Appendix B: Simulations and Studies

Attachment B-1

Visual Simulation

PHOTO SIMULATION NOTES:

THESE PHOTO SIMULATIONS ARE AN INTERPRETATION OF THE GENERAL APPEARANCE OF THE PROPOSED INSTALLATION. EACH PHOTO SIMULATION IS BASED ON THE SCALING CRITERIA OR ASSUMPTIONS IDENTIFIED:

- THE FINAL TURBINE DESIGN WAS NOT AVAILABLE AT THE TIME THE PHOTO SIMULATION WAS PREPARED. THEREFORE, TYPICAL TURBINES OF SIMILAR SIZE WERTE UTILIZED FOR SIMULATION PURPOSES

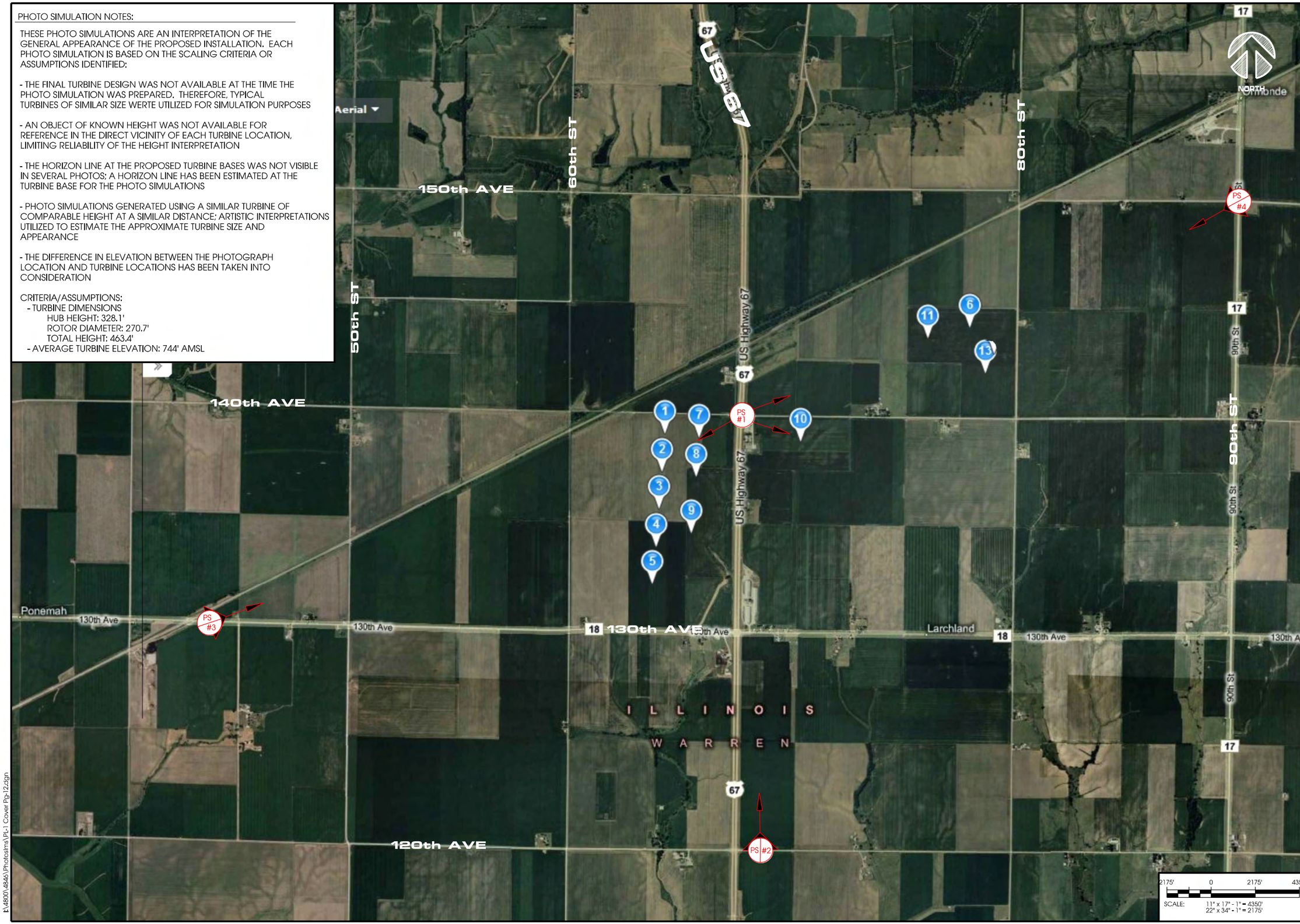
- AN OBJECT OF KNOWN HEIGHT WAS NOT AVAILABLE FOR REFERENCE IN THE DIRECT VICINITY OF EACH TURBINE LOCATION, LIMITING RELIABILITY OF THE HEIGHT INTERPRETATION

- THE HORIZON LINE AT THE PROPOSED TURBINE BASES WAS NOT VISIBLE IN SEVERAL PHOTOS; A HORIZON LINE HAS BEEN ESTIMATED AT THE TURBINE BASE FOR THE PHOTO SIMULATIONS

- PHOTO SIMULATIONS GENERATED USING A SIMILAR TURBINE OF COMPARABLE HEIGHT AT A SIMILAR DISTANCE; ARTISTIC INTERPRETATIONS UTILIZED TO ESTIMATE THE APPROXIMATE TURBINE SIZE AND APPEARANCE

- THE DIFFERENCE IN ELEVATION BETWEEN THE PHOTOGRAPH LOCATION AND TURBINE LOCATIONS HAS BEEN TAKEN INTO CONSIDERATION

CRITERIA/ASSUMPTIONS:
- TURBINE DIMENSIONS
  - HUB HEIGHT: 328.1'
  - ROTOR DIAMETER: 270.7'
  - TOTAL HEIGHT: 463.4'
- AVERAGE TURBINE ELEVATION: 744' AMSL



2175' 0 2175' 4350'

SCALE: 11" x 17" - 1" = 4350'
22" x 34" - 1" = 2175'

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SHEET TITLE:

PHOTO SIM. LOCATIONS
MONARCH WARREN CO. WIND FARM
KIRKWOOD, ILLINOIS

ISSUE DATE:
PHOTO SIMULATION - SEPT 2010

REVISIONS:

DRAWN BY: TLD
CHECKED BY: DLL
PLOT DATE: 10/13/2010
PROJECT NUMBER: 3376
FILE NAME: PL-1 Cover Pg-12.dgn

SHEET NUMBER:
PL-Z

I:\4800\4846\Photosims\PL-1 Cover Pg-12.dgn

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PHOTO SIMULATION DESCRIPTION:

FOLLOWING UTILIZED FOR PHOTO SIMULATION
- PHOTOGRAPH OF EXISTING TOWER AT SIMILAR DISTANCE USED TO SCALE PHOTOGRAPH
- PHOTOGRAPH OF EXISTING WIND TURBINE RENDERED TO REPRESENT A 100m TURBINE AT LISTED DISTANCES

TURBINE 9
PHOTO DISTANCE: 3159'

TURBINE 5
PHOTO DISTANCE: 4723'

TURBINE 4
PHOTO DISTANCE: 3878'

TURBINE 8
PHOTO DISTANCE: 1888'

TURBINE 3
PHOTO DISTANCE: 3098'

TURBINE 2
PHOTO DISTANCE: 2379'

TURBINE 7
PHOTO DISTANCE: 1166'

TURBINE 1
PHOTO DISTANCE: 1910'

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SHEET TITLE:

PHOTO SIMULATION 1

MONARCH WARREN CO. WIND FARM

KIRKWOOD, ILLINOIS

ISSUE DATE:
PHOTO SIMULATION - SEPT 2010

REVISIONS:
PHOTO SIMULATION - JUNE 2011

DRAWN BY: TLD
CHECKED BY: DLL
PLOT DATE: 6/24/2011
PROJECT NUMBER: 3376
FILE NAME: PS-1_2011-06-24.dgn

SHEET NUMBER:
PS-1a

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- PHOTOGRAPH OF EXISTING TOWER AT SIMILAR DISTANCE USED TO SCALE PHOTOGRAPH
- PHOTOGRAPH OF EXISTING WIND TURBINE RENDERED TO REPRESENT A 100m TURBINE AT LISTED DISTANCES

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SHEET TITLE:

PHOTO SIMULATION 1
MONARCH WARREN CO. WIND FARM
KIRKWOOD, ILLINOIS

ISSUE DATE:
PHOTO SIMULATION - SEPT 2010

REVISIONS:

DRAWN BY: TLD
CHECKED BY: DLL
PLOT DATE: 10/13/2010
PROJECT NUMBER: 3376
FILE NAME: PS-1 -12.dgn

SHEET NUMBER:
PS-1b

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PHOTO SIMULATION DESCRIPTION:

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- PHOTOGRAPH OF EXISTING TOWER AT SIMILAR DISTANCE USED TO SCALE PHOTOGRAPH
- PHOTOGRAPH OF EXISTING WIND TURBINE RENDERED TO REPRESENT A 100m TURBINE AT LISTED DISTANCE

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SHEET TITLE:

PHOTO SIMULATION 1
MONARCH WARREN CO. WIND FARM
KIRKWOOD, ILLINOIS

ISSUE DATE:
PHOTO SIMULATION - SEPT 2010

REVISIONS:

DRAWN BY: TLD
CHECKED BY: DLL
PLOT DATE: 9/16/2010
PROJECT NUMBER: 3376
FILE NAME: PS-1.dgn

SHEET NUMBER:
PS-1c

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PHOTO SIMULATION DESCRIPTION:

FOLLOWING UTILIZED FOR PHOTO SIMULATION
- PHOTOGRAPH OF EXISTING TOWER AT SIMILAR DISTANCE USED TO SCALE PHOTOGRAPH
- PHOTOGRAPH OF EXISTING WIND TURBINE RENDERED TO REPRESENT 100m TURBINES AT KNOWN DISTANCES

DISTSANCES

TURBINE 1: 10,476'
TURBINE 2: 9566'
TURBINE 3: 8669'
TURBINE 4: 7800'
TURBINE 5: 6918'
TURBINE 6: 14,179'
TURBINE 7: 10,253'
TURBINE 8: 9305'
TURBINE 9: 7962'
TURBINE 10: 10,255'
TURBINE 11: 13,568'
TURBINE 13: 13,328'

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SHEET TITLE:

PHOTO SIMULATION 2
MONARCH WARREN CO. WIND FARM
KIRKWOOD, ILLINOIS

ISSUE DATE:
PHOTO SIMULATION - SEPT 2010

REVISIONS:

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PLOT DATE: 10/13/2010
PROJECT NUMBER: 3376
FILE NAME: PS-2-12.dgn
SHEET NUMBER: PS-2

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PHOTO SIMULATION DESCRIPTION:

FOLLOWING UTILIZED FOR PHOTO SIMULATION
- PHOTOGRAPH OF EXISTING TOWER AT SIMILAR DISTANCE USED TO SCALE PHOTOGRAPH
- PHOTOGRAPH OF EXISTING WIND TURBINE RENDERED TO REPRESENT A 100m TURBINE AT LISTED DISTANCES

DISTSANCES

TURBINE 1: 11,988'
TURBINE 2: 11,595'
TURBINE 3: 11,228'
TURBINE 4: 10,963'
TURBINE 5: 10,775'

TURBINE 7: 12,730'
TURBINE 8: 12,354'
TURBINE 9: 11,901

TURBINE 10: 15,045'

TURBINE 6: 19,949'
TURBINE 11: 18,908'

TURBINE 13: 19,907'

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SHEET TITLE:

PHOTO SIMULATION 3
MONARCH WARREN CO. WIND FARM
KIRKWOOD, ILLINOIS

ISSUE DATE:
PHOTO SIMULATION - SEPT 2010

REVISIONS:

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CHECKED BY: DLL
PLOT DATE: 10/13/2010
PROJECT NUMBER: 3376
FILE NAME: PS-3 -12.dgn

SHEET NUMBER:
PS-3

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- PHOTOGRAPH OF EXISTING WIND TURBINE RENDERED TO REPRESENT A 100m TURBINE AT LISTED DISTANCES

DISTANCES

TURBINE 1: 15,334'
TURBINE 2: 15,768'
TURBINE 3: 16,279'
TURBINE 4: 16,791'
TURBINE 5: 17,342'

TURBINE 7: 14,600'
TURBINE 8: 15,072'
TURBINE 9: 15,850'

TURBINE 10: 12,412'

TURBINE 6: 7384'
TURBINE 11: 8417'

TURBINE 13: 7628'

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PHOTO SIMULATION 4

MONARCH WARREN CO. WIND FARM
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ISSUE DATE:
PHOTO SIMULATION - SEPT 2010

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PLOT DATE: 10/13/2010
PROJECT NUMBER: 3376
FILE NAME: PS-4 -12.dgn

SHEET NUMBER:
PS-4

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  - HUB HEIGHT: 328.1'
  - ROTOR DIAMETER: 270.7'
  - TOTAL HEIGHT: 463.4'
- AVERAGE TURBINE ELEVATION: 744' AMSL

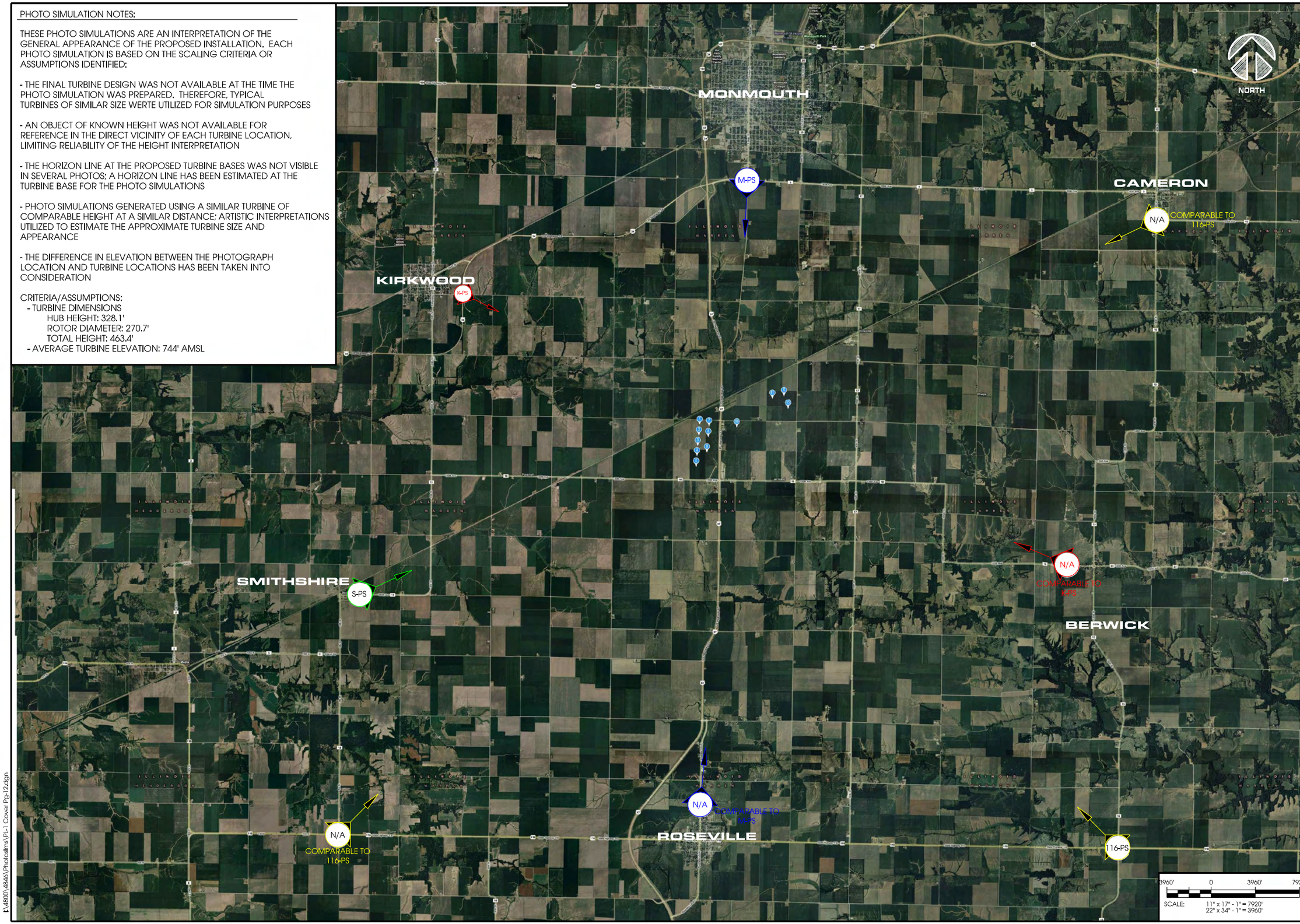

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PHOTO SIMULATION - SEPT 2010

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PLOT DATE: 10/14/2010
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- PHOTOGRAPH OF EXISTING TOWER AT SIMILAR DISTANCE USED TO SCALE PHOTOGRAPH
- PHOTOGRAPH OF EXISTING WIND TURBINE RENDERED TO REPRESENT A 100m TURBINE AT LISTED DISTANCES

DISTSANCES

TURBINE 1: 22,238'
TURBINE 2: 23,200'
TURBINE 3: 24,140'
TURBINE 4: 25,051'
TURBINE 5: 25,983'

TURBINE 7: 22,236'
TURBINE 8: 23,193
TURBINE 9: 24,565

TURBINE 10: 22,069'

TURBINE 6: 19,500'
TURBINE 11: 19,595'

TURBINE 13: 20,661'

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SHEET TITLE:

MONMOUTH PHOTOSIM

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KIRKWOOD, ILLINOIS

ISSUE DATE:
PHOTO SIMULATION - SEPT 2010

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PLOT DATE: 10/13/2010
PROJECT NUMBER: 3376
FILE NAME: PS-Monmouth -12.dgn
SHEET NUMBER: M-PS

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PHOTO SIMULATION DESCRIPTION:

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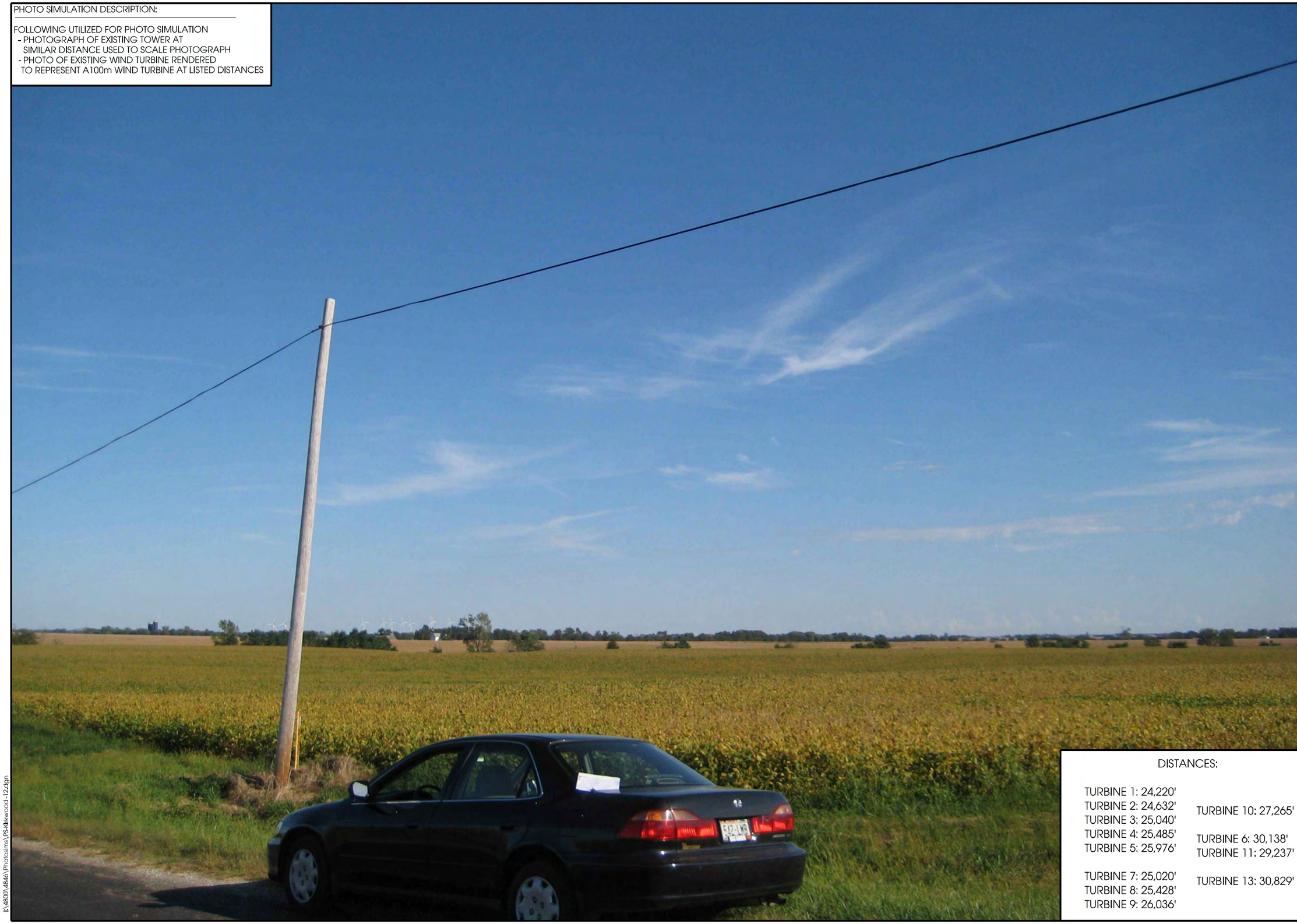
- PHOTO OF EXISTING WIND TURBINE RENDERED TO REPRESENT A100m WIND TURBINE AT LISTED DISTANCES



DISTANCES:

TURBINE 1: 24,220'
TURBINE 2: 24,632'
TURBINE 3: 25,040'
TURBINE 4: 25,485'
TURBINE 5: 25,976'

TURBINE 7: 25,020'
TURBINE 8: 25,428'
TURBINE 9: 26,036'

TURBINE 10; 27,265'

TURBINE 6: 30,138'
TURBINE 11: 29,237'

TURBINE 13: 30,829'

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SHEET TITLE:

KIRKWOOD PHOTOSIM

MONARCH WARREN CO. WIND FARM
KIRKWOOD, ILLINOIS

ISSUE DATE:
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K-PS

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PHOTO SIMULATION DESCRIPTION:

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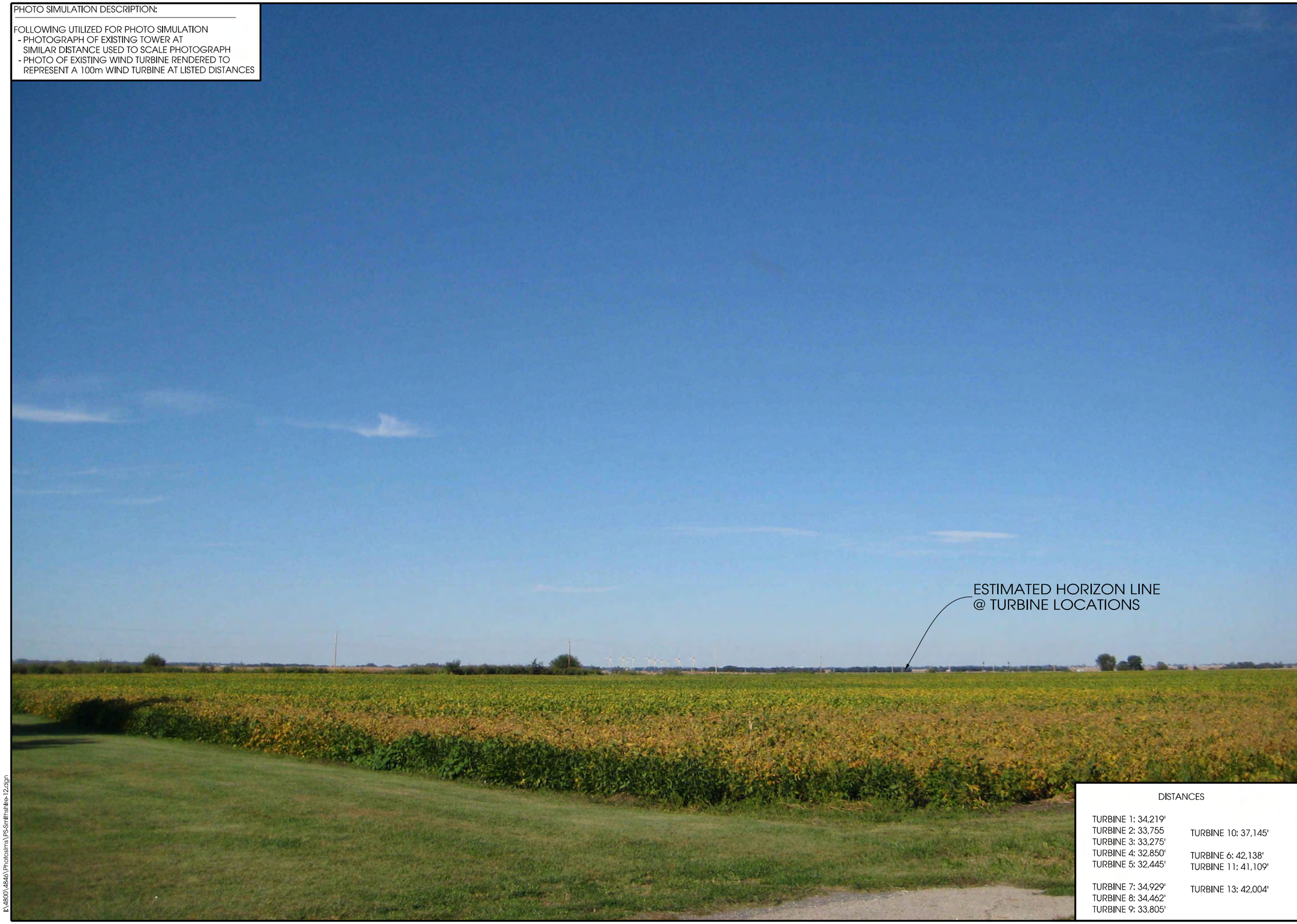
- PHOTO OF EXISTING WIND TURBINE RENDERED TO REPRESENT A 100m WIND TURBINE AT LISTED DISTANCES



