February 2002

[2] Proposed Joint Development Agreements with the towns of Randolph and Scott

*Noise Assessment-Township Limits*
All non-participating landowners are located 1000 feet or farther from any proposed wind turbine location. The table below shows that the proposed Township's limit of 50 dBA will be met with all turbine models under consideration for the project. Detailed calculations are given in the Discussion section.

| Turbine Model | dB(A) | Limit |
|---|---|---|
| MODEL A | 45 | 50 |
| MODEL B | 47 | 50 |
| MODEL C | 45 | 50 |
| MODEL D | 45 | 50 |
| MODEL E | 49 | 50 |

***Table 2.0.2****: Tabulation of Estimated Turbine Immission Levels at 1000 feet from a 4-unit array.*

Computer modeling that more accurately accounts for the cumulative effect of all turbines is presented as equal level noise level contours on Plots 1 and 2. For maximum size, these Plots are attached after the text portion of the report. These plots show compliance with the 50 dBA requirement at any residence, participating or non-participating. The difference between the plots is simply Plot 1 shows all turbines under consideration while Plot 2 shows all turbines except model E.

*Noise Assessment-Ambient Level Increases*
The computed increase-to-ambient level is highly variable for wind turbine projects due to a large number of variables that change with time and wind speed. The variables are discussed later in detail and a "worse case" scenario is adapted for computation of the increases to ambient for all turbine models under consideration.

With this simplifying scenario, the table below shows the expected maximum increases for each model turbine. The operational scenario assumes a high wind speed at turbine hub height (maximum noise emissions) and a low wind speed at ear height for receptors at 1000 feet. The calculations are done for locations where the maximum cumulative effect occurs due to adjacent turbines and assumes full load noise emissions whereas the emissions will be slightly lower (on the order of 1-2 dBA). Hence the computed results are conservative and should be lower during more favorable wind differentials and at other locations throughout the project where the density of surrounding turbines is lower.

| | A-WEIGHTED SOUND LEVEL, dBA | | |
|---|---|---|---|
| TURBINE MODEL | ON (NOTE 1) | OFF (NOTE 2) | INCREASE (ON-OFF) |
| MODEL A | 45 | 37 | 8 |
| MODEL B | 47 | 37 | 10 |
| MODEL C | 45 | 37 | 8 |
| MODEL D | 45 | 37 | 8 |
| MODEL E | 49 | 37 | 12 |

Note 1: Worst-case calculations for a 4-unit turbine array at full speed operation at 1000 feet from closest turbine
Note 2: Average 10-minute LA90 at 4 m/s wind speed (10 m height) from attended & continuous measurements

***Table 2.0.3****: Tabulation of estimated turbine immission levels at 1000 feet from the closest array turbine, the area ambient and calculated increase to ambient.*

It can be concluded that all project noise requirements will be met including sleep interference recommendations and low frequency noise limitations discussed in detail in Section 5.0. Based on the presented measurements and analyses, we conclude the planned project should not result in any material adverse noise impact for the residential communities. It should be noted that the wind turbines will be perceptible outdoors during most operation and some noise complaints may be anticipated.

## .3.0_ Definitions and Background Information

***Units and Discussion for Sound Levels***

The universal measure of noise in decibels used throughout the world is the A-weighted sound level, abbreviated dB(A) or dBA. The overall sound level is defined as the summed level in decibels over the entire *audible* frequency range (for young adults) of approximately 20 to 20,000 cycles/second (Hertz). It is a single number to quantify the entire spectrum of sound. A-weighting is an electronic filter applied to the spectrum that reshapes the spectrum to simulate human hearing response to frequency content. Lower frequency sound is subtracted by the A-weighting filter since humans perceive higher frequencies easier than lower notes. The reshaped or weighted new spectrum is summed over the same audible frequency span and is called the overall A-weighted level. Thus, the A-weighted sound level is an excellent single number descriptor for audible sounds.

The *instantaneous* A-weighted sound level in any residential community over any sampling period, such as the 10-minute intervals used for this survey, varies as sporadic noise events occur. Such events may be passing vehicles, aircraft or rail events, dog barking, tree leaf rustle, etc. To condense this varying data to a more usable form, standard measurement metrics are defined. The obvious ones are the minimum, maximum and average level that occurs over the interval. The max and min are the highest and lowest measured level during the sampling period. The average, designated Leq is the *equivalent* steady sound level that has the same acoustic energy as the actual time varying signal. It can be thought of as the true energy average, and is not simply the arithmetic average over the period.

Percentile levels or exceedence levels, designated LA1, LA5, LA10, LA50 and LA90 are the statistically derived units over the sampling period. They are the levels exceeded for 1, 5, 10, 50 and 90% of the sampling time. Of these, Leq and L90 are the most useful for evaluating community noise.

The L90 percentile level may be the most useful for evaluating community noise in rural environments where wind turbines are typically used for power generation. LA90 is defined as the "residual" sound level, which is the quasi-steady level that occurs in the absence of all identifiable sporadic sound levels occurring over the interval. The vast majority of all residual sound levels found in communities come from far-away unidentifiable steady levels from traffic and/or industrial sources. Typical residual daytime levels found throughout the U.S. under calm and still wind conditions are shown below:

**Typical Residential Area Sound Levels**

Daytime Residual Level, dBA, Level Exceeded 90% of the Time, LA90

| Description | Typical Range | Average |
|---|---|---|
| Very Quiet Rural or Remote Area | 26 to 30 inclusive | 28 (New, HAI Study) |
| Very Quiet Suburban or Rural Area | 31 to 35 inclusive | 33 (ANSI B133.8) |
| Quiet Suburban Residential | 36 to 40 inclusive | 38 |
| Normal Suburban Residential | 41 to 45 inclusive | 43 |
| Urban Residential | 46 to 50 inclusive | 48 |
| Noisy Urban Residential | 51 to 55 inclusive | 53 |
| Very Noisy Urban Residential | 56 to 60 Inclusive | 58 |

Source: (Average 38 – 58 dBA) U.S. EPA Community Noise Study, 1971

Based on the above, we should expect to find minimum ambient levels in the 26 to 35 dBA range depending on the proximity of major roads.

## 4.0_ Measurement Methodology

Two measurement methods were employed for this project. The primary method is prescribed by the PSCW protocol, reference 1, and consists of manual frequency-dependent 10-minute samples taken during four daily time periods starting at 6 am, 12 noon, 6 pm and 10 pm. These measurements are usually taken during "calm and still" or at least very moderate wind conditions. Calm and still is defined as essentially no wind and no audible sounds from grass or tree-leaf rustle. Minimum ambient levels occur during these conditions and provide the most conservative baseline for assessing power-plant noise intrusions[3]. These measurements were made for two days yielding eight samples at four locations or 32 measurements.

For wind turbine operation during windy conditions, it is necessary to account for sound masking by developing typical ambient sound levels as a function of wind speed. The sound emissions from wind turbines also vary with wind speed, and increase gradually from the start or cut-in speed of approximately 3 or 4 m/s to a maximum noise emission level at approximately 6 to 8 m/s for most wind turbines.

Measuring low level ambient noise during windy conditions is problematical. Special methods were employed to insure that wind induced turbulence did not give a false reading or effect the measurements. Essentially a much larger windscreen (7 inch diameter) was used and the microphone was placed at an elevation of only 1 meter above grade. The larger windscreen lowers turbulence reaching the microphone and the wind velocity is lowered if the microphone is only a meter above grade. The measured wind induced noise at the turbine cut-in speed is well less than 25 dBA. This technique was developed in a study in an aero-acoustic wind tunnel in Germany funded by the author's company to study wind effects on microphone response[4].

Measurements were made from June 25$^{th}$ thru July 8$^{th}$, 2008. Figure 1.0.1 (at end of text) shows the measurement locations relative to the road network.

## 4.1_PSCW Protocol Measurements

Four locations were chosen after review of the site with Mr. J. Lepinski of the PSCW. The locations shown were chosen to represent spots that would have a future turbine located approximately 1000 feet away, and to cover the entire wind project area. All four locations are close to functioning meteorological data collection towers.

- Location 1 is at the east end of the development 3000 feet from a functional ethanol plant.
- Location 2 is fairly central to the project.
- Location 3 is north central location.
- Location 4 is at the west end of the project

[3] Hessler, G.F., "Controlling noise impact in the community from power plant operations-Recommendations for ambient measurements", Noise Control Engineering Journal, Volume 48, Number 5, 2000 Sept-Oct.
[4] Hessler, G.F., "Experimental study to determine wind-induced noise and windscreen attenuation effects on microphone response for environmental wind turbine and other applications", Noise Control Engineering Journal, Volume 56, Number 4, 2008 Sept-Oct.

*Measurement Results*
The table below tabulates the measured 10-minute LA50 and LA90 residual sound levels. Appendix A tabulates the notes taken by the test engineer for each measurement period to identify observed sources.

| A-WEIGHTED LEVELS | | SITE 1 | | | | | SITE 2 | | | | | SITE 3 | | | | | SITE 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | INTERVAL | LAeq | LA01 | LA10 | LA50 | LA90 | LAeq | LA01 | LA10 | LA50 | LA90 | LAeq | LA01 | LA10 | LA50 | LA90 | LAeq | LA01 | LA10 | LA50 | LA90 |
| 25-Jun-08 | 6-8AM | 64.6 | 78.8 | 58.9 | 44.5 | 41.1 | 57.8 | 71.7 | 54.8 | 40.5 | 36.5 | 43.9 | 49.0 | 46.9 | 42.6 | 39.8 | 54.1 | 62.0 | 42.2 | 38.4 | 36.6 |
| 27-Jun-08 | | 64.1 | 75.4 | 48.1 | 43.4 | 41.2 | 55.7 | 69.5 | 42.3 | 38.4 | 36.8 | 64.7 | 77.0 | 50.5 | 39.2 | 36.8 | 49.0 | 57.8 | 42.4 | 39.6 | 38.3 |
| 26-Jun-08 | 12-2PM | 60.1 | 75.5 | 49.6 | 38.7 | 36.7 | 57.1 | 72.0 | 40.8 | 36.9 | 35.2 | 49.6 | 53.8 | 52.1 | 49.3 | 45.3 | 50.0 | 57.0 | 43.9 | 40.9 | 37.7 |
| 3-Jul-08 | | 62.0 | 75.8 | 57.3 | 36.8 | 35.0 | 58.9 | 71.3 | 40.9 | 35.2 | 34.2 | 58.0 | 73.6 | 51.4 | 44.5 | 40.1 | 56.4 | 68.3 | 59.3 | 46.5 | 41.5 |
| 25-Jun-08 | 6-8PM | 45.2 | 54.7 | 41.8 | 39.3 | 37.6 | 53.9 | 62.3 | 39.9 | 36.5 | 35.3 | 53.8 | 61.8 | 51.6 | 47.0 | 43.5 | 46.1 | 56.7 | 37.6 | 35.3 | 34.3 |
| 26-Jun-08 | | 61.6 | 76.1 | 54.5 | 40.5 | 38.1 | 61.2 | 76.0 | 57.0 | 38.5 | 35.7 | 55.0 | 65.3 | 46.3 | 40.9 | 38.0 | 36.6 | 40.4 | 38.2 | 36.3 | 34.4 |
| 26-Jun-08 | 10-12PM | 42.9 | 49.8 | 44.0 | 42.1 | 40.4 | 34.0 | 35.0 | 34.7 | 33.7 | 33.7 | 34.8 | 37.9 | 35.5 | 34.5 | 33.8 | 45.4 | 56.0 | 36.5 | 34.8 | 34.2 |
| 26-Jun-08 | | 37.4 | 39.2 | 38.4 | 37.4 | 36.4 | 34.7 | 41.0 | 34.8 | 33.8 | 33.5 | 34.7 | 37.0 | 35.6 | 34.6 | 34.0 | 38.2 | 43.9 | 41.4 | 36.8 | 34.4 |
| MINIMUM, ANY SURVEY | | | | | 36.8 | 35.0 | | | | 33.7 | 33.5 | | | | 34.5 | 33.8 | | | | 34.8 | 34.2 |
| LOG AVERAGE: | | | | | 41.1 | 38.8 | | | | 37.3 | 35.3 | | | | 44.2 | 40.6 | | | | 40.4 | 37.2 |
| ARITHMETIC AVERAGE: | | | | | 40.3 | 38.3 | | | | 36.7 | 35.1 | | | | 41.6 | 38.9 | | | | 38.6 | 36.4 |
| STD. DEV.: | | | | | 2.8 | 2.3 | | | | 2.4 | 1.2 | | | | 5.4 | 4.1 | | | | 3.8 | 2.6 |

