Sound Study

Shady Oaks Wind 2, LLC

Shady Oaks 2 Wind Project
Project No. 118183

Revision 3
3/11/2020

Sound Study

prepared for

Shady Oaks Wind 2, LLC
Shady Oaks 2 Wind Project
Lee County, Illinois

Project No. 118183

Revision 3
3/11/2020

prepared by

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TABLE OF CONTENTS

Page No.

LIST OF TABLES

Page No.

LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
ANSI	American National Standards Institute
CadnaA	Computer Aided Noise Abatement
dB	decibel
dBA	A-weighted decibels
DEM	Digital Elevation Model
Developer	Shady Oaks Wind 2, LLC
EPA	U.S. Environmental Protection Agency
Hz	Hertz
IAC	Illinois Administrative Code
IEC	International Electrotechnical Commission
IPCB	Illinois Pollution Control Board
ISO	International Organization for Standardization
L_{90}	90-percent exceedance sound level
L_{eq}	equivalent sound level
L_x	exceedance sound level
MP	measurement point
Project	Shady Oaks 2 Wind Project
the Act	Noise Control Act of 1972
USGS	U.S. Geological Survey
WTG	wind turbine generators

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1.0 EXECUTIVE SUMMARY

Burns & McDonnell was retained by Shady Oaks Wind 2, LLC (Developer) to conduct a sound study for the Shady Oaks 2 Wind Project (Project). The Project will be located in Lee County Illinois, approximately 70 miles west of the city of Chicago. The Project is an expansion to the existing Shady Oaks Wind Farm. The Project could consist of wind turbine generators (WTG) at up to 28 potential locations, but not necessarily all would be built. To predict future worst-case noise impacts, all 28 potential locations were modeled with turbines operating at their maximum sound levels. The Project will consist of two wind turbine types: Vestas V150-5.6 machines with a 105-meter hub height and Siemens Gamesa G114-2.625 machines with a hub height of 80 meters. The existing Shady Oaks Wind Farm WTGs were also included in the model to address the potential cumulative impacts of both wind farms being operational. Each Project WTG was modeled with the turbine type that would potentially be installed, and the exiting turbines were modeled with the WTG currently installed at that location.

There were several objectives in this study, which included:

- Identification of applicable county, city, State, or Federal noise ordinances;
- Estimation of the operational sound levels from the Project layout using the three-dimensional sound modeling program Computer Aided Noise Abatement (CadnaA); and
- Determination of whether the Project can operate in compliance with the identified applicable regulatory standards.

There are no Federal noise regulations that apply to this Project. Therefore, only local regulations apply. The State of Illinois provides sound emissions standards that are broken down by octave band based on the class of emitting and receiving land use. The most restrictive applicable limits are for sound emitted from Class C land to Class A land during nighttime hours. Lee County has a code relating to Wind Energy Systems, which states that all operational WTGs shall comply with the State of Illinois regulations.

The wind turbines were modeled using maximum vendor-provided sound power levels for each machine. In addition to the Project WTG sound sources, the WTGs from the existing Shady Oaks Wind Farm, located more than 4,600 feet to the west, were modeled to show the potential for cumulative impacts from both wind farms together. Sound pressure levels were predicted at all identified receivers within and surrounding the Project area. The modeling results show that there are no expected exceedances of the IPCB noise regulations at any of the identified residential receivers, due to operation of the Project.

2.0 ACOUSTICAL TERMINOLOGY

The terms “noise level” and “sound level” are often used interchangeably to describe two different sound characteristics called sound power and sound pressure. Every source that produces sound has a sound power level. The sound power level is the acoustical energy emitted by a sound source and is an absolute number that is not affected by the environment. The acoustical energy produced by a source propagates through the air as air pressure fluctuations. These pressure fluctuations, also called sound pressure, are what human ears hear and microphones measure.

Sound energy is physically characterized by amplitude and frequency. Sound amplitude is measured in decibels (dB) as the logarithmic ratio of a sound pressure to a reference sound pressure (20 microPascals). The reference sound pressure corresponds to the typical threshold of human hearing. A 3-dB change in a continuous broadband sound level is generally considered “just barely perceptible” to the average listener. A 6-dB change is generally considered “clearly noticeable,” and a 10-dB change is generally considered a doubling (or halving, if the sound is decreasing) of the apparent loudness.

Frequency is measured in Hertz (Hz), which is the number of cycles per second. The typical human ear can hear frequencies ranging from approximately 20 to 20,000 Hz. Normally, the human ear is most sensitive to sounds in the middle frequencies (1,000 to 8,000 Hz) and is less sensitive to sounds in the low and high frequencies. As such, the A-weighted scale was developed to simulate the frequency response of the human ear to sounds at typical environmental levels. The A-weighted scale emphasizes sounds in the middle frequencies and de-emphasizes sounds in the low and high frequencies. Any sound level to which the A-weighted scale has been applied is expressed in dBA. For reference, the sound pressure level and subjective loudness associated with some common sound sources are listed in Table 2-1.

Sound in the environment is constantly fluctuating, for example, when a car drives by, a dog barks, or a plane passes overhead. Although an instantaneous sound level measured in dBA may indicate the level of noise experienced by an observer at that point in time, environmental noise levels vary continuously. Most ambient environmental noise includes a mixture of noise from some identifiable sources plus a relatively steady background noise where no particular source is identifiable. A single descriptor called the equivalent sound level (L_{eq}) is used to describe sound that is constant or changing in level. The L_{eq} is the average sound level for a specific time period.

Table 2-1: Typical Sound Pressure Levels Associated with Common Sound Sources

Sound Pressure Level (dBA)	Subjective Evaluation	Environment	
		Outdoor	Indoor
140	Deafening	Jet aircraft at 75 ft.	--
130	Threshold of pain	Jet aircraft during takeoff at a distance of 300 ft.	--
120	Threshold of feeling	Elevated train	Hard rock band
110	--	Jet flyover at 1,000 ft.	Inside propeller plane
100	Very loud	Power mower, motorcycle at 25 ft., auto horn at 10 ft., crowd noise at football game	--
90	--	Propeller plane flyover at 1,000 ft., noisy urban street	Full symphony or band, food blender, noisy factory
80	Moderately loud	Diesel truck (40 mph) at 50 ft.	Inside auto at high speed, garbage disposal
70	Loud	B-757 cabin during flight	Close conversation, vacuum cleaner
60	Moderate	Air-conditioner condenser at 15 ft., near highway traffic	General office
50	Quiet	--	Private office
40	--	Farm field with light breeze, birdcalls	Soft stereo music in residence
30	Very quiet	Quiet residential neighborhood	Bedroom, average residence (without TV and stereo)
20	--	Rustling leaves	Quiet theater, whisper
10	Just audible	--	Human breathing
0	Threshold of hearing	--	--

Sources:
(1) Adapted from *Architectural Acoustics*, M. David Egan, 1988
(2) *Architectural Graphic Standards*, Ramsey and Sleeper, 1994

Sound metrics have been developed to quantify fluctuating environmental sound levels. These metrics include the exceedance sound level. The exceedance sound level, L_x, is the sound level exceeded during "x" percent of the sampling period. The L_{90} is a common L_x value and represents the sound level exceeded for 90 percent of the time period during which sound levels are measured. The L_{90} metric is regarded as the most accurate tool for measuring relatively constant background noise and for minimizing the influence of isolated spikes in sound levels (i.e., barking dog, door slamming).

3.0 APPLICABLE REGULATIONS

3.1 Federal

The Noise Control Act of 1972 (the Act) mandated a national policy, "…to promote an environment for all Americans free from noise that jeopardizes their health or welfare, to establish a means for effective coordination of Federal research activities in noise control, to authorize the establishment of Federal noise emission standards for products distributed in commerce, and to provide information to the public respecting the noise emission and noise reduction characteristics of such products."

As required by the Act, the U.S. Environmental Protection Agency (EPA) established criteria for protecting the public health and wellbeing; however, these criteria do not constitute enforceable Federal regulations or standards. The EPA has since delegated regulatory authority to local entities. Therefore, no Federal noise regulations apply to this Project.

3.2 State of Illinois

The Illinois Pollution Control Board (IPCB) regulates noise from property-line-noise-sources under the Illinois Administrative Code (IAC) Title 35 Part 901: Sound Emission Standards and Limitations for Property Line Noise Sources. The Illinois sound emissions standards are broken down by octave band based on the class of emitting and receiving land use. The most restrictive applicable limits are for sound emitted from Class C land to Class A land during nighttime hours. All sound limits are based on the sound emitted by the Project and are not inclusive of background sound levels.

Based on the code's definition for land classification, this study is conducted under the assumption that the Project is an industrial class property (Class C Land) emitting sound onto residential properties (Class A Land). Daytime hours are defined as the period between 7:00 AM and 10:00 PM; nighttime hours are defined as the period between 10:00 PM and 7:00 AM. The Project sound levels are compared to the limits provided in Table 3-1.

Table 3-1: IAC Title 35 Sound Level Limits

Sound Level Limit	Time	Sound Pressure Level (dB)								
		31.5	63	125	250	500	1000	2000	4000	8000
Class C to A	Daytime	75	74	69	64	58	52	47	43	40
	Nighttime	69	67	62	54	47	41	36	32	32

Source: Amended at 30 Ill. Reg.5533, effective March 10, 2006

3.2.1 IPCB Prominent Discrete Tones

IPCB also has a noise regulation regarding prominent discrete tones. The definition for a prominent discrete tone is as follows:

> ***Prominent discrete tone****: sound, having a one-third octave band sound pressure level which, when measured in a one-third octave band at the preferred frequencies, exceeds the arithmetic average of the sound pressure levels of the two adjacent one-third octave bands on either side of such one-third octave band by:*
>
> *5 dB for such one-third octave band with a center frequency from 500 Hz to 10,000 Hz inclusive. Provided: such one-third octave band sound pressure level exceeds the sound pressure level of each adjacent one-third octave band, or;*
>
> *8 dB for such one-third octave band with a center frequency from 160 Hz to 400 Hz, inclusive. Provided: such one-third octave band sound pressure level exceeds the sound pressure level of each adjacent one-third octave band, or;*
>
> *15 dB for such one-third octave band with a center frequency from 25 Hz to 125 Hz, inclusive. Provided: such one-third octave band sound pressure level exceeds the sound pressure level of each adjacent one-third octave band*

The following standards regarding prominent discrete tones are applicable to the Project:

> ***Section 901.106 Prominent Discrete Tones***
>
> *a) No person shall cause or allow the emission of any prominent discrete tone from any property-line-noise-source located on any Class A, B or C land to any receiving Class A, B or C land, provided, however, that no measurement of one-third octave band sound pressure levels shall be made less than 25 feet from such property-line source.*
>
> *b) This rule shall not apply to prominent discrete tones having a one-third octave band sound pressure level 10 or more dB below the allowable octave band sound pressure level specified in Sections 901.102 through 901.104 for the octave bands which contains such one-third octave band. In the application of this sub-section, the applicable numeric standard for sound emitted from any existing property-line-noise-source to receiving Class A land, for both daytime and nighttime operations, is found in Section 901.102(a).*

3.3 Lee County

Lee County, Illinois, has a section of the county code pertaining to the Project, Chapter 10-15-15: Wind Energy Systems.[1] Section 10-15-15I states that all operational WTGs shall comply with the IPCB regulations. Therefore, the IPCB regulations are used to satisfy any and all sound regulations for purposes of this analysis.

[1] http://sterlingcodifiers.com/codebook/index.php?book_id=334&chapter_id=8241#s970010

4.0 AMBIENT SOUND SURVEY

Burns & McDonnell personnel conducted an ambient sound level survey on September 18 and 19, 2019. The sound survey consisted of short-term measurements to establish the existing ambient sound levels in the area of the Project.

The survey was conducted based on the instrumentation requirements outlined in IAC Title 35 Part 910.102, and the measurement techniques outlined in IAC Title 35 Part 910.106. The IPCB provides that measurements for obtaining background ambient sound level should be measured for a 10-minute interval with an integrating sound level meter with an octave-band or 1/3 octave-band filter.

Measurements were taken using American National Standards Institute (ANSI) S1.4 type 1 sound level meter (Larson Davis Model 831). The sound level meters were calibrated at the beginning and end of each set of measurements. None of the calibration level changes exceeded ± 0.5 dB. Windscreens were used at all times on the microphones, and the meters were mounted on a tripod. The microphones were located approximately 5 feet above ground level. All measurements were taken when meteorological conditions were favorable for conducting sound level measurements per ANSI standards. Meteorological conditions were measured with a Kestral 5000 handheld anemometer.

4.1 Short-Term Ambient Measurements

Short-term ambient measurements were taken during four time periods over a 24-hour span on September 18 and 19, 2019. Measurements were made at ten (10) measurement locations labeled measurement point (MP) MP01 to MP10. The measured sound levels and extraneous noise sources observed for each measurement are presented in Appendix A. The measurement locations are shown in Figure B-1 of Appendix B. The measurement locations were selected because they were accessible and representative of existing sound levels in the direction of noise-sensitive receivers. Short-term measurements were 10 minutes in duration, and measured values were logged by the sound level meter at each measurement point. The overall A-weighted L_{eq} and L_{90} sound level collected during the measurements as shown below in Table 4-1.