DISTANCES

TURBINE 1: 34,219'
TURBINE 2: 33,755
TURBINE 3: 33,275'
TURBINE 4: 32,850'
TURBINE 5: 32,445'

TURBINE 7: 34,929'
TURBINE 8: 34,462'
TURBINE 9: 33,805'

TURBINE 10: 37,145'

TURBINE 6: 42,138'
TURBINE 11: 41,109'

TURBINE 13: 42,004'

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SHEET TITLE:

SMITHSHIRE PHOTOSIM

MONARCH WARREN CO. WIND FARM
KIRKWOOD, ILLINOIS

ISSUE DATE:
PHOTO SIMULATION - SEPT 2010

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FILE NAME: PS-Smithshire-12.dgn

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- PHOTO OF EXISTING WIND TURBINE RENDERED TO REPRESENT A 100m WIND TURBINE AT LISTED DISTANCES

DISTANCES

TURBINE 1: 53,180'
TURBINE 2: 52,562'
TURBINE 3: 51,980'
TURBINE 4: 51,406'
TURBINE 5: 50,820'

TURBINE 7: 52,505'
TURBINE 8: 51,8687'
TURBINE 9: 50,997'

TURBINE 10: 50,753'

TURBINE 6: 50,277'
TURBINE 11: 50,701'

TURBINE 13: 49,168'

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SHEET TITLE:
HWY 116/130TH ST PHOTOSIM
MONARCH WARREN CO. WIND FARM
KIRKWOOD, ILLINOIS

ISSUE DATE:
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REVISIONS:

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PLOT DATE: 11/3/2010
PROJECT NUMBER: 3376
FILE NAME: PS-HWY 116-12.dgn
SHEET NUMBER: 116-PS

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Attachment B-2

Shadow Flicker Report

Shadow Flicker Analysis – Monarch Wind Turbine Project

As part of our preparation for the zoning hearings for the Monarch Wind project in Monmouth, IL, we have developed a very simple method for estimating the shadow flicker effects at occupied houses near the site. This analysis is a "worst-case" scenario analysis and its focus is on explaining flicker in a simple way that homeowners can understand.

The goals of this method are:

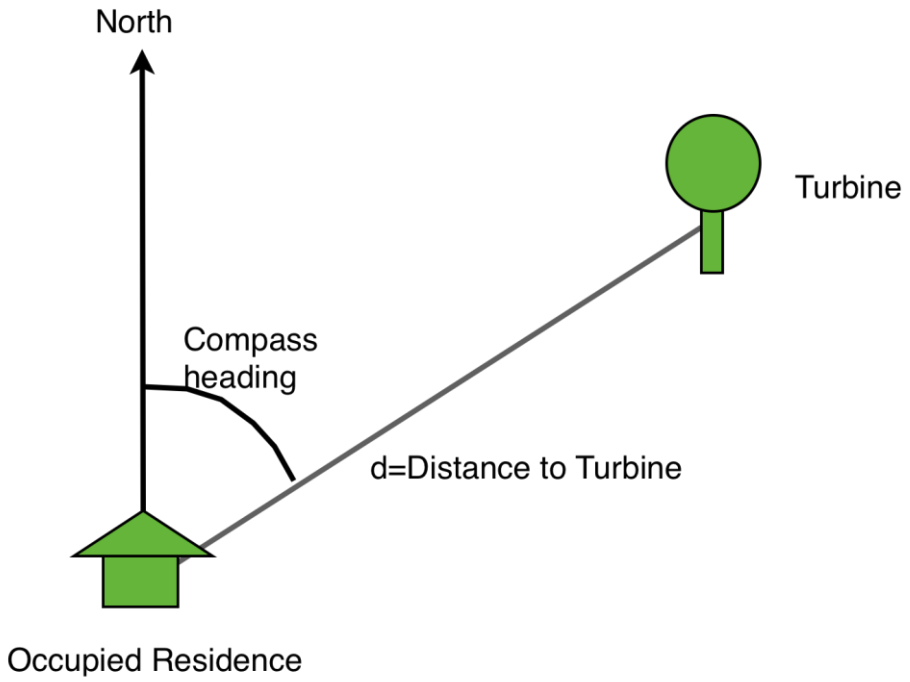
- Determine the maximum number of hours of shadow flicker that are possible for a given occupied residence due to nearby turbines
- Be able to present the results of this shadow flicker study in a clear and understandable ways to interested non-scientists (residents, zoning board members, and others).

We believe that the ability to present and explain our results to non-scientists is a very important part of this effort

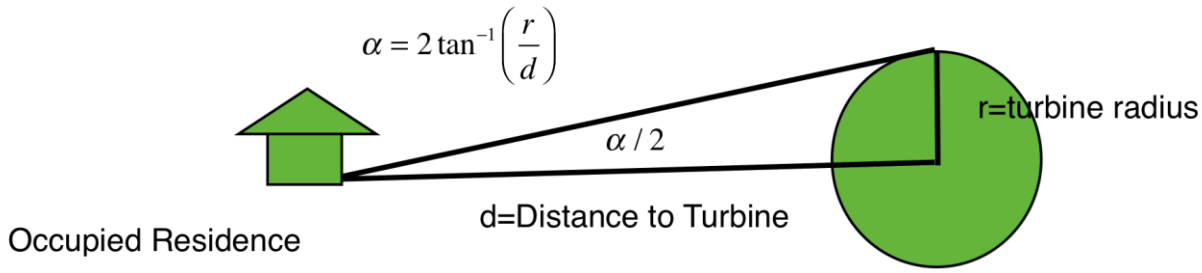
To achieve these goals, we have used the open source Astronomy/Planetarium program known as "Stellarium." Stellarium allows a user to view the sky from any location on the surface of the earth. A simple scripting language allows a user to place simple objects in the sky.

For our analysis, we

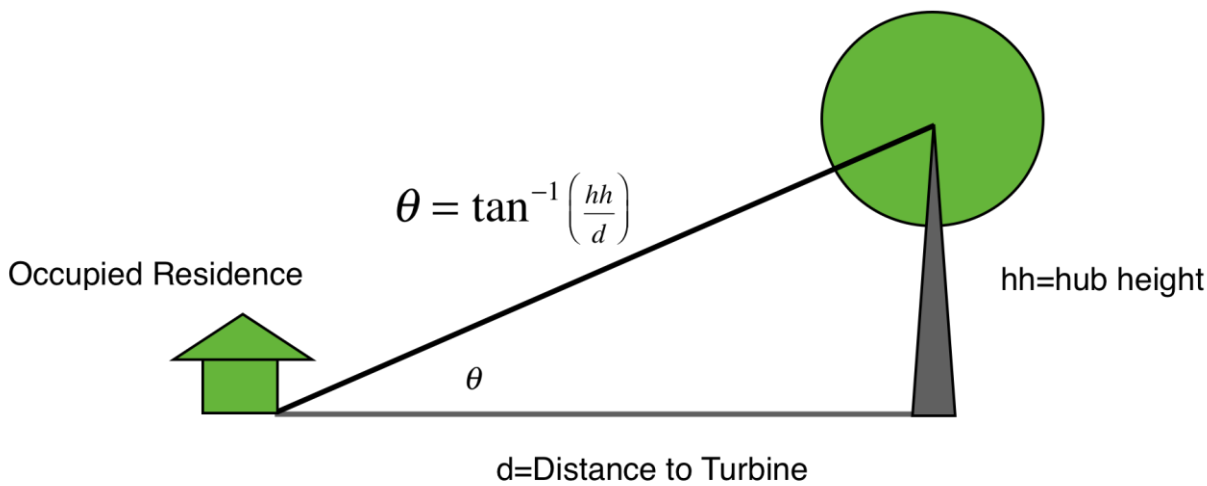
- Place the viewer at the location of the house being analyzed.
- From that location, we measure the location of each turbine to be considered (compass heading). This is shown below.



- Using the distance from the turbine to the house and the diameter of the turbine, we compute the angular size of a circle made by the blades (shown below).



- Using the height of the turbine hub, compute the angular position above the horizon of the center of the turbine hub.



- Using the Stellarium scripting language place a circle at the location (compass location and height) that correctly represents the disk of the turbine blades.
- With turbine disk in place, run Stellarium to see if, when, and for how long the sun passes behind the disk of the turbine.

Our assumptions make this a worst-case scenario. :

- We assume that there are no obstructions between the turbine and the house.
- We assume that every day is perfectly clear. More realistic computations would include the average cloud cover.
- A more realistic treatment would only produce flicker when a turbine blade covers 20% of the solar disk. We do not include the fraction of the solar disk that is covered and we assume that any part of the blade will cause flicker.

- We assume that the turbine disk is oriented to produce the maximum angular size. A more realistic calculation would incorporate a wind rose to properly weight the orientation of the turbine disk.

Detailed Analysis specific to the Monarch Site:

We describe the location of the houses considered, the turbines considered, and the results.

House 1 Lat 40°49′12.0116″ $Long$ – 90°40′16.5758″	Compass Heading in degrees	Distance to Turbine in feet	Hub Height: angle above horizon in degrees	Angular size of disk of blades in degrees	Predicted flicker in hours
Turbine 5	62°	1908 ft	$\theta = 9.76°$	$\alpha = 8.12°$	0
Total for House 1					0

Notes on House 1: House 1 is south and west of turbine 5. No flicker is predicted. Because of the position of the turbine, the sun only passes under the blade disk near the summer solstice.

House 2 Lat 40°49′7.7800″ $Long$ – 90°39′49.9734″	Compass Heading in degrees	Distance to Turbine in feet	Hub Height: angle above horizon in degrees	Angular size of disk of blades in degrees	Predicted flicker in hours
Turbine 5	330°	1544 ft	-	-	0
Total					0

Notes on House 2: House 2 is south and east of turbine 5. No flicker predicted. Turbine 5 is too far north of west to cast a shadow on house 2.

House 3 Lat 40°49′38.9246″ $Long$ −90°39′23.1075″	Compass Heading in degrees	Distance to Turbine in feet	Hub Height: angle above horizon in degrees	Angular size of disk of blades in degrees	Predicted flicker in hours
Turbine 1	310°	2776 ft	$\theta = 6.74°$	$\alpha = 5.58°$	0
Turbine 2	292°	2361 ft.	$\theta = 7.91°$	$\alpha = 6.56°$	10
Turbine 4	248°	2465 ft.	$\theta = 7.58°$	$\alpha = 6.29°$	Aligned with turbine 9
Turbine 5	232°	2984 ft	$\theta = 6.27°$	$\alpha = 5.19°$	5
Turbine 8	300°	1525 ft	$\theta = 12.14°$	$\alpha = 10.14°$	0
Turbine 9	248°	1520 ft	$\theta = 12.18°$	$\alpha = 10.18°$	7
Total for House 3					22

Notes on House 3: House 3 is located on Rte. 67. Since turbine 4 is aligned with turbine 9 and turbine 9 is closer, only turbine 9 has been included. All of the flicker hours for house 3 are near sunset.

Houses 4 and 5 Lat 40°50′2.5398″ $Long$ −90°38′42.8622″	Compass Heading in degrees	Distance to Turbine in feet	Hub Height: angle above horizon in degrees	Angular size of disk of blades in degrees	Predicted flicker in hours
Turbine 10	250°	2022 ft.	$\theta = 9.22°$	$\alpha = 7.66°$	0
Turbine 12	65°	3140 ft.	$\theta = 5.97°$	$\alpha = 4.94°$	10
Turbine 13	70°	2621 ft.	$\theta = 7.14°$	$\alpha = 5.91°$	5
Total for Houses 4 and 5					15

Notes on Houses 4 and 5: Since houses 4 and 5 are physically close, we have considered them together. Calculation of predicted flicker hours does not include the effect of the large tree(s) that are on the east side of the property. These trees will serve to reduce the visible flicker.

House 6 *Lat* 40°50′0.7953″ *Long* – 90°38′22.7792″	Compass Heading in degrees	Distance to Turbine in feet	Hub Height: angle above horizon in degrees	Angular size of disk of blades in degrees	Predicted flicker in hours
Turbine13	46°	1511ft	-	-	0
Total for House 6					0

Notes on Houses 6: Turbine 13 is too far north of east to cast a shadow on House 6

Conclusion:

We predict that the maximum flicker observed at any occupied residence will be 22 hours or less. The uncertainty in this prediction arises from the uncertainties in our ability to measure inputs for our analysis. Our ability to precisely and accurately determine the compass heading of each turbine as viewed from a residence is likely the most uncertain input. Nevertheless, we believe that the observed flicker will be less than or equal to our prediction given the overall conservative nature of our analysis.

Attachment B-3

Noise Report

WES Engineering Inc.

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Monarch Wind Noise Analysis

WES Engineering Inc.
Ph# 608-259-9304

Created October 2010

ACRONYMS

dB	decibel
dBA	decibel on an A-weighted scale, used to approximate the human ear's response to sound
DNL	Day Night Average Sound Level
DOE	U.S. Department of Energy
hz	Hertz
IPCB	Illinois Pollution Control Board
MWP	Monarch Wind Project
WTG	wind turbine generator

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SUMMARY OF RESULTS

Predicted Wind Turbine Generator (WTG) noise levels would be below Illinois Pollution Control Board (IPCB) noise standards at all residential (receptor) locations in the study area except for one (Receptor 19). At this location, predicted WTG noise levels are slightly higher than the nighttime standard at one specific frequency [1,000 hertz (Hz)]. However, 24-hour noise monitoring also conducted in the study area revealed that ambient noise levels already exceed IPCB standards at this and other receptor locations. In addition, WTG noise levels would increase overall ambient noise levels at this receptor location by less than 1 A-weighted decibel (dBA), which is an insignificant increase in noise level. Depending on a number of factors, including fluctuating ambient noise levels, WTG noise would be audible sometimes in the study area.

1. BACKGROUND

Sound is a result of fluctuating air pressure. The standard unit for measuring sound pressure levels is the decibel (dB). A decibel is a unit that describes the amplitude (or difference between levels) of sound, equal to 20 times the logarithm to the base 10 of the ratio of the measured pressure to the reference pressure, which is 20 micropascals. Typically, environmental and occupational sound pressure levels are measured in dBA. The A-weighted scale de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear. The Day Night Average Sound Level (DNL) is a standard environmental noise descriptor that is essentially a 24- hour average noise level with ten decibels added to the nighttime noise levels. This 10 dBA penalty accounts for increased sensitivity to noise at night.

Sound levels decrease significantly with distance from the source. For example, the sound pressure level at 25 feet from a wind turbine hub drops by a factor of 4 at 50 feet, and by a factor of 16 at 100 feet. In the logarithmic scale of decibels, this equates to a drop of approximately 6 dBA for each doubling of the distance from a point sound source. At a distance of approximately 1,150 feet, the sound pressure level from a wind turbine is around 45 dBA, while the sound pressure level at the nacelle is 104 dBA.

Modern wind turbines have been designed to significantly reduce the noise of mechanical components, so the most audible noise is the sound of the wind interacting with the rotor blades, often resulting in what can be described as a “whooshing” sound (BLM 2005). Noise generated by a wind turbine usually stems from two mechanisms: mechanical or aerodynamic. The aerodynamic noise, generated by the interaction of air flow across rotating turbine blades, is typically the dominant source. The aerodynamic noise has a frequency range approximately between 500 to 1,000 Hz.

In addition, maximum WTG noise levels occur when wind speeds are above 18 miles per hour. Thus, high wind speeds generally increase ambient noise levels, which tends to mask WTG noise. Modern wind turbines are anticipated to be less noticeable when compared to sound from road traffic, agricultural machines and industrial buildings in the area.

Table 1 shows the sound pressure levels from a variety of sources in the environment.

Table 1. Typical Sound Pressure Levels in the Environment

TYPICAL SOUND PRESSURE LEVELS MEASURED IN THE ENVIRONMENT AND INDUSTRY

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

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

1.1 Absolute and Relative Noise Impacts

The degree of intrusiveness of a new environmental noise source is measured in terms of "absolute" and "relative" noise impact. An absolute impact refers to a new noise source exceeding a certain local, State, or Federal noise standard stated in terms of an absolute numeric limit (in decibels). A relative impact refers to the degree to which the new noise source exceeds existing ambient noise levels.

2. EXISTING NOISE REGULATIONS

2.1 Environmental Protection Agency

The U.S. Environmental Protection Agency has an existing design goal of a DNL less than or equal to 65 dBA and a future design goal DNL of 55 dBA for exterior sound levels (EPA 1977). It is important to note that the Federal noise guidelines are design goals and not enforceable regulations. However, these guidelines and design goals are useful tools for assessing the sound environment.

2.2 Illinois Pollution Control Board

The IPCB has developed a comprehensive approach to the measurement and assessment of commercial and industrial noise, and thus is relevant to the development and operation of wind energy projects.

Section 901.101 Classification of Land According to Use
Illinois defines land as one of three types: Class A is residential; Class B is mixed use and Class C is industrial. The below rules apply to noise regulation from Class C land, which includes alternative energy sources (the wind project), to Class A land (residential).

> "Except as elsewhere provided in this Part, no person shall cause or allow the emission of sound during daytime hours from any property-line-noise-source located on any Class A, B or C land to any receiving Class A land which exceeds any allowable octave band sound pressure level specified in the following tables [Tables 2 and 3], when measured at any point within such receiving Class A land, provided, however, that no measurement of sound pressure levels shall be made less than 25 feet from such property-line-noise-source."

For the nearby residential areas, noise monitoring was done near the property line of the houses on small lots and near the residence on larger parcels of land. These ambient noise measurements were made to assess the potential audibility of WTG noise in residential areas near proposed WTG locations. In addition, it is important to determine whether or not ambient noise levels already exceed IPCB noise level limits.

For this assessment, the first column is used from the nighttime limits, as the wind turbine is assumed to be Class C land, and the night limits are lower than the day limits. The IL PCB 35 IAC 901 regulations contain tables of land class, and an "alternative energy source" function code 4314 is a land class C[1].

There are also limits to any "tonal" conditions, which are defined as sound spectra in which any one-third linear octave band sound pressure level exceeds the arithmetic average of the two adjacent one-third octave bands by the following amounts:

- 5 dB for such one-third octave band with a center frequency from 500 to 10,000 Hz, inclusive
- 8 dB for such one-third octave band with a center frequency from 160 to 400 Hz, inclusive
- 15 dB for such one-third octave band with a center frequency from 25 to 125 Hz, inclusive

The wind turbine does not have any tonal conditions per this definition, as can be seen in Table 4, in terms of sound power levels.

Table 2. IPCB Allowable Daytime Octave Band Sound Pressure Level Limits

Octave Band Center Frequency (hertz)	Allowable Octave Band Sound Pressure Levels (dB) of Sound Emitted to any Receiving Class A Land from		
	Class C Land	Class B Land	Class A Land
31.5	75	72	72
63	74	71	71
125	69	65	65
250	64	57	57

1. Title 35 Environmental Protection, Subtitle H: Noise Chapter I: Pollution Control Board Part 901 Sound Emission Standards and Limitations for Property Line-Noise-Sources.

500	58	51	51
1000	52	45	45
2000	47	39	39
4000	43	34	34
8000	40	32	32

Source: Sec. 901.102 of the Illinois State Noise Regulation, Amended at 30 Ill. Reg.5533, effective March 10, 2006.

Table 3. IPCB Allowable Nighttime Octave Band Sound Pressure Level Limits

Octave Band Center Frequency (hertz)	Allowable Octave Band Sound Pressure Levels (dB) of Sound Emitted to any Receiving Class A Land from		
	Class C Land	Class B Land	Class A Land
31.5	69	63	63
63	67	61	61
125	62	55	55
250	54	47	47
500	47	40	40
1000	41	35	35
2000	36	30	30
4000	32	25	25
8000	32	25	25

Source: Sec. 901.102 of the Illinois State Noise Regulation, Amended at 30 Ill. Reg.5533, effective March 10, 2006.

Table 4 shows the octave band values at nominal turbine operation, typically corresponding to wind speeds greater than 10 meters per second at a 10-meter height. Octave band spectra as a function of smaller wind speeds at a 10-meter height depend on hub height and surface roughness.

Table 4. GE XLE Wind Turbine Generator Octave Band Sound Power Level

Octave (hertz)	Sound Power Level (dB)
63	83.4
125	92.2
250	97.8
500	99.4
1,000	97.7
2,000	93.4
4,000	86.6
8,000	84.8
Sum	**104.0**

Note: The octave band spectra are informative only.

Indicative octave band values can be derived using the table below thereby multiplying the tabled values below with the L_{WA} level for a given wind speed at a height of 10 meters and dividing this by 104 dBA, as indicated in the equation:

Octave band value ($V_{i,\ 10\text{-}m}$) = Octave band value (nominal operation): L_{WA} ($V_{i,\ 10\text{-}m}$) / 104 dBA

3. AMBIENT NOISE MEASUREMENTS

3.1 Ambient Noise Measurements

The existing noise environment in this area is characterized by traffic from U.S. Highway 67 (a 4-lane highway) and occasional trains from the Burlington Northern Sante Fe railroad line north of the proposed WTG location. Industrial facilities and businesses along Highway 67 are major contributors to overall ambient noise levels. During daytime hours, local traffic and agricultural work in the area also contribute to ambient noise levels. Summertime noise sources also include insects and birds during the day and evening.

The study area has several neighboring residences, all at a significant distance from the proposed WTG. The noise level from the turbines at each residence was modeled and is presented in the Noise Modeling section of this document. WES Engineering performed a preliminary ambient noise measurement in August 2010 by taking three 1-hour-long noise measurement samples at two locations (see Figure 2). Based on the results of this measurement, a decision was made to expand the background noise measurement study and collect 24- hour data at three locations. The 24- hour noise measurement study was performed on September 27 and September 28, 2010. Twenty-four-hour noise measurements were conducted simultaneously at three locations, and a fourth sound level meter was used to collect 1-hour noise measurements at various locations in the study area. The collected data were analyzed and are presented in the following section.

The noise measurements were conducted between approximately 2:40 p.m. on September 27th and 5:20 p.m. on September 28th. WES Engineering used Larson Davis Sound Level Meters (LD 824 and LD 820), calibrated to a known reference sound level.

3.2 Ambient Noise Measurement Locations

Ambient noise measurements were conducted to determine the potential audibility of WTG noise at nearby sensitive receptors and for comparison with IPCB criteria. Ambient noise levels are an important consideration, particularly if levels already exceed IPCB criteria at certain receptor locations. Figure 1 shows the ambient noise measurement locations.