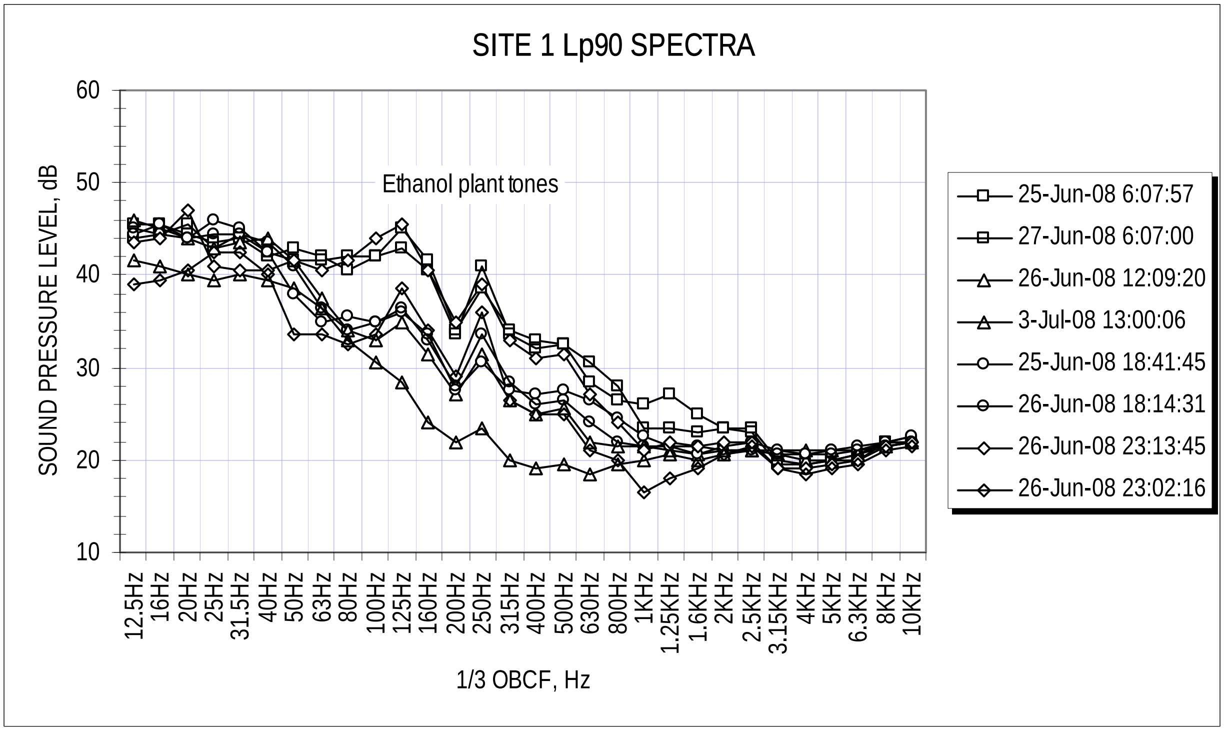
| C-WEIGHTED LEVELS | | SITE 1 | | | | | SITE 2 | | | | | SITE 3 | | | | | SITE 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | INTERVAL | LCeq | LC01 | LC10 | LC50 | LC90 | LCeq | LC01 | LC10 | LC50 | LC90 | LCeq | LC01 | LC10 | LC50 | LC90 | LCeq | LC01 | LC10 | LC50 | LC90 |
| 25-Jun-08 | 6-8AM | 58.0 | | 61.6 | 56.7 | 54.6 | 55.4 | | 64.0 | 53.6 | 49.9 | 48.2 | | 51.8 | 47.7 | 45.1 | 53.7 | | 58.9 | 53.2 | 49.1 |
| 27-Jun-08 | | 56.9 | | 58.7 | 55.9 | 54.6 | 53.4 | | 55.3 | 52.9 | 51.3 | 54.2 | | 59.8 | 52.9 | 48.8 | 54.0 | | 56.8 | 53.6 | 51.3 |
| 26-Jun-08 | 12-2PM | 57.4 | | 63.4 | 56.5 | 52.2 | 58.9 | | 65.0 | 58.5 | 53.1 | 53.9 | | 59.0 | 54.0 | 48.7 | 60.2 | | 66.2 | 59.8 | 54.7 |
| 3-Jul-08 | | 53.0 | | 57.7 | 51.3 | 48.9 | 51.3 | | 56.3 | 50.2 | 47.2 | 50.5 | | 55.9 | 50.1 | 44.6 | 56.5 | | 64.7 | 54.8 | 50.8 |
| 25-Jun-08 | 6-8PM | 55.0 | | 58.9 | 54.1 | 52.5 | 57.0 | | 63.1 | 56.8 | 51.0 | 52.2 | | 57.7 | 51.5 | 47.9 | 50.6 | | 54.8 | 49.9 | 47.7 |
| 26-Jun-08 | | 57.9 | | 62.9 | 57.4 | 52.4 | 60.1 | | 65.0 | 59.5 | 55.0 | 49.2 | | 52.9 | 48.7 | 45.8 | 48.6 | | 52.5 | 48.3 | 45.0 |
| 26-Jun-08 | 10-12PM | 55.9 | | 57.3 | 55.8 | 54.7 | 47.3 | | 51.5 | 46.7 | 43.8 | 40.9 | | 43.3 | 40.4 | 39.0 | 49.0 | | 51.2 | 48.9 | 46.5 |
| 26-Jun-08 | | 51.0 | | 52.4 | 51.0 | 49.6 | 43.2 | | 45.2 | 42.8 | 41.1 | 38.5 | | 42.6 | 37.7 | 36.1 | 46.3 | | 55.5 | 44.9 | 41.0 |
| LOG AVERAGE: | | | | | 55.4 | 52.9 | | | | 55.2 | 50.8 | | | | 50.2 | 46.1 | | | | 53.9 | 49.9 |
| ARITHMETIC AVERAGE: | | | | | 54.8 | 52.4 | | | | 52.6 | 49.1 | | | | 47.9 | 44.5 | | | | 51.7 | 48.3 |
| STD. DEV.: | | | | | 2.5 | 2.2 | | | | 5.8 | 4.7 | | | | 5.9 | 4.6 | | | | 4.6 | 4.2 |

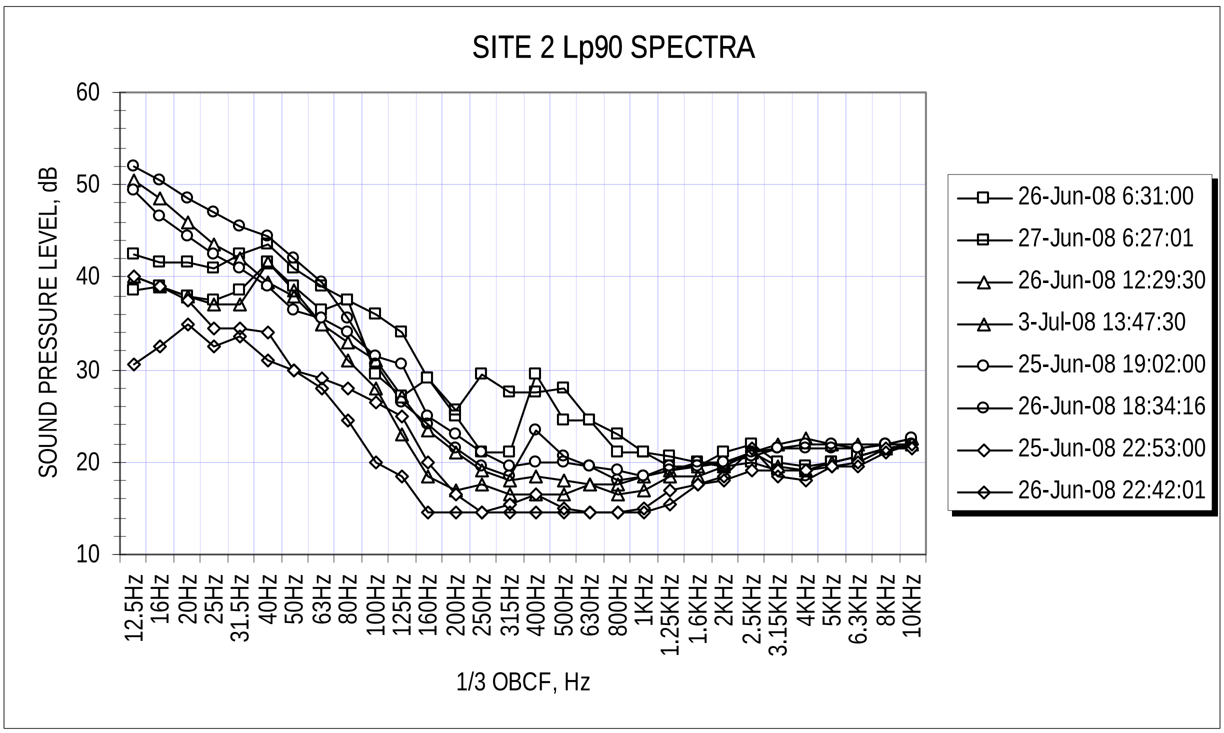
***Table 4.1.1** Measurement results for the PSCW protocol sound survey.*

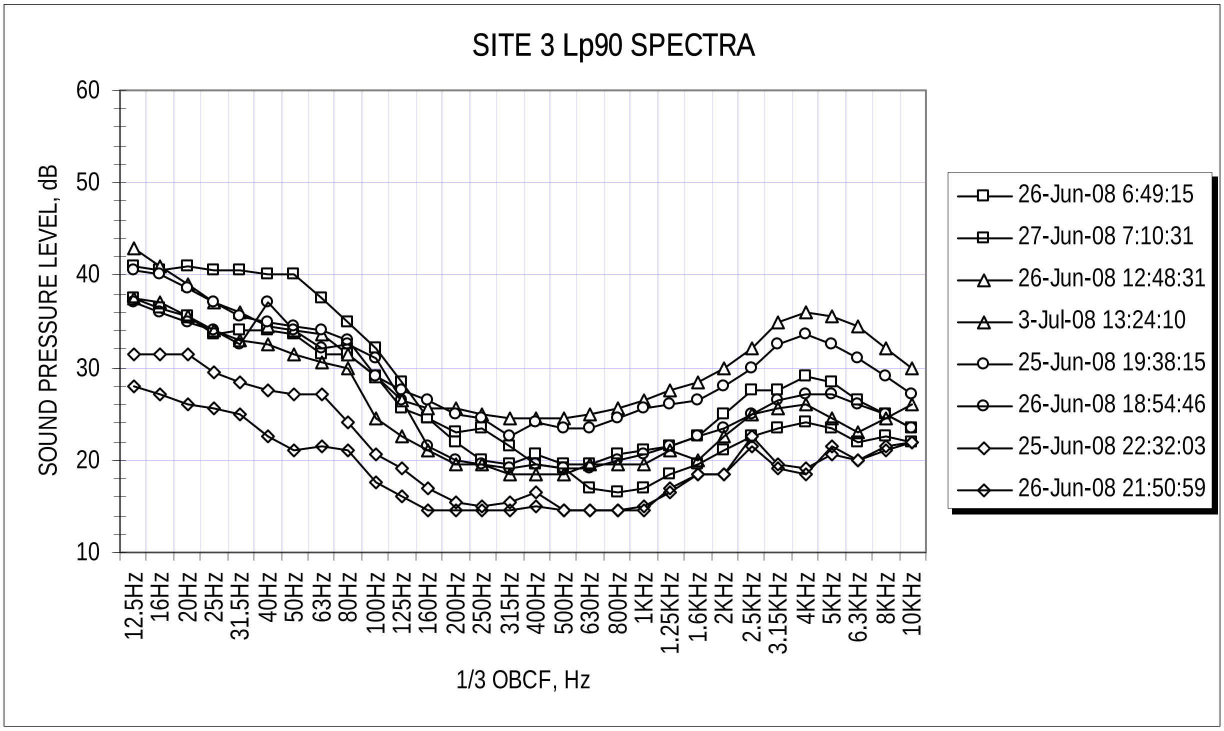
A good case can be made for using LA50 as the ambient metric of choice in quiet rural areas. It can be shown that LA50 best describes the slowly varying natural sounds in such an environment, but excludes high level sporadic sources such as passing traffic, aircraft, etc. Nevertheless there is a lot of precedence for using LA90 that can be characterized as the minimum ambient that occurs only 10% of the sampling time. It is postulated in reference 11 that the conservatism of using the LA90 metric is the principle reason that three states using this threshold have had successful experience for decades.

