Appendix H: Acoustic Assessment Report

Seneca Wind
Acoustic Assessment

Seneca County, Ohio

July 2018

Prepared for

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ACRONYMS AND ABBREVIATIONS

µPa	micropascals
ANSI	American National Standards Institute
CadnaA	Computer-Aided Noise Abatement Program
dB	decibel
dBA	A-weighted decibel
GE	General Electric
Hz	Hertz
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
kHz	kiloHertz
L_{eq}	equivalent sound level
L_{max}	maximum instantaneous sound level
L_p	sound pressure levels
L_W	sound power level
m	meter
ML	Monitoring Location
m/s	velocity in meters per second
mph	miles per hour
MW	megawatt
NIST	National Institute of Standards and Technology
OPSB	Ohio Power Siting Board
the Project	Seneca Wind
the Project Area	approximately 56,900 acres of Seneca County within which the Seneca Wind project is located
pW	picowatt
Seneca Wind	Seneca Wind LLC
Tetra Tech	Tetra Tech, Inc.
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
W	watt
WTG	wind turbine generator

1.0 INTRODUCTION

Seneca Wind LLC (Seneca Wind) is proposing to develop the Seneca Wind project (the Project) located in Seneca County, Ohio. The Project is a new 212-megawatt (MW) wind energy facility consisting of 85 wind turbine generator (WTG) locations; a total of 94 WTGs were evaluated to provide for nine alternate locations. The WTGs evaluated include:

- One General Electric (GE) 2.3-MW WTG with a rotor diameter of 116 meters (m) (380 feet) and a hub height of 80 m (262 feet);
- One GE 2.3-MW WTG with a rotor diameter of 116 m (380 feet) and a hub height of 90 m (295 feet);
- Eight GE 2.3-MW WTGs with a rotor diameter of 116 m (380 feet) and a hub height of 94 m (308 feet); and
- Eighty-four GE 2.5-MW WTGs with a rotor diameter of 127 m (417 feet) and a hub height of 1134 m (440 feet).[1]

The Project's associated substation and 138-kilovolt electric generation tie, which will transmit the Project's power to the point of interconnection at the Melmore Substation, will be the subject of a separate filing with the Ohio Power Siting Board (OPSB) and is not reflected in this analysis.

To characterize the existing acoustic environment within the Project area, Tetra Tech, Inc. (Tetra Tech) completed a baseline sound survey. In addition, an acoustic modeling analysis was conducted to review operational sound levels resulting from the Project and compliance was assessed at nearby noise sensitive areas (i.e., occupied residences) relative to the OPSB noise requirements (see Section 2.0 of this report). The results of the baseline sound survey and modeling analysis are documented in this Acoustic Assessment report.

1.1 Project Area

The Project is located within an approximately 56,900-acre portion of Seneca County (the Project Area), in northwestern Ohio, with Huron County bordering the Project Area to the east and Crawford County bordering the Project Area to the south. The topography of Seneca County, and the Project Area, is characterized as level to gently sloping. The highest elevation is about 296 m (971 feet) above sea level, along Columbus Sandusky Road in the southeastern portion of Seneca County. The lowest elevation, about 200 m (656 feet) above sea level, is at a point near a gravel pit south of the City of Bettsville.

The Project Area predominantly reflects existing farm land. Areas of wooded vegetation, local roadways, and residential development also occur throughout the Project Area. Residences are widely scattered throughout the Project Area, with 2,715 residences presumed to be occupied identified within a 1-mile radius. Patches of trees and shrubs exist throughout and are found primarily between agricultural fields, in drainages, and as shelter belts around homesteads. Figure 1 presents the location of the Project WTGs evaluated in this report, as well as the occupied residences (i.e., receptors) that were included in the modeling analysis. Ambient noise monitoring locations (MLs) and on-site meteorological stations used in the baseline sound survey are also identified on Figure 1.

[1] It is possible that some 2.5-MW WTGs may be installed on 112-m towers to address location-specific issues; if this should be the case, the Project will demonstrate its ability to comply with regulatory requirements.

1.2 Acoustic Terminology

Airborne sound is described as the rapid fluctuation or oscillation of air pressure above and below atmospheric pressure, creating a sound wave. Sound is characterized by properties of the sound waves (i.e., frequency, wavelength, period, amplitude, and velocity). Noise is defined as unwanted sound. A sound source is defined by a sound power level (L_W), which is independent of any external factors. The acoustic sound power is the rate at which acoustical energy is radiated outward and is expressed in units of watts (W). Sound energy travels in the form of a wave, a rapid fluctuation or oscillation of air pressure above and below atmospheric pressure. A sound pressure level (L_P) is a measure of this fluctuation and can be directly determined with a microphone or calculated from information about the source sound power level and the surrounding environment through predictive acoustic modeling. While the sound power of a source is strictly a function of the total amount of acoustic energy being radiated by the source, the sound pressure levels produced by a source are a function of the distance from the source and the effective radiating area or physical size of the source. In general, the magnitude of a source's sound power level is always considerably higher than the observed sound pressure level near a source due to the fact that the acoustic energy is being radiated in various directions.

Sound levels are presented on a logarithmic scale to account for the large pressure response range of the human ear, and are expressed in units of decibels (dB). A dB is defined as the ratio between a measured value and a reference value usually corresponding to the lower threshold of human hearing defined as 20 micropascals (µPa). Conversely, sound power is commonly referenced to 1 picowatt (pW), which is one trillionth of a watt. Broadband sound includes sound energy summed across the frequency spectrum. In addition to broadband sound pressure levels, analysis of the various frequency components of the sound spectrum is often completed to determine tonal characteristics. The unit of frequency is Hertz (Hz), which corresponds to the rate in cycles per second that sound pressure waves are generated. Typically, a sound frequency analysis examines 11 octave (or 33⅓ octave) bands ranging from 20 Hz (low) to 20,000 Hz (high). This range encompasses the entire human audible frequency range. Since the human ear does not perceive every frequency with equal loudness, spectrally varying sounds are often adjusted with a weighting filter. The A-weighted filter is applied to compensate for the frequency response of the human auditory system. Sound exposure in acoustic assessments is commonly measured and calculated as A-weighted dB (dBA).

Sound can be measured, modeled, and presented in various formats, with the most common metric being the equivalent sound level (L_{eq}). The equivalent sound level has been shown to provide both an effective and uniform method for comparing time-varying sound levels and is widely used in acoustic assessments, including in OPSB review.

Estimates of noise sources and outdoor acoustic environments, and the comparison of relative loudness are presented in Table 1. Table 2 provides additional reference information on acoustic terminology.

Table 1. Sound Pressure Levels and Relative Loudness of Typical Noise Sources and Soundscapes

Noise Source or Activity	Sound Level (dBA)	Subjective Impression	Relative Loudness (perception of different sound levels)
Jet aircraft takeoff from carrier (50 feet)	140	Threshold of pain	64 times as loud
50-hp siren (100 feet)	130		32 times as loud
Loud rock concert near stage or jet takeoff (200 feet)	120	Uncomfortably loud	16 times as loud
Float plane takeoff (100 feet)	110		8 times as loud
Jet takeoff (2,000 feet)	100	Very loud	4 times as loud
Heavy truck or motorcycle (25 feet)	90		2 times as loud
Garbage disposal, food blender (2 feet), or Pneumatic drill (50 feet)	80	Loud	Reference loudness
Vacuum cleaner (10 feet)	70	Moderate	1/2 as loud
Passenger car at 65 miles per hour (mph) (25 feet)	65		
Large store air-conditioning unit (20 feet)	60		1/4 as loud
Light auto traffic (100 feet)	50	Quiet	1/8 as loud
Quiet rural residential area with no activity	45		
Bedroom or quiet living room or bird calls	40	Faint	1/16 as loud
Typical wilderness area	35		
Quiet library, soft whisper (15 feet)	30	Very quiet	1/32 as loud
Wilderness with no wind or animal activity	25	Extremely quiet	
High-quality recording studio	20		1/64 as loud
Acoustic test chamber	10	Just audible	
	0	Threshold of hearing	

Adapted from: Beranek 1988; United States Environmental Protection Agency (USEPA) 1971a.

Table 2. Acoustic Terms and Definitions

Term	Definition
Noise	Typically defined as unwanted sound. This word adds the subjective response of humans to the physical phenomenon of sound. It is commonly used when negative effects on people are known to occur.
Sound Pressure Level (L_P)	Pressure fluctuations in a medium. Sound pressure is measured in decibels referenced to 20 µPa, the approximate threshold of human perception to sound at 1,000 Hz.
Sound Power Level (L_W)	The total acoustic power of a noise source measured in decibels referenced to picowatts (one trillionth of a watt). Noise specifications are provided by equipment manufacturers as sound power as it is independent of the environment in which it is located. A sound level meter does not directly measure sound power.
A-Weighted Decibel (dBA)	Environmental sound is typically composed of acoustic energy across all frequencies. To compensate for the auditory frequency response of the human ear, an A-weighting filter is commonly used for describing environmental sound levels. Sound levels that are A-weighted are presented as dBA in this report.
Propagation and Attenuation	Propagation is the decrease in amplitude of an acoustic signal due to geometric spreading losses with increased distance from the source. Additional sound attenuation factors include air absorption, terrain effects, sound interaction with the ground, diffraction of sound around objects and topographical features, foliage, and meteorological conditions including wind velocity, temperature, humidity, and atmospheric conditions.
Octave Bands	The audible range of humans spans from 20 to 20,000 Hz and is typically divided into center frequencies ranging from 31 to 8,000 Hz for noise modeling evaluations.
Broadband Sound	Noise which covers a wide range of frequencies within the audible spectrum, i.e., 200 to 2,000 Hz.
Masking	Interference in the perception of one sound by the presence of another sound. At elevated wind speeds, leaf rustle and noise made by the wind itself can mask wind turbine sound levels, which remain relatively constant.
Frequency (Hz)	The rate of oscillation of a sound, measured in units of Hz or kilohertz (kHz). One hundred Hz is a rate of one hundred times (or cycles) per second. The frequency of a sound is the property perceived as pitch: a low-frequency sound (such as a bass note) oscillates at a relatively slow rate, and a high-frequency sound (such as a treble note) oscillates at a relatively high rate. For comparative purposes, the lowest note on a full range piano is approximately 32 Hz and middle C is 261 Hz.

Note: Compiled by Tetra Tech from multiple technical and engineering resources.

2.0 NOISE REGULATIONS AND GUIDELINES

No noise rules or regulations exist at the state level in Ohio, other than those recently established by the OPSB. The OPSB has established requirements for addressing both construction and operational noise, as well as specific guidelines for acceptable sound level increases for wind energy facilities. There are no noise requirements at the county or local levels.

The OPSB requirements include:

- A description of the noise-sensitive areas within 1 mile of the Project Area (as required in 4906-4-08(A)(3)(c)); provided in Section 1.1 of this report;
- Results of a preconstruction background noise study of the Project Area that includes measurements taken under both day and nighttime conditions (as required in 4906-4-08(A)(3)(e)); provided in Section 3.0 of this report;
- Construction noise levels at the nearest property boundary (as required in 4906-4-08(A)(3)(a)); provided in Section 5.0 of this report;
- Operational noise levels at the nearest property boundary (as required in 4906-4-08(A)(3)(b)) and at noise-sensitive areas (as required in 4906-4-08(A)(3)(c)); provided in Section 4.4 of this report, with consideration for broadband, tonal and low-frequency noise; and
- Equipment and procedures to mitigate the effects of noise emissions, as applicable, as required in 4906-4-08(A)(3)(d); provided in Section 5.0 for construction impacts and Section 4.4 for operational impacts, respectively.

The OPSB provides additional guidance within Section 4906-4-09(F) that limit the hours of general construction activities, and establish operational noise requirements for the effect of WTGs on non-participating landowners (in this context, a property for which the owner has not signed a waiver or otherwise agreed to be subject to a higher noise level). In addition to requiring implementation of a complaint resolution process, acceptable noise levels at non-participating properties within 1 mile are established as 5 dBA over the ambient nighttime L_{eq}, with higher daytime limits also established. For the purposes of this report, the nighttime ambient is used to assess the Project sound level. Seneca Wind's complaint resolution program is outlined in Appendix A.

3.0 EXISTING ACOUSTIC CONDITIONS

Tetra Tech conducted a baseline sound survey to characterize the existing acoustic environment near the Project. The baseline sound survey commenced on May 15, 2018 with data logged continuously over a 10-day period ending May 25, 2018.

This section summarizes the methodology used by Tetra Tech to conduct the sound survey, describes the measurement locations, and presents the measured ambient sound levels.

3.1 Field Methodology

Ambient sound level measurements were conducted using a Larson Davis Model 831 precision integrating sound-level analyzer that meets the requirements of American National Standards Institute (ANSI) Standards for Type 1 instruments. This instrument has an operating range of 5 to 140 dB and an overall frequency range of 8 to 20,000 Hz.

The Larson Davis 831 sound level analyzer is designed for service as a long-term environmental sound level data logger measuring the A-weighted sound level. Each analyzer used was enclosed in a weatherproof case and equipped with a self-contained microphone tripod. During the measurements, the microphone and windscreen were tripod-mounted at an approximate height of 1.5 to 1.7 m (4.9 to 5.6 feet) above grade. The sound level meter was calibrated at the beginning and end of the measurement period using a Larson Davis Model CAL200 acoustic calibrator following procedures that are traceable to the National Institute of Standards and Technology (NIST). Table 3 lists the measurement equipment employed during the survey. The analyzers were programmed to sample and store A-weighted and octave band sound level data, including equivalent (L_{eq}) sound levels.

Table 3. Measurement Equipment

Description	Manufacturer	Type
Signal Analyzer	Larson Davis	831
Preamplifier	Larson Davis	PRM902
Microphone	PCB	377B02
Environmental Protection Kit	Larson Davis	EPS2116
Calibrator	Larson Davis	CAL200

3.2 Monitoring Duration and Locations

The monitoring program extended over a 10-day period to collect data for a range of meteorological conditions. Monitoring locations were selected with the assistance of Seneca Wind to be representative of occupied residences located in proximity to proposed WTGs. Continuous measurements were made in 10-minute intervals at each location and then correlated with wind speed data collected by the on-site meteorological towers shown in Figure 1. Using the sound level measurement and wind speed data, a regression analysis was conducted for each monitoring location to calculate the best fit correlation coefficient trend. The 10-minute L_{eq} sound levels were divided into daytime (7:00 a.m. to 10:00 p.m.) and nighttime (10:00 p.m. to 7:00 a.m.) periods to show diurnal variation at each monitoring position.

A description of each of the five monitoring locations and resulting measurements (including time history and regression analysis plots) are provided below.

3.2.1 Monitoring Location 1

Monitoring Location 1 (ML-1) was situated on agricultural land at 16301-16791 Township Road 12 in Attica, Ohio (Universal Transverse Mercator [UTM] Zone 17T: 344191.2, 4547783.65). A Larson Davis 831, Serial No. 3556, was used to collect data at this location. The distance to the closest proposed WTG is approximately 350 m and represents the southeastern portion of the Project Area. Observations recorded during deployment indicated the location was relatively quiet, with roadway noise associated with Township Road 12, railway activities, and sporadic noise from animals onsite contributing to ambient sound levels. Figure 2 includes photographs of the monitoring location relative to one of the occupied residential structures and the viewpoint from the monitoring in the direction of the Project. Figure 3 provides the time history and Figure 4 provides the regression analyses of ambient sound levels during daytime and nighttime monitoring periods.

3.2.2 Monitoring Location 2

Monitoring Location 2 (ML-2) was situated at an occupied residence along 11119 Township Road 8 in Republic, Ohio (UTM Zone 17T: 335817, 4552881.53). A Larson Davis 831, Serial No. 3326, was used to collect data at this location. The distance to the closest proposed WTG is approximately 360 m. Observations recorded during deployment indicated the location was relatively quiet, with agricultural activities and sporadic roadway noise potentially contributing to ambient sound levels. Figure 5 includes photographs of the monitoring location relative to one of the occupied residential structures and the viewpoint to the west from the monitoring location. Figure 6 provides the time history and Figure 7 provides the regression analyses of ambient sound levels during daytime and nighttime monitoring periods.

3.2.3 Monitoring Location 3

Monitoring Location 3 (ML-3) was situated at an occupied residence along 402 N Main Street in Attica, Ohio (UTM Zone 17T: 341527.19, 4548276.61). A Larson Davis 831, Serial No. 3545, was used to collect data at this location. The distance to the closest proposed WTG is approximately 620 m. Observations recorded during deployment identified railway activities and sporadic roadway noise potentially contributing to ambient sound levels. Figure 8 includes photographs of the monitoring location relative to one of the occupied residential structures and the viewpoint from the monitoring in the direction of the Project. Figure 9 provides the time history and Figure 10 provides the regression analyses of ambient sound levels during daytime and nighttime monitoring periods.

3.2.4 Monitoring Location 4

Monitoring Location 4 (ML-4) was situated at an occupied residence along 7281-7497 E Country Road 12 in Bloomville, Ohio (UTM Zone 17T: 329509.08, 4546552.96). A Larson Davis 831, Serial No. 3331, was used to collect data at this location. The distance to the closest proposed WTG is approximately 550 m. Observations during deployment were that the location was relatively quiet, with agricultural activities and sporadic roadway noise potentially contributing to ambient sound levels. Figure 11 includes photographs of the monitoring location relative to one of the occupied residential structures and the viewpoint from the monitoring in the direction of the Project. Figure 12 provides the time history and Figure 13 provides the regression analyses of ambient sound levels during daytime and nighttime monitoring periods.

3.2.5 Monitoring Location 5

Monitoring Location 5 (ML-5) was situated at an occupied residence along 4400 E Country Road 12 in Bloomville, Ohio (UTM Zone 17T: 324716.52, 4543934.7). A Larson Davis 831, Serial No. 3219, was used to collect data at this location. The distance to the closest proposed WTG is approximately 282 m. Observations recorded during deployment indicated the location was relatively quiet, with agricultural activities and sporadic roadway noise potentially contributing to ambient sound levels. Figure 14 includes photographs of the monitoring location relative to one of the occupied residential structures and the viewpoint from the monitoring in the direction of the Project. Figure 15 provides the time history and Figure 16 provides the regression analyses of ambient sound levels during daytime and nighttime monitoring periods.

3.3 Baseline Sound Survey Results

Table 4 provides the results of the regression analyses for each monitoring location and cumulatively for all locations, representing the ambient sound levels across the Project Area. Table 4 displays daytime and nighttime ambient sound levels for each monitoring location within the Project Area for wind speed conditions ranging from calm to maximum rotational wind speed. The results show a generally homogenous ambient acoustic environment throughout the Project Area with limited variation in measured sound levels.

Table 4. Baseline Sound Survey Results, L_{eq} (dBA)

Monitoring Location	Coordinates (UTM Zone 16N)		Time Period	Wind Speed, meters per second (m/s)								
	Easting (m)	Northing (m)		4	5	6	7	8	9	10	11	12
ML-1	344191.2	4547783.65	Day	47	47	48	49	50	52	54	57	60
			Night	43	42	42	43	45	49	53	59	65
ML-2	335817	4552881.53	Day	47	47	47	47	47	47	47	47	47
			Night	38	41	44	46	47	48	48	48	47
ML-3	341527.19	4548276.61	Day	50	50	50	51	51	52	53	53	54
			Night	47	47	47	47	48	50	52	55	58
ML-4	329509.08	4546552.96	Day	46	46	46	46	47	47	48	50	51
			Night	37	36	35	36	39	42	47	53	61
ML-5	324716.52	4543934.7	Day	43	44	44	45	45	46	46	47	47
			Night	36	35	35	36	39	42	47	52	59
Seneca Wind Project Area			Day	48	49	49	50	51	53	54	55	57
			Night	39	40	41	42	44	46	49	52	56

4.0 ACOUSTIC MODELING METHODOLOGY

Sound generated by an operating WTG is made up of both aerodynamic and mechanical sound, with the dominant sound component from modern utility scale WTGs being largely aerodynamic. Aerodynamic sound refers to the sound produced from air flow and the interaction with the WTG tower structure and moving rotor blades. Mechanical sound is generated at the gearbox, generator, and cooling fan, and is radiated from the surfaces of the nacelle and machinery enclosure and by openings in the nacelle casing. Due to the improved design of WTG mechanical components and the use of improved noise damping materials within the nacelle, including elastomeric elements supporting the generator and gearbox, mechanical noise emissions have been minimized in modern WTGs. Sound reduction elements designed as a part of the WTGs include impact noise insulation of the gearbox and generator, sound-reduced gearbox, sound-reduced nacelle, and rotor blades designed to minimize noise generation.

Wind energy facilities are somewhat unique in that the sound generated by each individual WTG will increase as the wind speed increases up to a certain point. WTG sound is negligible when the rotor is at rest, increases as the rotor tip speed increases, and is generally constant once rated power output and maximum rotational speed are achieved. The WTG maximum sound power level will be reached at approximately 10 m/s at the hub height according to the GE specifications for the proposed equipment. It is important to recognize that, as wind speeds increase, background ambient sound levels will generally increase as well, resulting in acoustic masking effects. The net result is that, during periods of elevated wind speeds when higher WTG sound emissions occur, the sound produced from a WTG operating at maximum rotational speed may be largely or fully masked due to wind-generated sound in foliage or vegetation. In practical terms, this means a nearby receptor would tend to hear leaves or vegetation rustling rather than WTG noise. This relationship is expected to further minimize the potential for adverse noise effects of the Project, but is not taken into account in the modeling results.

4.1 Acoustic Modeling Software and Calculation Methods

The operational acoustic assessment was performed using the Project shown in Figure 1, consisting of 94 potential WTG locations with two different turbine types; WTGs will only be constructed in 85 of the studied locations. The acoustic modeling analysis was conducted using the most recent version of DataKustic GmbH's computer-aided noise abatement program or CadnaA (v 2017 MR1). CadnaA is a comprehensive 3-dimensional acoustic software model that conforms to the International Organization for Standardization (ISO) standard ISO 9613-2 "Attenuation of Sound during Propagation Outdoors." The engineering methods specified in this standard consist of full (1/1) octave band algorithms that incorporate: geometric spreading due to wave divergence; reflection from surfaces; atmospheric absorption; screening by topography and obstacles; ground effects; source directivity; heights of both sources and receptors; seasonal foliage effects; and meteorological conditions.

Topographical information was imported into the acoustic model using the official United States Geological Survey (USGS) digital elevation dataset to accurately represent terrain in three dimensions. Terrain conditions, vegetation type, ground cover, and the density and height of foliage can also influence the absorption that takes place when sound waves travel over land. The ISO 9613-2 standard accounts for ground absorption rates by assigning a numerical coefficient of G=0 for acoustically hard, reflective surfaces and G=1 for absorptive surfaces and soft ground. If the ground is hard-packed dirt, typically found in industrial complexes, pavement, bare rock or for sound traveling over water, the absorption coefficient is defined as G=0 to account for reduced sound attenuation and higher reflectivity. In contrast, ground covered in vegetation, including suburban lawns, livestock and agricultural fields (both fallow with bare soil and planted with crops), will be acoustically absorptive and aid in sound attenuation (i.e., G=1.0). A mixed (semi-reflective) ground factor of G=0.5 was used in the Project acoustic modeling analysis. In addition to geometrical divergence, attenuation factors include topographical features, terrain coverage, and/or other natural or anthropogenic obstacles that can affect sound attenuation and result in acoustical screening. To be conservative, sound attenuation through foliage and diffraction around and over existing anthropogenic structures, such as buildings, was ignored in this analysis.

Sound attenuation by the atmosphere is not strongly dependent on temperature and humidity; a temperature of 10° Celsius (50° Fahrenheit) and 70 percent relative humidity parameters were selected as representative of a median. Atmospheric absorption depends on temperature and humidity, and is most important at higher frequencies. Over short distances, the effects of atmospheric absorption are minimal. The ISO 9613-2 standard calculates attenuation for meteorological conditions favorable to propagation, i.e., downwind sound propagation, or what might occur typically during a moderate atmospheric ground level inversion. Though a physical impracticality, the ISO 9613-2 standard simulates omnidirectional downwind propagation. For receivers located between discrete WTG locations or WTG groupings, the acoustic model may, therefore, result in over-prediction. In addition, the acoustic modeling algorithms essentially assume laminar atmospheric conditions, in which neighboring layers of air do not mix. This assumption is also conservative assumption, as air movement naturally incorporates turbulent eddies and micrometeorological inhomogeneities when winds change speed or direction, which would interfere with the sound wave propagation path and increase attenuation effects to reduce experienced sound levels.

4.2 Acoustic Modeling Input Parameters

Wind turbine manufacturers report WTG sound power data at integer wind speeds referenced to the effective hub height, ranging from cut-in to full-rated power per International Electrotechnical Commission (IEC) standard IEC 61400-11:2006 Wind Turbine Generator Systems – Part 11: Acoustic Noise Measurement Techniques. This IEC standard was developed to ensure consistent and comparable sound emission data of utility-scale WTGs between manufacturers. Tables 5 and 6 present a summary of sound power data correlated to winds at the hub heights of 80 m, 90 m, and 94 m for the GE 2.3-116 as well as at the hub height of 134 m for the GE 2.5-127 WTGs.

The specification for the WTGs includes an expected warranty confidence interval, or k-factor, of 2 dB, which was added to the nominal sound power level in the acoustic model. This confidence interval applies a margin to reflect the applied probability level and standard deviation for test measurement reproducibility, as well as product variability.

Table 5. Broadband Sound Power Levels (dBA) Correlated with Wind Speed, GE 2.3-116

	WTG L_{max} Sound Power Level (L_W) at Reference Wind Speed (m/s)									
Wind Speed	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0
GE 2.3-116	95.0	95.8	98.2	101.6	104.5	105.8	107.5	107.5	107.5	107.5

Table 6. Broadband Sound Power Levels (dBA) Correlated with Wind Speed, GE 2.5-127

	WTG L_{max} Sound Power Level (L_W) at Reference Wind Speed (m/s)									
Wind Speed	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0
GE 2.5-127	96.7	96.9	100.4	103.9	106.8	109.2	110.0	110.0	110.0	110.0

Wind turbines can be somewhat directional, radiating more sound in some directions than others. The IEC test measurement protocol requires that sound measurements are made for the maximum downwind directional location when reporting apparent sound power levels. Thus, it is assumed that WTG directivity and sound-generating efficiencies are inherently incorporated in the sound source data and used in acoustic model development. A summary of sound power data by octave band center frequency for WTGs operating at maximum rotation are presented in Tables 7 and 8 (1/1 octave band frequency data provided with stated intended use limited for informational purposes only).

Table 7. Sound Power Level by Octave Band Center Frequency, GE 2.3-116

	Octave Band Sound Power Level (dBA)									Broadband
Frequency (Hz)	32	63	125	250	500	1000	2000	4000	8000	**(dBA)**
GE 2.3 - 116	79.0	88.9	95.0	99.6	102.9	102.3	97.8	89.0	68.1	107.5

Table 8. Sound Power Level by Octave Band Center Frequency, GE 2.5-127

	Octave Band Sound Power Level (dBA)									Broadband
Frequency (Hz)	32	63	125	250	500	1000	2000	4000	8000	**(dBA)**
GE 2.5 -127	82.8	92.6	98.0	100.6	104.2	105.5	102.1	94.1	76.0	110.0

4.3 Critical Design Wind Speed

The critical design wind speed is defined as the operational condition when the greatest differential occurs between the pre-construction background sound level and the wind turbine sound power level at the corresponding given wind speed. Although not initially intuitive, the operational noise condition that results in the greatest incremental increase relative to baseline does not always occur at full-rated power, when the wind turbine is at its maximum noise emission level. Table 9 identifies the critical design wind speed for the GE 2.5-127-60 Hz (which is not only the primary turbine type used for the Project, but as reflected in Tables 7 and 8, has the higher noise emission level) assuming a wind speed at a hub height averaged for the Project (114 m); critical design wind speed is identified by comparing the net differential between the WTG sound power level and the background nighttime L_{eq} sound level measured during the 2018 survey and at the averaged hub height. Table 9 shows that, for the GE 2.5-127-60 Hz, the critical design wind speed occurs at the reference wind speed range of 9 m/s (20.1 mph).

Acoustic modeling was completed for Project operation at the critical design wind speed, where the sound power octave band data was scaled accordingly. The results from modeling this scenario were then used to evaluate the Project's sound level and compare it to nighttime ambient conditions; at 9 m/s, nighttime ambient was measured to be 46 dBA.

Table 9. Critical Design Operational Condition, GE 2.5-127

Wind Speed	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
GE 2.5 L_{max} Sound Power Level at Reference Wind Speed	96.7	96.9	100.4	103.9	106.8	**109.2**	110.0	110.0	110.0
Background Nighttime L_{eq}	39.0	40.0	41.0	42.0	44.0	**46.0**	49.0	52.0	56.0
Net Differential	57.7	56.9	59.4	61.9	62.8	**63.2**	61.0	58.0	54.0

Bold type indicates critical design wind speeds.

4.4 Acoustic Modeling Results and Compliance

Acoustic modeling was completed for WTG critical design wind speed (9 m/s) operating conditions. When calculating received sound levels, it was assumed that all WTGs were operating continuously and concurrently at the given operating condition. A sound contour plot displaying Project operational sound levels in color-coded isopleths is provided in Figure 17. Figure 17 shows broadband (dBA) operational sound levels at wind speeds corresponding to wind turbine operation at the critical design wind speed. The detailed modeling results are presented in Appendix B; Table B-1 includes the residence identifier, UTM coordinates, residence status (participant or non-participant), and the received sound levels at each residence. The **bold** sound levels in Table B-1 indicate exceedences greater than 5 dBA over the ambient sound level. The tabulated results and contour plot are independent of the existing acoustic environment and are representative of expected Project sound levels only.

When compared to the measured nighttime ambient sound level, the acoustic modeling results indicate that initial modeling results exceed an increase of 5 dBA over ambient for certain non-participating landowners.

Therefore, Seneca Wind has incorporated additional noise reduction features at 12 turbine locations (that contributed to those levels) to reduce sound levels at the non-participating residences. The noise emission level for the GE 2.5 in noise-reduced mode is summarized in Table 10. With the incorporation of the additional noise reduction, the noise impacts at all non-participating residences will be 51 dBA or below and will, therefore, comply with the OPSB noise criterion. The revised acoustic modeling results by residence, incorporating the identified WTGs operating in noise reduced mode, are included in the results presented in Appendix B.

Table 10. Sound Power Level by Octave Band Center Frequency, GE 2.5-127 with Noise Reduction

	Octave Band Sound Power Level (dBA)									Broadband
Frequency (Hz)	32	63	125	250	500	1000	2000	4000	8000	(dBA)
GE 2.5 -127 with Noise Reduction	82.8	92.6	97.2	98.2	100.4	103.8	102.7	95.0	76.9	108.5

5.0 CONSTRUCTION NOISE

Acoustic emission levels for activities associated with Project construction were based upon typical ranges of energy equivalent noise levels at construction sites, as documented by the USEPA (USEPA 1971b) and the USEPA's "Construction Noise Control Technology Initiatives" (USEPA 1980). The USEPA methodology distinguishes between type of construction and construction phase.

Using those energy equivalent noise levels (L_{eq}) as input to a basic propagation model, construction noise levels were calculated at the nearest non-participating residential structure and at the furtherst non-participating residential structure.

The basic model assumed spherical wave divergence from a point source located at the acoustic center of a turbine location. Furthermore, the model conservatively assumed that all pieces of construction equipment associated with an activity would operate simultaneously for the duration of that activity. An additional level of conservatism was built into the construction noise model by excluding potential shielding effects due to intervening structures and buildings along the propagation path from the site to receiver locations.

Construction activities associated with the Project also have the potential for localized noise on a temporary basis as construction activities progress through certain locations within the Project Area. Construction activities the Project can be generally divided into four phases:

1. *Site Clearing*: The initial site mobilization phase includes the establishment of temporary site offices, workshops, stores, and other on-site facilities. Installation of erosion and sedimentation control measures will be completed as well as the preparation of initial haulage routes.
2. *Excavation*: This phase would begin with the excavation and formation of access roads and preparation of laydown areas. Excavation for the concrete turbine foundations would also be completed, which incorporates necessary rock drilling.
3. *Foundation Work*: Construction of the reinforced concrete turbine foundations would take place in addition to installation of the internal transmission network.
4. *Wind Turbine Installation*: Delivery of the turbine components would occur, followed by their installation and commissioning.

Note that these activities would occur sequentially for discrete groupings of WTGs, with the potential for overlap. In addition to the WTGs, construction activities will also occur for supporting infrastructure. The electrical collector lines are likely to be completed while each respective WTG is being constructed; other Project-related elements, such as the operations and maintenance building, would occur independently and then be complete.

The construction of the Project is likely to cause short-term but unavoidable noise impacts. Based on sound propagation calculations, construction sound levels are predicted to range from 55 dBA to 62 dBA at the nearest non-participating residential structure (approximately 1,260 feet from the turbine). Table 11 summarizes the predicted Project construction noise levels at varying distances; sound decreases with distance. Periodically, sound levels may be higher or lower than those presented in Table 11 depending on several factors, such as the type, number, and age of construction equipment in use, the specific equipment manufacturer and model, the operations being performed, and the overall condition of the equipment and its exhaust system mufflers.

Table 11. Projected Construction Noise Levels by Phase (dBA)

Construction Phase	Construction Noise Level at 50 Feet	Construction Noise Level at 1,260 Feet (nearest non-participating residential structure)	Construction Noise Level at 1,500 Feet
Phase 1: Site Clearing	86	58	56
Phase 2: Excavation	90	62	61
Phase 3: Foundation Work	85	57	55
Phase 4: Wind Turbine Installation	83	55	54

All reasonable efforts will be made to minimize the temporary impact of noise resulting from construction activities. As the design of the Project progresses and construction scheduling is finalized, community notifications with information regarding the construction schedule and duration will be provided. To the extent practicable, louder construction activities (rock drilling and horizontal directional drilling) will be scheduled during daytime hours, between 10:00 a.m. and 5:00 p.m, and general construction activities will be limited to the greatest extent practicable to between the hours of 7:00 a.m. and 7:00 p.m., consistent with OPSB Section 4906-4-09(F)(1). Where necessary for such activities requiring continuous activity (such as foundation pours) or for activities where daytime activities might be more disruptive (such as flying rotors), care will be taken to minimize noise to the greatest extent practicable. Internal combustion engines will be equipped with appropriately-sized muffler systems to minimize noise emissions. Blasting is not expected to be required based on preliminary geological studies conducted for the Project; appropriate notifications will be made should it be required.

In addition to construction equipment, the increased levels of traffic on local roads, associated with workers and deliveries, can also result in temporary increases in sound levels. However, travel will occur largely along existing roads that currently experience truck traffic or on accessways across private property. At the early stage of construction, equipment and materials will be delivered, and set-up will occur at laydown yards. Site preparation efforts (e.g., creation of access roads, preparation of foundation platforms) will require that equipment such as hydraulic excavators and associated spreading and compacting equipment be delivered and used at each location, moving on to the next location once each task is completed. Equipment for lifting the towers and vehicles delivering turbine components is larger and will move more slowly on the local roadways. Deliveries will occur for each WTG and will be timed, to the extent practicable, to allow for immediate assembly. The local community will be notified of the timing of large equipment deliveries. For the cranes and assembly equipment, once they are local, they will move from location to location until all WTGs are installed. It is not expected that traffic noise will make a significant contribution to community sound, particularly due to its transient nature.

6.0 CONCLUSIONS

Project operational sound has been calculated, and has been determined to meet OPSB standards, even with the conservative assumptions and maximum impact case reflected in the modeling. For most locations, standard mitigation design can achieve this goal. However, for 12 WTGs, where they have the potential to affect non-participating landowners at slightly higher levels, additional mitigation has been incorporated to achieve the appropriate sound levels.

7.0 REFERENCES

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Figures

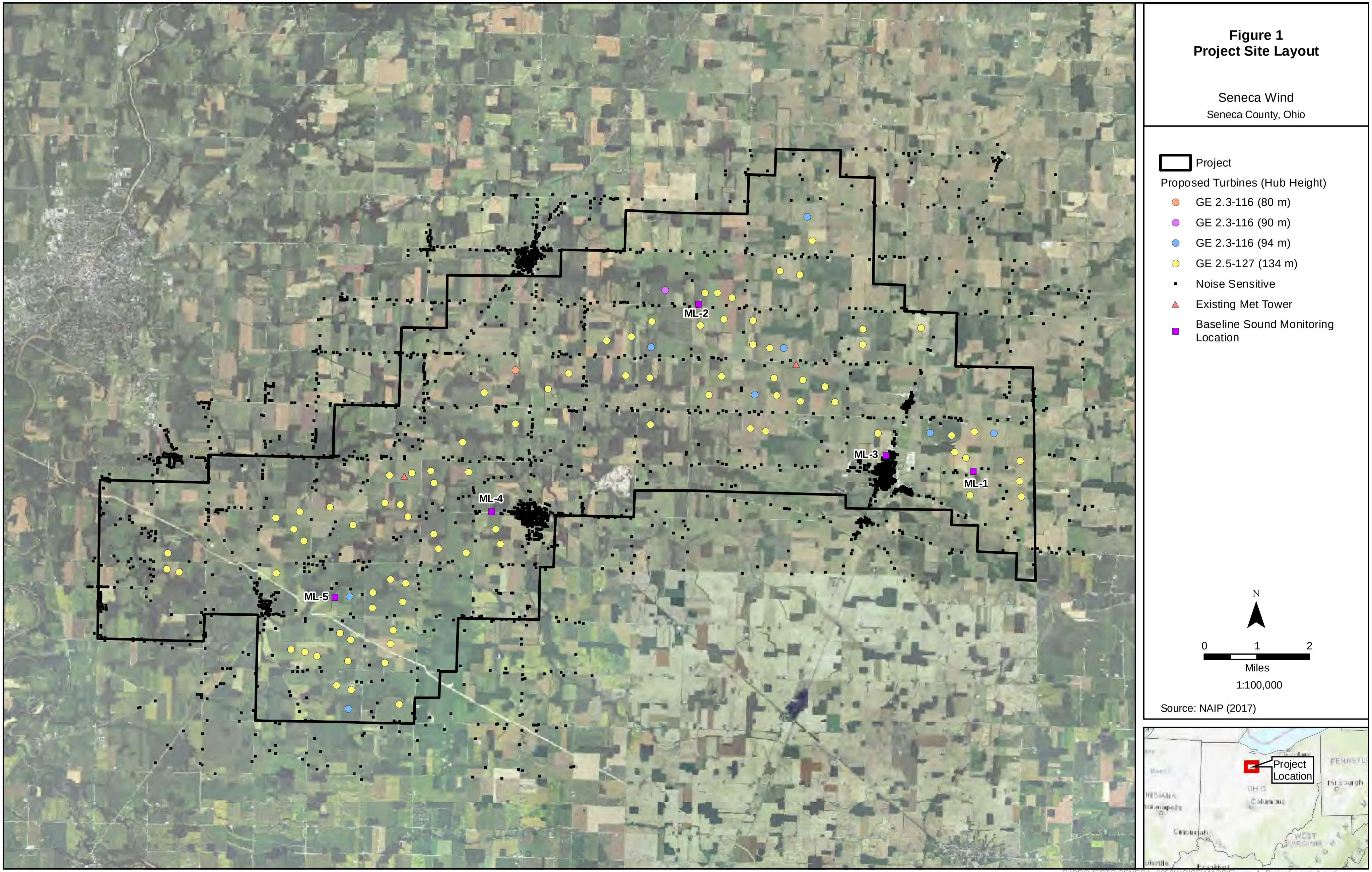

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Figure 2. Photographs of ML-1

View northwest, toward the nearest proposed Project turbine location.

View east, toward the nearest residence.

Figure 3. ML-1 Time History Plot

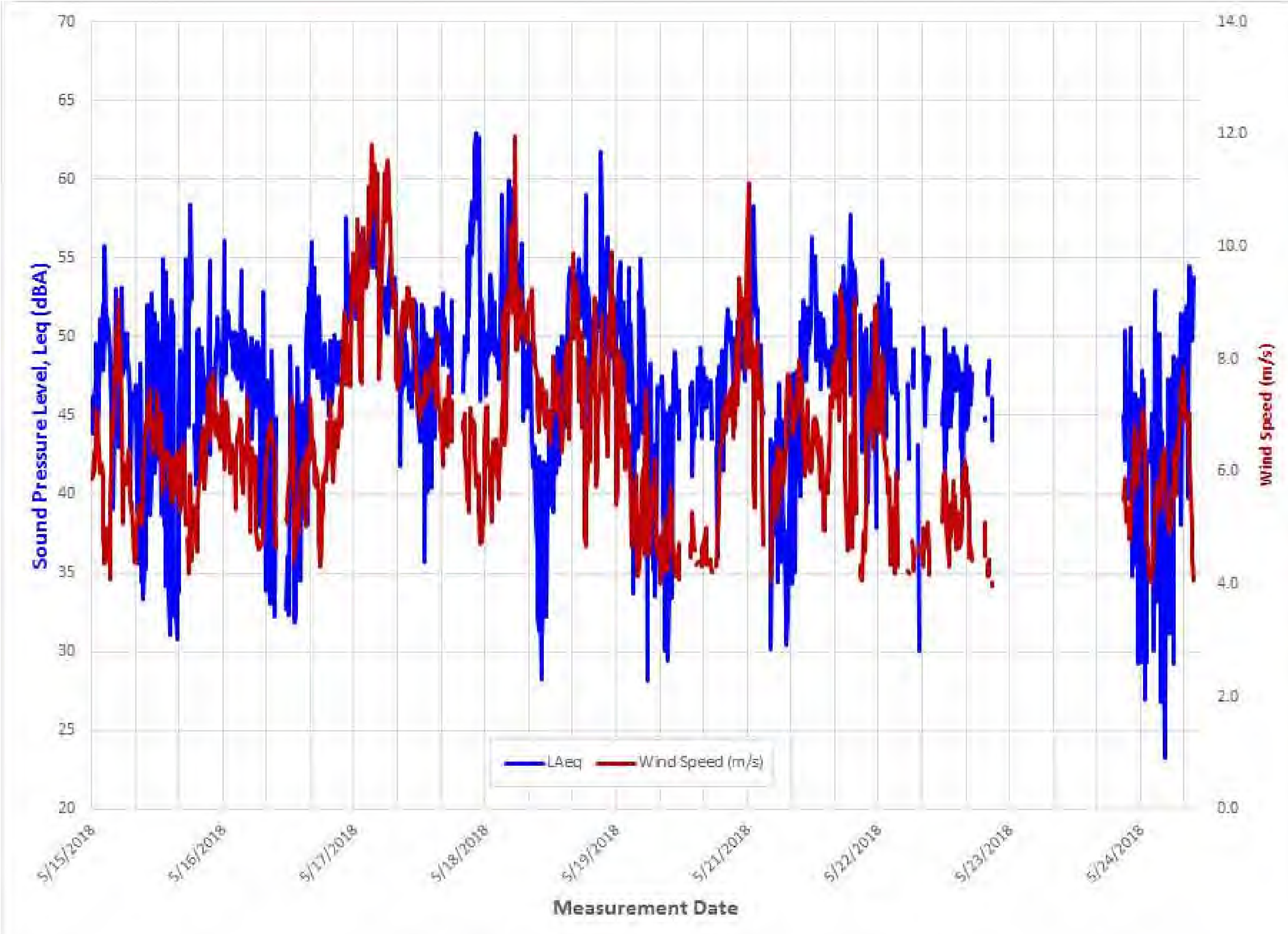


Figure 4. ML-1 Regression Analysis

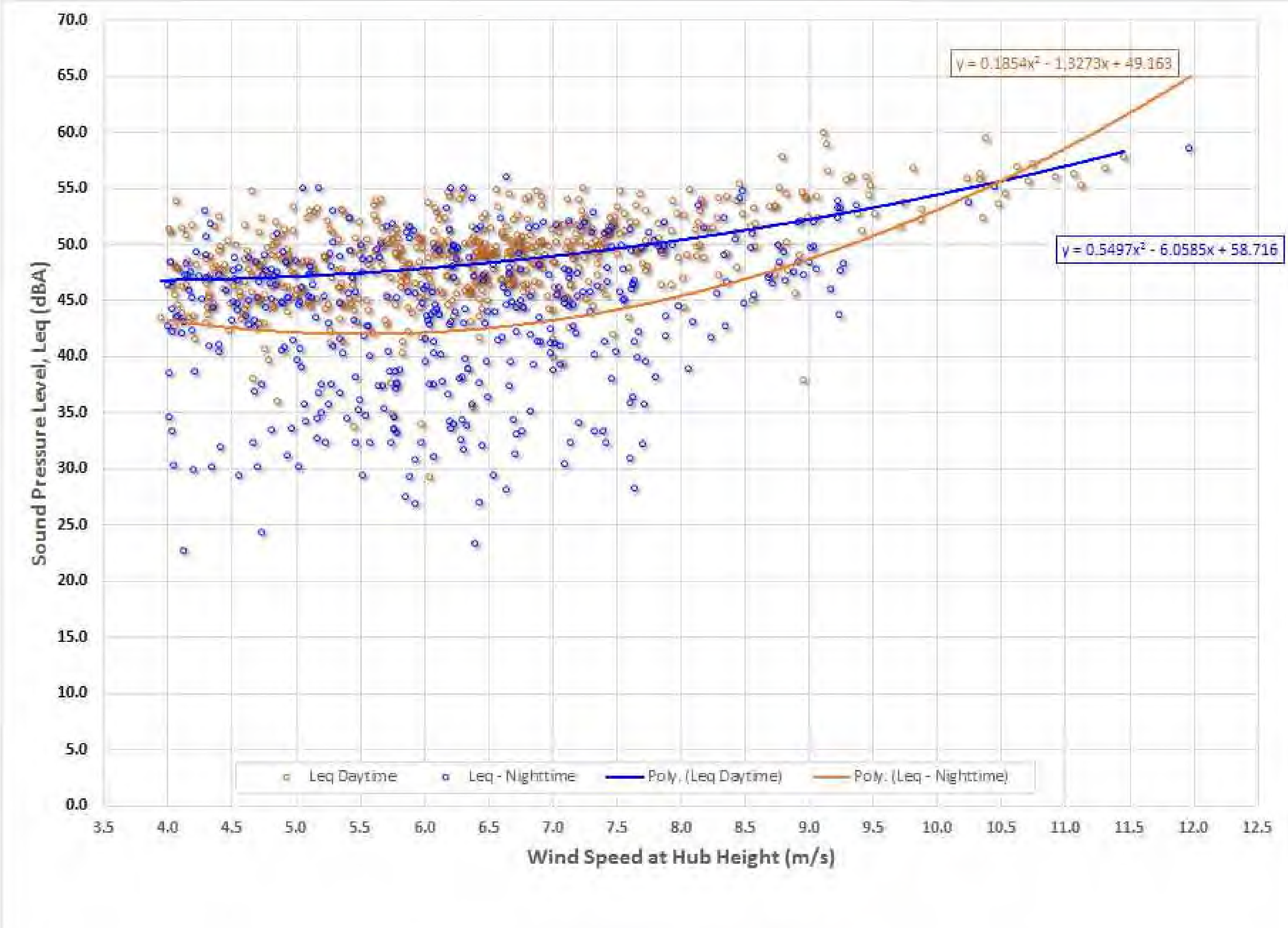


Figure 5. Photographs of ML-2

View south, toward the nearest proposed Project turbine location.