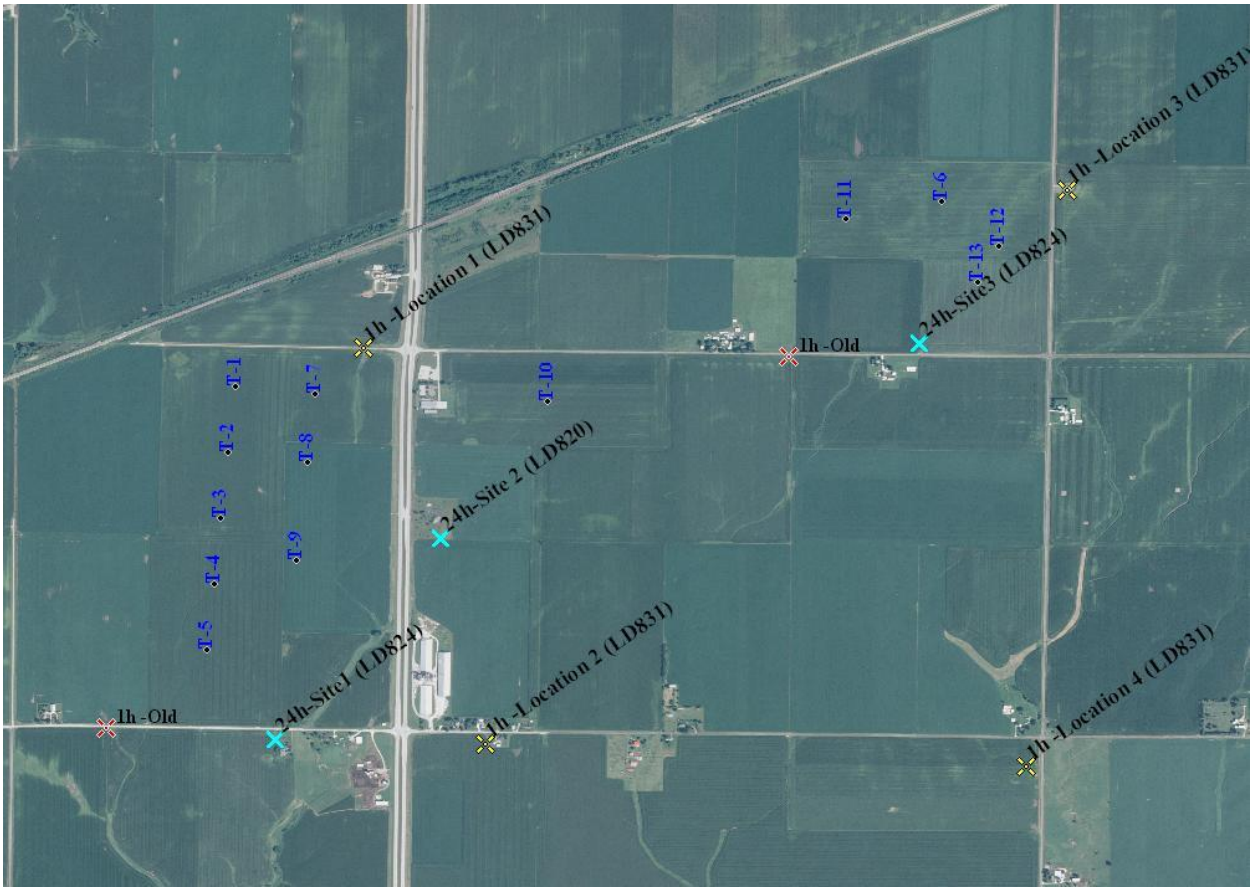

Figure 1. Study Area and Ambient Noise Measurement Locations

The WTG locations are marked with black dots and blue labels (from T-1 to T-13). The twenty-four-hour noise measurement locations are marked with the light blue **"X"** and a label showing the site number and the instrument used for the measurement. All four of the current 1-hour measurements are marked with a yellow "X" and are labeled with the location number and the instrument used. The two red "X" marks identify the two locations used in the measurement performed in August and are labeled "1h-Old."

3.3 Methodology

The following noise measurement guidelines were used:

- A minimum distance of 120 feet was kept from the main roads
- A minimum distance of 25 feet was kept from buildings and other sound-reflecting objects
- The 24-hour measurements were performed at a 9.8-foot height
- The instruments were calibrated before each measurement
- The microphones were protected with a windscreen.

The start and end times for the 24-hour noise measurements are shown in Table 5.

Table 5. Dates/Times of 24-Hour Ambient Noise Measurements

	Start Date/Time	End Date/Time
Site 1 – LD824		
	September 27, 16:45	September 28, 17:25
Site 2 – LD820		
	September 27, 15:25	September 28, 16:55
Site 3 – LD824		
	September 27, 15:35	September 28, 17:10

The start and end times for the 1-hour noise measurements are shown in Table 6.

Table 6. Dates/Times of 1-Hour Ambient Noise Measurements

	Start Date/Time	End Date/Time
Location-1 – LD831		
	September 27, 17:15	September 27, 18:15
Location-2 – LD831		
	September 28, 8:20	September 28, 9:20
Location-3 – LD831		
	September 28, 11:00	September 28, 12:06
Location-4 – LD831		
	September 28, 12:20	September 28, 13:20

Photographs of the ambient noise measurement sites are shown in the attachment to this analysis.

3.4 Wind Conditions

The average wind speed during the period of measurement was between 1 mile per hour and 8 miles per hour on September 27th and between 2 miles per hour and 9 miles per hour on September 28th (Figure 2).

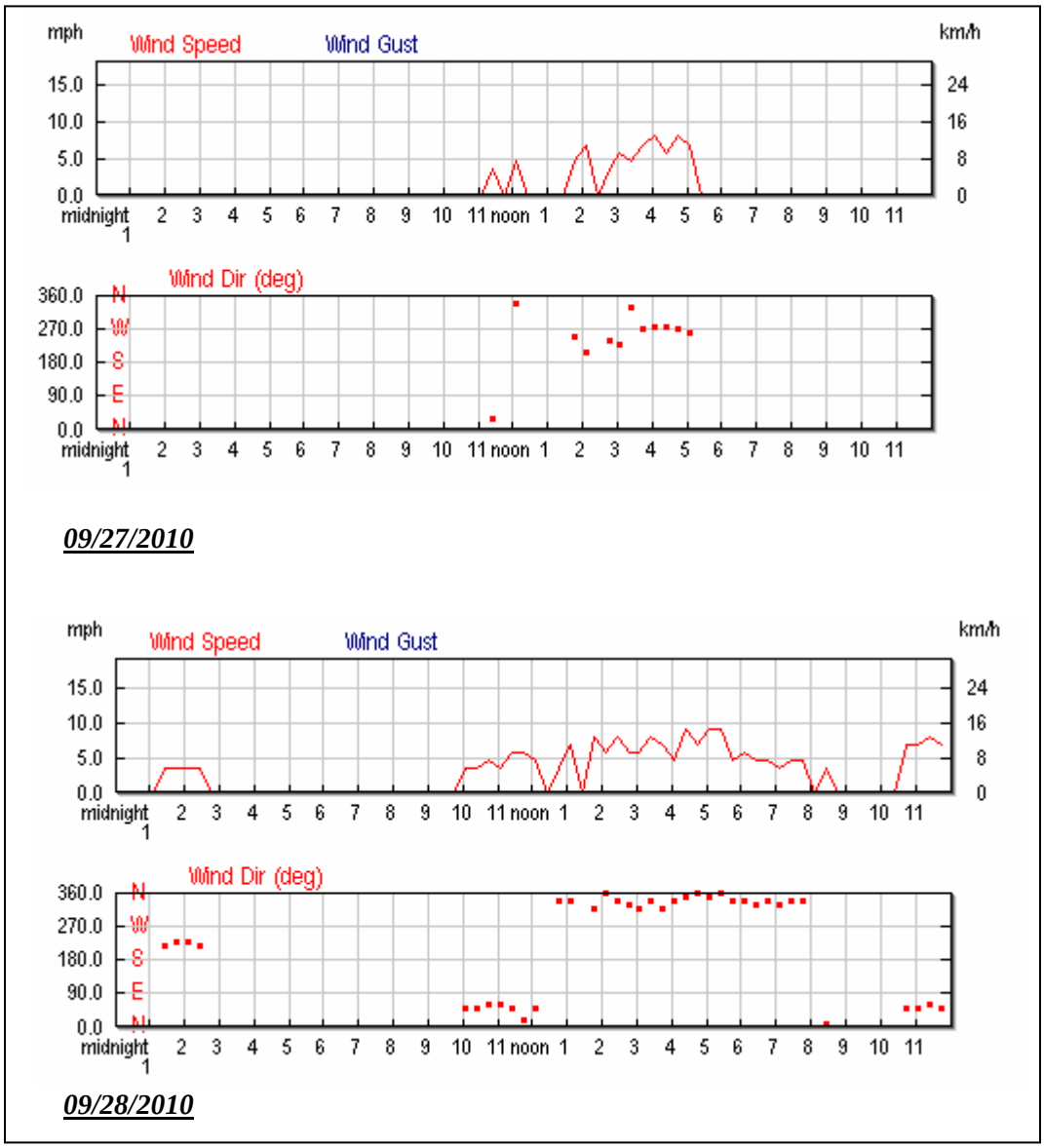

Figure 2. Wind Speed and Direction during Ambient Noise Measurements

4. RESULTS AND ANALYSIS

The results of the data analysis for each site are presented in Table 7 through 9.

4.1 24-Hour Ambient Noise Measurement Data

Table 7. Site 1 – 24-Hour Measurement – 09/27/2010 from 16:15 to 09/28/2010 17:25

Time	L_{eq}	L_{Min}	L_{Max}	L_1	L_{10}	L_{33}	L_{50}	L_{90}	L_{99}
0:00	**48.5**	36.6	61.6	57.2	53.1	45.7	42.6	**38.2**	37.2
1:00	**49.9**	35.2	59.5	58.2	54.2	49.3	45.8	**39.1**	36.5
2:00	**47.7**	34.8	58.6	57.3	51.5	46.3	40.8	**37.2**	35.6
3:00	**43.1**	35.0	57.6	55.0	44.7	39.2	37.9	**35.8**	35.3
4:00	**48.5**	37.1	60.0	59.5	52.4	44.2	41.6	**38.6**	37.4
5:00	**49.6**	38.5	62.4	60.3	53.3	46.2	44.1	**40.7**	39.4
6:00	**53.2**	39.0	68.6	63.6	56.8	50.6	47.7	**43.2**	40.0
7:00	**55.2**	43.8	67.7	65.3	58.6	52.7	50.6	**46.9**	44.5
8:00	**53.4**	44.1	67.8	63.9	56.9	51.1	48.5	**45.9**	44.7
9:00	**51.9**	44.4	69.8	63.6	52.6	48.6	47.8	**45.9**	44.8
10:00	**54.7**	45.6	69.9	66.6	56.1	49.6	48.5	**46.6**	45.8
11:00	**53.5**	43.5	74.3	65.4	53.4	47.4	46.7	**45.3**	44.2
12:00	**59.4**	43.2	73.1	69.9	64.5	54.5	49.5	**44.9**	43.9
13:00	**57.1**	43.9	69.9	67.3	61.4	52.8	48.2	**45.3**	44.5
14:00	**52.7**	41.4	69.4	63.8	55.6	49.3	46.9	**44.0**	42.2
15:00	**53.7**	43.4	70.3	65.0	55.8	49.1	47.4	**44.9**	44.0
16:00	**53.5**	42.9	72.5	65.5	54.9	48.7	47.3	**44.7**	43.6
17:00	**59.6**	40.5	72.2	69.4	64.5	54.4	48.3	**42.7**	41.3
18:00	**52.2**	38.1	73.8	63.9	50.9	44.4	42.4	**40.4**	39.1
19:00	**47.7**	37.1	63.2	57.8	50.1	45.4	43.5	**39.9**	38.2
20:00	**49.9**	39.9	66.4	60.5	52.1	46.7	44.5	**41.8**	40.4
21:00	**47.0**	40.4	59.3	54.0	49.9	46.8	45.0	**42.4**	41.0
22:00	**51.1**	37.5	64.9	59.9	54.9	49.7	46.9	**40.0**	38.0
23:00	**48.5**	38.4	59.7	56.6	52.5	47.0	44.5	**41.4**	38.7

Location: South of 130th Avenue and West of U.S. Highway 67.
Coordinates: 40° 49.150' N, 90° 39.749' W.

Table 8. Site 2 – 24 Hour Measurement – 09/27/2010 from 15:25 to 09/28/2010 16:55

Time	L_{eq}	L_{Min}	L_{Max}	L_1	L_{10}	L_{33}	L_{50}	L_{90}	L_{99}
0:00	**55.3**	70.2	47.9	64.7	58.4	53.4	52.1	**50.1**	48.3
1:00	**56.4**	66.8	47.3	65	59.9	54.9	52.3	**49.5**	48.1
2:00	**53.3**	67.2	45.5	61.1	56.3	52.6	51.2	**48**	46.2
3:00	**54**	72.5	45	64.9	57.1	49.8	48.7	**47.1**	46
4:00	**56.5**	73.1	44.3	67.8	60.5	51.3	48.9	**45.7**	44.5
5:00	**58.4**	69.7	47.1	67	62.5	57.3	54.8	**49.6**	48
6:00	**59.9**	69.4	51.9	66.5	63	60.1	58.4	**54.6**	53.1
7:00	**61.4**	73.1	47.7	70.3	64.6	60.9	58.9	**53.4**	49.6
8:00	**54.7**	69.5	45.8	63.8	58.6	53	51.2	**47.8**	46.3
9:00	**52.7**	74.9	44.3	61.3	54.3	50.5	49	**46.3**	45
10:00	**50.5**	68.3	42.5	61.8	52.4	48.2	47	**44.5**	43.2
11:00	**51.8**	76.9	40.2	58.7	52.2	48.1	46.7	**43.9**	42
12:00	**52.6**	74.7	40.7	63.5	53.3	49	47.5	**44.5**	42.7
13:00	**52**	71.5	41.3	59.8	55	50.8	48.9	**45.1**	42.8
14:00	**53.2**	75.7	41.6	61	55.9	51.8	49.9	**46.1**	43.9
15:00	**54.1**	69.2	43.1	61.8	57.3	53.7	51.7	**47.1**	44.6
16:00	**54.7**	66.9	43.6	62.5	57.9	54.6	52.9	**47.7**	44.9
17:00	**57.3**	74	46.6	64.1	60.3	57.2	55.7	**50.8**	48.2

Table 8. Site 2 – 24 Hour Measurement – 09/27/2010 from 15:25 to 09/28/2010 16:55 (continued)

Time	L_{eq}	L_{Min}	L_{Max}	L_1	L_{10}	L_{33}	L_{50}	L_{90}	L_{99}
18:00	**57.5**	67.9	45.9	65.1	60.8	57.4	55.9	**50**	47.1
19:00	**57.3**	68.2	47.1	65.5	61	57	54.8	**48.6**	47.3
20:00	**57.7**	67.2	47.5	65	61.7	57.4	55.4	**50.3**	48.1
21:00	**56.4**	69.6	46.3	65.5	59.6	55.7	53.7	**48.9**	47.2
22:00	**58.4**	69.7	47.4	66.9	62.8	57.1	54.6	**50.2**	48.4
23:00	**57.1**	73	47.2	67.9	59.9	55.1	52.2	**49.4**	48.1

Location: South of 130th Avenue and West of U.S. Highway 67.
Coordinates: 40° 49.608' N, 90° 39.373' W.

Table 9. Site 3 – 24 Hour Measurement – ***09/27/2010 from 15:35 to 09/28/2010 17:10***

Time	L_{eq}	L_{Min}	L_{Max}	L_1	L_{10}	L_{33}	L_{50}	L_{90}	L_{99}
0:00	**47.6**	34.9	65.9	57.1	52.1	44.8	40.2	**36.2**	35.1
1:00	**58**	36	77	71.1	60.4	52.1	45.3	**38.3**	36.6
2:00	**53.7**	36.5	75.1	63.4	57.9	49.6	42.3	**38.8**	37.4
3:00	**49.9**	36.4	77.3	59.7	43.9	40.5	39.7	**37.9**	36.8
4:00	**52.9**	35.9	72.8	63.9	56.4	43.2	41.5	**38.5**	36.4
5:00	**55.5**	37.3	79.7	65.8	56.1	44.6	43.3	**40.5**	38.4
6:00	**54.7**	38.4	76.1	67.1	57.0	46.5	44.0	**40.6**	39.2
7:00	**54.9**	38.8	75.6	68.9	55.2	46.1	44.8	**41.3**	39.7
8:00	**53.1**	39.6	74.4	64.5	53.6	48.1	46.7	**42.5**	41.0
9:00	**49.7**	39.5	72	62.0	48.1	46.4	45.1	**41.4**	40.2
10:00	**46.7**	41.1	61.4	53.7	49.0	46.4	45.7	**43.7**	42.1
11:00	**46.9**	41.8	58.5	52.6	50.7	45.9	45.2	**43.5**	42.3
12:00	**51.4**	41.1	77.3	55.5	51.2	48.4	46.6	**43.6**	42.2
13:00	**51.5**	43.1	74.1	58.9	51.8	50.1	48.2	**45.8**	44.3
14:00	**49.5**	43.2	67.9	54.8	50.9	49.8	48.9	**45.8**	44.2
15:00	**46.9**	42.5	63.1	53.5	49.3	46.3	45.5	**44.1**	43.1
16:00	**48.4**	42.8	61.9	56.4	49.4	46.7	45.9	**44.3**	43.2
17:00	**49.7**	42.4	70.3	60.0	48.3	47.2	46.6	**44.6**	43.2
18:00	**47.2**	39.8	67.7	54.8	49.8	45.5	44.4	**41.6**	40.2
19:00	**44.4**	38.5	60	55.4	45.0	42.8	41.9	**40.1**	39.1
20:00	**49.6**	39.1	62.6	60.4	54.0	45.1	42.5	**40.5**	39.5
21:00	**50.9**	37.1	72.3	63.4	52.8	42.1	40.2	**38.4**	37.4
22:00	**55.8**	36.3	75.2	68.0	58.0	49.7	43.1	**38.0**	36.3
23:00	**52.8**	34.9	77.9	63.0	53.0	39.7	38.1	**35.7**	35.1

Location: South of 130th Avenue and West of U.S. Highway 67.
Coordinates: 40° 50.053' N, 90° 38.279' W.

4.2 1-Hour Ambient Noise Measurement Data

The data from the four additional measurement locations are summarized in the following section.

Location 1 – 1-hour data
At this additional testing location, the measured ambient noise level was significantly higher than Sites 1 and 3, but lower than Site 2.

Based on the comparison of the simultaneous measurements at all the locations and the L90 comparison graph below, the 24-hour sites are representative of Location 1 and the dwellings near it.

Location 2 – 1-hour data
At this additional testing location, the measured ambient noise level was significantly higher than all three sites.

Based on the comparison of the simultaneous measurements at all the locations and comparing the L90 values, the 24-hour sites are representative of or at lower noise levels than Location 2 and the dwellings near it.

Location 3 – 1-hour data
At this additional testing location, the measured ambient noise level was significantly lower than all three sites.

Based on the comparison of the simultaneous measurements at all the locations and comparing the L90 values, the 24-hour sites are not representative of Location 3. This does not affect the overall ambient noise measurement results because there are no dwellings near Location 3.

Location 4 – 1-hour data
At this additional testing location, the measured ambient noise level was significantly lower than all three sites.

Based on the comparison of the simultaneous measurements at all the locations and comparing the L90 values, the 24-hour sites are not fully representative of Location 4. This does not affect the overall ambient noise measurement campaign because the dwellings near Location 4 are far away from the proposed turbines. The maximum turbine noise level at the dwelling nearest to Location 4 would be 35 dBA, and ambient noise levels are even lower for the dwellings that are farther east or south.

5. NOISE MODELING

MWP has selected the GE xle 1.6 MW model turbine for the proposed project. The GE xle turbine consists of a 82-meter (270-foot) diameter, three-blade rotor mounted on a tubular steel monopole with a hub height of 80 meters (262 feet). The overall height of the wind turbine is 121 meters (397 feet). According to the manufacturer's specifications, the maximum sound power level at the nacelle is 104 dB. MWP intends to install 12 GE xle wind turbines in the area.

Some of the major sources of noise in the vicinity of the proposed project are the railroad tracks northwest of the site, the traffic on U.S. Highway 67 crossing through the middle of the project, the traffic on the smaller roads, the noise from the wind blowing in the fields, and the few small businesses in the area. The existing noise environment for this area is characterized by local tractor-trailer traffic, passenger vehicles traffic, and rail traffic.

WES Engineering performed noise modeling with WindFarmer software to assess the potential noise impacts from operation of the proposed wind turbines. Tables 10 and 11 list the WTG and receptor locations, respectively, where the noise samples were taken.

Table 10. WTG Latitude and Longitude

Turbine ID	Eastings (meters)	Northings (meters)	Height of base (meters)
1	191043.8	4526638	225
2	191008.2	4526357.9	225
3	190973	4526080.4	225
4	190939.2	4525802.9	224
5	190903	4525525.7	223
6	193341.1	4527326	233
7	191296.9	4526594.8	225
8	191260.6	4526305.7	225
9	191206.3	4525894.6	225
10	192041.5	4526534	226
11	193029.9	4527261.6	232
13	193441.7	4526980.7	232

The wind turbine locations used in the WindFarmer model are in the Universal Transverse Mercator, or UTM, coordinate system (WGS72).

Table 11. Modeled WTG Noise Levels by Receptor Number

Receptor ID	Name	Distance to nearest turbine (meters)	Eastings (meters)	Northings (meters)	Noise Prediction (dBA)
19	Dwelling 19	471.5	191660	4526023	48.14
1	Dwelling 1	530.2	191567	4527051	45.81
46	Dwelling 46	471.2	193109	4526647	45.11
20	Dwelling 20	496.6	191132	4525085	44.76
22	Dwelling 22	554.2	191289	4525128	44.48
48	Dwelling 48	595.6	192600	4526741	44.35
47	Dwelling 47	629.2	192687	4526734	44.29
23	Dwelling 23	628.1	191380	4525117	43.83
21	Dwelling 21	590.6	190375	4525261	43.54
24	Dwelling 24	833.9	191660	4525176	42.66
25	Dwelling 25	885	191713	4525169	42.29
26	Dwelling 26	919.8	191778	4525174	41.95
49	Dwelling 49	602.6	193693	4526433	41.86
28	Dwelling 28	954.8	191835	4525176	41.63
27	Dwelling 27	1011.6	191826	4525095	41.16
29	Dwelling 29	1016.4	191914	4525165	41.12
32	Dwelling 32	1369.6	192379	4525187	38.92
30	Dwelling 30	1349.3	192272	4525067	38.82
33	Dwelling 33	1441.9	192438	4525145	38.46
31	Dwelling 31	1422.9	192373	4525080	38.44
4	Dwelling 4	1080	193001	4528351	38.24
62	Dwelling 62	1060.5	193716	4528318	37.56
50	Dwelling 50	1226.6	190208	4524515	37.21
61	Dwelling 61	1116.9	194076	4528167	37
2	Dwelling 2	1593.8	191860	4528344	36.57
3	Dwelling 3	1470.6	192172	4528456	36.35
12	Dwelling 12	1545.9	189883	4527659	36.3
5	Dwelling 5	1830.5	191257	4528456	35.47
6	Dwelling 6	1845.7	190965	4528482	35.01
9	Dwelling 9	1778.7	190372	4528285	34.92

Table 11. Modeled WTG Noise Levels by Receptor Number (continued)

Receptor ID	Name	Distance to nearest turbine (meters)	Eastings (meters)	Northings (meters)	Noise Prediction (dBA)
8	Dwelling 8	1820.9	190381	4528334	34.7
7	Dwelling 7	1872.5	190781	4528492	34.69
34	Dwelling 34	1884.8	193507	4525097	34.53
63	Dwelling 63	1481.4	194535	4528203	34.38
10	Dwelling 10	2048.7	189624	4528115	33.42
58	Dwelling 58	1857.6	190844	4523669	33.38
18	Dwelling 18	2272.4	188765	4526721	33.14
16	Dwelling 16	2313.1	188749	4526928	32.81
59	Dwelling 59	1989.2	190981	4523538	32.77
40	Dwelling 40	1785.9	194805	4525827	32.64
17	Dwelling 17	2372.8	188677	4526807	32.63
51	Dwelling 51	2298.6	188611	4525351	32.22
57	Dwelling 57	2062	190027	4523659	32.22
35	Dwelling 35	2096.6	194252	4525047	32.21
60	Dwelling 60	2537.1	193607	4524449	32.15
42	Dwelling 42	1833.8	195251	4526682	32.11
64	Dwelling 64	1858.1	194948	4528259	32.1
52	Dwelling 52	2363.3	188552	4525285	31.88
11	Dwelling 11	2451.7	188903	4527833	31.73
45	Dwelling 45	1926.9	195363	4527128	31.68
67	Dwelling 67	1977.8	195371	4527416	31.5
53	Dwelling 53	2548.2	188359	4525380	31.2
44	Dwelling 44	2017.1	195406	4526522	31.13
43	Dwelling 43	2018.6	195426	4526610	31.12
13	Dwelling 13	2681.3	188719	4527974	30.8
37	Dwelling 37	2379.3	194873	4525080	30.38
54	Dwelling 54	2738.6	188178	4525253	30.36
41	Dwelling 41	2245.9	195264	4525668	30.35
36	Dwelling 36	2448.8	194825	4524960	30.23
66	Dwelling 66	2225.7	195407	4528154	30.2
65	Dwelling 65	2269.3	195420	4528236	29.97
38	Dwelling 38	2611.3	195155	4525010	29.34
55	Dwelling 55	3093.4	187811	4525433	29.13
14	Dwelling 14	3201.3	188477	4528551	28.72
15	Dwelling 15	3228.2	188795	4528954	28.59
56	Dwelling 56	3140.1	187860	4524751	28.54
39	Dwelling 39	2813.1	195378	4524940	28.5

GE xle 1.6 MW specifications state that the maximum sound power level of the wind turbine is 104 dB when operating at full power. With this guaranteed value at the source, the maximum sound pressure levels due to the operation of the wind turbine can be calculated for the surrounding area. Figures 3 and 4 show the contour maps of the calculated sound pressure levels. The calculated sound pressure levels are conservative and can be viewed as the upper-bound limit, in that the model does not account for attenuation for a number of environmental factors (e.g., atmospheric absorption, and ground absorption).