It can be seen that the average daily LA90 level is fairly uniform from day to day, during the different time of day and night periods and for all four measurement locations. The highest LA90 is at site 1, which is attributable to noise contributions from the operating ethanol plant. Such uniformity is typical of a large area "macro-ambient". The arithmetic average daily LA90 based on the eight sampling periods for this survey is 37 dBA.

Spectral data at each site was also acquired and is presented graphically below:


SITE 1 Lp90 SPECTRA
SOUND PRESSURE LEVEL, dB
60
50
40
30
20
10
Ethanol plant tones
12.5Hz
16Hz
20Hz
25Hz
31.5Hz
40Hz
50Hz
63Hz
80Hz
100Hz
125Hz
160Hz
200Hz
250Hz
315Hz
400Hz
500Hz
630Hz
800Hz
1KHz
1.25KHz
1.6KHz
2KHz
2.5KHz
3.15KHz
4KHz
5KHz
6.3KHz
8KHz
10KHz
1/3 OBCF, Hz
25-Jun-08 6:07:57
27-Jun-08 6:07:00
26-Jun-08 12:09:20
3-Jul-08 13:00:06
25-Jun-08 18:41:45
26-Jun-08 18:14:31
26-Jun-08 23:13:45
26-Jun-08 23:02:16


SITE 2 Lp90 SPECTRA
SOUND PRESSURE LEVEL, dB
60
50
40
30
20
10
12.5Hz
16Hz
20Hz
25Hz
31.5Hz
40Hz
50Hz
63Hz
80Hz
100Hz
125Hz
160Hz
200Hz
250Hz
315Hz
400Hz
500Hz
630Hz
800Hz
1KHz
1.25KHz
1.6KHz
2KHz
2.5KHz
3.15KHz
4KHz
5KHz
6.3KHz
8KHz
10KHz
1/3 OBCF, Hz
26-Jun-08 6:31:00
27-Jun-08 6:27:01
26-Jun-08 12:29:30
3-Jul-08 13:47:30
25-Jun-08 19:02:00
26-Jun-08 18:34:16
25-Jun-08 22:53:00
26-Jun-08 22:42:01



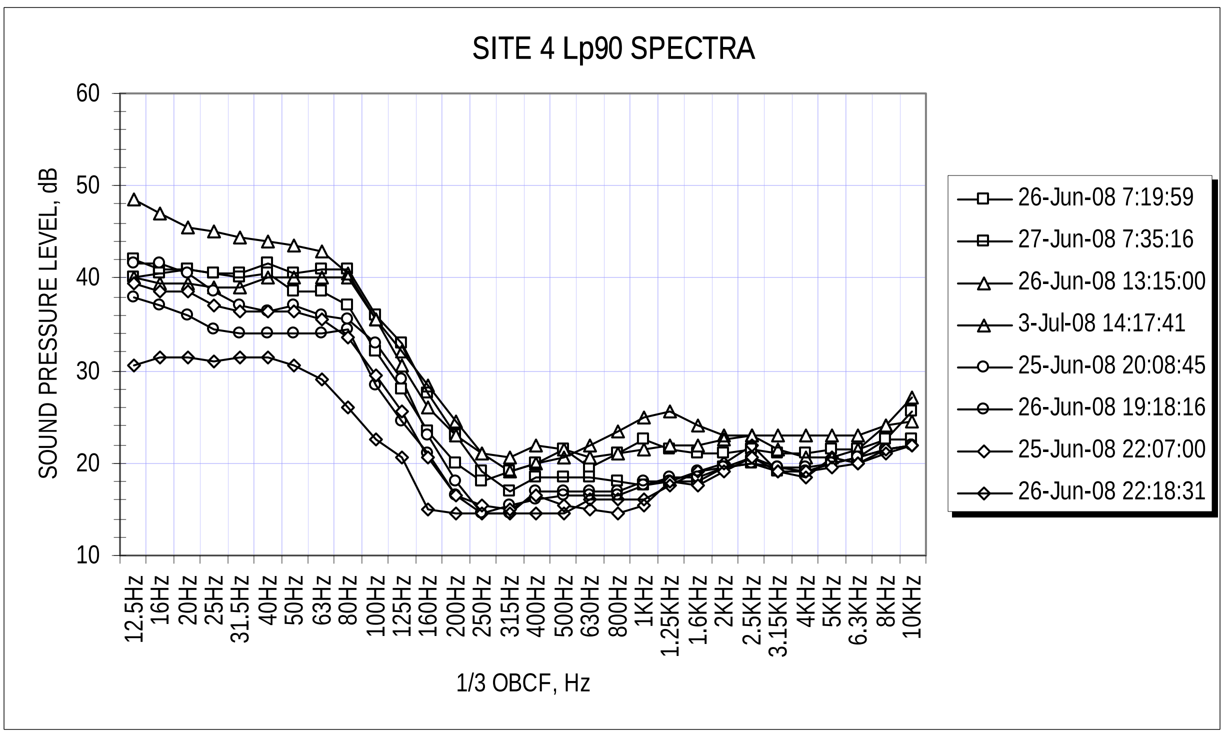




***Figure 4.1.1:*** *10-minute LA90 spectral plots at four measurement locations.*

## 4.2_Coninuous Monitor Measurements

The following graphics plot the measured sound levels in 10-minute intervals over the 13 day period from June 25th through July 8th.

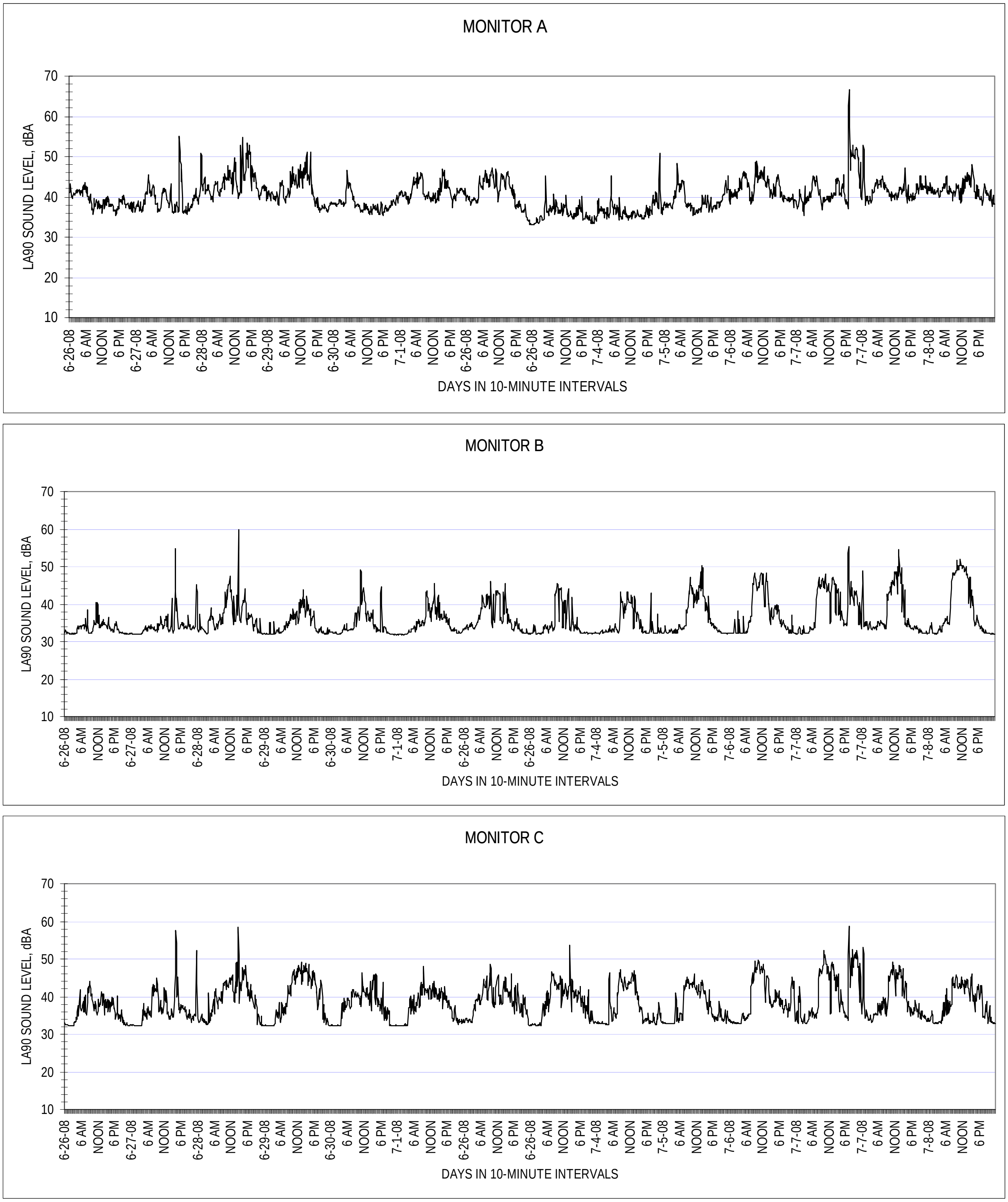



***Figure 4.2.1:*** *Continuous monitor plots for a 13-day period at three site locations*

Monitors B and C exhibit the usual temporal pattern of daytime road use where quietest hours are at night, while monitor A, about 3000 feet from the Ethanol plant, is less patterned.

One purpose of continuous measurements, in addition to viewing the daily temporal pattern, is to relate the results to wind speed. Wind can generate false low frequency levels from turbulence at the microphone diaphragm, but at the same time it creates natural foliage, tree leaf and grass rustling sound, a major source of environmental sounds in a rural area. It is difficult to separate wind created true environmental sound and other sources. One test is to compare the correlation between wind speed and measured sound levels as is done below.