View west, toward the nearest residence.

Figure 6. ML-2 Time History Plot

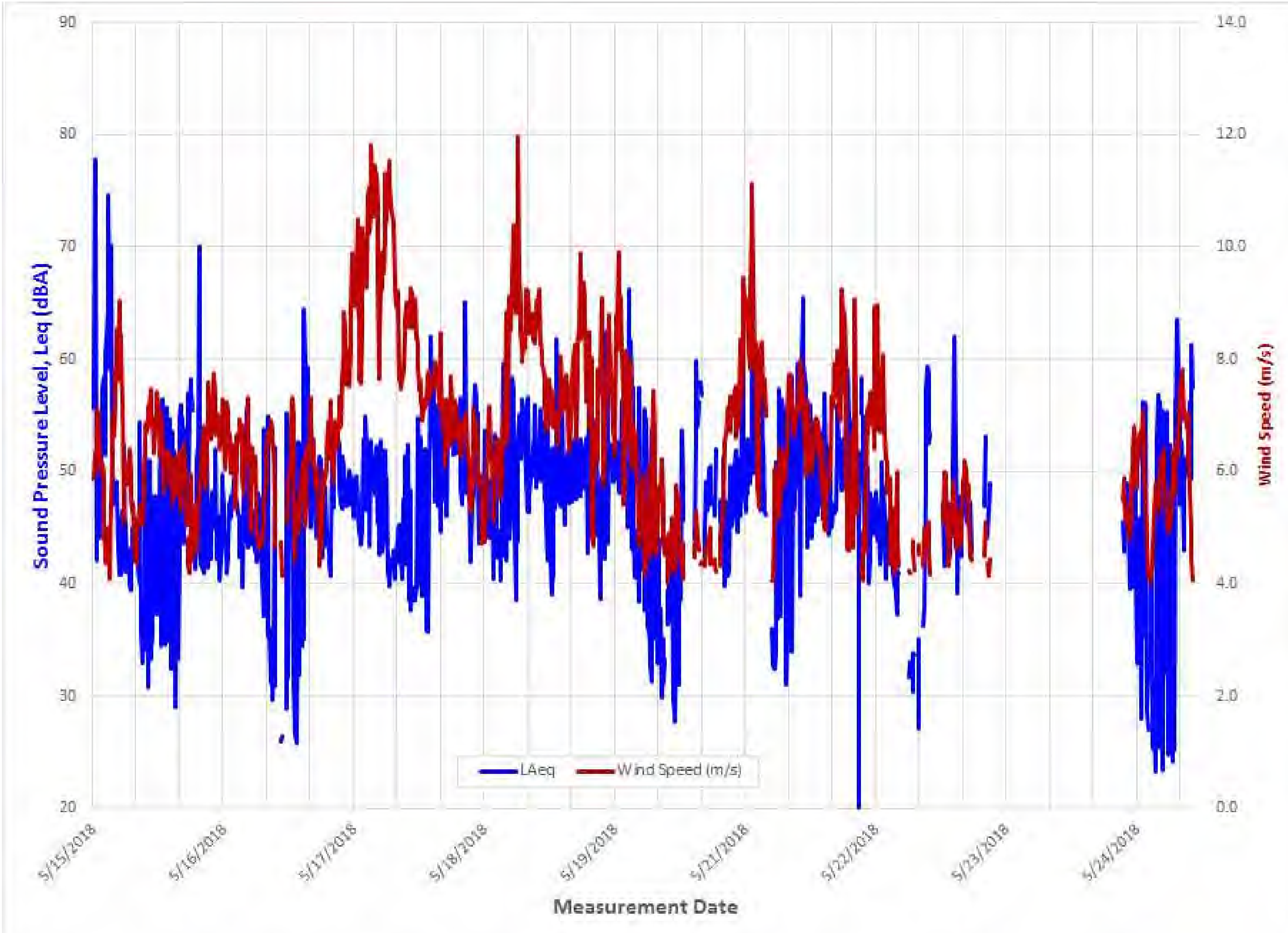


Figure 7. ML-2 Regression Analysis

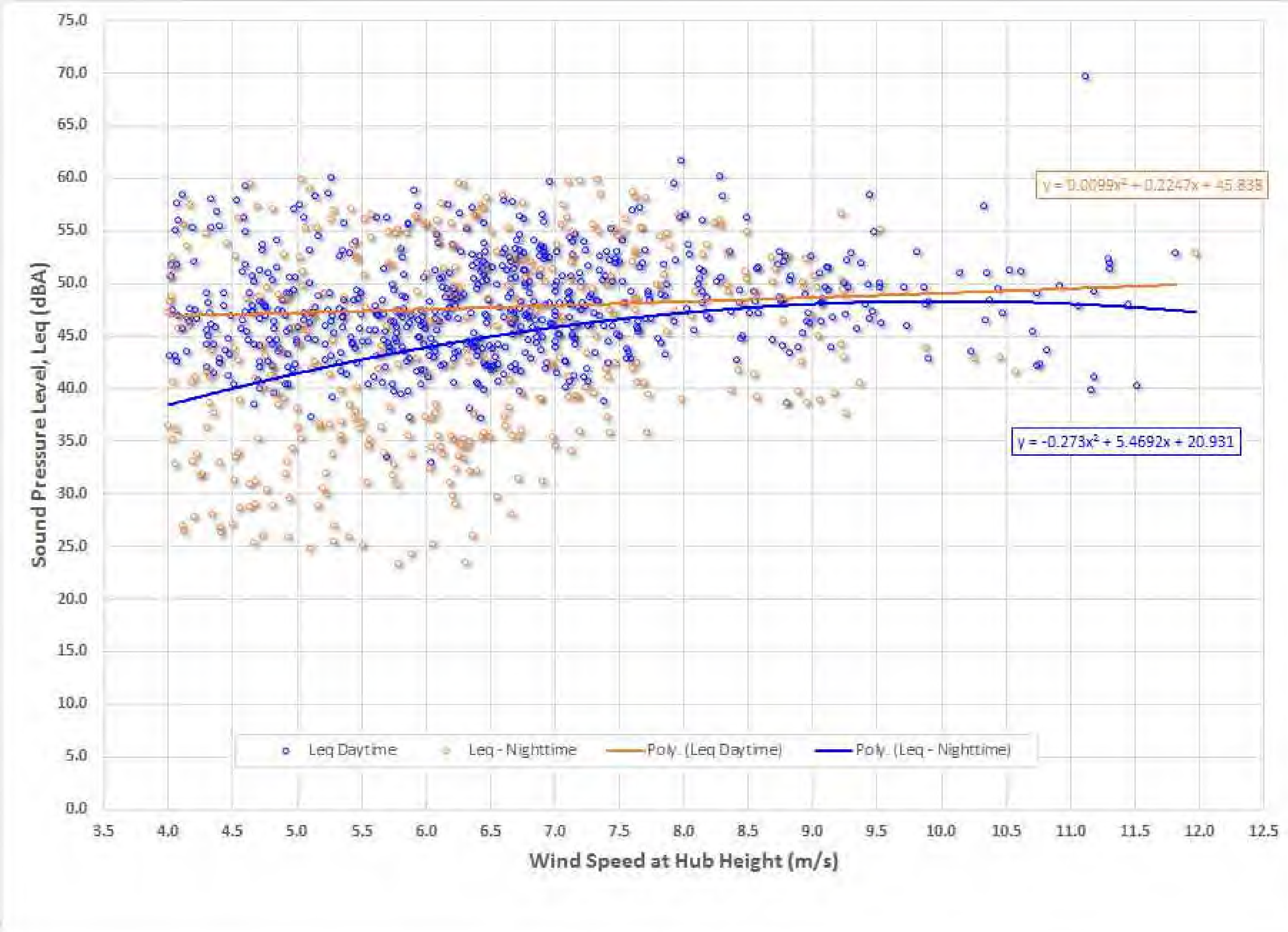


Figure 8. Photographs of ML-3

View north, toward the nearest proposed Project turbine location.

View east, toward the nearest residence.

Figure 9. ML-3 Time History Plot

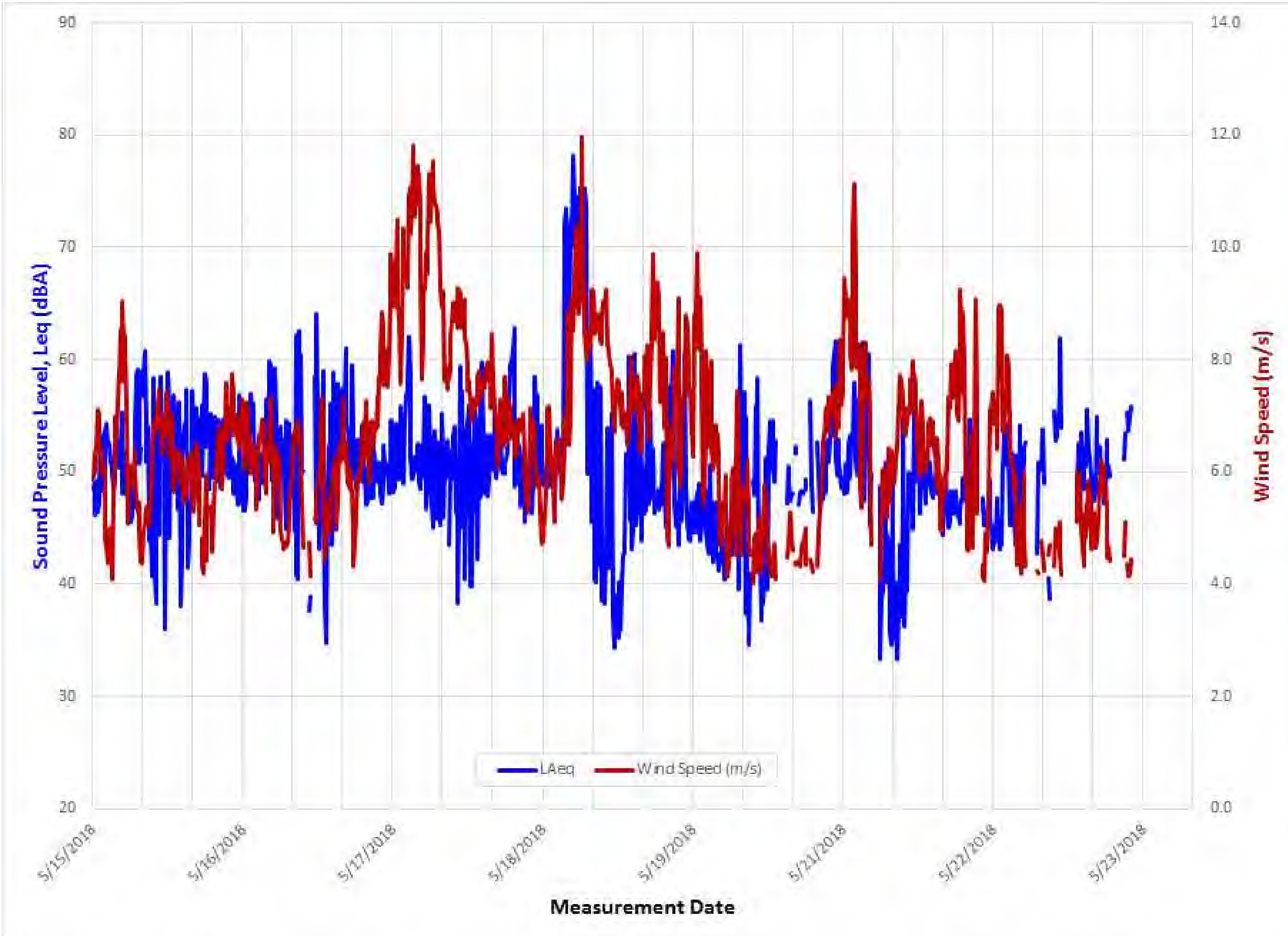


Figure 10. ML-3 Regression Analysis

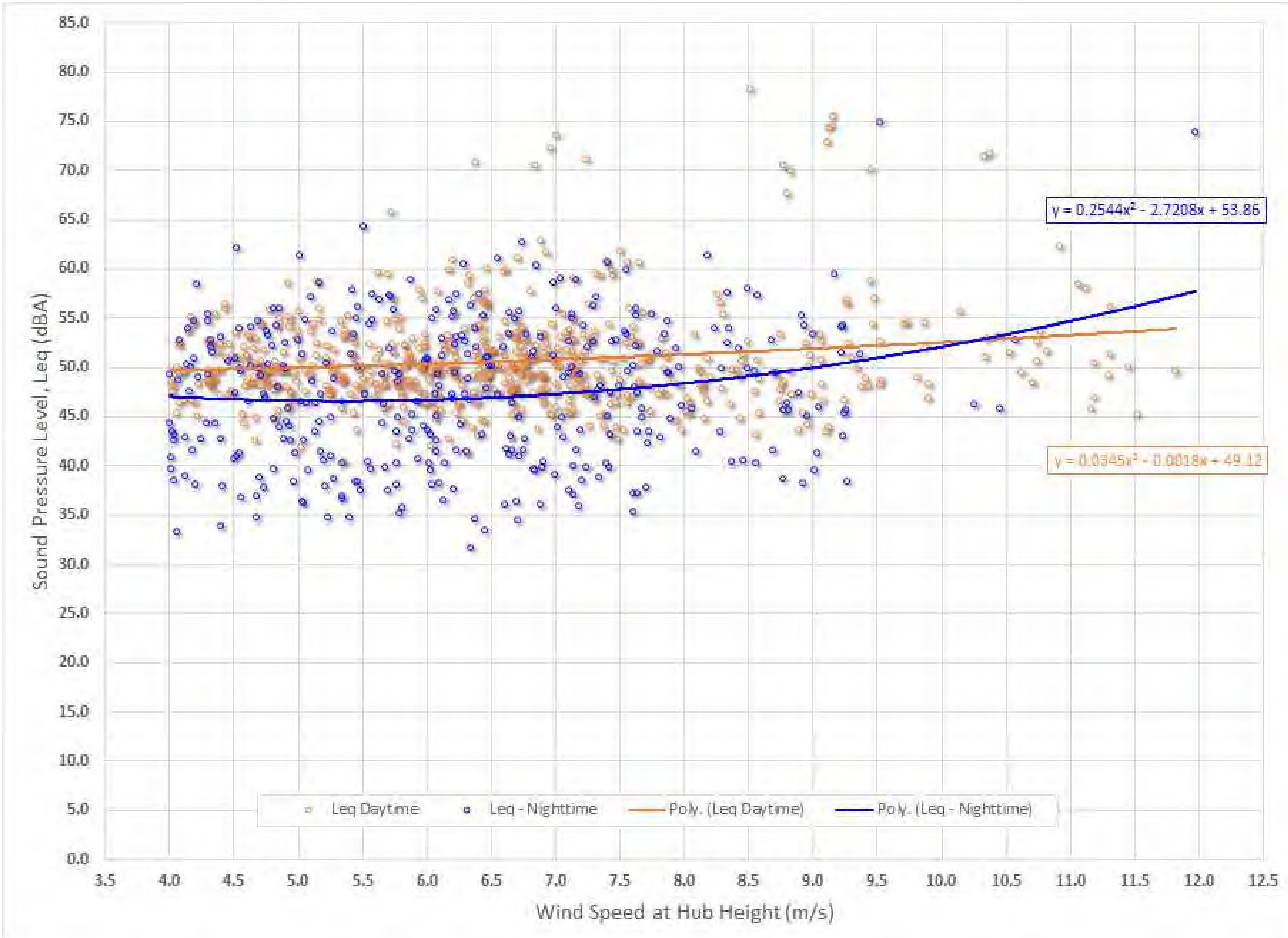


Figure 11. Photographs of ML-4

View south, toward the nearest proposed Project turbine location.

View west, toward the nearest residence.

Figure 12. ML-4 Time History Plot

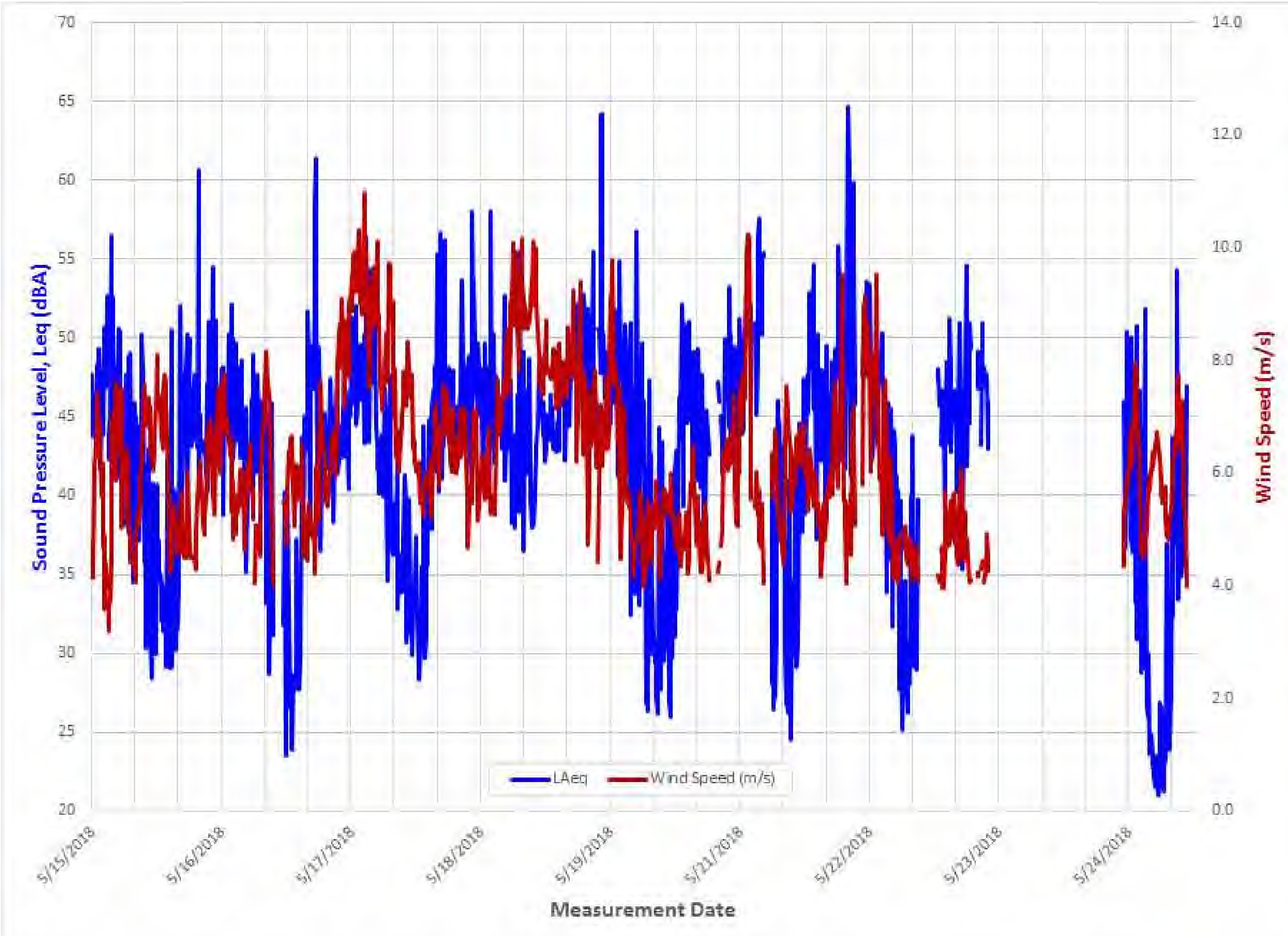


Figure 13. ML-4 Regression Analysis

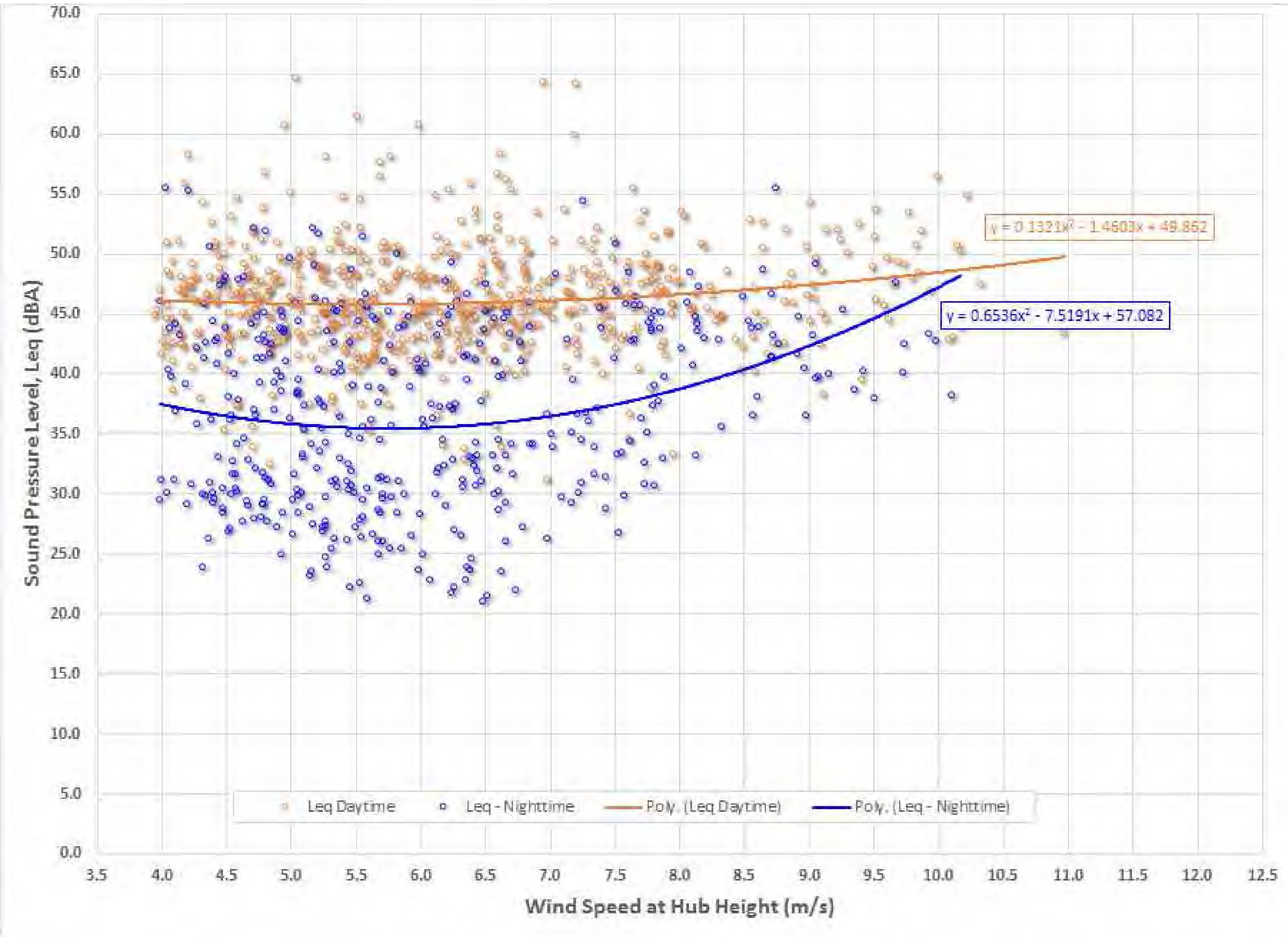


Figure 14. Photographs of ML-5

View south, toward the nearest proposed Project turbine location.

View southwest, toward the nearest residence.

Figure 15. ML-5 Time History Plot

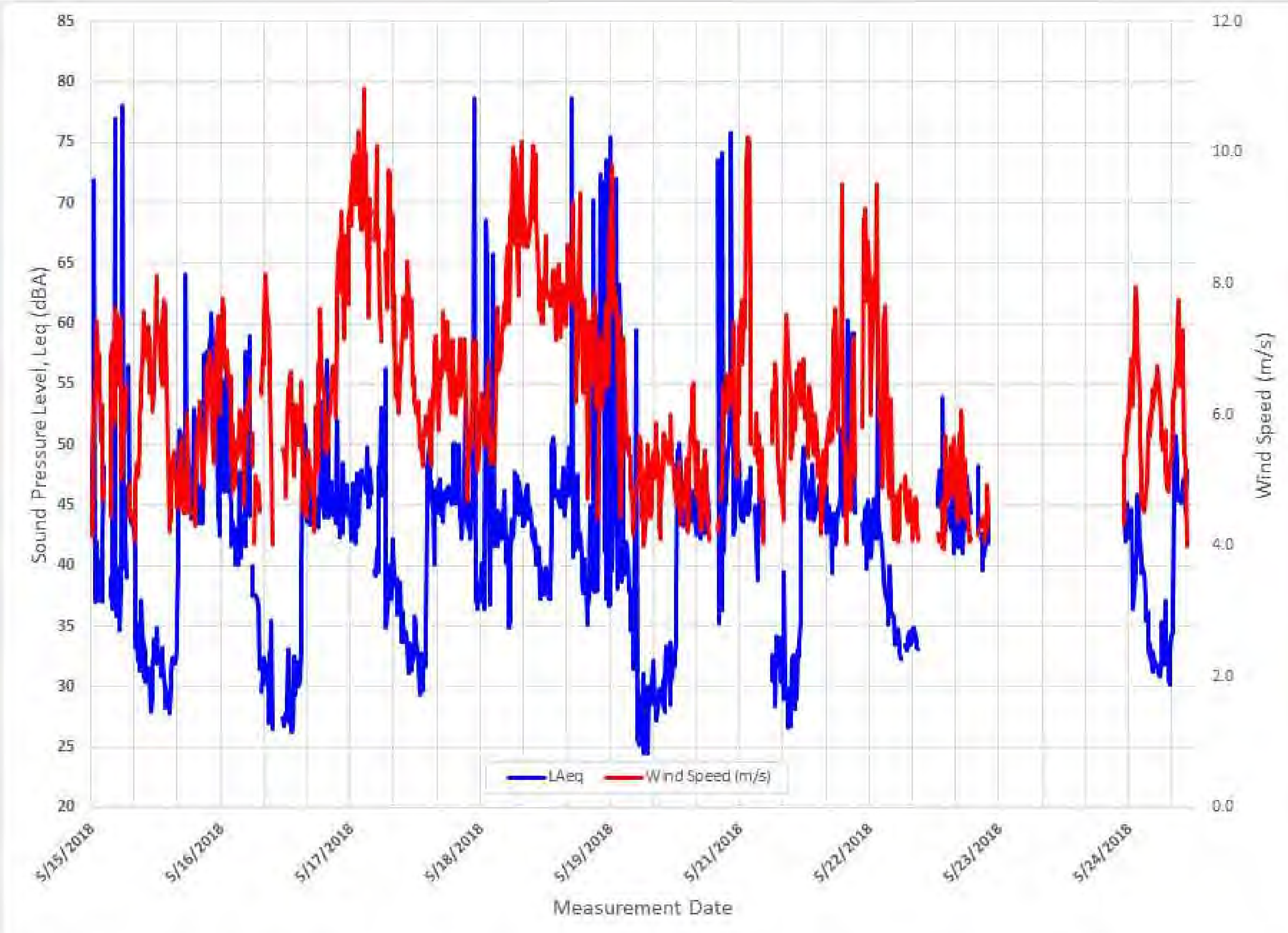
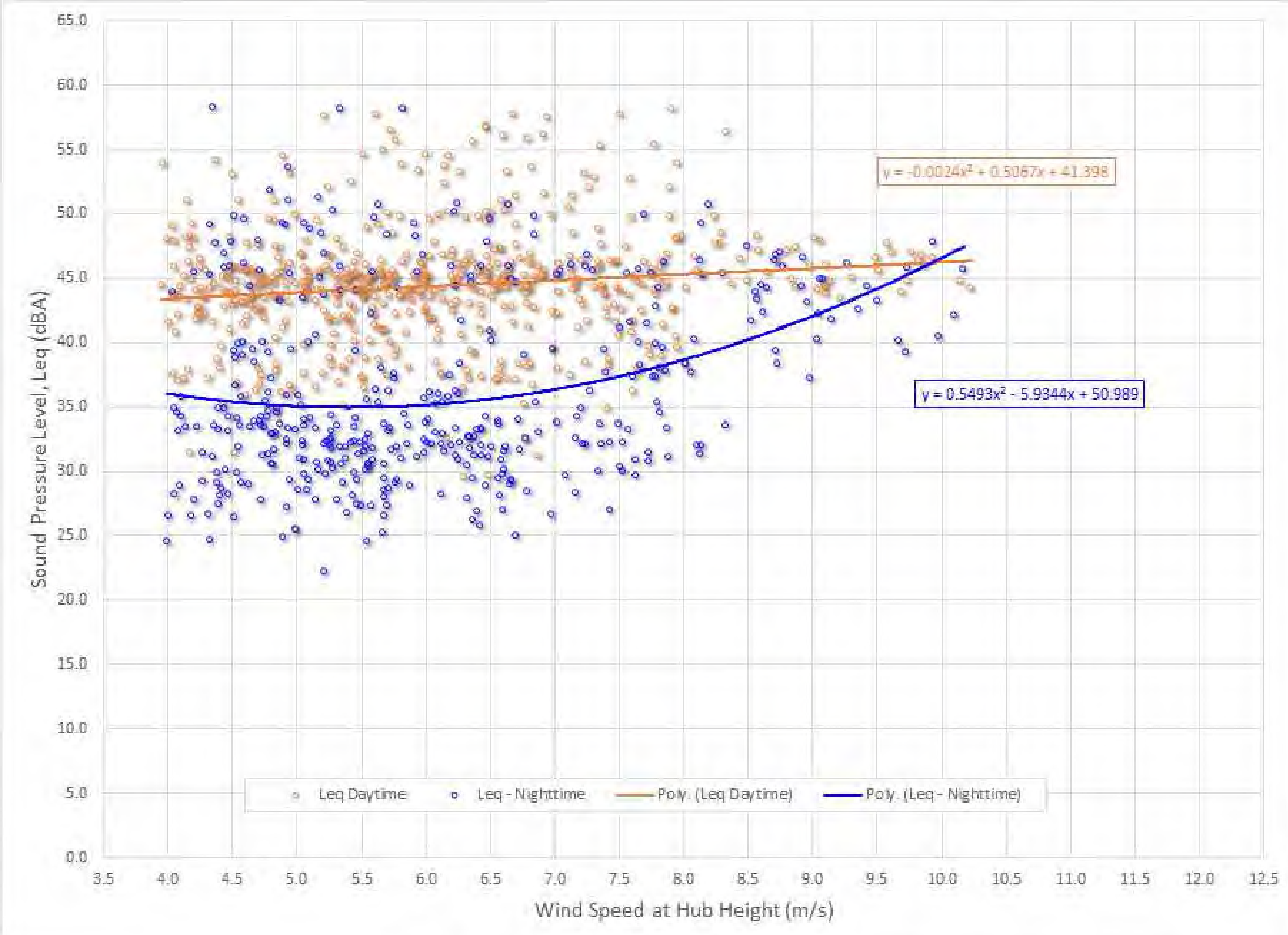
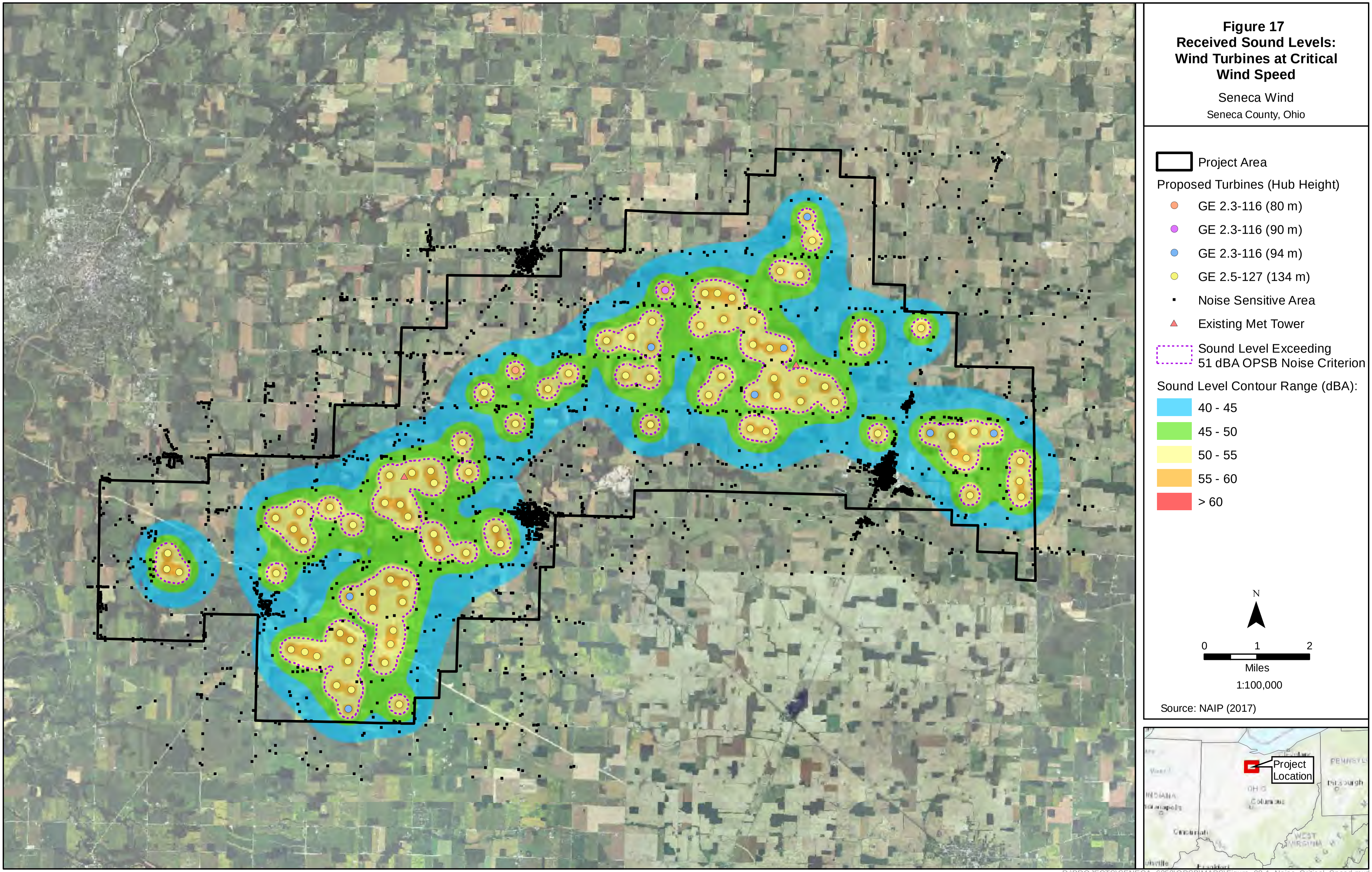


Figure 16. ML-5 Regression Analysis





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Appendix A

Complaint Resolution Procedure

Seneca Wind
Complaint Resolution Program

1. INTRODUCTION

Seneca Wind LLC (Seneca Wind) has developed a complaint resolution program for implementation during the construction of the Seneca Wind project (the Project) to provide an effective process for identification and resolution of concerns voiced by members of the community.

Seneca Wind is committed to complying with requirements established through the Ohio Power Siting Board (OPSB) and other regulatory processes, and to establishing an accessible process for community members to voice concerns and for those concerns to be addressed as quickly and effectively as possible. Maintaining detailed records of all complaints and resulting actions is an important aspect of the complaint resolution program.

Seneca Wind's policy is to take all reasonable necessary actions to rectify legitimate interference or disturbances that are a direct result of the Project.

2. COMPLAINT RESOLUTION PROCEDURE

2.1 Seneca Wind Contacts

Seneca Wind will establish a toll-free telephone number prior to the Project being commercially operational and will provide that number to the county commissioners, township trustees, emergency responders, schools, and public libraries within the Project Area; that number will also be posted on the Project website. To register a complaint, individuals may either call the telephone number and leave a message or go to the local construction office during regular business hours.

2.2 Notification

In addition to providing the contact information and procedure to the officials and public locations noted above, Seneca Wind will maintain a Project contact list for residents and will provide notification to residences located within 1 mile of construction activities that construction is about to commence.

2.3 Complaint Documentation and Follow-Up

Seneca Wind will keep a logbook to register every complaint received. The logbook will include pertinent information about the person making the complaint, the issues surrounding the complaint, and the date the complaint was received; an example of a complaint resolution form is attached.

The logbook will also document Seneca Wind's recommended resolution, the date agreement was reached on a proposed resolution, and the date when the proposed resolution was implemented. Seneca Wind personnel will generate a quarterly report based on the information recorded in the log book about the nature and resolution of all complaints received in that quarter, and file the report with the OPSB on January 31, April 30, July 31, and October 31 of each calendar year or portion thereof during construction.

Individuals who register a complaint with Seneca Wind will receive correspondence from Seneca Wind no later than 2 business days after registering the complaint. The intent of the initial correspondence is to gather more information to better understand the complaint. Within 30 days of the complaint being logged, Seneca Wind will initiate reasonable action to resolve the legitimate interference or disturbance that is a direct result of the Project.

If Seneca Wind and the complaining individual cannot agree to a resolution, Seneca Wind will provide a summary of the complaint and proposed resolution to the complaining individual so the complaint can be brought to the OPSB.

Seneca Wind
Complaint Resolution Form

Complaint Log Number: _____________ Complainant's name and address: Phone number/email:
Date complaint received: ______________ Time complaint received: ______________ Date complainant first contacted: ____________
Nature of complaint:
Definition of problem after investigation:
Description of corrective measures taken: Complainant's signature: ____ Date: _____________
This information is certified to be correct: Site Manager's Signature: _______________________________________ Date: _____________

(Attach additional pages and supporting documentation, as required.)

Appendix B

Tabulated Acoustic Modeling Results by Residence

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1	Non-Participating	330889	4540036	29	29
2	Non-Participating	330435	4539874	30	30
3	Non-Participating	329891	4539942	31	31
4	Non-Participating	329023	4539625	33	33
5	Non-Participating	328063	4539899	36	36
6	Non-Participating	327501	4540037	40	40
7	Non-Participating	326691	4539837	42	42
8	Non-Participating	326131	4539967	43	42
9	Non-Participating	325613	4539784	42	42
10	Non-Participating	323045	4540078	37	37
11	Non-Participating	322909	4540115	37	37
12	Non-Participating	322311	4539744	34	34
13	Non-Participating	321806	4540152	34	34
14	Non-Participating	320833	4540183	32	32
15	Non-Participating	320691	4539780	31	31
16	Non-Participating	320528	4540980	32	32
17	Non-Participating	320623	4540974	33	33
18	Non-Participating	320659	4540965	33	33
19	Non-Participating	320651	4540884	33	32
20	Non-Participating	320668	4541331	33	33
21	Non-Participating	320835	4540845	33	33
22	Non-Participating	321232	4541292	35	35
23	Non-Participating	321110	4541213	34	34
24	Non-Participating	321342	4541295	35	35
25	Non-Participating	321673	4541532	36	36
26	Non-Participating	321296	4541773	36	35
27	Non-Participating	321438	4541773	36	36
28	Non-Participating	321540	4541764	36	36
29	Non-Participating	321557	4541778	36	36
30	Non-Participating	322297	4541621	39	39
31	Non-Participating	321870	4540410	35	35
32	Non-Participating	322243	4540481	36	36
33	Non-Participating	322362	4541224	39	38
34	Non-Participating	322357	4541778	40	40
35	Non-Participating	323345	4541053	42	42
36	Non-Participating	323371	4540944	42	42
37	Non-Participating	323600	4540680	41	41

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
38	Non-Participating	323644	4540447	41	41
39	Non-Participating	323831	4540176	40	40
40	Non-Participating	323860	4540871	44	43
41	Non-Participating	323442	4541669	47	47
42	Non-Participating	323889	4541722	51	50
43	Non-Participating	323752	4541681	48	48
44	Non-Participating	324009	4540172	41	41
45	Participating	324306	4541678	51	51
46	Participating	325534	4541351	**52**	**52**
47	Participating	325402	4541362	**53**	**53**
48	Participating	325843	4540451	45	45
49	Non-Participating	325893	4540279	44	44
50	Non-Participating	326004	4540715	46	46
51	Participating	325835	4541358	48	48
52	Non-Participating	326170	4541417	49	49
53	Participating	327049	4541666	45	44
54	Non-Participating	327144	4540720	48	48
55	Non-Participating	327102	4540399	47	47
56	Non-Participating	326706	4540143	47	47
57	Non-Participating	326588	4540129	46	46
58	Non-Participating	326529	4540170	47	47
59	Participating	327182	4540226	43	43
60	Participating	327627	4540273	40	40
61	Non-Participating	328272	4540383	37	37
62	Non-Participating	328666	4541269	36	36
63	Non-Participating	327239	4541405	43	43
64	Non-Participating	329098	4540071	33	33
65	Non-Participating	329659	4540061	32	32
66	Non-Participating	329974	4540072	31	31
67	Non-Participating	330379	4540335	31	31
68	Non-Participating	330440	4540371	31	31
69	Non-Participating	330418	4540781	31	31
70	Non-Participating	330431	4541012	32	32
71	Non-Participating	330458	4541435	32	32
72	Non-Participating	330518	4541466	32	32
73	Non-Participating	330459	4541583	32	32
74	Non-Participating	330566	4543084	35	35

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
75	Non-Participating	330341	4543249	35	35
76	Non-Participating	330197	4543204	36	36
77	Non-Participating	329957	4543263	36	36
78	Non-Participating	329821	4543251	37	36
79	Non-Participating	329561	4543236	37	37
80	Non-Participating	329514	4543206	37	37
81	Non-Participating	329459	4541700	35	35
82	Non-Participating	329949	4541774	34	34
83	Non-Participating	330473	4541835	33	33
84	Non-Participating	330420	4542510	34	34
85	Non-Participating	330414	4542668	34	34
86	Non-Participating	328689	4542924	39	38
87	Non-Participating	328344	4543247	40	40
88	Non-Participating	327740	4542940	43	42
89	Non-Participating	327465	4542903	44	44
90	Non-Participating	327243	4541783	44	43
91	Participating	327894	4541705	40	40
92	Non-Participating	328548	4541841	38	37
93	Participating	326320	4543329	**52**	51
94	Non-Participating	325634	4542448	51	51
95	Non-Participating	325782	4541871	51	51
96	Non-Participating	327202	4542304	45	45
97	Participating	326951	4542998	50	49
98	Non-Participating	325283	4543331	49	49
99	Non-Participating	325191	4543426	49	49
100	Participating	324966	4543212	**52**	**52**
101	Participating	324639	4542961	**54**	**54**
102	Participating	324578	4542962	**53**	**52**
103	Participating	324265	4541812	**52**	**52**
104	Non-Participating	323814	4543297	45	45
105	Non-Participating	323808	4543200	45	45
106	Non-Participating	322925	4542987	44	44
107	Non-Participating	323182	4543373	43	43
108	Non-Participating	323107	4543362	43	43
109	Non-Participating	322697	4543384	42	41
110	Non-Participating	322521	4543381	41	41
111	Non-Participating	322589	4543284	41	41

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
112	Non-Participating	322564	4543115	41	41
113	Non-Participating	322559	4542938	42	42
114	Non-Participating	322418	4542843	41	41
115	Participating	322819	4542166	46	46
116	Non-Participating	323595	4541804	50	50
117	Non-Participating	320960	4543386	38	38
118	Non-Participating	320773	4542844	36	36
119	Non-Participating	320769	4542797	36	36
120	Non-Participating	320775	4542768	36	36
121	Non-Participating	320774	4542730	36	36
122	Non-Participating	320770	4542379	35	35
123	Non-Participating	322093	4542184	39	39
124	Non-Participating	321921	4542264	39	38
125	Non-Participating	320720	4542770	36	36
126	Non-Participating	320632	4543164	37	37
127	Non-Participating	320715	4543392	38	38
128	Non-Participating	319748	4543405	39	39
129	Non-Participating	319120	4543830	40	40
130	Non-Participating	318958	4543950	40	40
131	Non-Participating	318959	4544211	42	42
132	Non-Participating	319124	4544435	46	46
133	Non-Participating	319115	4544620	48	48
134	Non-Participating	319082	4544799	48	48
135	Non-Participating	318911	4545027	45	45
136	Non-Participating	319194	4545018	50	50
137	Participating	319203	4544791	51	51
138	Non-Participating	319193	4544580	49	49
139	Non-Participating	320658	4543464	38	38
140	Non-Participating	320741	4544084	41	41
141	Non-Participating	320777	4545009	43	43
142	Participating	320267	4545017	50	50
143	Non-Participating	320793	4543577	38	38
144	Non-Participating	321035	4543573	38	38
145	Non-Participating	320998	4544626	41	41
146	Non-Participating	321851	4544798	41	41
147	Non-Participating	322159	4544538	43	43
148	Non-Participating	322269	4544374	43	43

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
149	Non-Participating	322360	4544362	44	44
150	Non-Participating	322350	4544295	44	44
151	Non-Participating	322253	4544218	42	42
152	Non-Participating	322272	4544191	42	42
153	Non-Participating	322285	4544161	42	42
154	Non-Participating	322326	4544085	42	42
155	Non-Participating	322347	4544041	42	42
156	Non-Participating	322363	4544133	43	43
157	Non-Participating	322487	4544033	43	43
158	Non-Participating	322426	4543933	42	42
159	Non-Participating	322423	4543665	41	41
160	Non-Participating	322528	4543670	41	41
161	Non-Participating	322542	4543585	41	41
162	Non-Participating	322635	4543514	41	41
163	Non-Participating	322616	4543432	41	41
164	Non-Participating	322662	4543424	41	41
165	Non-Participating	322675	4543426	41	41
166	Non-Participating	322748	4543407	42	42
167	Non-Participating	322764	4543536	42	42
168	Non-Participating	322706	4543681	42	42
169	Non-Participating	322913	4543858	43	43
170	Non-Participating	322772	4543816	43	43
171	Non-Participating	322471	4543976	42	42
172	Non-Participating	322490	4543438	41	41
173	Non-Participating	322844	4543414	42	42
174	Non-Participating	322942	4543432	42	42
175	Non-Participating	323005	4543417	42	42
176	Non-Participating	323032	4543412	43	42
177	Non-Participating	323141	4543481	43	43
178	Non-Participating	323540	4543552	43	43
179	Non-Participating	323946	4544712	44	44
180	Non-Participating	323782	4544727	45	45
181	Non-Participating	323801	4544840	45	45
182	Non-Participating	323930	4544953	45	45
183	Non-Participating	323792	4544968	46	46
184	Non-Participating	323542	4544981	46	46
185	Non-Participating	322424	4544933	46	46