The modeling results show that WTG noise levels at the closest building would be a maximum 48.1 dBA. Noise levels at the second closest building would be 45.8 dBA. There are nine other buildings close to

where the turbines would be located with maximum sound levels between 42 and 45.1 dBA. Five more buildings in the vicinity would have maximum noise levels ranging from 41 to 42 dBA.

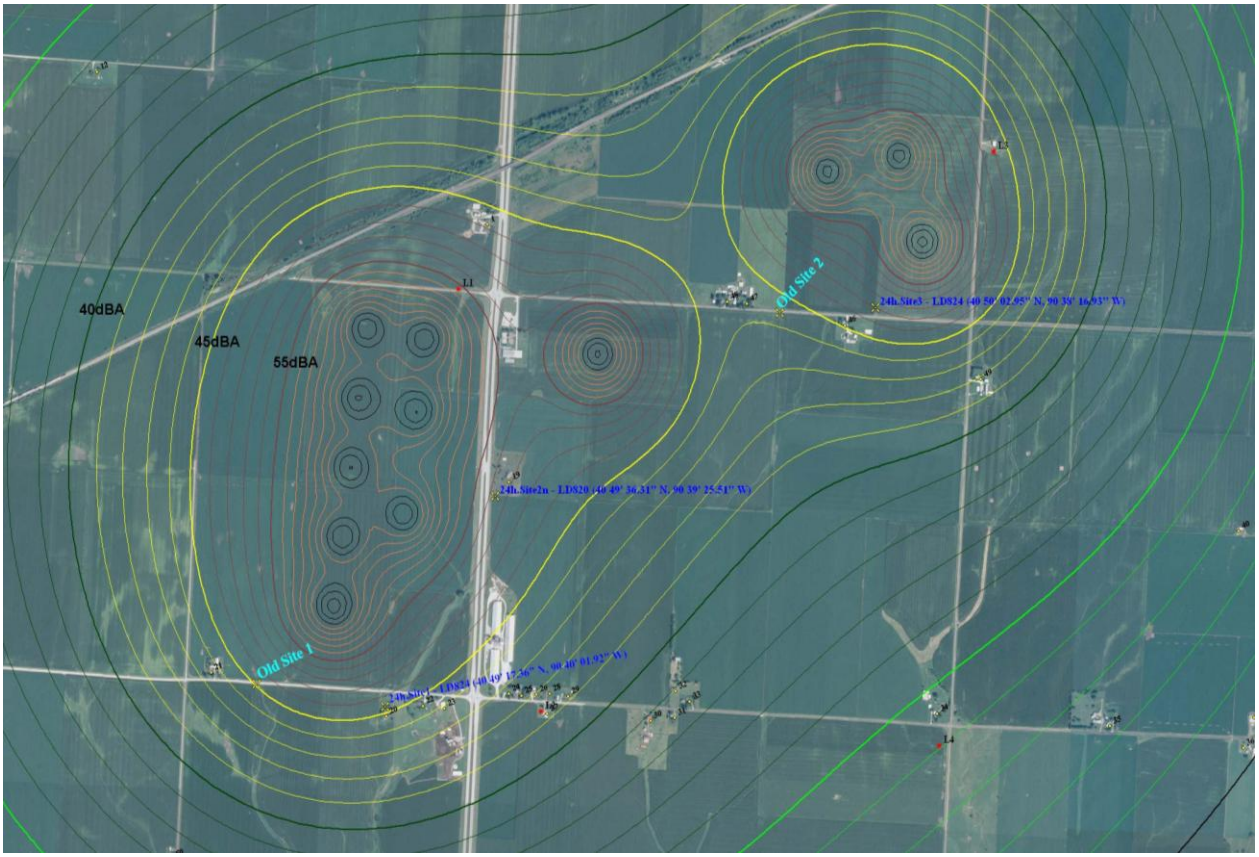

Figure 3. Monarch Wind Project Noise Contours in dBA: Small Scale

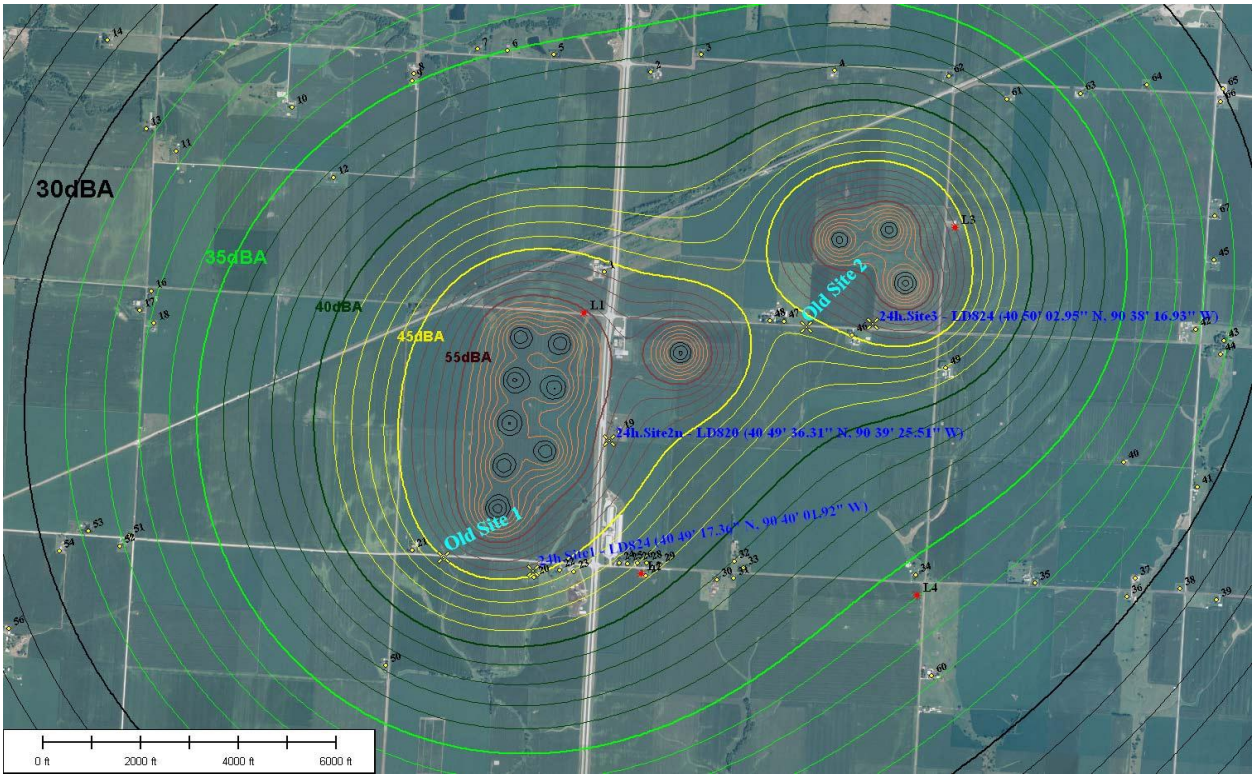

Figure 4. Monarch Wind Project Noise Modeling in dBA: Large Scale

The GE xle 1.6 MW turbine can operate on reduced speeds (with lower power generation) which will reduce noise levels. Table 12 lists such noise-reduced operation modes.

Table 12. GE XLE Noise Reduction Options

NRO Label	Nominal Power (kW)	Nominal Rotor Speed (RPM)	Reduced Reference Value L_{WA} (dB)
Baseline	1,500	16.8	104
NRO 103-Rev. 3	1,400	16.0	103
NRO 102-Rev. 3	1,240	15.3	102
NRO 101-Rev. 3	1,080	14.6	101
NRO 100-Rev. 3	935	14.0	100

dB = decibel; kW = kilowatt; NRO = noise reduction option; RPM = revolutions per minute.

6. ASSESSMENT OF IMPACTS

6.1 Summary of Noise Impact Criteria

The following criteria were used to evaluate the wind turbine noise impacts at nearby sensitive receptors (e.g., residences, churches, and schools):

- DNL values less than or equal to 65 dBA and a future design goal DNL of 55 dBA for exterior sound levels. Assuming the wind turbine is operating at steady state sound level at the receiver location, the DNL is approximately 6.4 dB above the measured L_{eq}, so DNL 55 dBA corresponds to maximum L_{eq} of 48.6 dBA.

- IPCB nighttime octave frequency band decibel limits for Class A land from Class C land (see Table 3).
- Comparison of WTG noise levels with ambient levels (less than a 3-dBA increase).

6.2 Comparison of WTG Projected Noise Levels to IPCB Standards and Measured Ambient Noise Levels

Table 13 contains the modeled noise prediction for the turbines at the 29 closest receptor locations in comparison with the IPCB limits. The table notes five receptor locations at which the turbine noise output would exceed IPCB standards for at least one octave band (this is conservative since modeling did not fully account for atmospheric absorption). WTG noise levels in octave bands were also compared with ambient L90 data in octave bands. Where WTG noise levels would meet or exceed ambient L90 data, WTG could be audible at certain times at certain locations, as noted in the table.

Table 13. Summary of Noise Levels for the 29 Closest Receptors to WTGs

Receptor ID	Predicted Turbine Noise Level (dBA)	Exceeds the IPCB Limit by dBA	Exceeds the IPCB Limit by Octave	Notes and Comments for the GE xle 1.6 MW Without Noise Reduction Option
19	48.14	No	Yes	*Exceeds IPCB levels at 1000, 2000 and 4000 Hz - Could be audible*
1	45.81	No	Yes	*Exceeds IPCB levels at 1000 and 2000 Hz- Could be audible*
20	44.76	No	Yes	*Exceeds IPCB level at 2000 Hz - Could be audible*
22	44.48	No	Yes	*Exceeds IPCB level at 2000 Hz - Could be audible*
48	44.35	No	Yes	*Exceeds IPCB level at 2000 Hz - Could be audible*
46	45.11	No	No	Fully complies to the IL-PCB limits - Could be audible
47	44.29	No	No	Equals to the IPCB level at 2000 Hz - Could be audible
23	43.83	No	No	Fully complies to the IL-PCB limits - Could be audible
21	43.54	No	No	Fully complies to the IL-PCB limits - Could be audible
24	42.66	No	No	Fully complies to the IL-PCB limits - Could be audible
25	42.29	No	No	Fully complies to the IL-PCB limits - Could be audible
26	41.95	No	No	Fully complies to the IL-PCB limits - Could be audible
49	41.86	No	No	Fully complies to the IL-PCB limits - Could be audible
28	41.63	No	No	Fully complies to the IL-PCB limits - Could be audible
27	41.16	No	No	Fully complies to the IL-PCB limits - Could be audible
29	41.12	No	No	Fully complies to the IL-PCB limits - Could be audible
32	38.92	No	No	Fully complies to the IL-PCB limits - Not likely to be audible
30	38.82	No	No	Fully complies to the IL-PCB limits - Not likely to be audible
33	38.46	No	No	Fully complies to the IL-PCB limits - Not likely to be audible
31	38.44	No	No	Fully complies to the IL-PCB limits - Not likely to be audible
4	38.24	No	No	Fully complies to the IL-PCB limits - Could be audible
62	37.56	No	No	Fully complies to the IL-PCB limits - Could be audible
50	37.21	No	No	Fully complies to the IL-PCB limits - Not likely to be audible
61	37	No	No	Fully complies to the IL-PCB limits - Could be audible
2	36.57	No	No	Fully complies to the IL-PCB limits - Not likely to be audible
3	36.35	No	No	Fully complies to the IL-PCB limits - Not likely to be audible
12	36.3	No	No	Fully complies to the IL-PCB limits - Not likely to be audible
5	35.47	No	No	Fully complies to the IL-PCB limits - Not likely to be audible
6	35.01	No	No	Fully complies to the IL-PCB limits - Not likely to be audible

WindFarmer software accounts for atmospheric absorption in an approximate fashion by subtracting a single overall value that is accurate from an overall A-weighted noise level perspective; however, high frequencies are attenuated much more than what this method would indicate. As a result of this

approximation, WindFarmer indicates that five receptors would slightly exceed the nighttime IPCB standard at certain middle to high frequencies. Table 14 shows a more-detailed breakdown of these five receptors. The standard on calculating absorption of sound (ANSI S1.26 – 1995) provides the detailed octave band atmospheric absorption coefficients for a wide range of temperatures and humidity. Assuming "standard day" meteorology (15 degrees Celsius and 50 percent humidity), mid- to high-frequency atmospheric absorption would substantially reduce the predicted mid- to high-frequency WTG noise levels shown in Table 14. Accounting for this would result in all receptors except Receptor 19 being below the IPCB standards. With regard to Receptor 19, only the predicted WTG noise level at 1,000 Hz would be slightly above the nighttime IPCB standard (43.2 dB versus 41 dB). All other frequencies would be below the IPCB standard at this location.

Table 14. Detailed Noise Data at Five Receptors

Monarch Wind - Ambient to WTG noise comparison Day/Night/Total

WES Engineering Inc.
10/21/2010

Day Time is assumed to be from 7:00am to 9:59pm
Night Time is from 10:00pm to 6:59am

Record #	Receptor ID	Distance to the Nearest Turbine [m]	[ft]	dBA Day Time WTG LAeq	Day Time Ambient LAeq	Day Time Ambient L90	Night Time WTG LAeq	Night Time Ambient LAeq	Night Time Ambient L90	TOTAL WTG LAeq	TOTAL Ambient LAeq	TOTAL Ambient L90	TOTAL Ambient Increase
1	19	471.5	1546.52	48.15	57.8	48.4	48.15	52.62	43.8	48.14	56.49	47.2	0.5927
2	1	530.2	1739.06	45.81	54.38	49.1	45.81	49.2	44.4	45.81	53.07	47.8	0.7479
3	20	496.6	1628.85	44.76	54.88	44.6	44.76	49.7	39.9	44.76	53.57	43.3	0.5366
4	22	554.2	1817.78	44.48	54.88	44.6	44.48	49.7	39.9	44.48	53.57	43.3	0.5050
5	48	595.6	1953.57	44.35	50.31	43.1	44.35	54.4	38.6	44.35	52.31	41.9	0.6444

IPCB Limit by Day and Night

Hz	Day Time - from 7:00am to 9:59pm 31.5	63	125	250	500	1000	2000	4000	8000	Night Time - from 10:00pm to 6:59am 31.5	63	125	250	500	1000	2000	4000	8000
PCB-dBA	36	47.8	52.9	55.4	54.8	52	48.2	44	38.9	30	40.8	45.9	45.4	43.8	41	37.2	33	30.9

Modeled Maximum WTG Noise / Ambient Noise

Record #	Receptor ID	Hz	31.5	63	125	250	500	1000	2000	4000	8000	31.5	63	125	250	500	1000	2000	4000	8000
1	19	WTG.dBA	-12.5	3.7	22.6	35.7	42.7	44.2	41.1	34.1	30.2	-12.5	3.7	22.6	35.7	42.7	44.2	41.1	34.1	30.2
		Ambient	24.9	38.4	44.4	46.7	50.4	54.0	50.5	45.3	41.3	28.8	36.1	40.5	44.3	47.9	47.8	41.7	33.5	25.0
		SUM	24.9	38.4	44.4	47.1	51.1	54.5	51.0	45.6	41.7	28.8	36.1	40.5	44.8	49.1	49.4	44.4	36.8	31.3
		Increase	0.0	0.0	0.0	0.3	0.7	0.4	0.5	0.3	0.3	0.0	0.0	0.1	0.6	1.1	1.6	2.7	3.3	6.3
2	1	WTG.dBA	-14.8	1.4	20.3	33.4	40.4	41.9	38.8	31.8	27.9	-14.8	1.4	20.3	33.4	40.4	41.9	38.8	31.8	27.9
		Ambient	21.5	35.0	41.0	43.3	47.0	50.6	47.1	41.8	37.9	25.4	32.7	37.0	40.9	44.5	44.4	38.3	30.1	21.6
		SUM	21.5	35.0	41.0	43.7	47.8	51.1	47.7	42.3	38.3	25.4	32.7	37.1	41.6	45.9	46.3	41.6	34.0	28.8
		Increase	0.0	0.0	0.0	0.4	0.9	0.5	0.6	0.4	0.4	0.0	0.0	0.1	0.7	1.4	1.9	3.2	3.9	7.2
3	20	WTG.dBA	-15.9	0.3	19.2	32.3	39.3	40.8	37.7	30.7	26.8	-15.9	0.3	19.2	32.3	39.3	40.8	37.7	30.7	26.8
		Ambient	22.0	35.5	41.5	43.8	47.5	51.1	47.6	42.3	38.4	25.9	33.2	37.5	41.4	45.0	44.9	38.8	30.6	22.1
		SUM	22.0	35.5	41.5	44.1	48.1	51.5	48.0	42.6	38.7	25.9	33.2	37.6	41.9	46.1	46.3	41.3	33.7	28.1
		Increase	0.0	0.0	0.0	0.3	0.6	0.4	0.4	0.3	0.3	0.0	0.0	0.1	0.5	1.0	1.4	2.5	3.1	6.0
4	22	WTG.dBA	-16.2	0.0	18.9	32.0	39.0	40.5	37.4	30.4	26.5	-16.2	0.0	18.9	32.0	39.0	40.5	37.4	30.4	26.5
		Ambient	22.0	35.5	41.5	43.8	47.5	51.1	47.6	42.3	38.4	25.9	33.2	37.5	41.4	45.0	44.9	38.8	30.6	22.1
		SUM	22.0	35.5	41.5	44.1	48.0	51.5	48.0	42.6	38.7	25.9	33.2	37.6	41.8	46.0	46.2	41.2	33.5	27.9
		Increase	0.0	0.0	0.0	0.3	0.6	0.4	0.4	0.3	0.3	0.0	0.0	0.1	0.5	1.0	1.4	2.4	2.9	5.8
5	48	WTG.dBA	-16.3	-0.1	18.8	31.9	38.9	40.4	37.3	30.3	26.4	-16.3	-0.1	18.8	31.9	38.9	40.4	37.3	30.3	26.4
		Ambient	21.4	31.2	37.3	38.1	44.3	44.7	38.5	43.3	39.5	27.8	35.6	39.1	43.8	50.7	50.3	40.9	29.3	22.8
		SUM	21.4	31.2	37.3	39.0	45.4	46.1	40.9	43.5	39.7	27.8	35.6	39.2	44.1	51.0	50.7	42.5	32.9	28.0
		Increase	0.0	0.0	0.1	0.9	1.1	1.4	2.5	0.2	0.2	0.0	0.0	0.0	0.3	0.3	0.4	1.6	3.5	5.2

Note:

The predicted high WTG in the high frequency range is due to the used assumption that all frequencies have the same absorption in air. In reality the higher frequencies will experience higher absorption in air and at such significant distance will be greatly reduced.

Values in red indicate an exceedence of the IPCB standards, for both ambient and WTG noise levels.

7. CONCLUSION

The data show that WTG noise levels would exceed the nighttime IPCB standard at one receptor location and only slightly at one frequency (1,000 Hz). However, ambient noise levels (without the turbines) already exceed the IPCB standards at this location (as well as the other four receptor locations shown in Table 14). In addition, the analysis shows that predicted WTG noise levels would increase ambient noise levels at these locations by less than 1 dB (1 dBA). A 3-dB change is the threshold of perception of change for most people; therefore, WTG noise levels would not significantly increase ambient noise levels. Consequently, DOE no significant noise impacts are expected as a result of MWP's proposed project.

8. REFERENCES

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Kamperman G.W. and R. R. James. 2009. "Guidelines for selecting wind turbine sites. Sound and Vibration: 8-12." July. http://www.sandv.com/home.htm.

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Attachment: Photographs of Ambient Noise Measurement Locations

24h - Site3

1h-Location1

1h-Location2

1h-Location3

1h-Location4

Attachment B-4

Archaeological Survey

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Phase I Archaeological Reconnaissance Survey
Monarch Wind Farm Project
Lenox Township, Warren County, Illinois
IHPA Log # 038021610

Prepared for:
Monarch Wind Power LLC
1455 Delbrook Way
Marco Island, Florida 34145-4603

Edge Project Number 4846

June 17, 2010

INTRODUCTION

From May 24 through June 17, 2010, Mr. Richard Johnson, Archaeologist with Edge Consulting Engineers, Inc. completed a Phase I Literature Review and Archaeological Reconnaissance Survey in order to assess the potential for intact archaeological deposits located within the boundaries of the proposed Monarch Wind Farm project comprising 13 turbines, turbine access roads and an electrical substation (IHPA Log # 038021610). The proposed undertaking is located east and west sides of U.S. Route 67, in portions of Sections 20, 29 and 30, Township 10 North, Range 2 West of the Forth Principle Meridian (Lenox Township) in Warren County, Illinois (Appendix A: Figure 1).

The project included a review of historic maps, local and regional histories, aerial photographs, topographic quadrangles, soil surveys and physiographic data, inventories of previously recorded archaeological sites, burial sites, and historic structures, NRHP listings, and inventories of previous archeological surveys within the area of potential effect. The project also included a Phase I field survey of all areas where ground disturbance is proposed.

Historical plats and a 1982 topographic map indicate the presence of a cemetery located on the southwest corner of U.S. Route 67 and 140th Avenue. The cemetery was associated with the Warren County Alms House. The cemetery location is near the location of a proposed electrical substation. Cemetery burials were relocated in 1991 prior to the widening of Route 67 to a four lane divided highway. The former cemetery location is now occupied by a portion of the highway and adjacent drainage swale. The reconnaissance survey did not locate any cultural material. No further archaeological work is necessary. It is recommended that the undertaking proceed.

PHYSICAL SETTING

The undertaking is located in portions of Sections 20, 29 and 30 in Township 10 North, Range 2 West (Lenox Township) in Warren County, Illinois. The survey areas are located in nearly level agricultural fields along the southern edge of the upland interfluve between the Illinois River and Mississippi River watersheds. The center of the survey areas (Turbine No. 10 location) is located at UTM coordinates: Zone 15, 4522763 North, 697986 East (Latitude 40˚49′ 55.2721″ N, Longitude 90˚ 39′ 7.6629″ W).

The study area is on a loess-covered till plain, part of the Winnebago formation of the Illinois Episode of glaciation (ISGS 2009). The undertaking is located within the Western Forest-Prairie Division, Galesburg Section (Schwegman 1973). This section comprises a dissected Illinoisan till plain. Native vegetation consisted of forest in the river and creek valleys with open forest and prairie on the uplands. The soil composition within the study parcels can be found in Table 1 and Appendix A: Figure 2 (NRCS 2009).

Table 1. Soils found within the survey areas.

Soil Type	Drainage	Native vegetation	Location
Osco silt loam 2-5% slopes(86), eroded (86B)	well drained	tall grass prairie	loess-covered till plains
Muscatine silt loam 0-2% slopes (51A)	poorly drained	tall grass prairie	loess-covered till plains
Sable silty clay loam 0-2% slopes (68A)	poorly drained	marsh grass & sedges	inter-stream divides on loess-covered till plains

The pre-settlement vegetation in the area surrounding the proposed undertaking consisted of forest in dissected river and creek valleys grading to open forest and tall grass prairie on the uplands. Shallow upland depressions were covered by marsh grass and sedge. Prehistoric people would have focused their long-term habitation on the valleys and used the prairie for hunting and foraging excursions. This pattern appears to be verified by the fact that all of the recorded prehistoric sites in the area are located at the edges of drainages leading into Henderson and Cedar Creeks.

BACKGROUND

Archival background research was conducted online using the HAARGIS, CRM Report Archive Database and Illinois Site File databases. The HAARGIS database did not list any buildings within the boundaries of the proposed project. The site file search did not identify any archaeological resources within one mile of the current undertaking. The CRM Report Archive Database listed two surveys within one mile of the undertaking. These surveys were conducted prior to improvements to U.S. Route 67.