Table 4-1: Short-Term Ambient Measurement Data

Measurement Point	Sound Pressure Level (dBA)							
	Afternoon (1:00 PM on 09/18/19)		Evening (7:00 PM on 09/18/19)		Midnight (1:00 AM on 09/19/19)		Morning (7:00 AM on 09/19/19)	
	L_{eq}	L_{90}	L_{eq}	L_{90}	L_{eq}	L_{90}	L_{eq}	L_{90}
MP01	50	49	49	44	51	51	52	50
MP02	52	51	53	42	55	53	53	51
MP03	48	46	53	46	50	49	49	48
MP04	54	51	66	64	56	55	59	53
MP05	64	54	68	57	57	56	59	56
MP06	50	49	50	50	53	52	62	51
MP07	50	49	55	55	53	53	57	50
MP08	59	40	58	58	46	45	63	44
MP09	52	50	49	49	55	54	53	52
MP10	57	45	60	60	54	52	63	48

The sound levels varied at each measurement point due to the proximity to highway traffic and extraneous noises that occurred during each measurement. The Project is near several other wind farms, including the Shady Oaks Wind Farm. None of the other wind farm’s WTGs were audible at the measurement locations during these measurement periods. Extraneous sounds included constant insect noise, wind blowing crops, local and highway traffic, airplanes, and wildlife. The detailed measurement sound level data inclusive of octave band data and extraneous noise sources is presented in Appendix A.

5.0 SOUND MODELING

5.1 Wind Turbine and Transformer Sound Characteristics

The sound commonly associated with a wind turbine is described as a rhythmic “whoosh” caused by aerodynamic processes. This sound is created as air flow interacts with the surface of rotor blades. As air flows over the rotor blade, turbulent eddies form in the surface boundary layer and wake of the blade. These eddies are where most of the “whooshing” sound is formed. Additional sound is generated from vortex shedding produced by the tip of the rotor blade. Air flowing past the rotor tip creates alternating low-pressure vortices on the downstream side of the tip causing sound generation to occur. Older wind turbines, built with rotors which operate downwind of the tower (downwind turbines), often have higher aerodynamic impulse sound levels. This is caused by the interaction between the aerodynamic lift created on the rotor blades and the turbulent wake vortices produced by the tower. Modern wind turbine rotors are mostly built to operate upwind of the tower (upwind turbines). Upwind wind turbines are not impacted by wake vortices generated by the tower and, therefore, overall sound levels can be as much as 10 dBA less for similarly sized turbines. The rhythmic fluctuations of the overall sound level are less perceivable farther from the turbine. Additionally, multiple turbines operating at the same time will create the whooshing sound at different times. These non-synchronized sounds will blend together to create a more constant sound to an observer at most distances from the turbines. Another phenomenon that reduces perceivable noise from turbines is the wind itself. Higher wind speed produces noise that tends to mask (or drown out) the sounds created by wind turbines.

Advancement in wind turbine technology has reduced pure tonal emissions of modern wind turbines. Manufacturers have reduced distinct tonal sounds by reshaping turbine blades and adjusting the angle at which air contacts the blade. Pitching technology allows the angle of the blade to adjust when the maximum rotational speed is achieved, which allows the turbine to maintain a constant rotational velocity. Therefore, sound emission levels remain constant as the velocity remains the same.

Wind turbines can create limited noise in other ways as well. Wind turbines have a nacelle where the mechanical portions of the turbine are housed. The current generation of wind turbines uses multiple techniques to reduce the noise from this portion of the turbine: vibration isolating mounts, special gears, and acoustic insulation. In general, all moving parts and the housing of the current generation wind turbines have been designed to minimize the noise they generate.

5.2 Model Inputs and Settings

Predicted sound levels were modeled using industry-accepted sound modeling software. The program used to model the turbines was CadnaA, Version 2020, published by DataKustik, Ltd., Munich, Germany. The CadnaA program is a scaled, three-dimensional program that takes into account air absorption, terrain, ground absorption, and ground reflection for each piece of noise-emitting equipment and predicts downwind sound pressure levels. The model calculates sound propagation based on International Organization for Standardization (ISO) 9613-2:1996, General Method of Calculation. ISO 9613, and therefore CadnaA, assesses the sound pressure levels based on the octave-band center-frequency range from 31.5 to 8,000 Hz. CadnaA has been used to predict sound level impacts for past projects accepted by Lee County and the State of Illinois. The ISO standard used for the calculations is generally accepted as the most appropriate method of prediction. Predicted compliance with the regulations for all turbines operating implies predicted compliance for any combination of the turbines operating.

5.2.1 Project Layout

The Project's proposed layout contains 28 potential WTG locations which consist of either Vestas V150-5.6 machines or Siemens Gamesa G114-2.625 machines. All potential turbine locations were modeled, but not all of the turbine locations would necessarily be built. Predictive modeling was conducted using the proposed layout shown in Figure B-2 of Appendix B. The existing Shady Oaks Wind Farm turbines, which are located more than 4,600 feet to the west of the Project, were also included in the model.

5.2.2 Terrain and Vegetation

Terrain and attenuation from ground absorption can have a significant impact on sound transmission. U.S. Geological Survey (USGS) Digital Elevation Model (DEM) contours were imported into the model to account for topographic variations around the Project. The terrain around the proposed Project is mostly rural with minor changes in elevation.

The land is primarily used for agricultural purposes. As such, vegetation is mostly low-lying with some small areas of trees. Therefore, all vegetation was excluded from the analysis to maintain conservativeness in the model. Ground attenuation is expected to be fairly high due to the "soft ground" of the surrounding areas but was set to a more conservative value of 0.5.

5.2.3 Sound Propagation and Directivity

CadnaA calculates downwind sound propagation using ISO 9613 standards, which use omni-directional downwind sound propagation and worst-case directivity factors. In other words, the model assumes that each turbine propagates its maximum sound level in all directions at all times. This will likely over-predict upwind sound levels.

5.2.4 Atmospheric Conditions

Atmospheric conditions were based on program defaults. Layers in the atmosphere often form where temperature increases with height (temperature inversions). Sound waves can reflect off the temperature inversion layer and return to the surface of the earth. This process can increase sound levels at the surface, especially if the height of the inversion begins near the surface of the earth. Temperature inversions tend to occur mainly at night when winds are light or calm, usually when wind turbines are not operating. CadnaA calculates the downwind sound in a manner which is favorable for propagation (worst-case scenario) by assuming a well-developed moderate ground-based temperature inversion such as can occur at night. Therefore, predicted sound levels tend to be higher than would likely occur.

The atmosphere does not flow smoothly and tends to have swirls and eddies, also known as turbulence. Turbulence is basically formed by two processes: thermal turbulence and mechanical turbulence. Thermal turbulence is caused by the interaction of heated air rapidly rising from the heated earth’s surface with cooler air descending from the atmosphere. Mechanical turbulence is caused as moving air interacts with objects such as trees, buildings, and wind turbines. Turbulent eddies generated by wind turbines and other objects can cause sound waves to scatter, which in turn, provides sound attenuation between the wind turbine and the receiver. The acoustical model assumes laminar air flow, which minimizes sound attenuation that would occur in a realistic nonhomogeneous atmosphere. This assumption also causes the predicted sound levels to be higher than would likely occur.

5.2.5 Sound Emission Data

Acoustical modeling was completed for the Project and the existing Shady Oaks WTGs. Wind turbine heights and acoustical emissions were input into the model. The expected most conservative overall sound power levels for the Project turbines were contained in documents provided by the Developer from the vendors, Vestas and Siemens Gamesa. The overall sound power levels for the existing Shady Oaks Wind Farm turbines were provided in the noise impact assessment completed by HFP Acoustical Consultants Corp. on April 01, 2011. Vendor-provided octave-band sound power levels for the existing turbines were scaled to match the overall sound power levels provided in the noise impact assessment.

The data is based on various wind speeds, and the loudest overall sound power levels for each machine were used in the model. The sound emissions data was developed by the vendors using the International Electrotechnical Commission (“IEC”) 61400-11 acoustic measurement standards. IEC 61400-11 is used to determine the max sound power level of the overall turbine assembly. The noise generated by the nacelle is included as part of the overall wind turbine sound power level. The expected sound power levels and modeled hub heights for each turbine type modeled are displayed in Table 5-1.

Table 5-1: Wind Turbine Modeled Sound Power Levels

Turbine[a,b]	Height (m)	Sound Power Level (dBA)									
		31.5	63	125	250	500	1000	2000	4000	8000	A-wt.[c]
G114-2.652	80	75	84	92	98	101	102	99	93	81	107
V150-5.6	105	76	87	96	101	103	102	98	90	80	108
GW82/1500	85	71	82	92	97	97	98	94	84	71	103
GW100/2500	100	80	90	94	98	101	101	96	85	79	106

a) The G114-2.652 and V150-5.6 turbines are a part of this Project. The GW82/1500 and GW100/2500 turbines are existing.
b) The noise impact assessment for the existing turbines provided the GW82/1500 maximum sound power level is 103.2 dBA and the GW100/2500 maximum sound power level is 106.0 dBA.
c) A-wt. = A-weighted decibels

A point source located at the hub height of each proposed turbine location was used to model sound emissions from each of the wind turbines. The wind turbine blades and the nacelle both generate noise, and combined, represent the total wind turbine sound level. Modeling the wind turbine as a single point source is appropriate for simulating wind turbine sound emissions due to the large distances between the turbines and the receivers as compared to the dimensions of the wind turbines. The corresponding sound levels from the table above were applied to every point source.

Locations of wind turbines and residential receivers around the Project area were provided by the Developer and the Project layout is shown in Figure B-3 Appendix B. Each receiver was assumed to have a height of 1.52 meters (5.0 feet) above ground level. Compliance with the regulation was assessed at each identified residence (each receiver).

The following assumptions were made to maintain the inherent conservativeness of the model and to estimate the worst case modeled sound levels:

- Attenuation was not included for sound propagation through wooded areas, existing barriers, and shielding
- All turbines were assumed to be operating at maximum power output (and therefore, maximum sound levels) at all times to represent worst-case noise impacts from the wind farm as a whole

5.3 Acoustical Modeling Results

Sound pressure levels were predicted for the identified receivers in the CadnaA noise modeling software using the manufacturer-specified sound power levels and the assumptions listed above. CadnaA modeling results have been demonstrated in previous studies to conservatively approximate real-life measured noise from a source when extraneous noises are not present.

As previously mentioned, decibels are a logarithmic ratio of a sound pressure to a reference sound pressure. Therefore, they must be logarithmically added to determine a cumulative impact (i.e., logarithmically adding 50 dBA and 50 dBA results in 53 dBA). Logarithmically adding each of the individual turbine's impacts at each receiver provides an overall Project impact at each receiver. The maximum model-predicted sound pressure levels at each receiver (the logarithmic addition of sound levels from every turbine), as well as the limits in each frequency, are included in Appendix C for the turbine layout. These values represent only the noise emitted by the Project, and do not include any extraneous noises (traffic, etc.) that could be present during physical noise measurements.

Figures B-4 and B-5 of Appendix B show graphical representations of the expected sound pressure levels generated by the simultaneous operation of all wind turbines proposed for the Project. The figures show a graphical representation of the overall sound pressure levels and sound pressure levels at the worst-case frequency with respect to the regulatory limits (1,000 Hz), generated by simultaneous operation of all wind turbines modeled. As can be seen in the figures, sound from the turbines will propagate in approximately circular contours of equal sound pressure from each turbine, and areas where two or more turbines interact are clearly visible.

6.0 CONCLUSION

Burns & McDonnell conducted a predictive sound assessment study for the Shady Oaks 2 Wind Project. The sound study included identification of applicable sound regulations and predicative modeling to estimate Project-related sound levels in the surrounding community. A comparison to the IPCB nighttime noise limits for Class C to Class A land was performed.

The wind turbines were modeled using maximum vendor-provided sound power levels for each machine. In addition to the Project WTG sound sources, the WTGs from the existing Shady Oaks Wind Farm were modeled to show the potential for cumulative impacts from both wind farms together. Sound pressure levels were predicted at identified residences within and surrounding the Project area. A number of conservative assumptions were applied to provide worst-case predicted sound pressure levels for the Project. Those results were then compared to the IPCB regulations. The modeling results show that no exceedances of the IPCB regulations are expected at any of the identified residences due to operation of the Project.