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
186	Non-Participating	322433	4544496	47	47
187	Non-Participating	322798	4543981	44	44
188	Non-Participating	322858	4544017	44	44
189	Non-Participating	322910	4544078	45	45
190	Non-Participating	322956	4544094	46	46
191	Non-Participating	323016	4544085	45	45
192	Non-Participating	324038	4544925	45	45
193	Non-Participating	324182	4544912	45	45
194	Participating	324658	4543915	48	47
195	Non-Participating	324623	4544209	46	46
196	Non-Participating	324775	4544353	46	46
197	Non-Participating	325585	4544833	46	46
198	Non-Participating	325569	4544777	47	47
199	Non-Participating	324408	4544831	44	44
200	Non-Participating	324366	4544932	44	44
201	Participating	325205	4544196	**54**	**54**
202	Participating	325553	4544028	**54**	**53**
203	Participating	325706	4544871	47	47
204	Participating	327261	4544606	50	50
205	Participating	327267	4544349	51	51
206	Non-Participating	327216	4543576	50	49
207	Non-Participating	326539	4543384	**52**	51
208	Non-Participating	327336	4544919	47	47
209	Non-Participating	327650	4544739	46	46
210	Non-Participating	327298	4544196	50	50
211	Non-Participating	327811	4543344	43	42
212	Non-Participating	327923	4543397	42	42
213	Non-Participating	328595	4543383	40	40
214	Non-Participating	328669	4543362	40	39
215	Non-Participating	328909	4544547	44	44
216	Participating	328550	4544582	45	45
217	Non-Participating	327895	4544792	47	47
218	Non-Participating	328911	4543328	39	39
219	Non-Participating	328941	4543477	39	39
220	Non-Participating	329148	4543344	38	38
221	Non-Participating	329199	4543372	38	38
222	Non-Participating	328950	4543824	40	40

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
223	Non-Participating	328947	4543863	40	40
224	Non-Participating	328944	4543905	40	40
225	Non-Participating	329364	4544899	45	45
226	Non-Participating	329839	4544867	44	44
227	Non-Participating	330516	4543366	35	35
228	Non-Participating	330354	4543328	35	35
229	Non-Participating	330170	4543450	36	36
230	Non-Participating	329659	4544149	40	40
231	Non-Participating	329713	4544062	39	39
232	Non-Participating	329777	4544059	39	39
233	Non-Participating	330101	4544071	38	38
234	Non-Participating	330154	4544065	38	38
235	Non-Participating	330860	4544835	39	39
236	Non-Participating	330670	4543666	36	36
237	Non-Participating	330608	4543668	36	36
238	Non-Participating	330595	4543628	36	36
239	Non-Participating	330600	4543603	36	36
240	Non-Participating	330850	4544952	39	39
241	Non-Participating	330823	4544936	39	39
242	Non-Participating	330633	4545575	42	42
243	Non-Participating	331041	4545767	39	39
244	Non-Participating	331039	4545827	39	39
245	Non-Participating	330948	4545711	40	40
246	Non-Participating	331057	4546023	39	39
247	Non-Participating	331217	4546092	38	38
248	Non-Participating	331421	4546441	37	37
249	Non-Participating	331220	4546282	38	38
250	Non-Participating	331239	4546446	38	38
251	Non-Participating	331367	4546510	37	37
252	Non-Participating	331277	4546735	38	37
253	Non-Participating	331207	4546765	38	38
254	Non-Participating	330824	4546821	39	39
255	Non-Participating	330682	4546916	40	39
256	Non-Participating	330371	4546892	41	41
257	Non-Participating	330213	4546665	43	43
258	Non-Participating	330064	4546548	45	45
259	Non-Participating	330018	4546556	45	45

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
260	Non-Participating	330110	4546488	45	45
261	Non-Participating	330252	4546474	44	44
262	Non-Participating	330334	4546334	44	44
263	Non-Participating	330438	4546298	43	43
264	Non-Participating	330448	4546173	43	43
265	Non-Participating	330601	4546083	42	42
266	Non-Participating	331154	4546099	39	38
267	Non-Participating	331498	4546416	37	37
268	Non-Participating	331617	4546411	36	36
269	Non-Participating	331702	4546423	36	36
270	Non-Participating	331684	4546475	36	36
271	Non-Participating	331647	4546487	36	36
272	Non-Participating	331602	4546495	37	36
273	Non-Participating	331553	4546502	37	37
274	Non-Participating	331441	4546166	37	37
275	Non-Participating	332251	4546119	35	35
276	Non-Participating	329836	4546475	48	48
277	Non-Participating	329799	4546492	48	48
278	Participating	329084	4546510	45	45
279	Non-Participating	329007	4545660	50	50
280	Non-Participating	329797	4544940	45	45
281	Non-Participating	330036	4544931	44	44
282	Non-Participating	330155	4544927	43	43
283	Non-Participating	330480	4544909	41	41
284	Non-Participating	330441	4545477	44	44
285	Non-Participating	328318	4545051	50	50
286	Participating	328177	4545007	50	50
287	Participating	327926	4544978	50	50
288	Non-Participating	327353	4544992	47	47
289	Participating	327347	4545665	51	51
290	Participating	327504	4546343	50	50
291	Non-Participating	327503	4546520	49	49
292	Non-Participating	328416	4546210	46	46
293	Non-Participating	328954	4546260	46	46
294	Participating	327306	4546405	**52**	**52**
295	Non-Participating	327195	4545951	50	50
296	Non-Participating	326893	4545019	48	48

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
297	Non-Participating	325779	4545033	46	46
298	Non-Participating	326609	4545686	46	46
299	Non-Participating	326749	4545783	47	47
300	Non-Participating	325610	4545011	46	46
301	Participating	325445	4545058	45	45
302	Non-Participating	324876	4545244	45	44
303	Non-Participating	324447	4545165	45	45
304	Non-Participating	324374	4545038	45	45
305	Non-Participating	324291	4545041	45	45
306	Non-Participating	324073	4545182	47	47
307	Non-Participating	323918	4545147	48	48
308	Participating	324577	4545839	47	47
309	Participating	324669	4546017	48	48
310	Participating	324735	4546243	50	50
311	Participating	324004	4546310	51	51
312	Participating	322463	4546096	48	48
313	Participating	322375	4545405	43	43
314	Participating	322396	4546012	46	46
315	Non-Participating	321425	4546581	39	39
316	Non-Participating	321315	4546612	38	38
317	Non-Participating	321268	4546609	38	38
318	Non-Participating	321228	4546610	38	38
319	Non-Participating	321181	4546610	38	38
320	Non-Participating	321115	4546611	38	38
321	Non-Participating	321102	4546540	38	38
322	Non-Participating	321154	4546507	38	38
323	Non-Participating	320882	4546530	38	38
324	Non-Participating	320871	4546576	37	37
325	Non-Participating	320872	4546620	37	37
326	Non-Participating	320861	4546397	38	38
327	Non-Participating	320868	4546293	38	38
328	Participating	321587	4545306	40	40
329	Non-Participating	321347	4545672	39	39
330	Non-Participating	321142	4546611	38	38
331	Non-Participating	319230	4545655	47	47
332	Non-Participating	319236	4545735	45	45
333	Non-Participating	319262	4545875	44	44

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
334	Non-Participating	319265	4545949	43	43
335	Non-Participating	320813	4546614	37	37
336	Non-Participating	320792	4546162	39	39
337	Participating	319106	4545080	48	48
338	Non-Participating	318804	4545114	43	43
339	Non-Participating	319057	4545767	43	43
340	Non-Participating	319102	4545809	43	43
341	Non-Participating	318838	4545880	41	41
342	Non-Participating	318845	4546040	40	40
343	Non-Participating	319038	4545896	42	42
344	Non-Participating	319122	4545954	42	42
345	Non-Participating	319129	4546769	36	36
346	Non-Participating	320882	4546808	37	37
347	Non-Participating	320693	4547460	35	35
348	Non-Participating	320820	4547903	34	34
349	Non-Participating	320825	4547993	34	34
350	Non-Participating	320795	4548090	34	34
351	Non-Participating	320666	4548194	33	33
352	Non-Participating	320559	4548192	33	33
353	Non-Participating	320504	4548189	33	33
354	Non-Participating	320924	4548216	33	33
355	Non-Participating	320895	4547558	35	35
356	Non-Participating	320824	4547434	35	35
357	Non-Participating	320894	4547135	36	36
358	Non-Participating	321487	4546672	39	39
359	Non-Participating	321680	4546688	39	39
360	Participating	321866	4546674	41	41
361	Non-Participating	322158	4546650	43	43
362	Non-Participating	321900	4547972	36	36
363	Non-Participating	322540	4547973	38	38
364	Non-Participating	322523	4547704	39	39
365	Non-Participating	322530	4547607	40	40
366	Non-Participating	322527	4547553	40	40
367	Non-Participating	322626	4546948	45	45
368	Non-Participating	322572	4546684	49	49
369	Non-Participating	324025	4547286	45	45
370	Non-Participating	323781	4548175	39	39

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
371	Non-Participating	323445	4548194	39	39
372	Non-Participating	322516	4547816	39	39
373	Non-Participating	324238	4548179	40	40
374	Non-Participating	324177	4548004	40	40
375	Non-Participating	324187	4547520	43	43
376	Non-Participating	324152	4547490	43	43
377	Non-Participating	324100	4547482	44	43
378	Non-Participating	324139	4547200	46	46
379	Non-Participating	325513	4547181	46	46
380	Non-Participating	325719	4547495	46	46
381	Non-Participating	325595	4547436	46	46
382	Non-Participating	325727	4548130	44	44
383	Non-Participating	325584	4548157	43	43
384	Non-Participating	325527	4548174	42	42
385	Non-Participating	325412	4548174	42	42
386	Non-Participating	325016	4547989	41	41
387	Non-Participating	324989	4548148	41	41
388	Participating	326150	4548184	47	47
389	Non-Participating	326427	4548172	49	49
390	Non-Participating	326850	4548156	50	50
391	Non-Participating	328016	4546600	47	47
392	Non-Participating	328947	4546706	44	44
393	Non-Participating	328496	4546956	46	46
394	Non-Participating	328622	4546995	46	46
395	Non-Participating	328818	4547025	45	45
396	Non-Participating	328975	4547130	46	46
397	Non-Participating	328951	4547197	46	46
398	Non-Participating	328941	4547282	48	48
399	Participating	328852	4548070	**52**	**52**
400	Participating	328612	4548114	51	51
401	Non-Participating	328509	4548111	50	50
402	Participating	328199	4548129	48	48
403	Non-Participating	329143	4546562	45	45
404	Non-Participating	329025	4546561	45	45
405	Non-Participating	329284	4547437	46	46
406	Non-Participating	329398	4547533	45	45
407	Non-Participating	329577	4547581	44	44

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
408	Non-Participating	329803	4547583	42	42
409	Non-Participating	330097	4547610	41	41
410	Non-Participating	330639	4547174	39	39
411	Non-Participating	330181	4548006	41	41
412	Non-Participating	332661	4546395	34	34
413	Non-Participating	332780	4546375	34	34
414	Non-Participating	333018	4546380	34	34
415	Non-Participating	333068	4546375	34	34
416	Non-Participating	333269	4546374	33	33
417	Non-Participating	333761	4546350	33	33
418	Non-Participating	334404	4546136	33	33
419	Non-Participating	334791	4546205	33	33
420	Non-Participating	335372	4546264	33	33
421	Non-Participating	335403	4546111	33	33
422	Non-Participating	335492	4546008	32	32
423	Non-Participating	336367	4546305	33	33
424	Non-Participating	337087	4546281	34	34
425	Non-Participating	338888	4546252	34	34
426	Non-Participating	340618	4545792	33	33
427	Non-Participating	340644	4545855	33	33
428	Non-Participating	340595	4545851	33	33
429	Non-Participating	340732	4545895	33	33
430	Non-Participating	340651	4545898	33	33
431	Non-Participating	340678	4545935	33	33
432	Non-Participating	340676	4546217	34	34
433	Non-Participating	340636	4546217	34	34
434	Non-Participating	340736	4546195	34	34
435	Non-Participating	340780	4546166	34	34
436	Non-Participating	340795	4546075	33	33
437	Non-Participating	340755	4546091	33	33
438	Non-Participating	340963	4546126	34	34
439	Non-Participating	341008	4546203	34	34
440	Non-Participating	341059	4546228	34	34
441	Non-Participating	341041	4546293	34	34
442	Non-Participating	340949	4546347	34	34
443	Non-Participating	340852	4546281	34	34
444	Non-Participating	341116	4546159	34	34

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
445	Non-Participating	341086	4546214	34	34
446	Non-Participating	341114	4546196	34	34
447	Non-Participating	341166	4546179	34	34
448	Non-Participating	341288	4546136	34	34
449	Non-Participating	341756	4545915	34	34
450	Non-Participating	341965	4545984	35	34
451	Non-Participating	342038	4545883	34	34
452	Non-Participating	342045	4545929	34	34
453	Non-Participating	342455	4545755	35	35
454	Non-Participating	345268	4545761	39	39
455	Non-Participating	345571	4545684	38	38
456	Non-Participating	345457	4545909	40	40
457	Non-Participating	345467	4545909	40	40
458	Non-Participating	330689	4547155	39	39
459	Non-Participating	331142	4546799	38	38
460	Non-Participating	331922	4546474	36	36
461	Non-Participating	332225	4546984	35	35
462	Non-Participating	332236	4546973	35	35
463	Non-Participating	332256	4547799	36	36
464	Non-Participating	331938	4547939	37	37
465	Non-Participating	331857	4547937	37	37
466	Non-Participating	331820	4547671	37	37
467	Non-Participating	331651	4547976	37	37
468	Non-Participating	331045	4548103	39	39
469	Non-Participating	330714	4548042	40	40
470	Non-Participating	330694	4547967	40	40
471	Non-Participating	330704	4547684	39	39
472	Non-Participating	330799	4547638	39	39
473	Non-Participating	332257	4546446	35	35
474	Non-Participating	332269	4546527	35	35
475	Non-Participating	332350	4546445	35	35
476	Non-Participating	332274	4546582	35	35
477	Non-Participating	332311	4546639	35	35
478	Non-Participating	332258	4546685	35	35
479	Non-Participating	332272	4546721	35	35
480	Non-Participating	332262	4546766	35	35
481	Non-Participating	332280	4546810	35	35

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
482	Non-Participating	333604	4546576	32	32
483	Non-Participating	333484	4546424	33	33
484	Non-Participating	333954	4547524	36	36
485	Non-Participating	334523	4546542	34	33
486	Non-Participating	335512	4547172	35	35
487	Non-Participating	334788	4547967	38	38
488	Non-Participating	334356	4547769	37	37
489	Participating	334143	4547972	38	38
490	Non-Participating	334264	4547419	36	36
491	Non-Participating	335602	4547965	38	38
492	Non-Participating	336949	4547354	37	37
493	Non-Participating	336536	4547382	37	37
494	Non-Participating	336919	4546892	35	35
495	Non-Participating	336080	4547022	35	35
496	Non-Participating	337150	4547908	40	40
497	Non-Participating	337283	4546806	35	35
498	Non-Participating	338595	4546638	35	35
499	Non-Participating	338524	4546640	35	35
500	Non-Participating	338443	4546644	35	35
501	Non-Participating	338028	4546756	35	35
502	Non-Participating	338312	4547810	40	40
503	Non-Participating	337524	4547900	41	41
504	Non-Participating	338978	4547889	39	39
505	Non-Participating	339640	4546378	34	34
506	Non-Participating	339124	4546456	34	34
507	Non-Participating	340370	4547799	38	38
508	Non-Participating	340423	4547790	38	38
509	Non-Participating	340691	4547789	39	39
510	Non-Participating	340658	4547790	39	39
511	Non-Participating	340735	4547776	39	39
512	Non-Participating	340886	4547822	39	39
513	Non-Participating	341816	4547093	37	37
514	Non-Participating	341714	4547025	37	37
515	Non-Participating	340899	4546396	34	34
516	Non-Participating	341047	4547532	38	38
517	Non-Participating	341055	4547377	37	37
518	Non-Participating	341065	4546875	36	36

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
519	Non-Participating	341040	4546759	35	35
520	Non-Participating	341018	4546699	35	35
521	Non-Participating	341091	4546748	35	35
522	Non-Participating	341206	4547019	36	36
523	Non-Participating	341241	4547135	37	37
524	Non-Participating	341302	4547218	37	37
525	Non-Participating	341550	4546267	35	35
526	Non-Participating	342067	4547168	38	38
527	Non-Participating	342326	4547047	39	39
528	Non-Participating	342328	4547164	39	39
529	Non-Participating	342298	4547244	39	39
530	Non-Participating	342057	4547313	39	39
531	Non-Participating	341804	4547805	40	40
532	Non-Participating	341852	4548052	41	41
533	Non-Participating	341766	4548056	41	41
534	Non-Participating	341791	4548205	42	42
535	Non-Participating	341884	4548280	43	43
536	Non-Participating	341660	4548382	44	44
537	Non-Participating	341588	4548204	43	43
538	Non-Participating	341423	4548190	43	43
539	Non-Participating	341349	4547995	41	41
540	Non-Participating	341294	4547979	41	41
541	Non-Participating	341195	4547912	40	40
542	Non-Participating	341105	4547780	39	39
543	Non-Participating	341011	4547910	40	40
544	Non-Participating	340940	4547952	40	40
545	Non-Participating	340887	4547971	40	40
546	Non-Participating	340882	4547880	40	40
547	Non-Participating	340445	4547899	39	39
548	Non-Participating	340527	4547895	39	39
549	Non-Participating	340584	4547893	39	39
550	Non-Participating	340751	4548025	40	40
551	Non-Participating	340686	4548068	40	40
552	Non-Participating	340697	4548133	41	41
553	Non-Participating	342540	4547039	39	39
554	Non-Participating	342779	4547002	40	40
555	Non-Participating	342878	4547011	40	40

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
556	Non-Participating	342995	4546939	41	41
557	Non-Participating	343226	4546807	42	42
558	Non-Participating	342652	4547699	42	42
559	Non-Participating	342856	4547846	44	44
560	Non-Participating	343308	4547750	46	46
561	Non-Participating	343600	4547732	48	48
562	Non-Participating	343719	4547734	49	49
563	Non-Participating	343985	4547663	49	49
564	Non-Participating	345025	4547351	47	47
565	Non-Participating	345126	4546944	48	48
566	Non-Participating	344571	4546164	41	41
567	Participating	343986	4546438	44	44
568	Non-Participating	343950	4546366	43	43
569	Non-Participating	343738	4546423	43	43
570	Non-Participating	345219	4547162	50	50
571	Non-Participating	346095	4547857	49	49
572	Participating	345239	4546339	43	43
573	Non-Participating	345355	4546628	48	48
574	Non-Participating	345721	4549277	42	42
575	Participating	345665	4549252	42	42
576	Participating	345229	4547900	50	50
577	Participating	344952	4549319	49	49
578	Participating	343850	4549323	50	50
579	Participating	343743	4549332	50	50
580	Non-Participating	343670	4547796	50	50
581	Non-Participating	344463	4547863	48	48
582	Non-Participating	344655	4547856	46	46
583	Non-Participating	342347	4547878	42	42
584	Participating	342060	4549268	44	44
585	Non-Participating	342897	4549365	50	50
586	Non-Participating	341787	4548565	45	45
587	Non-Participating	341737	4548621	46	46
588	Non-Participating	341751	4548674	47	47
589	Non-Participating	341786	4548723	47	47
590	Non-Participating	341809	4548789	47	47
591	Non-Participating	341841	4548908	46	46
592	Non-Participating	341796	4548996	47	47

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
593	Non-Participating	341775	4549407	44	44
594	Non-Participating	341526	4549404	47	47
595	Non-Participating	341178	4549412	48	48
596	Non-Participating	341051	4549416	47	47
597	Non-Participating	340989	4549421	46	46
598	Non-Participating	340991	4548002	41	41
599	Non-Participating	341002	4547996	41	41
600	Non-Participating	341032	4547995	41	41
601	Non-Participating	341050	4547994	41	41
602	Participating	340380	4549443	46	46
603	Non-Participating	339914	4549425	49	49
604	Non-Participating	339097	4549274	46	46
605	Non-Participating	338774	4547966	40	40
606	Participating	339148	4547939	39	39
607	Non-Participating	339389	4547937	39	39
608	Non-Participating	340198	4548372	40	40
609	Non-Participating	339761	4548395	40	40
610	Non-Participating	339570	4548684	42	42
611	Non-Participating	340346	4548642	42	42
612	Participating	337659	4549510	51	51
613	Non-Participating	337302	4547961	41	41
614	Non-Participating	337728	4547985	42	42
615	Non-Participating	338273	4547971	41	41
616	Non-Participating	337083	4549510	49	49
617	Non-Participating	336421	4549547	46	46
618	Non-Participating	335872	4549564	46	46
619	Participating	335850	4548007	38	38
620	Non-Participating	336413	4548076	39	39
621	Participating	336552	4548008	39	39
622	Non-Participating	336665	4547990	40	40
623	Non-Participating	337058	4548408	44	44
624	Non-Participating	335544	4549557	44	44
625	Non-Participating	334899	4549592	45	45
626	Participating	334683	4549611	47	47
627	Participating	333966	4549628	46	46
628	Non-Participating	333948	4548084	39	39
629	Non-Participating	334973	4548027	38	38

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
630	Non-Participating	335452	4548295	39	39
631	Non-Participating	335464	4548354	39	39
632	Non-Participating	333809	4549623	45	45
633	Non-Participating	333338	4549637	42	42
634	Non-Participating	332348	4549673	41	41
635	Non-Participating	332332	4549055	39	39
636	Non-Participating	332343	4549107	39	39
637	Non-Participating	332316	4548568	38	38
638	Participating	333878	4548355	40	40
639	Non-Participating	333900	4548849	45	45
640	Non-Participating	332093	4549599	42	42
641	Non-Participating	332021	4549632	42	42
642	Non-Participating	331974	4549615	42	42
643	Non-Participating	331876	4549630	42	42
644	Non-Participating	331261	4549680	45	45
645	Non-Participating	330752	4549369	47	47
646	Non-Participating	330748	4549217	47	47
647	Non-Participating	330739	4549116	47	47
648	Non-Participating	330723	4548977	46	46
649	Non-Participating	330749	4549152	47	47
650	Non-Participating	330725	4548827	44	44
651	Non-Participating	330846	4548120	40	40
652	Non-Participating	330802	4548221	40	40
653	Non-Participating	331115	4548357	40	40
654	Non-Participating	331305	4548408	39	39
655	Non-Participating	331702	4548687	39	39
656	Non-Participating	332164	4548573	38	38
657	Non-Participating	329735	4549694	46	46
658	Participating	329664	4549596	46	46
659	Non-Participating	329613	4549656	46	46
660	Non-Participating	329425	4548156	45	45
661	Non-Participating	329778	4548198	43	43
662	Non-Participating	329860	4548140	42	42
663	Non-Participating	330308	4548130	41	41
664	Non-Participating	330352	4548167	41	41
665	Non-Participating	330397	4548166	41	41
666	Non-Participating	330459	4548148	41	41

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
667	Non-Participating	330663	4548133	40	40
668	Participating	328881	4549723	45	45
669	Non-Participating	328455	4549721	43	43
670	Participating	327999	4549718	41	41
671	Participating	327960	4549721	41	41
672	Non-Participating	327430	4549724	39	39
673	Non-Participating	327460	4549635	40	40
674	Non-Participating	327444	4549406	41	41
675	Non-Participating	327455	4549261	41	41
676	Participating	327406	4548705	44	44
677	Non-Participating	328042	4548189	49	49
678	Non-Participating	324144	4549053	36	36
679	Non-Participating	324143	4548998	36	36
680	Non-Participating	324143	4548968	37	37
681	Non-Participating	324142	4548930	37	37
682	Non-Participating	324141	4548896	37	37
683	Non-Participating	324138	4548860	37	37
684	Non-Participating	324139	4548810	37	37
685	Non-Participating	324137	4548779	37	37
686	Non-Participating	324135	4548742	37	37
687	Non-Participating	324135	4548711	37	37
688	Non-Participating	324135	4548671	37	37
689	Non-Participating	324401	4548267	39	39
690	Non-Participating	324597	4548239	40	40
691	Non-Participating	324631	4548241	40	40
692	Non-Participating	324665	4548241	40	40
693	Non-Participating	324710	4548239	40	40
694	Non-Participating	324750	4548241	40	40
695	Non-Participating	324780	4548237	40	40
696	Non-Participating	325159	4548242	41	41
697	Non-Participating	325278	4548231	41	41
698	Non-Participating	325313	4548385	41	41
699	Participating	325706	4548260	43	43
700	Non-Participating	321670	4548265	35	35
701	Non-Participating	321566	4548297	35	35
702	Non-Participating	321495	4548304	34	34
703	Non-Participating	321274	4548328	34	34

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
704	Non-Participating	320925	4548479	33	33
705	Non-Participating	320870	4548692	32	32
706	Non-Participating	324149	4549895	34	34
707	Non-Participating	324221	4550057	34	34
708	Non-Participating	324129	4550271	33	33
709	Non-Participating	324591	4549842	35	35
710	Non-Participating	325019	4549939	35	35
711	Non-Participating	325259	4549852	36	35
712	Non-Participating	327467	4550675	37	37
713	Non-Participating	327466	4550646	37	37
714	Non-Participating	327460	4550589	37	37
715	Non-Participating	327464	4550424	37	37
716	Non-Participating	327429	4550160	38	38
717	Non-Participating	327477	4549967	39	39
718	Non-Participating	326612	4549813	38	38
719	Non-Participating	326196	4549878	37	37
720	Non-Participating	325982	4549837	37	37
721	Non-Participating	327805	4550529	38	38
722	Non-Participating	327550	4550148	38	38
723	Non-Participating	330298	4549841	46	46
724	Non-Participating	329928	4549756	46	46
725	Non-Participating	329732	4549769	46	46
726	Non-Participating	329665	4549784	47	47
727	Non-Participating	330017	4550364	46	46
728	Participating	331373	4551273	45	45
729	Participating	331529	4551274	46	45
730	Non-Participating	331913	4551272	48	48
731	Non-Participating	332320	4550958	48	48
732	Non-Participating	332320	4550666	48	48
733	Non-Participating	332309	4550624	48	48
734	Non-Participating	332302	4550421	46	46
735	Non-Participating	332282	4550385	46	46
736	Non-Participating	331838	4549739	43	43
737	Non-Participating	332401	4550527	46	46
738	Non-Participating	334068	4551237	50	50
739	Non-Participating	335356	4551193	45	44
740	Non-Participating	335494	4549639	44	44

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
741	Non-Participating	334739	4549676	46	45
742	Non-Participating	334541	4549672	48	48
743	Participating	334176	4549817	46	46
744	Non-Participating	338364	4551108	**52**	51
745	Non-Participating	338519	4549582	50	50
746	Non-Participating	338082	4549574	50	50
747	Non-Participating	337748	4549594	49	49
748	Non-Participating	337528	4549601	50	50
749	Participating	337372	4549582	50	50
750	Participating	339093	4551088	50	49
751	Participating	339390	4551083	47	47
752	Participating	339725	4551071	46	46
753	Participating	340365	4550300	48	48
754	Participating	340380	4549706	49	49
755	Non-Participating	343459	4549428	48	48
756	Non-Participating	343540	4549399	49	49
757	Non-Participating	343661	4549401	49	49
758	Participating	343819	4549392	48	48
759	Non-Participating	344657	4549374	49	49
760	Non-Participating	344716	4549374	49	49
761	Non-Participating	345220	4550031	40	40
762	Non-Participating	344616	4550947	37	37
763	Non-Participating	344049	4550949	38	38
764	Non-Participating	342285	4550051	41	41
765	Non-Participating	342298	4550072	41	41
766	Non-Participating	342319	4550108	41	41
767	Non-Participating	342357	4550106	41	41
768	Non-Participating	342349	4550073	41	41
769	Non-Participating	342328	4550129	41	41
770	Non-Participating	342312	4550184	41	41
771	Non-Participating	346093	4550060	37	37
772	Non-Participating	345996	4549934	38	38
773	Non-Participating	345710	4549928	39	39
774	Non-Participating	346091	4549637	38	38
775	Non-Participating	346357	4549648	37	37
776	Non-Participating	346435	4549701	37	37
777	Non-Participating	346343	4552287	30	30

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
778	Non-Participating	345621	4552510	31	31
779	Participating	345334	4551448	34	34
780	Non-Participating	344916	4551093	36	36
781	Non-Participating	343831	4551023	38	38
782	Non-Participating	341796	4552640	42	42
783	Non-Participating	341420	4552647	43	43
784	Non-Participating	341231	4552650	44	44
785	Non-Participating	340538	4552478	49	49
786	Non-Participating	340988	4551096	46	46
787	Participating	341319	4551086	44	44
788	Non-Participating	339390	4552701	43	42
789	Non-Participating	338863	4552527	44	43
790	Non-Participating	338943	4551157	48	48
791	Non-Participating	335779	4552808	51	49
792	Non-Participating	336219	4551254	47	46
793	Non-Participating	336279	4551238	47	47
794	Non-Participating	336428	4551233	48	48
795	Non-Participating	336658	4551230	48	48
796	Non-Participating	337198	4552027	**52**	50
797	Non-Participating	335544	4552809	48	47
798	Non-Participating	335086	4552816	47	46
799	Participating	334604	4552830	49	49
800	Non-Participating	334417	4552837	49	49
801	Participating	334167	4552845	48	48
802	Non-Participating	331806	4551356	46	46
803	Non-Participating	331737	4551337	46	46
804	Non-Participating	331638	4551357	45	45
805	Participating	331579	4551434	44	44
806	Non-Participating	331379	4551368	44	44
807	Non-Participating	330794	4552021	39	39
808	Non-Participating	330821	4552404	38	37
809	Participating	330810	4552760	36	36
810	Participating	331620	4552855	37	37
811	Participating	331827	4552800	38	38
812	Non-Participating	332044	4552884	39	38
813	Non-Participating	330128	4552924	35	35
814	Non-Participating	328268	4551385	37	37

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
815	Non-Participating	328199	4551386	37	37
816	Non-Participating	328146	4551386	36	36
817	Non-Participating	328095	4551384	36	36
818	Non-Participating	327845	4551391	36	36
819	Non-Participating	327737	4551434	35	35
820	Non-Participating	327555	4551766	34	34
821	Non-Participating	327647	4552113	33	33
822	Non-Participating	327548	4552419	32	32
823	Non-Participating	327684	4552733	32	32
824	Non-Participating	327667	4552927	31	31
825	Non-Participating	327709	4552921	31	31
826	Non-Participating	327791	4552926	31	31
827	Non-Participating	327990	4552925	32	32
828	Non-Participating	329049	4554536	29	29
829	Non-Participating	328849	4554543	29	29
830	Non-Participating	329323	4554524	30	30
831	Non-Participating	329363	4554523	30	30
832	Non-Participating	329428	4554502	30	30
833	Non-Participating	329753	4554527	30	30
834	Non-Participating	329838	4554535	30	30
835	Non-Participating	329942	4554522	31	30
836	Non-Participating	329980	4554521	31	30
837	Non-Participating	330025	4554432	31	31
838	Non-Participating	330092	4554534	31	31
839	Non-Participating	330223	4554533	31	31
840	Non-Participating	330257	4554540	31	31
841	Non-Participating	330309	4554532	31	31
842	Non-Participating	330409	4554537	31	31
843	Non-Participating	330443	4554581	31	31
844	Non-Participating	330787	4554788	31	31
845	Non-Participating	330789	4554758	31	31
846	Non-Participating	330829	4554715	31	31
847	Non-Participating	330831	4554789	31	31
848	Non-Participating	330891	4554574	32	32
849	Non-Participating	330894	4554263	32	32
850	Non-Participating	330148	4554067	32	32
851	Non-Participating	329949	4553445	33	33

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
852	Non-Participating	330737	4553179	35	35
853	Non-Participating	330861	4553111	35	35
854	Non-Participating	330522	4554746	31	31
855	Non-Participating	329914	4554586	30	30
856	Non-Participating	329837	4554588	30	30
857	Non-Participating	329726	4554638	30	30
858	Non-Participating	329689	4554606	30	30
859	Non-Participating	331064	4553013	36	36
860	Non-Participating	331559	4552957	37	37
861	Non-Participating	331623	4553028	37	37
862	Non-Participating	333988	4553441	43	43
863	Non-Participating	333662	4552929	44	44
864	Non-Participating	333567	4552949	43	43
865	Non-Participating	333512	4552940	43	43
866	Non-Participating	333449	4552930	43	43
867	Participating	333260	4552942	42	42
868	Non-Participating	332744	4552946	41	40
869	Non-Participating	335555	4554420	41	40
870	Participating	335461	4553825	45	44
871	Non-Participating	335627	4553608	48	47
872	Non-Participating	335389	4552877	47	46
873	Non-Participating	335033	4552887	48	48
874	Participating	338473	4554335	49	49
875	Non-Participating	338758	4554278	49	49
876	Non-Participating	338335	4552809	45	44
877	Non-Participating	337288	4552832	51	49
878	Participating	337302	4553588	46	45
879	Participating	338968	4554330	48	48
880	Non-Participating	339195	4554319	49	49
881	Non-Participating	337258	4554449	42	41
882	Non-Participating	337260	4554506	42	41
883	Non-Participating	331319	4554581	32	32
884	Non-Participating	340519	4554352	39	39
885	Non-Participating	341527	4554343	36	36
886	Non-Participating	330879	4553464	34	34
887	Non-Participating	330866	4553260	35	35
888	Non-Participating	332249	4553045	39	38

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
889	Non-Participating	330779	4540044	30	30
890	Non-Participating	329693	4548208	43	43
891	Non-Participating	330660	4548340	41	41
892	Non-Participating	330646	4548415	42	42
893	Non-Participating	330627	4548906	47	47
894	Non-Participating	328310	4548219	48	48
895	Non-Participating	328620	4548170	50	50
896	Non-Participating	327155	4549739	39	39
897	Non-Participating	326585	4549715	38	38
898	Non-Participating	326286	4549744	37	37
899	Non-Participating	325598	4549776	36	36
900	Non-Participating	324940	4549761	35	35
901	Non-Participating	324578	4549776	35	35
902	Non-Participating	324162	4549622	35	35
903	Participating	323893	4549776	34	34
904	Non-Participating	324095	4549319	35	35
905	Non-Participating	324025	4548715	37	37
906	Non-Participating	324069	4548546	38	38
907	Non-Participating	324066	4548486	38	38
908	Non-Participating	323717	4548241	39	39
909	Non-Participating	323324	4548289	38	38
910	Non-Participating	322827	4548273	37	37
911	Non-Participating	322607	4548512	36	36
912	Non-Participating	322622	4548612	36	36
913	Non-Participating	322758	4548686	36	36
914	Non-Participating	322328	4548295	36	36
915	Non-Participating	321961	4548273	35	35
916	Non-Participating	325604	4551373	32	32
917	Non-Participating	325822	4551340	32	32
918	Non-Participating	325783	4551374	32	32
919	Non-Participating	326374	4551127	34	34
920	Participating	326686	4551340	34	34
921	Participating	326725	4551307	34	34
922	Non-Participating	326920	4551308	34	34
923	Non-Participating	327051	4551343	34	34
924	Non-Participating	327056	4551275	34	34
925	Non-Participating	327025	4551238	34	34

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
926	Non-Participating	327258	4551337	34	34
927	Non-Participating	327435	4551327	35	35
928	Non-Participating	327484	4551327	35	35
929	Non-Participating	327455	4551261	35	35
930	Non-Participating	327450	4551071	35	35
931	Non-Participating	327427	4550906	36	36
932	Non-Participating	327436	4550828	36	36
933	Non-Participating	327470	4550797	36	36
934	Non-Participating	327470	4550766	36	36
935	Non-Participating	327470	4550734	36	36
936	Non-Participating	327467	4550707	36	36
937	Non-Participating	327591	4550016	39	39
938	Non-Participating	328380	4549784	42	42
939	Participating	329044	4549781	48	48
940	Non-Participating	328875	4550760	43	43
941	Participating	329125	4551305	40	40
942	Non-Participating	327557	4550536	37	37
943	Non-Participating	327532	4550473	37	37
944	Non-Participating	329361	4551173	42	42
945	Participating	330238	4551315	47	47
946	Participating	331457	4549822	47	47
947	Participating	332640	4551262	46	46
948	Non-Participating	333065	4551262	49	49
949	Participating	333394	4551258	48	48
950	Non-Participating	333881	4551223	49	49
951	Participating	333936	4550410	51	51
952	Participating	332354	4549733	42	42
953	Non-Participating	332400	4549961	43	43
954	Participating	332394	4550395	45	45
955	Non-Participating	337187	4551151	49	48
956	Participating	337128	4550333	50	50
957	Participating	337124	4550233	50	50
958	Non-Participating	336981	4549622	47	47
959	Non-Participating	336666	4549602	46	46
960	Participating	336090	4549633	49	48
961	Non-Participating	335806	4549740	48	48
962	Non-Participating	335732	4549630	45	45

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
963	Non-Participating	337843	4550997	**52**	50
964	Non-Participating	340463	4551050	45	45
965	Non-Participating	340622	4551049	46	46
966	Non-Participating	340938	4551035	46	45
967	Non-Participating	340984	4551041	45	45
968	Non-Participating	342028	4549726	42	42
969	Non-Participating	340827	4549474	45	45
970	Non-Participating	340469	4550767	45	45
971	Non-Participating	342159	4549582	43	43
972	Non-Participating	342145	4549677	42	42
973	Non-Participating	342260	4549959	41	41
974	Non-Participating	342332	4549967	41	41
975	Non-Participating	342163	4549915	41	41
976	Non-Participating	342057	4549802	42	42
977	Non-Participating	342124	4549829	42	42
978	Non-Participating	342176	4549445	44	43
979	Non-Participating	342626	4549428	47	47
980	Non-Participating	342956	4549429	49	49
981	Non-Participating	343009	4549428	49	49
982	Non-Participating	343321	4549438	48	48
983	Non-Participating	342582	4550858	40	40
984	Participating	342620	4550794	40	40
985	Participating	342602	4550755	40	40
986	Non-Participating	342425	4550452	40	40
987	Non-Participating	345266	4549364	45	45
988	Non-Participating	345303	4550349	38	38
989	Non-Participating	345299	4550493	37	37
990	Non-Participating	345438	4550909	35	35
991	Non-Participating	346063	4550302	36	36
992	Non-Participating	343735	4552580	38	38
993	Non-Participating	343962	4552574	36	36
994	Non-Participating	344434	4552573	34	34
995	Non-Participating	345080	4552492	33	33
996	Non-Participating	345251	4551701	34	34
997	Non-Participating	343233	4552575	42	42
998	Non-Participating	342735	4552600	48	48
999	Non-Participating	342678	4552608	48	48

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1000	Non-Participating	342629	4552610	48	48
1001	Non-Participating	342383	4552609	47	47
1002	Non-Participating	342285	4551061	41	41
1003	Non-Participating	339650	4551149	46	46
1004	Non-Participating	339988	4551316	45	45
1005	Non-Participating	340266	4551120	45	45
1006	Non-Participating	340397	4551506	49	49
1007	Non-Participating	340179	4551856	46	46
1008	Non-Participating	338484	4552705	45	44
1009	Non-Participating	338022	4552734	47	46
1010	Participating	337537	4552734	52	50
1011	Participating	338053	4551185	**53**	**52**
1012	Participating	338625	4551165	51	50
1013	Non-Participating	337231	4552776	51	50
1014	Participating	337056	4552751	**52**	51
1015	Non-Participating	336256	4552783	53	51
1016	Non-Participating	335814	4551259	45	45
1017	Non-Participating	333955	4552793	46	46
1018	Non-Participating	333247	4552825	43	43
1019	Non-Participating	332527	4552902	40	40
1020	Non-Participating	332431	4552719	41	41
1021	Participating	333572	4551320	49	49
1022	Non-Participating	332347	4552809	40	40
1023	Participating	332375	4552653	41	41
1024	Non-Participating	332341	4552489	41	41
1025	Participating	332360	4552254	43	43
1026	Participating	332315	4552191	43	43
1027	Participating	332333	4552124	43	43
1028	Non-Participating	332356	4551748	45	45
1029	Participating	332189	4551346	45	45
1030	Non-Participating	329418	4552795	34	34
1031	Participating	329646	4552493	36	36
1032	Participating	329309	4552262	36	36
1033	Non-Participating	328956	4551998	36	36
1034	Non-Participating	328896	4552064	36	36
1035	Non-Participating	328748	4551850	36	36
1036	Non-Participating	328765	4551861	36	36

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1037	Non-Participating	328570	4551633	37	37
1038	Non-Participating	328445	4551421	37	37
1039	Non-Participating	328539	4552922	32	32
1040	Non-Participating	329202	4552636	34	34
1041	Non-Participating	328641	4551375	38	38
1042	Non-Participating	327150	4552109	32	32
1043	Non-Participating	327130	4551394	34	34
1044	Non-Participating	326799	4551391	34	34
1045	Non-Participating	326655	4551404	33	33
1046	Non-Participating	326583	4551406	33	33
1047	Non-Participating	326226	4551402	33	33
1048	Non-Participating	327414	4552988	31	31
1049	Non-Participating	328216	4552980	32	32
1050	Non-Participating	328681	4552992	33	33
1051	Non-Participating	330916	4554513	32	32
1052	Non-Participating	330963	4554420	32	32
1053	Non-Participating	331114	4554336	33	32
1054	Non-Participating	330771	4554130	32	32
1055	Non-Participating	330766	4553796	33	33
1056	Non-Participating	330441	4553797	33	33
1057	Non-Participating	330106	4553776	32	32
1058	Non-Participating	330187	4553886	32	32
1059	Non-Participating	330280	4554017	32	32
1060	Non-Participating	330353	4554120	32	32
1061	Non-Participating	330250	4554170	32	31
1062	Non-Participating	330280	4554269	31	31
1063	Non-Participating	330331	4554316	31	31
1064	Non-Participating	330306	4554410	31	31
1065	Non-Participating	330278	4554455	31	31
1066	Participating	329459	4553026	34	34
1067	Non-Participating	329617	4553116	34	34
1068	Non-Participating	329838	4553300	33	33
1069	Non-Participating	329861	4553328	33	33
1070	Non-Participating	329883	4553364	33	33
1071	Non-Participating	332341	4554015	36	35
1072	Non-Participating	331632	4554519	33	33
1073	Non-Participating	331575	4554520	33	33

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1074	Non-Participating	331338	4554522	33	32
1075	Non-Participating	331187	4554514	32	32
1076	Non-Participating	331108	4554525	32	32
1077	Non-Participating	330925	4553952	33	33
1078	Non-Participating	332930	4554485	35	35
1079	Participating	333304	4554476	36	36
1080	Non-Participating	333442	4554471	37	36
1081	Non-Participating	333939	4554457	38	37
1082	Non-Participating	334052	4554462	38	38
1083	Participating	333989	4553514	42	42
1084	Non-Participating	334153	4552925	46	46
1085	Participating	335845	4552931	**52**	51
1086	Participating	336671	4552848	**55**	**53**
1087	Non-Participating	337238	4553301	50	49
1088	Non-Participating	336096	4554373	42	41
1089	Non-Participating	337455	4554387	43	42
1090	Participating	338151	4554355	48	48
1091	Non-Participating	339437	4554302	47	47
1092	Non-Participating	339769	4554300	44	44
1093	Non-Participating	340453	4553353	40	40
1094	Non-Participating	340419	4552770	43	43
1095	Non-Participating	339439	4552768	42	42
1096	Non-Participating	340617	4552747	44	44
1097	Non-Participating	340901	4552737	45	45
1098	Non-Participating	341054	4552735	44	44
1099	Non-Participating	342026	4552772	42	42
1100	Non-Participating	342178	4552723	43	43
1101	Non-Participating	342653	4552673	46	46
1102	Non-Participating	344586	4552625	34	34
1103	Non-Participating	344586	4552646	34	34
1104	Non-Participating	344612	4552639	34	34
1105	Non-Participating	345970	4552595	31	31
1106	Non-Participating	345318	4552958	31	31
1107	Non-Participating	345311	4552996	31	31
1108	Non-Participating	340782	4555755	36	36
1109	Non-Participating	340204	4555926	39	38
1110	Non-Participating	339006	4554402	49	49

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1111	Participating	339390	4554381	49	49
1112	Non-Participating	339883	4554479	44	44
1113	Non-Participating	337357	4556003	36	36
1114	Non-Participating	337335	4555343	39	38
1115	Non-Participating	337300	4554588	41	41
1116	Non-Participating	338643	4554399	47	47
1117	Non-Participating	337226	4556019	36	36
1118	Non-Participating	336653	4554489	42	40
1119	Non-Participating	336298	4554477	42	40
1120	Non-Participating	335991	4554474	41	40
1121	Non-Participating	335315	4554491	40	39
1122	Non-Participating	334964	4554508	40	39
1123	Non-Participating	334515	4554521	39	38
1124	Non-Participating	334123	4554540	38	37
1125	Non-Participating	333734	4554542	37	37
1126	Non-Participating	333544	4554544	37	36
1127	Non-Participating	333060	4554551	35	35
1128	Non-Participating	332408	4554564	34	34
1129	Non-Participating	331242	4554568	32	32
1130	Non-Participating	331215	4554689	32	32
1131	Non-Participating	331110	4554569	32	32
1132	Non-Participating	331038	4554583	32	32
1133	Non-Participating	330887	4554892	31	31
1134	Non-Participating	330848	4554909	31	31
1135	Non-Participating	330849	4554953	31	31
1136	Non-Participating	330933	4554960	31	31
1137	Non-Participating	330868	4555004	31	31
1138	Non-Participating	338645	4556041	42	42
1139	Non-Participating	339181	4556075	45	45
1140	Non-Participating	339530	4556090	42	42
1141	Non-Participating	320311	4542497	35	35
1142	Non-Participating	336829	4547313	37	37
1143	Non-Participating	327315	4548461	46	46
1144	Non-Participating	327279	4548745	44	44
1145	Non-Participating	327350	4549407	40	40
1146	Non-Participating	326136	4548246	46	46
1147	Non-Participating	326193	4548232	46	46

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1148	Non-Participating	326244	4548227	46	46
1149	Non-Participating	326855	4548235	49	49
1150	Non-Participating	327086	4548536	45	45
1151	Non-Participating	326527	4548581	44	44
1152	Non-Participating	326559	4548659	43	43
1153	Non-Participating	326694	4548723	43	43
1154	Non-Participating	326636	4548907	42	42
1155	Non-Participating	326883	4548900	42	42
1156	Non-Participating	326729	4549232	40	40
1157	Non-Participating	326968	4549190	41	41
1158	Participating	334203	4551310	**52**	**52**
1159	Non-Participating	335040	4551275	46	45
1160	Non-Participating	335582	4551302	45	44
1161	Non-Participating	335590	4551507	46	45
1162	Non-Participating	330161	4551363	46	46
1163	Participating	329902	4551368	44	44
1164	Participating	330553	4552280	38	38
1165	Non-Participating	329802	4552241	37	37
1166	Non-Participating	342810	4551491	43	43
1167	Non-Participating	342987	4551882	48	48
1168	Non-Participating	341772	4547113	37	37
1169	Non-Participating	341832	4547245	38	38
1170	Non-Participating	341858	4547169	38	38
1171	Non-Participating	342220	4549745	42	42
1172	Non-Participating	342317	4549859	42	42
1173	Non-Participating	330908	4554933	31	31
1174	Non-Participating	329561	4554522	30	30
1175	Non-Participating	330881	4554776	31	31
1176	Non-Participating	327427	4550984	36	36
1177	Non-Participating	334627	4551179	49	49
1178	Non-Participating	342076	4549697	42	42
1179	Non-Participating	320849	4547418	35	35
1180	Non-Participating	324156	4547921	41	41
1181	Non-Participating	334227	4547401	36	36
1182	Non-Participating	341078	4549411	47	47
1183	Non-Participating	341818	4548630	45	45
1184	Non-Participating	339852	4546239	34	33