Research was also conducted at the Warren County Library in Monmouth, Illinois. Early plats, atlases and regional histories were consulted in order to ascertain the potential for unrecorded historic period resources located within the undertaking (Appendix A: Figures 4-8). The 1844 General Land Office plat of Lenox Township shows the location of the current undertaking within a large area of prairie with no cultural resources present within or immediately adjacent the property.

The proposed wind farm will occupy portions of three sections of Lenox Township. The proposed turbine sites and access roads for Turbines Nos. 6 and11-13 are located in the NW, NE and SE quarters of the SE quarter of Section 20. Ownership of the parcels containing proposed turbine and access road locations changes through time but no buildings are shown within the portion of the proposed undertaking in Section 20 on any of the plats.

The proposed turbine site and access road for Turbine No. 10 is located in the NW quarter of the NW quarter of Section 29. The plats show this location within property owned by the Warren County Farm. Warren County is the current property owner. The St. Louis branch of the Chicago, Burlington and Quincy Railroad ran just to the west side of the proposed Turbine No. 10 location. The CB&Q tracks were taken up in 1958 (Warren County Genealogical Society 2003). No buildings are shown within the portion of the proposed undertaking in Section 29 on any of the plats.

The proposed turbine sites and access roads for Turbines Nos. 1-5 and 7-9 and a proposed substation are located in the E1/2 of the NW and SW quarters and the W1/2 of the NE and SE quarters of Section 30. Ownership of the parcels containing proposed turbine and access road locations changes through time but no buildings are shown within the portion of the proposed undertaking in Section 30 on any of the plats.

The proposed location of an electrical substation is in an agricultural field on the southwest corner of U.S. Route 67 and 140th Avenue. The 1893 plat of Lenox Township depicts a cemetery on that corner (Appendix A: Figure 6). On the plat, the cemetery is within the boundaries of the Warren County Farm. Maps and local histories verify that the cemetery was associated with that facility. The facility was established in 1859 and closed in 1970. The County Farm residence was located on the east side of U.S. Route 67, almost opposite the cemetery. The cemetery appear s

on the 1982 edition of the Kirkwood East Quadrangle (Appendix A: Figure 9) but does not appear on the 1998 edition. Prior to a U.S. Route 67 widening project in 1991, state and county officials supervised the removal of the cemetery burials (Appendix C). One hundred burials were reinterred at the Lenox Union Cemetery and a marker was placed at the former cemetery location (Warren County Genealogical Society 2003).

FIELD SURVEY

A phase I reconnaissance survey of the proposed Monarch Wind Farm project in Lenox Township, Warren County, Illinois was conducted on May 25-27, 2010. Field methods employed during the survey were in accordance with the Illinois Historic Preservation Agency's *Protecting Illinois Cultural Resources - An Introduction to Archaeological Surveys* Cultural Resources guidelines and the *Survey and Reporting Requirements Addendum* memorandum dated 1 January 2005.

The project comprises 13 wind turbine locations, turbine access roads and an electrical substation, all to be located in agricultural fields (Appendix A: Figure 3). The fields are nearly level and were planted with soybeans and corn at the time of the survey. Young plants were 2-4 inches high. Ground surface visibility ranged from 50-90%. That part of the proposed undertaking to undergo ground disturbance, and that part considered here for archaeological investigations includes the wind turbine locations and surrounding 40 meter by 40 meter (131 foot by131 foot) area temporary work areas (40 meter by 80 meter (262 foot) areas for Turbines Nos. 7-9), 3.6 meter (12 foot) wide turbine access roads and a 1.4 acre electrical substation area. Turbine and access road locations had been staked prior to the survey.

Because ground surface visibility was greater than 25%, pedestrian survey methods were used. The access roads were surveyed by walking two parallel transects at a five meter interval. The turbine areas were walked on transects at five meter intervals, centered on each turbine location. The substation area was also walked on transects at five meter intervals. The field survey discussion is divided into four sections based on the grouping of elements of the proposed wind farm.

Area A

This survey area included Turbines Nos. 1-5 and 7-9, turbine access roads and a main access road connecting the turbine locations (Appendix B: Photo 1). The main access road runs between 130th and 140th Avenues. These wind farm elements are located in three fields with varying conditions. The amount of land surveyed in Area A totaled 9.9 acres. Pedestrian survey of Area A did not locate any cultural materials.

Field 1

This survey area included Turbines Nos. 4 and 5, the access road to Turbine No. 9 and 805 meters (2641 feet) of the main access road. There is a shallow drainage swale and a couple of small, shallow depressions along the southern end of the main access. Soil in these areas was wet but soils in the remainder of the survey area were dry. The field was planted in soybeans. Surface visibility was 70%. The survey was conducted parallel to the planted rows.

Field 2

This survey area included Turbines Nos. 8 and 9. The field was planted in corn. Surface visibility was 90%. The survey was conducted parallel to the planted rows.

Field 3
This survey area included Turbines Nos. 1-3 and 7, the 220 meter (722 feet) access roads for Turbines Nos. 7 and 8 and 805 meters (2641 feet) of the main access road. The field was planted in corn and some crop debris was present. Surface visibility was 60%. The survey was conducted parallel to the planted rows.

Area B
This approximately 2.4 acre survey area is the proposed location of an electrical substation (Appendix B: Photo 2). Area B is located in an agricultural field on the southwest corner of U.S. Route 67 and 140th Avenues. The ground slopes down gradually from the east field edge and then moderately into a wet drainage along the west edge of Area B. The soils in the area were somewhat eroded due to the slope. The field was planted in corn and some crop debris was present. Surface visibility ranged from 50-90%. The survey was conducted parallel to the planted rows. Pedestrian survey of Area B did not locate any cultural materials.

Historical plats and the 1982 USGS 7.5' Quadrangle indicate that the location of the Warren County Farm Cemetery was on the southwest corner of U.S. Route 67 and 140th Avenues. The cemetery was moved in 1991 prior to the widening of U.S. Route 67. A stone monument marks the former cemetery location (Appendix B: Photos 3 and 4). The original cemetery location is now occupied by the shoulder and southbound lane of U.S. Route 67 and a grass-covered drainage swale along the roadway edge (Appendix B: Photos 5 and 6). The former cemetery grounds were disturbed by highway construction.

Area C
This 0.9 acre survey area included Turbine No. 10 and its 150 meter (492 foot) access road (Appendix B: Photo 7). The access road extends south from 140th Avenue. The nearly flat field was planted in corn and some crop debris was present. Surface visibility was 60%. Pedestrian survey of Area C did not locate any cultural materials.

Area D
This 4.3 acre survey area included Turbines Nos. 6 and 11-13 (Appendix B: Photo 8). The1029 meter (3375 foot) access road connecting the turbine locations extends north from 140th Avenue. The survey area is nearly flat with scattered shallow depressions. The field was planted in corn and some crop debris was present. Surface visibility was 60%. Pedestrian survey of Area C did not locate any cultural materials.

SUMMARY AND RECOMMENDATIONS

In May and June of 2009, Edge Consulting Engineers, Inc. conducted a Phase I Archaeological Reconnaissance Survey and Literature Review of several parcels of land located in portions of Sections 20, 29 and 30 of Lenox Township, Warren County, Illinois. The land comprises the proposed Monarch Wind Farm project. The study parcels are located in cultivated fields.

Historical maps indicate the presence of the Warren County Alms House cemetery located on the southwest corner of U.S. Route 67 and 140th Avenue. This is near the location of a proposed electrical substation. The cemetery burials were relocated in 1991 prior to the widening of Route 67 to a four lane divided highway. The former cemetery grounds were disturbed by highway construction. No cultural material was recovered by the survey. No further archaeological work is necessary. It is recommended that the undertaking proceed.

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Anonymous

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Warren County Genealogical Society

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Appendix A

Figures and Maps

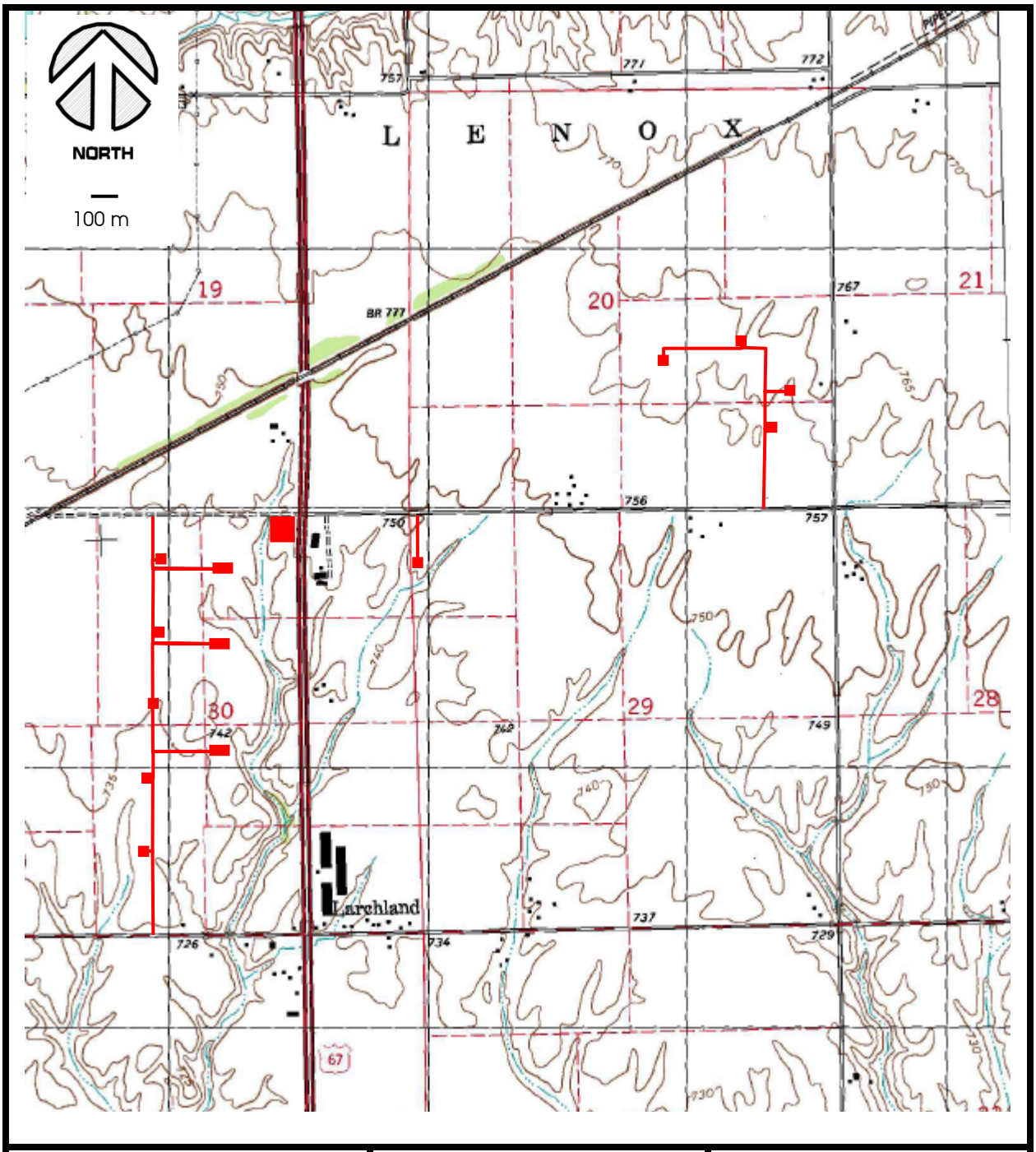


Figure #1 Portion of 1998 USGS 7.5′ Kirkwood East Quadrangle showing the survey areas.	Phase I Archaeological Survey # 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

Figure #2 Aerial photograph showing soil series in the survey areas.	Phase I Archaeological Survey # 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

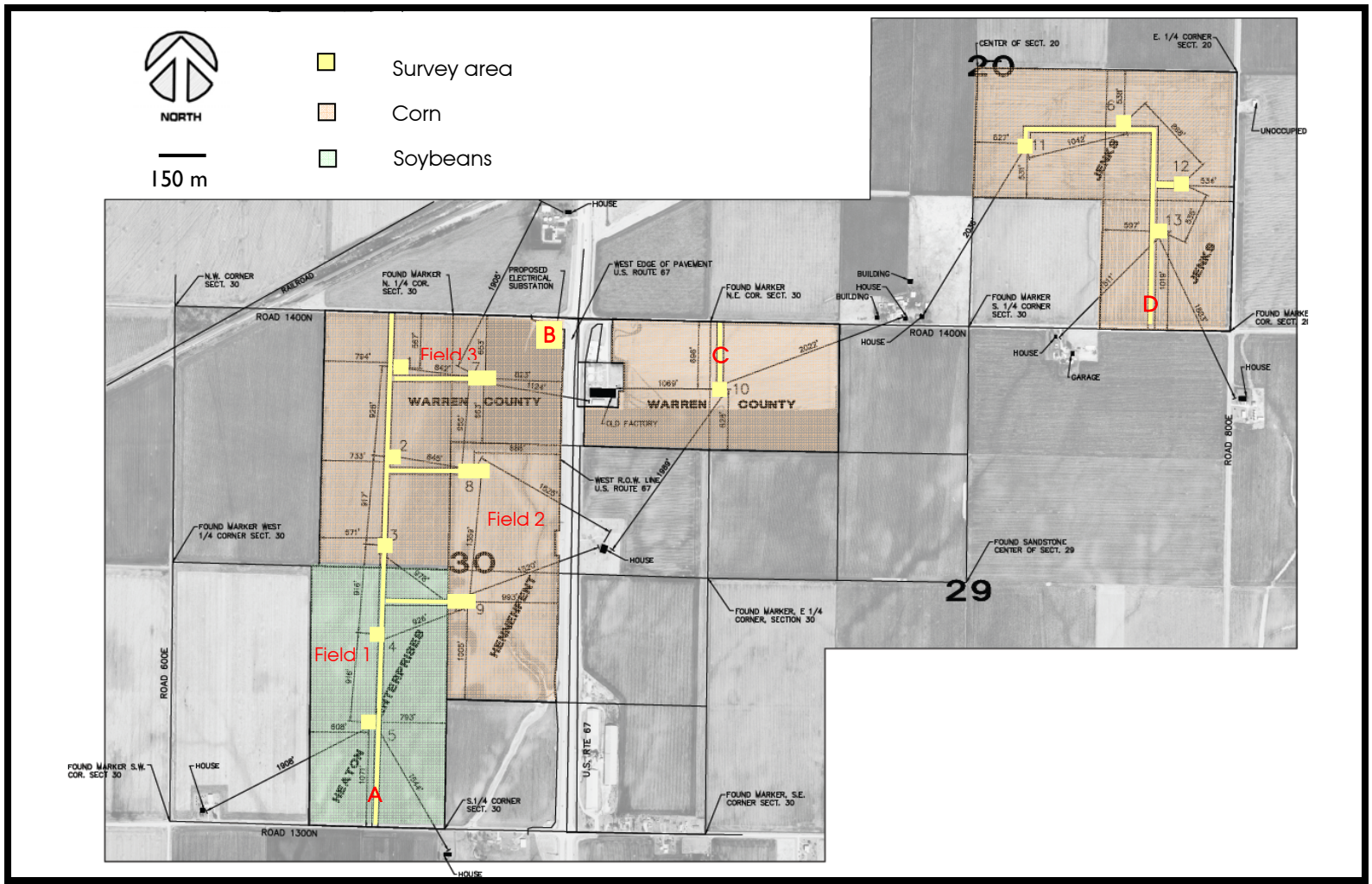


Figure #3
Project Plan showing the survey areas and crop types.

Phase I Archaeological Survey
4846 Monarch Wind Farm
Lenox Township,
Warren County, Illinois

Edge
Consulting Engineers, Inc.

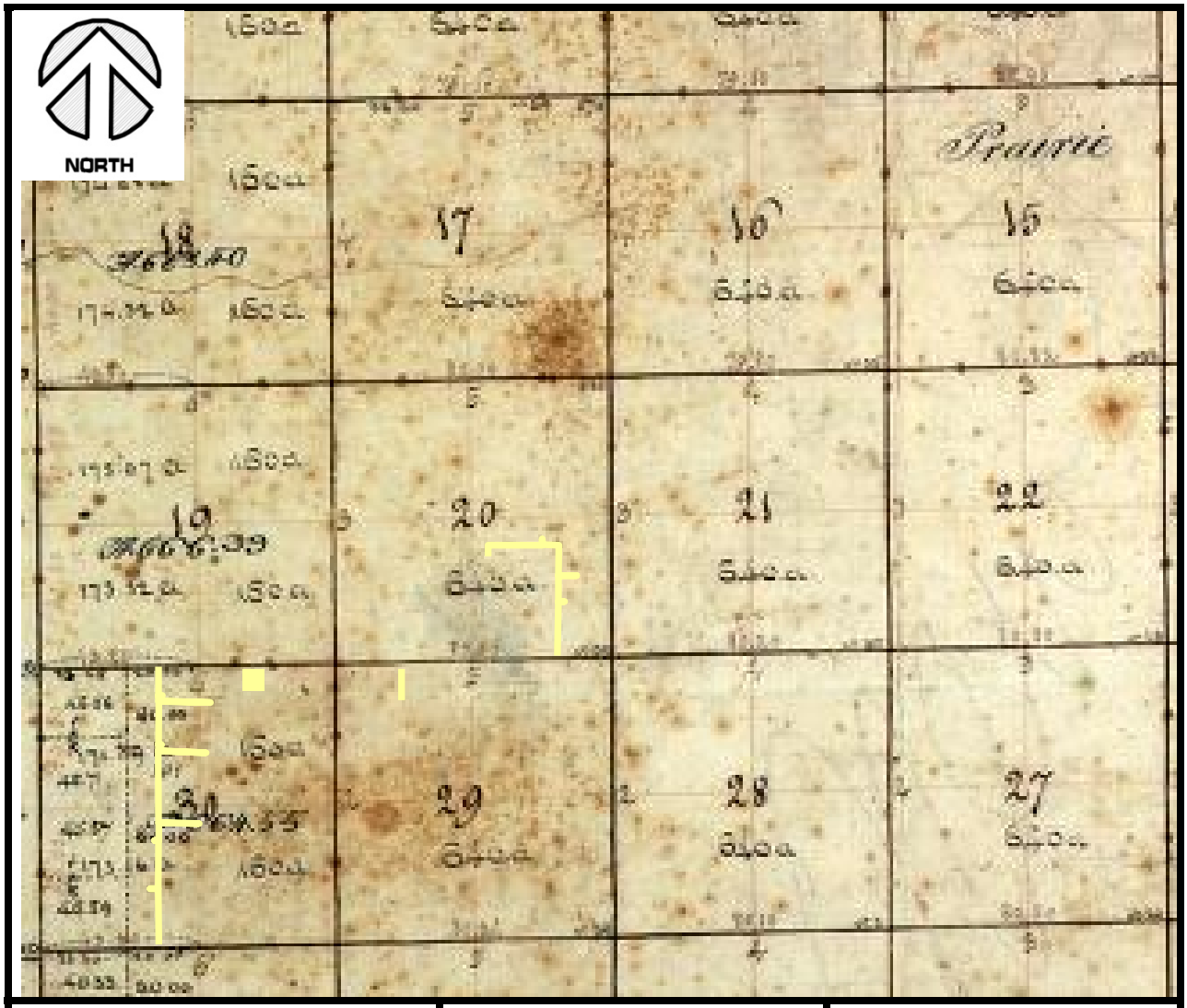


Figure #4
Portion of ca.1844 GLO plat of Lenox Township showing the approximate location of the survey areas.

Phase I Archaeological Survey
4846 Monarch Wind Farm
Lenox Township,
Warren County, Illinois

Edge
Consulting Engineers, Inc.

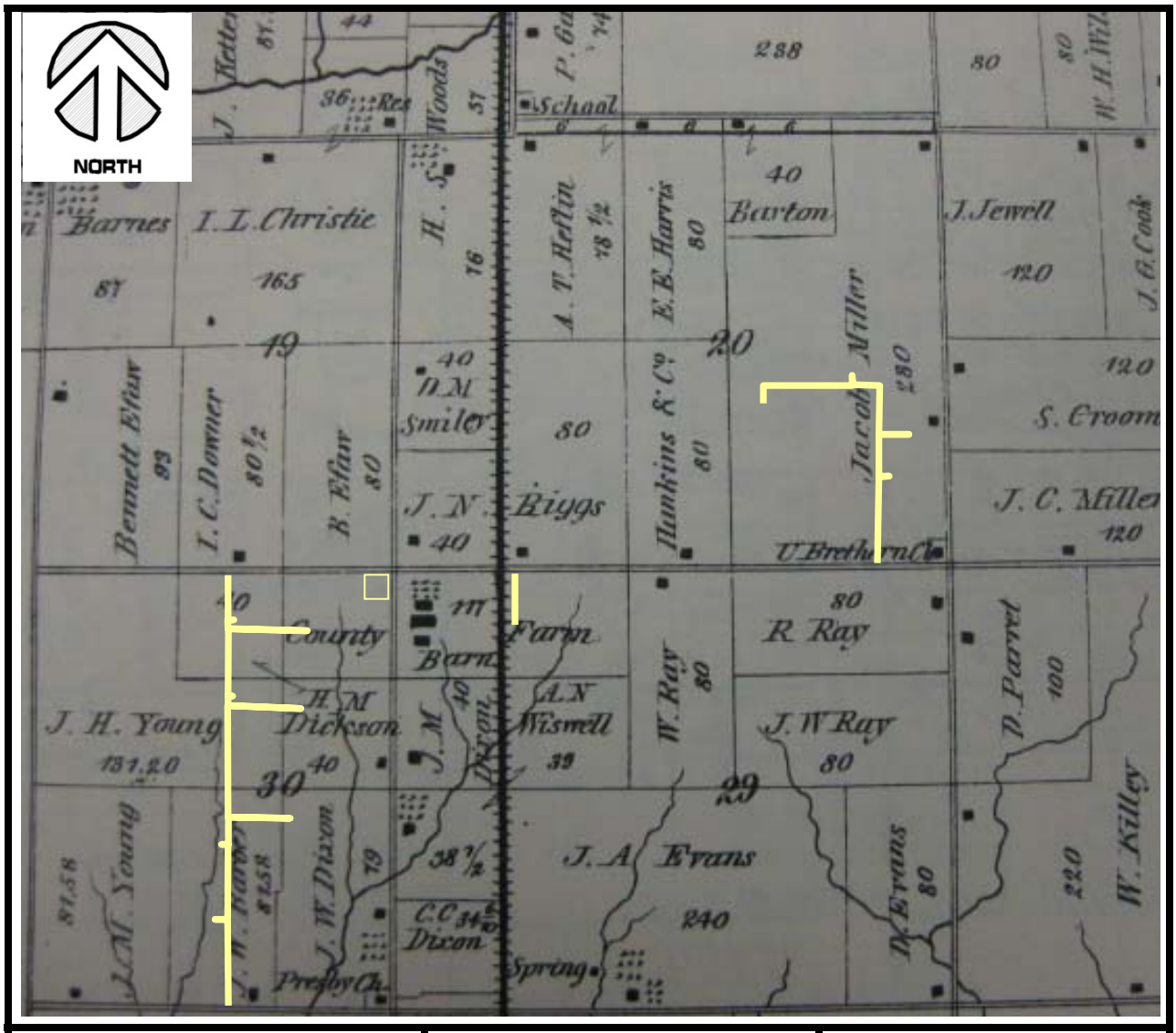


Figure # 5 Portion of 1872 plat of Lenox Township showing the survey areas.	Phase I Archaeological Survey # 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