APPENDIX A – SOUND SURVEY DATA

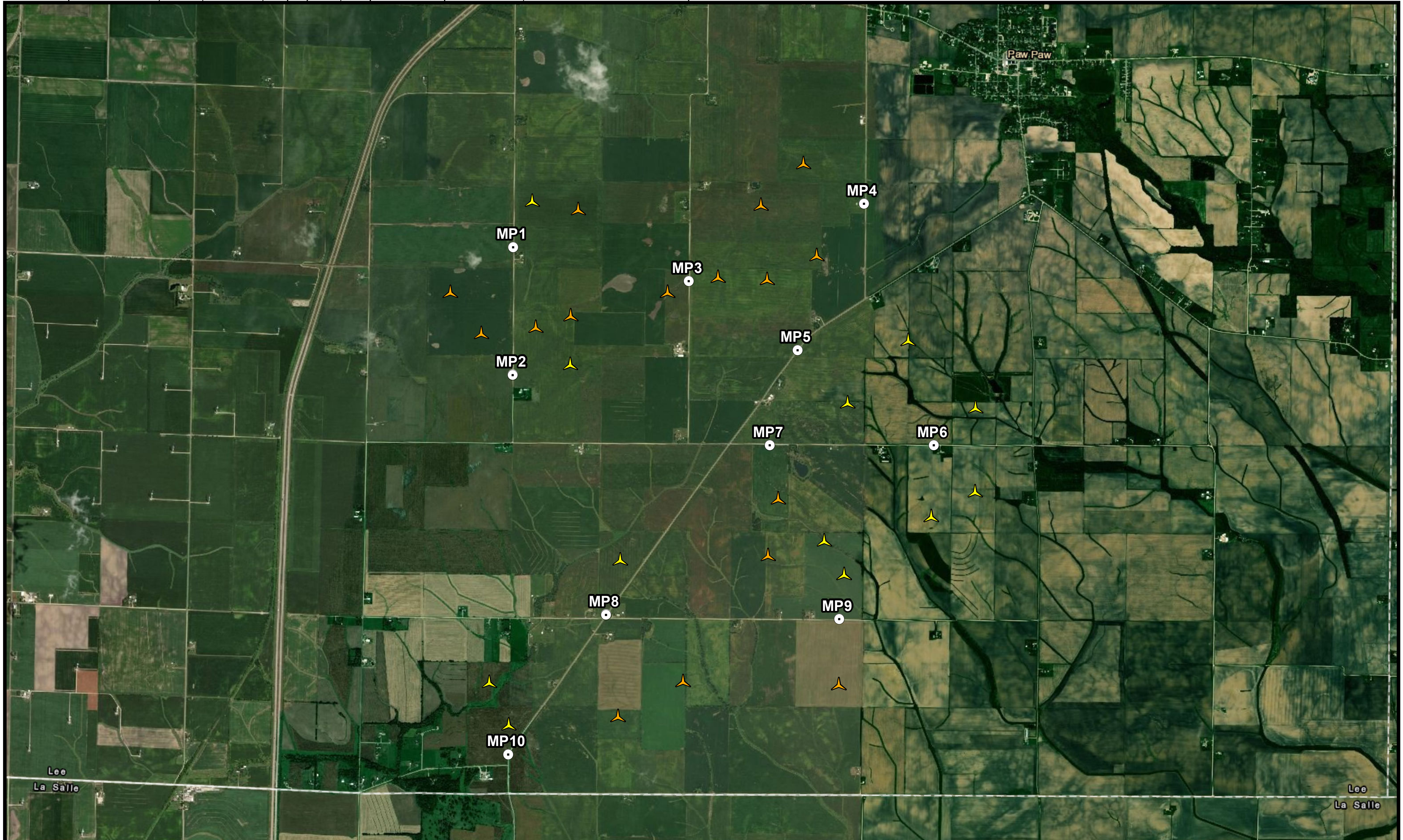
Appendix A

Shady Oaks II - Ambient Measurements

			Octave Band Frequency (Hz) L_{eq} (dB)									
Point Number	***L_{eq}***	***L_{90}***	**31.5**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	***Notes***
Daytime Afternoon 9/18/2019 - 1:00 PM to 3:00 PM												
Weather: 77°F, 69°F dew point, 70% Humidity, 5-9 mph winds												
MP1	50.5 dBA	49.1 dBA	53	48	40	37	35	35	35	42	51	Constant insects, airplane, distant interstate traffic
MP2	52.1 dBA	50.9 dBA	52	46	39	36	35	35	37	45	53	Constant insects, airplane, distant interstate traffic, corn stalks in wind
MP3	47.6 dBA	45.5 dBA	56	48	40	37	33	33	35	41	49	Constant insects, airplane, distant interstate traffic
MP4	54.1 dBA	51.3 dBA	56	49	41	36	33	35	37	44	54	Constant insects, airplane, distant interstate traffic, corn stalks in wind, paused for passing vehicle
MP5	63.8 dBA	53.8 dBA	54	58	57	56	58	60	56	49	55	Constant insects, trees in wind, passing traffic
MP6	49.9 dBA	49.0 dBA	56	51	48	37	35	35	36	40	51	Constant insects, dogs, farm equipment
MP7	49.7 dBA	48.7 dBA	54	49	43	35	33	34	36	40	51	Constant insects, distant farm equipment, birds
MP8	59.4 dBA	40.1 dBA	56	59	57	52	51	56	54	46	45	Constant insects, local traffic, waving flag
MP9	51.7 dBA	50.4 dBA	51	46	54	46	39	34	36	43	52	Constant insects, crops in wind, distant traffic
MP10	56.9 dBA	45.3 dBA	58	56	53	48	50	54	50	44	48	Constant insects, distant farm equipment, crops in wind, distant traffic, passing traffic
Daytime Evening 9/18/2019 - 7:00 PM to 9:00 PM												
Weather: 76°F, 67°F dew point, 74% Humidity, 1-3 mph winds												
MP1	48.5 dBA	43.7 dBA	50	47	41	38	35	34	34	40	46	Constant insects, distant interstate traffic, airplane
MP2	52.6 dBA	42.2 dBA	51	45	41	38	33	32	34	41	50	Constant insects, distant interstate traffic, distant talking, airplane
MP3	52.8 dBA	45.9 dBA	46	44	36	34	31	32	34	41	48	Constant insects, distant interstate traffic, airplane
MP4	66.0 dBA	63.9 dBA	47	42	37	31	32	33	35	43	61	Constant insects, distant interstate traffic
MP5	68.3 dBA	57.1 dBA	50	52	49	46	44	51	49	47	61	Constant insects, local traffic, distant interstate traffic, airplane, dog barking
MP6	50.5 dBA	50.5 dBA	46	43	37	31	32	33	36	44	47	Constant insects, distant traffic, airplanes
MP7	54.7 dBA	54.7 dBA	44	42	37	31	31	33	36	41	50	Constant insects, distant traffic
MP8	58.0 dBA	58.0 dBA	53	55	60	51	51	55	51	46	43	Constant insects, distant traffic, airplanes, passing traffic
MP9	48.7 dBA	48.7 dBA	45	43	39	32	32	33	41	42	46	Constant insects, distant traffic
MP10	60.1 dBA	60.1 dBA	51	58	55	51	52	54	51	44	51	Constant insects, distant interstate traffic, local traffic, airplanes
Nighttime Midnight 9/18/2019 - 1:00 AM to 3:00 AM												
Weather: 66°F, 60°F dew point, 81% Humidity, calm winds												
MP1	51.2 dBA	50.5 dBA	52	47	38	36	38	36	35	48	48	Constant insects, distant interstate traffic
MP2	54.7 dBA	53.1 dBA	50	46	39	37	35	34	37	53	49	Constant insects, distant interstate traffic
MP3	50.4 dBA	49.0 dBA	49	44	37	33	33	32	35	48	47	Constant insects, distant interstate traffic
MP4	55.8 dBA	55.3 dBA	50	44	39	31	31	32	35	54	50	Constant insects, distant interstate traffic
MP5	57.5 dBA	56.2 dBA	47	43	38	34	30	32	35	53	55	Constant insects, distant interstate traffic, dog barking
MP6	53.0 dBA	52.3 dBA	50	46	38	32	32	33	36	52	46	Constant insects, distant interstate traffic
MP7	53.4 dBA	52.7 dBA	53	47	42	33	32	33	37	52	47	Constant insects, distant interstate traffic, train horn
MP8	45.6 dBA	45.0 dBA	50	47	42	35	36	34	37	42	46	Constant insects, distant interstate traffic
MP9	54.6 dBA	54.0 dBA	51	49	43	35	32	33	42	53	48	Constant insects, distant interstate traffic, distant train
MP10	53.6 dBA	51.8 dBA	50	48	42	36	36	34	36	50	49	Constant insects, distant interstate traffic, train horn
Daytime Morning 9/12/2019 - 7:00 AM to 9:00 AM												
Weather: 65°F, 59°F dew point, 77% Humidity, 3-5 mph winds												
MP1	51.6 dBA	49.7 dBA	58	56	49	47	48	45	37	47	45	Constant insects, distant interstate traffic, airplanes
MP2	52.6 dBA	51.3 dBA	57	54	46	47	46	41	35	50	46	Constant insects, distant interstate traffic, birds, airplanes
MP3	48.5 dBA	47.5 dBA	57	58	48	43	41	36	35	45	46	Constant insects, distant interstate traffic, local traffic, birds, airplanes
MP4	58.5 dBA	52.7 dBA	55	53	44	37	34	33	35	50	56	Constant insects, distant interstate traffic, local traffic, corn stalks in wind, distant talking
MP5	59.0 dBA	55.5 dBA	55	57	63	51	50	51	48	52	55	Constant insects, distant interstate traffic, local traffic, birds, airplanes
MP6	61.8 dBA	51.4 dBA	58	68	58	57	57	58	52	52	49	Constant insects, distant interstate traffic, birds, farm equipment, dogs
MP7	57.3 dBA	49.7 dBA	57	58	54	51	56	53	42	47	49	Constant insects, distant interstate traffic, birds, passing traffic
MP8	62.9 dBA	43.9 dBA	59	60	56	53	56	60	56	48	44	Constant insects, distant interstate traffic, passing traffic
MP9	53.4 dBA	52.0 dBA	54	52	46	36	34	34	36	52	48	Constant insects, distant interstate traffic, birds
MP10	62.9 dBA	47.6 dBA	60	64	60	57	58	60	56	49	45	Constant insects, distant interstate traffic, passing traffic

APPENDIX B – FIGURES

Path: Z:\Clients\ENS\LIBERTYPOWER\118183_ShadyOak2SUP\Studies\Permitting\Modeling\Noise\GIS\Figure B-1 Ambient Measurement Locations.mxd gweger 2/4/2020



Project Wind Turbine (G114-2.652)

Project Wind Turbine (V150-5.6)

Measurement Point

NORTH

4,000 2,000 0 4,000

Scale in Feet

BURNS McDONNELL

Figure B-1

Shady Oaks 2 Wind Project Ambient Measurement Locations

Source: ESRI, Burns & McDonnell

Issued: 2/4/2020

Path: Z:\Clients\ENS\LIBERTYPOWER\118183_ShadyOak2SUP\Studies\Permitting\Modeling\Noise\GIS\Figure B-2 Turbine Layout REV3.mxd gweger 3/11/2020

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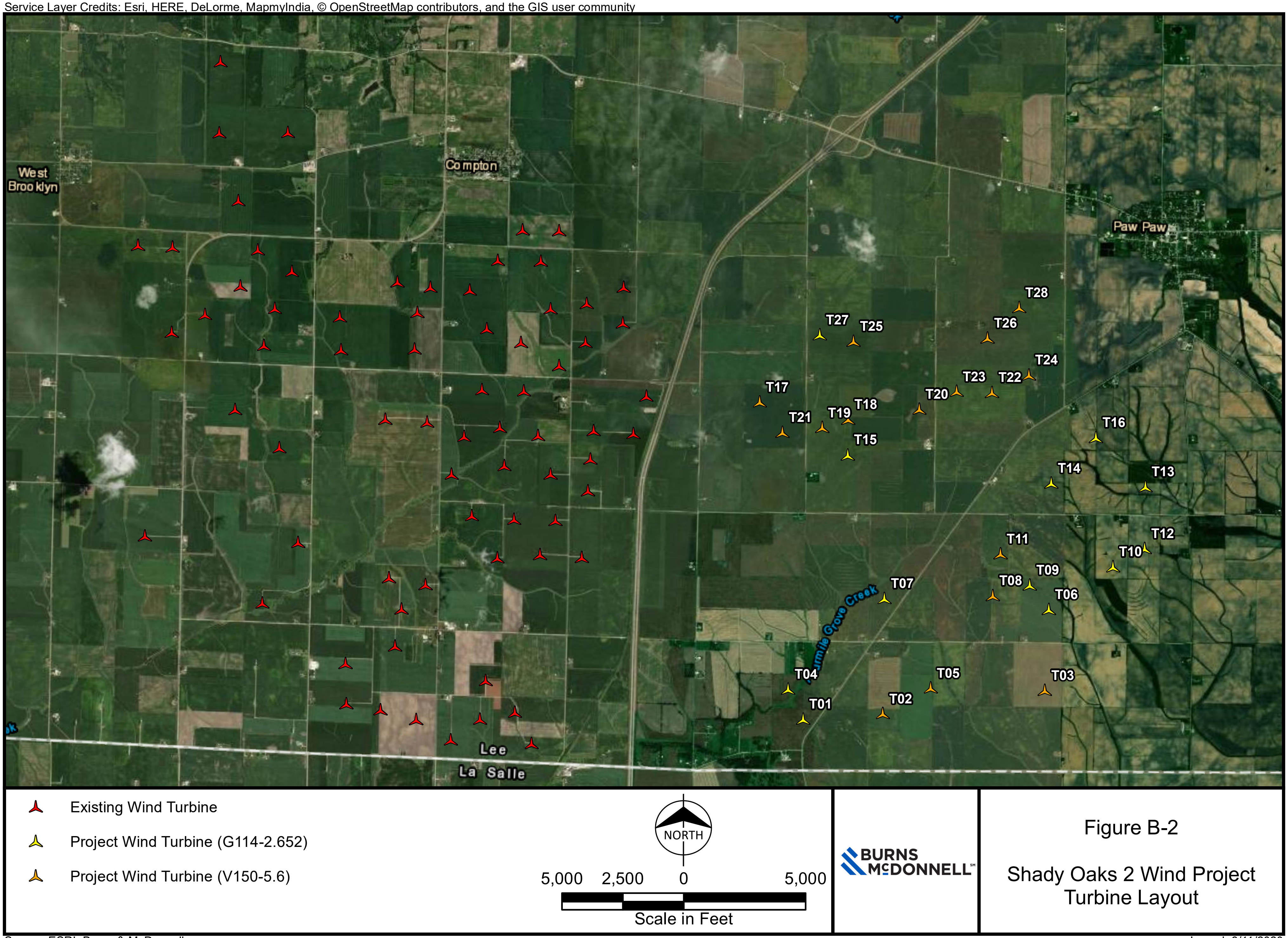