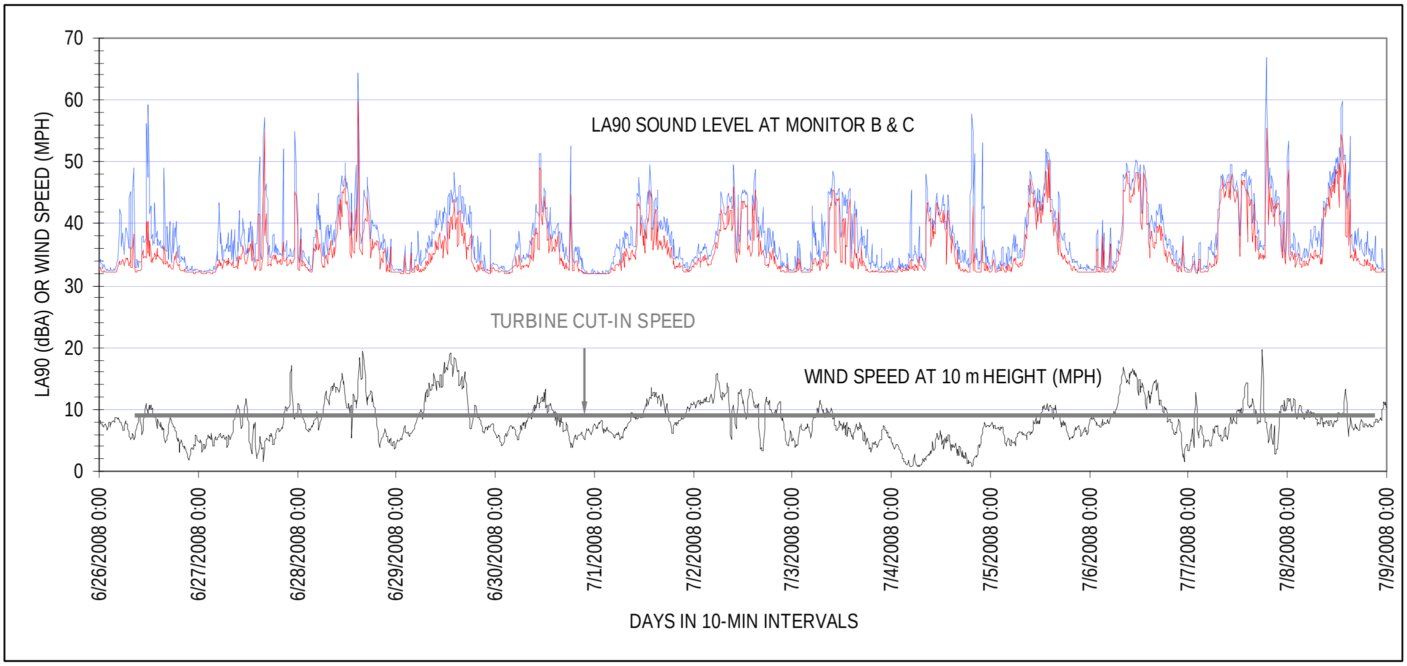



***Figure 4.2.2:*** *Comparison of sound and wind measurements*

Examination reveals there is a good correlation when the wind is at high speed but poor at low speed. This is expected since both microphone turbulence and wind created sound becomes more important at high wind speed. If the correlation was good at all speeds one could suspect the microphone is unduly affected.

Another way to examine this issue is to plot wind speed versus sound as is done below in Figure 4.2.3. This plot shows, perhaps coincidentally, that LA90 at turbine cut-in speed is 37 dBA, the same result obtained with the attended PSCW test method.

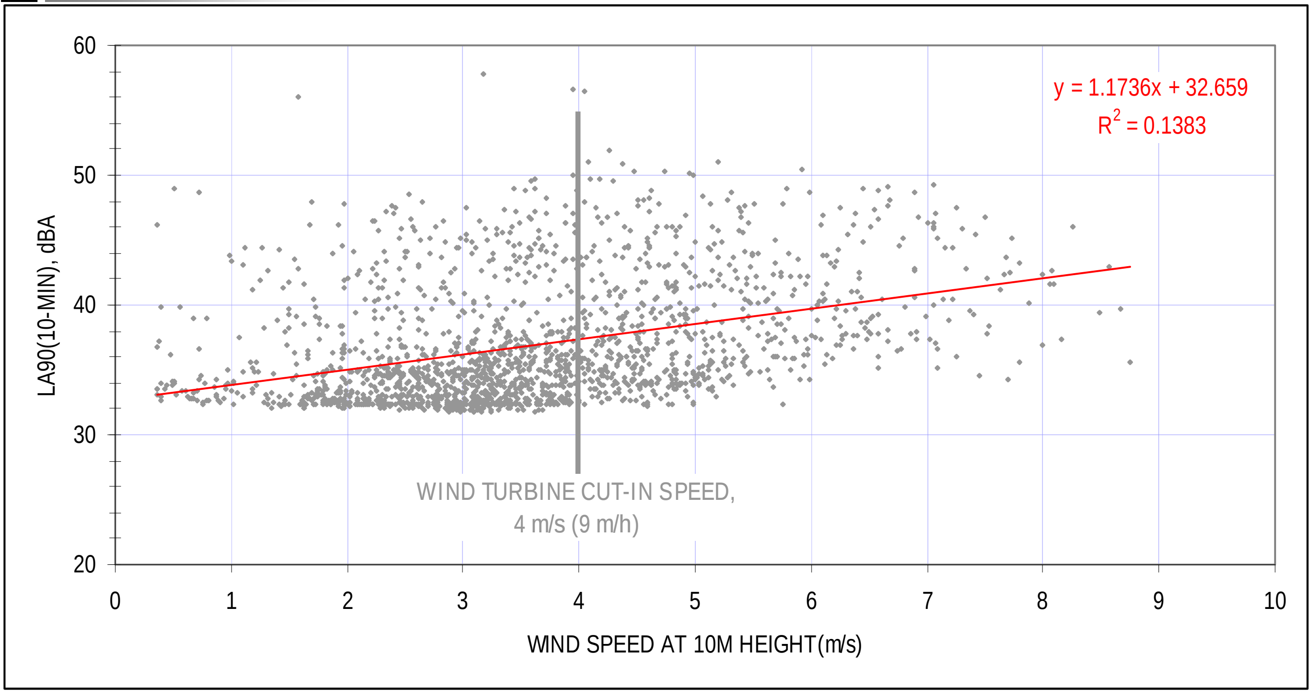



***Figure 4.2.3:*** *Regression of sound level measurements with wind speed.*

The correlation is poor indicating the sound measurements are composed of far-off traffic and other true environmental sources. The data does show a weak trend of increasing sound with increasing wind. The rate is approximately 1 dBA increase for each 1 m/s wind speed increase. Accordingly, the residual sound level as a function of wind speed is established as:

| WIND SPEED (m/s) AT 10m HEIGHT | | | | |
|---|---|---|---|---|
| 4 | 5 | 6 | 7 | 8 |
| RESIDUAL LA90 SOUND LEVEL (NOTE 1) | | | | |
| 37 | 38 | 39 | 40 | 41 |

Note 1: LA90 at 4 m/s wind velocity at 10 m elevation is the arithmetic average of attended measurements at sites 1 thru 4 as tabulated. Trend data shows a 1 dBA rise per m/s increase in wind speed.

***Table 4.2.3:*** *LA90 residual sound level ambient as a function of wind speed (10 m height)*

## 5.0_Environmental Noise Assessment Criteria

Potential adverse health effects and annoyance from both low frequency and audible frequency sound attributable to the wind turbines are discussed in this section.

## 5.1_Health Effects-EPA and WHO Guidelines

The magnitude of sound from the wind turbines will be very low. The only possible adverse health effect may be sleep interference. The U.S. EPA[5] concluded that a steady level of approximately 35 dBA in sleeping rooms was adequate to avoid sleep interference. The World Health Organization (WHO)[6] in more recent studies has concluded that a background level of 30 dBA inside sleeping rooms is appropriate. Both of these recommendations appear quite conservative since the normal low-level sound of airflow in heating and cooling ducts is approximately 40-42 dBA in bedrooms for residential construction. Ambient levels in bedrooms without central HVAC ducting have been measured in the 30-35 dBA range in a quiet suburban environment.

The noise reduction for residences in cold-climate construction from outside to inside the bedroom has been measured at 17 dBA for partially open windows and 34 dBA for closed windows[7]. Assuming a summertime worst case with windows open, the maximum level outside to prevent sleep interference is in the range of 47 to 52 dBA depending on the reference used (EPA or WHO). The average of 50 dBA will be used for assessment purposes measured outside the residence.

## 5.2_Low Frequency Noise

There were significant low frequency noise problems with very early wind turbine designs[8]. Such problems occurred both in the audible low frequencies from 20 to 250 Hz, and in the inaudible infrasound range at frequencies below 20 Hz. Current wind turbine designs are vastly improved, and do not result in low frequency issues. Nevertheless it is prudent to investigate frequency spectrum content, and the PSCW protocol requires consideration of low frequency noise by prescribing octave band frequency analysis.

Extensive research with low frequency noise effects is underway in Europe and Asia and a good summary of these efforts is given in reference [9]. Based on this study and extensive direct experience with low frequency site problems[10], an unbalanced spectrum can be detected by the quantity, dBC – dBA =< 20 dB. If the difference in levels exceeds 20 dB, the low frequency portion of the "unbalanced" spectrum becomes dominant, noticeable and potentially annoying.

---

[5] "Information on levels of environmental noise requisite to protect public health and welfare with an adequate margin of Safety", EPA Report PB-239429, March 1974.
[6] WHO, "Occupational and Community Noise", Fact Sheet 258, Revised Feb. 2001
[7] Sutherland, L.C., "Indoor Noise Environmental Due to Outdoor Noise Sources", Noise Control Engineering Journal, Nov-Dec. 1978
[8] Stephens, D. G. et al, "Guide to the evaluation of human exposure to noise from large wind turbines", NASA, Langley Research Center, Technical Memorandum 83288, March 1982.
[9] Leventhall, G.,"A review of published research on low frequency noise and its effects ", Report for the UK Department for Environment, Food and Rural Affairs, May 2003.
[10] Hessler, G.F., "Proposed criteria in residential communities for low frequency noise emissions from industrial sources", Noise Control Engineering Journal, Volume 52, Number 4, 2004 July-August.

Direct experience with low frequency noise issues is summarized in reference 7 - a peer-reviewed journal article. Acceptable C-weighted sound level criteria to avoid perceptible vibration and low frequency noise complaints are suggested in the paper. A maximum C-weighted level of 60 dBC for industrial sources is recommended for very quiet rural areas with sustained 24/7 operation of the facility. For more sporadic or seasonal operation, the recommended limit is higher at 65 dBC. Wind turbines operate periodically during sufficiently high wind conditions when the quiet ambient level also increases. Thus, an appropriate limit would fall somewhere between 60 to 65 dBC for wind turbines based on reference 7. This 60 to 65 dBC range is recommended for the project.

### 5.3_Audible Frequency Range and Annoyance Issues

The issue of annoyance is addressed by reviewing the increase in noise level brought about by the planned project. For conventional power plants, it is generally accepted in the scientific community that an increase of 5 dBA or less to existing ambient levels does not cause adverse noise impact. This is based on conventional power plants that operate at steady levels during calm and still low ambient conditions, where the increase to ambient is repeatable from day to day. The increase to ambient for a wind turbine project is highly variable as discussed in section 6.0.

There is an additional attitude factor to consider for all power projects. Those opposed to the project are likely to be dissatisfied if any sound of the turbines can be perceived at all or at any time. Achieving this would require essentially inaudibility or no increase to existing ambient levels resulting in magnitudes higher buffer distances than 1000 feet.

