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Bricker & Eckler
ATTORNEYS AT LAW

COLUMBUS | CLEVELAND
CINCINNATI-DAYTON

BRICKER & ECKLER LLP
100 South Third Street
Columbus, Ohio 43215-4291
MAIN: 614.227.2300
FAX: 614.227.2390

www.bricker.com
info@bricker.com

Sally W. Bloomfield
614.227.2368
sbloomfield@bricker.com

December 11, 2009

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Via Hand Delivery

Ms. Renee Jenkins
Administration/Docketing
Ohio Power Siting Board
180 East Broad Street, 11th Floor
Columbus, Ohio 43215-3793

Re: Hardin Wind Energy LLC, Case No. 09-479-EL-BGN
Responses to Staff Data Requests

Dear Ms. Jenkins:

Attached please find Hardin Wind Energy LLC's (Hardin) responses to Staff's Data Requests and Interrogatories Request Nos. 31 with attachment, 54 and No. 56 with attachment.

If you have any questions, please call me at the number listed above.

Sincerely,

Sally W. Bloomfield

Sally W. Bloomfield

Attachment

Cc: Parties of Record

3479210v1

Data Requests and Interrogatories, Cont'd.
Hardin Wind Farm / Invenergy
December 11, 2009

31. ***Have any actual (e.g., existing, day vs. night and season vs. season) ambient noise measurements been conducted? If so, what actual values were measured and when were the measurements conducted? If not, why not, and does the Applicant plan to conduct such measurements?***

Yes, see attached a report discussing ambient noise measurements.

54. ***Please provide the forecasted $L_{night,outside}$ noise level[1] for all residences within one mile of the project area. Please list, in table format and in a corresponding electronic spreadsheet, the residence address, contributing turbine(s), distance from the nearest turbine, and measured L_{90} nighttime ambient noise level.***

Pease see response to Data Request No. 39. Measured L90 daytime and nighttime by reference wind speed at hub height is provided in the table below. Sound levels shown below are project wide values.

Measured Sound Levels Referenced to Wind Speeds at 80m Hub Height

Sound Metric	Regression Analysis Equation	Monitoring Period	Wind Speed at Hub Height					
			Calm	4 m/s (9 mph)	5 m/s (11.2 mph)	6 m/s (13.4 mph)	7 m/s (15.9 mph)	8 m/s (17.9 mph)
L_{eq}	y = 0.1444x2 - 0.7975x +	Day	39.9	39.7	40.2	41.0	42.1	43.4
	y = 0.1692x2 - 0.4268x +	Night	30.7	32.0	33.1	34.5	36.3	38.4
L_{10}	y = 0.147x2 - 0.683x + 41.9	Day	41.4	41.5	42.2	43.1	44.3	45.8
	y = 0.1861x2 - 0.5098x +	Night	32.5	33.8	34.9	36.5	38.4	40.7
L_{50}	y = 0.1266x2 - 0.2833x +	Day	34.5	35.5	36.4	37.5	38.9	40.5
	y = 0.1805x2 - 0.6374x +	Night	29.4	30.2	31.2	32.5	34.2	36.3
L_{90}	y = 0.1078x2 - 0.1314x +	Day	30.9	32.1	33.0	34.0	35.3	36.8
	y = 0.1578x2 - 0.5632x +	Night	27.5	28.2	29.0	30.2	31.7	33.5

[1] World Health Organization Regional Office for Europe. (2009). *Night Noise Guidelines for Europe*. Retrieved from WHO/Europe Web site. http://www.euro.who.int/Document/E92845.pdf

55. What forecasted ambient noise level was input to model Figure 08-01 of the application and subsequent data request items?

Figure 08-01 of the application presents Project generated sound, i.e. projected sound levels are independent of existing conditions.

56. Using the actual ambient noise levels instead of forecasted levels, please re-run the model and produce a new noise contour map (similar to Figure 08-01 of the application).

Please see the attached Revised Figure 08-01, which accounts for the cumulative effects of project-generated sound in conjunction with daytime ambient L_{eq} sound levels under maximum rotational wind speed. As shown in the above table, nighttime ambient L_{eq} sound levels under maximum rotational wind speed are lower than daytime L_{eq} sound levels. Cumulative effects of project-generated sound and nighttime ambient L_{eq} sound levels under maximum rotational wind speed would be negligible.

Hardin Wind Farm
Baseline Sound Survey Report

Hardin County, Ohio

December 11, 2009

Prepared for

Hardin Wind Energy LLC

Prepared by

TETRA TECH EC, INC.