BURNS McDONNELL

Figure B-2

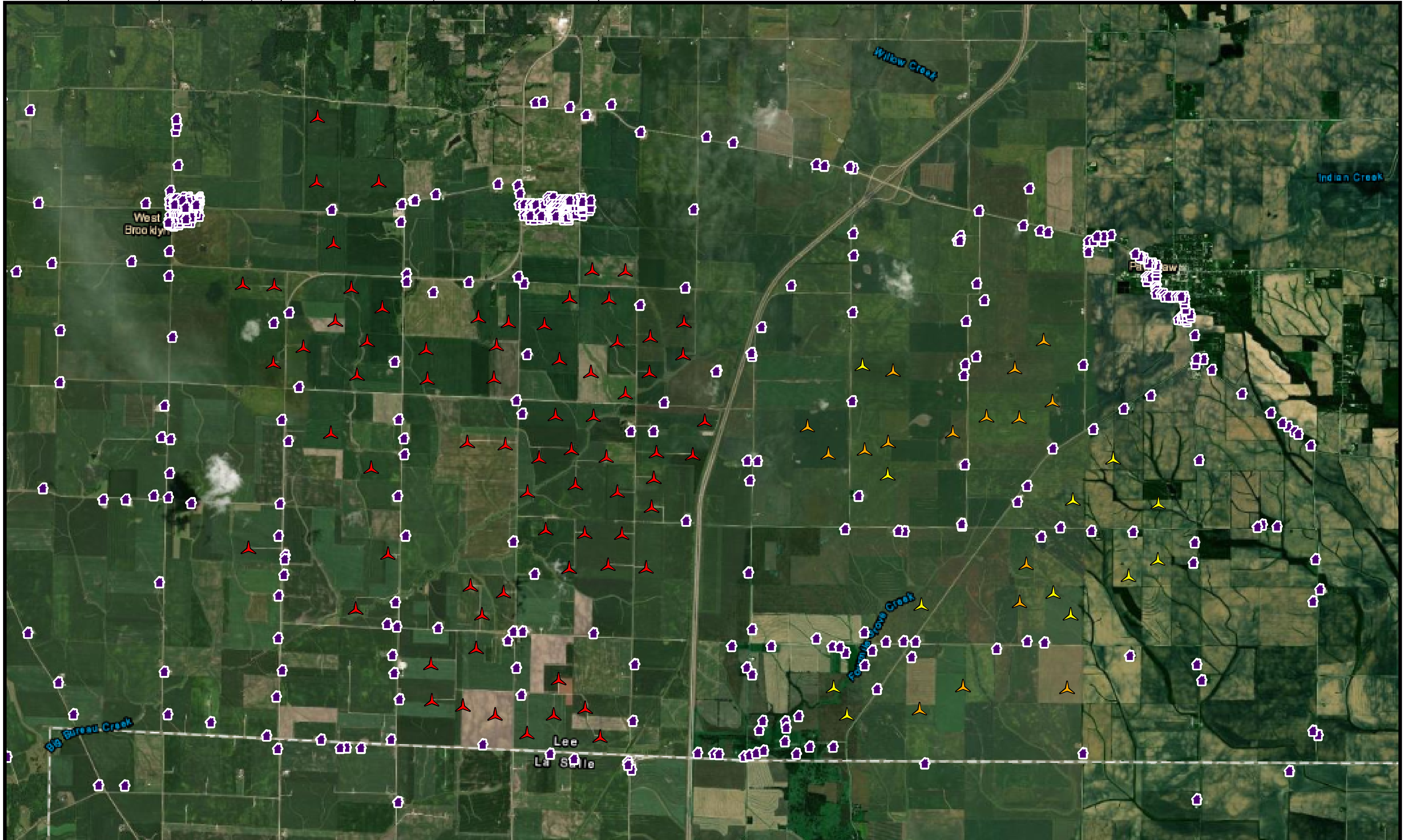
Shady Oaks 2 Wind Project Turbine Layout

Source: ESRI, Burns & McDonnell

Issued: 3/11/2020

Path: Z:\Clients\ENS\LIBERTYPOWER\118183_ShadyOak2SUP\Studies\Permitting\Modeling\Noise\GIS\Figure B-3 Turbine Layout with Receivers.mxd rjgurreri 2/28/2020

Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community



Residential Receiver

Existing Wind Turbine

Project Wind Turbine (G114-2.652)

Project Wind Turbine (V150-5.6)

NORTH

6,000 3,000 0 6,000

Scale in Feet

BURNS McDONNELL

Figure B-3

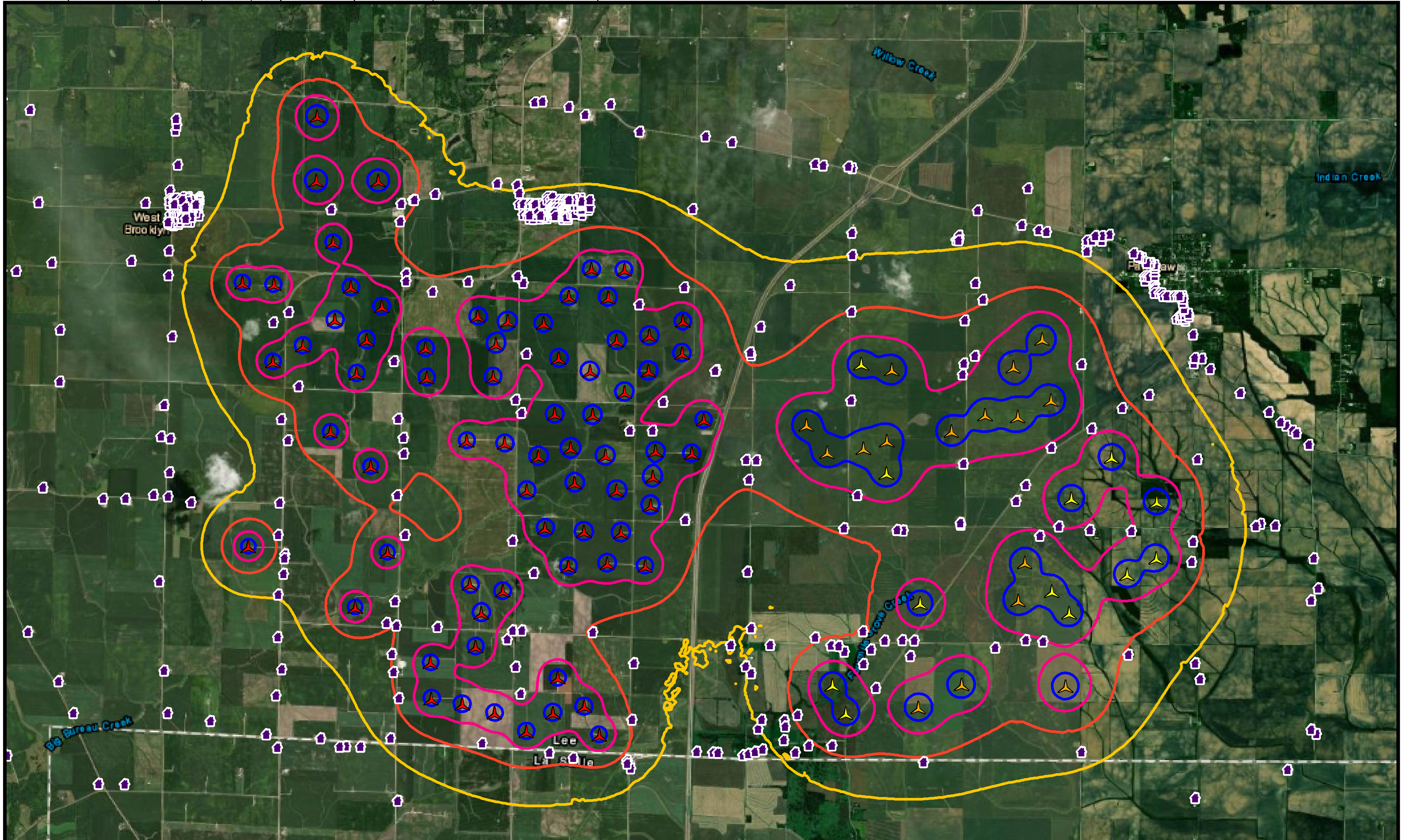
Shady Oaks 2 Wind Project
Turbine Layout with Receivers

Source: ESRI, Burns & McDonnell

Issued: 2/28/2020

Path: Z:\Clients\ENS\LIBERTYPOWER\118183_ShadyOak2SUP\Studies\Permitting\Modeling\Noise\GIS\Figure B-4 Sound Level Contours (dBA).mxd rjgurreri 2/28/2020

Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community



35 dBA	Residential Receiver
40 dBA	Existing Wind Turbine
45 dBA	Project Wind Turbine (G114-2.652)
50 dBA	Project Wind Turbine (V150-5.6)

NORTH

6,000 3,000 0 6,000
Scale in Feet

BURNS McDONNELL

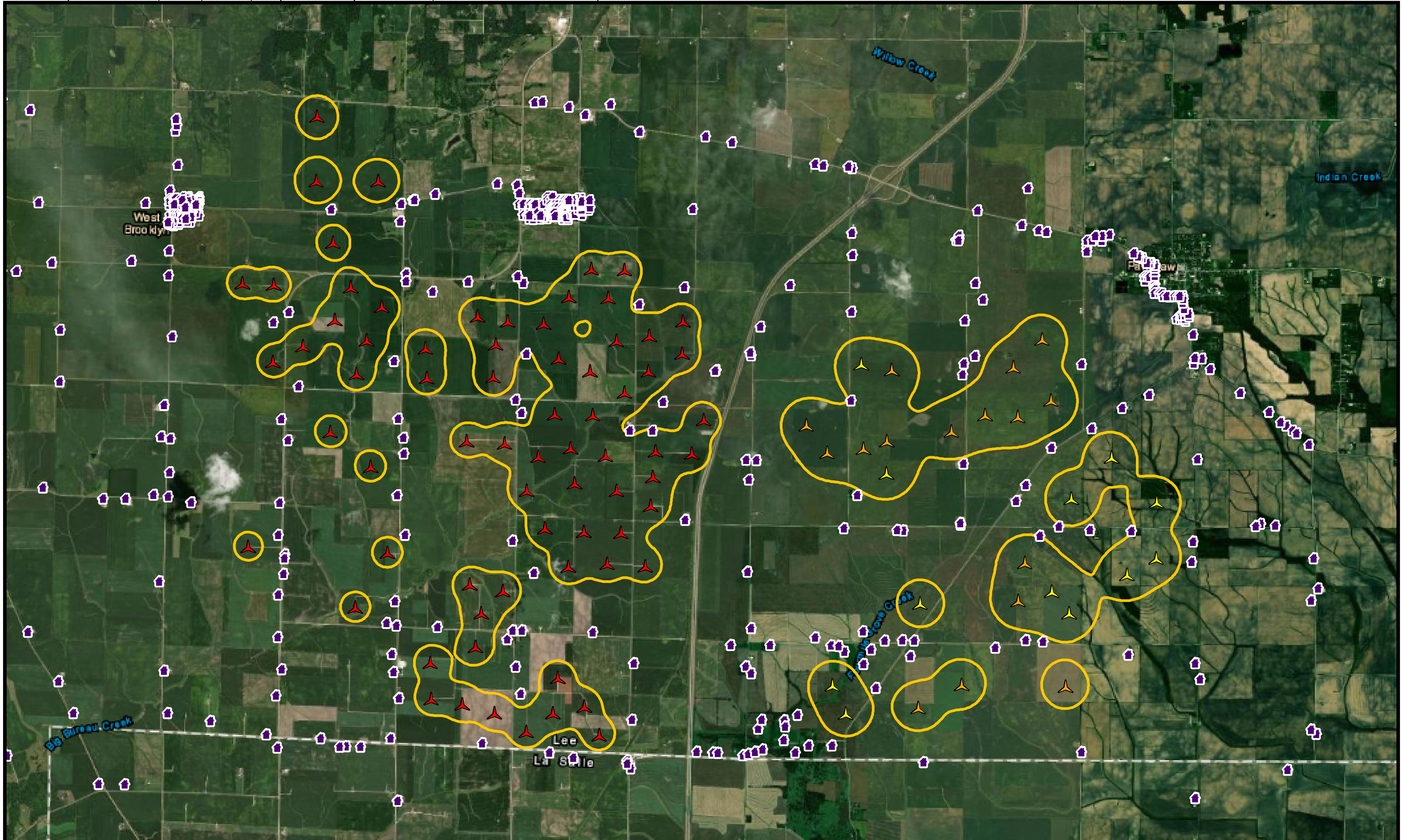
Figure B-4

Shady Oaks 2 Wind Project
Sound Level Contours
(Overall A-weighted)

Source: ESRI, Burns & McDonnell

Issued: 2/28/2020

Path: Z:\Clients\ENS\LIBERTYPOWER\118183_ShadyOak2SUP\Studies\Permitting\Modeling\Noise\GIS\Figure B-5 Sound Level Contours (1000 Hz).mxd rjgurreri 2/28/2020



— 41 dB
Residential Receiver
Existing Wind Turbine
Project Wind Turbine (G114-2.652)
Project Wind Turbine (V150-5.6)

Note: The IPCB sound level limits limit noise generated from a Class C source to a Class A receiver to 41 dBA in the 1000-Hz octave band during nighttime hours.