### 5.4_Summary of Impact Analysis Criteria and Compliance

In addition to the described criteria above, the Townships of Randolph and Scott have a proposed of limit of 50 dBA at any non-participating residence in either Township. Based on this and the above criteria sections, no adverse impact should occur for this project if the following limits and guidelines are met outdoors measured in the vicinity of adjacent residences:

| DESCRIPTOR | LIMIT | APPLICABILITY | COMPLIANCE |
|---|---|---|---|
| TOWNSHIP NOISELIMITS | 50 dBA | NON-PARTICIPATING RESIDENCES | YES |
| LEASE AGREEMENT | 50 dBA | 200' FROM PARTICIPATING RESIDENCES | YES (NOTE 1) |
| PSCW ASSESSMENT OF AMBIENT INCREASE | AS REQUIRED | ALL RESIDENCES | YES |
| EPA/WHO HEALTH EFFECTS | 50 dBA | ALL RESIDENCES | YES |
| LOW FREQUENCY NOISE (LFN) | 60 TO 65 dBC | ALL RESIDENCES | YES |

Note 1: Modeled level at 3 residences is 50.3 dBA for the loudest turbine,
but the actual level is expected to be less due to the conservative assumptions used the model.

***Table 5.4.1:*** *Tabulation of Noise Criteria for Assessing Impact on Adjacent Residential Land-use*

The final column indicates compliance is achieved except as noted for the project.

## 6.0_ Predicting Wind Turbine Noise Emissions

Two methods will be used to predict wind turbine noise at residences. One, the octave band and A & C-weighted levels can be manually calculated for an array of turbines. Since the minimum buffer distance is 1000 feet, the values will be predicted at this distance from an array of turbines. The second is computer modeling that better accounts for the actual distance from turbines to receptors.

## 6.1_Predicting Turbine Emissions by Single Calculation

The calculation of wind turbine sound emissions by octave bands and A & C-weighted levels for turbine emissions at maximum levels is given in the table below. The sound power source levels from the suppliers for each turbine are shown in blue. The algorithms for path losses are all standardized values, except for the cumulative effect. It can be shown that the cumulative effect of multiple adjacent turbines can be approximated by an allowance of 4 dB in each octave band for a typical project. The table below gives a sample calculation for the worst case loudest turbine.

| | | OCTAVE BAND CENTER FREQUENCY, HZ | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 16 | 31 | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | dB(A) | dB(C) | C-A |
| MAXIMUM LEVEL OCTAVE BAND DATA FROM MANUFACTURERS | | | | | | | | | | | | | | |
| MODEL A | | | 114 | 110 | 109 | 105 | 101 | 97 | 92 | 85 | 78 | 103 | 115 | |
| MODEL B | | | 115 | 111 | 108 | 107 | 104 | 99 | 94 | 89 | 87 | 105 | 116 | |
| MODEL C | | | 110 | 109 | 107 | 105 | 100 | 97 | 94 | 93 | 81 | 103 | 113 | |
| MODEL D | | | 114 | 111 | 107 | 103 | 99 | 97 | 94 | 91 | 78 | 103 | 115 | |
| MODEL E | | | 114 | 112 | 111 | 111 | 106 | 99 | 94 | 89 | 86 | 107 | 117 | |
| MAXIMUM Lw OF ANY TURBINE TO BE USED | | | 115 | 112 | 111 | 111 | 106 | 99 | 94 | 93 | 87 | 107 | 118 | |
| Lw = SOUND POWER, dB RE. 1 pW | | | | | | | | | | | | | | |
| ARRAY MODEL USING ISO 9613 MODEL | | | | | | | | | | | | | | |
| MAXIMUM TURBINE Lw | | | 115 | 112 | 111 | 111 | 106 | 99 | 94 | 93 | 87 | 107 | 118 | |
| PATH ATTENUATION: | | | | | | | | | | | | | | |
| HEMISPHERICAL SPREADING, R,feet= | 1000 | | -58 | -58 | -58 | -58 | -58 | -58 | -58 | -58 | -58 | | | |
| DIRECTIVITY, 0-110 DEG.(HAI), ANGLE= | NONE | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| AIR ABSORPTION,59F(15C)70%RH (EEI), R= | 1000 | | 0 | 0 | 0 | 0 | -1 | -1 | -3 | -8 | -27 | | | |
| ANOMALOUS EXCESS ATTN. (EEI), R= | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| NUMBER OF IDENTICAL SOURCES= | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| SUMMER GROUND EFFECTS (ALPHA = 0.5) | 1000 | | 0 | 0 | -2 | -5 | -4 | -2 | -2 | -2 | -2 | | | |
| CUMMULATIVE EFFECT (10LOG(4)-2) | | | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | | | |
| MISCELLANEOUS | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| SUM OF PATH ATTENUATION: | | | -54 | -54 | -56 | -59 | -58 | -57 | -58 | -63 | -82 | | | |
| CALCULATED Lp FROM FOUR TURBINE ARRAY | | | 61 | 58 | 55 | 52 | 48 | 42 | 36 | 30 | 5 | 49.2 | 62.5 | 13.4 |
| NOTE: ACTUAL LEVELS WOULD BE 2 TO 4 dBA & dBC LOWER FOR TURBINES OTHER THAN MODEL D | | | | | | | | | | | | | | |

***Table 6.1.1:*** *Sample calculation for the worst case wind turbine.*

The results for all turbines are tabulated below. The left hand table shows the expected range is 45 to 49 dBA depending on turbine model but that all turbines would be below 50 dBA at the minimum set-back distance. The right-hand graphic shows the A & C-weighted levels and the difference C-A. It has been determined that there *may* be a low frequency noise problem if this difference is 20 dB or more. This is the trigger level to investigate the spectrum. Clearly, no low frequency noise problem is indicated by the prediction calculations.

| Turbine Model | dB(A) | dB(C) | C-A |
|---|---|---|---|
| MODEL A | 45 | 61 | 15 |
| MODEL B | 47 | 61 | 14 |
| MODEL C | 45 | 58 | 13 |
| MODEL D | 45 | 61 | 16 |
| MODEL E | 49 | 62 | 13 |

| Turbine Model | dB(A) | Limit |
|---|---|---|
| MODEL A | 45 | 50 |
| MODEL B | 47 | 50 |
| MODEL C | 45 | 50 |
| MODEL D | 45 | 50 |
| MODEL E | 49 | 50 |

***Table 6.1.2:*** *Table of calculation results for all turbine models for an array of turbines.*

Expected spectra for each turbine are plotted below:

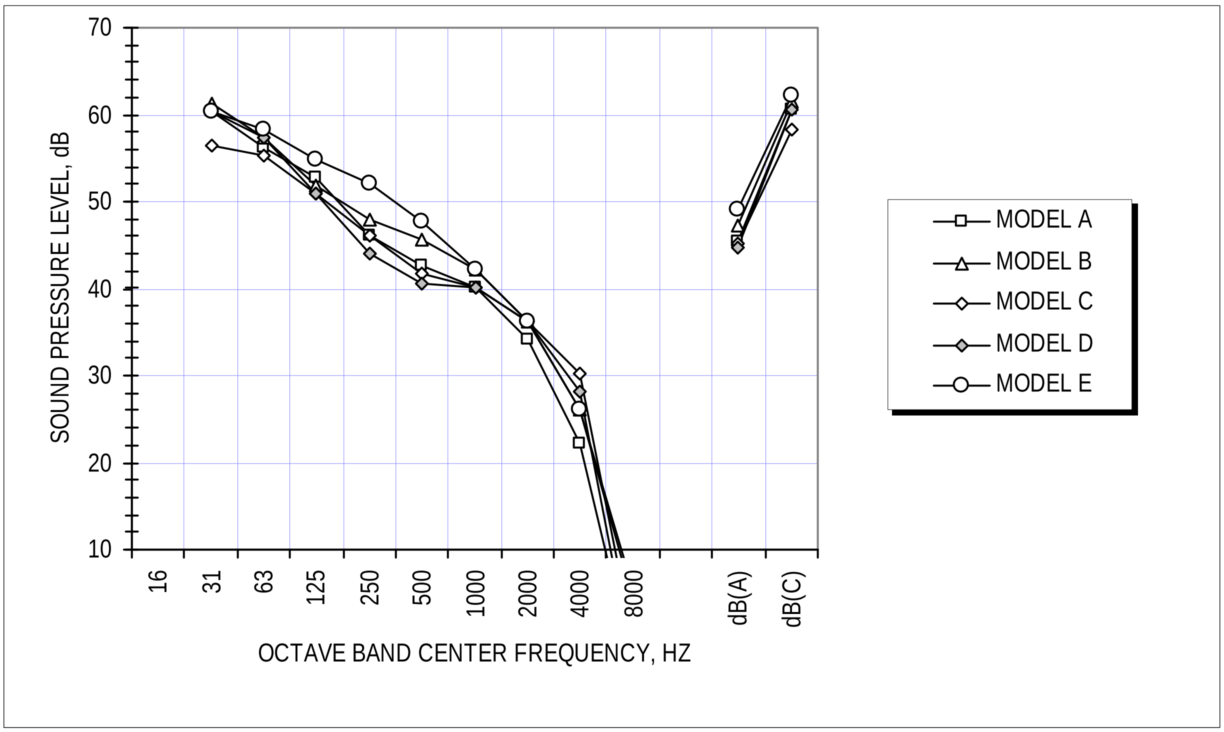



***Figure 6.1.1:*** *Spectra plots for calculated worse case turbine immissions at 1000 feet.*

We can conclude from these calculations that the 50 dBA would be met at any location on site.

### 6.2_Predicting Turbine Emissions by Computer Modeling

A-weighted sound level contour maps are computed and drawn over aerial photos. The graphics were prepared using CadNA (Computer Aided Design for Noise Abatement) published by Datakustik, GmbH in Germany, a dedicated computer sound propagation model expressly developed for power plant applications. The program uses algorithms from ISO 9613. Our experience has demonstrated excellent agreement between predicted and measured using this program. Usually, measured levels are at the predicted levels or 1 to 3 dBA below. The source for the model is the turbine sound power levels furnished by the manufacturers.

The models assume an omni-directional wind, meaning the maximum downwind noise is predicted in all directions, so the models are inherently conservative. Nevertheless, one can observe the maximum downwind wind turbine noise level at any location for the project.

Plots 1 and 2 present the results. Plot 1 shows the sound level contours using the highest sound source possible,. This plot shows there are three residences (one non-participating and two participating) alone E. Friesland road near Highway 33 that may be marginal for meeting the lease agreement of 50 dBA at 200 feet from the home. Another participating residence in the same area but south of Highway 33 would also be marginal for meeting the lease requirement. The modeled level at these residences is 50.3 dBA, but the actual level is expected to be less due to the conservative assumptions used in the model.

Plot 2 uses the next loudest turbine as the source at a power level of 105 dBA. Clearly all requirements at all residences are met with this turbine and the other quieter turbines.

### 6.3_Predicting Increases to Ambient Sound Levels

The increase to ambient (turbines on minus off) is highly variable for wind turbine projects due to the large number of variables. Recent measurement experience demonstrates this variability[11]. The main variable is the difference in wind speed at the high elevation of the turbine hub and ear height of a receptor at ground level. The measured wind speed at 1m and 80m hub height at another project in the same type of rural farm field ground cover is plotted below. Note the differences for each interval are not constant.