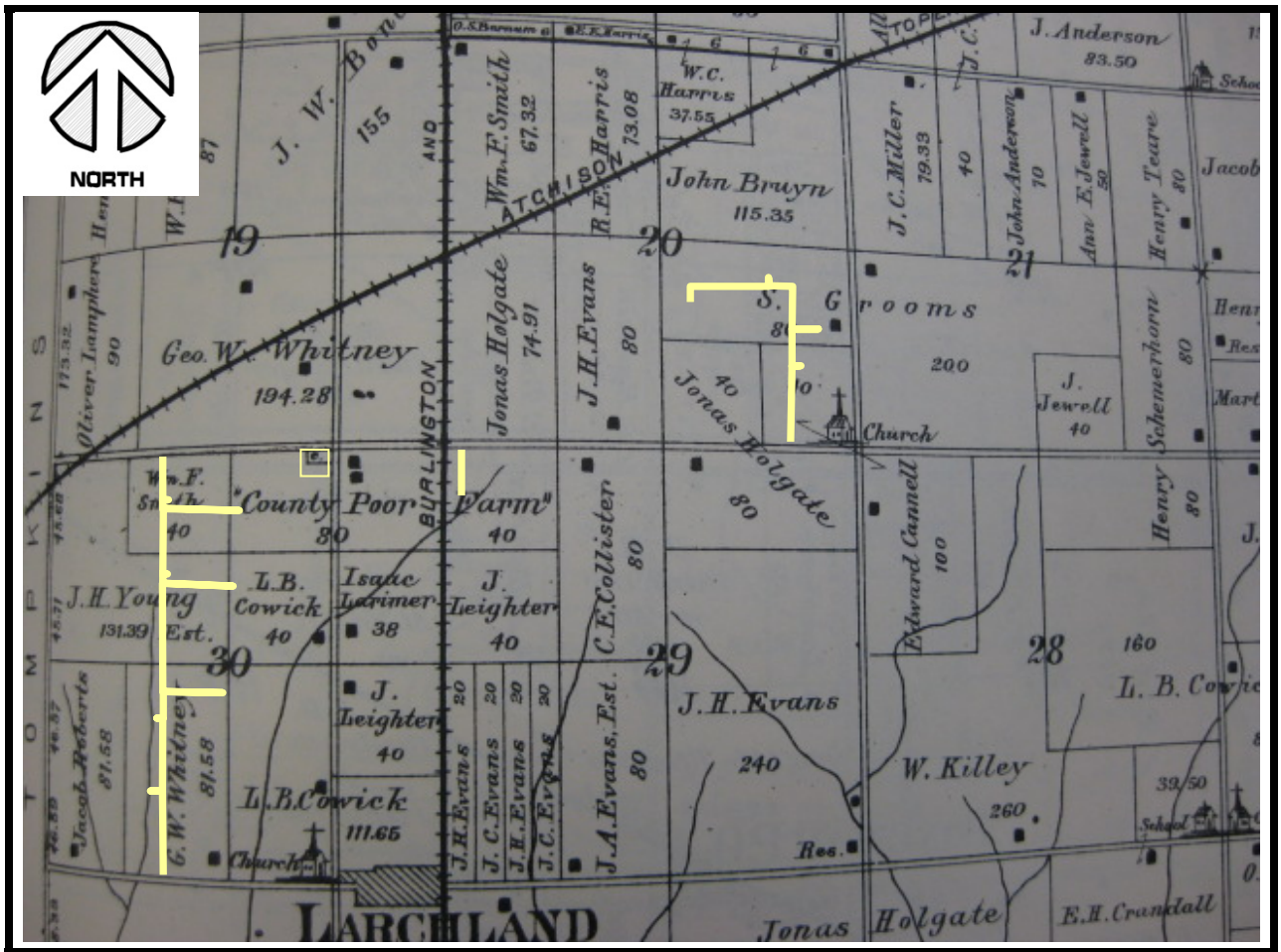


Figure # 6 Portion of 1893 plat of Lenox Township showing the survey areas.	Phase I Archaeological Survey # 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

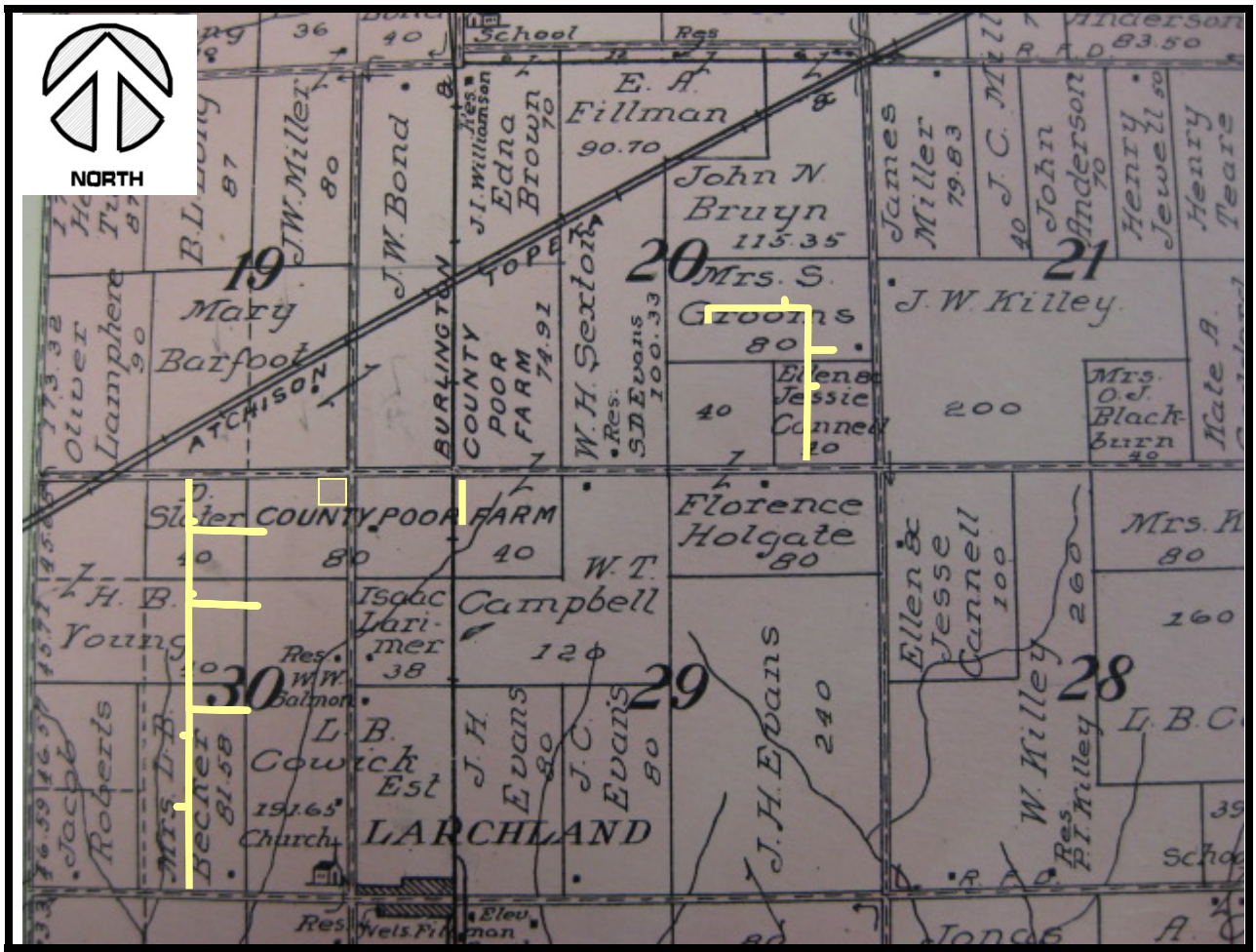


Figure # 7 Portion of 1912 plat of Lenox Township showing the survey areas.	Phase I Archaeological Survey # 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

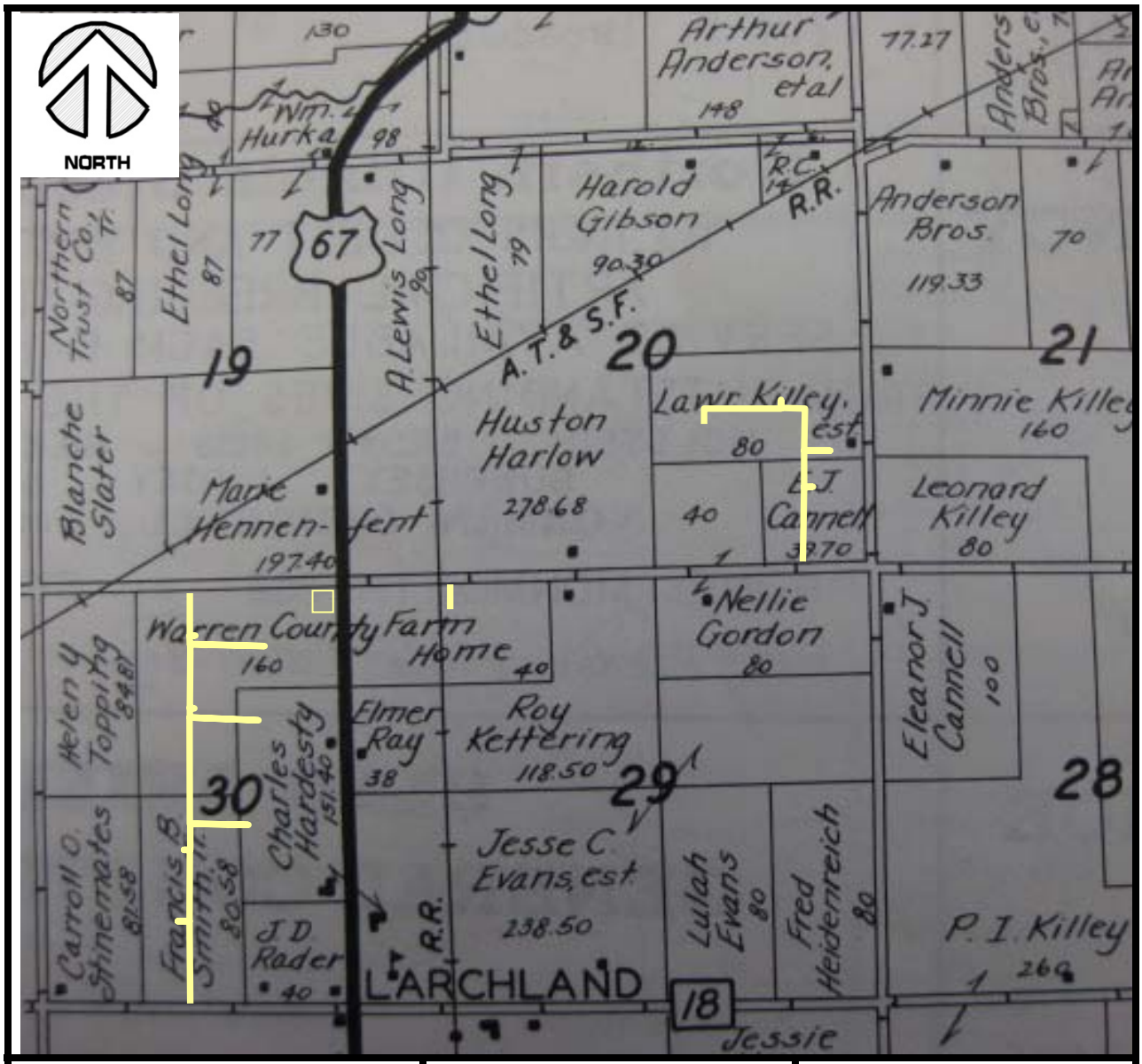


Figure # 8 Portion of 1956 plat of Lenox Township showing the survey areas.	Phase I Archaeological Survey # 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

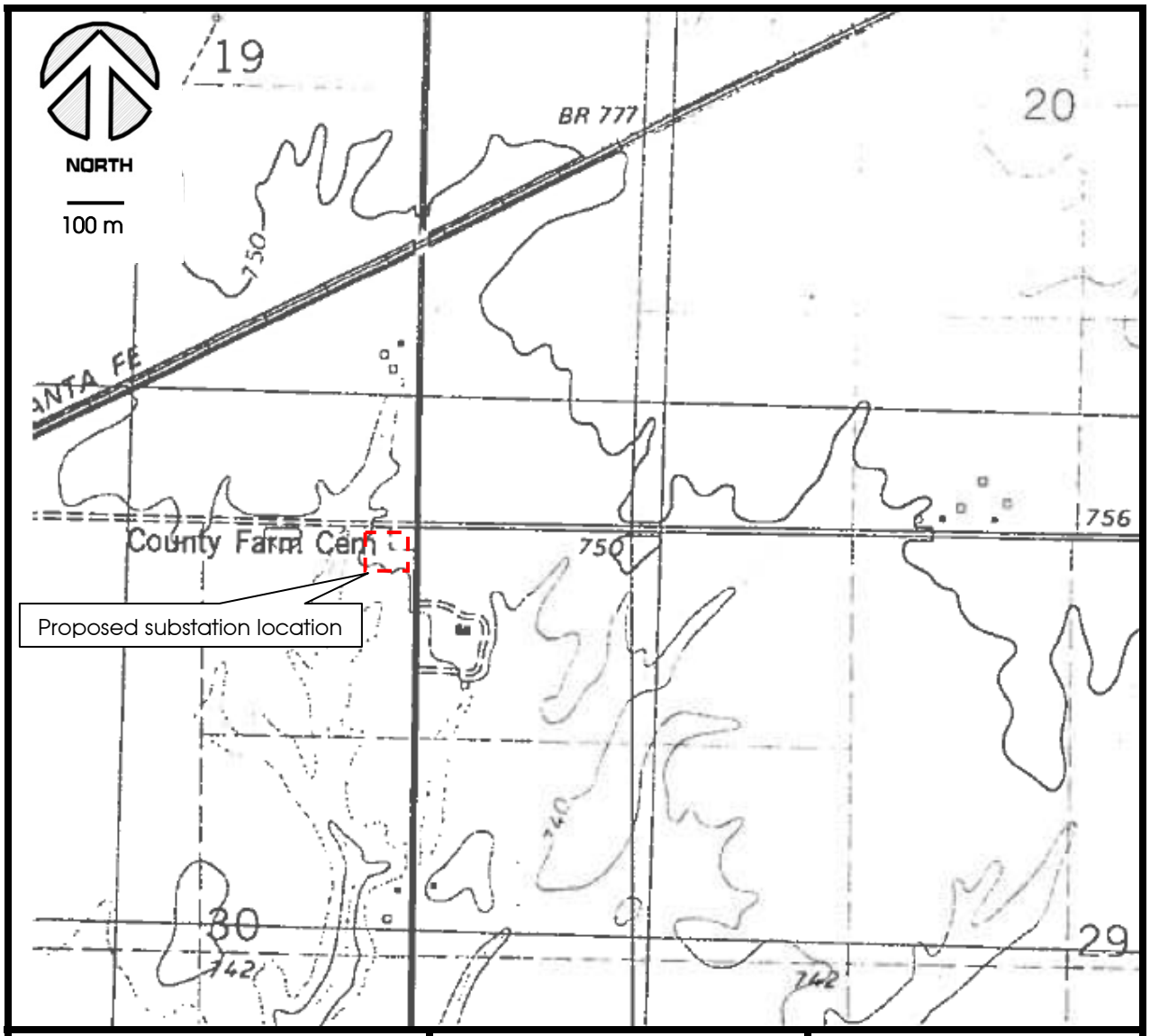


Figure # 9 Portion of 1982 USGS 7.5' Kirkwood East Quadrangle.	Phase I Archaeological Survey # 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

Appendix B

Project Photographs

Photo 1 – Survey Area A looking south.

Photo 2 – Survey Area B looking south.

Site Photographs	Phase I Archaeological Survey # 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

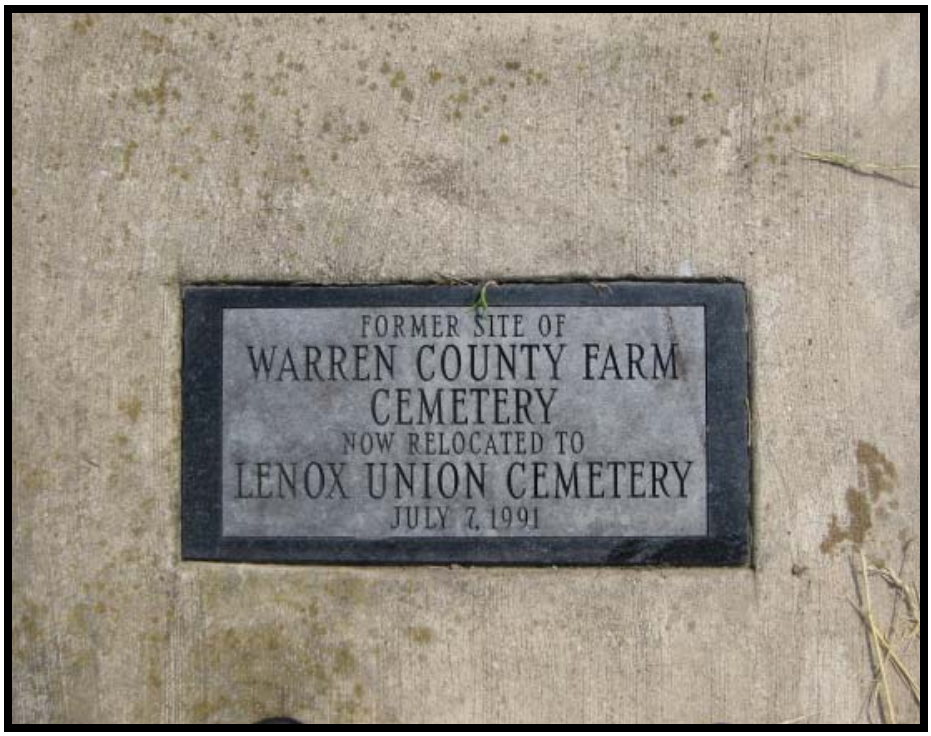


Photo 3 – Warren County Farm Cemetery relocation marker.

Photo 4 – Warren County Farm Cemetery relocation marker facing south.

Photo 5 – Former Warren County Farm Cemetery location facing south.

Photo 6 – Former Warren County Farm Cemetery location facing north.

Site Photographs	Phase I Archaeological Survey # 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

Photo 7 – Survey Area C looking south.

Photo 8 – Survey Area D looking north.

Site Photographs	Phase I Archaeological Survey # 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

Appendix C

Warren County Farm Cemetery Background Documents

Hoover-Hall Memorial Chapel, P.C.

Stephen S. Hall — Directors — Aloysius J. McGuire

900 North Main Street
Monmouth, Illinois 61462-1205
Telephone 309/734-7730
Fax 309/734-7044

200 East Hunt
Alexis, Illinois 61412
Telephone 309/482-6142

To whom it may concern,

During the months of June, July and August, 1991, human remains were disinterred from the Warren County Cemetery located on the Warren County, Illinois, farm at the intersection of U.S. Route 67 and 140th Avenue. This action came about because of the expansion of U.S. Route 67 from a two (2) lane to a four (4) lane highway. The remains were re-interred in Union Cemetery located in rural Warren County, Illinois.

I was a funeral director with Hoover Memorial Chapel at the time and oversaw the operation that was undertaken by the three Warren County funeral homes (Hoover Memorial Chapel, Corman Memorial Home and Turnbull Funeral Home). To the best of our abilities all human remains were removed from the site based on the technology and equipment available at the time. All due diligence was used during the operation but I cannot guarantee that no human remains are not still present at the site.

This letter was prepared on my behalf and the request of Warren County State's Attorney, Albert G. Algren. If you have any questions you may contact me at:

Hoover-Hall Memorial Chapel
900 North Main Street
Monmouth, Illinois 61462
(309) 734-7730.

Sincerely,

Stephen S. Hall

Stephen S. Hall
Funeral Director

Sworn to before me this 8th day of June, 2010.

Tammy L Davis

Notary Public

OFFICIAL SEAL
TAMMY L DAVIS
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES 4-5-2013

Making way for a highway

Register Mail

State to begin exhuming burials in old 'poor farm'

By CAROL CLARK
Staff Writer

MONMOUTH — Years ago, before public aid and welfare, many indigent citizens were shuttled off to county poor farms to spend their remaining days.

Their existence depended on the township where they had lived for monetary support and on the food products raised at the farm.

Warren County had such a poor farm, and across the road from the county farm was the cemetery where many of its residents were buried.

The lives of many of those who lived at the poor farm were filled with hardship, and it is those same men and women who will have to endure hardship even in death — the exhumation and reburial of their remains.

The relocation of those remains is the price to be paid for progress — a four-lane road linking Monmouth and Macomb.

The state will soon begin the monumental task of locating, exhuming and reburying the remains of 40 or so individuals buried in the County Farm Cemetery, commonly called the paupers cemetery, located west of the former Warren County Home.

Most of the burials there were pre-1900, which makes the task "a logistical nightmare," Dan Turner, chief negotiator for land acquisition for the Illinois Department of Transportation, told members of the Warren County Board last week.

Relocating the cemetery is necessary because it lies in the path of a new four-lane roadway. The land where the cemetery is located is owned by Warren County, and at its Dec. 10 meeting, the county board agreed to sell that land and a small portion of land on the east side of the roadway to the state for a right-of-way. In all, the state will buy 9.798 acres of land for $21,100.

The major problem facing the state and local funeral homes who will be doing the work is identifying the grave sites.

"I'd be surprised if there were more than stains in the ground" Richard B. Cridlebaugh, chief appraiser for land acquisition for the IDOT told the county board Dec. 13.

Cridlebaugh said that once the exhumation begins, the local funeral homes will dig down six feet and put whatever is there in a casket for reburial.

History books on Warren County all mention in some detail how the county farm, or the "poor farm" as it was most often called, was formed. But there is little written information on who is buried in that cemetery, and when or where the burials were made.

The most complete information on the cemetery was compiled in 1981 by the Warren County Genealogical Society and it is that information state officials will be using when relocating the remains.

Turner said last week that all the information the state has on the cemetery is from the local genealogical society.

"The county farm, in its earlier time known as the Warren County Alms House, was established to care for and give shelter to those individuals who either had not the ability or were without the resources for maintaining themselves," the genealogical society wrote in a history of the county farm cemetery. "The cemetery was for inmates of the farm who died without the means for burial elsewhere. Most of the burials were prior to 1900."

There is one large monument near the front of the cemetery bearing the names of 20 individual.

The earliest burial on that marker is that of A. Vandermarker who died April 17, 1863. The last burial listed on that marker is A. Johnson who died Jan. 8, 1884.

In the shadow of that monument are two small stones in memory of Oscar Young, 1844-1931 and Jennie Bebee, 1871-1936. Bebee's burial appears to be the last one in the cemetery.

There are 18 other small monuments behind the large marker.

The earliest grave among those markers appears to be J. Peterson who died April 30, 1885, and the latest is that of Ellen Chandler, who died Jan. 27, 1893.

The late Ralph Eckley, a newspaper man and Monmouth historian, said in the October 1988 issue of LifeTimes Magazine, "The history of the county farm goes back 125 years, for at the June term of the county court, in 1853, a petition was presented by Abner C. Harding asking the court to purchase land and to use it for the care of the poor. It was four years later, in June 1857, before the court took the step and bought 120 acres of land in Lenox Township for $3,360.

"A building was presently erected and became available in the fall of 1859. A century ago it housed 27 inmates, 12 males and 15 females. Before the new building became available in 1904, there were 40 inmates. The greatest number of inmates in the old building was 63 and then the 1904 building had as many as 80 as recently as 1922."

The History of Warren County, published in 1903, said, "It was not until the June session of the county court, in 1853, that any definite steps were taken to provide a home for the poor of the county. Prior to that date, Warren County, in common with other counties, let out its poor to the person who could maintain them at the lowest expense to the county."

After the formation of townships, the individual townships farmed out the poor. At the Dec. 10, 1856, meeting of the county board of supervisors, a committee was appointed to purchase a tract of land which would be suitable for the county farm.

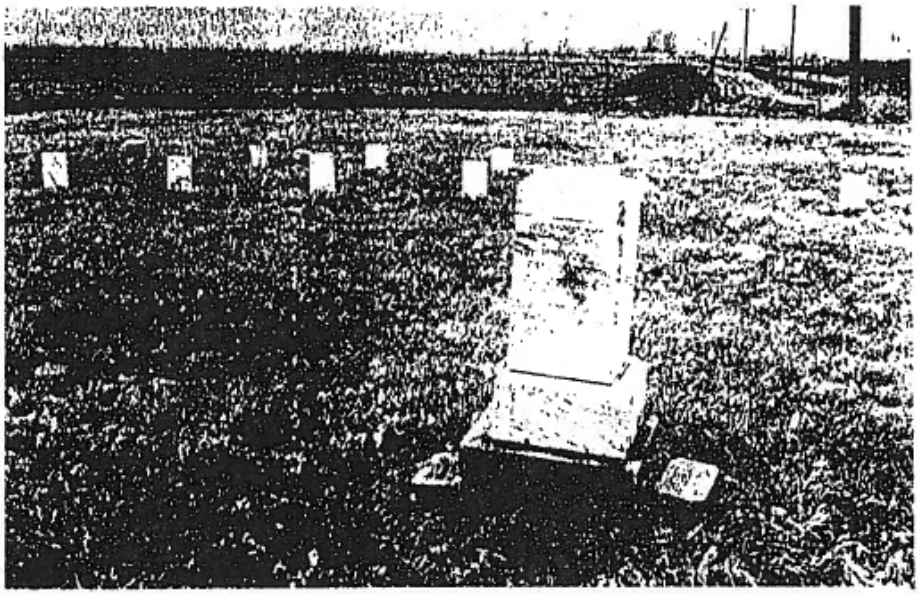
That same month, the committee recommended that 120 acres in Lenox Township, five miles south of Monmouth, be purchased from Luther Dickson for $3,360, or $28 per acre.