NORTH

6,000 3,000 0 6,000
Scale in Feet

BURNS McDONNELL

Figure B-5

Shady Oaks 2 Wind Project Sound Level Contours (1000-Hz Octave Band)

Source: ESRI, Burns & McDonnell

Issued: 2/28/2020

APPENDIX C – MODEL INPUTS AND RESULTS

TURBINE LAYOUT - Combined Layouts 60b and 64b				
Turbine Name	Easting [m]	Northing [m]	Turbine Model	Hub Height [m]
T01	330,445	4,611,006	G114-2.625	80
T02	331,443	4,611,077	V150-5.6	105
T03	333,470	4,611,368	V150-5.6	105
T04	330,259	4,611,384	G114-2.625	80
T05	332,041	4,611,397	V150-5.6	105
T06	333,518	4,612,381	G114-2.625	80
T07	331,465	4,612,515	G114-2.625	80
T08	332,819	4,612,554	V150-5.6	105
T09	333,281	4,612,684	G114-2.625	80
T10	334,322	4,612,912	G114-2.625	80
T11	332,913	4,613,077	V150-5.6	105
T12	334,720	4,613,139	G114-2.625	80
T13	334,728	4,613,915	G114-2.625	80
T14	333,552	4,613,959	G114-2.625	80
T15	331,003	4,614,312	G114-2.625	80
T16	334,109	4,614,530	G114-2.625	80
T17	329,901	4,614,973	V150-5.6	105
T18	331,010	4,614,757	V150-5.6	105
T19	330,687	4,614,653	V150-5.6	105
T20	331,898	4,614,886	V150-5.6	105
T21	330,189	4,614,595	V150-5.6	105
T22	332,811	4,615,092	V150-5.6	105
T23	332,364	4,615,107	V150-5.6	105
T24	333,269	4,615,312	V150-5.6	105
T25	331,079	4,615,734	V150-5.6	105
T26	332,755	4,615,773	V150-5.6	105
T27	330,653	4,615,812	G114-2.625	80
T28	333,148	4,616,156	V150-5.6	105
Existing Turbines - Shady Oaks Wind Farm				
Ex_T01	328,200	4,616,406	GW82	85
Ex_T02	327,737	4,616,206	GW82	85
Ex_T03	327,726	4,615,718	GW82	85
Ex_T04	327,286	4,616,139	GW82	85
Ex_T05	327,394	4,615,426	GW82	85
Ex_T06	328,484	4,615,044	GW82	85
Ex_T07	328,323	4,614,581	GW82	85
Ex_T08	327,393	4,617,114	GW82	85
Ex_T09	326,953	4,615,114	GW82	85
Ex_T10	326,489	4,615,892	GW82	85
Ex_T11	326,935	4,617,125	GW82	85
Ex_T12	326,626	4,616,744	GW82	85
Ex_T13	327,783	4,614,261	GW82	85
Ex_T14	327,131	4,614,555	GW82	85
Ex_T15	326,429	4,615,127	GW82	85
Ex_T16	326,276	4,616,375	GW82	85
Ex_T17	326,651	4,614,655	GW82	85

TURBINE LAYOUT - Combined Layouts 60b and 64b

Turbine Name	Easting [m]	Northing [m]	Turbine Model	Hub Height [m]
Ex_T18	327,286	4,614,073	GW82	85
Ex_T19	327,756	4,613,862	GW82	85
Ex_T20	326,706	4,614,176	GW82	85
Ex_T21	326,206	4,614,543	GW82	85
Ex_T22	325,785	4,616,409	GW82	85
Ex_T23	325,619	4,616,091	GW82	85
Ex_T24	327,347	4,613,494	GW82	85
Ex_T25	325,583	4,615,636	GW82	85
Ex_T26	325,744	4,614,721	GW82	85
Ex_T27	326,831	4,613,506	GW82	85
Ex_T28	325,370	4,616,475	GW82	85
Ex_T29	326,045	4,614,070	GW82	85
Ex_T30	327,678	4,613,030	GW82	85
Ex_T31	326,299	4,613,552	GW82	85
Ex_T32	327,154	4,613,065	GW82	85
Ex_T33	325,220	4,614,756	GW82	85
Ex_T34	326,620	4,613,023	GW82	85
Ex_T35	324,652	4,616,037	GW82	85
Ex_T36	324,667	4,615,625	GW82	85
Ex_T37	325,720	4,612,689	GW82	85
Ex_T38	324,049	4,616,607	GW82	85
Ex_T39	325,264	4,612,777	GW82	85
Ex_T40	323,838	4,616,146	GW82	85
Ex_T41	323,702	4,615,682	GW82	85
Ex_T42	325,421	4,612,385	GW82	85
Ex_T43	323,896	4,614,400	GW82	85
Ex_T44	323,623	4,616,873	GW82	85
Ex_T45	326,474	4,611,493	GW82	85
Ex_T46	323,404	4,616,423	GW82	85
Ex_T47	324,001	4,618,341	GW100	100
Ex_T48	324,125	4,613,216	GW82	85
Ex_T49	325,343	4,611,920	GW82	85
Ex_T50	323,340	4,614,880	GW82	85
Ex_T51	323,380	4,617,490	GW82	85
Ex_T52	326,839	4,611,095	GW82	85
Ex_T53	322,962	4,616,067	GW82	85
Ex_T54	326,404	4,611,006	GW82	85
Ex_T55	327,047	4,610,701	GW82	85
Ex_T56	324,721	4,611,702	GW82	85
Ex_T57	323,143	4,618,340	GW100	100
Ex_T58	325,604	4,611,003	GW82	85
Ex_T59	326,039	4,610,748	GW82	85
Ex_T60	322,557	4,616,910	GW82	85
Ex_T61	323,681	4,612,461	GW82	85
Ex_T62	324,733	4,611,202	GW82	85
Ex_T63	323,156	4,619,229	GW100	100

TURBINE LAYOUT - Combined Layouts 60b and 64b

Turbine Name	Easting [m]	Northing [m]	Turbine Model	Hub Height [m]
Ex_T64	322,125	4,616,932	GW82	85
Ex_T65	322,210	4,613,297	GW82	85
Ex_T66	325,157	4,611,125	GW82	85
Ex_T67	322,548	4,615,844	GW82	85
Ex_T68	327,824	4,614,615	GW82	85
Ex_T69	326,918	4,615,715	GW82	85
Ex_T70	327,167	4,616,731	GW82	85
Ex_T71	328,190	4,615,962	GW82	85

Notes:
[1] All coordinates presented in UTM NAD83 Zone 16N (meters)
[2] All coordinates provided in "SOII_LAY60 LAY64 V150 G114 Turbine Coordinates.csv" and "SOI_ExistingTurbines.csv"
[2] Updated coordinates for turbine Locations T01, T04, T12, and T23 provided on February 27, 2020 by Dana Thompson
[3] Turbine location T08 could have either wind turbine installed. Therefore, the louder of the two options (V150) was modeled at that location.

NOISE MODELING RESULTS - Combined Layouts 60b and 64b

Receiver	Coordinates			Modeled Sound Level (dB)								
	Easting (m)	Northing (m)	Base Elevation (m)	31.5 (Hz)	63 (Hz)	125 (Hz)	250 (Hz)	500 (Hz)	1000 (Hz)	2000 (Hz)	4000 (Hz)	8000 (Hz)
IPCB Individual Octave Band Frequency Sound Pressure Level Limits (Nighttime)				69	67	62	54	47	41	36	32	32
REC-001	325,237	4,616,947	289	56	53	48	44	38	36	26	4	--
REC-002	325,997	4,616,928	292	56	54	49	45	39	38	28	3	--
REC-003	325,921	4,617,020	294	56	53	48	44	39	37	26	--	--
REC-004	326,044	4,615,956	282	58	56	52	48	42	41	32	11	--
REC-005	325,897	4,615,320	277	57	55	51	47	41	40	30	7	--
REC-006	325,976	4,615,140	276	58	56	51	47	42	40	30	8	--
REC-007	325,855	4,613,374	270	56	54	49	46	40	38	28	5	--
REC-008	324,371	4,613,456	269	55	53	49	45	39	37	29	11	--
REC-009	326,142	4,612,934	276	56	54	50	46	40	39	29	7	--
REC-010	324,270	4,609,789	270	47	45	39	36	29	25	9	--	--
REC-011	327,501	4,610,907	270	53	51	46	42	37	35	26	3	--
REC-012	326,955	4,612,117	283	54	52	47	43	37	35	22	--	--
REC-013	327,525	4,611,691	285	53	50	45	41	35	32	19	--	--
REC-014	327,596	4,616,635	282	57	55	51	47	42	40	31	10	--
REC-015	327,468	4,614,893	276	58	56	52	48	42	41	31	9	--
REC-016	327,603	4,619,014	300	47	45	38	34	27	22	3	--	--
REC-017	326,849	4,619,248	303	49	46	39	34	27	22	1	--	--
REC-018	327,200	4,619,396	303	46	44	37	33	25	20	--	--	--
REC-019	326,158	4,619,419	296	48	45	37	33	26	20	--	--	--
REC-020	326,626	4,619,358	303	49	46	38	34	27	21	--	--	--
REC-021	326,263	4,619,431	297	49	46	38	34	27	21	--	--	--
REC-022	325,916	4,618,285	300	52	49	42	38	32	28	10	--	--
REC-023	325,640	4,618,304	300	53	50	43	38	32	28	10	--	--
REC-024	325,944	4,618,167	300	52	50	43	39	32	28	12	--	--
REC-025	325,939	4,618,013	298	53	50	43	39	33	29	13	--	--
REC-026	326,035	4,618,024	298	52	50	43	39	33	29	14	--	--
REC-027	326,375	4,618,121	300	52	50	43	39	33	29	15	--	--
REC-028	321,114	4,617,375	294	50	47	40	36	30	27	13	--	--
REC-029	315,324	4,618,244	267	--	--	--	--	--	--	--	--	--
REC-030	316,138	4,618,730	261	--	--	--	--	--	--	--	--	--
REC-031	317,035	4,618,387	265	--	--	--	--	--	--	--	--	--
REC-032	316,774	4,618,469	261	--	--	--	--	--	--	--	--	--
REC-033	317,874	4,618,294	267	--	--	--	--	--	--	--	--	--
REC-034	318,245	4,618,323	268	--	--	--	--	--	--	--	--	--
REC-035	319,320	4,618,041	275	42	39	30	25	18	12	--	--	--
REC-036	315,065	4,617,778	267	--	--	--	--	--	--	--	--	--
REC-037	316,126	4,617,589	279	--	--	--	--	--	--	--	--	--
REC-038	315,675	4,617,302	278	--	--	--	--	--	--	--	--	--
REC-039	315,795	4,617,289	277	--	--	--	--	--	--	--	--	--
REC-040	317,454	4,617,252	285	--	--	--	--	--	--	--	--	--
REC-041	317,232	4,617,263	288	--	--	--	--	--	--	--	--	--
REC-042	319,502	4,617,213	291	43	40	33	28	21	15	--	--	--
REC-043	320,793	4,618,032	283	49	46	37	33	27	23	4	--	--
REC-044	321,129	4,618,205	285	50	47	39	34	29	24	7	--	--
REC-045	321,125	4,618,088	285	50	47	39	34	29	25	7	--	--
REC-046	321,304	4,618,110	286	50	47	39	35	29	25	9	--	--
REC-047	321,533	4,618,112	288	52	49	40	36	31	27	12	--	--
REC-048	321,523	4,618,091	288	52	49	40	36	31	27	12	--	--
REC-049	321,528	4,618,071	288	52	49	41	36	31	27	12	--	--
REC-050	321,529	4,618,049	289	52	49	41	36	31	27	12	--	--
REC-051	321,528	4,618,015	290	52	49	41	36	31	28	12	--	--
REC-052	321,507	4,618,013	290	52	49	41	36	31	27	12	--	--
REC-053	321,125	4,618,007	286	50	47	39	35	29	25	8	--	--
REC-054	321,125	4,618,065	285	50	47	39	34	29	25	8	--	--
REC-055	321,235	4,618,557	291	51	47	39	34	29	24	6	--	--
REC-056	321,180	4,617,725	289	50	47	40	36	30	26	11	--	--
REC-057	321,115	4,617,814	287	50	47	39	35	29	25	9	--	--
REC-058	321,126	4,617,872	287	50	47	39	35	29	25	9	--	--
REC-059	321,252	4,617,739	289	51	48	40	36	30	27	12	--	--

Notes:
[1} "--" shows the windfarm has minimal impact
[2] All coordinates presented in UTM NAD83 Zone 16N (meters)
[3] All coordinates provided in "Houses_GoogleEarth_Nov212018.xlxs"