[11] HAI Report Number 061608-1, Post Construction Noise Survey Blue Sky & Green Field Project, June 2008

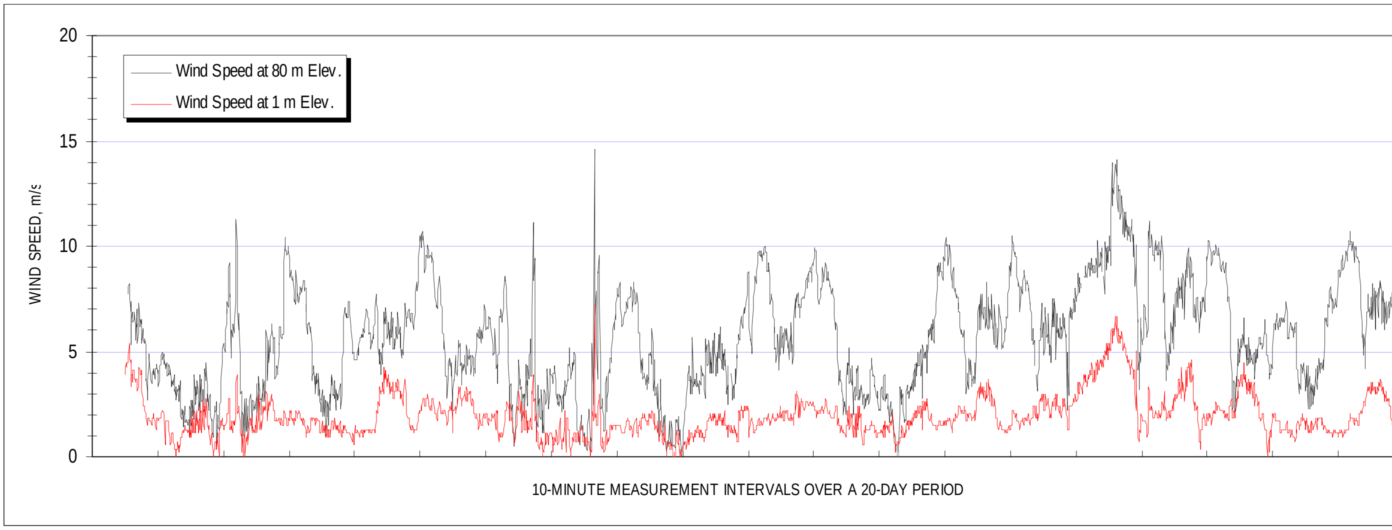



***Figure 6.3.1:*** *Measured wind speed at two elevations.*

This leads to a situation where at times there is high wind at 80 m to operate the turbines but relatively low wind at ground level. At other times the wind speed is high at both elevations, thus the perceived noise and resulting increase above ambient varies with time. Experience indicates the worst case is when the wind speed is in range of 4 to 6 m/s (10 m height) with the turbine at near maximum sound output but the ambient level at near calm conditions. We can then calculate the increase to ambient with this "worst case" scenario as summarized below.

| | A-WEIGHTED SOUND LEVEL, dBA | | |
|---|---|---|---|
| TURBINE MODEL | ON (NOTE 1) | OFF (NOTE 2) | INCREASE (ON-OFF) |
| MODEL A | 45 | 37 | 8 |
| MODEL B | 47 | 37 | 10 |
| MODEL C | 45 | 37 | 8 |
| MODEL D | 45 | 37 | 8 |
| MODEL E | 49 | 37 | 12 |

Note 1: Worst-case calculations for a 4-unit turbine array at full speed operation at 1000 feet from closest turbine
Note 2: Average 10-minute LA90 at 4 m/s wind speed (10 m height) from attended & continuous measurements

***Table 6.3.1:*** *Expected increase to ambient during worst case operating scenario.*

At times, the level increase should be significantly lower than that shown. The level increase will also be lower at locations where fewer turbines contribute to operating levels.

## 7.0 Noise Impact from Construction

There is minimal if any impact from construction noise for wind turbine projects. Because the buffer distances are large for operational impact considerations, on-site construction noise that reaches residential locations will be low. For example, the *maximum* noise from a 500 HP dozer would be 59 dBA at the closest non-participating residence. The background level in a luxury automobile at highway speed is over 60 dBA. We can only conclude that construction noise may at worse cause some sporadic and temporary noise annoyance.

## 8.0_Compliance Analyses

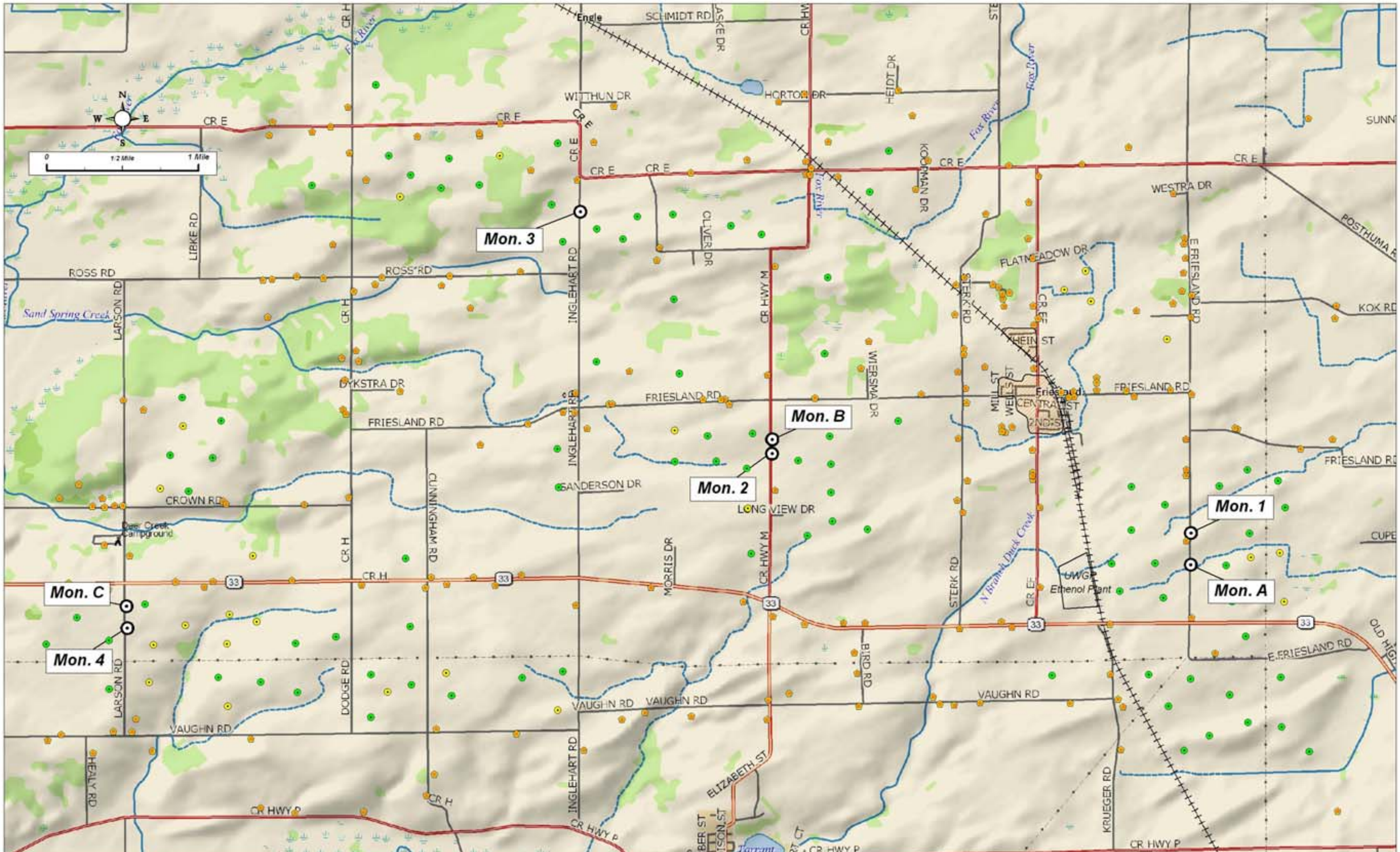
Calculations and computer modeling both show that the A-weighted sound level attributable to the turbines does not exceed 50 dBA at any non-participating residence, i.e. those located 1000 feet from a cluster of units. Computer modeling indicates there are a few participating residences that may slightly exceed 50 dBA at 200 feet from residence, but only if the loudest turbine is selected. The modeled level at these residences is 50.3 dBA, but the actual level is expected to be less due to the conservative assumptions used in the model.

Since the health effects sleep interference guideline and Township limit are both 50 dBA, we can conclude that both requirements are met for any residence.

The calculated C-weighted sound level ranges from 58 to 62 dBC depending on model at the closest potential non-participating residence. The recommended range to avoid low frequency annoyance is 60 to 65 dBC so no LFN issue should occur for the project.

Annoyance analysis in the metric of ambient level increase indicates that the level-increase varies with certain wind conditions. Based on a worst case analysis, the estimated level increases are calculated for each turbine model. Whether annoyance occurs is another matter and cannot be predicted on an individual basis.

End of Text




| Project: Randolph Wind Farm | Description: | Legend: |
| --- | --- | --- |
| Prepared for: We Energies | **Figure 1.0.1** | Turbine Location |
| Date: September 26, 2008 / Drawing #: WER-Rev-B-2-1 | **Ambient Noise Measurement Locarions** | Non-Participating House; Sound Monitoring Location |

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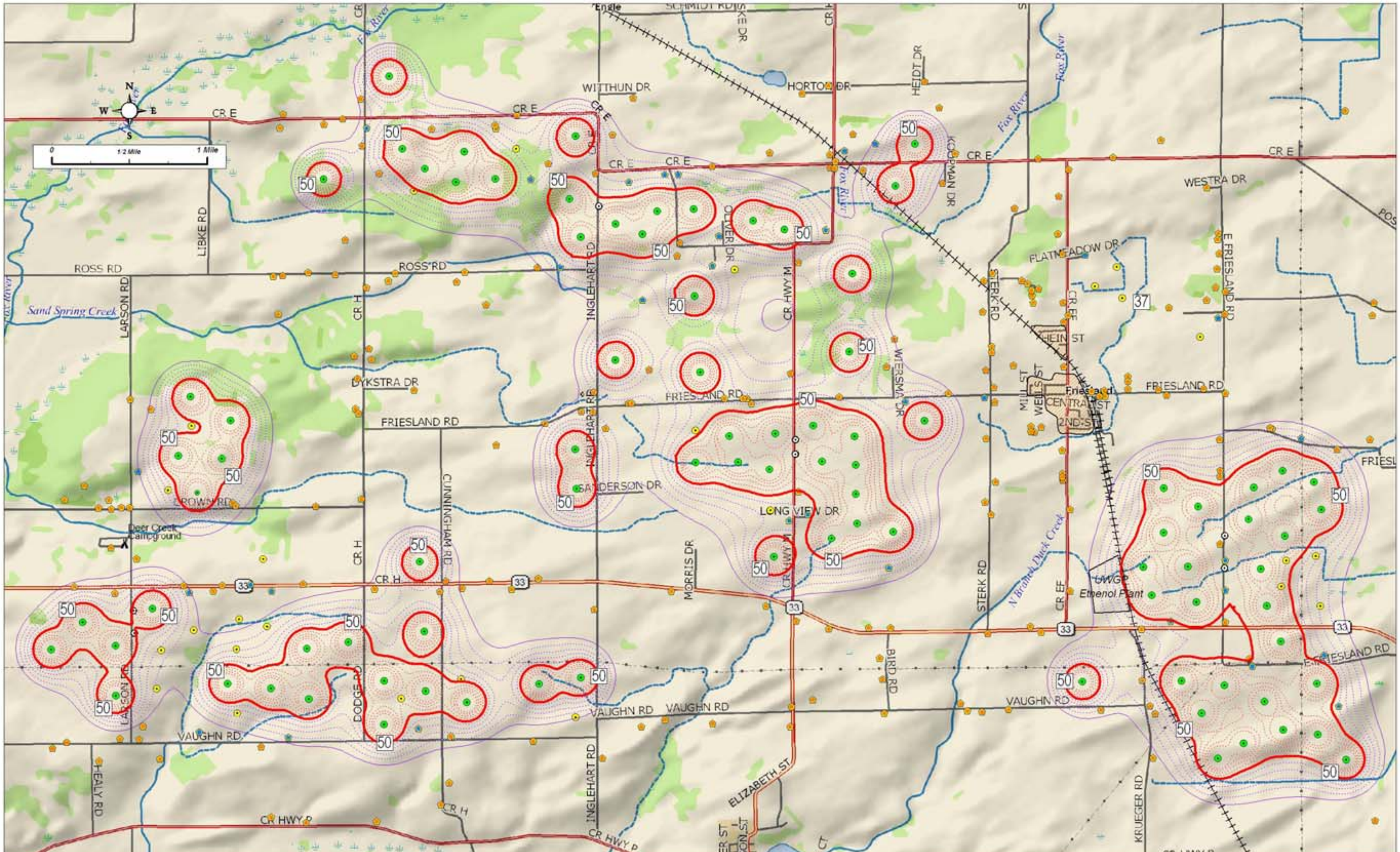


| Project: | Description: | Legend: |
|---|---|---|
| **Glacier Hills Wind Park** | **Plot 1** | Turbine Location; 50 dBA Contour |
| Prepared for: **We Energies** | **Predicted Sound Contours (dBA) of Hypothetical Worst CaseTurbines with an Omnidirectional Wind** | Non-Participating House; 45 dBA Contour |
| Date: October 1, 2008 / Drawing #: WER-Rev-D-1-1 | | Participating House; Alternative Turbine Location |