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1185	Non-Participating	340552	4545847	33	33
1186	Non-Participating	343189	4549240	51	51
1187	Non-Participating	322359	4544396	44	44
1188	Non-Participating	330437	4544924	42	42
1189	Non-Participating	327939	4544794	47	47
1190	Non-Participating	323580	4541662	47	47
1191	Participating	335820	4548603	40	40
1192	Non-Participating	329895	4546591	45	45
1193	Non-Participating	341423	4554272	36	36
1194	Non-Participating	341035	4554249	37	37
1195	Non-Participating	341344	4554332	36	36
1196	Non-Participating	342092	4554315	35	35
1197	Non-Participating	341985	4554306	35	35
1198	Non-Participating	341942	4554320	35	35
1199	Non-Participating	341792	4554335	36	35
1200	Non-Participating	342743	4554241	34	34
1201	Non-Participating	342789	4554299	34	34
1202	Non-Participating	343167	4554281	33	33
1203	Non-Participating	343696	4553873	34	34
1204	Non-Participating	343492	4553218	36	36
1205	Non-Participating	341560	4555969	33	33
1206	Non-Participating	342049	4555924	32	32
1207	Non-Participating	342068	4555858	32	32
1208	Non-Participating	341150	4555981	34	34
1209	Non-Participating	341225	4555879	34	34
1210	Non-Participating	342113	4555058	33	33
1211	Non-Participating	342110	4554996	34	33
1212	Participating	343318	4555839	30	30
1213	Non-Participating	343001	4555899	30	30
1214	Non-Participating	342810	4555836	31	31
1215	Non-Participating	343771	4555809	29	29
1216	Non-Participating	344337	4555498	29	29
1217	Non-Participating	344065	4554775	31	31
1218	Non-Participating	344144	4554788	31	31
1219	Non-Participating	344100	4554899	30	30
1220	Non-Participating	327075	4553021	30	30
1221	Non-Participating	326948	4553001	30	30

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1222	Non-Participating	327040	4552939	31	31
1223	Non-Participating	324396	4553047	27	27
1224	Non-Participating	324222	4552408	28	28
1225	Non-Participating	324317	4552424	28	28
1226	Non-Participating	324269	4551588	30	30
1227	Non-Participating	324213	4551351	31	31
1228	Non-Participating	324326	4551420	31	31
1229	Non-Participating	324442	4551415	31	31
1230	Non-Participating	324684	4551405	31	31
1231	Non-Participating	324794	4551403	31	31
1232	Non-Participating	324880	4551347	31	31
1233	Non-Participating	326604	4553007	30	30
1234	Non-Participating	324941	4553199	28	28
1235	Non-Participating	325090	4551497	31	31
1236	Non-Participating	325314	4551480	32	32
1237	Non-Participating	345258	4551741	34	34
1238	Non-Participating	324172	4550568	32	32
1239	Non-Participating	346676	4548264	41	41
1240	Non-Participating	325325	4545018	45	45
1241	Non-Participating	317577	4544267	33	33
1242	Non-Participating	317643	4544255	34	34
1243	Non-Participating	326535	4552862	30	30
1244	Non-Participating	326405	4553016	30	30
1245	Non-Participating	326334	4553014	29	29
1246	Non-Participating	325991	4553043	29	29
1247	Non-Participating	325889	4553041	29	29
1248	Non-Participating	325898	4552806	29	29
1249	Non-Participating	325322	4553016	28	28
1250	Non-Participating	325094	4553096	28	28
1251	Non-Participating	325093	4553027	28	28
1252	Non-Participating	325024	4553017	28	28
1253	Non-Participating	324941	4553089	28	28
1254	Non-Participating	324977	4553010	28	28
1255	Non-Participating	324902	4553012	28	28
1256	Non-Participating	324889	4553096	28	28
1257	Non-Participating	324265	4551914	30	30
1258	Non-Participating	324272	4551514	30	30

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1259	Non-Participating	324171	4551489	30	30
1260	Non-Participating	345239	4551778	34	34
1261	Non-Participating	324180	4550778	32	32
1262	Non-Participating	324157	4550612	32	32
1263	Non-Participating	345816	4549425	41	41
1264	Participating	329124	4548083	49	49
1265	Non-Participating	318538	4546224	37	37
1266	Non-Participating	318451	4546306	36	36
1267	Non-Participating	318449	4546415	35	35
1268	Non-Participating	318190	4546329	35	35
1269	Non-Participating	317774	4546834	31	31
1270	Non-Participating	317574	4546658	31	31
1271	Non-Participating	317593	4546448	31	31
1272	Non-Participating	317661	4546497	32	32
1273	Non-Participating	317979	4545203	36	36
1274	Non-Participating	318112	4545044	37	37
1275	Non-Participating	318433	4545023	40	40
1276	Non-Participating	322416	4543339	41	40
1277	Non-Participating	320788	4541604	34	34
1278	Participating	329030	4546496	45	45
1279	Non-Participating	318502	4545123	40	40
1280	Non-Participating	318484	4544824	40	40
1281	Non-Participating	318569	4544868	41	41
1282	Non-Participating	317700	4544256	34	34
1283	Non-Participating	317762	4544253	34	34
1284	Non-Participating	317807	4544252	34	34
1285	Non-Participating	318002	4544241	36	36
1286	Non-Participating	318090	4544416	36	36
1287	Non-Participating	318535	4544237	39	39
1288	Non-Participating	329691	4540075	32	32
1289	Non-Participating	345274	4551786	34	33
1290	Non-Participating	324845	4548251	40	40
1291	Non-Participating	336786	4556022	36	35
1292	Non-Participating	336635	4556815	33	33
1293	Non-Participating	336644	4556941	33	32
1294	Non-Participating	337251	4556891	34	33
1295	Non-Participating	337286	4556825	34	34

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1296	Non-Participating	337922	4556940	34	34
1297	Non-Participating	337665	4556806	34	34
1298	Non-Participating	338995	4556695	37	37
1299	Non-Participating	338910	4556822	36	36
1300	Non-Participating	340500	4556494	35	35
1301	Non-Participating	341588	4556835	31	31
1302	Non-Participating	341025	4556765	32	32
1303	Non-Participating	342241	4556614	30	30
1304	Non-Participating	343757	4556172	29	28
1305	Non-Participating	343767	4556373	28	28
1306	Non-Participating	344496	4555977	27	27
1307	Non-Participating	344606	4556036	27	27
1308	Non-Participating	344773	4556491	25	25
1309	Non-Participating	345116	4555759	27	27
1310	Non-Participating	345607	4555648	26	26
1311	Non-Participating	344510	4555466	28	28
1312	Non-Participating	345465	4554205	29	29
1313	Non-Participating	345054	4554252	30	30
1314	Non-Participating	338412	4554926	44	44
1315	Non-Participating	337240	4554962	40	39
1316	Non-Participating	335753	4556101	34	34
1317	Non-Participating	335762	4556157	34	34
1318	Non-Participating	331078	4554617	32	32
1319	Non-Participating	330869	4554579	32	32
1320	Non-Participating	330850	4554577	32	31
1321	Non-Participating	330822	4554580	32	31
1322	Non-Participating	330826	4554612	31	31
1323	Non-Participating	330826	4554646	31	31
1324	Non-Participating	330721	4554629	31	31
1325	Non-Participating	330740	4554661	31	31
1326	Non-Participating	330755	4554738	31	31
1327	Non-Participating	330549	4554592	31	31
1328	Non-Participating	330596	4554590	31	31
1329	Participating	330045	4553367	33	33
1330	Non-Participating	330327	4553853	33	32
1331	Non-Participating	330356	4553854	33	32
1332	Non-Participating	330357	4553787	33	33

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1333	Non-Participating	330267	4553787	33	32
1334	Non-Participating	330225	4553786	32	32
1335	Non-Participating	330167	4553795	32	32
1336	Non-Participating	330149	4553839	32	32
1337	Non-Participating	330374	4554536	31	31
1338	Non-Participating	330409	4554506	31	31
1339	Non-Participating	330371	4554452	31	31
1340	Non-Participating	330405	4554452	31	31
1341	Non-Participating	330440	4554443	31	31
1342	Non-Participating	330470	4554447	31	31
1343	Non-Participating	330509	4554445	31	31
1344	Non-Participating	330507	4554476	31	31
1345	Non-Participating	330473	4554503	31	31
1346	Non-Participating	330503	4554502	31	31
1347	Non-Participating	330503	4554541	31	31
1348	Non-Participating	330474	4554545	31	31
1349	Non-Participating	330553	4554542	31	31
1350	Non-Participating	330560	4554519	31	31
1351	Non-Participating	330555	4554502	31	31
1352	Non-Participating	330608	4554493	31	31
1353	Non-Participating	330339	4554480	31	31
1354	Non-Participating	330315	4554451	31	31
1355	Non-Participating	330409	4554407	31	31
1356	Non-Participating	330447	4554409	31	31
1357	Non-Participating	330482	4554407	31	31
1358	Non-Participating	330514	4554414	32	31
1359	Non-Participating	330501	4554330	32	32
1360	Non-Participating	330439	4554313	32	31
1361	Non-Participating	330407	4554258	32	32
1362	Non-Participating	330400	4554206	32	32
1363	Non-Participating	330430	4554205	32	32
1364	Non-Participating	330456	4554258	32	32
1365	Non-Participating	330343	4554175	32	32
1366	Non-Participating	330373	4554219	32	32
1367	Non-Participating	330330	4554087	32	32
1368	Non-Participating	330312	4554067	32	32
1369	Non-Participating	330294	4554035	32	32

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1370	Non-Participating	330331	4553999	32	32
1371	Non-Participating	330345	4554026	32	32
1372	Non-Participating	330393	4554094	32	32
1373	Non-Participating	330407	4554109	32	32
1374	Non-Participating	330425	4554134	32	32
1375	Non-Participating	330485	4554130	32	32
1376	Non-Participating	330499	4554112	32	32
1377	Non-Participating	330464	4554077	32	32
1378	Non-Participating	330499	4554075	32	32
1379	Non-Participating	330403	4554015	32	32
1380	Non-Participating	330504	4554036	32	32
1381	Non-Participating	330545	4554041	32	32
1382	Non-Participating	330575	4553997	32	32
1383	Non-Participating	330633	4553997	33	32
1384	Non-Participating	330638	4553963	33	33
1385	Non-Participating	330608	4553962	33	33
1386	Non-Participating	330633	4554034	32	32
1387	Non-Participating	330587	4554033	32	32
1388	Non-Participating	330552	4554076	32	32
1389	Non-Participating	330550	4554134	32	32
1390	Non-Participating	330638	4554098	32	32
1391	Non-Participating	330717	4554031	33	32
1392	Non-Participating	330694	4553999	33	33
1393	Non-Participating	330683	4553919	33	33
1394	Non-Participating	330709	4553914	33	33
1395	Non-Participating	330705	4553890	33	33
1396	Non-Participating	330678	4553890	33	33
1397	Non-Participating	330749	4554031	33	33
1398	Non-Participating	330772	4554050	33	33
1399	Non-Participating	330686	4554073	32	32
1400	Non-Participating	330683	4554031	33	32
1401	Non-Participating	330745	4554122	32	32
1402	Non-Participating	330824	4554234	32	32
1403	Non-Participating	330770	4554176	32	32
1404	Non-Participating	330778	4554226	32	32
1405	Non-Participating	330780	4554256	32	32
1406	Non-Participating	330746	4554263	32	32

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1407	Non-Participating	330723	4554268	32	32
1408	Non-Participating	330694	4554270	32	32
1409	Non-Participating	330691	4554252	32	32
1410	Non-Participating	330683	4554229	32	32
1411	Non-Participating	330694	4554200	32	32
1412	Non-Participating	330688	4554164	32	32
1413	Non-Participating	330720	4554161	32	32
1414	Non-Participating	330648	4554168	32	32
1415	Non-Participating	330650	4554192	32	32
1416	Non-Participating	330650	4554211	32	32
1417	Non-Participating	330606	4554200	32	32
1418	Non-Participating	330603	4554166	32	32
1419	Non-Participating	330547	4554175	32	32
1420	Non-Participating	330552	4554195	32	32
1421	Non-Participating	330563	4554214	32	32
1422	Non-Participating	330607	4554233	32	32
1423	Non-Participating	330644	4554230	32	32
1424	Non-Participating	330648	4554276	32	32
1425	Non-Participating	330649	4554249	32	32
1426	Non-Participating	330605	4554252	32	32
1427	Non-Participating	330547	4554255	32	32
1428	Non-Participating	330552	4554278	32	32
1429	Non-Participating	330581	4554278	32	32
1430	Non-Participating	330504	4554171	32	32
1431	Non-Participating	330505	4554209	32	32
1432	Non-Participating	330559	4554310	32	32
1433	Non-Participating	330590	4554345	32	32
1434	Non-Participating	330547	4554400	32	31
1435	Non-Participating	330650	4554404	32	32
1436	Non-Participating	330646	4554324	32	32
1437	Non-Participating	330643	4554380	32	32
1438	Non-Participating	330703	4554321	32	32
1439	Non-Participating	330696	4554365	32	32
1440	Non-Participating	330694	4554395	32	32
1441	Non-Participating	330775	4554401	32	32
1442	Non-Participating	330776	4554347	32	32
1443	Non-Participating	330726	4554343	32	32

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1444	Non-Participating	330783	4554299	32	32
1445	Non-Participating	330918	4554315	32	32
1446	Non-Participating	330827	4554304	32	32
1447	Non-Participating	330822	4554408	32	32
1448	Non-Participating	330852	4554402	32	32
1449	Non-Participating	330916	4554399	32	32
1450	Non-Participating	330920	4554363	32	32
1451	Non-Participating	330892	4554363	32	32
1452	Non-Participating	330971	4554388	32	32
1453	Non-Participating	330959	4554363	32	32
1454	Non-Participating	330995	4554333	32	32
1455	Non-Participating	331026	4554396	32	32
1456	Non-Participating	331050	4554381	32	32
1457	Non-Participating	331021	4554267	33	32
1458	Non-Participating	330859	4554186	32	32
1459	Non-Participating	330848	4554106	33	33
1460	Non-Participating	330481	4553914	33	32
1461	Non-Participating	330618	4553922	33	33
1462	Non-Participating	330539	4553919	33	33
1463	Non-Participating	330436	4553931	32	32
1464	Non-Participating	330644	4553875	33	33
1465	Non-Participating	330615	4553845	33	33
1466	Non-Participating	330277	4554137	32	32
1467	Non-Participating	330696	4554473	32	31
1468	Non-Participating	330706	4554500	32	31
1469	Non-Participating	330730	4554525	32	31
1470	Non-Participating	330788	4554529	32	31
1471	Non-Participating	330783	4554477	32	32
1472	Non-Participating	330754	4554446	32	32
1473	Non-Participating	330709	4554438	32	32
1474	Non-Participating	330825	4554444	32	32
1475	Non-Participating	330878	4554439	32	32
1476	Non-Participating	330923	4554441	32	32
1477	Non-Participating	330924	4554472	32	32
1478	Non-Participating	330830	4554478	32	32
1479	Non-Participating	330827	4554504	32	32
1480	Non-Participating	330825	4554533	32	32

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1481	Non-Participating	331267	4554511	32	32
1482	Non-Participating	332352	4553004	39	39
1483	Non-Participating	343910	4553445	34	34
1484	Non-Participating	343959	4553442	34	34
1485	Non-Participating	344387	4553326	33	33
1486	Non-Participating	344372	4553276	33	33
1487	Non-Participating	344316	4553183	34	34
1488	Non-Participating	345304	4553216	31	31
1489	Non-Participating	345411	4553503	30	30
1490	Non-Participating	345408	4553911	30	30
1491	Non-Participating	345832	4554130	28	28
1492	Non-Participating	346642	4552561	29	29
1493	Non-Participating	342899	4551467	42	42
1494	Participating	341544	4551116	43	43
1495	Non-Participating	339980	4551421	45	45
1496	Participating	337687	4552642	**52**	51
1497	Non-Participating	335836	4551191	45	45
1498	Participating	334639	4551301	50	50
1499	Participating	332347	4552611	41	41
1500	Non-Participating	332250	4552338	42	42
1501	Participating	332672	4551329	47	47
1502	Non-Participating	324238	4550455	33	33
1503	Non-Participating	323506	4549874	33	33
1504	Non-Participating	323408	4549871	33	33
1505	Non-Participating	327436	4549877	39	39
1506	Non-Participating	330685	4549765	45	45
1507	Non-Participating	329846	4549767	46	46
1508	Participating	333016	4549766	42	42
1509	Participating	333362	4549723	43	43
1510	Participating	333778	4549703	45	44
1511	Non-Participating	336566	4549628	46	46
1512	Non-Participating	336519	4551173	49	49
1513	Participating	339326	4549536	48	48
1514	Non-Participating	342126	4549861	42	42
1515	Non-Participating	342167	4549891	42	42
1516	Non-Participating	342204	4549829	42	42
1517	Non-Participating	342194	4549811	42	42

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1518	Non-Participating	342183	4549770	42	42
1519	Non-Participating	342214	4549848	42	42
1520	Non-Participating	342219	4549868	42	42
1521	Non-Participating	342231	4549891	42	42
1522	Non-Participating	342242	4549911	42	42
1523	Non-Participating	342397	4549892	42	42
1524	Non-Participating	342349	4549889	42	42
1525	Non-Participating	342305	4549914	42	42
1526	Non-Participating	342276	4549883	42	42
1527	Non-Participating	342246	4549815	42	42
1528	Non-Participating	342250	4549794	42	42
1529	Non-Participating	342240	4549768	42	42
1530	Non-Participating	342258	4549735	42	42
1531	Non-Participating	342192	4549669	43	42
1532	Non-Participating	342178	4549621	43	43
1533	Non-Participating	342156	4549704	42	42
1534	Non-Participating	342143	4549726	42	42
1535	Non-Participating	342104	4549763	42	42
1536	Non-Participating	342210	4549928	41	41
1537	Non-Participating	342204	4549901	42	42
1538	Non-Participating	345159	4550116	40	40
1539	Non-Participating	345296	4550172	39	39
1540	Non-Participating	346533	4548289	42	42
1541	Non-Participating	341762	4547819	40	40
1542	Non-Participating	341731	4547798	40	40
1543	Non-Participating	341711	4547811	40	40
1544	Non-Participating	341685	4547820	40	40
1545	Non-Participating	341651	4547832	40	40
1546	Non-Participating	341638	4547808	40	40
1547	Non-Participating	341599	4547814	40	40
1548	Non-Participating	341580	4547817	40	40
1549	Non-Participating	341555	4547821	40	40
1550	Non-Participating	341524	4547808	40	40
1551	Non-Participating	341498	4547823	40	40
1552	Non-Participating	341491	4547795	40	40
1553	Non-Participating	341447	4547812	40	40
1554	Non-Participating	341458	4547847	40	40

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1555	Non-Participating	341420	4547860	40	40
1556	Non-Participating	341382	4547842	40	40
1557	Non-Participating	341360	4547858	40	40
1558	Non-Participating	341339	4547863	40	40
1559	Non-Participating	341320	4547869	40	40
1560	Non-Participating	341293	4547880	40	40
1561	Non-Participating	341265	4547887	40	40
1562	Non-Participating	341281	4547927	40	40
1563	Non-Participating	341289	4547949	41	41
1564	Non-Participating	341324	4547951	41	41
1565	Non-Participating	341390	4547903	40	40
1566	Non-Participating	341359	4547941	41	41
1567	Non-Participating	341396	4547943	41	41
1568	Non-Participating	341430	4547972	41	41
1569	Non-Participating	341433	4548033	41	41
1570	Non-Participating	341413	4548141	42	42
1571	Non-Participating	341457	4548138	42	42
1572	Non-Participating	341480	4548173	42	42
1573	Non-Participating	341429	4547885	40	40
1574	Non-Participating	341472	4547885	40	40
1575	Non-Participating	341478	4547904	40	40
1576	Non-Participating	341455	4547940	41	41
1577	Non-Participating	341469	4547961	41	41
1578	Non-Participating	341496	4547959	41	41
1579	Non-Participating	341490	4547936	41	41
1580	Non-Participating	341503	4547975	41	41
1581	Non-Participating	341551	4547950	41	41
1582	Non-Participating	341542	4547924	41	41
1583	Non-Participating	341537	4547902	40	40
1584	Non-Participating	341530	4547863	40	40
1585	Non-Participating	341571	4547865	40	40
1586	Non-Participating	341592	4547864	40	40
1587	Non-Participating	341616	4547861	40	40
1588	Non-Participating	341628	4547905	40	40
1589	Non-Participating	341634	4547925	41	41
1590	Non-Participating	341593	4547925	41	41
1591	Non-Participating	341674	4547866	40	40

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1592	Non-Participating	341706	4547894	40	40
1593	Non-Participating	341727	4547865	40	40
1594	Non-Participating	341781	4547867	40	40
1595	Non-Participating	341801	4547949	41	41
1596	Non-Participating	341810	4548002	41	41
1597	Non-Participating	341839	4548007	41	41
1598	Non-Participating	341808	4548057	41	41
1599	Non-Participating	341725	4548033	41	41
1600	Non-Participating	341696	4547981	41	41
1601	Non-Participating	341680	4547926	41	41
1602	Non-Participating	341651	4547940	41	41
1603	Non-Participating	341611	4547956	41	41
1604	Non-Participating	341666	4548000	41	41
1605	Non-Participating	341636	4548007	41	41
1606	Non-Participating	341602	4547984	41	41
1607	Non-Participating	341571	4547989	41	41
1608	Non-Participating	341578	4548015	41	41
1609	Non-Participating	341576	4548040	41	41
1610	Non-Participating	341515	4547993	41	41
1611	Non-Participating	341520	4548011	41	41
1612	Non-Participating	341531	4548028	41	41
1613	Non-Participating	341489	4548045	41	41
1614	Non-Participating	341507	4548073	42	42
1615	Non-Participating	341553	4548096	42	42
1616	Non-Participating	341598	4548059	41	41
1617	Non-Participating	341604	4548080	42	42
1618	Non-Participating	341627	4548076	42	42
1619	Non-Participating	341670	4548030	41	41
1620	Non-Participating	341677	4548057	41	41
1621	Non-Participating	341614	4548107	42	42
1622	Non-Participating	341614	4548134	42	42
1623	Non-Participating	341560	4548120	42	42
1624	Non-Participating	341563	4548143	42	42
1625	Non-Participating	341573	4548168	42	42
1626	Non-Participating	341566	4548212	43	43
1627	Participating	341526	4548250	43	43
1628	Non-Participating	341632	4548157	42	42

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1629	Non-Participating	341639	4548183	42	42
1630	Non-Participating	341640	4548205	42	42
1631	Non-Participating	341728	4548177	42	42
1632	Non-Participating	341719	4548159	42	42
1633	Non-Participating	341718	4548131	42	42
1634	Non-Participating	341733	4548101	42	42
1635	Non-Participating	341750	4548127	42	42
1636	Non-Participating	341761	4548161	42	42
1637	Non-Participating	341734	4548215	42	42
1638	Non-Participating	341671	4548235	43	43
1639	Non-Participating	341603	4548251	43	43
1640	Non-Participating	341622	4548284	43	43
1641	Non-Participating	341627	4548305	43	43
1642	Non-Participating	341635	4548319	44	43
1643	Non-Participating	341639	4548340	44	44
1644	Non-Participating	341653	4548360	44	44
1645	Non-Participating	341662	4548269	43	43
1646	Non-Participating	341731	4548261	43	43
1647	Non-Participating	341770	4548294	43	43
1648	Non-Participating	341783	4548332	43	43
1649	Non-Participating	341777	4548369	43	43
1650	Non-Participating	341735	4548324	43	43
1651	Non-Participating	341739	4548344	43	43
1652	Non-Participating	341749	4548376	44	44
1653	Non-Participating	341685	4548318	43	43
1654	Non-Participating	341675	4548298	43	43
1655	Non-Participating	341710	4548339	43	43
1656	Non-Participating	341834	4548291	43	43
1657	Non-Participating	341241	4547855	40	40
1658	Non-Participating	341228	4547826	40	40
1659	Non-Participating	341282	4547837	40	40
1660	Non-Participating	341309	4547824	40	40
1661	Non-Participating	341349	4547817	40	40
1662	Non-Participating	340772	4548112	41	41
1663	Non-Participating	340760	4547903	39	39
1664	Non-Participating	340941	4547824	39	39
1665	Non-Participating	341018	4547767	39	39

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1666	Non-Participating	330665	4549577	47	47
1667	Non-Participating	329313	4548221	46	46
1668	Non-Participating	326307	4548233	47	47
1669	Participating	325071	4548101	41	41
1670	Non-Participating	322586	4548701	35	35
1671	Non-Participating	322555	4549471	33	33
1672	Non-Participating	321420	4548294	34	34
1673	Non-Participating	321224	4548819	33	33
1674	Non-Participating	320871	4549149	31	31
1675	Non-Participating	320969	4549313	31	31
1676	Non-Participating	320772	4548167	33	33
1677	Non-Participating	320720	4548189	33	33
1678	Participating	327701	4546799	48	48
1679	Non-Participating	330111	4546547	44	44
1680	Non-Participating	330128	4546545	44	44
1681	Non-Participating	330166	4546546	44	44
1682	Non-Participating	330195	4546544	44	44
1683	Non-Participating	330223	4546543	43	43
1684	Non-Participating	330263	4546535	43	43
1685	Non-Participating	330289	4546534	43	43
1686	Non-Participating	330314	4546537	43	43
1687	Non-Participating	330343	4546534	43	43
1688	Non-Participating	330369	4546533	42	42
1689	Non-Participating	330391	4546533	42	42
1690	Non-Participating	330424	4546529	42	42
1691	Non-Participating	330466	4546525	42	42
1692	Non-Participating	330494	4546525	42	42
1693	Non-Participating	330520	4546522	42	42
1694	Non-Participating	330535	4546522	41	41
1695	Non-Participating	330576	4546519	41	41
1696	Non-Participating	330607	4546513	41	41
1697	Non-Participating	330622	4546529	41	41
1698	Non-Participating	330580	4546558	41	41
1699	Non-Participating	330344	4546575	42	42
1700	Non-Participating	330311	4546570	43	43
1701	Non-Participating	330307	4546634	42	42
1702	Non-Participating	330350	4546604	42	42

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1703	Non-Participating	330306	4546664	42	42
1704	Non-Participating	330354	4546763	41	41
1705	Non-Participating	330426	4546762	41	41
1706	Non-Participating	330429	4546695	41	41
1707	Non-Participating	330411	4546861	41	41
1708	Non-Participating	330464	4546695	41	41
1709	Non-Participating	330507	4546760	41	41
1710	Non-Participating	330542	4546771	41	41
1711	Non-Participating	330570	4546767	40	40
1712	Non-Participating	330594	4546807	40	40
1713	Non-Participating	330477	4546806	41	41
1714	Non-Participating	330614	4546693	40	40
1715	Non-Participating	330615	4546747	40	40
1716	Non-Participating	330476	4546617	41	41
1717	Non-Participating	330471	4546584	42	42
1718	Non-Participating	330419	4546573	42	42
1719	Non-Participating	330617	4546582	41	41
1720	Non-Participating	330617	4546604	41	41
1721	Non-Participating	330622	4546644	41	40
1722	Non-Participating	330625	4546668	40	40
1723	Non-Participating	330668	4546724	40	40
1724	Non-Participating	330665	4546674	40	40
1725	Non-Participating	330744	4546768	40	40
1726	Non-Participating	330771	4546769	39	39
1727	Non-Participating	330817	4546767	39	39
1728	Non-Participating	330852	4546762	39	39
1729	Non-Participating	330793	4546818	39	39
1730	Non-Participating	330752	4546816	39	39
1731	Non-Participating	330681	4546812	40	40
1732	Non-Participating	331192	4546613	38	38
1733	Non-Participating	331170	4546626	38	38
1734	Non-Participating	331151	4546638	38	38
1735	Non-Participating	331135	4546661	38	38
1736	Non-Participating	331291	4546535	38	38
1737	Non-Participating	330530	4546659	41	41
1738	Non-Participating	330459	4546656	41	41
1739	Non-Participating	330310	4546770	42	42

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1740	Non-Participating	330805	4546706	39	39
1741	Non-Participating	330854	4546705	39	39
1742	Non-Participating	330855	4546670	39	39
1743	Non-Participating	330856	4546650	39	39
1744	Non-Participating	330854	4546629	39	39
1745	Non-Participating	330854	4546611	39	39
1746	Non-Participating	330859	4546586	39	39
1747	Non-Participating	330861	4546542	39	39
1748	Non-Participating	330860	4546511	40	40
1749	Non-Participating	330839	4546510	40	40
1750	Non-Participating	330823	4546508	40	40
1751	Non-Participating	330755	4546517	40	40
1752	Non-Participating	330719	4546512	40	40
1753	Non-Participating	330706	4546541	40	40
1754	Non-Participating	330659	4546536	41	41
1755	Non-Participating	330660	4546574	41	40
1756	Non-Participating	330664	4546602	40	40
1757	Non-Participating	330667	4546629	40	40
1758	Non-Participating	330889	4546514	39	39
1759	Non-Participating	330907	4546503	39	39
1760	Non-Participating	330926	4546504	39	39
1761	Non-Participating	330923	4546533	39	39
1762	Non-Participating	330888	4546533	39	39
1763	Non-Participating	330887	4546597	39	39
1764	Non-Participating	330912	4546563	39	39
1765	Non-Participating	330929	4546590	39	39
1766	Non-Participating	330924	4546621	39	39
1767	Non-Participating	330925	4546645	39	39
1768	Non-Participating	330890	4546670	39	39
1769	Non-Participating	330928	4546673	39	39
1770	Non-Participating	330959	4546679	39	39
1771	Non-Participating	330956	4546638	39	39
1772	Non-Participating	330955	4546607	39	39
1773	Non-Participating	330955	4546586	39	39
1774	Non-Participating	330956	4546558	39	39
1775	Non-Participating	330999	4546562	39	39
1776	Non-Participating	331022	4546577	39	39

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1777	Non-Participating	331022	4546627	39	39
1778	Non-Participating	330978	4546504	39	39
1779	Non-Participating	330946	4546504	39	39
1780	Non-Participating	331009	4546500	39	39
1781	Non-Participating	331058	4546535	39	39
1782	Non-Participating	331050	4546506	39	39
1783	Non-Participating	331078	4546523	38	38
1784	Non-Participating	331100	4546524	38	38
1785	Non-Participating	331063	4546495	39	39
1786	Non-Participating	331078	4546500	38	38
1787	Non-Participating	331103	4546494	38	38
1788	Non-Participating	331143	4546491	38	38
1789	Non-Participating	331161	4546490	38	38
1790	Non-Participating	331189	4546493	38	38
1791	Non-Participating	331135	4546536	38	38
1792	Non-Participating	330785	4546550	40	40
1793	Non-Participating	332700	4547111	35	35
1794	Non-Participating	340767	4546325	34	34
1795	Non-Participating	340798	4546306	34	34
1796	Non-Participating	340766	4546265	34	34
1797	Non-Participating	340703	4546276	34	34
1798	Non-Participating	340820	4546239	34	34
1799	Non-Participating	340898	4546260	34	34
1800	Non-Participating	340926	4546210	34	34
1801	Non-Participating	340968	4546219	34	34
1802	Non-Participating	340907	4546302	34	34
1803	Non-Participating	340938	4546291	34	34
1804	Non-Participating	340965	4546265	34	34
1805	Non-Participating	341008	4546250	34	34
1806	Non-Participating	340995	4546317	34	34
1807	Non-Participating	341220	4546872	36	36
1808	Non-Participating	341089	4546931	36	36
1809	Non-Participating	341143	4547051	36	36
1810	Non-Participating	341182	4547096	37	37
1811	Non-Participating	341186	4547119	37	37
1812	Non-Participating	341195	4547151	37	37
1813	Non-Participating	341215	4547205	37	37

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1814	Non-Participating	342290	4547061	38	38
1815	Non-Participating	342255	4547074	38	38
1816	Non-Participating	342205	4547096	38	38
1817	Non-Participating	342176	4547117	38	38
1818	Non-Participating	342130	4547143	38	38
1819	Non-Participating	342339	4547091	39	39
1820	Non-Participating	342312	4547117	39	39
1821	Non-Participating	342291	4547123	39	39
1822	Non-Participating	342262	4547134	39	39
1823	Non-Participating	342214	4547158	39	39
1824	Non-Participating	342142	4547193	39	38
1825	Non-Participating	342117	4547202	38	38
1826	Non-Participating	342088	4547213	38	38
1827	Non-Participating	342061	4547226	38	38
1828	Non-Participating	342101	4547292	39	39
1829	Non-Participating	342133	4547270	39	39
1830	Non-Participating	342176	4547255	39	39
1831	Non-Participating	342222	4547227	39	39
1832	Non-Participating	342265	4547195	39	39
1833	Non-Participating	341913	4547186	38	38
1834	Non-Participating	341861	4547204	38	38
1835	Non-Participating	341796	4547170	38	38
1836	Non-Participating	342023	4547245	38	38
1837	Non-Participating	342018	4547300	39	39
1838	Non-Participating	341222	4547259	37	37
1839	Non-Participating	341263	4547321	37	37
1840	Non-Participating	341270	4547354	38	38
1841	Non-Participating	341820	4547207	38	38
1842	Non-Participating	341918	4547225	38	38
1843	Non-Participating	341979	4547255	38	38
1844	Non-Participating	341967	4547220	38	38
1845	Non-Participating	342010	4547172	38	38
1846	Non-Participating	342007	4547207	38	38
1847	Non-Participating	341120	4547769	39	39
1848	Non-Participating	341129	4547751	39	39
1849	Non-Participating	341156	4547748	39	39
1850	Non-Participating	341177	4547729	39	39

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1851	Non-Participating	341215	4547709	39	39
1852	Non-Participating	341236	4547706	39	39
1853	Non-Participating	341252	4547700	39	39
1854	Non-Participating	341276	4547689	39	39
1855	Non-Participating	341299	4547676	39	39
1856	Non-Participating	341326	4547672	39	39
1857	Non-Participating	341173	4547789	40	39
1858	Non-Participating	341182	4547784	39	39
1859	Non-Participating	341197	4547779	39	39
1860	Non-Participating	341246	4547761	39	39
1861	Non-Participating	341252	4547788	40	40
1862	Non-Participating	341272	4547776	40	39
1863	Non-Participating	341288	4547737	39	39
1864	Non-Participating	341309	4547729	39	39
1865	Non-Participating	341330	4547722	39	39
1866	Non-Participating	341343	4547778	40	40
1867	Non-Participating	341373	4547803	40	40
1868	Non-Participating	341351	4547744	39	39
1869	Non-Participating	341397	4547689	39	39
1870	Non-Participating	341421	4547748	40	39
1871	Non-Participating	341433	4547775	40	40
1872	Non-Participating	341470	4547742	40	39
1873	Non-Participating	341471	4547677	39	39
1874	Non-Participating	341503	4547655	39	39
1875	Non-Participating	341528	4547643	39	39
1876	Non-Participating	341543	4547683	39	39
1877	Non-Participating	341545	4547706	39	39
1878	Non-Participating	341563	4547727	40	39
1879	Non-Participating	341536	4547782	40	40
1880	Non-Participating	341562	4547775	40	40
1881	Non-Participating	341587	4547761	40	40
1882	Non-Participating	341613	4547755	40	40
1883	Non-Participating	341794	4547759	40	40
1884	Non-Participating	341784	4547733	40	40
1885	Non-Participating	341705	4547567	39	39
1886	Non-Participating	341716	4547559	39	39
1887	Non-Participating	341736	4547542	39	39

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1888	Non-Participating	341752	4547541	39	39
1889	Non-Participating	341767	4547534	39	39
1890	Non-Participating	341790	4547528	39	39
1891	Non-Participating	341803	4547520	39	39
1892	Non-Participating	341836	4547496	39	39
1893	Non-Participating	341678	4547527	39	39
1894	Non-Participating	341695	4547513	39	39
1895	Non-Participating	341716	4547510	39	39
1896	Non-Participating	341735	4547496	39	39
1897	Non-Participating	341756	4547487	39	39
1898	Non-Participating	341769	4547477	39	39
1899	Non-Participating	341786	4547474	39	39
1900	Non-Participating	341809	4547465	39	39
1901	Non-Participating	341748	4547409	38	38
1902	Non-Participating	341716	4547422	38	38
1903	Non-Participating	341662	4547424	38	38
1904	Non-Participating	341637	4547413	38	38
1905	Non-Participating	341673	4547593	39	39
1906	Non-Participating	341650	4547614	39	39
1907	Non-Participating	341602	4547610	39	39
1908	Non-Participating	341567	4547624	39	39
1909	Non-Participating	341581	4547662	39	39
1910	Non-Participating	341621	4547641	39	39
1911	Non-Participating	341588	4547694	39	39
1912	Non-Participating	341595	4547714	39	39
1913	Non-Participating	341625	4547707	39	39
1914	Non-Participating	341654	4547694	39	39
1915	Non-Participating	341711	4547671	39	39
1916	Non-Participating	341698	4547651	39	39
1917	Non-Participating	341628	4547670	39	39
1918	Non-Participating	341632	4547751	40	40
1919	Non-Participating	341649	4547744	40	40
1920	Non-Participating	341696	4547725	40	40
1921	Non-Participating	341721	4547709	40	40
1922	Non-Participating	341738	4547737	40	40
1923	Non-Participating	341687	4547778	40	40
1924	Non-Participating	341739	4547773	40	40

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1925	Non-Participating	341381	4547645	39	39
1926	Non-Participating	341452	4547622	39	39
1927	Non-Participating	341502	4547606	39	39
1928	Non-Participating	341518	4547602	39	39
1929	Non-Participating	341541	4547553	39	39
1930	Non-Participating	341558	4547580	39	39
1931	Non-Participating	341575	4547556	39	39
1932	Non-Participating	341593	4547533	39	39
1933	Non-Participating	341607	4547561	39	39
1934	Non-Participating	341588	4547581	39	39
1935	Non-Participating	341643	4547546	39	39
1936	Non-Participating	341242	4547472	38	38
1937	Non-Participating	341217	4547478	38	38
1938	Non-Participating	341227	4547433	38	38
1939	Non-Participating	341154	4547351	37	37
1940	Non-Participating	341231	4547360	38	38
1941	Non-Participating	341312	4547329	38	38
1942	Non-Participating	341315	4547350	38	38
1943	Non-Participating	341327	4547366	38	38
1944	Non-Participating	341361	4547352	38	38
1945	Non-Participating	341408	4547286	37	37
1946	Non-Participating	341419	4547241	37	37
1947	Non-Participating	341449	4547236	37	37
1948	Non-Participating	341477	4547235	37	37
1949	Non-Participating	341526	4547229	37	37
1950	Non-Participating	341563	4547235	38	37
1951	Non-Participating	341645	4547300	38	38
1952	Non-Participating	341646	4547350	38	38
1953	Non-Participating	341608	4547351	38	38
1954	Non-Participating	341581	4547350	38	38
1955	Non-Participating	341556	4547349	38	38
1956	Non-Participating	341521	4547349	38	38
1957	Non-Participating	341488	4547351	38	38
1958	Non-Participating	341455	4547350	38	38
1959	Non-Participating	341454	4547293	38	37
1960	Non-Participating	341494	4547291	38	38
1961	Non-Participating	341518	4547286	38	38

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1962	Non-Participating	341546	4547289	38	38
1963	Non-Participating	341574	4547289	38	38
1964	Non-Participating	341605	4547291	38	38
1965	Non-Participating	341404	4547330	38	38
1966	Non-Participating	341403	4547371	38	38
1967	Non-Participating	341338	4547397	38	38
1968	Non-Participating	341338	4547420	38	38
1969	Non-Participating	341369	4547402	38	38
1970	Non-Participating	341354	4547435	38	38
1971	Non-Participating	341359	4547454	38	38
1972	Non-Participating	341400	4547463	38	38
1973	Non-Participating	341362	4547476	38	38
1974	Non-Participating	341313	4547471	38	38
1975	Non-Participating	341310	4547459	38	38
1976	Non-Participating	341299	4547435	38	38
1977	Non-Participating	341282	4547403	38	38
1978	Non-Participating	341318	4547488	38	38
1979	Non-Participating	341336	4547526	38	38
1980	Non-Participating	341344	4547544	38	38
1981	Non-Participating	341351	4547560	39	39
1982	Non-Participating	341362	4547594	39	39
1983	Non-Participating	341221	4547548	38	38
1984	Non-Participating	341180	4547529	38	38
1985	Non-Participating	341431	4547592	39	39
1986	Non-Participating	341405	4547578	39	39
1987	Non-Participating	341395	4547556	39	39
1988	Non-Participating	341392	4547540	38	38
1989	Non-Participating	341383	4547509	38	38
1990	Non-Participating	341412	4547499	38	38
1991	Non-Participating	341429	4547485	38	38
1992	Non-Participating	341450	4547476	38	38
1993	Non-Participating	341426	4547409	38	38
1994	Non-Participating	341484	4547407	38	38
1995	Non-Participating	341515	4547404	38	38
1996	Non-Participating	341548	4547408	38	38
1997	Non-Participating	341577	4547408	38	38
1998	Non-Participating	341532	4547454	38	38

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
1999	Non-Participating	341507	4547463	38	38
2000	Non-Participating	341490	4547469	38	38
2001	Non-Participating	341528	4547497	38	38
2002	Non-Participating	341556	4547490	38	38
2003	Non-Participating	341546	4547526	39	39
2004	Non-Participating	341480	4547515	38	38
2005	Non-Participating	341464	4547521	38	38
2006	Non-Participating	341427	4547533	39	38
2007	Non-Participating	341592	4547469	38	38
2008	Non-Participating	341616	4547454	38	38
2009	Non-Participating	341638	4547447	38	38
2010	Non-Participating	341675	4547459	38	38
2011	Non-Participating	341585	4547512	39	39
2012	Non-Participating	341626	4547495	39	38
2013	Non-Participating	347112	4547030	38	38
2014	Non-Participating	347126	4546272	36	36
2015	Non-Participating	346164	4545431	35	35
2016	Non-Participating	345996	4545411	36	36
2017	Non-Participating	345002	4545296	36	36
2018	Non-Participating	342626	4545687	35	35
2019	Non-Participating	342905	4545592	35	35
2020	Non-Participating	343559	4545403	36	36
2021	Non-Participating	341306	4545501	33	32
2022	Non-Participating	341486	4545415	32	32
2023	Non-Participating	341590	4545294	32	32
2024	Non-Participating	340597	4545719	32	32
2025	Non-Participating	340472	4545701	32	32
2026	Non-Participating	335330	4545756	32	32
2027	Non-Participating	333786	4545788	33	32
2028	Non-Participating	331097	4545596	39	39
2029	Non-Participating	331336	4545494	37	37
2030	Non-Participating	331522	4545530	37	37
2031	Non-Participating	331236	4545428	38	38
2032	Non-Participating	331130	4546105	39	39
2033	Non-Participating	331104	4546105	39	39
2034	Non-Participating	331062	4546107	39	39
2035	Non-Participating	331049	4546164	39	39

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2036	Non-Participating	331152	4546162	38	38
2037	Non-Participating	331053	4546205	39	39
2038	Non-Participating	331078	4546205	39	39
2039	Non-Participating	331134	4546198	39	39
2040	Non-Participating	331081	4546277	39	39
2041	Non-Participating	331056	4546336	39	39
2042	Non-Participating	331088	4546338	39	39
2043	Non-Participating	331127	4546342	38	38
2044	Non-Participating	331155	4546337	38	38
2045	Non-Participating	331172	4546338	38	38
2046	Non-Participating	331194	4546335	38	38
2047	Non-Participating	331139	4546366	38	38
2048	Non-Participating	331089	4546372	39	39
2049	Non-Participating	331072	4546373	39	39
2050	Non-Participating	331047	4546369	39	39
2051	Non-Participating	331061	4546425	39	39
2052	Non-Participating	331081	4546424	39	39
2053	Non-Participating	331119	4546420	38	38
2054	Non-Participating	331044	4546460	39	39
2055	Non-Participating	331067	4546462	39	39
2056	Non-Participating	331086	4546458	38	38
2057	Non-Participating	331113	4546453	38	38
2058	Non-Participating	331175	4546449	38	38
2059	Non-Participating	331195	4546450	38	38
2060	Non-Participating	331221	4546422	38	38
2061	Non-Participating	331220	4546390	38	38
2062	Non-Participating	331225	4546349	38	38
2063	Non-Participating	331221	4546324	38	38
2064	Non-Participating	330921	4545711	40	40
2065	Non-Participating	330852	4545706	41	41
2066	Non-Participating	330801	4545705	41	41
2067	Non-Participating	330962	4545740	40	40
2068	Non-Participating	330688	4545718	42	42
2069	Non-Participating	330646	4545706	42	42
2070	Non-Participating	330650	4545741	42	42
2071	Non-Participating	330642	4545772	42	42
2072	Non-Participating	330677	4545749	42	42

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2073	Non-Participating	330584	4545718	43	43
2074	Non-Participating	330565	4545817	43	43
2075	Non-Participating	330641	4545815	42	42
2076	Non-Participating	330671	4545861	42	42
2077	Non-Participating	330650	4545900	42	42
2078	Non-Participating	330651	4545979	42	42
2079	Non-Participating	330751	4545946	41	41
2080	Non-Participating	330819	4545872	41	41
2081	Non-Participating	330822	4545830	41	41
2082	Non-Participating	330851	4545827	41	41
2083	Non-Participating	330874	4545824	40	40
2084	Non-Participating	330906	4545825	40	40
2085	Non-Participating	330955	4545815	40	40
2086	Non-Participating	330877	4545873	40	40
2087	Non-Participating	330908	4545870	40	40
2088	Non-Participating	330999	4545864	40	40
2089	Non-Participating	330875	4545933	40	40
2090	Non-Participating	330889	4546017	40	40
2091	Non-Participating	330924	4546017	40	40
2092	Non-Participating	330951	4546015	40	40
2093	Non-Participating	331009	4546007	39	39
2094	Non-Participating	330888	4546153	40	40
2095	Non-Participating	330966	4546157	40	40
2096	Non-Participating	331012	4546166	39	39
2097	Non-Participating	331013	4546219	39	39
2098	Non-Participating	330987	4546209	39	39
2099	Non-Participating	330955	4546206	40	39
2100	Non-Participating	330932	4546207	40	40
2101	Non-Participating	330913	4546239	40	40
2102	Non-Participating	330885	4546259	40	40
2103	Non-Participating	330887	4546291	40	40
2104	Non-Participating	331002	4546257	39	39
2105	Non-Participating	331001	4546291	39	39
2106	Non-Participating	331009	4546344	39	39
2107	Non-Participating	330936	4546344	39	39
2108	Non-Participating	330892	4546379	40	40
2109	Non-Participating	330892	4546410	40	40