NOISE MODELING RESULTS - Combined Layouts 60b and 64b

Receiver	Coordinates			Modeled Sound Level (dB)								
	Easting (m)	Northing (m)	Base Elevation (m)	31.5 (Hz)	63 (Hz)	125 (Hz)	250 (Hz)	500 (Hz)	1000 (Hz)	2000 (Hz)	4000 (Hz)	8000 (Hz)
IPCB Individual Octave Band Frequency Sound Pressure Level Limits (Nighttime)				69	67	62	54	47	41	36	32	32
REC-060	321,530	4,617,858	291	52	49	41	37	31	28	14	--	--
REC-061	321,422	4,617,812	291	51	48	41	37	31	28	13	--	--
REC-062	321,415	4,617,772	291	51	48	41	37	31	28	13	--	--
REC-063	321,308	4,617,770	290	51	48	40	36	31	27	12	--	--
REC-064	321,190	4,617,826	288	50	47	40	35	30	26	10	--	--
REC-065	321,249	4,617,774	289	51	48	40	36	30	27	11	--	--
REC-066	321,256	4,617,860	289	51	48	40	36	30	26	11	--	--
REC-067	321,251	4,617,820	289	51	48	40	36	30	26	11	--	--
REC-068	321,252	4,617,843	289	51	48	40	36	30	26	11	--	--
REC-069	321,178	4,617,773	288	50	47	40	35	30	26	11	--	--
REC-070	321,131	4,617,741	289	50	47	39	35	29	26	10	--	--
REC-071	321,105	4,617,764	288	50	47	39	35	29	26	10	--	--
REC-072	321,371	4,617,777	291	51	48	41	36	31	27	13	--	--
REC-073	321,486	4,617,899	291	52	49	41	37	31	28	13	--	--
REC-074	321,174	4,617,903	288	50	47	39	35	29	26	9	--	--
REC-075	321,197	4,617,904	288	51	47	40	35	30	26	10	--	--
REC-076	321,227	4,617,898	288	51	48	40	35	30	26	10	--	--
REC-077	321,254	4,617,899	288	51	48	40	36	30	26	10	--	--
REC-078	321,291	4,617,903	289	51	48	40	36	30	26	11	--	--
REC-079	321,440	4,617,903	291	51	48	41	36	31	27	12	--	--
REC-080	321,419	4,617,901	291	51	48	40	36	31	27	12	--	--
REC-081	321,322	4,617,905	289	51	48	40	36	30	27	11	--	--
REC-082	321,349	4,617,898	290	51	48	40	36	30	27	12	--	--
REC-083	321,375	4,617,897	290	51	48	40	36	31	27	12	--	--
REC-084	321,374	4,617,842	291	51	48	40	36	31	27	12	--	--
REC-085	321,302	4,617,855	290	51	48	40	36	30	27	11	--	--
REC-086	321,299	4,617,829	290	51	48	40	36	30	27	12	--	--
REC-087	321,371	4,617,857	291	51	48	40	36	31	27	12	--	--
REC-088	321,418	4,617,841	291	51	48	41	36	31	27	13	--	--
REC-089	321,349	4,617,812	291	51	48	40	36	31	27	12	--	--
REC-090	321,174	4,618,031	286	50	47	38	34	29	25	8	--	--
REC-091	321,181	4,618,089	285	50	47	38	34	29	25	8	--	--
REC-092	321,207	4,618,093	285	50	47	38	34	29	25	8	--	--
REC-093	321,257	4,618,073	287	50	47	39	35	30	25	9	--	--
REC-094	321,382	4,618,112	287	51	47	39	35	30	26	10	--	--
REC-095	321,376	4,618,090	288	51	48	40	36	30	26	10	--	--
REC-096	321,418	4,618,071	288	51	48	40	36	30	27	11	--	--
REC-097	321,295	4,618,012	288	51	48	40	35	30	26	10	--	--
REC-098	321,190	4,618,018	287	50	47	39	35	29	25	9	--	--
REC-099	321,360	4,618,012	289	51	48	40	36	30	26	11	--	--
REC-100	321,379	4,618,054	289	51	48	40	36	30	26	10	--	--
REC-101	321,296	4,618,071	287	50	47	39	35	30	26	9	--	--
REC-102	321,485	4,618,011	290	52	49	40	36	31	27	12	--	--
REC-103	321,339	4,617,975	289	51	48	40	36	30	26	11	--	--
REC-104	317,593	4,617,081	289	--	--	--	--	--	--	--	--	--
REC-105	319,014	4,617,096	285	36	33	28	23	15	9	--	--	--
REC-106	318,812	4,617,098	285	37	34	28	23	15	9	--	--	--
REC-107	320,596	4,617,238	291	49	46	38	34	27	23	6	--	--
REC-108	321,108	4,617,031	297	50	48	41	37	31	27	14	--	--
REC-109	321,157	4,616,191	294	50	47	40	37	30	27	12	--	--
REC-110	321,049	4,615,245	286	47	45	39	35	28	24	6	--	--
REC-111	321,003	4,614,813	285	46	44	38	34	27	23	4	--	--
REC-112	321,135	4,614,784	285	46	44	38	34	27	23	5	--	--
REC-113	321,119	4,614,324	283	46	44	38	34	27	23	6	--	--
REC-114	321,105	4,613,987	279	46	44	38	34	27	23	9	--	--
REC-115	320,900	4,614,010	282	45	43	37	33	26	22	6	--	--
REC-116	321,422	4,613,906	276	47	45	39	36	29	26	14	--	--
REC-117	320,521	4,613,955	282	44	42	36	31	24	19	1	--	--
REC-118	320,982	4,612,817	270	44	42	36	32	25	22	8	--	--

Notes:
[1} "--" shows the windfarm has minimal impact
[2] All coordinates presented in UTM NAD83 Zone 16N (meters)
[3] All coordinates provided in "Houses_GoogleEarth_Nov212018.xlxs"

NOISE MODELING RESULTS - Combined Layouts 60b and 64b

Receiver	Coordinates			Modeled Sound Level (dB)								
	Easting (m)	Northing (m)	Base Elevation (m)	31.5 (Hz)	63 (Hz)	125 (Hz)	250 (Hz)	500 (Hz)	1000 (Hz)	2000 (Hz)	4000 (Hz)	8000 (Hz)
IPCB Individual Octave Band Frequency Sound Pressure Level Limits (Nighttime)				69	67	62	54	47	41	36	32	32
REC-119	321,050	4,611,584	261	40	38	32	28	21	16	--	--	--
REC-120	321,096	4,610,999	262	40	37	31	27	19	14	--	--	--
REC-121	321,688	4,610,892	273	42	40	34	29	22	17	--	--	--
REC-122	319,797	4,610,998	261	32	30	24	20	12	6	--	--	--
REC-123	319,593	4,611,440	264	33	30	24	20	12	7	--	--	--
REC-124	319,169	4,612,121	270	32	30	24	20	12	6	--	--	--
REC-125	318,572	4,613,564	276	32	30	23	19	10	4	--	--	--
REC-126	320,207	4,613,953	279	42	40	34	30	22	17	--	--	--
REC-127	319,381	4,614,111	282	37	35	29	24	16	11	--	--	--
REC-128	316,441	4,614,167	288	--	--	--	--	--	--	--	--	--
REC-129	316,070	4,614,007	285	--	--	--	--	--	--	--	--	--
REC-130	319,619	4,616,283	297	41	39	33	29	21	15	--	--	--
REC-131	316,688	4,616,696	292	--	--	--	--	--	--	--	--	--
REC-132	316,310	4,615,672	294	--	--	--	--	--	--	--	--	--
REC-133	316,665	4,615,648	294	--	--	--	--	--	--	--	--	--
REC-134	316,904	4,615,554	294	--	--	--	--	--	--	--	--	--
REC-135	317,396	4,615,500	292	--	--	--	--	--	--	--	--	--
REC-136	318,527	4,615,504	294	31	29	23	18	10	3	--	--	--
REC-137	318,650	4,615,510	294	34	32	26	21	13	6	--	--	--
REC-138	319,613	4,615,569	292	41	39	33	28	20	15	--	--	--
REC-139	316,086	4,615,182	292	--	--	--	--	--	--	--	--	--
REC-140	317,868	4,615,060	291	--	--	--	--	--	--	--	--	--
REC-141	315,917	4,613,376	282	--	--	--	--	--	--	--	--	--
REC-142	316,054	4,612,562	277	--	--	--	--	--	--	--	--	--
REC-143	316,623	4,612,469	276	--	--	--	--	--	--	--	--	--
REC-144	316,922	4,612,539	273	--	--	--	--	--	--	--	--	--
REC-145	316,930	4,612,472	273	--	--	--	--	--	--	--	--	--
REC-146	317,738	4,612,452	270	--	--	--	--	--	--	--	--	--
REC-147	318,223	4,612,513	273	--	--	--	--	--	--	--	--	--
REC-148	315,258	4,611,851	273	--	--	--	--	--	--	--	--	--
REC-149	315,800	4,610,959	267	--	--	--	--	--	--	--	--	--
REC-150	316,149	4,610,972	270	--	--	--	--	--	--	--	--	--
REC-151	317,028	4,610,819	267	--	--	--	--	--	--	--	--	--
REC-152	318,489	4,611,402	267	--	--	--	--	--	--	--	--	--
REC-153	318,657	4,610,968	265	--	--	--	--	--	--	--	--	--
REC-154	318,622	4,611,069	267	--	--	--	--	--	--	--	--	--
REC-155	322,454	4,610,705	279	45	42	37	32	25	20	--	--	--
REC-156	322,608	4,610,521	279	45	42	37	32	25	20	--	--	--
REC-157	323,207	4,610,654	279	47	45	39	35	28	24	7	--	--
REC-158	323,557	4,610,539	277	47	45	40	36	29	26	10	--	--
REC-159	323,471	4,610,537	278	47	45	39	36	29	25	9	--	--
REC-160	324,167	4,610,650	280	50	48	43	40	33	31	19	--	--
REC-161	323,756	4,610,536	277	48	46	41	37	30	27	13	--	--
REC-162	325,435	4,610,586	277	54	52	48	44	39	37	28	7	--
REC-163	326,359	4,610,454	274	54	53	48	44	39	38	29	7	--
REC-164	326,689	4,610,384	272	54	52	47	44	38	37	27	5	--
REC-165	327,478	4,610,240	270	51	49	44	40	34	32	22	--	--
REC-166	327,433	4,610,344	270	52	50	45	41	35	34	24	2	--
REC-167	327,430	4,610,305	270	52	49	45	41	35	33	24	0	--
REC-168	322,589	4,611,246	270	46	44	38	34	27	23	5	--	--
REC-169	322,669	4,611,600	267	47	45	39	35	28	25	9	--	--
REC-170	322,614	4,612,048	264	48	46	40	36	30	27	13	--	--
REC-171	322,621	4,612,636	267	50	48	42	39	32	30	19	--	--
REC-172	322,692	4,612,922	269	51	49	44	40	34	32	22	--	--
REC-173	322,711	4,613,190	270	51	49	45	41	35	33	24	2	--
REC-174	322,704	4,613,131	270	51	49	45	41	35	33	24	2	--
REC-175	322,622	4,613,458	273	52	50	46	42	36	34	26	6	--
REC-176	322,642	4,613,901	276	51	49	43	40	33	31	20	--	--
REC-177	322,757	4,614,761	282	53	51	45	42	35	33	23	--	--

Notes:
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NOISE MODELING RESULTS - Combined Layouts 60b and 64b

Receiver	Coordinates			Modeled Sound Level (dB)								
	Easting (m)	Northing (m)	Base Elevation (m)	31.5 (Hz)	63 (Hz)	125 (Hz)	250 (Hz)	500 (Hz)	1000 (Hz)	2000 (Hz)	4000 (Hz)	8000 (Hz)
IPCB Individual Octave Band Frequency Sound Pressure Level Limits (Nighttime)				69	67	62	54	47	41	36	32	32
REC-178	322,664	4,615,053	285	53	51	45	42	36	34	23	--	--
REC-179	322,902	4,615,506	286	55	53	48	44	39	37	28	5	--
REC-180	324,222	4,615,849	286	57	55	50	47	41	40	31	9	--
REC-181	322,767	4,616,527	294	56	54	49	46	40	39	30	8	--
REC-182	322,553	4,616,390	295	56	54	49	45	40	38	29	7	--
REC-183	323,351	4,617,943	303	61	57	49	45	41	39	30	9	--
REC-184	324,305	4,617,776	302	57	54	46	42	38	35	24	--	--
REC-185	324,479	4,618,079	303	58	55	46	42	38	36	26	1	--
REC-186	324,317	4,618,022	303	60	56	48	43	40	38	28	6	--
REC-187	324,498	4,618,071	303	58	55	46	42	38	36	25	--	--
REC-188	324,786	4,618,155	303	55	52	44	40	36	32	20	--	--
REC-189	324,285	4,611,207	285	54	52	47	43	38	36	27	6	--
REC-190	324,213	4,611,568	276	53	51	47	43	37	36	26	3	--
REC-191	324,185	4,611,814	273	53	51	46	43	37	35	25	1	--
REC-192	324,114	4,612,243	268	54	52	47	43	37	36	26	4	--
REC-193	324,813	4,612,188	272	55	53	49	45	39	38	28	5	--
REC-194	324,246	4,612,205	269	53	51	47	43	37	35	25	--	--
REC-195	324,233	4,612,540	267	54	52	47	43	37	35	25	1	--
REC-196	324,263	4,614,004	273	54	52	47	43	37	35	25	1	--
REC-197	324,352	4,614,577	276	55	53	48	44	38	36	26	4	--
REC-198	324,345	4,614,798	279	55	53	47	44	38	36	24	--	--
REC-199	324,275	4,615,060	282	55	53	48	44	38	36	25	--	--
REC-200	324,380	4,617,060	294	56	53	47	44	38	36	25	0	--
REC-201	324,382	4,616,953	293	56	54	48	44	39	37	27	4	--
REC-202	324,751	4,616,810	294	56	53	48	44	38	36	25	--	--
REC-203	325,961	4,611,265	285	56	54	50	46	41	40	31	9	--
REC-204	325,892	4,611,641	285	55	53	49	45	39	38	28	2	--
REC-205	325,780	4,612,014	279	56	54	49	46	40	39	29	8	--
REC-206	325,849	4,612,142	278	56	54	49	46	40	38	29	6	--
REC-207	325,980	4,612,137	280	55	53	49	45	39	37	27	2	--
REC-208	318,886	4,610,414	260	--	--	--	--	--	--	--	--	--
REC-209	320,508	4,610,020	271	32	29	23	18	10	4	--	--	--
REC-210	320,144	4,610,023	273	31	29	23	18	10	3	--	--	--
REC-211	316,155	4,610,146	264	--	--	--	--	--	--	--	--	--
REC-212	315,939	4,610,557	265	--	--	--	--	--	--	--	--	--
REC-213	315,708	4,610,868	267	--	--	--	--	--	--	--	--	--
REC-214	314,850	4,612,578	279	--	--	--	--	--	--	--	--	--
REC-215	314,804	4,612,574	279	--	--	--	--	--	--	--	--	--
REC-216	314,762	4,612,578	280	--	--	--	--	--	--	--	--	--
REC-217	314,829	4,612,577	279	--	--	--	--	--	--	--	--	--
REC-218	314,469	4,613,931	279	--	--	--	--	--	--	--	--	--
REC-219	314,078	4,614,216	282	--	--	--	--	--	--	--	--	--
REC-220	316,148	4,618,922	261	--	--	--	--	--	--	--	--	--
REC-221	319,203	4,619,314	261	41	37	27	21	15	7	--	--	--
REC-222	318,783	4,619,443	261	--	--	--	--	--	--	--	--	--
REC-223	318,819	4,619,460	261	--	--	--	--	--	--	--	--	--
REC-224	321,204	4,619,025	276	50	47	37	33	28	23	4	--	--
REC-225	321,223	4,619,107	276	50	47	38	33	28	23	4	--	--
REC-226	321,212	4,619,193	273	49	46	36	31	27	22	3	--	--
REC-227	325,999	4,617,977	297	53	50	44	40	33	30	14	--	--
REC-228	326,000	4,618,020	298	53	50	43	39	33	29	14	--	--
REC-229	325,997	4,617,870	296	53	50	44	40	34	30	15	--	--
REC-230	326,086	4,617,813	295	53	51	44	40	34	31	17	--	--
REC-231	326,137	4,617,807	296	53	51	44	41	34	31	17	--	--
REC-232	326,054	4,617,865	296	53	50	44	40	34	31	16	--	--
REC-233	326,088	4,617,907	297	53	50	44	40	34	30	16	--	--
REC-234	326,142	4,617,860	296	53	50	44	40	34	31	16	--	--
REC-235	326,237	4,617,812	296	53	51	44	41	34	31	18	--	--
REC-236	326,258	4,617,902	297	53	50	44	40	34	31	17	--	--