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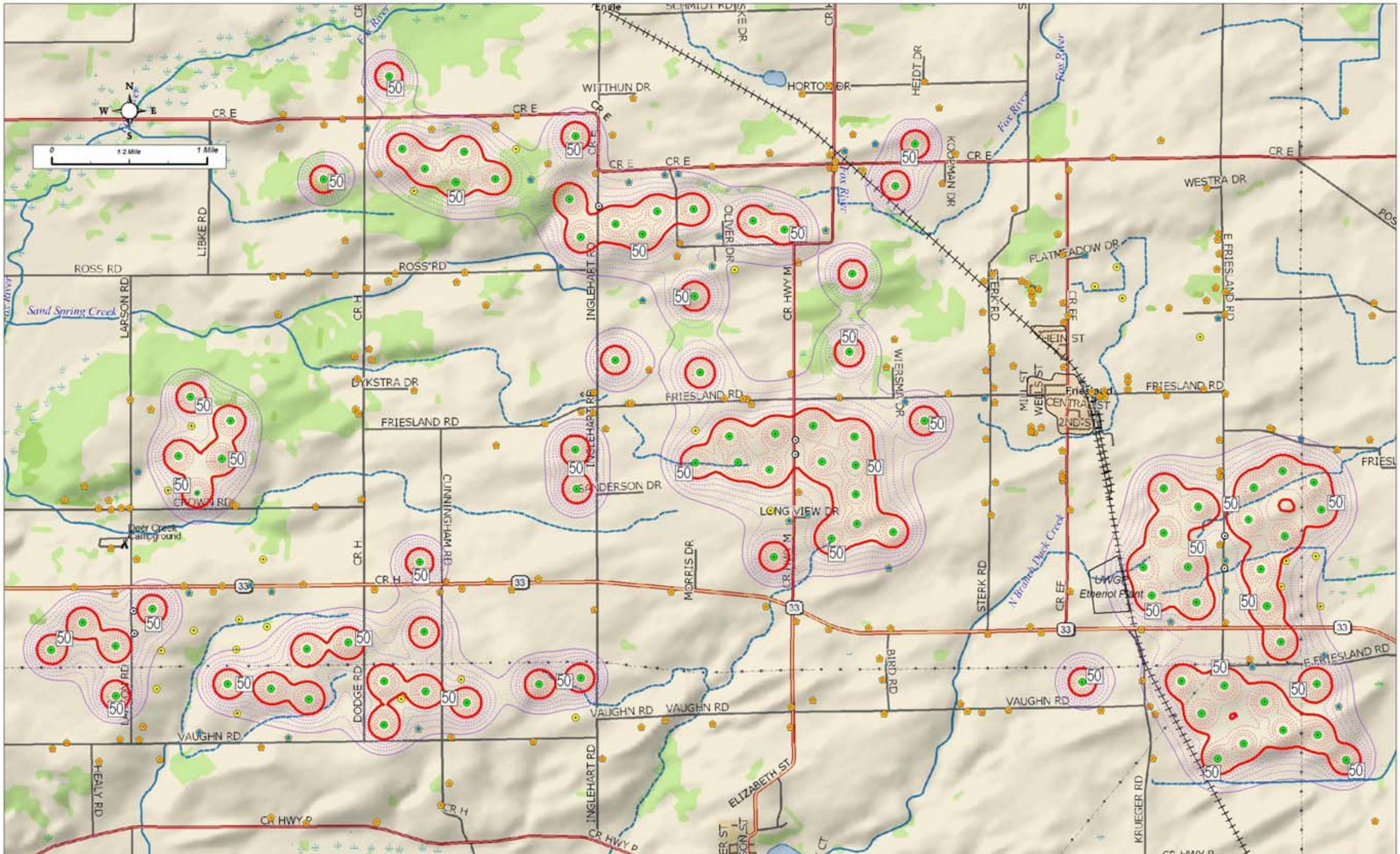


| Project: | | Description: |
|---|---|---|
| **Glacier Hills Wind Park** | | **Plot 2** |
| Prepared for: | | **Predicted Sound Contours (dBA) of Hypothetical Worst CaseTurbines (Not Including E Turbines) with an Omnidirectional Wind** |
| **We Energies** | | |
| Date: | Drawing #: | |
| October 1, 2008 | WER-Rev-D-2-1 | |

Legend:

- Turbine Location
- Non-Participating House
- Participating House
- 50 dBA Contour
- 45 dBA Contour
- Alternative Turbine Location

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6AM to 8AM

**Site 1 - E. Freisland Rd**

6/26/2008 Very light wind

| Time | Event |
|---|---|
| 6:07:57 | Background - Can hear plant clearly |
| 6:08:05 | Car passed |
| 6:08:25 | Car passed |
| 6:09:20 | Background - Can hear plant clearly |
| 6:09:42 | Car passed |
| 6:10:31 | Background - Can hear plant clearly |
| 6:10:52 | Car passed |
| 6:11:29 | 2nd car passed |
| 6:12:03 | Background - Can hear plant clearly |
| 6:14:58 | Car passed |
| 6:15:47 | Background - Can hear plant clearly |
| 6:17:57 | Stop |

**Site 1 - E. Freisland Rd**

6/27/2008 Very light wind

| Time | Event |
|---|---|
| 6:07:00 | Background - Can hear plant and birds |
| 6:07:46 | Motorcycle |
| 6:08:31 | Background - Can hear plant and birds |
| 6:10:49 | Truck passed |
| 6:11:18 | Loud truck on Highway 35 |
| 6:11:35 | Background - Can hear plant and birds |
| 6:11:52 | Car passed |
| 6:12:20 | Background - Can hear plant and birds |
| 6:16:41 | Car passed |
| 6:17:00 | Stop |

**Site 2 - County Highway M**

6/26/2008 Little to no wind

| Time | Event |
|---|---|
| 6:31:00 | Background - Tractor working in field across street |
| 6:31:48 | Tractor closer to road |
| 6:33:15 | Tractor farther & high altitude plane |
| 6:36:01 | Tractor only |
| 6:36:28 | Car passed |
| 6:37:02 | Background - Tractor working in field across street |
| 6:38:12 | Car passed |
| 6:38:46 | Background - Tractor working in field across street |
| 6:41:00 | Stop |

**Site 2 - County Highway M**

6/27/2008 Little to no wind

| Time | Event |
|---|---|
| 6:27:01 | Background - Birds & Faint Ethanol plant |
| 6:29:23 | Loud Truck on 33 |
| 6:29:30 | Background - Birds & Faint Ethanol plant |
| 6:32:21 | Truck passed |
| 6:33:05 | Truck Braking on 33 |
| 6:33:25 | Background - Birds & Faint Ethanol plant |
| 6:34:26 | Background - Birds & Ethanol plant becomes louder |
| 6:35:30 | Truck passed |
| 6:36:20 | Background - Birds & Ethanol plant |
| 6:37:01 | Stop |

6AM to 8AM

**Site 3 - Inglehart Rd**

6/26/2008 Little to no wind

| Time | Event |
|---|---|
| 6:49:15 | Background - Birds |
| 6:52:34 | Wind in trees |
| 6:53:44 | Plane - High Altitude |
| 6:55:17 | Wind in trees |
| 6:56:02 | Distant Farm Equipment |
| 6:59:13 | Distant Truck |
| 6:59:15 | Stop |

**Site 3 - Inglehart Rd**

6/27/2008 Little to no wind

| Time | Event |
|---|---|
| 7:10:31 | Background - Birds |
| 7:11:37 | Farm Equipment passed |
| 7:12:56 | Car passed |
| 7:13:34 | Plane - High Altitude |
| 7:16:32 | Background - Birds |
| 7:17:35 | Plane - High Altitude |
| 7:19:05 | Background - Birds |
| 7:19:21 | Wind in Trees |
| 7:20:31 | Stop |

**Site 4 - Larson Rd**

6/26/2008 Little to no wind

| Time | Event |
|---|---|
| 7:19:59 | Background - Distant traffic |
| 7:20:26 | Truck passed |
| 7:21:02 | Background - Distant traffic |
| 7:22:50 | Truck on 33 |
| 7:23:16 | Background - Distant traffic & Cricket |
| 7:23:31 | Background - Distant traffic only |
| 7:24:00 | Plane - High Altitude |
| 7:25:14 | Wind picks up - small gusts |
| 7:25:39 | Background - Distant traffic |
| 7:26:34 | Truck on 33 |
| 7:27:17 | Background - Distant traffic |
| 7:27:43 | Car on 33 |
| 7:27:57 | Background - Distant traffic |
| 7:30:00 | Stop |

**Site 4 - Larson Rd**

6/27/2008 Little to no wind

| Time | Event |
|---|---|
| 7:35:16 | Background - Distant traffic & Birds |
| 7:36:12 | Plane - High Altitude |
| 7:37:16 | Background - Distant traffic & Birds |
| 7:38:50 | Plane - High Altitude |
| 7:39:32 | Background - Distant traffic & Birds |
| 7:39:54 | Car passed |
| 7:40:47 | Background - Distant traffic & Birds |
| 7:45:16 | Stop |

12PM to 2PM

**Site 1 - E. Freisland Rd**

6/26/2008 Breezy

| Time | Event |
|---|---|
| 12:09:20 | Background - Plant noise is faint |
| 12:10:27 | Horn at plant |
| 12:10:30 | Background - Plant noise and wind through grass |
| 12:12:13 | Car passed |
| 12:12:32 | Background - Plant noise and wind through grass |
| 12:14:01 | Truck passed |
| 12:14:15 | Background |
| 12:15:15 | Louder truck on Highway 35 |
| 12:16:37 | Wind gusts |
| 12:16:49 | Plane - high altitude prop plane |
| 12:19:20 | Stop |

**Site 1 - E. Freisland Rd**

7/3/2008 Breezy

| Time | Event |
|---|---|
| 13:00:06 | Background - Can barely hear ethanol plant & wind in grass |
| 13:03:38 | Car passed |
| 13:04:15 | Background - Can barely hear ethanol plant & birds |
| 13:04:41 | Car passed |
| 13:05:22 | Truck passed |
| 13:05:57 | Background - Faint ethanol plant & birds |
| 13:06:20 | Truck passed |
| 13:07:01 | Car passed |
| 13:07:08 | 2nd Car passed |
| 13:07:49 | Truck passed |
| 13:08:37 | Background - Faint ethanol plant & wind in grass |
| 13:09:20 | Car passed |
| 13:09:45 | Background - Faint ethanol plant |
| 13:10:06 | Stop |