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2110	Non-Participating	331003	4546372	39	39
2111	Non-Participating	331023	4546443	39	39
2112	Non-Participating	331002	4546464	39	39
2113	Non-Participating	330980	4546465	39	39
2114	Non-Participating	330964	4546466	39	39
2115	Non-Participating	330935	4546453	39	39
2116	Non-Participating	330890	4546463	39	39
2117	Non-Participating	330831	4546460	40	40
2118	Non-Participating	330790	4546470	40	40
2119	Non-Participating	330755	4546467	40	40
2120	Non-Participating	330755	4546418	40	40
2121	Non-Participating	330759	4546386	40	40
2122	Non-Participating	330814	4546362	40	40
2123	Non-Participating	330840	4546379	40	40
2124	Non-Participating	330769	4546364	40	40
2125	Non-Participating	330756	4546337	41	41
2126	Non-Participating	330796	4546325	40	40
2127	Non-Participating	330754	4546283	41	41
2128	Non-Participating	330756	4546258	41	41
2129	Non-Participating	330751	4546230	41	41
2130	Non-Participating	330750	4546197	41	41
2131	Non-Participating	330792	4546200	41	41
2132	Non-Participating	330845	4546220	40	40
2133	Non-Participating	330838	4546177	40	40
2134	Non-Participating	330804	4546169	41	41
2135	Non-Participating	330751	4546178	41	41
2136	Non-Participating	330743	4546148	41	41
2137	Non-Participating	330749	4546104	41	41
2138	Non-Participating	330711	4546121	41	41
2139	Non-Participating	330693	4546122	41	41
2140	Non-Participating	330672	4546118	42	42
2141	Non-Participating	330652	4546122	42	42
2142	Non-Participating	330711	4546136	41	41
2143	Non-Participating	330716	4546172	41	41
2144	Non-Participating	330716	4546217	41	41
2145	Non-Participating	330686	4546252	41	41
2146	Non-Participating	330720	4546257	41	41

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2147	Non-Participating	330723	4546286	41	41
2148	Non-Participating	330722	4546317	41	41
2149	Non-Participating	330723	4546362	41	41
2150	Non-Participating	330716	4546380	41	41
2151	Non-Participating	330725	4546409	41	41
2152	Non-Participating	330727	4546473	40	40
2153	Non-Participating	330663	4546473	41	41
2154	Non-Participating	330665	4546431	41	41
2155	Non-Participating	330658	4546403	41	41
2156	Non-Participating	330658	4546384	41	41
2157	Non-Participating	330653	4546315	41	41
2158	Non-Participating	330701	4546312	41	41
2159	Non-Participating	330655	4546285	41	41
2160	Non-Participating	330655	4546261	41	41
2161	Non-Participating	330653	4546250	41	41
2162	Non-Participating	330650	4546220	42	42
2163	Non-Participating	330675	4546226	41	41
2164	Non-Participating	330652	4546187	42	42
2165	Non-Participating	330445	4546211	43	43
2166	Non-Participating	330464	4546288	43	43
2167	Non-Participating	330487	4546290	43	43
2168	Non-Participating	330505	4546291	43	43
2169	Non-Participating	330550	4546290	42	42
2170	Non-Participating	330610	4546285	42	42
2171	Non-Participating	330537	4546222	43	42
2172	Non-Participating	330531	4546154	43	43
2173	Non-Participating	330500	4546147	43	43
2174	Non-Participating	330580	4546145	42	42
2175	Non-Participating	330603	4546144	42	42
2176	Non-Participating	330610	4546178	42	42
2177	Non-Participating	330609	4546209	42	42
2178	Non-Participating	330611	4546231	42	42
2179	Non-Participating	330443	4546247	43	43
2180	Non-Participating	330603	4546317	42	42
2181	Non-Participating	330614	4546329	42	42
2182	Non-Participating	330616	4546353	41	41
2183	Non-Participating	330610	4546383	41	41

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2184	Non-Participating	330560	4546321	42	42
2185	Non-Participating	330570	4546351	42	42
2186	Non-Participating	330572	4546377	42	42
2187	Non-Participating	330539	4546380	42	42
2188	Non-Participating	330515	4546315	42	42
2189	Non-Participating	330512	4546343	42	42
2190	Non-Participating	330505	4546366	42	42
2191	Non-Participating	330462	4546377	43	43
2192	Non-Participating	330516	4546418	42	42
2193	Non-Participating	330521	4546448	42	42
2194	Non-Participating	330547	4546473	42	42
2195	Non-Participating	330560	4546410	42	42
2196	Non-Participating	330618	4546466	41	41
2197	Non-Participating	330525	4546479	42	42
2198	Non-Participating	330497	4546481	42	42
2199	Non-Participating	330476	4546482	42	42
2200	Non-Participating	330454	4546484	42	42
2201	Non-Participating	330469	4546408	42	42
2202	Non-Participating	330251	4546381	44	44
2203	Non-Participating	330295	4546407	44	44
2204	Non-Participating	330298	4546475	43	43
2205	Non-Participating	330189	4546484	44	44
2206	Non-Participating	330147	4546488	44	44
2207	Non-Participating	330221	4546484	44	44
2208	Non-Participating	330336	4546491	43	43
2209	Non-Participating	330353	4546491	43	43
2210	Non-Participating	330374	4546487	43	43
2211	Non-Participating	330387	4546485	43	43
2212	Non-Participating	330403	4546484	42	42
2213	Non-Participating	330423	4546483	42	42
2214	Non-Participating	330426	4546447	42	42
2215	Non-Participating	330393	4546425	43	43
2216	Non-Participating	330373	4546383	43	43
2217	Non-Participating	330413	4546386	43	43
2218	Non-Participating	330410	4546336	43	43
2219	Non-Participating	330378	4546331	43	43
2220	Non-Participating	326518	4545764	47	47

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2221	Non-Participating	320886	4545682	40	40
2222	Non-Participating	318936	4546046	40	40
2223	Non-Participating	322455	4544016	43	43
2224	Non-Participating	322702	4543825	42	42
2225	Non-Participating	322665	4543823	42	42
2226	Non-Participating	322625	4543826	42	42
2227	Non-Participating	322529	4543827	42	42
2228	Non-Participating	322469	4543863	42	42
2229	Non-Participating	322484	4543819	42	42
2230	Non-Participating	322425	4543802	41	41
2231	Non-Participating	322492	4543783	42	41
2232	Non-Participating	322531	4543727	41	41
2233	Non-Participating	322493	4543709	41	41
2234	Non-Participating	322403	4543696	41	41
2235	Non-Participating	322594	4543785	42	42
2236	Non-Participating	322633	4543720	42	42
2237	Non-Participating	322671	4543713	42	42
2238	Non-Participating	322665	4543688	42	42
2239	Non-Participating	322585	4543719	42	42
2240	Non-Participating	322722	4543714	42	42
2241	Non-Participating	322728	4543755	42	42
2242	Non-Participating	322790	4543773	42	42
2243	Non-Participating	322753	4543787	42	42
2244	Non-Participating	322708	4543643	42	42
2245	Non-Participating	322700	4543606	42	42
2246	Non-Participating	322691	4543582	42	42
2247	Non-Participating	322683	4543560	42	41
2248	Non-Participating	322685	4543530	41	41
2249	Non-Participating	322763	4543572	42	42
2250	Non-Participating	322648	4543596	41	41
2251	Non-Participating	322632	4543660	42	42
2252	Non-Participating	322580	4543640	41	41
2253	Non-Participating	322517	4543616	41	41
2254	Non-Participating	322526	4543641	41	41
2255	Non-Participating	322497	4543658	41	41
2256	Non-Participating	322465	4543663	41	41
2257	Non-Participating	322627	4543476	41	41

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2258	Non-Participating	322622	4543451	41	41
2259	Non-Participating	322721	4543437	42	42
2260	Non-Participating	322669	4543473	41	41
2261	Non-Participating	322673	4543503	41	41
2262	Non-Participating	331160	4544775	37	37
2263	Non-Participating	331487	4543330	33	33
2264	Non-Participating	331118	4541598	31	31
2265	Non-Participating	329985	4541634	34	33
2266	Non-Participating	329901	4541623	34	34
2267	Non-Participating	330937	4540052	29	29
2268	Non-Participating	330349	4539445	30	29
2269	Non-Participating	327246	4539576	38	38
2270	Non-Participating	324100	4539631	39	39
2271	Non-Participating	322912	4539420	35	35
2272	Non-Participating	320108	4539866	30	30
2273	Non-Participating	337331	4556993	33	33
2274	Non-Participating	337394	4557572	32	32
2275	Non-Participating	337446	4557399	32	32
2276	Non-Participating	338722	4557450	33	33
2277	Non-Participating	339010	4557257	34	34
2278	Non-Participating	339757	4556948	35	35
2279	Non-Participating	340323	4556820	34	34
2280	Non-Participating	340634	4557432	31	31
2281	Non-Participating	340529	4557604	31	31
2282	Non-Participating	340938	4557613	30	30
2283	Non-Participating	341523	4557584	29	29
2284	Non-Participating	342072	4557481	28	28
2285	Non-Participating	342237	4557473	28	28
2286	Non-Participating	342237	4557415	28	28
2287	Non-Participating	342432	4557469	28	28
2288	Non-Participating	342570	4557547	27	27
2289	Non-Participating	342969	4557456	27	27
2290	Non-Participating	342315	4557187	29	29
2291	Non-Participating	341848	4557111	30	30
2292	Non-Participating	342307	4556724	30	30
2293	Non-Participating	343286	4556701	28	28
2294	Non-Participating	343389	4556617	28	28

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2295	Non-Participating	343780	4557397	24	24
2296	Non-Participating	344138	4557499	24	24
2297	Non-Participating	344344	4557487	23	23
2298	Non-Participating	344791	4557337	23	23
2299	Non-Participating	344818	4557240	23	23
2300	Non-Participating	344883	4557269	23	23
2301	Non-Participating	344957	4557345	23	23
2302	Non-Participating	344997	4557300	23	23
2303	Non-Participating	345060	4557271	23	23
2304	Non-Participating	345087	4557518	22	22
2305	Non-Participating	345149	4557462	22	22
2306	Non-Participating	344747	4556718	25	25
2307	Non-Participating	344887	4556948	24	24
2308	Non-Participating	344911	4557038	23	23
2309	Non-Participating	344919	4557073	23	23
2310	Non-Participating	344952	4557144	23	23
2311	Non-Participating	344971	4557199	23	23
2312	Non-Participating	344991	4557234	23	23
2313	Non-Participating	345003	4557257	23	23
2314	Non-Participating	344392	4555227	29	29
2315	Non-Participating	346412	4553361	28	28
2316	Non-Participating	346480	4553423	28	28
2317	Non-Participating	347110	4553324	27	27
2318	Non-Participating	346797	4553211	28	28
2319	Non-Participating	347005	4552486	29	29
2320	Non-Participating	347380	4553095	27	27
2321	Non-Participating	347505	4553287	27	27
2322	Non-Participating	347744	4553279	26	26
2323	Non-Participating	347723	4553067	27	27
2324	Non-Participating	347637	4552920	27	27
2325	Non-Participating	347915	4552427	27	27
2326	Non-Participating	347530	4552171	28	28
2327	Non-Participating	347522	4551731	29	29
2328	Non-Participating	347458	4551642	29	29
2329	Non-Participating	347553	4551198	30	30
2330	Non-Participating	347536	4550965	30	30
2331	Non-Participating	347569	4550581	31	31

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2332	Non-Participating	347649	4549667	32	32
2333	Non-Participating	347882	4549729	32	32
2334	Non-Participating	347390	4548580	36	36
2335	Non-Participating	347192	4548177	37	37
2336	Non-Participating	347279	4548142	37	37
2337	Non-Participating	347987	4548179	33	33
2338	Non-Participating	347409	4546740	35	35
2339	Non-Participating	347616	4546701	34	34
2340	Non-Participating	347596	4546613	34	34
2341	Non-Participating	347841	4546703	33	33
2342	Non-Participating	347551	4545322	31	31
2343	Non-Participating	347563	4545244	31	31
2344	Non-Participating	347267	4545382	32	32
2345	Non-Participating	347092	4545329	33	33
2346	Non-Participating	347129	4545259	32	32
2347	Non-Participating	346832	4545423	34	34
2348	Non-Participating	346505	4545442	35	35
2349	Non-Participating	346252	4545318	35	35
2350	Non-Participating	346600	4545312	34	34
2351	Non-Participating	346733	4545285	33	33
2352	Non-Participating	346019	4544931	33	33
2353	Non-Participating	345114	4545361	36	36
2354	Non-Participating	343846	4545312	35	35
2355	Non-Participating	343470	4545269	35	35
2356	Non-Participating	343552	4545294	35	35
2357	Non-Participating	342358	4544614	31	31
2358	Non-Participating	341805	4544822	31	31
2359	Non-Participating	341698	4545003	32	32
2360	Non-Participating	342085	4544440	31	31
2361	Non-Participating	340518	4545376	32	32
2362	Non-Participating	340479	4545275	31	31
2363	Non-Participating	340249	4544890	31	31
2364	Non-Participating	340234	4544666	30	30
2365	Non-Participating	339685	4544705	30	30
2366	Non-Participating	339282	4544705	30	30
2367	Non-Participating	338656	4544649	30	30
2368	Non-Participating	338479	4544913	30	30

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2369	Non-Participating	338553	4545349	31	31
2370	Non-Participating	337627	4544861	30	30
2371	Non-Participating	337158	4544664	30	29
2372	Non-Participating	335485	4545322	31	31
2373	Non-Participating	335371	4544771	30	30
2374	Non-Participating	334307	4545154	31	31
2375	Non-Participating	335065	4545890	32	32
2376	Non-Participating	333182	4545228	32	32
2377	Non-Participating	333774	4544987	31	31
2378	Participating	333867	4545215	32	32
2379	Non-Participating	333838	4544674	31	31
2380	Non-Participating	333480	4544738	31	31
2381	Non-Participating	333429	4544806	31	31
2382	Non-Participating	332883	4544822	32	32
2383	Non-Participating	333783	4545499	32	32
2384	Non-Participating	330558	4545294	43	43
2385	Non-Participating	331784	4543252	32	32
2386	Non-Participating	332200	4543184	31	31
2387	Non-Participating	332299	4543145	31	31
2388	Non-Participating	332052	4543157	32	32
2389	Non-Participating	331556	4543201	33	33
2390	Non-Participating	332083	4542184	30	30
2391	Non-Participating	332064	4541630	30	30
2392	Non-Participating	331716	4541552	30	30
2393	Non-Participating	331620	4541649	30	30
2394	Non-Participating	331319	4541678	31	31
2395	Non-Participating	332570	4541544	28	28
2396	Non-Participating	331780	4540015	28	28
2397	Non-Participating	330887	4539863	29	29
2398	Non-Participating	331480	4539955	28	28
2399	Non-Participating	330453	4538640	28	28
2400	Non-Participating	330323	4538677	29	28
2401	Non-Participating	331935	4538759	26	25
2402	Non-Participating	332015	4538778	25	25
2403	Non-Participating	330959	4538473	27	27
2404	Non-Participating	329823	4538410	29	29
2405	Non-Participating	329321	4538747	30	30

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2406	Non-Participating	328930	4538455	30	30
2407	Non-Participating	327018	4539150	36	36
2408	Non-Participating	325565	4539721	42	42
2409	Non-Participating	325520	4538788	36	36
2410	Non-Participating	325318	4538556	35	35
2411	Non-Participating	324299	4539229	37	37
2412	Non-Participating	323847	4539188	36	36
2413	Non-Participating	323735	4539002	35	35
2414	Non-Participating	323921	4538821	35	35
2415	Non-Participating	324178	4538700	35	35
2416	Non-Participating	324511	4538797	36	36
2417	Non-Participating	325534	4538377	34	34
2418	Non-Participating	322927	4539183	34	34
2419	Non-Participating	322735	4539260	34	34
2420	Non-Participating	322297	4539085	33	33
2421	Non-Participating	322206	4538924	32	32
2422	Non-Participating	321066	4538556	29	29
2423	Non-Participating	320675	4538817	29	29
2424	Non-Participating	320611	4538871	29	29
2425	Non-Participating	320690	4539307	30	30
2426	Non-Participating	319720	4539330	29	28
2427	Non-Participating	319613	4539437	29	28
2428	Non-Participating	319259	4538883	27	26
2429	Non-Participating	319245	4540776	30	30
2430	Non-Participating	318786	4540591	29	29
2431	Non-Participating	318720	4540560	29	29
2432	Non-Participating	320245	4542789	36	36
2433	Non-Participating	319762	4542390	34	34
2434	Non-Participating	319440	4542511	34	34
2435	Non-Participating	319212	4542606	34	34
2436	Non-Participating	318910	4542587	33	33
2437	Non-Participating	318825	4542676	33	33
2438	Non-Participating	318568	4542688	33	33
2439	Non-Participating	318564	4542608	33	33
2440	Non-Participating	317716	4542622	30	30
2441	Non-Participating	317708	4542719	31	31
2442	Non-Participating	317603	4542723	30	30

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2443	Non-Participating	317572	4542787	30	30
2444	Non-Participating	317389	4542838	30	30
2445	Non-Participating	317590	4543024	31	31
2446	Non-Participating	317592	4543075	31	31
2447	Non-Participating	317757	4543559	33	33
2448	Non-Participating	317757	4543612	33	33
2449	Non-Participating	317743	4543680	33	33
2450	Non-Participating	317634	4543668	32	32
2451	Non-Participating	317611	4543670	32	32
2452	Non-Participating	317570	4543670	32	32
2453	Non-Participating	317568	4543596	32	32
2454	Non-Participating	317590	4543495	32	32
2455	Non-Participating	317648	4543592	32	32
2456	Non-Participating	317621	4543727	33	33
2457	Non-Participating	317582	4543791	32	32
2458	Non-Participating	317582	4543857	33	33
2459	Non-Participating	317584	4543909	33	33
2460	Non-Participating	317582	4543968	33	33
2461	Non-Participating	317592	4544016	33	33
2462	Non-Participating	317582	4544090	33	33
2463	Non-Participating	317502	4543810	32	32
2464	Non-Participating	317496	4543758	32	32
2465	Non-Participating	317487	4543721	32	32
2466	Non-Participating	317489	4543666	32	32
2467	Non-Participating	317485	4543612	32	32
2468	Non-Participating	317512	4544215	33	33
2469	Non-Participating	317510	4544265	33	33
2470	Non-Participating	317471	4544265	33	33
2471	Non-Participating	317329	4544256	32	32
2472	Non-Participating	317273	4544256	32	32
2473	Non-Participating	317243	4544263	32	32
2474	Non-Participating	317179	4544252	31	31
2475	Non-Participating	317605	4544917	34	34
2476	Non-Participating	318041	4546148	34	34
2477	Non-Participating	317352	4545047	33	33
2478	Non-Participating	317397	4545129	33	33
2479	Non-Participating	319301	4547138	34	34

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2480	Non-Participating	319183	4547426	33	33
2481	Non-Participating	319169	4547664	32	32
2482	Non-Participating	319298	4547749	32	32
2483	Non-Participating	319319	4547843	32	32
2484	Non-Participating	319210	4547994	31	31
2485	Non-Participating	317568	4546847	31	31
2486	Non-Participating	317671	4547263	30	30
2487	Non-Participating	317852	4547452	30	30
2488	Non-Participating	317885	4547510	30	30
2489	Non-Participating	317808	4547479	30	30
2490	Non-Participating	317854	4547539	30	30
2491	Non-Participating	317821	4547549	29	29
2492	Non-Participating	317794	4547572	29	29
2493	Non-Participating	317745	4547578	29	29
2494	Non-Participating	317708	4547576	29	29
2495	Non-Participating	317677	4547570	29	29
2496	Non-Participating	317629	4547572	29	29
2497	Non-Participating	317619	4547625	29	29
2498	Non-Participating	317675	4547516	29	29
2499	Non-Participating	317718	4547510	29	29
2500	Non-Participating	317767	4547500	29	29
2501	Non-Participating	317839	4547697	29	29
2502	Non-Participating	318737	4548162	30	30
2503	Non-Participating	318907	4548224	30	30
2504	Non-Participating	318967	4548239	30	30
2505	Non-Participating	319070	4548156	31	31
2506	Non-Participating	319105	4548298	30	30
2507	Non-Participating	319187	4548092	31	31
2508	Non-Participating	320354	4548230	32	32
2509	Non-Participating	319389	4549175	28	28
2510	Non-Participating	319539	4549027	29	29
2511	Non-Participating	319601	4549041	29	29
2512	Non-Participating	319630	4548986	29	29
2513	Non-Participating	319580	4548895	29	29
2514	Non-Participating	319601	4548858	30	30
2515	Non-Participating	319615	4548815	30	30
2516	Non-Participating	319640	4548757	30	30

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2517	Non-Participating	319657	4548675	30	30
2518	Non-Participating	319733	4548599	31	31
2519	Non-Participating	319753	4548553	31	31
2520	Non-Participating	319774	4548510	31	31
2521	Non-Participating	319817	4548455	31	31
2522	Non-Participating	319887	4548471	31	31
2523	Non-Participating	319313	4548039	31	31
2524	Non-Participating	319390	4548044	31	31
2525	Non-Participating	319353	4548119	31	31
2526	Non-Participating	319320	4548124	31	31
2527	Non-Participating	319376	4548195	31	31
2528	Non-Participating	319347	4548203	31	31
2529	Non-Participating	319304	4548187	31	31
2530	Non-Participating	319477	4548221	31	31
2531	Non-Participating	319511	4548221	31	31
2532	Non-Participating	319568	4548217	31	31
2533	Non-Participating	319607	4548223	31	31
2534	Non-Participating	319581	4548304	31	31
2535	Non-Participating	319526	4548341	31	31
2536	Non-Participating	319500	4548287	31	31
2537	Non-Participating	319635	4548301	31	31
2538	Non-Participating	319676	4548302	31	31
2539	Non-Participating	319728	4548305	31	31
2540	Non-Participating	319773	4548301	31	31
2541	Non-Participating	319827	4548309	31	31
2542	Non-Participating	319880	4548301	32	32
2543	Non-Participating	320035	4548233	32	32
2544	Non-Participating	319988	4548233	32	32
2545	Non-Participating	320010	4548174	32	32
2546	Non-Participating	320021	4548143	32	32
2547	Non-Participating	320036	4548114	32	32
2548	Non-Participating	320059	4548074	32	32
2549	Non-Participating	320072	4548027	33	33
2550	Non-Participating	319996	4548102	32	32
2551	Non-Participating	319929	4548108	32	32
2552	Non-Participating	319931	4548197	32	32
2553	Non-Participating	319922	4548253	32	32

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2554	Non-Participating	319868	4548213	32	32
2555	Non-Participating	319839	4548218	32	32
2556	Non-Participating	319789	4548220	32	32
2557	Non-Participating	319720	4548214	31	31
2558	Non-Participating	319659	4548231	31	31
2559	Non-Participating	319816	4548164	32	32
2560	Non-Participating	319826	4548128	32	32
2561	Non-Participating	319828	4548094	32	32
2562	Non-Participating	319829	4548064	32	32
2563	Non-Participating	319821	4548026	32	32
2564	Non-Participating	319813	4547995	32	32
2565	Non-Participating	319816	4547920	32	32
2566	Non-Participating	319741	4547904	32	32
2567	Non-Participating	319685	4547922	32	32
2568	Non-Participating	319672	4547951	32	32
2569	Non-Participating	319676	4547993	32	32
2570	Non-Participating	319675	4548036	32	32
2571	Non-Participating	319675	4548059	32	32
2572	Non-Participating	319678	4548099	32	32
2573	Non-Participating	319684	4548130	32	32
2574	Non-Participating	319690	4548174	32	32
2575	Non-Participating	319608	4547967	32	32
2576	Non-Participating	320791	4549438	30	30
2577	Non-Participating	320879	4549687	30	30
2578	Non-Participating	320723	4549735	30	30
2579	Non-Participating	320887	4549799	30	30
2580	Non-Participating	320902	4549877	30	30
2581	Non-Participating	320870	4549873	30	30
2582	Non-Participating	320842	4549872	29	29
2583	Non-Participating	320803	4549865	29	29
2584	Non-Participating	320781	4549866	29	29
2585	Non-Participating	320741	4549868	29	29
2586	Non-Participating	320700	4549870	29	29
2587	Non-Participating	320654	4549890	29	29
2588	Non-Participating	320589	4549864	29	29
2589	Non-Participating	320546	4549872	29	29
2590	Non-Participating	320965	4549965	29	29

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2591	Non-Participating	323028	4548770	36	36
2592	Non-Participating	323044	4548860	36	35
2593	Non-Participating	322474	4549506	33	33
2594	Non-Participating	322097	4549941	31	31
2595	Non-Participating	324040	4548909	37	37
2596	Non-Participating	322809	4549934	32	32
2597	Non-Participating	322735	4549947	32	32
2598	Non-Participating	322595	4549883	32	32
2599	Non-Participating	322595	4549926	32	32
2600	Non-Participating	322599	4549986	32	32
2601	Non-Participating	322604	4550021	32	32
2602	Non-Participating	322602	4550060	32	32
2603	Non-Participating	322602	4550103	32	32
2604	Non-Participating	322696	4550165	32	32
2605	Non-Participating	322589	4550274	31	31
2606	Non-Participating	322616	4550381	31	31
2607	Non-Participating	322618	4550455	31	31
2608	Non-Participating	322678	4550389	31	31
2609	Non-Participating	322748	4550381	31	31
2610	Non-Participating	322797	4550375	31	31
2611	Non-Participating	322863	4550375	31	31
2612	Non-Participating	322846	4550461	31	31
2613	Non-Participating	324049	4551442	30	30
2614	Non-Participating	324117	4551442	30	30
2615	Non-Participating	324156	4551439	31	31
2616	Non-Participating	327602	4553871	29	29
2617	Non-Participating	327631	4554229	28	28
2618	Non-Participating	326958	4554520	27	27
2619	Non-Participating	326964	4554365	27	27
2620	Non-Participating	327551	4554358	28	28
2621	Non-Participating	327553	4554396	28	28
2622	Non-Participating	327553	4554443	28	28
2623	Non-Participating	327550	4554509	28	28
2624	Non-Participating	327545	4554544	28	28
2625	Non-Participating	327503	4554538	27	27
2626	Non-Participating	327464	4554542	27	27
2627	Non-Participating	327423	4554543	27	27

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2628	Non-Participating	327328	4554556	27	27
2629	Non-Participating	327352	4554507	27	27
2630	Non-Participating	327597	4554528	28	28
2631	Non-Participating	327613	4554555	28	28
2632	Non-Participating	327684	4554529	28	28
2633	Non-Participating	327756	4554527	28	28
2634	Non-Participating	328372	4554629	28	28
2635	Non-Participating	328240	4554617	28	28
2636	Non-Participating	328030	4554604	28	28
2637	Non-Participating	327987	4554605	28	28
2638	Non-Participating	327846	4554627	28	28
2639	Non-Participating	327736	4554608	28	28
2640	Non-Participating	327649	4554643	27	27
2641	Non-Participating	327628	4554685	27	27
2642	Non-Participating	327641	4554816	27	27
2643	Non-Participating	327638	4554732	27	27
2644	Non-Participating	327569	4554783	27	27
2645	Non-Participating	327636	4555143	26	26
2646	Non-Participating	327638	4555092	26	26
2647	Non-Participating	327635	4555033	27	27
2648	Non-Participating	327629	4554973	27	27
2649	Non-Participating	327568	4554951	27	27
2650	Non-Participating	327563	4554903	27	27
2651	Non-Participating	327564	4554866	27	27
2652	Non-Participating	327667	4554866	27	27
2653	Non-Participating	327664	4554913	27	27
2654	Non-Participating	327515	4555068	26	26
2655	Non-Participating	327580	4555308	26	26
2656	Non-Participating	329206	4555777	27	27
2657	Non-Participating	329276	4556217	26	26
2658	Non-Participating	329555	4556234	27	26
2659	Non-Participating	330103	4556211	27	27
2660	Non-Participating	330198	4556199	27	27
2661	Non-Participating	330272	4556205	27	27
2662	Non-Participating	330617	4556228	28	28
2663	Non-Participating	331364	4556228	29	29
2664	Non-Participating	330241	4556114	27	27

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2665	Non-Participating	330905	4556071	29	29
2666	Non-Participating	330880	4555907	29	29
2667	Non-Participating	330899	4555851	29	29
2668	Non-Participating	330910	4555684	29	29
2669	Non-Participating	330876	4555535	30	29
2670	Non-Participating	330779	4555510	30	29
2671	Non-Participating	331272	4555465	30	30
2672	Non-Participating	331309	4555534	30	30
2673	Non-Participating	331312	4555606	30	30
2674	Non-Participating	331439	4555716	30	30
2675	Non-Participating	331488	4555771	30	30
2676	Non-Participating	331541	4555852	30	30
2677	Non-Participating	331609	4555942	30	30
2678	Non-Participating	331739	4555939	30	30
2679	Non-Participating	331547	4555602	31	30
2680	Non-Participating	331647	4555669	31	30
2681	Non-Participating	330777	4555315	30	30
2682	Non-Participating	330873	4555292	30	30
2683	Non-Participating	330883	4555217	30	30
2684	Non-Participating	330851	4555110	31	30
2685	Non-Participating	330850	4555062	31	30
2686	Non-Participating	330968	4555037	31	31
2687	Non-Participating	331077	4555153	31	31
2688	Non-Participating	331097	4555185	31	31
2689	Non-Participating	331118	4555215	31	31
2690	Non-Participating	332503	4555476	32	32
2691	Non-Participating	332527	4555820	31	31
2692	Non-Participating	332519	4555968	31	31
2693	Non-Participating	332517	4555999	31	31
2694	Non-Participating	332517	4556034	31	31
2695	Non-Participating	332642	4556092	31	31
2696	Non-Participating	332840	4556079	31	31
2697	Non-Participating	332824	4555942	32	31
2698	Non-Participating	331961	4556176	30	30
2699	Non-Participating	332015	4556176	30	30
2700	Non-Participating	332072	4556174	30	30
2701	Non-Participating	332408	4556254	30	30

Table B-1. Summary of Acoustic Modeling Results

Residence ID	Participant Status	UTM Coordinates (m)		Received Sound Levels (dBA)	
		Easting (X)	Northing (Y)	Critical Design Wind Speed	Critical Design Wind Speed Incorporating Noise-Reduction Technology
2702	Non-Participating	332949	4556187	31	31
2703	Non-Participating	333140	4556110	32	31
2704	Non-Participating	333213	4556082	32	31
2705	Non-Participating	333256	4556086	32	31
2706	Non-Participating	333289	4556088	32	31
2707	Non-Participating	333346	4556100	32	31
2708	Non-Participating	333676	4556082	32	32
2709	Non-Participating	334097	4556086	33	32
2710	Non-Participating	334775	4556055	34	33
2711	Non-Participating	335764	4556226	34	34
2712	Non-Participating	346712	4556826	20	20
2713	Non-Participating	346664	4556281	21	21
2714	Non-Participating	343727	4557670	24	24
2715	Non-Participating	344948	4557762	22	22

Appendix I: Geotechnical Report

Geotechnical Engineering Report
Seneca Wind Project

Seneca County, Ohio

Prepared for
sPower
Salt Lake City, Utah

June 2018

Geotechnical Engineering Report
Seneca Wind Project

Seneca County, Ohio

Prepared for
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Geotechnical Engineering Report
Seneca Wind Project
sPower
Seneca County, Ohio

June 2018

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Certifications

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

DRAFT FOR REVIEW	June 6, 2018
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PE #: PE74783	

1.0 Introduction

Barr Engineering Co. (Barr), under contract and authorization with sPower, completed a design phase geotechnical investigation of the proposed Seneca Wind Project. The Seneca Wind Project is a proposed wind project consisting of approximately 84 wind turbine generators. Barr completed a design phase geotechnical investigation of the site in the spring of 2018. The Seneca Wind Project is located in Seneca County in Ohio. Barr was instructed to hold on investigation for 19 initially proposed wind turbine locations and the ancillary structure sites during the investigation. As a result, this draft report pertains only to the wind turbine locations investigated to date. The remaining locations will be included in a future version of this report.

This report describes the investigation and testing performed, presents the results of this work, and provides geotechnical analyses and conclusions in support of design for wind turbine and associated ancillary structure foundations. As part of this work, a discussion of potential geologic and geotechnical risks is also presented.

1.1 Site Location

The proposed Seneca Wind Project is located in southeastern Seneca County, Ohio, east of the town of Tiffin, as indicated on Figure 1. Figure 2 shows the proposed layout of the project site including the current wind turbine layout. The coordinates of the boring locations and corresponding testing locations completed as part of this investigation are included in Appendix A.

1.2 Site Geology

1.2.1 Regional Physiography

The project site is located in the Central Lowland physiographic region of the Interior Plains division of the United States (Physiographic Regions of Ohio, 1998). On a smaller scale, the project site is located in the Till Plains, locally referred to as the Central Ohio Clayey Till Plain. The Central Ohio Clayey Till Plain is characterized by having a surface of clayey till with well-defined moraines, few lake basins, and limited sand and gravel outwash overlying Paleozoic aged carbonate rocks.

1.2.2 Geologic History

The surficial geology is likely derived from Wisconsinan aged till from the Erie glacial lobe and lacustrine deposits. Prior to the advance of the glaciers, the area had moderate to high relief resulting from the faulted and folded Silurian aged carbonate and shale bedrock. Glaciers gouged and evened the bedrock and filled the valleys with sediment. As a result, the pre-glacial valleys are not identified at the surface, but many extend deep beyond the surface (Central Lowlands, 2008).

1.2.3 Surficial Geology

The USDA (SSURGO, 2018) maps the surficial soil parent material primarily as Wisconsin till on the eastern portion of the project site with occasional fingers of generalized till and loamy alluvium. On the west part of the project site, the primary soil parent material is mapped as both Wisconsin till and glaciolacustrine deposits, with thin fingers of loess, outwash, and generalized till (Figure 3). Glacial till and glaciolacustrine deposits in this part of Ohio tend to be clayey with occasional sand and gravel seams. Figure 6 indicates the drift thickness, which indicates the presence of occasional deep subsurface valleys.

1.2.4 Bedrock Geology

From the west to the east, the primary bedrock formations at the site are:

- Tymochtee and Greenfield Dolomites, Undivided: Silurian aged, olive gray to yellowish brown, thin to massive bedded dolomite and shale
- Salina Group: Silurian aged, gray to yellow gray to olive gray, laminated to thinly bedded dolomite with gray shale, anhydrite, and gypsum laminations
- Columbus Limestone: Devonian aged, gray to brown, massive bedding, fossiliferous limestone to dolomite
- Delaware Limestone: Devonian aged, gray to brown, thinly bedded to massive limestone
- Olentangy Shale: Devonian aged, greenish gray to medium gray, thinly bedded shale with occasional limestone seams
- Ohio Shale: Devonion aged, brownish black to greenish gray, carbonaceous to clayey, laminated to thinly bedded shale

The data above was taken from USGS (2018). Based on the mapped data, the wind turbines on the western portion of the site are primarily underlain by the Columbus Limestone Formation, and the glacial drift thickness relatively thin. The proposed wind turbine locations on the eastern part of the site are generally mapped as underlain by the Ohio Shale Formation, and the glacial drift thickness is greater than on the western portion of the site.

1.2.5 Geologic Hazards

The following sections present a summary of the potential geologic and geotechnical hazards at the project site. Of the most common potential geologic hazards (seismicity, slope stability, shallow groundwater and flooding, soil collapse, and karst), some are present at the project site on a limited basis, and others are more widespread.

The following sections summarize the geological and geotechnical hazards that may be present at the site.

1.2.5.1 Seismicity and Faults

The project is located in a relatively inactive seismic area, but is on the periphery of the New Madrid Seismic Zone, which has some heightened level of risk. Very few earthquakes have been observed in Seneca County and frequency is generally low (Hansen, 2012). A review of the Quaternary faults and folds database indicate that there are no Quaternary faults (active in the last 1.6 million years) near the project site (USGS, 2018).

1.2.5.2 Slope Stability

The topography of the site consists of relatively flat areas divided by dendritic drainage features. While the proposed wind turbine locations are primarily located in relatively flat areas, some areas associated with drainage features may have an increased potential for slope failure, especially in areas near narrow drainage systems. The risk of slope instability at the proposed wind turbine locations is low due to the relatively flat terrain.

1.2.5.3 Shallow Groundwater and Flooding

Shallow groundwater (less than 10 feet below surface) was observed at a few of the geotechnical boring and piezometer locations during the investigation. Water wells in the area of the site generally indicate water is in the upper 50 feet, with shallower levels observed on the western part of the site (ODNR, 2018).

Surficial soils throughout the project site have poor drainage due to the high clay content and high plasticity, and precipitation may have a tendency to pool at the surface following periods of intense precipitation. Temporary flooding or ponding of water in low areas following precipitation events or spring thaw should be anticipated. During the site investigation, significant precipitation was encountered, and ponded water was observed in the farm fields following rain events. Potential flooding is generally not considered a cause for relocation of turbine locations provided that the backfill soil covering the foundations are adequately protected from erosion. The potential for erosion will depend on the energy of the flowing water (i.e. ability to transport soil particles) and proximity to water drainages.

1.2.5.4 Soil Collapse and Shrink-Swell

The geologic history of the site indicates that the surficial soils are anticipated to consist of glacial till soil. Typically glacial deposits have a low risk of soil collapse and swell. Based on Barr's understanding of the area and other nearby investigations, the soil is likely to be low plasticity, and should not exhibit appreciable swell potential.

1.2.5.5 Soil Corrosion Potential

Based on the minerology and chemical make-up of the soils at the site, corrosion of steel and concrete foundations may be a factor in foundation design. The mapped data indicates that the majority of the near surface soil is likely to have a high corrosion potential for steel foundations in direct contact with the soil (Figure 4). This was generally confirmed based on the completed field electrical resistivity testing.

In addition, the mapped data indicates that the soils are likely to have a low to moderate reactivity to concrete foundations (Figure 5).

1.2.5.6 Karst and Ground Subsidence

There is potential for karst risk at the site. Karst generally refers to "regions of exposed soluble bedrock having an abundance of surface landforms, such as sinkholes, sinking streams, and springs that reflect the presence of subsurface voids or caves" (Weary and Doctor, 2014). Caves and related solution features pose a risk to structures such as wind turbines. Other rock types that can cause similar problems include limestone and evaporites (salts).

Ohio has approximately 500 caves and caverns, most of which are developed mainly in the Columbus and Delaware Formations (both of which are mapped at the site). Karst development in Ohio is fairly widespread through this area of Ohio. Just to the north of the project site near the community of Flat Rock, Ohio, is a tourist attraction called the Seneca Caverns is present. The Seneca Caverns consist of seven distinct "rooms" or "levels" which extend to a maximum depth of about 90 feet. An underground stream is present for much of the year in the lowest level (Ruedisili et al, 1990). While not within the project boundary, the presence of known caverns is indicative of some level of potential for karst at the project site.

A nation-wide study of karst deposits does indicate karst features within the vicinity of the site and near turbine locations (Weary and Doctor, 2014). Figure 8 provides the mapped known and probable karst locations from the Ohio Division of Geological Survey (1999). From the figure, it appears that several known and probably karst features are present on the southwestern portion of the site, where the mapped bedrock consists of the Columbus Limestone. In addition, the drift thickness is generally less on the western side of the site, which is observed to contain mapped karst features in this area. The north-central and central portion of the site has occasional mapped karst features, but these are generally not in the vicinity of proposed wind turbine locations.

Assessing the level of karst risk for the project site is difficult. While some physical evidence of karst features may be present at the surface, most of the risk is hidden underground. The presence of soluble bedrock is the key factor in determining that some risk is present, and thereafter that risk level cannot be completely eliminated. The most well-known form of surface subsidence due to karst features are sinkholes. Sinkholes form when caves or caverns grow so large that the roof can no longer support the load of the overlying soil and rock (or structures), and a catastrophic failure occurs. However, collapse of smaller scale features such as relatively thin but fairly continuous voids or weak zones in the rock also can occur. Typically, if these smaller void zones collapse, smaller scale, rapid settlement of the ground surface can be experienced.

Soil raveling, another type of subsidence due to karst, typically manifests itself as a relatively slow process, associated with long term surface settlement from migration of soils into the voids. As the soils migrate, support for the proposed overlying structures is reduced, typically resulting in settlement and potential tilting. Since raveling tends to form at specific points on the site, the settlement tends to be localized, not uniform, and the full magnitude may be realized as differential settlement beneath the proposed structures.

However, there are many steps available to evaluate the situation and thereby better quantify the level of risk and reduce the risk of adverse effects on the proposed project.

Further discussion of karst potential risk is provided in Section 3.7 and 4.5.

1.3 Previous Investigation

At the time of this report, Barr is not aware of any previous geotechnical investigations within the project boundaries. Barr performed a limited desktop study of the site during a previous phase of development for the project under a different owner. Results from the previous study were reviewed but are not included herein unless noted.

1.4 Turbine Nomenclature

In this report (including all tables, figures, and appendices), investigation locations are identified using the geotechnical identification (Geotech ID) numbers. Appendix A provides a conversion between the current wind turbine location number and the Geotech ID number. The current layout Barr received is dated April 4, 2018 and reflects Barr's understanding of the most recent wind turbine array. Appendix A provides reference for all test locations from the current wind turbine layout and the identification used during the geotechnical analysis. The Geotech ID is also used in the appendices, tables, and figures in this report for consistency.

2.0 Geotechnical Exploration Methods

The geotechnical investigation for the Seneca Wind Project consisted of geotechnical borings, standard penetration tests (SPT), rock coring, split-spoon soil sampling, undisturbed thin-wall tube sampling, bulk soil sampling, shallow groundwater piezometers, geophysical surveys, and general soil laboratory testing. This program of geotechnical investigation was selected to accurately and efficiently evaluate the strength, compressibility, stiffness, and density characteristics of the soils at the project site.

In addition to the geotechnical investigation, thermal resistivity tests and field electrical resistivity tests were conducted in support of the project electrical design (to be completed by others).

The primary site investigation was performed from March to May of 2018. Laboratory testing was initiated in April of 2018 and was completed in May of 2018. A summary of the investigation and test locations completed to date is included in Appendix A. As indicated previously, 19 potential locations were not drilled at this time based on conversations with s-Power.

2.1 Field Investigations

2.1.1 Geotechnical Borings

A total of 77 geotechnical borings were completed at proposed wind turbine locations as part of the design phase geotechnical investigation (Figure 8) in general accordance with ASTM D1452, “Standard Practice for Soil Exploration and Sampling by Auger Borings”. Where bedrock was encountered, NQ sized coring techniques were used to extend the boreholes to the target depth in accordance with ASTM D2113, “Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration”. Borings at the proposed wind turbine locations were extended to a target depth of approximately 60 feet. When auger refusal was encountered at depths of 47.5 feet and greater, rock coring methods were not utilized, and the depth of drilling was considered representative for foundation design and analysis. Table 1 includes the investigated depth and depth to intact bedrock at each completed soil boring location.

Soil sampling and classification was performed at maximum 5-foot intervals extending to the termination depth in all of the geotechnical borings. All split spoon sampling and standard penetration testing was performed in accordance with ASTM D1586, “Standard Test Method for Penetration Tests and Split-Barrel Sampling of Soils”. Three-inch diameter thin-walled tube (Shelby tube) samples were collected at selected depths and located in accordance with ASTM D1587, “Standard Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes”. Samples were sealed in the field in order to preserve the in-situ moisture content.

The geotechnical borings were performed by EPC Engineering and Testing of Duluth, Minnesota under subcontract to Barr. The geotechnical borings were performed with track-mounted drill rigs using primarily hollow-stem auger drilling techniques and rock coring techniques when bedrock was encountered. The geotechnical borings were observed by Barr personnel.

Soil samples collected during the geotechnical borings were transported to Soil Engineering Testing Inc. (SET) in Bloomington, Minnesota, for laboratory testing. The geotechnical boring logs from the design phase geotechnical investigation are provided in Appendix B. Field SPT *N*-values and RQD values are provided on the boring logs.

2.1.2 Shallow Groundwater Piezometers

Standpipe piezometers were installed at ten proposed wind turbine locations during the geotechnical investigation in order to estimate the long-term groundwater level at the project site. The piezometers were constructed of 1-inch diameter schedule 40 PVC pipe. The bottom 5 feet of the piezometer consisted of slotted screen. The bottom 7 to 8 feet of the annulus surrounding the screen and riser was filled with sand pack and hydrated bentonite chips were placed above the sand pack to seal the piezometer from surface water infiltration. The piezometers were installed to a depth of approximately 12 feet below the existing ground surface. The piezometers were measured approximately one week after installation, and will be measured again prior to the submittal of the final report.

2.1.3 Geophysical Survey

The Hutchinson Group Geophysics, Ltd. (THG), completed a surface geophysical survey for the project under subcontract to Barr. During the design phase investigation, THG completed Multi-Channel Analysis of Surface Waves (MASW) and seismic refraction tomography (SRT) at six proposed wind turbine locations to measure shear and compression wave velocities. The geophysical survey locations are shown on Figure 9. Both of these methods (MASW and SRT) are non-intrusive surface geophysical methods. The geophysical survey report from the investigation is included as Appendix C.

2.2 Laboratory Testing

The following tests were performed by SET:

- Moisture content tests were performed in accordance with ASTM D2216, "Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass"
- Dry density tests were performed in accordance with ASTM D7263, "Standard Test Methods for Laboratory Determination of Density (Unit Weight) of Soil Specimens"
- Atterberg Limit determinations in accordance with ASTM D4318, "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils"
- Sieve and hydrometer analysis in accordance with ASTM D422, "Standard Test Method for Particle-Size Analysis of Soils"
- Unconsolidated-Undrained (UU) triaxial tests in accordance with ASTM D2850, "Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils"
- Unconfined compressive strength in accordance with ASTM D2166, "Standard Test Method for Unconfined Compressive Strength of Cohesive Soil"

- Consolidation tests in accordance with ASTM D2435, "Standard Test Methods for One-Dimensional Consolidation Properties of Soil Using Incremental Loading"

- Standard Proctor Density determinations in accordance with ASTM D698, "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))"

- Soil pH tests in accordance with ASTM D4972, "Standard Test Method for pH of Soils"

- Soluble chloride and soluble sulfate of soils in accordance with EPA Method 9056, "Determination of Inorganic Anions by Ion Chromatography"

Laboratory test results are included in Appendix D.