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NOISE MODELING RESULTS - Combined Layouts 60b and 64b

Receiver	Coordinates			Modeled Sound Level (dB)								
	Easting (m)	Northing (m)	Base Elevation (m)	31.5 (Hz)	63 (Hz)	125 (Hz)	250 (Hz)	500 (Hz)	1000 (Hz)	2000 (Hz)	4000 (Hz)	8000 (Hz)
IPCB Individual Octave Band Frequency Sound Pressure Level Limits (Nighttime)				69	67	62	54	47	41	36	32	32
REC-237	326,146	4,617,905	297	53	50	44	40	34	30	16	--	--
REC-238	326,192	4,617,860	296	53	50	44	40	34	31	17	--	--
REC-239	326,161	4,617,860	296	53	50	44	40	34	31	17	--	--
REC-240	326,170	4,617,906	297	53	50	44	40	34	31	16	--	--
REC-241	326,323	4,617,856	297	53	50	44	41	34	31	18	--	--
REC-242	326,321	4,617,822	297	53	51	45	41	34	32	18	--	--
REC-243	326,319	4,617,901	297	53	50	44	40	34	31	17	--	--
REC-244	326,091	4,617,974	297	53	50	44	40	33	30	15	--	--
REC-245	326,176	4,617,947	297	53	50	44	40	34	30	16	--	--
REC-246	326,135	4,617,974	297	53	50	44	40	33	30	15	--	--
REC-247	326,290	4,617,902	297	53	50	44	40	34	31	17	--	--
REC-248	326,096	4,618,022	298	52	50	43	40	33	30	14	--	--
REC-249	326,206	4,618,020	298	52	50	44	40	33	30	15	--	--
REC-250	326,282	4,617,843	297	53	51	44	41	34	31	18	--	--
REC-251	326,275	4,617,969	297	53	50	44	40	34	30	16	--	--
REC-252	326,137	4,618,015	298	52	50	44	40	33	30	14	--	--
REC-253	326,165	4,618,017	298	52	50	44	40	33	30	15	--	--
REC-254	326,223	4,617,902	297	53	50	44	40	34	31	17	--	--
REC-255	326,193	4,617,903	297	53	50	44	40	34	31	16	--	--
REC-256	326,086	4,617,862	296	53	50	44	40	34	31	16	--	--
REC-257	326,278	4,617,946	297	53	50	44	40	34	31	16	--	--
REC-258	326,319	4,617,971	298	53	50	44	40	34	30	16	--	--
REC-259	326,322	4,617,949	298	53	50	44	40	34	31	17	--	--
REC-260	326,234	4,617,857	297	53	50	44	40	34	31	17	--	--
REC-261	326,378	4,617,855	297	53	51	44	41	34	32	18	--	--
REC-262	326,277	4,618,024	298	52	50	44	40	33	30	15	--	--
REC-263	326,326	4,618,118	300	52	50	43	39	33	29	14	--	--
REC-264	326,330	4,618,077	299	52	50	43	39	33	30	15	--	--
REC-265	326,370	4,618,077	299	52	50	43	40	33	30	15	--	--
REC-266	326,422	4,618,070	300	52	50	43	40	33	30	16	--	--
REC-267	326,467	4,618,078	300	52	50	43	40	33	30	16	--	--
REC-268	326,404	4,618,115	300	52	50	43	39	33	29	15	--	--
REC-269	326,500	4,618,079	300	52	50	43	40	33	30	16	--	--
REC-270	326,539	4,618,075	300	52	50	43	40	33	30	16	--	--
REC-271	326,564	4,618,076	300	52	50	44	40	33	30	16	--	--
REC-272	326,601	4,618,075	300	52	50	44	40	33	30	16	--	--
REC-273	326,372	4,618,010	299	52	50	44	40	33	30	16	--	--
REC-274	326,404	4,618,006	299	52	50	44	40	34	30	16	--	--
REC-275	326,423	4,618,008	299	52	50	44	40	34	30	16	--	--
REC-276	326,471	4,618,009	300	52	50	44	40	34	30	17	--	--
REC-277	326,518	4,618,002	299	52	50	44	40	34	31	17	--	--
REC-278	326,552	4,618,002	299	52	50	44	40	34	31	17	--	--
REC-279	326,578	4,618,000	299	52	50	44	40	34	31	17	--	--
REC-280	326,617	4,618,004	299	52	50	44	40	34	31	18	--	--
REC-281	326,371	4,617,962	298	53	50	44	40	34	31	17	--	--
REC-282	326,395	4,617,962	298	53	50	44	40	34	31	17	--	--
REC-283	326,410	4,617,962	299	53	50	44	40	34	31	17	--	--
REC-284	326,430	4,617,959	299	53	50	44	40	34	31	17	--	--
REC-285	326,466	4,617,959	299	53	50	44	40	34	31	17	--	--
REC-286	326,519	4,617,954	299	53	50	44	40	34	31	18	--	--
REC-287	326,554	4,617,955	299	53	50	44	40	34	31	18	--	--
REC-288	326,570	4,617,952	298	53	50	44	40	34	31	18	--	--
REC-289	326,587	4,617,953	298	53	50	44	40	34	31	18	--	--
REC-290	326,618	4,617,952	298	53	50	44	40	34	31	18	--	--
REC-291	326,368	4,617,900	298	53	50	44	40	34	31	18	--	--
REC-292	326,390	4,617,856	297	53	51	44	41	34	32	18	--	--
REC-293	326,410	4,617,852	297	53	51	45	41	34	32	19	--	--
REC-294	326,394	4,617,897	298	53	50	44	41	34	31	18	--	--
REC-295	326,409	4,617,895	298	53	50	44	41	34	31	18	--	--

Notes:
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[3] All coordinates provided in "Houses_GoogleEarth_Nov212018.xlxs"

NOISE MODELING RESULTS - Combined Layouts 60b and 64b

Receiver	Coordinates			Modeled Sound Level (dB)								
	Easting (m)	Northing (m)	Base Elevation (m)	31.5 (Hz)	63 (Hz)	125 (Hz)	250 (Hz)	500 (Hz)	1000 (Hz)	2000 (Hz)	4000 (Hz)	8000 (Hz)
IPCB Individual Octave Band Frequency Sound Pressure Level Limits (Nighttime)				69	67	62	54	47	41	36	32	32
REC-296	326,427	4,617,893	298	53	50	44	41	34	31	18	--	--
REC-297	326,436	4,617,852	298	53	51	45	41	35	32	19	--	--
REC-298	326,547	4,617,808	297	53	51	45	41	35	32	20	--	--
REC-299	326,569	4,617,904	298	53	50	44	41	34	32	19	--	--
REC-300	326,606	4,617,885	297	53	51	45	41	35	32	19	--	--
REC-301	326,575	4,617,887	298	53	50	45	41	35	32	19	--	--
REC-302	326,611	4,617,842	297	53	51	45	41	35	32	20	--	--
REC-303	326,613	4,617,806	297	53	51	45	41	35	33	21	--	--
REC-304	326,550	4,617,844	297	53	51	45	41	35	32	20	--	--
REC-305	326,574	4,617,843	297	53	51	45	41	35	32	20	--	--
REC-306	326,597	4,617,841	297	53	51	45	41	35	32	20	--	--
REC-307	326,658	4,617,883	297	53	51	45	41	35	32	20	--	--
REC-308	326,688	4,617,891	297	53	51	45	41	35	32	20	--	--
REC-309	326,752	4,617,885	297	53	51	45	41	35	32	20	--	--
REC-310	326,755	4,617,905	297	53	50	45	41	35	32	20	--	--
REC-311	326,812	4,617,869	296	53	51	45	41	35	33	21	--	--
REC-312	326,714	4,617,883	297	53	51	45	41	35	32	20	--	--
REC-313	326,757	4,617,948	297	53	50	44	41	34	32	19	--	--
REC-314	326,901	4,617,939	295	53	50	45	41	35	32	20	--	--
REC-315	326,797	4,617,925	296	53	50	45	41	35	32	20	--	--
REC-316	326,801	4,617,945	297	53	50	44	41	34	32	20	--	--
REC-317	326,920	4,617,976	294	52	50	44	41	34	32	19	--	--
REC-318	326,655	4,617,997	299	52	50	44	40	34	31	18	--	--
REC-319	326,673	4,617,997	298	52	50	44	40	34	31	18	--	--
REC-320	326,697	4,617,995	298	52	50	44	40	34	31	18	--	--
REC-321	326,751	4,617,997	298	52	50	44	40	34	31	18	--	--
REC-322	326,796	4,618,005	297	52	50	44	40	34	31	18	--	--
REC-323	326,797	4,618,030	297	52	50	44	40	34	31	18	--	--
REC-324	326,796	4,618,097	297	52	50	44	40	33	30	17	--	--
REC-325	326,748	4,618,062	298	52	50	44	40	34	31	17	--	--
REC-326	326,729	4,618,094	298	52	50	44	40	33	30	17	--	--
REC-327	326,912	4,618,070	294	51	49	44	40	33	31	18	--	--
REC-328	326,800	4,618,055	297	52	50	44	40	34	31	18	--	--
REC-329	326,696	4,618,067	299	52	50	44	40	33	30	17	--	--
REC-330	326,676	4,618,068	299	52	50	44	40	33	30	17	--	--
REC-331	326,628	4,618,071	300	52	50	44	40	33	30	17	--	--
REC-332	328,509	4,618,946	291	46	43	37	33	26	21	--	--	--
REC-333	328,876	4,618,871	288	45	43	37	33	26	20	--	--	--
REC-334	330,021	4,618,568	279	47	45	38	33	27	20	--	--	--
REC-335	330,534	4,618,509	277	48	45	38	33	28	20	--	--	--
REC-336	330,480	4,618,536	276	48	45	38	33	27	20	--	--	--
REC-337	330,131	4,618,546	278	47	45	38	33	27	20	--	--	--
REC-338	328,335	4,617,948	288	50	48	42	38	32	28	12	--	--
REC-339	328,218	4,616,871	282	55	53	48	44	38	37	27	5	--
REC-340	328,655	4,615,732	279	56	54	48	45	39	37	27	3	--
REC-341	328,643	4,615,719	279	56	54	49	45	39	37	27	3	--
REC-342	329,268	4,616,329	282	54	52	46	42	36	32	18	--	--
REC-343	329,137	4,615,930	282	55	52	46	43	38	34	21	--	--
REC-344	329,123	4,615,974	281	54	52	46	43	37	34	21	--	--
REC-345	327,924	4,615,291	278	57	55	51	47	41	40	30	7	--
REC-346	327,779	4,614,896	276	58	56	52	48	43	41	33	15	--
REC-347	329,069	4,614,489	280	56	54	48	44	39	36	24	--	--
REC-348	329,110	4,614,220	285	55	53	47	43	38	35	22	--	--
REC-349	328,230	4,613,661	285	56	54	49	45	39	37	27	3	--
REC-350	329,089	4,612,950	288	53	51	45	40	35	30	13	--	--
REC-351	329,140	4,612,169	285	53	50	43	39	34	29	14	--	--
REC-352	328,857	4,611,940	280	50	47	42	38	33	28	13	--	--
REC-353	329,064	4,611,643	273	52	49	43	38	34	29	16	--	--
REC-354	329,135	4,611,550	271	51	47	42	38	34	30	18	--	--

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NOISE MODELING RESULTS - Combined Layouts 60b and 64b