The first Warren County Alms House, as it was originally called, opened in the fall of 1858 and cost about $3,000 to build. The second, larger Alms House cost about $50,000. It closed around 1970 and was torn down shortly after.

The home was nearly self-sufficient. The barns included a model dairy barn and feeding floors, an up-to-date poultry house and vegetable cellar.

Milk came from 15 purebred Holstein cows, and 250 hogs and 800 chickens furnished eggs, poultry and pork.

Eckley reported that the county did not pay for the care of the men and women who lived there because the various townships levied a house tax to support those township residents who lived at the county farm. Other income was generated from the rental of the farm, he said.



Register-Mail photo by Carol Clark

County Farm Cemetery

The remains of about 40 individuals buried in the County Farm Cemetery west of the former Warren County Home will be exhumed and relocated to make way for a four-lane road linking Monmouth with Macomb. This large marker, which bears 20 names, dwarfs about 20 smaller stones throughout the paupers cemetery. Residents of the county's "poor farm" are buried in the cemetery.

1991 Galesburg Register Mail article.

Appendix D

Illinois Archaeological Survey Short Report

Project Correspondence

ARCHAEOLOGICAL SURVEY SHORT REPORT
Illinois Historic Preservation Agency
Old State Capital Building
Springfield, Illinois 62701 (217/785-4997)

REVIEWER_____
Date: _____
_____Accepted _____Rejected
IHPA USE ONLY (Form ASSR0886)

IHPA Log # 038021610

Locational Information and Survey Conditions

County: Warren

Quadrangle: Kirkwood East

ProjectType/Title: New Construction, Monarch Wind Farm, East and West sides of U.S. Route 67 between 130th Ave. and 150th Ave.

Funding and/or Permitting Federal/State Agencies: DOE
(i.e., CoE, HUD, IEPA, FmHA, etc.)

Sec: 20, 29 and 30 T.: 10N R.: 2W Natural Division (No.): 7a

U.T.M.: Zone 15, 697986 E, 4522763 N near center of survey areas (Turbine # 10 location)

Project Description: Phase I archaeological reconnaissance survey for a proposed wind farm project on agricultural land approx.. four miles south of Monmouth Illinois

Topography: Uplands

(Soils) Osco silt loam, Muscatine silt loam and Sable silty clay loam

Drainage: Cedar Creek to Spoon River

Land Use/Ground Cover (Include % Visibility): Agriculture/young row crops, 50-90% visibility

Survey Limitations: None

Archaeological and Historical Information

Historic Plats/Atlases/Sources: 1872, 1893, 1912 and 1956 plats and atlases

Previously Reported Sites: None within 1 mile

Previous Surveys: ASSR # 2959, 1158 within 1 mile

Regional Archaeologists Contacted: Mark Branstner

Investigation Techniques: Pedestrian survey at 5 m intervals within 40 m by 40 m areas around wind tubine locations (40 m by 80 m for turbines 7-9), double pedestrian transects at 5 m intervals along access corridors.

Time Expended: 3 person days

Sites/Find Spots Located: None

Cultural Material: N/A

(Curated at) N/A

Collection Techniques: N/A

Area Surveyed (Acres & Square Meters): 17.5 acres/70767 square meters

(OVER)

Results Of Investigation And Recommendations: *(Check One)*

☒ Phase I Archaeological Reconnaissance Has Located No Archaeological Material; Project Clearance Is Recommended.

☐ Phase I Archaeological Reconnaissance Has Located Archaeological Materials; Site(s) Does (Do) Not Meet Requirements For National Register Eligibility; Project Clearance Is Recommended.

☐ Phase I Archaeological Reconnaissance Has Located Archaeological Materials; Site(s) May Meet Requirements for National Register Eligibility; Phase II Testing Is Recommended.

☐ Phase II Archaeological Investigation Has Indicated That Site(s) Does (Do) Not Meet Requirements for National Register Eligibility; Project Clearance Is Recommended.

☐ Phase II Archaeological Investigation Has Indicated That Site(s) Meet Requirements For National Register Eligibility; Formal Report Is Pending And A Determination Of Eligibility Is Recommended.

Comments:

Archaeological Contractor Information:

Archaeological Contractor: Edge Consulting Engineers, Inc.

Address/Phone: 624 Water Street

Prairie du Sac, WI 53578 (608) 644-1449

Surveyor(s): Richard B. Johnson Survey Dates(s): May 25-27, 2010

Report Completed By: Richard B. Johnson Date: 6/17/2010

Submitted By (Signature And Title): Archaeologist

Attachment Check List: *(#1 Through #4 Are **MANDATORY**)*

☒ 1) Relevant Portion Of USGS 7.5' Topographic Quadrangle Map(s) Showing Project Location And Any Recorded Sites;

☒ 2) Project Map(s) Depicting Survey Limits And, When Applicable, Approximate Site Limits, And Concentrations Of Cultural Materials;

☐ 3) Site Form(s): Two Copies Of Each Form;

☒ 4) All Relevant Project Correspondence;

☒ 5) Additional Information Sheets As Necessary.

Address Of Owner/Agent/Agency To Whom SHPO Comment Should Be Mailed:

Edge Consulting Engineers, Inc.

624 Water Street

Prairie du Sac, WI 53578

Contact Person: Ms. Tracy Drunasky , Phone Number: (608) 644-1449

Reviewers Comments:

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_____

_____

Illinois Historic
Preservation Agency

FAX (217) 782-8161

1 Old State Capitol Plaza • Springfield, Illinois 62701-1512 • www.illinois-history.gov

Warren County
Larchland
New Construction, Monarch Wind Farm
East and West sides of U.S. Route 67 between 130th Ave. and 150th Ave.
MEAI-03-15-10014
IHPA Log #038021610

March 5, 2010

MACOMB
RECEIVED
MAR 09 2010

Chris Firof
McClure Engineering Associates, Inc.
714 E. Jackson
Macomb, IL 61455

Dear Mr. Firof:

Thank you for requesting comments from our office concerning the possible effects of your project on cultural resources. Our comments are required by Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations, 36 CFR 800: "Protection of Historic Properties".

Our staff has reviewed the specifications of the referenced project as submitted by your office. We cannot adequately review this proposed project until the following additional documentation has been submitted to our Agency:

Architectural survey of project area documenting structures within the viewshed of any proposed turbine, clearly labeled and keyed to a site map.

In your reply, please refer to IHPA Log #038021610. If you have any further questions, please contact me at 217/785-5027.

Sincerely,

Anne E. Haaker

Anne E. Haaker
Deputy State Historic
Preservation Officer

Attachment B-5

Architectural Survey

Edge
Consulting Engineers, Inc.

624 Water Street
Prairie du Sac, WI 53578
608.644.1449 phone
www.edgeconsult.com

Architectural Survey
Monarch Wind Farm Project
Lenox Township, Warren County, Illinois
IHPA Log # 038021610

Prepared for:

Monarch Wind Power LLC
1455 Delbrook Way
Marco Island, Florida 34145-4603

Edge Project Number 4846

June 18, 2010

INTRODUCTION

On From May 24 through June 18, 2010, Mr. Richard Johnson, Archaeologist with Edge Consulting Engineers, Inc. completed an architectural review within the visual Areas of Potential Effects (APE) surrounding the proposed turbine locations of the Monarch Wind Farm (IHPA Log # 038021610). The project will consist of 13 turbines and an electrical substation. The proposed undertaking is located east and west of U.S. Route 67, in portions of Sections 20, 29 and 30, Township 10 North, Range 2 West of the Forth Principle Meridian (Lenox Township) in Warren County, Illinois (Appendix A: Figure 1).

The review included a field survey and a records review of the area within a 0.75 mile (1.2 kilometer) radius collective visual APE from each proposed turbine location. The field survey comprised photographing all buildings older than 50 years of age. These buildings were evaluated for their eligibility for inclusion on the National Register of Historic Places (NRHP). If a building was determined to have potential eligibility, an assessment was made of visual effects on the historic resource by proposed wind turbine positions.

The field survey and records review of the Monarch Wind Farm collective visual APE identified seven buildings older than 50 years in age. Four of these were determined to be ineligible for inclusion on the NRHP because the buildings are not a good example of a particular architectural style and/or because modifications have resulted in a loss of architectural characteristics. The remaining three buildings may be eligible for listing on the NRHP. An examination was made to determine whether any of the proposed wind turbine locations resulted in visual effects on these architectural resources. It was determined that observers of the primary facades of Architectural Resources A1 and A3 would have no view of proposed turbine locations but an observer of the primary facade of Architectural Resource A2 would have a view of Turbine No. 10.

METHODS

A 0.75 mile collective visual APE that included the individual visual APE of each turbine was mapped onto the USGS Kirkwood East 7.5' Quadrangle (Appendix A: Figure 2). Current NRHP, National Historic Landmark and Historic Architectural and Archaeology Resources Geographical Information System (HAARGIS) records were examined to identify any listed buildings in the Monarch Wind Farm collective visual APE. Historical plats were examined to identify the origins of extant buildings. Local histories were searched to reveal any significant events or persons associated with extant buildings.

Using the USGS/APE map, the field survey was conducted along all public roads within the collective visual APE. Photographs of the principle facade and any unique elements of buildings older than 50 years of age and any buildings for which an age determine could not be made were taken from the public right-of-way. Buildings that were obviously modern or buildings that were not accessible from a public right-of-way were not photographed. Photography logs and field notes were taken. Building locations and orientation of the principle facades were plotted on the map.

Photographs and notes were examined to determine if a building might be eligible for inclusion on the NRHP. Building age determinations were made by comparing extant building locations with building locations on historical plats and by examining architectural style and building materials. If it was determined that a building might be eligible, potential visual effects resulting from proposed wind turbine locations were analyzed.

RESULTS

A review of national, state and local documents pertaining to historical buildings in the vicinity of the proposed undertaking did not reveal any extant listed buildings within the collective visual APE of the current undertaking. The HAARGIS database did list one structure within the collective visual APE of the current undertaking. Property Information Report # 303923 describes the residence and hospital building of the Warren County Farm located near the southeast corner of the intersection of 140th Avenue and US Route 67. This building was constructed in 1903 and facility was closed in 1970. The property surrounding the facility was sold and the building was razed and replaced by a factory, now vacant.

Also, the review did not locate any buildings with a potential for NRHP eligibility under Criterion A) association with events that have made a significant contribution to the broad pattern of history or Criterion B) association with the lives of significant persons or Criterion D) have yielded, or may be likely to yield important information in history or prehistory. Evaluation of eligibility for historical buildings identified within the current undertaking focused on Criterion C) buildings that embody the distinctive characteristics of a type, period or method of construction or that represent the work of a master or that possess high artistic value or that represent a significant and distinguishable entity whose components may lack individual distinction.

Integrity of the original design was considered when evaluating a building. A building was not considered NRHP eligible if modifications have altered the design to a point where the building is no longer a good example of its type. The four buildings in this category identified within the collective visual APE of the current undertaking are included in Appendix A as Modified Resources (Appendix B: Photos 7-14).

There has been a great deal of redevelopment on the farmsteads in the region surrounding the proposed wind farm and in the community of Larchland. Many old residences and outbuildings have been razed and replaced by modern buildings or have been left as vacant spaces. All of the outbuildings within the project collective visual APE are either of modern construction or are common types that do not display distinctive characteristics. The three architectural resources within the Monarch Wind Farm collective visual APE that may be eligible for listing on the NRHP are described below.

Architectural Resource A1: This building is a Queen Anne style residence located just east of the northeast corner of 140th Avenue and 60th Street (Appendix B: Photos 1 and 2). A building first appears in this location on the 1872 plat (Appendix A: Figure 4). It is likely that the extant residence dates to at least that period. The residence has been modernized (windows, roof and siding) and a single-story addition has been added to the back (north elevation) of the residence. Much of the original architectural design and some of the exterior decoration still remain including cutaway and overhanging bays and gable detailing. Architectural Resource A1 may be eligible for listing on the NRHP under Criterion C as a relatively unaltered example of a Queen Anne farmhouse.

The primary facade of Architectural Resource A1 fronts 130th Avenue. An observer viewing the primary facade from the public right-of-way would be facing north and have no view of the proposed wind turbine locations (Appendix A: Figure 2).

Architectural Resource A2: This is a single-story brick commercial building on the north side of 130th Avenue in the unincorporated community of Larchland (Appendix B: Photos 3-5). The

building has a new metal roof and new siding on the front gable end but the rest of the building does not appear altered. The front of the building is shaded by a metal shed roof and has an entrance centered on the elevation. There is a large window to the left of the entrance and an overhead garage door to the right. Although the window is boarded, it probably fronts an office area. There is a mechanics bay behind the garage door. Windows in the north half of the building have arched white brick lintels and sills. The large front window is trimmed in white brick. A small brick chimney extends from the roof ridge near the north end of the building. The north end of the building has a hipped roof. A small brick structure with shed roof behind the larger building may be a privy.

Plats do not depict individual buildings within Larchland but a local history describes a gas station operated in the early 1930s in which the operator lived in the north part of the building (Warren County Genealogical Society 2003). The description in the local history fits with the characteristics of Architectural Resource A2 with the office and mechanics bay fronting 130th Avenue representing the commercial enterprise and the windowed north portion with chimney and possible privy representing the living quarters. Architectural Resource A2 may be eligible for listing on the NRHP under Criterion C as a local example of a historic commercial building.

The primary facade of Architectural Resource A2 fronts 130th Avenue. An observer viewing the primary facade from the public right-of-way would be facing north. To the observer, the proposed location of Turbine No. 10 would be a couple degrees east of north at a distance of 0.9 miles. The observer would have a view of the proposed wind turbine location (Appendix A: Figure 3).

Architectural Resource A3: This building is a vernacular cross-gabled residence located on the west side of US Highway 67 between 140th Avenue and the BNSF railroad (Appendix B: Photo 6). A building first appears in this location on the 1893 plat (Appendix A: Figure 5). There is no building depicted in the location on the 1872 plat indicating that the extant residence was constructed between those two dates. Although there have been some modernizations to the building (windows, roof), the residence retains most of its original design including flared eaves and a wrap-around porch. Architectural Resource A3 may be eligible for listing on the NRHP under Criterion C as a relatively unaltered example of a vernacular farmhouse.

The primary facade of Architectural Resource A3 fronts US Highway 67. An observer viewing the primary facade from the public right-of-way would be facing west and have no view of the proposed wind turbine locations (Appendix A: Figure 3).

RECOMMENDATIONS

In May and June, 2010, Edge Consulting Engineers, Inc. completed an architectural review within the visual Areas of Potential Effects (APE) surrounding the proposed turbine locations of the Monarch Wind Farm located east and west of U.S. Route 67, in portions of Sections 20, 29 and 30, Township 10 North, Range 2 West of the Forth Principle Meridian (Lenox Township) in Warren County, Illinois

A field survey and records review of the Monarch Wind Farm 0.75 mile (1.2 kilometer) collective visual APE identified seven buildings older than 50 years in age. Four of these were determined to be ineligible for inclusion on the NRHP because the buildings are not a good example of a particular architectural style and/or because modifications have resulted in a loss of architectural characteristics. The remaining three buildings may be eligible for listing on the NRHP.

An evaluation of potential visual effects the proposed wind turbine might have on these architectural resources determined that an observer on the public right-of-way viewing the primary facades of Architectural Resources A1 and A3 would have no view of proposed turbine locations. An observer on the public right-of-way viewing the primary facade of Architectural Resource A2 would have a view of proposed Turbine No. 10 at a distance of 0.9 miles. It is recommended that the location of Monarch Wind Farm Turbine No. 10 will have a visual effect on Architectural Resource A2. No other effects associated with the proposed Monarch Wind Farm were identified.

REFERENCES CITED

Illinois Architectural and Archaeological Resources Geographic Information System (HAARGIS)
2010 Viewed online at http://gis.hpa.state.il.us/hargis on June 14, 2010.

McAlester, Virginia and Lee McAlester
1984 *A Field Guide to American Houses*. Alfred A. Knopf, Inc., New York

National Park Service
2010 National Historic Landmark Program (NHLP). Viewed online at http://tps.cr.nps.gov/nhl/default.cfm on June 14, 2010.
2010 National Register of Historic Places (NRHP). Viewed online at http://nrhp.focus.nps.gov/natreghome.do on June 14, 2010.

United States Geologic Survey
1998 7.5' Kirkwood East, Illinois Quadrangle.
1998 7.5' Berwick, Illinois Quadrangle.

Warren County Genealogical Society
2003 *Warren County, Illinois; History and Families*. Turner Publishing Company. Paducah, Kentucky

Appendix A

Project Maps and Plats

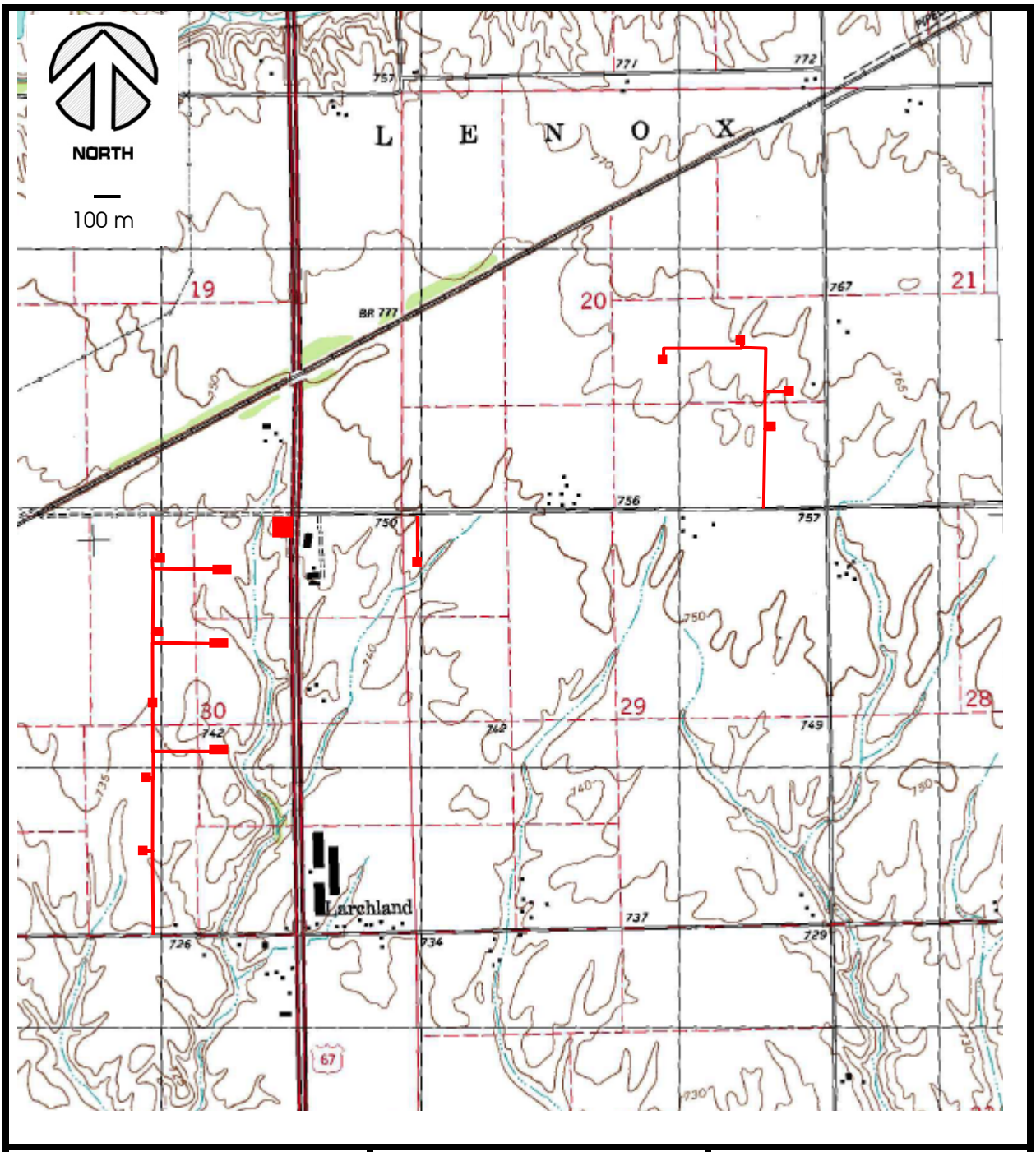

Figure #1 Portion of 1998 USGS 7.5' Kirkwood East Quadrangle showing the project location.	# 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

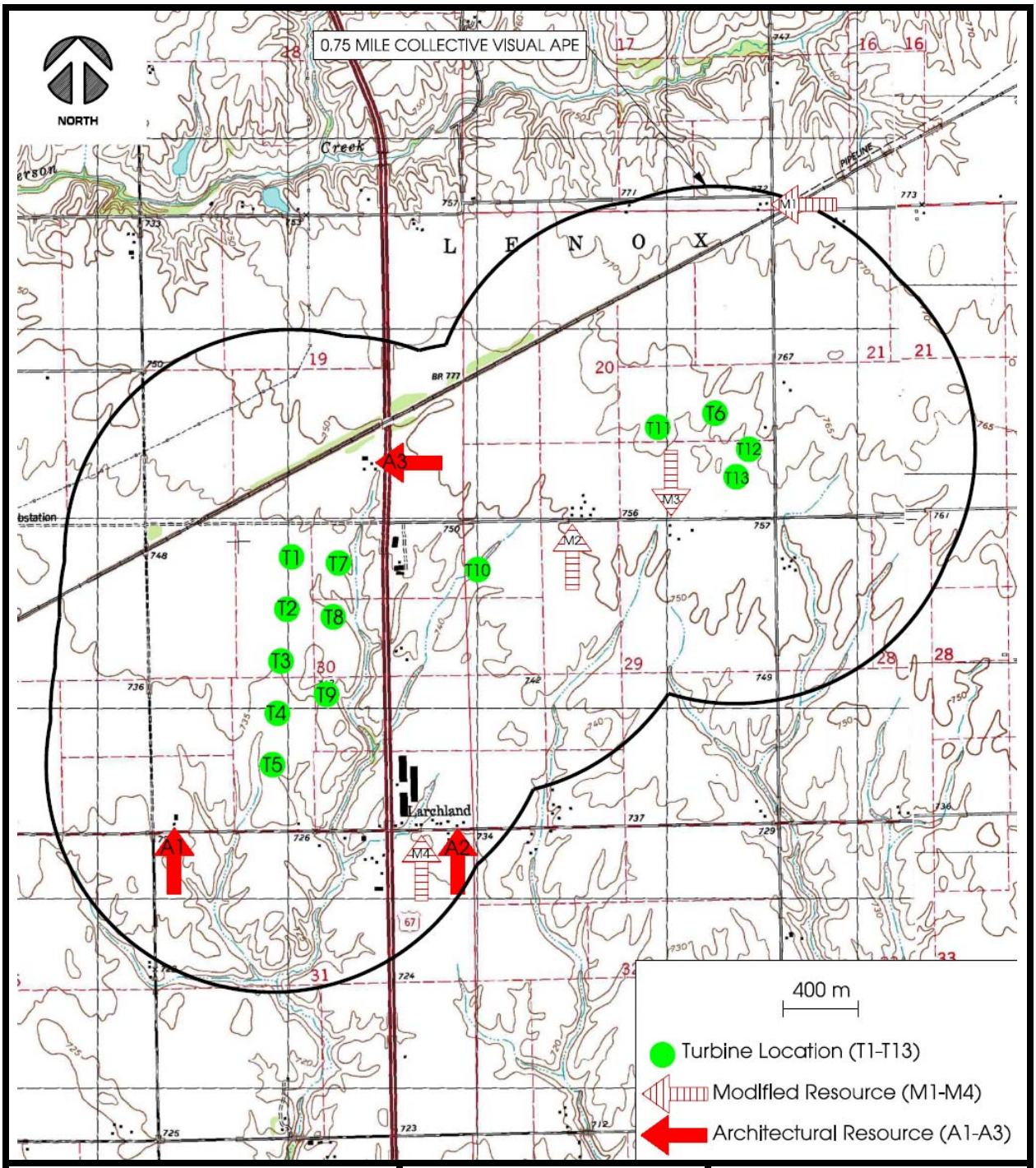

Figure #2
Portions of Kirkwood East & Berwick 7.5' Quadrangles showing the collective visual APE, turbine locations and resource view direction.

4846 Monarch Wind Farm Lenox Township, Warren County, Illinois

Edge
Consulting Engineers, Inc.