**Site 2 - County Highway M**

6/26/2008 Breezy

| Time | Event |
|---|---|
| 12:29:30 | Background - Tractor in field across street |
| 12:31:42 | Tractor leaves- Background - wind in grass |
| 12:35:00 | Car passed |
| 12:35:19 | Background - Wind in grass |
| 12:36:58 | Motorcycle passed |
| 12:37:27 | Background - Wind in grass |
| 12:38:08 | Wind picks up |
| 12:39:30 | Stop |

**Site 2 - County Highway M**

7/3/2008 Breezy

| Time | Event |
|---|---|
| 13:47:30 | Background - Birds, Distant Farm Equip & Wind in Grass |
| 13:48:45 | Truck passed |
| 13:49:13 | Background - Birds, Distant Farm Equip & Wind in Grass |
| 13:55:53 | Truck passed |
| 13:56:11 | Background - Birds, Distant Farm Equip & Wind in Grass |
| 13:57:30 | Stop |

12PM to 2PM

**Site 3 - Inglehart Rd**

6/26/2008 Little to no wind

| Time | Event |
|---|---|
| 12:48:30 | Background - Wind in trees/grass & Birds |
| 12:51:46 | Wind picks up |
| 12:52:26 | Plane - High altitude |
| 12:54:00 | Background - Wind in trees/grass & Birds |
| 12:54:46 | Plane - High altitude |
| 12:56:16 | Background - Wind in trees/grass & Birds |
| 12:58:30 | Stop |

**Site 3 - Inglehart Rd**

7/3/2008 Little to no wind

| Time | Event |
|---|---|
| 13:24:10 | Background - Birds & Wind in grass |
| 13:24:21 | Car passed |
| 13:24:55 | Background - Birds & Wind in grass |
| 13:25:00 | Plane - High altitude |
| 13:26:22 | Background - Birds & Wind in grass |
| 13:28:51 | Truck passed |
| 13:30:01 | Background - Birds & Wind in grass |
| 13:30:22 | Car passed |
| 13:30:51 | Background - Birds & Wind in grass |
| 13:31:34 | Truck in distance |
| 13:31:54 | Background - Birds & Wind in grass |
| 13:34:10 | Stop |

**Site 4 - Larson Rd**

6/26/2008 Little to no wind

| Time | Event |
|---|---|
| 13:15:00 | Car passed |
| 13:15:18 | Background - Wind in grass & Distant traffic |
| 13:16:40 | Plane - High Altitude |
| 13:17:09 | Truck on 33 |
| 13:17:58 | Truck on 33 |
| 13:18:39 | Distant traffic |
| 13:20:34 | Wind dies down - no distant traffic |
| 13:20:47 | Truck on 33 |
| 13:21:10 | Plane - High Altitude |
| 13:22:39 | Wind in Grass |
| 13:23:33 | Truck on 33 |
| 13:24:33 | Wind in Grass |
| 13:25:00 | Stop |

**Site 4 - Larson Rd**

7/3/2008 Little to no wind

| Time | Event |
|---|---|
| 14:17:30 | Background - Distant Traffic and loud bird |
| 14:20:14 | Truck passed |
| 14:20:37 | Background - Distant Traffic and loud bird |
| 14:23:11 | Truck passed |
| 14:23:28 | Background - Distant Traffic and loud bird |
| 14:27:30 | Stop |

6pm to 8PM

**Site 1 - E. Freisland Rd**

6/25/2008 Calm wind

| Time | Event |
|---|---|
| 18:41:45 | Start - Can hear ethanol plant |
| 18:45:58 | Car |
| 18:46:10 | Background - can hear plant |
| 18:51:45 | Stop |

**Site 1 - E. Freisland Rd**

6/26/2008 Light wind

| Time | Event |
|---|---|
| 18:14:30 | Plane at high altitude and Truck going passed |
| 18:16:00 | Background - can hear ethanol plant |
| 18:16:17 | Car passed |
| 18:17:01 | Background - can hear ethanol plant |
| 18:17:21 | Car passed |
| 18:18:36 | Ethanol plant becomes louder |
| 18:19:23 | Car passed |
| 18:19:57 | Background - can hear ethanol plant |
| 18:22:17 | Car passed |
| 18:22:39 | Background - can hear ethanol plant |
| 18:23:14 | Car passed |
| 18:23:30 | 2nd Car passed |
| 18:24:31 | Stop |

**Site 2 - County Highway M**

6/25/2008 Windy

| Time | Event |
|---|---|
| 19:02:00 | Background - Birds |
| 19:03:38 | Distant Motorcycle - on 33 |
| 19:04:41 | 2nd Distant Motorcycle |
| 19:05:40 | Background - Birds |
| 19:06:38 | Distant Car |
| 19:07:08 | Car passed |
| 19:08:31 | Distant traffic |
| 19:09:40 | Car passed |
| 19:10:15 | Background - Birds |
| 19:11:24 | Prop plane - high altitude |
| 19:12:00 | Stop |

**Site 2 - County Highway M**

6/26/2008 Breezy

| Time | Event |
|---|---|
| 18:34:16 | Background - Birds |
| 18:34:40 | Motorcycle passed |
| 18:35:18 | Truck passed |
| 18:36:09 | Background - Birds |
| 18:36:45 | Car passed |
| 18:37:16 | 2 Trucks passed |
| 18:38:06 | 3rd Truck passed |
| 18:38:49 | Background - Birds |
| 18:40:42 | High Altitude plane |
| 18:41:20 | Car passed |
| 18:42:04 | Background - Birds |
| 18:43:11 | Car passed |
| 18:44:01 | Distant tractor |
| 18:44:16 | Stop |

6pm to 8PM

**Site 3 - Inglehart Rd**

6/25/2008 Windy

| Time | Event |
|---|---|
| 19:38:15 | Background - Dogs Barking & Wind in trees |
| 19:39:04 | Distant truck |
| 19:39:15 | Background - Birds & Wind in trees |
| 19:45:30 | Car passed |
| 19:46:06 | Background - Dogs Barking, Birds & Wind in trees |
| 19:48:15 | Stop |

**Site 3 - Inglehart Rd**

6/26/2008 Breezy

| Time | Event |
|---|---|
| 18:54:46 | Background - Wind in Trees & Birds |
| 18:58:50 | Truck in distance |
| 18:59:21 | Truck passed |
| 19:00:05 | Background - Wind in Trees & Birds |
| 19:04:01 | Car in distance |
| 19:04:19 | Background - Wind in Trees & Birds |
| 19:04:46 | Stop |

**Site 4 - Larson Rd**

6/25/2008 Little to no wind

| Time | Event |
|---|---|
| 20:08:45 | Background - Distant Traffic & Birds |
| 20:14:38 | Car passed |
| 20:15:40 | Background - Distant Traffic & Birds |
| 20:18:39 | Car passed |
| 20:18:45 | Stop |

**Site 4 - Larson Rd**

6/26/2008 No wind

| Time | Event |
|---|---|
| 19:18:16 | Background - Distant traffic & Birds |
| 19:19:56 | No traffic - no wind |
| 19:20:31 | Distant traffic |
| 19:21:07 | Plane - High Altitude |
| 19:22:31 | Distant traffic |
| 19:28:16 | Stop |

10PM to 12AM

**Site 1 - E. Freisland Rd**

6/25/2008 Little to no wind

| Time | Event |
|---|---|
| 23:13:45 | Background - Can hear ethanol plant clearly |
| 23:14:00 | Car |
| 23:14:15 | Background - Can hear ethanol plant clearly |
| 23:18:04 | Ethanol plant gets louder |
| 23:22:01 | Sound from plant changes |
| 23:22:28 | Train horn |
| 23:22:35 | Train horn |
| 23:22:40 | Train horn |
| 23:22:49 | Train horn |
| 23:23:00 | Ethanol plant noise |
| 23:23:44 | Distant traffic |
| 23:23:45 | Stop |

**Site 1 - E. Freisland Rd**

6/26/2008 No wind

| Time | Event |
|---|---|
| 23:02:16 | Background - Ethanol plant and bugs |
| 23:10:06 | Plane - High Altitude |
| 23:12:06 | Background - Ethanol plant and bugs |
| 23:12:16 | Stop |

**Site 2 - County Highway M**

6/25/2008 Little to no wind

| Time | Event |
|---|---|
| 22:53:00 | Background - Bugs |
| 23:03:00 | Stop |

**Site 2 - County Highway M**

6/26/2008 No wind

| Time | Event |
|---|---|
| 22:42:01 | Background - Bugs |
| 22:46:05 | High Altitude Plane |
| 22:48:04 | Background - Bugs |
| 22:52:01 | Stop |

10PM to 12AM

**Site 3 - Inglehart Rd**

6/25/2008 Windy

| Time | Event |
|---|---|
| 22:32:03 | Background - Bugs |
| 22:33:50 | Plane - High Altitude |
| 22:34:50 | Background - Bugs |
| 22:38:15 | Car door slam |
| 22:38:19 | Background - Bugs |
| 22:42:03 | Stop |

**Site 3 - Inglehart Rd**

6/26/2008 No wind

| Time | Event |
|---|---|
| 21:50:59 | Background - Bugs and Birds |
| 21:59:58 | Plane - High Altitude |
| 22:00:59 | Stop |

**Site 4 - Larson Rd**

6/25/2008 Little to no wind

| Time | Event |
|---|---|
| 22:07:00 | Car passed |
| 22:07:27 | Background - Distant Traffic & Bugs |
| 22:08:49 | Distant Loud Car |
| 22:09:05 | Background - Distant Traffic & Bugs |
| 22:09:53 | Very distant plane |
| 22:10:50 | Distant Loud Car |
| 22:11:04 | Background - Distant Traffic & Bugs |
| 22:11:35 | Wind in Grass |
| 22:11:42 | Background - Distant Traffic & Bugs |
| 22:14:32 | Plane - High Altitude Plane |
| 22:15:49 | Distant Loud Truck |
| 22:16:44 | 2nd Distant Truck |
| 22:17:00 | Stop |

**Site 4 - Larson Rd**

6/26/2008 No wind

| Time | Event |
|---|---|
| 22:18:31 | Background - Distant traffic and bugs |
| 22:28:31 | Stop |

# Public Service Commission of Wisconsin

Eric Callisto, Chairperson
Mark Meyer, Commissioner
Lauren Azar, Commissioner

610 North Whitney Way
P.O. Box 7854
Madison, WI 53707-7854



July 8, 2009

**VIA ELECTRONIC MAIL**

Mr. Roman Draba, Vice President Regulatory Affairs and Policy
Wisconsin Electric Power Company
231 West Michigan Street
Milwaukee, WI 53203

Re: Application of Wisconsin Electric Power Company for a Certificate of Public Convenience and Necessity to Construct a Wind Electric Generation Facility and Associated Electric Facilities, to be Located in the Towns of Randolph and Scott, Columbia County, Wisconsin — 6630-CE-302

Dear Mr. Draba:

Public Service Commission (Commission) staff has the following data request regarding Wisconsin Electric Power Company's October 30, 2008, application in the docket listed above:

21.01 *(Application TSD, Appendix R)* It appears that the test engineer's field notes for the only 6:00 a.m. to 8:00 a.m. measurement period are included with this report. Provide the engineer's filed notes for the remaining measurement periods. If appropriate, file a complete, revised report as your response to this request, rather than just the additional pages.

Please post your response to this request to the Commission's Electronic Regulatory Filing system. If you have any questions regarding this request, please contact me at (608) 266-0478.

Sincerely,

Jim Lepinski, P.E.
Docket Coordinator
Gas and Energy Division

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