Receiver	Coordinates			Modeled Sound Level (dB)								
	Easting (m)	Northing (m)	Base Elevation (m)	31.5 (Hz)	63 (Hz)	125 (Hz)	250 (Hz)	500 (Hz)	1000 (Hz)	2000 (Hz)	4000 (Hz)	8000 (Hz)
IPCB Individual Octave Band Frequency Sound Pressure Level Limits (Nighttime)				69	67	62	54	47	41	36	32	32
REC-355	328,389	4,610,468	265	50	47	41	37	31	27	10	--	--
REC-356	328,614	4,610,459	263	49	47	40	36	31	26	10	--	--
REC-357	328,684	4,610,451	261	49	46	40	36	31	26	10	--	--
REC-358	329,027	4,610,417	260	49	46	40	36	31	27	13	--	--
REC-359	329,103	4,610,441	258	50	46	40	36	32	28	14	--	--
REC-360	329,192	4,610,470	255	50	46	40	36	32	28	15	--	--
REC-361	329,296	4,610,501	251	50	47	40	36	33	29	17	--	--
REC-362	329,234	4,610,783	255	51	47	41	37	33	30	18	--	--
REC-363	329,287	4,610,909	258	51	48	41	37	34	31	20	--	--
REC-364	329,780	4,610,976	257	55	51	45	41	39	37	29	8	--
REC-365	329,596	4,610,903	255	53	49	43	39	37	34	25	--	--
REC-366	329,604	4,610,815	258	52	48	42	38	36	33	24	--	--
REC-367	329,587	4,610,630	256	51	47	41	38	35	32	22	--	--
REC-368	329,747	4,610,455	252	52	48	42	38	35	32	23	--	--
REC-369	330,254	4,610,556	261	56	52	46	42	40	38	31	13	--
REC-370	329,929	4,610,557	256	53	50	43	39	37	35	26	4	--
REC-371	331,516	4,610,321	251	54	51	45	41	38	34	23	--	--
REC-372	333,694	4,610,462	237	52	49	43	39	35	31	19	--	--
REC-373	336,931	4,610,714	229	44	40	32	27	23	15	--	--	--
REC-374	336,855	4,610,776	230	44	40	32	27	23	16	--	--	--
REC-375	336,953	4,612,721	239	47	42	35	30	27	21	2	--	--
REC-376	336,853	4,612,554	241	47	43	35	31	27	22	3	--	--
REC-377	336,894	4,613,131	245	47	43	36	31	28	22	4	--	--
REC-378	336,362	4,613,581	248	47	43	37	33	30	25	11	--	--
REC-379	336,824	4,614,702	262	46	42	35	30	27	21	2	--	--
REC-380	336,513	4,614,964	267	48	44	37	32	28	23	4	--	--
REC-381	336,601	4,614,894	267	48	44	37	32	28	22	4	--	--
REC-382	336,655	4,614,859	266	47	43	36	31	28	22	3	--	--
REC-383	336,437	4,615,011	268	48	44	37	32	29	23	5	--	--
REC-384	336,274	4,615,151	269	48	44	38	33	29	23	6	--	--
REC-385	335,883	4,615,413	274	49	46	39	34	30	25	8	--	--
REC-386	335,468	4,615,740	282	50	47	40	35	32	26	9	--	--
REC-387	335,243	4,615,822	285	51	47	40	36	32	27	10	--	--
REC-388	335,347	4,615,888	285	50	47	40	36	32	26	9	--	--
REC-389	335,254	4,615,894	285	50	47	40	36	32	27	10	--	--
REC-390	329,401	4,611,935	275	51	48	42	38	34	31	19	--	--
REC-391	330,023	4,612,043	273	54	51	44	40	38	35	26	3	--
REC-392	330,244	4,611,932	273	56	52	46	42	39	37	29	10	--
REC-393	330,426	4,611,845	268	57	53	47	43	40	38	31	13	--
REC-394	330,343	4,611,926	270	56	52	46	42	40	37	29	10	--
REC-395	330,419	4,613,547	291	56	53	47	43	39	35	23	--	--
REC-396	330,604	4,614,002	288	59	56	50	46	43	40	32	12	--
REC-397	329,212	4,614,486	282	56	54	48	44	40	36	24	--	--
REC-398	330,517	4,615,311	289	59	57	51	47	44	41	33	12	--
REC-399	330,520	4,616,534	291	55	52	46	42	38	35	25	1	--
REC-400	329,672	4,616,897	282	52	50	44	39	34	29	14	--	--
REC-401	330,533	4,617,317	291	51	49	42	38	33	28	12	--	--
REC-402	330,525	4,617,619	287	50	48	41	37	32	26	8	--	--
REC-403	332,006	4,617,542	280	50	48	42	37	33	27	9	--	--
REC-404	331,967	4,617,523	280	49	47	41	37	33	27	9	--	--
REC-405	332,004	4,617,582	279	50	48	41	37	33	27	9	--	--
REC-406	331,998	4,617,518	280	50	48	42	37	33	27	9	--	--
REC-407	332,231	4,616,932	289	53	51	44	40	37	32	18	--	--
REC-408	332,335	4,616,702	292	54	52	46	42	38	34	21	--	--
REC-409	332,080	4,616,413	289	55	53	47	43	39	35	23	--	--
REC-410	332,220	4,615,927	294	58	56	50	46	43	39	29	7	--
REC-411	332,068	4,615,822	291	58	56	50	46	42	39	28	2	--
REC-412	332,055	4,615,671	290	58	56	50	46	43	39	29	5	--
REC-413	332,066	4,614,436	288	59	56	51	46	43	40	30	10	--

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NOISE MODELING RESULTS - Combined Layouts 60b and 64b

Receiver	Coordinates			Modeled Sound Level (dB)								
	Easting (m)	Northing (m)	Base Elevation (m)	31.5 (Hz)	63 (Hz)	125 (Hz)	250 (Hz)	500 (Hz)	1000 (Hz)	2000 (Hz)	4000 (Hz)	8000 (Hz)
IPCB Individual Octave Band Frequency Sound Pressure Level Limits (Nighttime)				69	67	62	54	47	41	36	32	32
REC-414	332,028	4,613,598	282	57	54	47	43	40	36	23	--	--
REC-415	332,021	4,613,623	282	57	54	47	43	40	36	23	--	--
REC-416	331,238	4,613,520	288	56	54	47	43	40	36	25	--	--
REC-417	331,149	4,613,525	288	56	54	47	43	40	36	25	--	--
REC-418	330,680	4,612,129	267	55	52	45	41	39	35	25	--	--
REC-419	330,980	4,611,997	274	56	53	46	42	40	36	27	2	--
REC-420	331,225	4,612,006	279	57	54	47	43	41	38	29	9	--
REC-421	331,387	4,612,001	276	57	54	48	44	41	38	30	11	--
REC-422	330,790	4,611,875	266	56	52	46	42	40	36	27	2	--
REC-423	331,333	4,611,787	276	57	54	48	44	41	38	28	4	--
REC-424	330,688	4,611,679	264	57	53	47	43	41	38	31	11	--
REC-425	330,856	4,611,345	267	58	54	48	44	42	40	32	12	--
REC-426	332,261	4,617,928	279	49	47	40	36	31	25	5	--	--
REC-427	332,952	4,618,234	282	48	45	39	34	29	22	2	--	--
REC-428	332,867	4,617,732	288	50	47	41	36	32	26	9	--	--
REC-429	333,098	4,617,656	291	50	48	41	37	32	27	10	--	--
REC-430	333,208	4,617,634	290	50	48	41	37	32	27	11	--	--
REC-431	334,076	4,617,598	288	49	46	40	35	31	25	7	--	--
REC-432	333,764	4,617,415	288	50	48	41	37	33	27	12	--	--
REC-433	333,765	4,617,463	289	50	48	41	36	32	27	11	--	--
REC-434	333,764	4,617,513	289	50	47	41	36	32	26	10	--	--
REC-435	333,836	4,617,513	289	50	47	41	36	32	26	10	--	--
REC-436	333,972	4,617,507	288	49	47	40	36	32	26	9	--	--
REC-437	333,970	4,617,575	288	49	47	40	35	31	25	8	--	--
REC-438	333,881	4,617,577	289	49	47	40	36	31	25	9	--	--
REC-439	333,765	4,617,360	288	50	48	41	37	33	28	12	--	--
REC-440	333,692	4,615,809	288	57	55	49	45	42	38	28	5	--
REC-441	333,277	4,614,654	285	58	56	50	46	43	40	30	7	--
REC-442	336,532	4,610,217	225	43	39	31	26	22	15	--	--	--
REC-443	335,328	4,611,467	237	50	47	40	35	32	27	11	--	--
REC-444	335,258	4,611,691	242	51	48	40	36	33	29	14	--	--
REC-445	335,208	4,613,082	258	56	52	46	42	40	38	31	12	--
REC-446	335,230	4,613,363	258	56	52	46	42	40	38	30	10	--
REC-447	336,161	4,613,610	255	51	47	39	35	32	28	14	--	--
REC-448	336,092	4,613,580	255	51	47	40	36	33	29	15	--	--
REC-449	335,291	4,614,498	273	54	50	43	39	37	33	24	--	--
REC-450	334,622	4,615,390	285	54	51	44	40	37	33	21	--	--
REC-451	334,254	4,615,206	285	56	53	46	42	39	36	26	3	--
REC-452	333,830	4,614,927	285	58	55	49	45	42	40	31	13	--
REC-453	335,258	4,609,831	229	46	43	35	31	26	20	--	--	--
REC-454	334,339	4,611,801	251	55	51	45	41	38	35	23	--	--
REC-455	333,807	4,613,524	270	58	55	48	45	42	40	31	12	--
REC-456	334,382	4,613,511	271	59	55	49	45	43	41	33	15	--
REC-457	332,924	4,612,007	264	58	55	50	45	43	40	31	8	--
REC-458	333,164	4,611,989	263	59	56	50	46	43	40	32	12	--
REC-459	332,502	4,611,902	264	57	55	49	45	42	38	28	3	--
REC-460	333,381	4,613,571	273	59	56	50	45	43	41	33	16	--
REC-461	333,118	4,613,443	275	59	56	51	46	44	41	32	14	--
REC-462	332,787	4,613,927	288	57	55	48	44	41	37	27	0	--
REC-463	332,921	4,614,144	291	58	55	48	44	42	38	28	4	--
REC-464	335,229	4,616,215	282	50	47	40	35	31	25	7	--	--
REC-465	335,003	4,616,435	279	50	47	40	36	32	26	8	--	--
REC-466	335,126	4,616,405	281	49	47	40	35	31	25	7	--	--
REC-467	335,053	4,616,433	280	50	47	40	35	31	26	7	--	--
REC-468	335,048	4,616,487	280	49	47	40	35	31	25	7	--	--
REC-469	335,089	4,616,439	280	49	47	40	35	31	25	7	--	--
REC-470	335,117	4,616,439	281	49	46	40	35	31	25	7	--	--
REC-471	335,078	4,616,486	280	49	46	40	35	31	25	7	--	--
REC-472	335,111	4,616,516	281	49	46	39	35	31	25	6	--	--

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NOISE MODELING RESULTS - Combined Layouts 60b and 64b

Receiver	Coordinates			Modeled Sound Level (dB)								
	Easting (m)	Northing (m)	Base Elevation (m)	31.5 (Hz)	63 (Hz)	125 (Hz)	250 (Hz)	500 (Hz)	1000 (Hz)	2000 (Hz)	4000 (Hz)	8000 (Hz)
IPCB Individual Octave Band Frequency Sound Pressure Level Limits (Nighttime)				69	67	62	54	47	41	36	32	32
REC-473	335,120	4,616,484	281	49	46	39	35	31	25	6	--	--
REC-474	335,105	4,616,544	281	49	46	39	35	31	25	6	--	--
REC-475	335,172	4,616,469	282	49	46	39	35	31	25	6	--	--
REC-476	335,168	4,616,501	282	49	46	39	35	31	25	6	--	--
REC-477	335,104	4,616,574	280	48	46	39	35	31	25	6	--	--
REC-478	335,088	4,616,658	279	49	46	39	35	31	24	6	--	--
REC-479	334,569	4,616,959	284	50	47	40	36	32	26	9	--	--
REC-480	334,566	4,617,023	285	49	47	40	36	32	26	8	--	--
REC-481	334,598	4,617,020	284	49	47	40	35	31	26	8	--	--
REC-482	334,628	4,617,018	285	49	47	40	35	31	25	8	--	--
REC-483	334,702	4,616,911	283	49	47	40	35	31	25	8	--	--
REC-484	334,698	4,616,864	283	50	47	40	36	32	26	8	--	--
REC-485	334,702	4,616,839	282	50	47	40	36	32	26	8	--	--
REC-486	334,699	4,616,790	282	50	47	40	36	32	26	9	--	--
REC-487	334,763	4,616,792	282	50	47	40	36	32	26	8	--	--
REC-488	334,801	4,616,785	282	50	47	40	35	31	26	8	--	--
REC-489	334,821	4,616,745	282	50	47	40	36	31	26	8	--	--
REC-490	334,904	4,616,744	282	49	47	40	35	31	25	7	--	--
REC-491	334,947	4,616,745	282	49	47	40	35	31	25	6	--	--
REC-492	334,868	4,616,749	282	49	47	40	35	31	25	7	--	--
REC-493	334,990	4,616,747	282	49	46	39	35	31	25	6	--	--
REC-494	334,969	4,616,750	282	49	46	39	35	31	25	6	--	--
REC-495	335,090	4,616,745	282	49	46	39	34	30	24	5	--	--
REC-496	335,094	4,616,712	281	49	46	39	34	30	24	5	--	--
REC-497	335,012	4,616,749	282	49	46	39	35	31	24	6	--	--
REC-498	335,047	4,616,745	282	49	46	39	35	30	24	5	--	--
REC-499	334,705	4,617,028	285	49	47	40	35	31	25	7	--	--
REC-500	334,705	4,617,087	286	49	46	40	35	31	25	6	--	--
REC-501	334,702	4,617,141	288	49	46	39	35	30	24	6	--	--
REC-502	334,701	4,617,176	288	49	46	39	35	30	24	6	--	--
REC-503	334,650	4,617,206	288	49	46	39	35	30	24	6	--	--
REC-504	334,628	4,617,201	288	49	46	39	35	31	24	6	--	--
REC-505	334,595	4,617,203	288	49	46	39	35	31	25	7	--	--
REC-506	334,533	4,617,270	288	49	46	39	35	31	25	7	--	--
REC-507	334,498	4,617,281	288	49	46	40	35	31	25	7	--	--
REC-508	334,470	4,617,296	288	49	46	40	35	31	25	7	--	--
REC-509	334,409	4,617,336	288	49	46	40	35	31	25	7	--	--

Notes:
[1} "--" shows the windfarm has minimal impact
[2] All coordinates presented in UTM NAD83 Zone 16N (meters)
[3] All coordinates provided in "Houses_GoogleEarth_Nov212018.xlxs"

CREATE AMAZING.

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