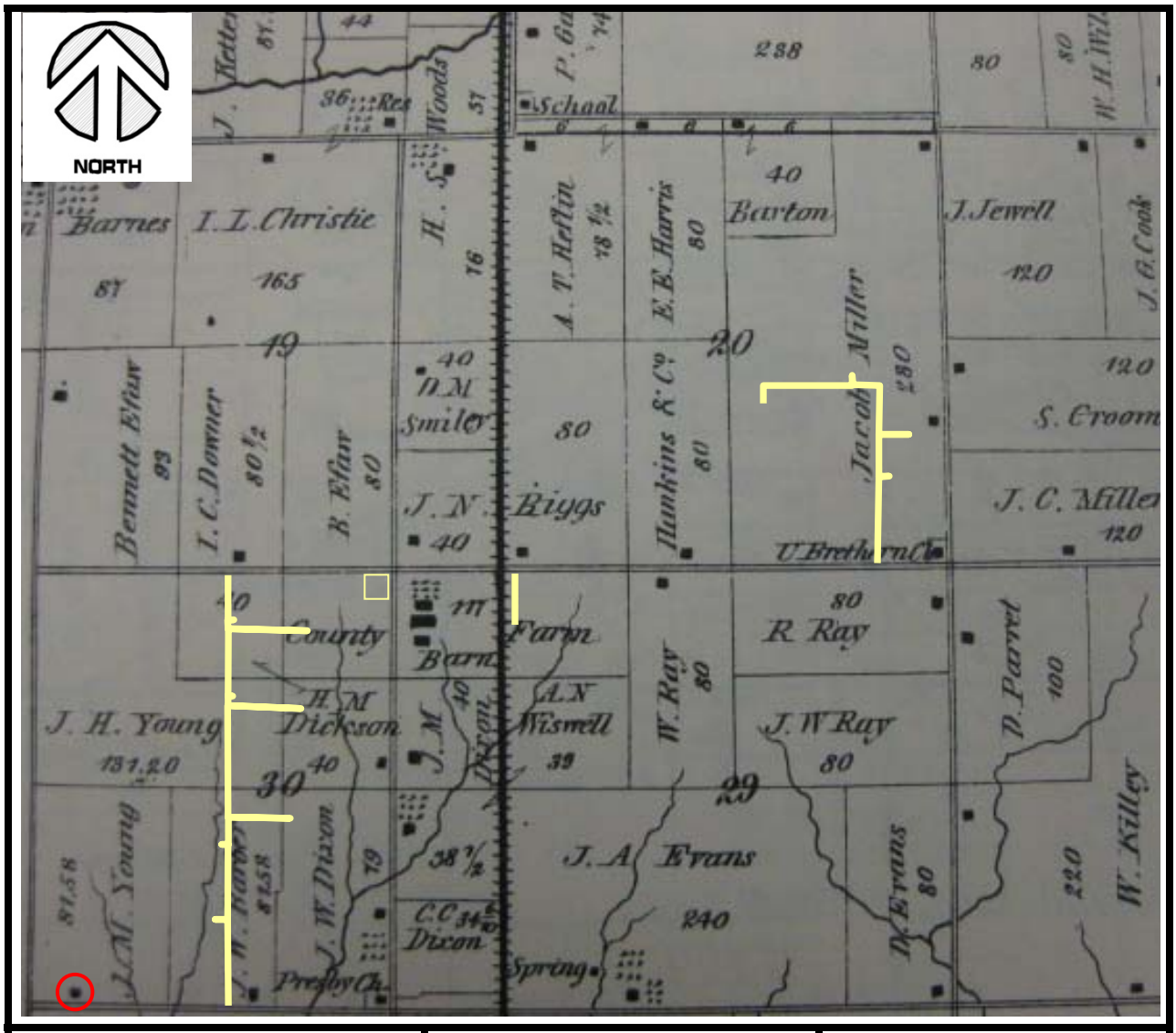

Figure # 3
Portion of 1872 plat of Lenox Township showing the project location and Architectural Resource A1 (red circle).

4846 Monarch Wind Farm
Lenox Township,
Warren County, Illinois

Edge
Consulting Engineers, Inc.

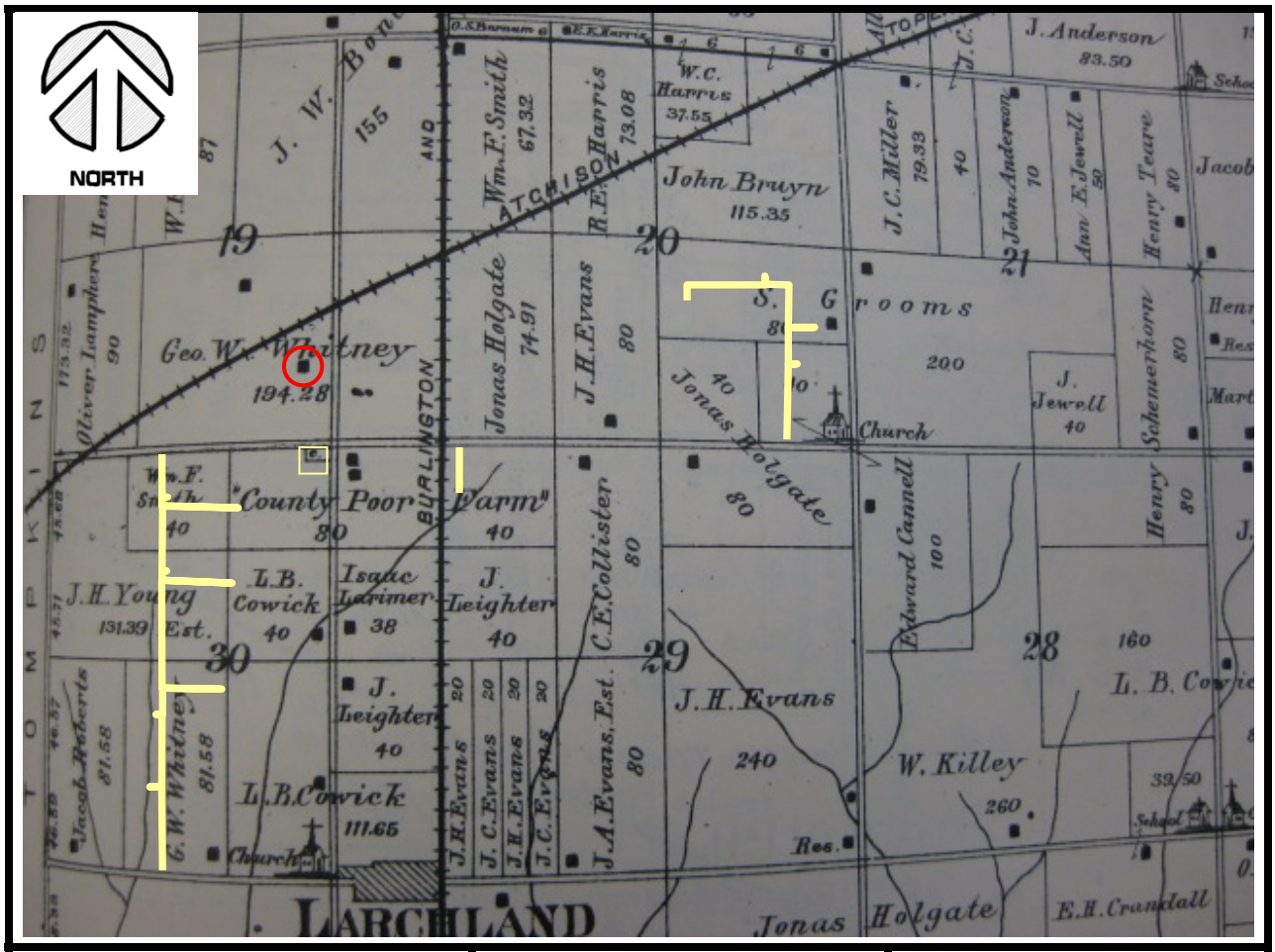

Figure # 4
Portion of 1893 plat of Lenox Township showing the project location and Architectural Resource A3 (red circle).

4846 Monarch Wind Farm
Lenox Township,
Warren County, Illinois

Edge
Consulting Engineers, Inc.

Appendix B

Project Photographs

Photo 1 – Architectural Resource A1, south elevation.

Photo 2 – Architectural Resource A1, west elevation.

Site Photographs	# 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

Photo 3 – Architectural Resource A2, south elevation.

Photo 4 – Architectural Resource A2, west elevation.

Site Photographs	# 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

Photo 5 – Architectural Resource A2, east elevation.

Photo 6 – Architectural Resource A3, east elevation.

Site Photographs	# 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

Photo 7 – Modified Resource M1, east elevation.

Photo 8 – Modified Resource M1, north elevation.

Site Photographs	# 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

Photo 9 – Modified Resource M2, south elevation.

Photo 10 – Modified Resource M2, east elevation.

Site Photographs	# 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

Photo 11 – Modified Resource M3, north elevation.

Photo 12 – Modified Resource M3, east elevation.

Site Photographs	# 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

Photo 13 – Modified Resource M4, south elevation.

Photo 14 – Modified Resource M4, east and south elevations.

Site Photographs	# 4846 Monarch Wind Farm Lenox Township, Warren County, Illinois	Edge Consulting Engineers, Inc.

Attachment B-6

Wildlife Report

Wildlife Study – Monarch Wind Farm Proposal, Warren County, IL

Kenneth L. Cramer, Ph.D.

Modified, 13 February 2010

This study was commissioned by Clean Energy Concepts to assess the potential for the proposed Monarch Wind Farm in Warren Co., IL to impact wildlife populations, and specifically to comply with state and federal regulations regarding threatened and endangered species and habitats.

1) EcoCAT analysis

The project description and area covered was submitted to the on-line service EcoCAT of the Illinois Department of Natural Resources. The automatically generated report (attached) indicated no state-listed threatened or endangered species and no Illinois Nature Preserves or registered Land and Water Reserves in the vicinity of the project location.

Further consultation via e-mail with Keith Shank of the Illinois DNR indicates that migratory birds and bats are the principal concern with the project proposal as with most wind power projects. He also mentioned the nearby prairie remnant that was originally established for a relict population of Massasauga rattlesnakes. These wildlife populations will be addressed below in section 3 on potential wildlife impacts.

2) Site inspection

I drove the area to confirm the habitat types within the study area as identified on aerial and topographic maps, to be sure that no unique or potential valuable habitats were overlooked. More than 95% of the area is developed agricultural land predominantly planted in row crops of corn and soybean with the remainder in small areas (less than 5 ha contiguous) of pasture and small drainages. The entire area of the proposed study is highly modified by human use, principally agricultural.

3) Potential for Wildlife Impacts

a) Threatened and Endangered species

Non-flying species – *Terrestrial wildlife* impact will be minimal. Wildlife remaining in this highly developed agricultural area is highly adapted to human impact and rare species have been extirpated. Row crops do not provide adequate habitat for threatened or endangered species. There is a 6.2 acre Massasauga Prairie Nature Preserve approximately 2 miles southeast of the southeastern corner of the study area which at one time held a relict population of Eastern Massasauga rattlesnakes (*Sistrurus catenatus*). The current status of this endangered species in the area is unknown but they have probably been extirpated. In any case, only building of access roads through prairie habitat would potentially impact this endangered reptile, and given the final proposed locations of the turbines, the closest access road would occur more than 2.5 miles in a direct line from the nature preserve. Thus, there would be no direct impact on this species should it still occur at the site. Since there are no significant wetland areas within the proposed project area, impacts on *aquatic species* will also be negligible. As with any construction project, care should be taken in the design and construction of access roads and turbine tower pads to minimize erosion and runoff into nearby waterways.

Flying species

Residents. There is a remote possibility that some endangered species of grassland ground-nesting birds could nest in the area on pasture or Conservation Reserve Program (CRP) lands. Four species of concern that have been recorded in Illinois and that prefer grassland habitats include Henslow's sparrow (*Ammodramus henslowii*), upland sandpiper (*Bartramia longicauda*), northern harrier (*Circus cyaneus*), and short-eared owls (*Asio flammeus*) (Herkert 1992). However, nearly all of these species except the upland sandpiper require areas of pasture or grassland greater than 50 ha in size for breeding and no fragments approaching this size exist within the project area. If construction of access roads and turbines will intersect large areas of pasture or CRP lands, a breeding bird survey is recommended in these areas to check for these species. Should any be identified, delaying construction in these areas to outside of the breeding season would mitigate impacts. Alternatively, moving access roads or the turbine site to avoid these areas is preferable. Another nesting species of potential concern is the loggerhead shrike (*Lanius ludovicianus*), a species that nests in hedgerows, primarily with Osage orange, multiflora rose, or other spiny or thorny plants. The potential for impact here is even less than with the grassland birds, assuming that fence lines will not be disrupted during construction.

Migrants. Red-shouldered hawks (*Buteo lineatus*) and Swainson's hawks (*Buteo swainsoni*) are the only threatened or endangered raptors potentially migrating through the area, though they are generally associated with forested areas in the eastern part of the state. Whooping cranes (*Grus americana*) from a breeding population established in Wisconsin have been observed at a various localities in Illinois during the fall and spring migrations, but none have occurred in Warren county where wetlands used as migration stopovers are rare. More will be addressed below on the threat to migrating birds in general. Gray bats (*Myotis grisescens*) use caverns in west-central Illinois during late summer early fall as staging areas for migration to over-wintering caves in Missouri (Herkert 1992). Indiana bats (*Myotis sodalis*) are primarily associated with riparian habitat, but migrating to and from winter cave sites could expose them to mortality at the proposed site. However, it is important to note that although hundreds of bat mortalities have been documented at wind farms, no documented mortalities of protected bats have ever been recorded (Kunz et al. 1997).

b) Potential for Bird and Bat Mortality

The impact of wind turbines on birds and bats is the most significant area for potential concern. Any structure rising significantly above the landscape has the potential to cause bird/bat mortality as has been shown in previous studies of television towers, communication towers and tall buildings (Avery and Clement 1972, Crawford and Baker 1981, Hazard 1982, Timm 1989). Because of the high speed of turbine blades (greater than 200 km/h at the tip), however, the potential for evasion by both bats and birds is reduced compared to stationary towers and buildings (Barclay et al. 2007, Horn et al. 2008). Most of the mortality at wind power sites has involved migrating bats and birds, not resident species (Johnson et al. 2002, Johnson et al. 2004)

Birds. Although much concern was raised about large rates of bird mortality from one early project in California that killed large numbers of raptors (Orloff and Flannery 1992), newer monopole construction and careful location of towers away from daily migratory routes has shown this to be an anomaly. Bird mortality at wind turbine installations varies from 0 to 11 birds/MW/year with the highest mortality occurring at forested ridgetop sites (Kunz et al. 2007a). Songbirds (passerines) are most

commonly killed. At a site in Minnesota in habitat similar to that at the proposed project (Johnson et al. 2002), the majority of bird mortalities were passerines. Over 70% were migrants and the remainder were breeding birds (20%) or permanent residents (9%). Only one raptor (large predatory birds such as hawks, eagles, owls) was killed during the 3-year study period. Radar data indicated that over 3.5 million birds migrate over the area each year. Birds generally migrate at heights much above the level of even new, taller turbines. Inclement weather can sometimes drive birds lower so that often much of the kill at turbine sites can be from a single, rare event. At the Minnesota site, 25% of the observed mortality occurred in a single night during a severe thunderstorm that killed 14 birds (Johnson et al. 2002). More than 90% of the mortality was attributed to inclement weather such as fog, gusty winds, or thunderstorms. Another study at the same area estimated avian mortality at <1 bird/turbine/year (Osborn et al. 2000).

The proposed Monarch wind facility lies within the Mississippi migratory flyway and as such has the potential to intercept migrants during inclement weather or when birds are landing or taking off (Kunz et al. 2007a). However, because the sites are not located near any significant habitat such as ponds, lakes or large forested tracts that would be sought by resting migrants, the potential for collision with turbines while ascending or descending is probably very low. Most migratory birds would fly over the predominantly agricultural habitat. Thus, inclement weather forcing birds to migrate at lower altitudes would carry the most potential for causing mortality.

Bats. Although studies of bird and bat mortality at wind facilities is in its infancy, there is a growing literature on the subject that has been recently summarized by Arnett et al.. (2008) and Kunz et al.. (2007a, 2007b). While early studies focused on avian mortality, recent studies have shown that bats are more at risk than birds at most wind turbine installations. Bat mortality varies from 15 to 41 bats/MW/year depending on the habitat type and time of year (Kunz et al.. 2007a). The highest mortality was recorded at a mountain top installation in a forested area where 0.24 bats per *night* per turbine were found dead, or about 90 bats/year/turbine (Kerns et al. 2005).

Three species of lasiurine bats (hoary bat, *Lasiurus cinereus*; red bat, *Lasiurus borealis*; and silver-haired bat, *Lasionycteris noctivagans*) comprise the bulk of mortality at wind turbine sites (Kunz et al. 2007b). It is unknown why this specific group is more vulnerable but multiple studies have shown that these migratory, tree-roosting bats are much more likely to be killed (Johnson et al. 2003, 2004). At a Minnesota wind farm, 76% of bats killed were hoary bats; 90% were hoary or red bats (genus *Lasiurus*). However, other bat species are affected. For instance, Arnett et al. (2008) note that at one Iowa site, 25% of bat mortality was comprised of big brown bats (*Eptesicus fuscus*). In general, bat activity is lower over crop and CRP land (Johnson et al. 2004) and shows no relationship to distance of turbines from nearby woodlots. Mortality rates were about 1-3 bats/turbine/year. Reynolds (2006) reported that most foraging bat activity is below the height of turbine towers (but see Horn et al. 2008 below). His study reinforces the supposition that migrating bats are most at risk.

Cryan and Brown (2007) offer clues to conditions under which migrating bats may be more vulnerable in their study of hoary bat migration past an island stopover point on their migration route in California. Numbers of migrating bats increased with increasing cloud cover and decreasing wind speeds and moonlight. Migration peaked in autumn, a fact that corresponds with information on bat mortality data from wind turbine installations that also peaks in the late summer and early fall (Johnson et al. 2004; Kunz et al. 2007a). Reynolds (2006) also noted that spring bat migration was higher on days with lower wind speeds and warmer weather.

Barclay et al. (2007) showed that at turbine tower heights above 65 meters bat mortality increased exponentially. The diameter of the rotor had no effect on mortality rates. Horn et al. (2008)

used thermal imaging to conclude that bats foraged between 20 and 111m of the ground but were concentrated in the rotor-swept zone (nacelle at 70 m). Two-thirds of the bats observed foraging near the towers entered the rotor-swept zone and some individual bats had repeated near misses with the blade suggesting they were perhaps returning to investigate the blade, possibly attracted by the sound. Lighting on towers had no effect on bat activity or mortality. No bats struck a stationary blade, the nacelle or the monopole, but bats investigated all aspects of the turbine towers even alighting briefly on the monopole and stationary blades. Horn et al. (2008) suggest that bats were sometimes trapped in the vortices of the blade as they flew nearby and determined that *slower* rotor speeds increased mortality rates, a fact confirmed by other studies (Arnett et al. 2008, Kunz et al. 2007b).

In sum, most bat mortality occurs among tree-roosting lasiurine species during migration. However, foraging bats are also at risk, particularly in forested areas on mountain ridges. Both birds and bats are most vulnerable during periods of bad weather during migration; resident species are at lower risk but foraging bats do fly in the rotor-swept zone and are most threatened by towers over 65 m in height. The proposed project is in a grassland/agricultural habitat type that has generally shown the lowest risk to bats and birds compared to other sites, but the proposed height of the towers (80 m) does indicate bats in the area will be susceptible to collisions. Bats not currently considered endangered are declining (e.g. red bats) and even apparently minor mortality rates can have significant impacts on these slowly reproducing animals which normally produce only 1-2 offspring per female per year. In addition, because of the potential occurrence of several endangered species of birds and bats in the project area, pre-construction surveys should be conducted as well as post-construction monitoring for several years to adequately assess and minimize risk to endangered birds and bats.

4) Long-term Bird and Bat Mortality Monitoring Plan

Sampling methods for accurately determining levels of bird and bat mortality at wind turbine sites are now fairly well-established after more than a decade of experience at various facilities. Smallwood (2007) has summarized the best practices and suggested methodology for monitoring studies and we suggest following his prescriptions with some modifications based on the location of the study site.

The two most significant variables affecting estimates of mortality from wind turbines are searcher bias (the ability of searchers to find dead birds and bats) and scavenger removal rates (Smallwood 2007). In his survey of 24 earlier studies he found that 12 estimates were biased low and only 3 high, largely because of inaccurate assumptions of searcher efficiency and scavenger removal. We will use the formula $M_A = M_U/Rp$ where M_U is the unadjusted mortality (number of birds/bats found) expressed preferably as number/MW/year for consistency across studies; R is the proportion of fatalities remaining since the last carcass search; and p is the proportion of carcasses found by searchers during detection trials.

Bats persist from 2-12 days after mortality (Arnett et al. 2008) but an average of 10 days in an area similar to the proposed site (Johnson et al. 2003). Birds can persist up to 23 days but are more likely to be removed completely by large scavengers than bats, which are most frequently scavenged by insects than larger animals (Johnson set al. 2003). The more often an area is searched, the less loss is due to scavenger removal and therefore the potential of underestimating mortality is lowered.

Searcher efficiency ranges from 25-75% and is highest in more open habitats (Arnett et al. 2008). However, short vegetation such as pasture or grassland is often more dense and actually reduces

searcher efficiency (Smallwood 2007). Not surprisingly, larger birds are found more easily than smaller birds and bats in all studies. The longer scavenger removal trials are run, the lower the scavenger removal rates appear to be, probably because of "swamping" with large numbers of dead birds/bats placed in the field initially. After a few days, those not initially removed by a scavenger (swamped by an abundance of carcasses) will decrease in quality and never be removed by scavengers. Such long trials with large numbers of carcasses will thus bias mortality estimates lower than reality, so shorter trials are recommended. Finally, searcher efficiency must be determined for each wind turbine installation and at various times during the year.

To reduce the variability introduced by the various factors mentioned above and increase the reliability of our mortality estimates, I propose the following protocol:

a) *Scavenger removal rates*. I suggest three studies in spring, summer, and fall as vegetation height at these times in agricultural areas is highly variable and will influence rates of removal by scavengers (as well as searcher detection). To minimize scavenger swamping, I recommend placing no more than 5 bird and 5 bat carcasses per turbine per trial. The trials will last for two weeks.

b) *Searcher detection rates*. Likewise, searcher detection trials should be run three times during the year, but not simultaneously with scavenger removal trials. To accurately mimic conditions searchers are likely to encounter, I recommend placing no more than 3 birds or bats per turbine. Species likely to be encountered during the study and also with injuries or fragmentation should be randomly placed for searcher trials (Smallwood 2007).

c) *Estimation of mortality*. Searching for carcasses beneath turbines after calculating appropriate R and p values above should be done within a 30 m radius of each turbine, creating a square 60 x 60 m plot. Plots will be searched every five to seven days from May through October by walking 10 transects and visually searching 3 meters to each side of the transect. A typical plot could be searched in 45-60 minutes, requiring one full person/day of field work per week for each search at the eight proposed turbines. From these data, estimated mortality rates for birds and bats can be calculated after Smallwood (2007) using the formula above.

5) Recommendations

I recommend two primary actions for wildlife mitigation. First, a pre-construction survey for breeding birds should be conducted. A survey in June lasting two weeks should be able to identify if any endangered or threatened species are nesting in the area, a prospect that is unlikely but that should be checked. Since 1) no endangered bats have been recorded in Warren County, 2) the intensively farmed area to be used has few, if any roosting sites, and 3) endangered bats have never been recorded killed by a wind turbine (tree-roosting lasiurine species seem to be most susceptible), a survey for bats in the project area is unwarranted.

Second, post-construction monitoring of bird and bat mortality at turbines should be conducted as described above in section 4, accurately accounting for scavenger removal rates and searcher detection rates to obtain reliable estimates of mortality.

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Monarch Wind Power
Attn: Robert Gay 4 June 2010

Dear Sir or Madam:

I am writing to convey my modification of my recommendations for a breeding bird survey on the sites of the turbines being planned south of Monmouth, IL by your company. I drove through the area on June 1, 2010, with the updated map of final turbine pad and access road locations and see no need to pursue a breeding bird survey as I originally suggested. The area I was concerned with in my initial report is to the southeast of the specific localities you are actually using. This area has some forested riparian zones and open grasslands that could potentially harbor rare or threatened species. The current map of final turbine locations indicates there will be no construction of roads or pads in this area, and that construction will impact only agricultural fields with no substantial wetland or grassland habitat for some of the rare species that might be encountered. Thus, a breeding bird survey is not necessary.

Sincerely,

Kenneth L. Cramer, Ph.D.
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