2.3 Electrical Resistivity Testing

Soil resistivity testing was completed by Barr personnel in accordance with ASTM method G57 "Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method" (equivalent to IEEE Std. 81). For the design phase geotechnical investigation, testing was performed at seven locations provided to Barr by sPower (Figure 10). Testing was performed at six proposed wind turbine locations and one test was performed at the proposed substation location. At each location, measurements were taken to determine average soil resistivity in two perpendicular arrays. Five electrode "a"-spacings of 2.5, 5, 10, 20, and 40 feet were used during the testing at the tested locations. The soil electrical resistivity report is included as Appendix E.

2.4 Thermal Resistivity Testing

Soil samples for thermal resistivity testing were collected at seven locations provided to Barr by sPower (Figure 10) by Barr personnel. Samples were collected from six proposed wind turbine locations and one sample was collected from the proposed substation location. Bulk samples for testing were obtained from cuttings generated from geotechnical borings at a depth of approximately 1 to 3 feet below the surface. The samples were transported to SET for laboratory testing. SET completed the thermal resistivity tests in May of 2018. Thermal resistivity tests were performed in accordance with ASTM D5334, "Standard Test Method for Determination of Thermal Conductivity of Soil and Soft Rock by Thermal Needle Probe Procedure". Laboratory tests included measurement of the soil's moisture content, maximum dry density, and thermal dryout characteristics, which is a function of moisture content. The soil thermal resistivity report is included as Appendix F.

3.0 Results

Section 2 described the field and laboratory investigation procedures. Section 3 presents the data from testing and investigation and provides further analysis of these results.

3.1 Subsurface Stratigraphy

The results of the geotechnical borings (Appendix B) and laboratory tests (Appendix D) were compiled to obtain an understanding of the subsurface stratigraphy of the study areas.

The results of the soil borings completed at the site indicated that the general soil stratigraphy consisted of a thin layer of topsoil or mixed soil used for farming overlying lean clay glacial till soil, with occasional interbedded sandy outwash zones. Underlying the glacial deposits was limestone of the Columbus Formation. The western portion of the project site generally had shallower limestone bedrock, and bedrock was often not encountered on the eastern portion of the site. The results of the soil borings in the north-central and eastern part of the project site often did not encounter bedrock, or encountered it deep in the soil borings. The bedrock in that area consisted of the Ohio Shale.

3.1.1 Topsoil and Surficial Soil

The project site is mainly used for agricultural purposes and primarily consists of pastures or planted fields. The geotechnical investigation determined the topsoil ranged from 2 to 18 inches thick, but typically ranges from 6 to 12 inches thick. A clearly defined "topsoil" layer was not present at several locations, as the very top soil was observed to be consistent with the tilled zone. Localized zones of thicker or thinner topsoil should be expected across the site, depending on the agricultural use and topography. In most cases, the topsoil consisted of dark brown lean to fat clay with roots and organic debris associated with agricultural land use.

3.1.2 Clay

Clay soils were encountered in the majority of the geotechnical borings completed in this investigation. The clays encountered can be characterized as low plasticity lean clay to silty lean clay and contained varying levels of silt, sand, and gravel. In general, the clays were encountered from the ground surface and extended to the top of the sedimentary rock. The clay was brown in color at shallower depths, and transitioned to gray at depths generally ranging from 10 to 30 feet. Lesser amounts of sand and gravel were observed within the clay soil. The majority of the clay soils encountered at the site are anticipated to be glacial till soil.

Moisture contents in the clay soil ranged from 7 to 27 percent, with an average of about 17 percent.

Dry unit weight tests on the clay soil ranged from 103.4 to 125.2 pounds per cubic foot (pcf). The corresponding moist unit weight of the clay ranged from 127.1 to 141.5 pcf, with an average of about 135 pcf.

Atterberg Limits testing indicated that the liquid limit of the clay soil ranged from 18 to 36 percent, the plastic limit ranged from 14 to 19 percent, and the Plasticity index ranged from 4 to 19 percent. According to the Plasticity Chart (Das, 2007), these soils plot as CL (lean clay) and CL-ML (silty lean clay) soil.

Mechanical grain size testing indicated that the gravel content ranged from 0.1 to 5.7 percent, the sand content ranged from 8.6 to 25 percent, and the fines (silt and clay) content ranged from 69.3 to 91.3 percent. Hydrometer analyses indicated that the silt content ranged from 39.6 to 51.5 percent, and the clay content ranged from 29.7 to 39.8 percent.

Laboratory unconfined compressive strength testing indicated that the unconfined compressive strength of the clayey soil ranged from 1 to 6.6 tons per square foot (tsf). Hand penetrometer measurements indicated that the unconfined compressive strength of the soil ranged from 1 to 4.5 tsf. Laboratory unconsolidated undrianed triaxial compressive strength testing indicated that the maximum deviator stress of the clayey soil ranged from 1.5 to 7 tsf.

Standard Penetration Tests (SPT) conducted in the clays ranged from 4 blows per foot to greater than 50 blows for fewer than 6 inches of sampler penetration, but were typically on the order of 8 to 20 blows per foot. These results indicate that the clays typically have a medium stiff to very stiff consistency.

3.1.3 Sand

Sand soils were encountered in approximately 30 percent of the geotechnical borings and were commonly interbedded within the cohesive soils. The sand soils were classified in the field as a silty sand, clayey sand, and poorly graded sand with silt, and were generally fine to medium grained. The sand soils were typically observed in thinner layers on the order of 5 feet or less, but a few thicker zones were observed. The sand soils were typically water bearing and wet when encountered.

Moisture contents in the sand soil ranged from 4.6 to 23.1 percent, with an average of about 14 percent. One dry unit weight test on an intact sample of sand resulted in a dry unit weight of 93.3 pcf. The corresponding moist unit weight was 104 pcf.

Mechanical grain size testing indicated that the gravel content ranged from none to 13.6 percent, the sand content ranged from 52.2 to 82.1 percent, and the fines (silt and clay) content ranged from 15.1 to 47.8 percent.

Standard penetration tests conducted in the sands ranged from 3 blows per foot to greater than 50 blows for fewer than 6 inches of sampler penetration, but were typically on the order of 15 to 25 blows per foot. These results indicate that the sands typically have a dense to very dense relative density.

3.1.4 Gravel

Primarily gravel soils were encountered in six geotechnical borings (GEO-001 from 45 to 55 feet, GEO-013 from 30 to 35 feet, GEO-014 from 26 to 40.5, GEO-031 from 15 to 25.5, GEO-053 from 55 to 58 feet, and GEO-079 from 55 to 58.5). The gravel soil is not considered the primary soil type at the site, but may be encountered during construction at various turbine locations. The gravel soils were classified in the field as clayey gravel and poorly graded gravel, and commonly had significant sand and fines content. It is possible that the gravel soil observed overlying the bedrock is a weathered upper layer of the underlying bedrock, but the sampling method disturbed the structure of the gravel soil and specific characteristics of rock were not observed.

Moisture contents in the gravel soil ranged from 4.9 to 13 percent, with an average of about 10 percent.

Mechanical grain size testing indicated that the gravel content was 49.5 percent, the sand content was 39.8 percent, and the fines (silt and clay) content was 10.7 percent.

Standard penetration tests conducted in the gravel ranged from 11 blows per foot to greater than 50 blows for fewer than 6 inches of sampler penetration, but were typically greater than 30 blows per foot. These results indicate that the gravel typically has a dense to very dense relative density.

3.1.5 Weathered Rock

Highly weathered rock (primarily highly weathered limestone) was encountered in several geotechnical borings overlying the intact bedrock. The highly weathered rock was generally observed as a dense sand or gravel, but was not observed at most of the boring locations. The thickness of the weathered rock was generally less than 3 feet where observed.

Standard penetration tests conducted in the weathered rock typically exceeded greater than 50 blows for fewer than 6 inches of sampler penetration, indicating very dense conditions.

3.1.6 Bedrock

The predominant rock type observed at the site was limestone, presumably of the Columbus Formation, as determined through the geologic review. Limestone bedrock was encountered at depths ranging from 2.2 to 57.5 feet, primarily on the western side of the project site. The drift thickness of the glacial till was generally deeper on the eastern project part of the project site. The limestone ranged in color from gray to tan, and was generally massive. RQD values measured in the intact rock generally exceeded 50 percent with a few exceptions. The limestone was massive and commonly included vuggy zones and occasional pyrite minerals. Shale, presumably from the Ohio Shale Formation, was observed at GEO-039 at a depth of 48 feet, but was not observed at other boring locations.

At 15 locations, potential signs of karst were noted during the drilling/coring process. Further discussion of karst is provided in Section 3.7.

Moisture content tests on intact rock samples ranged from 1.9 to 3.2 percent. Dry unit weight measurements on intact rock core pieces ranged from 154.3 to 162.3 pcf. The calculated moist unit weight ranged from 159.2 to 165.4 pcf.

Uniaxial compressive strength tests indicated that the uniaxial compressive strength ranged from 867.5 to 1280.9 tsf.

3.2 Groundwater Conditions

The groundwater level at the site was measured while drilling the boreholes (Section 2.1.2). The majority of the geotechnical borings encountered groundwater at varying depths during or immediately after drilling (Table 2). This is consistent with past investigations in the area.

Geotechnical borings performed to date encountered groundwater at depths ranging from 0.5 to 55 feet below the existing ground surface during or immediately after drilling. The shallowest observed groundwater was at a depth of 0.5 feet after drilling at GEO-089. Based on the results of the groundwater measurements, the groundwater appears to generally be within the clayey glacial till soil overlying bedrock.

Shallow standpipe piezometers were installed at GEO-004, GEO-005, GEO-007, GEO-018, GEO-021, GEO-035, GEO-050, GEO-060, GEO-084, and GEO-092 to evaluate the long-term groundwater level. These locations were selected to provide spatial coverage cross the site and at locations that exhibited shallow groundwater during drilling. The results of the first piezometer measurements about one to two weeks after installation indicated groundwater levels ranging from 0.7 to 9.8 feet below the existing grade.

Due to the clayey nature of the site, the soils likely have a low permeability which may have minimized the amount of seepage into the boreholes during the short time they were open. Although considered unlikely, there exists the potential for shallow groundwater above the depths encountered during drilling at isolated locations. Based on the results to date, a buoyant foundation is anticipated for the majority of the project site. A design groundwater level of 0.5 feet is recommended at this time. If desired, a tiered foundation approach could be considered, but additional piezometer installation at the remainder of the proposed turbine locations would be required. Other sites in Ohio have also not exhibited widely differing groundwater levels, so a tiered foundation design may not be feasible with the site groundwater conditions.

Many factors contribute to water level fluctuations, such as heavy rainfall events, dry periods, etc., and groundwater levels encountered during construction may vary from those observed.

3.3 Chemical Testing

Chemical tests, consisting of soil pH, soluble chlorides, and soluble sulfates, were performed on four soil samples collected from the geotechnical borings. Samples were collected in the upper 3 feet of soil to represent the characteristics of the potential backfill material to be used for foundations. The results of the chemical tests from the design phase geotechnical investigations indicate that the soil pH level ranged from 4.6 to 7.1, the soluble chloride levels ranged from 85.2 to 249 mg/kg, and the soluble sulfate concentration ranged from below the detection limit of 50 mg/kg to 77.7 mg/kg. Chemical test results are included in Appendix D and summarized in Table 4.

3.4 General Soil Laboratory Testing

Laboratory test results from the geotechnical borings are included in Appendix D and summarized in Table 2.

3.4.1 Moisture Content

A total of 300 moisture content tests were conducted on soil and rock samples collected from the geotechnical borings. Results of the moisture content testing indicated that the native soils have a moisture content ranging 1.9 to 27 percent, with an overall average of about 16 percent.

3.4.2 Dry Unit Weight

A total of 68 dry unit weight tests were performed on selected soil and rock samples collected in the geotechnical borings. The dry unit weights of the soil/rock tested ranged from approximately 93.3 to 162.3 pounds per cubic foot (pcf), with an average of about 117 pcf. The corresponding moist unit weight was calculated using the measured moisture content of each sample. The calculated moist unit weight of the soil/rock ranged from 114.1 to 165.4 pcf, with an average of about 136 pcf.

3.4.3 Atterberg Limits

Atterberg limits testing was performed on soil samples and used to classify the material encountered in the geotechnical borings. A total of 12 Atterberg limits tests were conducted on selected samples from the geotechnical borings.

Overall results of the Atterberg limits tests indicate the soils at the site have liquid limits ranging from approximately 18 to 36 percent and plastic limits ranging from approximately 14 to 19 percent. This results in plasticity indices varying between 4 to 19 percent, classifying the soil as CL (lean clay) and CL-ML (silty lean clay) in accordance with the Unified Soil Classification System (USCS). These results indicate that the clays are likely to have low potential for swell. Further discussion on soil swell and associated design considerations is provided in 4.11.

3.4.4 Grain Size Analysis

Grain size analyses were performed on 10 soil samples collected at various depths from the geotechnical borings. The gravel content ranged from none to 49.5 percent, the sand content ranged from 8.6 to 82.1 percent, and the percent fines (percent by weight passing the number 200 sieve) ranged from 10.7 to 91.3 percent in the samples tested. Hydrometer analyses indicated that the silt content ranged from 39.6 to 51.5 percent, and the clay content ranged from 29.7 to 39.8 percent.

3.4.5 Standard Proctor Density Testing

A total of seven laboratory compaction tests were conducted on bulk soil samples collected from the near surface soils at investigated locations across the site. Standard Proctor density testing indicated the soil maximum dry density ranged from 100.3 to 105 pcf, with an average of 102.9 pcf. The corresponding optimum moisture content varied from 20 to 22.2 percent, with an average of 21.2 percent. The soils tested included lean clay (CL). The results of the standard Proctor compaction testing are provided in Table 5.

3.4.6 Consolidation Testing

Two laboratory consolidation tests were performed to evaluate compressibility characteristics of clayey soils at the site due to the presence of shallow groundwater. The samples tested were obtained from the geotechnical borings at geotech ID locations GEO-037 (gray clay) and GEO-079 (brown clay). The testing was performed according to ASTM D2435 using the incremental loading test procedure. The void ratio versus effective stress relationship for each sample is included in Appendix D. The results of the testing indicated that the compression index ranged from approximately 0.13 to 0.16, the recompression index ranged from approximately 0.02 to 0.03, the preconsolidation pressure ranged from approximately 4 to 4.2 tsf, the initial void ratio ranged from approximately 0.482 to 0.498, and the corresponding overconsolidation ratio was estimated to range from approximately 3.1 to 3.7, indicating the samples were overconsolidated. The results of the consolidation testing were used to evaluate the long term settlement of the foundations in a later section of this report. Results of the consolidation testing are summarized in Table 3.

3.5 Shear Strength

3.5.1 Undrained Shear Strength

The results of the geotechnical investigation indicate that the shallower soils are predominantly cohesive (clay). The undrained shear strength of these soils was estimated primarily from laboratory unconfined compressive strength tests, laboratory unconsolidated undrained triaxial compressive strength tests, and hand penetrometer tests. The laboratory strength tests were also reviewed with respect to SPT *N* values to screen the geotechnical borings for lower strength soil layers where more refined test data was not available. These results were taken into consideration when estimating the design value of the undrained shear strength.

Laboratory unconfined compressive strength and unconsolidated undrained triaxial compressive strength test results indicated undrained shear strengths ranging from approximately 1,000 to 7,000 psf. Hand penetrometer tests performed in the field on samples (Appendix B) estimated undrained shear strengths ranging from approximately 1,000 psf to over 4,500 psf, with estimates typically within the range of 2,000 to 4,000 psf.

The undrained shear strength was approximated through correlations from standard penetration test (SPT) results collected during sampling in the boreholes. The SPT results for all turbine locations are shown on the boring logs (Appendix B). Based on the correlation between the measured SPT results and corresponding laboratory test results, an SPT value of 7 generally correlates to an undrained shear strength of approximately 1,250 psf. For wind turbine foundation design, an approximate lower bound SPT value of 7 is recommended based on the boring results.

Accounting for all of the available information, for design purposes, an undrained shear strength of 1,250 psf is recommended for cohesive material at the project site. The results of the investigation indicate that while the majority of the soils are well in excess of the recommended design undrained shear strength value, some isolated soil layers at various depths exhibit strength less than the recommended design value.

3.5.2 Drained Shear Strength

The results of the geotechnical investigation indicate that while the shallow soils are predominantly cohesive, occasional layers of granular (sandy) soils are present at some locations across the site. The drained shear strength (friction angle) of these granular soils was estimated using correlations to SPT results (Das, 2007) during sampling in the boreholes. The correlation is given below:

$$\phi' = 27.1 + 0.3N_{1(60)} - 0.00054N_{1(60)}^2$$

The SPT results for all geotechnical borings completed at turbine locations during the field investigation are shown on the boring logs (Appendix B). The results of the SPT testing indicated that the sand at the turbine locations had SPT values ranging from 3 blows per foot to greater than 50 blows per foot. For wind turbine foundation design, an approximate lower bound SPT value of 10 is recommended based on the boring results. Based on the correlation provided above, an SPT value of 10 correlates to a soil friction angle of approximately 30 degrees.

One laboratory direct shear test indicated that the peak friction angle was 39.3 degrees.

For design purposes, a drained friction angle of 30 degrees is recommended for granular soils at the project site.

3.5.3 Lower Strength Soil Layers

The SPT and laboratory test results indicated notably lower strength soils at various depths at some of the boring locations. These results may be an indication of soil layers exhibiting strength below the recommended design values. A summary of the lower strength soil layers are provided in Table 6. A summary of lower strength layers indicated by field or laboratory test results are provided below.

- GEO-007: SPT value of 6 at the 25-foot sample depth
- GEO-008: Hand penetrometer measurement of 1 tsf at the 25-foot sample depth
- GEO-009: Hand penetrometer measurement of 1 tsf at the 30-foot sample depth
- GEO-036: Hand penetrometer measurement of 1 tsf at the 20-foot sample depth
- GEO-038: SPT values of 6 at the 12.5-foot sample depth
- GEO-042: SPT value of 6 at the 30- and 35-foot sample depths
- GEO-047: SPT values of 4 at the 12-foot sample depth and SPT value of 2 at the 15-foot sample depth
- GEO-052: SPT value of 6 at the 20-, 30-, and 55-foot sample depths
- GEO-053: SPT value of 8 at the 25-foot sample depth

- GEO-056: SPT value of 6 at the 30- and 40-foot sample depths, hand penetrometer measurements of 1 tsf at the 25-foot sample depth, and hand penetrometer measurements of 0.5 tsf at the 30- and 40-foot sample depths
- GEO-059: SPT value of 6 at the 45-foot sample depth, and SPT value of 5 at the 60-foot sample depth
- GEO-062: Hand penetrometer measurement of 1 tsf at the 40-foot sample depth
- GEO-070: Hand penetrometer measurement of 0.75 tsf at the 30-foot sample depth and hand penetrometer measurement of 0.5 tsf at the 35-foot sample depth
- GEO-077: SPT value of 6 at the 20-foot sample depth, SPT value of 5 and hand penetrometer measurement 1 tsf at the 40-foot sample depth
- GEO-079: Hand penetrometer measurement of 0.75 tsf at the 35-foot sample depth
- GEO-082: Hand penetrometer measurement of 1 tsf at the 20-foot sample depth
- GEO-083: SPT value of 5 at the 15-foot sample depth
- GEO-091: Hand penetrometer measurement of 1 tsf at the 35-foot sample depth
- GEO-092: Hand penetrometer measurement of 1 tsf at the 45-foot sample depth
- GEO-093: Laboratory unconfined compressive strength measurement of 1 tsf at the 27-foot sample depth

Further discussion of lower strength soil layers and recommendations for these investigated locations are provided in Section 4.4.5.

3.6 Geophysical Testing

The shear and compression wave velocities were measured and analyzed using MASW and SRT methods at six proposed wind turbine locations by THG (Appendix C).

Based on the results of the shear wave testing and analysis, the weighted average interval shear wave velocities varied from 1,247 to 2,258 ft/sec (Table 7). It is recommended that the minimum interval weighted average shear wave velocity of 1,247 ft/sec be used in soil stiffness calculations as part of the structural foundation design and this value was used in the remainder of the calculations in this report for consistency.

The compression wave velocity was also measured during this investigation at locations selected to provide spatial coverage across the project site. Table 7 summarizes the compression wave velocity results measured by the seismic cone penetrometer at selected locations. The weighted average interval compression wave velocity (V_p) measured at selected sites varied from 5,386 to 9,128 ft/sec.

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

$$\nu = \left(\frac{v_p^2}{2v_s^2} - 1\right) / \left(\frac{v_p^2}{v_s^2} - 1\right)$$ (Bowles, 1996)

Table 7 summarizes the computed Poisson's Ratio at the locations where shear and compression wave velocities were measured. The Poisson's Ratio ranged from 0.42 to 0.48, with an average of 0.46. The minimum value of 0.42 is recommended as the design value.

3.7 Karst Potential

The soil borings were observed by Barr full time to observe if any indications of karst were observed. Indications of karst were observed through loss of drilling fluid circulation to the surface of the borehole and zones of very high weathering or low resistance on the core barrel. Based on the results of the borings, potential karstic conditions were observed at the following 15 borings and depths:

- GEO-003 from 22-28 feet
- GEO-021 from 30 to 31.5 feet
- GEO-022 from 25 to 40 feet
- GEO-025 from 57 to 60 feet
- GEO-028 from 9 to 12 feet
- GEO-045 from 57 to 60 feet
- GEO-047 from 43 to 59 feet
- GEO-048 from 22 to 23 feet, 35 to 36 feet, and 57.5 to 58 feet
- GEO-051 from 45 to 45.5 feet
- GEO-060 from 58 to 61 feet
- GEO-066 from 30 to 42.5 feet and 57.5 to 58 feet
- GEO-078 from 36 to 38 feet
- GEO-086 from 18.5 to 19.5 feet
- GEO-088 from 20 to 22 feet
- GEO-096 from 41.5 to 42.5 feet

These locations are identified in Table 1.

As discussed in Section 1.2.5.6, this area is known to have the potential for karstic conditions. The eastern part of the Seneca Wind Project site is underlain by Columbus Limestone as well as several other limestone or interbedded limestone/shale formations. These rock types, particularly the Columbus Limestone, are susceptible to dissolution by groundwater and known to have significant karst features in other areas of Ohio. Therefore some level of the risk for formation of karst features exist at this project site. The following table indicates some of the potential indicators for karst.

Table 3-1 Potential Indicators of Karst

Potential Indicator	Presence	Discussion
Presence of Dissolution Features	Yes	Portions of the rock coring exhibited zones of limestone containing frequent vugs and other dissolution features.
Loss of drill fluid	Yes	Drilling fluid was lost in the process of rock coring performed by Barr at wind turbine locations GEO-021, GEO-025, GEO-028, GEO-045, GEO-047, GEO-078, GEO-086, and GEO-096
Caving of drill hole or rod drop	Not Specifically	Actual drop of the tool string was not observed at a few locations, but weaker zones were noted during rock coring based on rapid advancement. These zones could be an indication of weaker rock, partial dissolution of the bedrock, or zones of soil infill in the existing voids
Rapid decrease in SPT values with increasing depth	Not specifically detected	The limestone encountered was too hard for drilling methods to penetrate, so rock coring was utilized that does not result in collection of SPT values.
Loose or soft material overlies highly fractured rock	Not specifically detected	Layer hardness appeared to fluctuate throughout the soil profile. The fluctuation appears to be more a function of differing degrees of soil type or weathering.
Absence of clay confining layer over limestone rock	Occasionally	The soils overlying the Columbus Limestone are comprised of clayey glacial till soils. The drift thickness varies significantly across the site, but the locations where karst was potentially observed had much thinner drift thickness. In some instances, bedrock is within a few feet of the surface with little covering materials.
Highly variable limestone surface over short distance	No	The Columbus Limestone was observed to be relatively consistent across the site where observed.
Surface depressions around boring/test hole or in nearby area	Possibly	Surface depressions were occasionally observed, but Barr has not yet completed the full site review.
Soil strata not in normal sequence	Possible	The soil is generally well ordered.
Variation in groundwater levels over short distances	Unknown	Detailed assessment of groundwater levels below a depth of about 12 feet was not performed, but groundwater levels were generally consistent within the glacial till or limestone formations at the karst boring locations.
Review of exposed outcrops for signs of karst features	Generally not detected	The site is generally flat, and no significant outcrops were available for inspection.
Review of historical documentation or local knowledge of karst	Yes	The Seneca Caverns caves are present northeast of the project site in Seneca County, Ohio. These are a tourist attraction that are formed in the Columbus Limestone and are open to the public. In addition, Figure 8 indicates areas of mapped karst features according to public data.

During the geotechnical investigation, at locations where the potential indicators for karst were observed as noted above, Barr performed video inspections of the boreholes to determine the extent of the potential karst. The boreholes were not pumped out upon completion of coring, and due to the coring activates, the water was often blurry during the first attempt to televise the boreholes. As a result, Barr left the majority of the boreholes open for an extended period of time to let the water stabilize, and televised them at a later date prior to backfilling. Video inspection was not performed at locations GEO-045 and GEO-51 because the features were considered to be deep enough and should not be impacted by the loading of the anticipated wind turbine foundation. In addition, the conditions at GEO-088 were not conducive to completing video inspection because the overburden soil had caved in.

The results of the video review completed by Barr did not indicate the presence of large caves or caverns for the depths explored. Several borings had zones of significant fracturing/jointing, washout zones, and vugs, but most of the features were relatively small in nature and significant tubes or voids extending beyond the view of the downhole camera were not observed. Results of the soil borings generally indicated smaller voids on the order of 1 to 6 inches, with a few larger openings observed, but these typically were observed to be filled with soil based on the videos collected. Pictures of some of the karst features observed during the video inspections are included in Appendix G.

Of the coreholes, televised, two locations (GEO-021 and GEO-066) indicated voids or tubes which extend back from the boreholes or large collapsed plates indicative of minor roof collapse. Use of these two locations is not recommended without remediation (likely consisting of grouting of the voids).

Further discussion of karst risk and potential mitigation strategies is provided in Section 4.5.

4.0 Wind Turbine Foundation Analysis and Recommendations

Results of the field and laboratory investigation have been presented in Section 3. Based on these results, Section 4 provides analysis, conclusions and recommendations for the design and construction of wind turbine foundations, as well as general construction considerations.

For foundations, the design factors addressed include bearing capacity, footing stiffness, foundation settlement, and sliding friction.

4.1 General Excavation and Fill

The following sub-sections present general recommendations for site clearing, grading, and compaction for construction of wind turbine foundations.

4.1.1 Clearing and Grubbing

The project site predominantly consists of agricultural farmland, and clearing and grubbing will generally be restricted to the removal of topsoil and crop or grass remains. Based on the results of the field investigations, the thickness of the topsoil ranged from 2 to 18 inches where observed, with a typical range of 6 to 12 inches. The topsoil and organic material is usually mixed during the excavation process, and thus, should not be reused for structural fill. This material should be placed separately away from the rest of the excavated material to avoid comingling. Topsoil removed during site stripping should be graded into existing site topography and may be used in grading non-structural fill such as fields, or service areas in which compressibility of the material does not have an impact on structures.

If the topsoil or surficial soil appears to have sufficient strength to support construction activities, removal of the full extent of the topsoil may not be required, but this should be determined by the on-site representative of the geotechnical engineer during construction.

4.1.2 Site Excavations and Grading

Results of the geotechnical exploration indicate that the majority of shallow cut and fill of the soil in the area can be achieved with conventional machinery.

At investigated locations GEO-018, GEO-028, GEO-049, GEO-060, GEO-066, GEO-078, GEO-086, and GEO-096, depending on the foundation embedment depth, intact rock may be encountered. Heavy duty rock breaking equipment may be required to reach the target excavation depth. Blasting may be used if necessary, although is not required.

4.1.3 OSHA Excavations and Grading in Cut

Grading in cut using conventional machinery should be able to remove all topsoil and organic material. The shallow medium stiff to stiff clay soils appear to be primarily Type B soils from OSHA soil classifications requiring a 1H:1V maximum slope (29 CFR 1926 Subpart P-Excavations). Sand soils and lower strength clay soils would be considered Type C soils requiring a 1.5H:1V maximum slope. Saturated sand and silt soils may be unstable in the presence of seepage and additional shoring or sloping, or other additional slope retention methods may be required. It is the responsibility of the competent field personnel to verify the in-situ soil classification at each excavation and insure that the benching or slopes are adequate during construction (29 CFR 1926 Subpart P-Excavations).

4.1.4 Grading in Fill

Based on soil conditions encountered at the minimum anticipated foundation depth of 8 feet, most of the potential wind turbine sites appear suitable for placement of foundations on natural ground. However, it is likely that thin isolated weak layers will be encountered during excavation of the foundations (Table 6) which will require soil improvement, or removal and replacement. If replacement of these lower strength soils with engineered fill is performed, the fill materials should comply with Ohio Department of Transportation Granular material, Spec Section 703.11 or similar, if approved by the foundation engineer, with no greater than 10 percent of the material passing the 200 sieve. Fill should be placed in loose lifts not exceeding 9 inches, and compacted to a 98 percent of the maximum standard Proctor density or to 75 percent relative density, whichever is greater.

4.1.5 Excavation, Backfill and Compaction for Foundations

Unless otherwise determined by visual observation of the completed excavation, compaction of native soils intended for support of the foundation base is not required, based on the investigations performed. The native subgrade soils should be firm, stable, and capable of providing sufficient support for the overlying structure.

If in the course of excavating the foundation, the base of the excavation becomes rutted, damaged or is otherwise determined to be of inadequate character, the following actions can be performed:

1. If the subgrade soils consist of primarily granular soils, the base excavation should be leveled, re-compacted, and proof rolled. Compaction of this material is required to achieve at least 98 percent of the laboratory maximum dry density measured according to Standard Proctor method. Testing should be performed to ensure proper support can be provided by the re-compacted materials.

2. If the subgrade soils cannot be properly re-graded and compacted, or consist of lower strength silts and clays, the inadequate materials can be removed and replaced with granular structural fill consisting of well-graded sand and gravel materials with less than 10 percent fines (similar to Ohio Department of Transportation Granular material, Spec Section 703.11 or similar). The removal and replacement of materials shall be performed extending out from the sides of the excavation a minimum distance equal to the over-excavation depth to create a 45 degree slope of materials below the base of the foundation. Compaction of this material is required to achieve the greater of a minimum of 75 percent relative density, or a minimum of 98 percent of the laboratory maximum dry density measured according to Standard Proctor.

Moisture content of the materials should be maintained within reasonable levels to allow for proper compaction. Compaction should only be carried out during favorable weather conditions. Fill materials should not be allowed to freeze. Placed fill material subgrades should be firm and stable after placement and compaction.

In all cases of foundation excavation, the soil base shall be protected against damage by use of a flowable concrete mud mat after final excavation (or fill placement). If proper compaction of backfill soils cannot be achieved, lean concrete (flowable fill) can be used as replacement fill in lieu of granular structural fill.

Based on results of Section 3.8, the minimum moist unit weight of the soils used as covering fill above the foundation should meet or exceed the design value of 110 pcf (approximately 95 pcf dry density at a long-term moisture content of about 15 percent) or 95 percent of maximum dry density as determined by laboratory Standard Proctor testing. Each lift should have a uniform thickness appropriate for the equipment being used. During construction, the top surface of the fill should be kept with sufficient slope (¼-inch per foot) to allow runoff of water during a rainfall without inducing erosion. Periodic inspection and testing should be performed during the work to verify that the recommended compaction has been achieved.

4.2 Dewatering and Buoyancy

Based on the results of the geotechnical investigation, many investigated locations at the site were observed to have groundwater in the upper 15 feet of soil (Table 2), but the remaining locations did not encounter groundwater shallower than 15 feet while drilling. However, it is likely that the primarily clayey soil at the site did not allow for the phreatic surface in the boreholes to stabilize. The results of the piezometer monitoring to date indicate that even though groundwater was observed deeper during the drilling process, the long term groundwater is generally present in the upper 15 feet of soil. Much of the project site tends to be poorly drained due to the clayey soils. In summary, a buoyant foundation may be necessary for the majority of the site. A design groundwater level of approximately 0.5 feet below the existing grade is recommended based on the piezometer readings to date.

In the event of heavy rainfall, the low permeability of the clay soils and rock could limit water outflow from the excavation and typical dewatering can be achieved by use of a sump pit and small pump. Sand seams or sand stringers of variable depth and location should be anticipated, and some dewatering due to perched water may be required, even where shallow groundwater is not identified. Other drainage elements such as sub-drains or fill instrumentation are likely not required, but multiple sumps and pumps may be needed for some excavations. Excavations should be allowed to dry before continuing with construction. At no time should water be allowed to pond on the base of the excavations as it may lead to softening of the subgrade soils.

4.3 Foundation Design Parameters

Investigation and testing of the proposed wind turbine locations found the presence of primarily clay soils overlying carbonate bedrock, with occasional sand layers. The results of the geotechnical investigation indicate that the site is suitable for a spread footing foundation system. Based on these conditions and the analysis presented below, a conventional spread footing bearing on native soil approximately 8 feet below grade is a feasible and cost effective foundation system to utilize.

A summary of the recommended geotechnical parameters for use in conventional spread footing wind turbine foundation design is provided in Table 8.

4.4 Spread Footing Foundation Analysis

At the time of this report, the current foundation design has not been provided to Barr. To estimate the allowable geotechnical limit states, the foundation parameters below were used, which were taken from a GE2.5-116 wind turbine with a 90 meter hub height. The following loading conditions were estimated for spread footing design and were used for analysis of the bearing capacity, stiffness, and settlement of the soils supporting the proposed foundation:

General Foundation Design Assumptions (GE 2.5-116 wind turbine):

Foundation Diameter = 54 ft

Embedment Depth = 8 ft

Normal Loading Conditions:

Vertical Load = 3,692 kips

Horizontal Load = 104 kips

Effective Area = 1,569 ft^2

Effective Length = 45.3 ft

Effective Width = 34.7 ft

Normal Extreme Loading Conditions:

Vertical Load = 3,690 kips

Horizontal Load = 115 kips

Effective Area = 1,378 ft^2

Effective Length = 47.6 ft

Effective Width = 31.3 ft

Abnormal Extreme Loading Conditions:

Vertical Load = 3,943 kips

Horizontal Load = 166 kips

Effective Area = 1,161 ft^2

Effective Length = 42.3 ft

Effective Width = 27.5 ft

Calculation of the ultimate and allowable bearing capacity (gross and net), anticipated total and differential settlement, and foundation stiffness should be performed by the foundation engineer based on the final foundation design/designs selected.

4.4.1 Allowable Bearing Capacity for Spread Footing Foundations

The spread footings should bear on a mixture of soil (clay and sand) and/or bedrock (limestone). The following sections discuss, in detail, the determination of the allowable bearing capacity for the wind turbine foundations.

Allowable soil bearing pressure for a spread footing is based on the shear strength obtained from testing and investigation. A discussion of the soil shear strength was provided in Section 3.5. The following is a more detailed description of the procedure used to determine the allowable bearing capacity.

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

$$q_{ult} = \tfrac{1}{2} b_{eff} \gamma' N_\gamma s_\gamma i_\gamma + p_o N_q s_q i_q + s_u N_c s_c i_c$$ (Riso, 2002)

where:

q_{ult} = ultimate bearing pressure

γ' = effective unit weight of the soil

b_{eff} = effective footing width over the length in bearing

N_γ = bearing capacity factor

p_o = surcharge at foundation level

N_q = bearing capacity factor

s_u = design undrained shear strength of the soil

N_c = bearing capacity factor

i = inclination factors

s = shape factors

The first and second terms of the above equation are associated with granular soils which typically exhibit drained modes of failure (except under earthquake loading) and where excess pore pressures are allowed to dissipate when the soil when sheared. These terms represent the ultimate drained bearing capacity.

The third term of the equation is associated with fine-grained/clayey soils which typically exhibit an undrained mode of failure and where excess pore pressures can build up in the soil when sheared. This term represents the ultimate undrained bearing capacity.

Since the soils encountered at the project site have layers of both granular and cohesive materials the critical mode of failure may be associated with either drained or undrained conditions and the ultimate bearing capacity was calculated for each.

4.4.1.1 Bearing Capacity – Undrained Analysis

During undrained loading conditions where excess pore pressures can build up in the soil when sheared, the first term is dropped from the Terzaghi equation, and the second term reduces to the overburden pressure, representing the ultimate undrained bearing capacity shown as follows:

$$q_{ult} = p_o + s_u N_c S_c i_c$$ (Riso, 2002)

The following are formulas for the dimensionless factor, N_c, and shape (i_c) and inclination (s_c) factors above (Riso, 2002):

$$N_c = \pi + 2 = 5.14 \text{ (for } \phi = 0)$$

$$i_c = \frac{1}{2} + \frac{1}{2}\sqrt{1 - \frac{H_d}{A_{eff} s_u}}$$

$$s_c = 1 + 0.2\frac{b_{eff}}{l_{eff}}$$

where:

b_{eff} = average effective footing width

l_{eff} = average effective footing length

H_d = design horizontal load

A_{eff} = effective area as a result of a wind load causing a moment on the foundation

The allowable soil bearing pressure is then obtained by dividing the ultimate bearing capacity by an appropriate factor of safety. The following factors of safety are taken from Bowles (1996):

	1.84 for abnormal extreme wind loads
Factor of safety =	2.26 for extreme wind loads
	3.00 for normal operation loads

The safety factor for abnormal extreme wind loads was adjusted by the ratio of the load factors for the abnormal extreme (1.1) and the extreme (1.35) wind loads.

Based on the assumed foundation design, a groundwater level of 0.5 feet below grade, and the recommended design undrained shear strength of 1,250 psf, the gross allowable soil bearing pressure is estimated to be approximately 2,600 psf under normal operation loads, 3,400 psf under extreme loading, and 4,100 psf under abnormal extreme loading.

4.4.1.2 Bearing Capacity – Drained Analysis

During drained loading conditions soils where excess pore pressures are allowed to dissipate when sheared, the third term is dropped from the Terzaghi equation and the ultimate gross drained bearing capacity is estimated as follows:

$$q_{ult} = \frac{1}{2} b_{eff} \gamma' N_\gamma s_\gamma i_\gamma + p_o N_q s_q i_q$$ (Riso, 2002)

The following are formulas for the dimensionless factors, N_γ and N_q, and shape (s_γ, s_q) and inclination (i_γ, i_q) factors above (Riso, 2002):

$$N_q = e^{\pi \tan\phi} \frac{1 + \sin\phi}{1 - \sin\phi}$$

$$N_\gamma = \frac{1}{4}\left(\left(N_q - 1\right)\cos\phi\right)^{3/2}$$

$$s_\gamma = 1 - 0.4 \frac{b_{eff}}{l_{eff}}$$

$$s_q = 1 + 0.2 \frac{b_{eff}}{l_{eff}}$$

$$i_q = \left(1 - \frac{H_d}{V_d}\right)^2$$

$$i_\gamma = F_{qi}^2$$

where:

q_{ult} = ultimate bearing pressure

γ' = effective unit weight of the soil

b_{eff} = average effective footing width in bearing

L_{eff} = average effective footing length in bearing

N_q, N_γ = bearing capacity factors

p_o = surcharge at foundation level

s,i= shape and inclination factors

Based on the assumed foundation design and the recommended design drained shear strength (friction angle) of 30 degrees for granular soils, the gross allowable soil bearing pressure is 7,000 psf for the normal load case, 9,800 psf for the normal extreme load case, and 10,900 for the abnormal extreme load case.

4.4.1.3 Bearing Capacity Determination

Based on the results of the bearing capacity analysis, the results based upon the undrained strength is the limiting case. Therefore, the gross allowable bearing capacity from the undrained strength analysis is recommended for design and presented in Table 8.

4.4.2 Foundation Stiffness for Spread Footing Foundations

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

$$G_O = \rho V_S^2 \qquad \text{(Kramer, 1996)}$$

where

G_o = shear modulus at small strain

V_s = shear wave velocity from geophysical testing

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

In order to estimate the small strain shear modulus, a shear wave velocity of 1,247 ft/s was selected as the design value (Section 3.6). For an in-situ soil unit weight of approximately 135 lbs/ft^3 (average value from laboratory testing), the small strain shear modulus is computed to be approximately G_o = 6,520 kips per square foot (ksf).

For foundation design, the structural engineer will need to reduce the shear modulus based upon the stress placed on the soil by the foundation.

4.4.3 Foundation Settlement for Spread Footing Foundations

Immediate, long-term, and differential settlements of the foundation were computed based on results of the geotechnical investigation and testing described here. The established limits for the tilt of the GE foundation are 0.17 degrees for soil settlement (or 3mm/m) (GE Wind Power, LLC. 2006). A total settlement limit is not stipulated. The tolerance of differential settlement is estimated to be approximately 1.05 inch over the effective area of foundation bearing for normal loading conditions, based on the assumed foundation design.

4.4.3.1 Elastic Settlement

Elastic or immediate settlement is caused by elastic deformation of soil particles when effective stress is increased and is considered to be fully recoverable. The wind turbine foundation is considered to be a flexible foundation with uniform contact pressure and non-uniform deformation. The immediate settlement can be computed based on the application of the abnormal extreme wind load, using the following equation based on elastic theory for clay soils:

$$S=\frac{b_{eff}q_o}{E_s}\left(1-\nu^2\right)I$$ (Das, 2007)

where:

S = elastic settlement

b_{eff} = effective foundation width

q_o = contact pressure applied from foundation

E_s = elastic soil modulus = $2G_o(1+\upsilon)b$ = 5,555 ksf (G_o = 6,520 ksf from Section 4.4.2 and b = 0.3, typical reduction factor from small strain to one percent strain)

ν = Poisson's ratio (0.42 from Section 3.6)

I = shape factor = 1.12 (Day, 2006)

Using this formula, the foundation design engineer can compute the immediate settlements induced by the footing under the abnormal extreme load. Based on an applied bearing pressure increase of approximately 2,800 psf (from the assumed foundation design), the total immediate settlement is estimated to be on the order of ¼-inch.

4.4.3.2 Long-Term Settlement

The subsurface conditions encountered during the field work indicated that the material encountered at the anticipated foundation bearing depth of approximately 8 feet below grade generally consists of clay, with few sand layers. Based on observations made during drilling at many wind turbine locations there appears to be significant units of saturated clay at depth. At these locations, the clay will be subject to consolidation or long-term settlement.

The long-term settlement of clay soils supporting the foundation can be computed using consolidation characteristics and the following equation:

$$S=\frac{C_r}{1+e_o}\cdot L\cdot\log\left(\frac{\sigma'_p}{\sigma'_{vo}}\right)+\frac{C_c}{1+e_o}\cdot L\cdot\log\left(\frac{\sigma'_f}{\sigma'_p}\right)$$ (Das, 2007)

where:

C_r = recompression index = 0.02 to 0.03 (Section 3.4.7)

C_c = compression index = 0.013 to 0.16 (Section 3.4.6)

e_o = initial void ratio = 0.482 to 0.498 (Section 3.4.6)

L = height of soil layer

σ'_p = maximum past effective stress where soil transitions from overconsolidated to normally consolidated

σ'_{vo} = original effective stress at the midpoint of the clay layer below foundation (normal operating load conditions)

σ'_f = final effective stress equal to $\sigma'_{vo} + \Delta\sigma'$, where $\Delta\sigma'$ = average pressure increase to the clay layer caused by the added load

A review of the preconsolidation pressures estimated from laboratory testing and computed overconsolidation ratios indicated that the clay soil is overconsolidated, which is relatively typical for glacial till soil.

Using this formula, the foundation design engineer can compute the long-term consolidation settlements induced by the footing, based on the application of the normal operating load. To calculate the consolidation settlement, the soil was split into multiple layers, with the effective stress recalculated at the midpoint of each layer. The depth of calculation was taken as twice the approximate width of the foundation plus embedment.

Considering the time required for long-term settlement from cohesive soils, differential settlement will be realized as a function of the applied foundation load during mean operating conditions at the center of the effective bearing area, and at the loaded edge of the wind turbine foundation. Based on the results of the settlement estimated laboratory consolidation testing, the differential settlement across the wind turbine foundation can be calculated using the following equation.

$$\Delta S = \frac{S - S_{edge}}{\frac{b}{2} + e}$$

where:

ΔS = differential settlement

S = settlement due to mean or normal operating load (calculated settlement at center of effective bearing area)

S_{edge} = settlement due to mean or normal operating load (calculated settlement at edge of the foundation)

B = effective bearing area width (calculated from 2*(R-e))

R = foundation radius

e = load eccentricity under mean operating conditions

The soil parameters over the footing width should remain constant, so only the applied load from the wind turbine differs from the center of the effective area to the edge of the wind turbine foundation. The soil stress from the wind turbine foundation at the center of the effective bearing area and at the edge of the foundation was calculated using the following formula:

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

where,

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

I = Influence factor varying with depth and location beneath foundation

q = foundation bearing pressure for mean operating load condition

The influence factor at the center of the effective bearing area was calculated using the following equation:

$$I = 1 - \frac{1}{\left[\left(\frac{0.5b}{D_{min} - D_f}\right)^2 + 1\right]^{\frac{3}{2}}} \qquad \text{(Das, 2000)}$$

where,

b = effective foundation width

D_{mid} = depth to midpoint of soil layer

D_f = bearing depth of foundation

The influence factor for the edge of the foundation was calculated using the design figure, Influence Value for Vertical Stress Under Uniformly Loaded Circular Area (NAVFAC, 1986), with an *x/r* value of 1.0, which is at the edge of the loaded area under mean loading conditions.

Influence values at the center of the area and at the edge of the foundation were calculated for at the midpoint of each layer where settlement was analyzed and calculated.

Based the results of the consolidation tests and a maximum net increase in applied loading pressure of about 1,925 psf, the calculated long-term settlement is on the order of 0.90 to 2.36 inches (center/max) and the corresponding differential settlement is estimated to range from approximately 0.41 to 1.03 inches. The calculated differential settlement was below the threshold of 1.05 inches, exhibiting differential settlement below the typical industry threshold value of 3 mm/m.

The immediate, long-term, and differential settlement estimates should be performed based on the final foundation design to verify that the settlement will be tolerable.

4.4.4 Shrink-Swell Potential

Clays of low plasticity were commonly encountered in the geotechnical borings across the project site. The shrink/swell potential of a soil is related to its liquid limit and plasticity index. Soils with liquid limit values less than 50 percent and plasticity index values less than 15 percent are considered to have low shrink-swell potential. Soils with liquid limit values less of 50 to 60 percent and plasticity index values of 15 to 30 are considered to have moderate shrink-swell potential. Soils with liquid limit values greater than 60 percent and plasticity index values greater than 30 are considered to have high shrink-swell potential (Das, 2007). Atterberg testing indicated Liquid Limits ranging from about 18 to 36 percent, Plastic Limits ranging from 14 to 19 percent, and Plasticity Indices ranging from 4 to 19 percent. Based on the results of the Atterberg Limits testing, the clay soils at the site are considered to have low shrink-swell potential, and the foundation design does not need to account for swelling soil. This is generally consistent for other nearby projects in Ohio constructed on glacial till soil.

4.4.5 Wind Turbine Locations with Lower Strength Soil

Based on the results of the geotechnical investigation, the following investigated wind turbine sites exhibit zones of lower strength or compressible soils (lower than the design shear strength from below the assumed foundation embedment depth) that may require further evaluation or some measure of soil remediation for support of wind turbine foundations:

- GEO-007
- GEO-008
- GEO-009
- GEO-036
- GEO-042
- GEO-047
- GEO-052
- GEO-053
- GEO-056
- GEO-059
- GEO-062
- GEO-070
- GEO-077
- GEO-079
- GEO-082
- GEO-083
- GEO-091
- GEO-092
- GEO-093

Further details regarding the additional analysis and recommendations or further analyses for these sites is provided in Appendix H.

The above list is based on the investigated wind turbine locations to date for the project.

Due to natural variations in the subsurface soil profile, it is possible that unsuitable soils may be encountered at any wind turbine location during the foundation excavation. A geotechnical engineer or person under direct supervision of this engineer should inspect the all excavations for unsuitable soils prior to placement of the mud mat. If unsuitable soils are encountered during the course of the foundation excavation, the foundation designer should be notified and methods for soil remediation should be implemented.

4.4.6 Soil Remediation

At this time, no investigated locations exhibited lower strength and/or higher compressibility soils considered unsuitable for wind turbine foundation support based on field and/or laboratory testing.

If required based on the results of construction phase testing, soil remediation via the use of engineered fill or stone columns/aggregate piers may be used. Specific details regarding different soil remediation options are discussed below.

4.4.6.1 Engineered Fill

Remediation by engineered fill includes the removal of weak material (over-excavation) and replacement with compacted engineered fill. An engineered fill approach is typically performed where improvement depths are no greater than 4 to 6 feet below the foundation embedment depth. At depths beyond 4 to 6 feet, the excavations generally become too large and expensive as a result of the need for oversizing, equipment limitations, and haul prices for fill.

Engineered fill used to replace the shallow soft soils at the proposed wind turbine sites should consist of granular material (Section 4.1.4.1). Alternative engineered fill materials may be used depending upon availability and approval by the foundation engineer. Loose lifts should not exceed 9 inches. The engineered fill should be compacted to a minimum of 98 percent of standard Proctor maximum dry density. The excavations and subsequent placement of engineered fill should be oversized by 1-foot on all sides for each foot of excavation below the foundation embedment depth. For example, a 1-foot excavation below the foundation depth will require a bottom of foundation width (and length) 2 feet wider than a standard foundation width (1-foot on each side of the footing). The base of every excavation should be inspected by a representative of the geotechnical engineer to evaluate the soil conditions at the over-excavation subgrade prior to engineered fill placement.

4.4.6.2 Stone Columns or Rigid Inclusions

An alternate ground improvement method is construction of aggregate piers, commonly referred to as stone columns or rigid inclusions. Stone columns are constructed by drilling to open a hole, then placing aggregate, and using deep vibratory and/or compaction methods to densify the aggregate and surrounding native soils to increase the strength and stiffness of the aggregate and surrounding soil. Stone columns are generally used when the depth of improvement ranges from 12 to 35 feet (although these limits are dependent on equipment and material considerations). Load tests should be conducted to verify the bearing capacity of the improved soil stratum. Alternative rigid inclusion ground improvement methods may also be considered.

4.4.6.3 Use of Alternate Turbine Location

A final option for the project is to relocate some or all of the wind turbine locations requiring soil remediation for wind turbine foundation support to alternate wind turbine locations, some of which have been explored as a part of this geotechnical investigation. If the alternate sites appear better suited to support the proposed foundations with little or no remediation required, a significant savings in construction costs can be realized by using these sites. If new (unexplored) turbine locations are selected which are greater than 50 feet from the investigated locations, each new location should be evaluated for foundation support by additional geotechnical exploration and engineering analysis of the test results. Evaluation at new locations should generally consist of geotechnical borings and laboratory testing.

4.4.7 Frost Depth

The extreme frost penetration depth for the wind turbine locations is a depth of 36 inches (NAVFAC, 1986). The anticipated embedment depth of the wind turbine foundations exceeds the published extreme frost penetration for the project area.

4.4.8 Sliding Friction

The friction coefficient between the soil at the site and concrete should be taken as 0.40 in accordance with recommendations provided by Potyondy (1961), assuming a plain concrete surface.

4.4.9 Seismic Design Parameters

The project site is located in a relatively inactive seismic region. The parameters outlined below are recommended for design based on the 2012/2015 International Building Code (USGS, 2018). Note that the parameters are based on Site Class B and should be revised accordingly by the foundation engineer to account for Site Class C conditions. Note that the east and west portions of the project site have different values and the foundation designer should consider the differences during foundation design.

S_S = 0.125g for the east portion of the site and 0.128g for the west portion of the site (Site Class B)

S_1 = 0.056g for the east portion of the site and 0.057g for the west portion of the site (Site Class B)

Recommended Site Classification: Class C

4.4.10 Cement Type

Based on the results of soil chemical testing presented in Section 3.3 and Table 5, the sulfate levels in the soil are considered negligible (ACI, 2014). Therefore, in accordance with recommendations by ACI (2014), the use of Type I cement appears suitable for use at the site. The presence of low pH values determined through laboratory testing may require an adjustment to the concrete mix. Specifically, the adjusted mix design should target a lower permeability to provide additional protection of the reinforcing steel. (Kosmatka and Panarese, 1988). The same methods used to create a mix design of this sort also serve to increase mix strength and reduce the time required to obtain that strength, which is often preferred by contractors. The foundation engineer of record has final responsibility for selection or approval of an appropriate concrete mix design.

4.4.11 Modulus of Subgrade Reaction

The following vertical moduli of subgrade reaction are recommended for the design of structures at this site based on soil types encountered in accordance with the Army Corp of Engineers Manual EM 1110-3-141 (1984):

Modulus of Soil Reaction (*k*) = 200 pounds per cubic inch (pci) – sand soils
100 pounds per cubic inch (pci) – clay soils

4.5 Discussion of Karst Potential Risk and Potential Mitigation Strategies

In summary, there is some potential for karst-related settlement at the site due to the presence of the underlying Columbus Limestone. Within the project boundaries, large voids or historic sinkholes were not observed across the site indicating the potential for rapid, large-scale collapse of the wind turbine sites is relatively low. However, the presence of the Seneca caverns northeast of the project site indicates that there is a historical presence for development of karst near the site.

Table 1 provides a summary of the overall risk of potential karst at each investigated location to date.

Based on the depth to the potential indicators of karst and a review of the video data at investigated locations GEO-025, GEO-045, GEO-047, GEO-051, and GEO-060, the risk of excessive settlement from karst development to the proposed wind turbines at those locations is considered low. In addition, the other investigated locations where potential indicators of karst were not observed are also considered to have a low risk.

Highly fractured zones and a high frequency of washouts and thinner soil-filled openings were observed at investigated locations GEO-003, GEO-022, GEO-028, GEO-048, GEO-078, GEO-086, GEO-088, and GEO-096, which indicate that collapse of karst features may be slightly more likely. The settlement would likely be on the order of several inches, but an exact magnitude of settlement is difficult to predict. These sites are considered to have a moderate risk for subsurface collapse at this time. Investigated locations GEO-021 and GEO-066 have a higher potential for collapse of the karst features due to frequent open or soil-filled voids extending away from the boreholes and higher magnitude settlement on the order of the thickness of the voids. Barr recommends grouting be performed at these sites to reduce the risk of collapse of the larger open voids observed in the borings.

It is possible that there are other conditions on the site similar to those encountered at investigated locations GEO-021 and GEO-066 which were not detected by the subsurface explorations. Ultimately, there is some level of risk associated with the site and proposed development due to the fact that the site is underlain by rock known to exhibit karst features. It is not possible to completely rule out the potential for sinkhole development or karst related problems in the future and the site developer/owner must understand that some level of karst risk remains.

Barr has performed grouting design for previous wind power projects situated on potentially karstic terrain as a mitigation strategy.

5.0 Limitations of Analysis

The analysis and conclusions provided are based on the results of fieldwork from the recent investigations. Using generally accepted engineering methods and practices, the investigation performed has made every reasonable effort to characterize the site. However, the likelihood that conditions may vary from any specific location tested is still possible, and careful attention to subsurface conditions should be undertaken during the time of construction by qualified personnel.

During construction, if wind turbines are subsequently relocated to different locations, additional soil testing may be recommended to ensure that soil conditions at the relocated wind turbines sites are of similar characteristics to that assumed when designing this project. Based on the conditions encountered at the project site, wind turbine relocations greater than 50 feet from the existing soil boring location should require re-testing.

6.0 References

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Tables

Table 1

Summary of Depth to Bedrock and Indications of Karst from Geotechnical Borings

Geotech ID	Investigated Depth [feet]	Depth to Intact Bedrock [feet]	Depth of Potential Observed Karst [feet]	Overall Risk of Potential Karst
GEO-001	56.5	55.0		Low
GEO-002	61.5	NE		Low
GEO-003	60.0	19.0	22-28	Medium
GEO-004	60.5	42.0		Low
GEO-005	60.5	46.0		Low
GEO-006	58.5	57.5		Low
GEO-007	60.5	32.0		Low
GEO-008	60.0	35.0		Low
GEO-009	62	NE		Low
GEO-010	Not drilled			
GEO-011	Not drilled			
GEO-012	Not drilled			
GEO-013	56.5	56.5		Low
GEO-014	56.5	51.5		Low
GEO-015	48.5	48.5		Low
GEO-016	60.0	NE		Low
GEO-017	Not drilled			
GEO-018	60.0	8.5		Low
GEO-019	62.5	17.5		Low
GEO-020	62.0	23.0		Low
GEO-021	60.0	17.5	30-31.5	High
GEO-022	60.0	20.0	25-40	Medium
GEO-023	Not drilled			
GEO-024	47.5	47.5		Low
GEO-025	60.0	40.0	57-60	Low
GEO-026	60.0	11.0		Low
GEO-027	Not drilled			
GEO-028	60.0	7.0	9-12	Medium
GEO-029	Not drilled			
GEO-030	47.5	47.5		Low
GEO-031	60.0	25.5		Low
GEO-032	Not drilled			
GEO-033	61.5	NE		Low
GEO-034	61.5	NE		Low
GEO-035	61.5	NE		Low
GEO-036	61.5	NE		Low
GEO-037	61.5	NE		Low
GEO-038	61.5	NE		Low
GEO-039	49.5	48.0		Low
GEO-040	61.5	NE		Low
GEO-041	61.5	NE		Low
GEO-042	61.5	NE		Low
GEO-043	61.5	NE		Low
GEO-044	61.5	NE		Low
GEO-045	60.0	17.5	57-60	Low
GEO-046	Not drilled			
GEO-047	61.0	20.5	43-59	Low
GEO-048	60.0	22.0	22-23, 35-36, 57.5-58	Medium

Geotech ID	Investigated Depth [feet]	Depth to Intact Bedrock [feet]	Depth of Potential Observed Karst [feet]	Overall Risk of Potential Karst
GEO-049	60.0	4.8		Low
GEO-050	60.0	11.5		Low
GEO-051	62.0	24.0	45-45.5	Low
GEO-052	61.5	NE		Low
GEO-053	61.5	NE		Low
GEO-054	Not drilled			
GEO-055	Not drilled			
GEO-056	61.5			Low
GEO-057	Not drilled			
GEO-058	Not drilled			
GEO-059	61.5	NE		Low
GEO-060	61.0	9.0	58-61	Low
GEO-061	51.5	51.5		Low
GEO-062	61.5	NE		Low
GEO-063	61.5	NE		Low
GEO-064	Not drilled			
GEO-065	Not drilled			
GEO-066	60.0	2.2	30-42.5, 57.5-58	High
GEO-067	Not drilled			
GEO-068	60.5	12.7		Low
GEO-069	60.0	26.4		Low
GEO-070	60.5	41.0		Low
GEO-071	61.5	NE		Low
GEO-072	55.5	55.5		Low
GEO-073	Not drilled			
GEO-074	61.5	NE		Low
GEO-075	61.5	NE		Low
GEO-076	61.5	NE		Low
GEO-077	61.5	NE		Low
GEO-078	60.0	7.0	36-38	Medium
GEO-079	61.5	NE		Low
GEO-080	Not drilled			
GEO-081	61.5	NE		Low
GEO-082	56.5	56.5		Low
GEO-083	50.0	50.0		Low
GEO-084	60.0	15.5		Low
GEO-085	61.5	NE		Low
GEO-086	61.5	8.5	18.5-19.5	Medium
GEO-087	50.0	50.0		Low
GEO-088	60.0	21.0	20-22	Medium
GEO-089	61.0	15.0		Low
GEO-090	61.5	NE		Low
GEO-091	61.5	NE		Low
GEO-092	61.5	NE		Low
GEO-093	61.5	NE		Low
GEO-094	60.5	24.5		Low
GEO-095	Not drilled			
GEO-096	60.0	8.4	41.5-42.5	Medium

*NE - Not Encountered

Table 2
Summary of Groundwater Levels from Geotechnical Borings and Piezometers

Geotech ID	Groundwater Depth [feet] While Drilling	After Drilling / Before Coring	Piezometer Measurement - May 2018
GEO-001	45.0	34.0	--
GEO-002	NE	NE	--
GEO-003	10.2	NE	--
GEO-004	26.0	15.5	1.9
GEO-005	NE	NE	1.4
GEO-006	30.5	NE	--
GEO-007	30.0	30.0	9.8
GEO-008	NE	29.0	--
GEO-009	41.5	42.0	--
GEO-010	Not drilled		--
GEO-011	Not drilled		--
GEO-012	Not drilled		--
GEO-013	20.0	NE	--
GEO-014	41.0	NE	--
GEO-015	38.0	36.5	--
GEO-016	30.0	9.5	--
GEO-017	Not drilled		--
GEO-018	3.0	2.0	3.7
GEO-019	12.0	17.5	--
GEO-020	9.5	16.8	--
GEO-021	16.0	8.0	0.7
GEO-022	9.0	6.3	--
GEO-023	Not drilled		--
GEO-024	NE	NE	--
GEO-025	29.5	33.7	--
GEO-026	11.0	12.0	--
GEO-027	Not drilled		--
GEO-028	NE	NE	--
GEO-029	Not drilled		--
GEO-030	21.0	15.0	--
GEO-031	NE	NE	--
GEO-032	Not drilled		--
GEO-033	60.5	44.0	--
GEO-034	20.0	30.0	--
GEO-035	25.0	51.0	2.8
GEO-036	20.0	NE	--
GEO-037	15.0	37.0	--
GEO-038	36.5	NE	--
GEO-039	40.0	32.0	--
GEO-040	25.0	35.0	--
GEO-041	56.3	37.5	--
GEO-042	46.0	38.0	--
GEO-043	55.0	54.0	--
GEO-044	12.5	55.0	--
GEO-045	8.0	2.0	--
GEO-046	Not drilled		--
GEO-047	4.5	15.0	--
GEO-048	6.0	15.5	--

Geotech ID	Groundwater Depth [feet] While Drilling	After Drilling / Before Coring	Piezometer Measurement - May 2018
GEO-049	5.0	5.0	--
GEO-050	7.8	8.0	3.3
GEO-051	12.5	8.5	--
GEO-052	NE	NE	--
GEO-053	25.0	17.5	--
GEO-054	Not drilled		--
GEO-055	Not drilled		--
GEO-056	35.5	50.0	--
GEO-057	Not drilled		--
GEO-058	Not drilled		--
GEO-059	40.0	NE	--
GEO-060	3.0	14.0	4.7
GEO-061	NE	NE	--
GEO-062	22.5	41.0	--
GEO-063	44.0	37.0	--
GEO-064	Not drilled		--
GEO-065	Not drilled		--
GEO-066	NE	NE	--
GEO-067	Not drilled		--
GEO-068	6.5	4.8	--
GEO-069	18.0	18.7	--
GEO-070	NE	32.0	--
GEO-071	31.0	35.0	--
GEO-072	29.0	29.0	--
GEO-073	Not drilled		--
GEO-074	NE	56.0	--
GEO-075	31.5	42.0	--
GEO-076	8.0	NE	--
GEO-077	40.0	43.0	--
GEO-078	NE	NE	--
GEO-079	51.5	50.0	--
GEO-080	Not drilled		--
GEO-081	25.0	40.0	--
GEO-082	45.0	NE	--
GEO-083	21.0	NE	--
GEO-084	12.0	4.0	3.8
GEO-085	35.0	NE	--
GEO-086	NE	NE	--
GEO-087	20.0	30.0	--
GEO-088	NE	NE	--
GEO-089	14.0	0.5	--
GEO-090	18.0	35.0	--
GEO-091	20.0	48.0	--
GEO-092	30.0	57.0	1.5
GEO-093	30.0	25.5	--
GEO-094	12.5	9.0	--
GEO-095	Not drilled		--
GEO-096	6.5	4.0	--

NE - Not Encountered
-- Piezometer Not Installed

Table 3
Physical Laboratory Testing Summary

Sample Location						Atterberg Limits													
Geotech ID	Depth [ft]	Approx. Soil Type	Moisture Content [%]	Dry Unit Weight [pcf]	Moist Unit Weight [pcf]	Liq. Limit	Plast. Limit	Plast. Index	Unconfined Compres-sive Strength [tsf]	UU Triaxial Maximum Deviator Stress [tsf]	Percent Gravel [%]	Percent Sand [%]	Percent Silt [%]	Percent Clay [%]	Percent Fines [%]	Peak Friction Angle [degrees]	Preconsol-idation Pressure, σ'_p [tsf]	Compression Index (C_c)	Recompression Index (C_r)
						[% moisture content]													
GEO-001	12.5-14	CL				31	16	15											
	17-19	CL	17.1	114.6	134.2					3.1									
	24-25.5	CL	17.3																
	35-36.5	CL	16.7																
	43-44.5	CL	16.1	117.5	136.4					4.8									
GEO-002	7.5-9	CL	16.3																
	15-16.5	CL	16.2																
	30-31.5	CL	16.6																
	45-46.5	SM	4.6								13.6	71.3			15.1				
	55-56.5	CL	12.8																
GEO-003	7.5-9	CL	14.4	120.4	137.7				6.6										
	15-16.5	CL	12.3			27	15	12											
	16.5-17.5	CL	14.7	120.1	137.8					1.5									
GEO-004	7.5-9	CL	15.8																
	15-16.5	CL	14.6																
	35-36.5	CL	18.5																
GEO-005	12.5-14	CL	15.9																
	20-21.5	CL	16.7																
	25-26	CL	16.8	115.0	134.3				2.5										
	35-36.5	CL	16.4																
GEO-006	10-11.5	CL	16.7																
	20-21.7	CL	16.6	115.9	135.1				3.3										
	30-31.5	CL	16.2																
	40-41.5	CL	15.7																
	45-47	CL	16.7	114.8	134.0				2.3										
	55-57	CL	16.9																
GEO-007	7.5-9	CL	16.6																
	12.5-14	CL	15.3																
	25-26.5	CL	15.0																
	27-29	CL	12.8	124.0	139.9					2.8									
GEO-008	10-11.5	CL	18.2																
	15-16.5	CL	17.5																
	20-22	CL	18.5	112.2	133.0					2.2									
	30-31.5	CL	14.2																
GEO-009	7.5-9	CL	16.6																
	22-24	CL	16.8	115.3	134.7				2.4										
	35-36.5	CL	16.3																
	55-56.5	CL	14.5																
GEO-010																			
GEO-011																			
GEO-012																			
GEO-013	7.5-9	CL	15.8																
	15-16.5	CL	16.9	115.2	134.7				4.9										
	20-21.5	CL	14.5																
	30-31.5	GP-GM	11.3								49.5	39.8			10.7				
	40-41.5	CL	24.2																
	50-51.5	SC	11.6																
GEO-014	10-11.5	CL	16.6																
	20-21.5	CL	14.9	120.5	138.5				6.3										
	35-36.5	SP-SM	13.6																
	45-46.5	SM									0.0	82.1			17.9				

Sample Location						Atterberg Limits													
Geotech ID	Depth [ft]	Approx. Soil Type	Moisture Content [%]	Dry Unit Weight [pcf]	Moist Unit Weight [pcf]	Liq. Limit [% moisture content]	Plast. Limit [% moisture content]	Plast. Index [% moisture content]	Unconfined Compres-sive Strength [tsf]	UU Triaxial Maximum Deviator Stress [tsf]	Percent Gravel [%]	Percent Sand [%]	Percent Silt [%]	Percent Clay [%]	Percent Fines [%]	Peak Friction Angle [degrees]	Preconsol-idation Pressure, σ'_p [tsf]	Compression Index (C_c)	Recompression Index (C_r)
GEO-015	7.5-9	CL	16.8																
	15-16.5	CL	18.1																
	25-26.5	CL	16.3																
	40-41.5	GC	8.9																
	48-48.5	SC	12.6																
GEO-016	10-11.5	CL	15.0																
	20-21.5	CL	17.1																
	28-30	CL	16.9	115.5	135.0				2.7										
	30-31.5	CL	18.3																
	45-46.5	GP-GM	5.4																
GEO-017																			
GEO-018	7.5-9	SC	17.3																
GEO-019	7.5-9	CL	19.6																
	12-14	CL	14.5	119.8	137.2					2.5									
GEO-020	7.5-9	CL	17.1																
	15-16.5	CL	15.3																
	16.5-18.5	CL	14.6	120.5	138.1					2.3									
GEO-021	7.5-9	CL	16.2																
	12.5-14	CL	13.0	125.2	141.5				4.3										
GEO-022	7.5-9.5	CL	18.5	111.0	131.5				2.6										
	12.5-14	CL	12.0																
	20-21.5	GP	13.0																
GEO-023																			
GEO-024	12.5-14	CL	18.0																
	20-21.5	CL	20.9			31	16	15											
	30-31.5	CL	13.9																
	40-41.5	SP-SM	17.7																
GEO-025	7.5-9	CL	17.2																
	15-16.5	CL	17.1			32	16	16											
	30-31.5	SM	14.5								0.0	54.7			45.3				
	47.5-48	CORE	3.2	154.3	159.2				867.5										
	58-58.5	CORE	1.9	162.3	165.4				874.1										
GEO-026	10-11.5	CL	22.5	105.2	128.9				2.1										
GEO-027																			
GEO-028																			
GEO-029																			
GEO-030	10-11.5	CL	10.3																
	20-21.5	CL	18.0																
	30-31.5	CL	15.1																
	40-41.5	SM	15.0	114.9	132.1											39.3			
GEO-031	7.5-9	CL	16.6																
	15-16.5	CL	16.3			29	16	13											
	25-26.5	SM	23.1																
	28.0	CORE	2.5	160.6	164.6				1280.9										
GEO-032																			
GEO-033	10-11.5	CL	16.2																
	20-21.5	CL	16.8																
	23-25	CL	16.9	114.9	134.3				2.1										
	35-36.5	CL	16.4																
	45-46.5	CL	16.0																
	60-61.5	ML	23.7																

Sample Location		Approx. Soil Type	Moisture Content [%]	Dry Unit Weight [pcf]	Moist Unit Weight [pcf]	Atterberg Limits [% moisture content]			Unconfined Compres-sive Strength [tsf]	UU Triaxial Maximum Deviator Stress [tsf]	Percent Gravel [%]	Percent Sand [%]	Percent Silt [%]	Percent Clay [%]	Percent Fines [%]	Peak Friction Angle [degrees]	Preconsol-idation Pressure, σ'_p [tsf]	Compression Index (C_c)	Recompression Index (C_r)
Geotech ID	Depth [ft]					Liq. Limit	Plast. Limit	Plast. Index											
GEO-034	7.5-9	CL	15.5																
	12.5-14	CL	16.2																
	20-21.5	CL	16.4																
	24-25	CL	16.1	111.3	129.2														
	35-36.5	CL	17.6																
	38-40	CL	15.8	117.3	135.8				3.0										
	50-51.5	SC	13.9																
GEO-035	7.5-9	CL				36	18	18											
	10-11.5	CL	15.7																
	18-20	CL	17.8	112.8	132.9				2.2										
	20-21.5	CL	17.6																
	22-24	CL	17.0	114.9	134.4				2.8										
	30-31.5	CL	17.0																
	37-39	CL	17.5	114.0	134.0				2.3										
	50-51.5	CL	16.4																
	60-61.5	CL	16.5																
GEO-036	10-11.5	CL	16.3																
	25-26.5	CL	17.9								1.8	15.4	46.3	36.5	82.8				
	33-35	CL	17.3	113.8	133.5				2.1										
	40.0	CL	17.0																
	55.0	SM	7.2																
GEO-037	10-11.5	CL	17.3																
	17-19	CL	17.0	115.0	134.6				3.2								4.0	0.13	0.02
	25-26.5	CL	17.0																
	33-35	CL	17.3	113.7	133.4				3.0										
	40-41.5	CL	17.0																
	55-56.5	SP-SM	18.3																
GEO-038	10-11.5	CL	19.3																
	14.5-16.5	CL	17.0	115.5	135.1					2.2									
	20-21.5	CL	17.0																
	35-36.5	CL	16.6																
	45-46.5	CL	11.1																
	60-61.5	CL	7.0																
GEO-039	7.5-9	CL	16.9																
	15-16.5	CL	14.8																
	25-26.5	CL	14.9																
	28-30	CL	14.0	123.1	140.3				2.5										
	40-41.5	CL	13.0																
GEO-040	10-11.5	CL	16.5																
	15-16.5	CL	16.0																
	23-25	CL	16.6	115.8	135.0				2.9										
	25-26.5	CL	16.3																
	35-36.5	CL	17.1																
	50-51.5	CL	17.8																
	60-61.5	GC-GM	11.2																
GEO-041	7.5-9	CL	13.1																
	15-17	CL	17.5	114.3	134.3				2.6										
	20-21.5	CL	17.4																
	30-31.5	CL	17.1																
	40-41.5	CL	15.8																
	55-56.5	CL	14.6																
GEO-042	7.5-9	CL	20.3																
	17-19	CL	17.1	114.5	134.1				2.2										
	37-39	CL	18.3	112.3	132.9				1.8										
	55-56.5	CL	17.2																

Sample Location						Atterberg Limits													
Geotech ID	Depth [ft]	Approx. Soil Type	Moisture Content [%]	Dry Unit Weight [pcf]	Moist Unit Weight [pcf]	Liq. Limit [% moisture content]	Plast. Limit [% moisture content]	Plast. Index [% moisture content]	Unconfined Compres-sive Strength [tsf]	UU Triaxial Maximum Deviator Stress [tsf]	Percent Gravel [%]	Percent Sand [%]	Percent Silt [%]	Percent Clay [%]	Percent Fines [%]	Peak Friction Angle [degrees]	Preconsol-idation Pressure, σ'_p [tsf]	Compression Index (C_c)	Recompression Index (C_r)
GEO-043	7.5-9	CL	15.4																
	10-11.5	CL				32	16	16											
	15-16.5	CL	13.0								2.1	18.6	44.0	35.3	79.3				
	25-26.5	CL	17.9																
	30-32	CL	18.6	112.2	133.1				2.0										
	35-36.5	CL	18.8																
	50-51.5	CL	17.3																
GEO-044	7.5-9	CL	15.1																
	12.5-14	CL	15.9																
	20-21.5	CL	17.7																
	25-27	CL	17.7	113.8	133.9				2.8										
	35-36.5	CL	18.5																
	45-46.5	CL	16.7																
	60-61.5	CL	10.5																
GEO-045	10-11.5	SC	19.6																
GEO-046																			
GEO-047	10-12	SM	22.3	93.3	114.1					1.3									
	20-21.5	CL	13.8																
GEO-048																			
GEO-049																			
GEO-050	10-11.5	CL	17.8	115.6	136.2				2.7										
GEO-051	10-11.5	CL	16.3																
	20-21.5	SC	14.7																
GEO-052	10-11.5	CL	14.4																
	22-24	CL	17.3	114.0	133.7					2.3									
	35-36.5	CL	19.3																
	55-56.5	CL	19.0																
GEO-053	7.5-8.5	CL	17.0	114.6	134.1					4.9									
	15-16.5	GP	4.9																
	25-26.5	SP-SM	18.5																
	35-36.5	CL	14.0	122.3	139.4				3.2										
	45-46.5	CL	14.4																
	55-56.5	SC	9.5																
GEO-054																			
GEO-055																			
GEO-056	7.5-9	CL	16.6																
	15-16.5	CL	16.5																
	17-19	CL	17.1	115.4	135.1				2.9										
	25-26.5	CL	17.4																
	43-45	CL	16.7	116.9	136.4				1.7										
	45-46.5	CL	16.2																
	55-56.5	CL				26	16	10											
	60-61.5	CL									5.7	25.0	39.6	29.7	69.3				
GEO-057																			
GEO-058																			

Sample Location		Approx. Soil Type	Moisture Content [%]	Dry Unit Weight [pcf]	Moist Unit Weight [pcf]	Atterberg Limits [% moisture content]			Unconfined Compres-sive Strength [tsf]	UU Triaxial Maximum Deviator Stress [tsf]	Percent Gravel [%]	Percent Sand [%]	Percent Silt [%]	Percent Clay [%]	Percent Fines [%]	Peak Friction Angle [degrees]	Preconsol-idation Pressure, σ'_p [tsf]	Compression Index (C_c)	Recompression Index (C_r)
Geotech ID	Depth [ft]					Liq. Limit	Plast. Limit	Plast. Index											
GEO-059	12.5-14	CL	17.2																
	18-20	CL	17.0	115.3	134.9				3.5										
	20-21.5	CL	12.6																
	30-31.5	CL	13.5																
	45-46.5	CL	18.0																
	47-49	CL	14.8	119.9	137.6				4.0										
	55-56.5	SC	12.7																
GEO-060																			
GEO-061	10-11.5	CL	15.9																
	20-21.5	CL	14.8																
	30-31.5	CL	14.1																
	45-46.5	CL	12.4																
GEO-062	7.5-9	CL	15.0																
	15-16.5	CL	15.2																
	30-31.5	CL	16.8																
	45-46.5	CL	14.6																
	60-61.5	CL	15.6																
GEO-063	10-11.5	CL	17.4																
	20-21.5	CL	17.3																
	23-25	CL	16.6	115.6	134.8				2.7										
	35-36.5	CL	15.8																
	50-51.5	CL	13.4																
GEO-064																			
GEO-065																			
GEO-066																			
GEO-067																			
GEO-068	10-11.5	ML	17.6																
GEO-069	10-11.5	CL	18.8																
	20-21.5	SM	14.5																
GEO-070	7.5-9	CL	16.4																
	15-16.5	CL	19.9																
	25-27	CL	17.0	115.2	134.8					2.2									
	30-31.5	CL	17.7																
GEO-071	10-11.5	CL	16.8																
	15-17	CL	16.4	116.3	135.4				2.6										
	20-21.5	CL	17.1																
	35-36.5	SC	14.0																
	45-46.5	CL	14.1																
	60-61.5	CL	14.0																
GEO-072	10-11.5	CL	15.9																
	18-20	CL	16.6	115.9	135.1				3.1										
	20-21.5	CL	16.5																
	28-30	CL-ML/ML	22.9	103.4	127.1					7.0									
	40-41.5	CL	13.5																
	50-51.5	SP-SM	14.3																

Sample Location						Atterberg Limits													
Geotech ID	Depth [ft]	Approx. Soil Type	Moisture Content [%]	Dry Unit Weight [pcf]	Moist Unit Weight [pcf]	Liq. Limit [% moisture content]	Plast. Limit [% moisture content]	Plast. Index [% moisture content]	Unconfined Compres-sive Strength [tsf]	UU Triaxial Maximum Deviator Stress [tsf]	Percent Gravel [%]	Percent Sand [%]	Percent Silt [%]	Percent Clay [%]	Percent Fines [%]	Peak Friction Angle [degrees]	Preconsol-idation Pressure, σ'_p [tsf]	Compression Index (C_c)	Recompression Index (C_r)
GEO-073																			
GEO-074	7.5-9	CL	14.9																
	15-16.5	CL	17.2																
	23-25	CL	16.9	115.3	134.8				2.6										
	30-31.5	CL	18.2																
	45-46.5	CL	13.4																
	60-61.5	CL	12.8																
GEO-075	10-11.5	CL	15.3																
	20-21.5	CL	16.9																
	35-36.5	CL	19.8																
	55-56.5	CL	14.4																
GEO-076	7.5-9	CL	12.3																
	15-17	CL	17.7	113.7	133.8				1.9										
	25-26.5	CL-ML	16.8			18	14	4											
	40-41.5	CL	18.0																
	55-56.5	CL	20.0																
GEO-077	22-24	CL	17.4	114.2	134.1				2.1										
	45-47	CL	16.9	117.2	137.0				1.7										
GEO-078	5-6.5	CL	19.8																
GEO-079	7.5-9	CL	17.2																
	15-16.5	CL	17.7																
	20-22	CL	17.2	114.8	134.5				2.8								4.2	0.2	0.03
	30-31.5	CL	17.1																
	35-37	CL	17.6	113.9	133.9				2.9										
	45-46.5	CL	18.3																
	60-61.5	SP-SM	13.1																
GEO-080																			
GEO-081	10-11.5	CL	16.3																
	22-24	CL	16.8	115.9	135.4				1.8										
	24-25.5	CL	18.6			30	15	15											
	40-41.5	CL	17.4																
	60-61.5	SP-SM	10.3																
GEO-082	10-11.5	CL	17.7			35	16	19											
	20-21.5	CL	18.6																
	30-31.5	CL	19.3																
	40-41.5	CL	15.7																
	55-55.9	CL	17.2																
GEO-083	10-11.5	CL	15.7																
	18-20	CL	17.5	114.0	134.0				2.3										
	20-21.5	CL	15.9																
	30-31.5	ML	16.8																
GEO-084	10-11.5	CL	19.3																
	15-15.5	CL	18.1	111.3	131.4					3.9									
GEO-085	7.5-9	CL	15.7																
	15-16.5	CL	15.4																
	30-31.5	CL	16.9																
	50-51.5	CL	14.2																
GEO-086	5-6.5	CL	18.3																
GEO-087	10-11.5	CL	16.3																
	18-20	CL	17.1	115.0	134.7				2.4										
	20-21.5	CL	16.4																
	30-31.5	CL	15.4																
	45-46.5	SP-SM	14.8																
GEO-088	7.5-9	CL	18.0																
	15-16.5	CL	16.7																

Sample Location						Atterberg Limits													
Geotech ID	Depth [ft]	Approx. Soil Type	Moisture Content [%]	Dry Unit Weight [pcf]	Moist Unit Weight [pcf]	Liq. Limit [% moisture content]	Plast. Limit	Plast. Index	Unconfined Compres-sive Strength [tsf]	UU Triaxial Maximum Deviator Stress [tsf]	Percent Gravel [%]	Percent Sand [%]	Percent Silt [%]	Percent Clay [%]	Percent Fines [%]	Peak Friction Angle [degrees]	Preconsol-idation Pressure, σ'_p [tsf]	Compression Index (C_c)	Recompression Index (C_r)
GEO-089	10-11.5	CL	18.9	110.7	131.6	36	19	17	4.9										
	15-16.5	CL	13.7																
GEO-090	10-11.5	CL	17.9																
	20-21.5	CL	16.5																
	40-41.5	SM	14.4								0.0	52.2			47.8				
	60-61.5	CL	15.9																
GEO-091	7.5-9	CL									0.1	8.6	51.5	39.8	91.3				
	10-11.5	CL	16.3																
	20-21.5	CL	14.5																
	23-25	CL	15.4	117.4	135.5				3.7										
	30-31.5	CL	16.9																
	45-46.5	CL	18.2																
	60-61.5	CL	12.3																
GEO-092	7.5-9	CL	16.6																
	15-16.5	CL	15.4																
	22-24	CL	17.1	114.6	134.2				2.6										
	30-31.5	CL	18.1																
	45-46.5	CL	18.9																
	47-49	CL	17.9	113.1	133.3				2.5										
	60-61.5	ML	27.0																
GEO-093	10-11.5	CL	16.1																
	20-21.5	CL	17.0																
	27-29	CL	18.0	113.2	133.6				1.0										
	40-41.5	CL	18.3																
	55-56.5	SM	14.3								2.8	63.7			33.5				
GEO-094	10-11.5	CL	14.2																
	20-21.5	GC	12.3																
GEO-095																			
GEO-096	7.5-9	ML	17.8																

Number of Tests	300	68	68	12	12	12	52	14	10	10	4	4	10	1	2	2	2
Minimum	1.9	93.3	114.1	18.0	14.0	4.0	1.0	1.3	0.0	8.6	39.6	29.7	10.7	39.3	4.00	0.13	0.02
Maximum	27.0	162.3	165.4	36.0	19.0	19.0	1280.9	7.0	49.5	82.1	51.5	39.8	91.3	39.3	4.20	0.16	0.03
Average	16.0	116.9	135.7	30.3	16.1	14.2	60.8	3.1	7.6	43.1	45.4	35.3	49.3	--	4.10	0.15	0.03
Standard Deviation	3.0	10.2	6.9	5.0	1.3	4.1	241.1	1.6	15.3	25.5	5.0	4.2	30.0	--	0.14	0.02	0.01

Table 4

Summary of Soil Chemical Test Results

Geotech ID	Depth [feet]	Soil Type	pH	Chloride [mg/kg]	Sulfate* [mg/kg]
GEO-005	1-3	CL	5.2	249.0	50.0
GEO-006	1-3	CL	5.5	148.0	69.4
GEO-015	1-3	CL	5.0	85.2	73.0
GEO-038	1-3	CL	4.6	110.0	50.0
GEO-087	1-3	CL	6.4	169.0	50.0
GEO-089	1-3	CL	5.1	106.0	77.7
Sub-Res	1-3	CL	7.1	104.0	50.0

Mean			5.6	138.7	60.0
St. Dev.			0.9	56.5	12.7
Min.			4.6	85.2	50.0
Max			7.1	249.0	77.7

*Some sufate tests resulted in measurements below the reporting limit of 50 mg/kg. A value of 50 mg/kg was used for analysis at those locations.

Table 5
Summary of Standard Proctor Test Results

Geotech ID	Depth [ft]	Soil Type	Standard Proctor Data: Maximum Dry Density [pcf]	Standard Proctor Data: Optimum Moisture [%]	95% Compaction Moist Unit Weight at Optimum Moisture [pcf]	In-Situ Moisture [%]	95% Compaction Moist Unit Weight at In-Situ Moisture [pcf]
GEO-005	1-3	CL	104.1	20.4	119.1	24.9	123.5
GEO-006	1-3	CL	103.0	21.1	118.5	23.4	120.7
GEO-015	1-3	CL	102.3	21.8	118.4	23.9	120.4
GEO-038	1-3	CL	102.5	21.4	118.2	24.8	121.5
GEO-087	1-3	CL	102.8	21.2	118.4	23.1	120.2
GEO-089	1-3	CL	105.0	20.0	119.7	22.2	121.9
Sub-Res	1-3	CL	100.3	22.2	116.4	25.8	119.9

Minimum	100.3	20.0	116.4	22.2	119.9
Maximum	105.0	22.2	119.7	25.8	123.5
Average	102.9	21.2	118.4	24.0	121.2
Standard Deviation	1.4	0.7	0.9	1.1	1.2

Table 6
Summary of Lower Strength Soil Layers and Anticipated Remediation at Turbine Locations

Geotech ID	Turbine ID (March 16, 2018 Layout)	Depth of Lower Strength Soils [feet]	Anticipated Soil Correction Depths [feet]	Anticipated Soil Correction Type
GEO-001	2.3-1	None Below 8 ft		
GEO-002	2.3-2	None Below 8 ft		
GEO-003	2.3-3	None Below 8 ft		
GEO-004	2.3-4	None Below 8 ft		
GEO-005	2.3-5	None Below 8 ft		
GEO-006	2.3-6	None Below 8 ft		
GEO-007	2.3-7	25-26.5	None-thin	
GEO-008	2.3-8	25-26.5	None-thin	
GEO-009	2.3-9	30-31.5	None-thin	
GEO-010	2.3-10	None Below 8 ft		
GEO-011	2.3-107	None Below 8 ft		
GEO-012	2.3-12	None Below 8 ft		
GEO-013	3.8-1	None Below 8 ft		
GEO-014	3.8-2	None Below 8 ft		
GEO-015	3.8-3	None Below 8 ft		
GEO-016	3.8-4	None Below 8 ft		
GEO-017	--	Not Drilled		
GEO-018	3.8-6	None Below 8 ft		
GEO-019	3.8-7	None Below 8 ft		
GEO-020	3.8-8	None Below 8 ft		
GEO-021	3.8-9	None Below 8 ft		
GEO-022	3.8-10	None Below 8 ft		
GEO-023	--	Not Drilled		
GEO-024	3.8-12	None Below 8 ft		
GEO-025	3.8-13	None Below 8 ft		
GEO-026	3.8-14	None Below 8 ft		
GEO-027	--	Not Drilled		
GEO-028	3.8-15	None Below 8 ft		
GEO-029	--	Not Drilled		
GEO-030	3.8-17	None Below 8 ft		
GEO-031	3.8-18	None Below 8 ft		
GEO-032	--	Not Drilled		
GEO-033	3.8-19	None Below 8 ft		
GEO-034	3.8-20	None Below 8 ft		
GEO-035	3.8-21	None Below 8 ft		
GEO-036	3.8-22	20-21.5	None-thin	
GEO-037	3.8-23	None Below 8 ft		
GEO-038	3.8-24	None Below 8 ft		
GEO-039	3.8-25	None Below 8 ft		
GEO-040	3.8-26	None Below 8 ft		
GEO-041	3.8-27	None Below 8 ft		
GEO-042	3.8-28	30-37	None	
GEO-043	3.8-29	None Below 8 ft		
GEO-044	3.8-29-2	None Below 8 ft		
GEO-045	3.8-30	None Below 8 ft		
GEO-046	--	Not Drilled		
GEO-047	3.8-31	8-20.5	None	
GEO-048	3.8-31-2	None Below 8 ft		
GEO-049	3.8-32	None Below 8 ft		
GEO-050	3.8-33	None Below 8 ft		
GEO-051	3.8-34	None Below 8 ft		
GEO-052	3.8-35	20-35, 55-56.5	None	
GEO-053	3.8-36	None Below 8 ft		
GEO-054	--	Not Drilled		
GEO-055	--	Not Drilled		
GEO-056	3.8-39	25-35, 40-41.5	None	
GEO-057	--	Not Drilled		
GEO-058	--	Not Drilled		
GEO-059	3.8-42	45-46.5, 60-61.5	None	
GEO-060	3.8-43	None Below 8 ft		
GEO-061	3.8-44	None Below 8 ft		
GEO-062	3.8-45	40-41.5	None-thin	
GEO-063	3.8-46	None Below 8 ft		
GEO-064	--	Not Drilled		
GEO-065	--	Not Drilled		
GEO-066	3.8-51	None Below 8 ft		
GEO-067	--	Not Drilled		
GEO-068	3.8-53	None Below 8 ft		
GEO-069	3.8-54	None Below 8 ft		
GEO-070	3.8-55	30-36.5	None	
GEO-071	2.3-11/3.8-56	None Below 8 ft		
GEO-072	3.8-57	None Below 8 ft		
GEO-073	3.8-58	None Below 8 ft		
GEO-074	3.8-59	None Below 8 ft		
GEO-075	3.8-60	None Below 8 ft		
GEO-076	3.8-61	None Below 8 ft		
GEO-077	3.8-62	20-21.5, 40-41.5	None	
GEO-078	3.8-63	None Below 8 ft		
GEO-079	3.8-101	35-36.5	None-thin	
GEO-080	3.8-101	None Below 8 ft		
GEO-081	3.8-104	None Below 8 ft		
GEO-082	3.8-105	20-21.5	None-thin	
GEO-083	3.8-106	15-18	None-thin	
GEO-084	3.8-5	None Below 8 ft		
GEO-085	3.8-11	None Below 8 ft		
GEO-086	3.8-14-2	None Below 8 ft		
GEO-087	3.8-16	None Below 8 ft		

Geotech ID	Turbine ID (March 16, 2018 Layout)	Depth of Lower Strength Soils [feet]	Anticipated Soil Correction Depths [feet]	Anticipated Soil Correction Type
GEO-088	3.8-18-2	None Below 8 ft		
GEO-089	3.8-37	None Below 8 ft		
GEO-090	3.8-38	None Below 8 ft		
GEO-091	3.8-40	35-36.5	None-thin	
GEO-092	3.8-47	45-46.5	None-thin	
GEO-093	3.8-47-2	27-29	None-two layer	
GEO-094	3.8-52	None Below 8 ft		
GEO-095	3.8-48	None Below 8 ft		
GEO-096	3.8-30-2	None Below 8 ft		

Table 7
Summary of Geophysical Survey Test Results

Geotech ID	Average Weighted Interval Shear Wave Velocity [ft/s]	Average Weighted Interval Compression Wave Velocity	Small Strain Shear Modulus (G_o)	Poisson's Ratio
	[ft/s]	[ft/s]	[ksf]	
GEO-003	1954	9128	15884	0.48
GEO-013	1958	5386	15961	0.42
GEO-033	1247	5651	6472	0.47
GEO-061	1532	5711	9773	0.46
GEO-066	2258	7889	21211	0.46
GEO-085	1385	6249	7980	0.47
Mean	1722	6669	12880	0.46
St. Dev.	393	1504	5703	0.02
Minimum	1247	5386	6472	0.42
Maximum	2258	9128	21211	0.48

Table 8
Summary of Recommended Geotechnical Parameters for Wind Turbine Foundation Design

Parameter	Value	Units
Undrained Soil Shear Strength (cohesive soil)	1,250	lb/ft^2
Soil Friction Angle (granular soil)	30	degrees
Allowable Gross Bearing Capacity, Normal Operating Load	2,600	lb/ft^2
Allowable Gross Bearing Capacity, Normal Extreme Load	3,400	lb/ft^2
Allowable Gross Bearing Capacity, Abnormal Extreme Load	4,100	lb/ft^2
Design Shear Wave Velocity	1,247	ft/s
Design Poisson's Ratio	0.42	--
Design Small Strain Shear Modulus	6,520	$kips/ft^2$
Minimum Foundation/Soil Friction Factor	0.40	--
Extreme Frost Depth	36	inches
Minimum Moist Density Backfill Over Foundation (dry density of 95 pcf at long term moisture content of 15 percent)	110	lb/ft^3

Figures

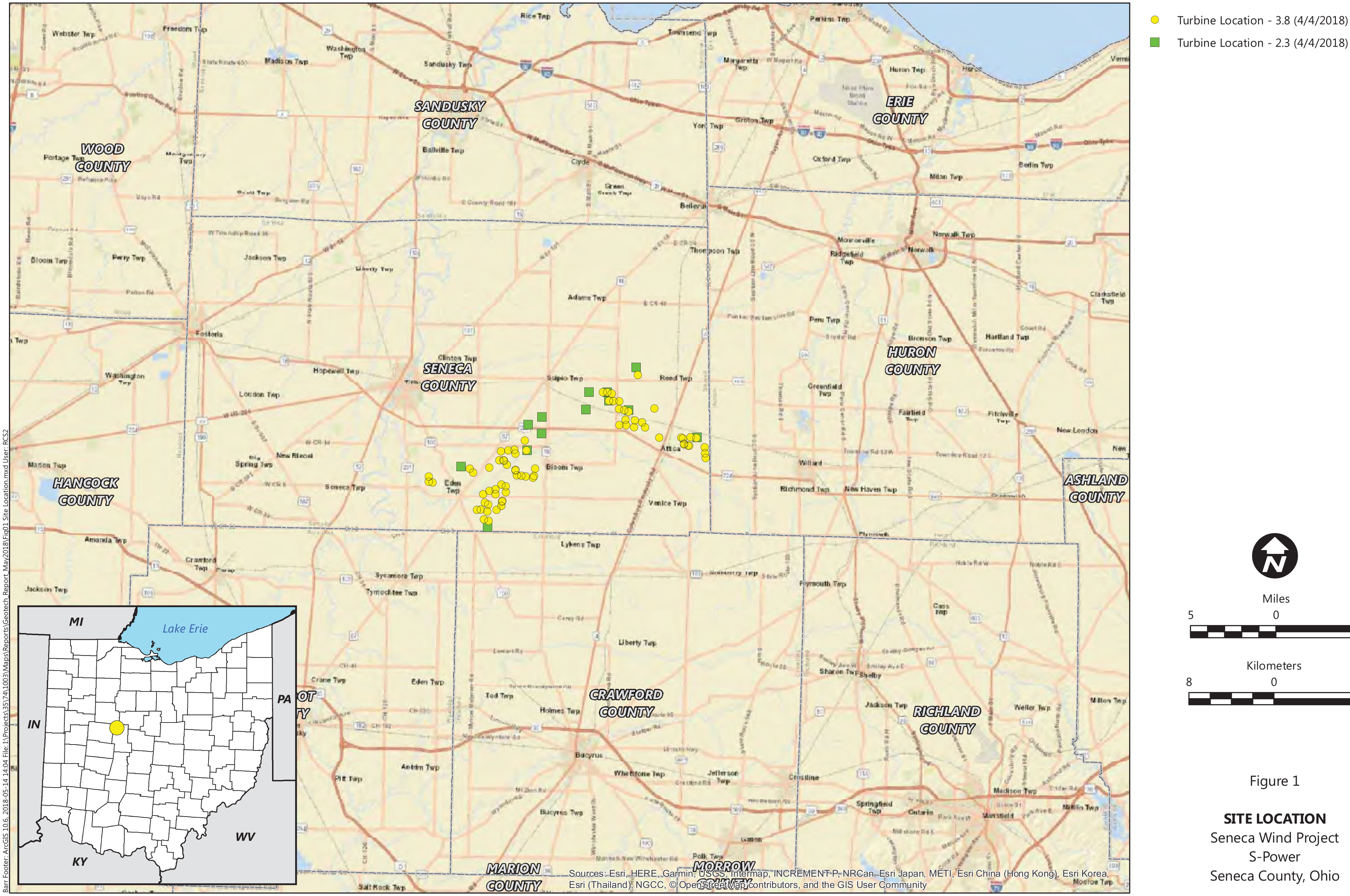
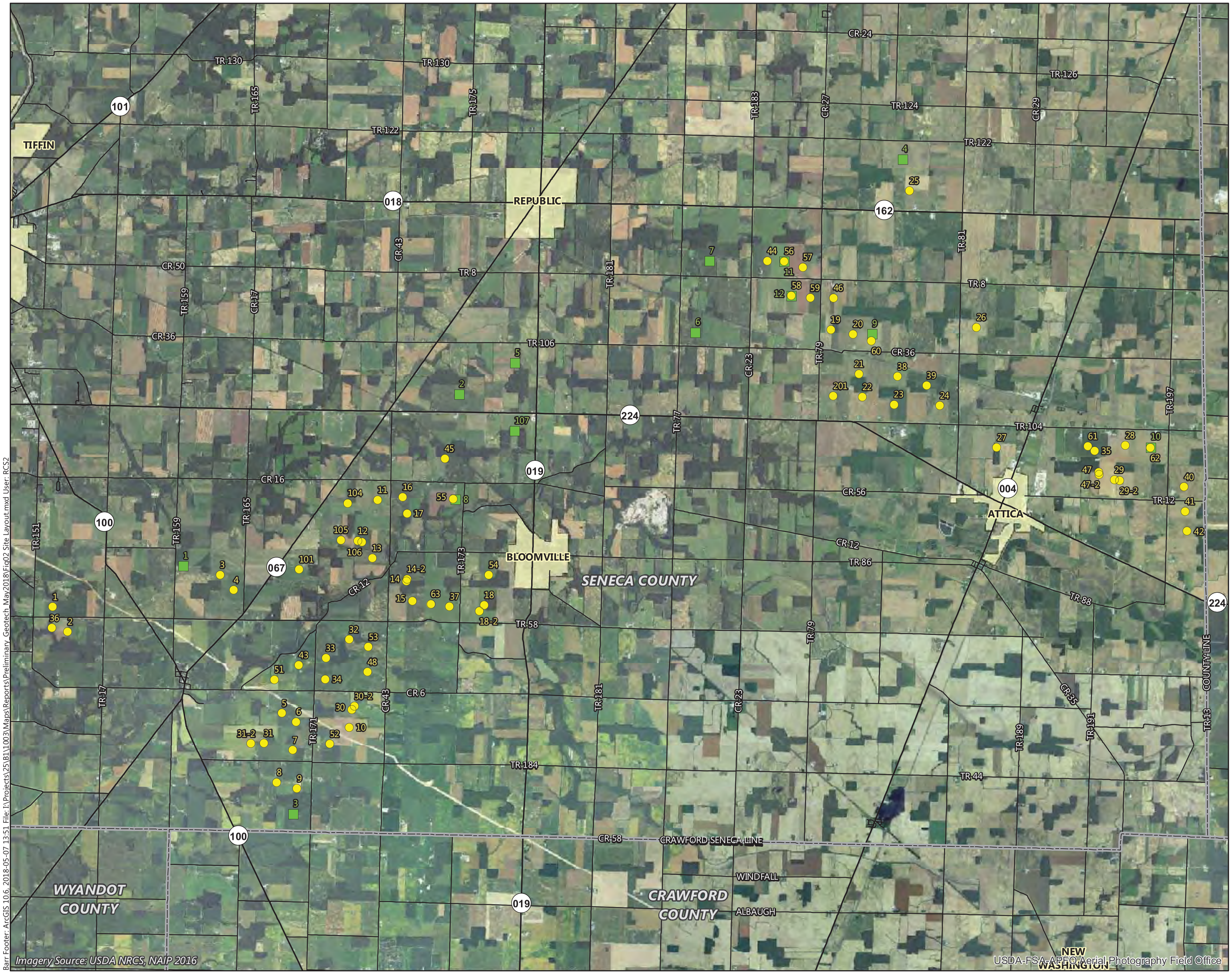


Figure 1

SITE LOCATION
Seneca Wind Project
S-Power
Seneca County, Ohio

Barr Footer: ArcGIS 10.6, 2018-05-14 14:04 File: I:\Projects\35\74\1003\Maps\Reports\Geotech Report May2018\Fig01 Site Location.mxd User: RCS2



- Turbine Location - 3.8 (4/4/2018)
- Turbine Location - 2.3 (4/4/2018)
- City Boundary
- County Boundary

Feet

7,000 0 7,000

Meters

2,000 0 2,000

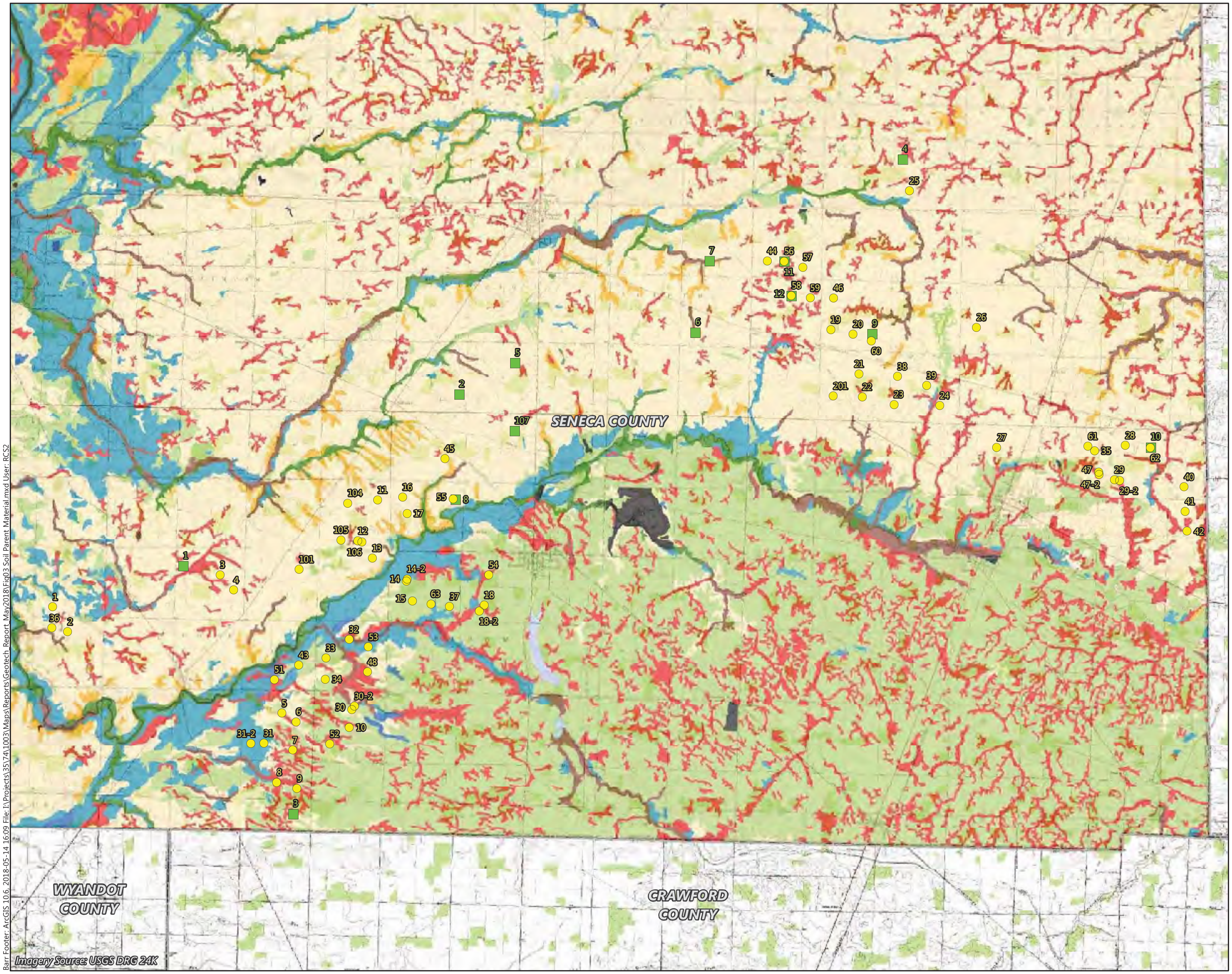
Figure 2

SITE LOCATION

Seneca Wind Project

S-Power

Seneca County, Ohio



- Turbine Location - 3.8 (4/4/2018)
- Turbine Location - 2.3 (4/4/2018)
- County Boundary

Soil Parent Material

- Alluvium
- Eolian Deposits over Till
- Generalized Clayey Till
- Generalized Glaciolacustrine Deposits
- Generalized Outwash
- Generalized Till
- Generalized Wisconsin Till
- Herbaceous Organic Material and/or Woody Organic Material
- Loamy Alluvium
- Loess over Till over Residuum weathered from Limestone and Dolomite
- Not Rated

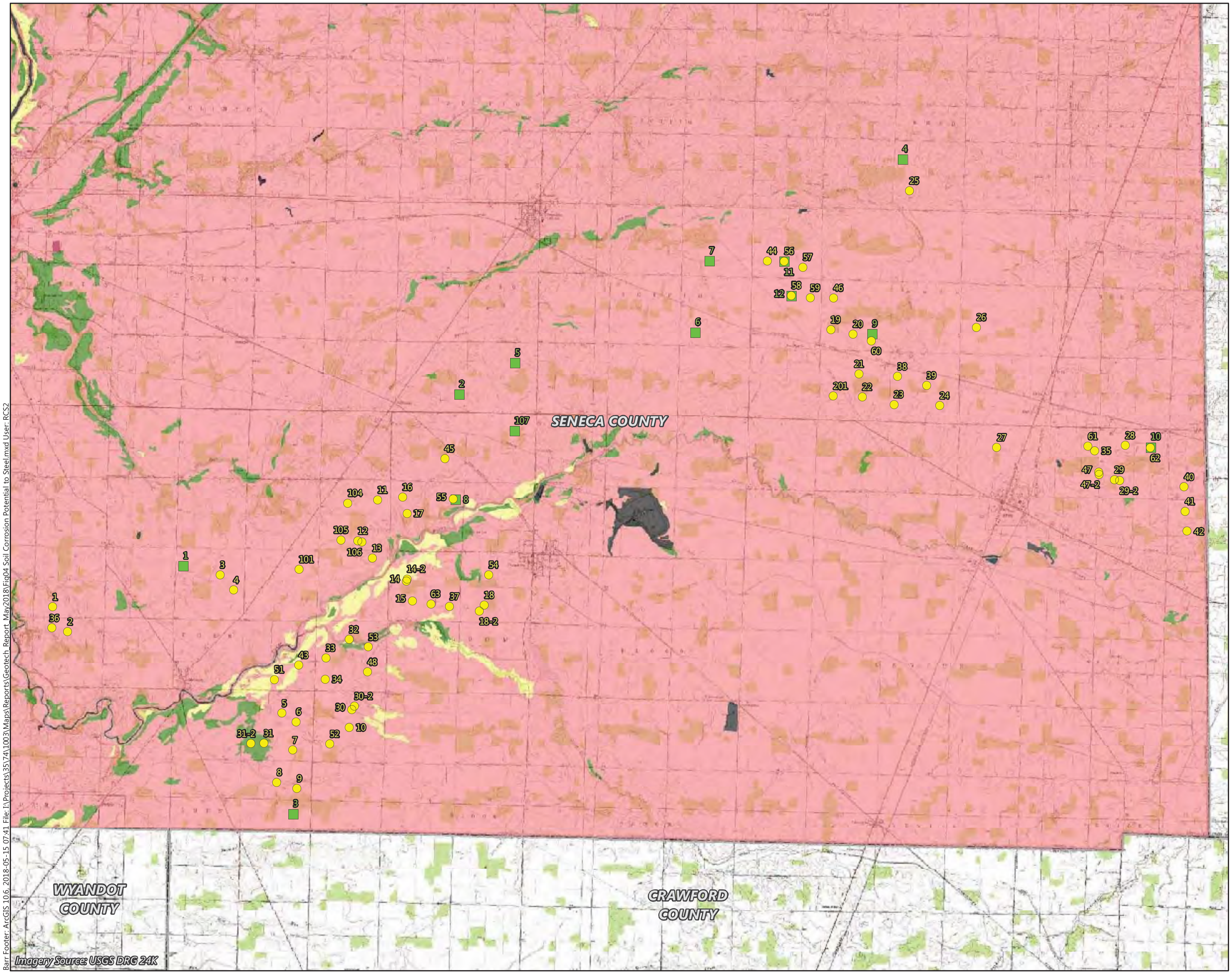
Data Source:
Soil Survey Staff, NRCS USDA. Soil Survey Geographic (SSURGO) Database. Available online at: https://sdmdataaccess.sc.egov.usda.gov. Accessed 5/14/2018.

Feet
7,000 0 7,000

Meters
2,000 0 2,000

Figure 3

SOIL PARENT MATERIAL
Seneca Wind Project
S-Power
Seneca County, Ohio



- Turbine Location - 3.8 (4/4/2018)
- Turbine Location - 2.3 (4/4/2018)
- City Boundary
- County Boundary

Soil Corrosion Potential to Steel

- High
- Moderate
- Low
- Not Rated

Data Source:
Soil Survey Staff, NRCS USDA. Soil Survey Geographic (SSURGO) Database. Available online at: https://sdmdataaccess.sc.egov.usda.gov. Accessed 5/14/2018.

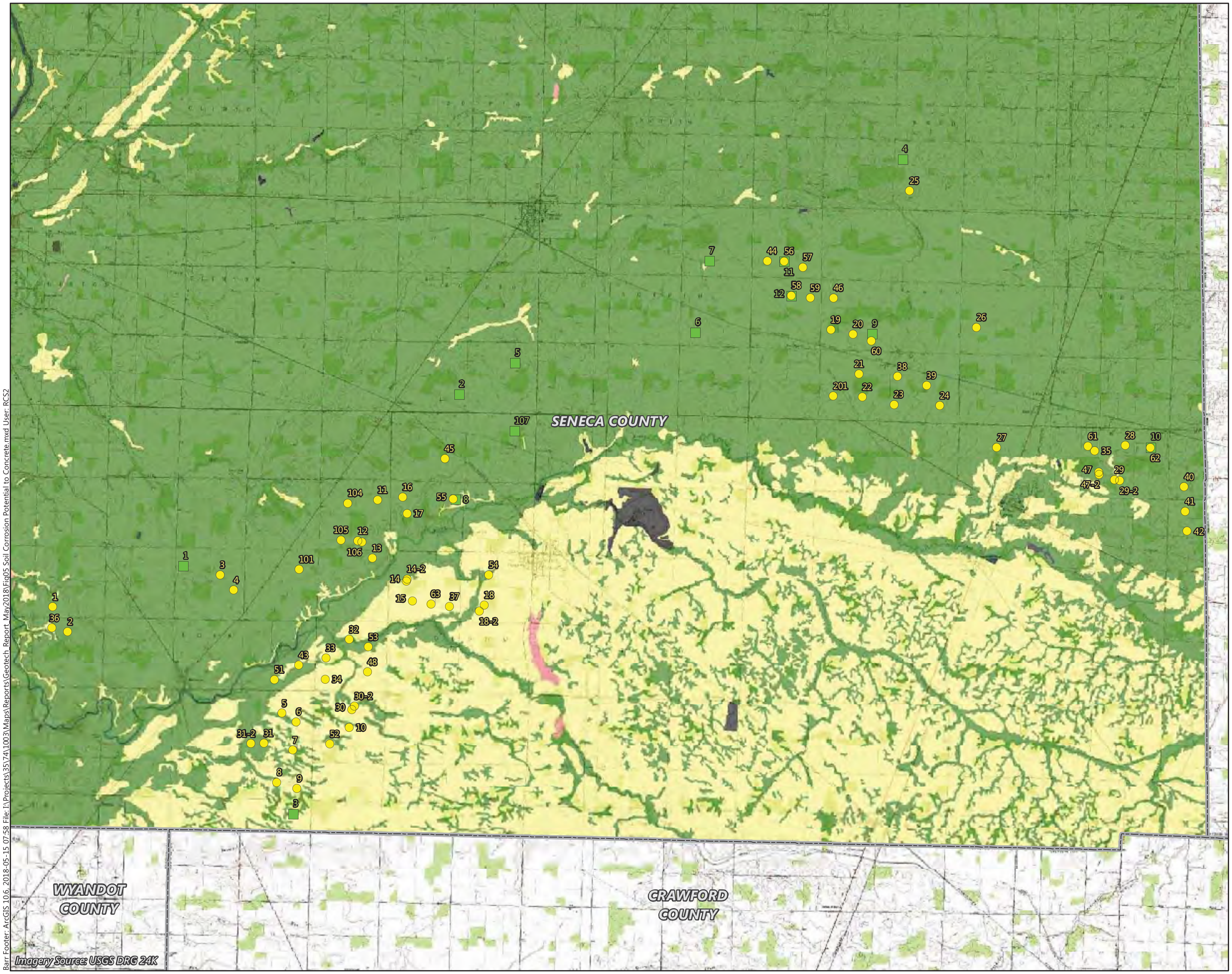
Feet: 7,000 — 0 — 7,000

Meters: 2,000 — 0 — 2,000

Figure 4

SOIL CORROSION POTENTIAL TO STEEL
Seneca Wind Project
S-Power
Seneca County, Ohio

Barr Footer: ArcGIS 10.6, 2018-05-15 07:41 File: I:\Projects\35\74\1003\Maps\Reports\Geotech Report_May2018\Fig04 Soil Corrosion Potential to Steel.mxd User: RCS2



- Turbine Location - 3.8 (4/4/2018)
- Turbine Location - 2.3 (4/4/2018)
- City Boundary
- County Boundary

Soil Corrosion Potential to Concrete

- High
- Moderate
- Low
- Not Rated

Data Source:
Soil Survey Staff, NRCS USDA. Soil Survey Geographic (SSURGO) Database. Available online at: https://sdmdataaccess.sc.egov.usda.gov. Accessed 5/14/2018.

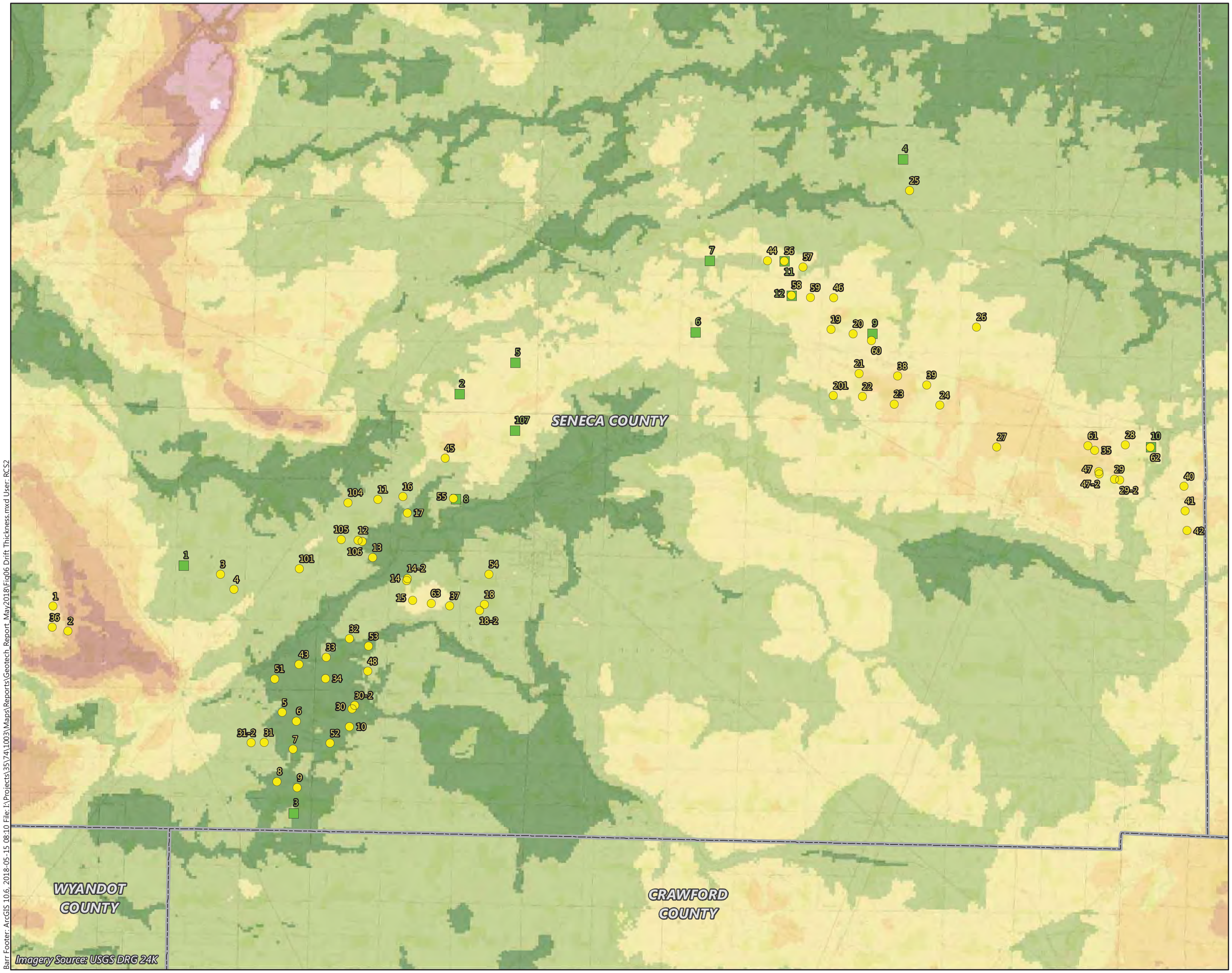
N

Feet
7,000 0 7,000

Meters
2,000 0 2,000

Figure 5

SOIL CORROSION POTENTIAL TO CONCRETE
Seneca Wind Project
S-Power
Seneca County, Ohio



Turbine Location - 3.8 (4/4/2018)
Turbine Location - 2.3 (4/4/2018)
County Boundary

Drift Thickness (feet)

0 - 25
25 - 50
50- 75
75 - 100
100 - 125
125 - 150
150 - 175
175 - 200

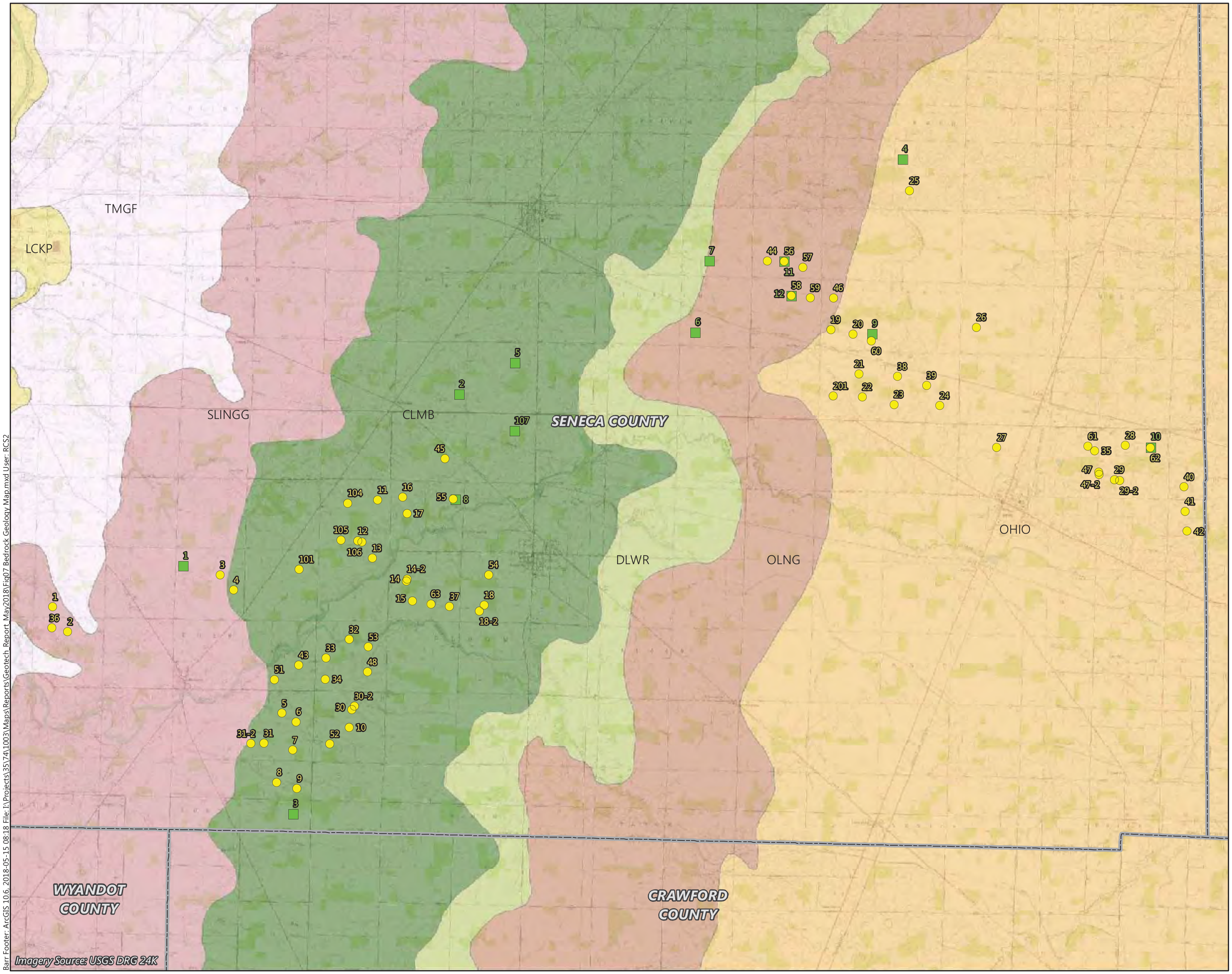
Data Source:
Powers, D, M., and Swinford, E. M., 2004,
Shaded drift-thickness of Ohio: Ohio Division
of Geological Survey Map SG-3, scale 1:500,000.

Feet
7,000 0 7,000

Meters
2,000 0 2,000

Figure 6

DRIFT THICKNESS
Seneca Wind Project
S-Power
Seneca County, Ohio



Turbine Location - 3.8 (4/4/2018)

Turbine Location - 2.3 (4/4/2018)

County Boundary

Bedrock Geology

CLMB - Columbus Limestone

DLWR - Delaware Limestone

LCKP - Lockport Dolomite

OHIO - Ohio Shale

OLNG - Olentangy Shale

SLINGG - Salina Group

TMGF - Tymochtee and Greenfield Dolomites, Undivided

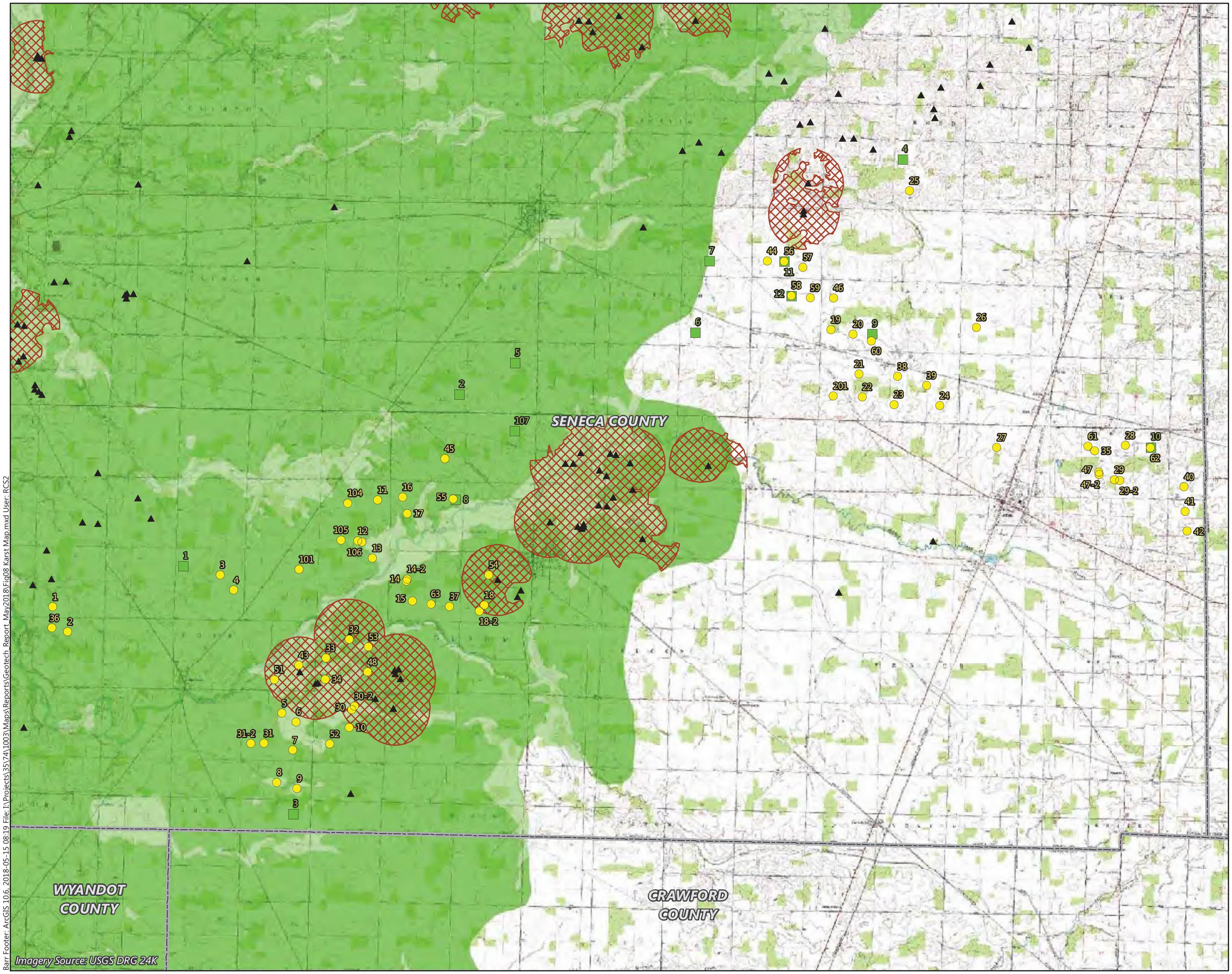
Data Source:
Slucher, E.R., (principal compiler), Swinford, E.M., Larsen, G.E., and others, with GIS production and cartography by Powers, D.M., 2006, Bedrock geologic map of Ohio: Ohio Division of Geological Survey BG-1, version 6.0, 1:500,000 scale.

Feet
7,000 0 7,000

Meters
2,000 0 2,000

Figure 7

BEDROCK GEOLOGY
Seneca Wind Project
S-Power
Seneca County, Ohio



- Turbine Location - 3.8 (4/4/2018)
- Turbine Location - 2.3 (4/4/2018)
- City Boundary
- County Boundary
- Known or Indicated Karst Feature
- Probable Karst Area
- Silurian- and Devonian-age carbonate bedrock overlain by less than 20 feet of glacial drift and/or alluvium
- Silurian- and Devonian-age carbonate bedrock overlain by more than 20 feet of glacial drift and/or alluvium

Data Source:
Pavey, R .R. et al, 1999 (revised 10/2007, 5/2006, 2002), Known and probable karst in Ohio: Ohio Divisionof Geological Survey Map EG-1, scale 1:500,000.

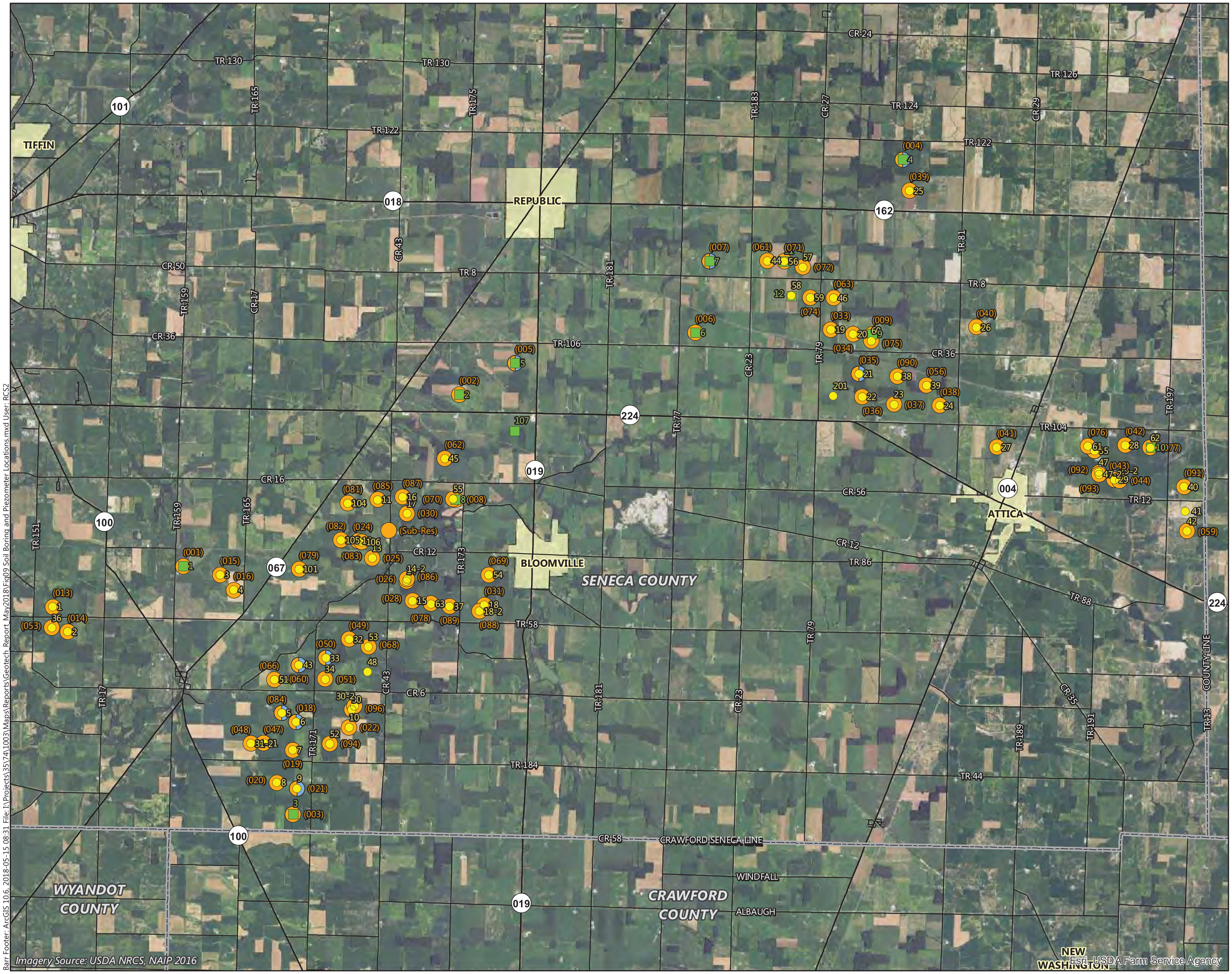
N

Feet
7,000 0 7,000

Meters
2,000 0 2,000

Figure 8

KARST GEOLOGY
Seneca Wind Project
S-Power
Seneca County, Ohio



- Turbine Location - 3.8 (4/4/2018)
- Turbine Location - 2.3 (4/4/2018)
- City Boundary
- County Boundary
- Soil Boring Location
- Soil Boring and Piezometer Location

*Note: Labeled with GEO- ID in parentheses.

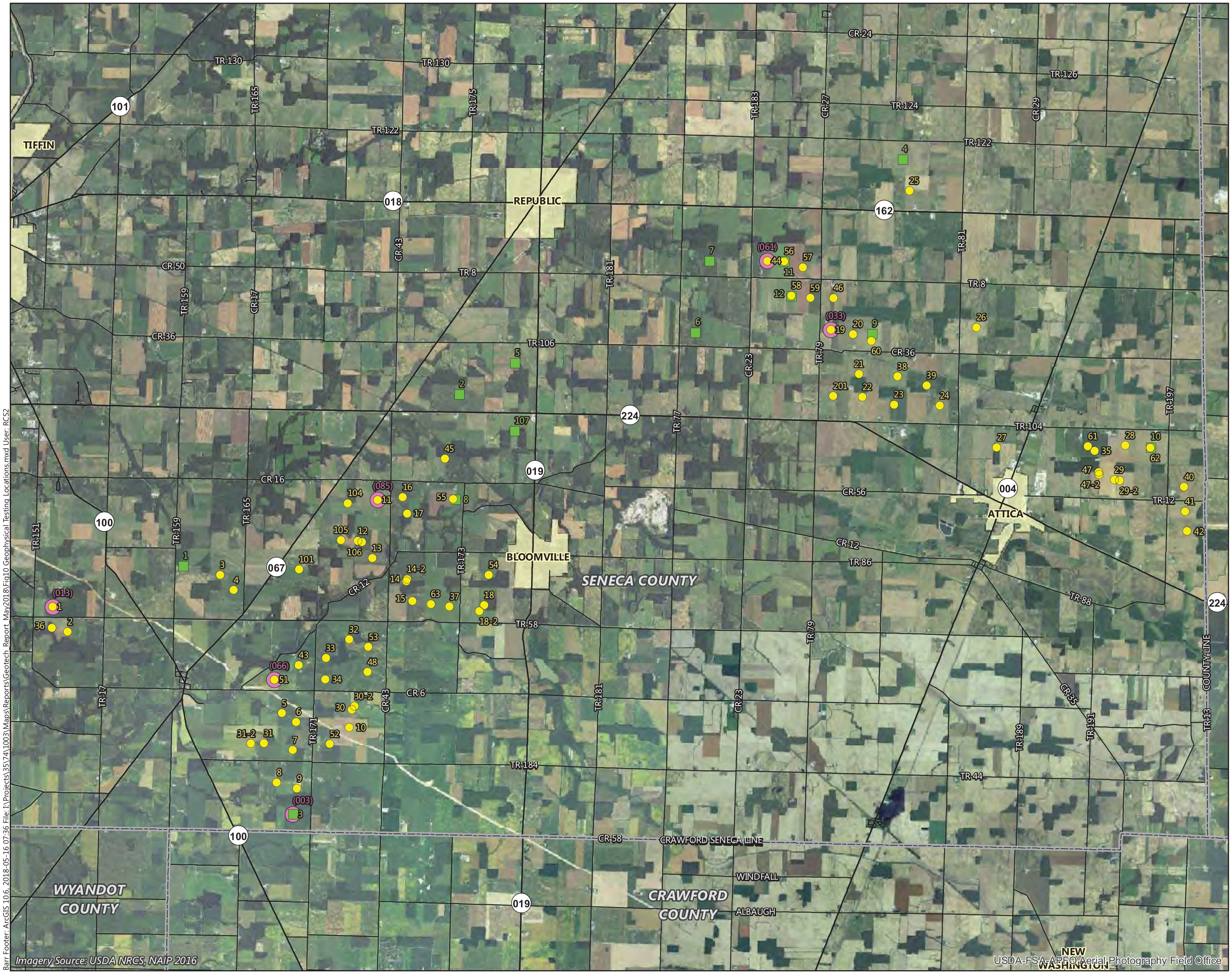
N

Feet
7,000 0 7,000

Meters
2,000 0 2,000

Figure 9

SOIL BORING AND PIEZOMETER LOCATIONS
Seneca Wind Project
S-Power
Seneca County, Ohio



- Turbine Location - 3.8 (4/4/2018)
- Turbine Location - 2.3 (4/4/2018)
- City Boundary
- County Boundary
- Geophysical Testing Location

*Note: Labeled with GEO- ID in parentheses.

Feet: 7,000 — 0 — 7,000

Meters: 2,000 — 0 — 2,000

Figure 10

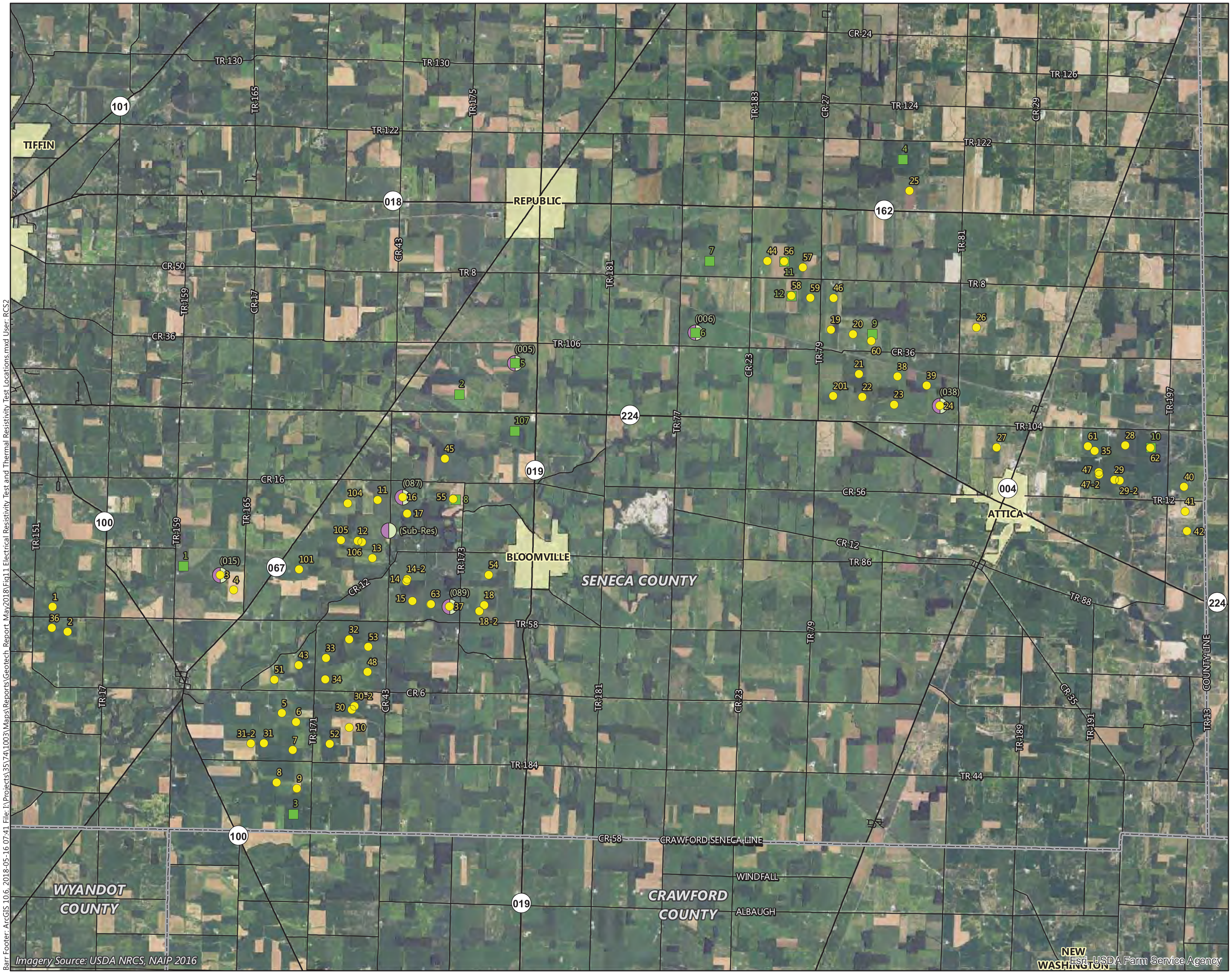
GEOPHYSICAL TESTING LOCATIONS

Seneca Wind Project

S-Power

Seneca County, Ohio

Barr Footer: ArcGIS 10.6, 2018-05-16 07:36 File: I:\Projects\35\74\1003\Maps\Reports\Geotech Report May2018\Fig10 Geophysical Testing Locations.mxd User: RCS2



- Turbine Location - 3.8 (4/4/2018)
- Turbine Location - 2.3 (4/4/2018)
- City Boundary
- County Boundary
- Electrical and Thermal Resistivity Test Locations

*Note: Labeled with GEO- ID in parentheses.

Feet: 7,000 0 7,000

Meters: 2,000 0 2,000

Figure 11

ELECTRICAL RESISTIVITY TEST AND THERMAL RESISTIVITY TEST LOCATIONS

Seneca Wind Project

S-Power

Seneca County, Ohio