133 Federal Street
Boston, MA 02110
617-457-8200

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TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

agl	above ground level
ANSI	American National Standards Institute
dB	decibel
dBA	A-weighted decibel
dBL	linear decibel
Hz	Hertz
Hardin Wind	Hardin Wind Energy LLC
L_{dn}	day-night averaged sound level
L_{Day}	daytime Leq
L_{eq}	equivalent sound level
L_{Night}	nighttime Leq
L_P	sound pressure level
L_W	sound power level
$L_{\%}$	statistical sound level
m	meter
m/s	velocity in meters per second
MP	monitoring position
mph	miles per hour
MW	megawatt
NIST	National Institute of Standards and Technology
NSA	noise sensitive area
OPSB	Ohio Power and Siting Board
Project	Hardin Wind Farm
pW	picowatt
QC	quality control
S/N	serial number
Tetra Tech	Tetra Tech EC, Inc.
µPa	micropascal
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
W	watt

1.0 Introduction

Hardin Wind Energy LLC ("Hardin Wind") is proposing to construct and operate a wind energy facility called the Hardin Wind Farm (the "Project"). The Project is located within Hardin County, Ohio and consists of General Electric (GE) xle series wind turbines with a nameplate capacity of either 1.5 megawatt (MW) or 1.6 MW and combined total production capacity of 300 MW. Tetra Tech EC, Inc. ("Tetra Tech") was retained by Hardin Wind to design and execute a baseline sound survey to measure and document the existing ambient sound environment within the project study area. Acoustical modeling and analyses of the project's construction and operational phases in support of permitting has been completed by Acentech, Inc., one of the leading acoustic engineering consulting firms in the United States. The following technical report provides information pertaining to the objectives, survey methodologies, measurement results, and the overall conclusions solely for the baseline sound study.

For wind energy facilities sited in the state of Ohio, the Ohio Power Siting Board (OPSB) Rule §4906-17-08(A)(2) defines certification requirements for the assessment of noise that must be addressed during the permitting process. The OPSB Rule does not define quantifiable sound limits either absolute or relative to existing conditions nor does it specifically require the completion of a baseline sound survey. This survey was completed as a proactive step by the Hardin Wind Farm, utilizing a well established methodology for baseline sound studies conducted in conjunction with wind energy facility siting assessments. Data reported may also be used in response to future OPSB interrogatories.

2.0 Setting

The Project is located entirely on privately owned lands, located approximately 6.4 kilometers (4 miles) south of the Town of Ada and 4.8 kilometers (3 miles) west of the Town of Kenton. The Project is close to Ohio State Route 309, which is located just north of the project boundary and runs east-west. The project site is west of Dodds Road (Township Road 65) in McDonald, Hardin County Ohio. According to the United States Geological Survey (USGS), elevation of the project site ranges from approximately 297 to 303 meters (975 to 995 feet) above mean sea level. In general the topography in the immediate vicinity of the site appears to slope gently to the northwest toward the Scioto River.

The main enterprises within the project site are agriculture, grain farming and some livestock production and dairying. Residences are scattered throughout the project site with a more densely populated area in the village of McGuffey. Patches of trees and shrubs exist throughout the project site and are found primarily between agricultural fields, in drainages, and as wind shelter belts around homesteads. Figure 1 presents the project site, locations of the baseline monitoring positions, project wind turbine layout and existing noise sensitive areas (NSAs).

Figure 1 Project Layout

3.0 Acoustic Terminology and Definitions

All sounds originate with a source whether it is a human voice, motor vehicles on a roadway, or a wind turbine. Sound energy propagates through a medium where it is sensed and then interpreted by a receiver. A sound source is defined by a sound power level (L_w), which is independent of any external factors. By definition, 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 at a given receiver location and can be obtained through the use of a microphone or calculated from information about the source sound power level and the surrounding environment. A source sound power level cannot be measured directly. It is calculated from measurements of sound intensity or sound pressure at a given distance from the source outside the acoustic and geometric near-field.

Sound levels are described on a logarithmic scale to account for the large range of pressure that the human ear can perceive, and is expressed in units of decibels (dB). A decibel 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 referenced to 1 picowatt (pW). Broadband sound includes sound energy summed across the frequency spectrum. In addition to broadband sound pressure levels, an acoustic assessment may also include the analysis of the various frequency components of the sound spectrum to determine tonal characteristics or low frequency noise components. The unit of frequency is Hertz (Hz), measuring the cycles per second of the sound pressure waves, and typically the frequency analysis examines 11 octave (or 1/3 octave) bands from 16 Hz (low) to 16,000 Hz (high).

Sound is typically composed of acoustic energy encompassing a wide range of frequencies, referred to as the frequency spectra; however, the human ear does not interpret the sound energy from each frequency as equally loud. The A-weighting filter attenuates low and high frequency energy to simulate the hearing response of the human auditory system. This weighting system has also been adopted in the evaluation of environmental sound levels and is the most widely accepted descriptor for community noise impact assessments. Sound levels that are A-weighted to reflect human response are presented as dBA in this report.

An inherent property of the logarithmic decibel scale is that the sound pressure levels of two separate sources are not directly additive. For example, if a sound of 50 dBA is added to another sound of 50 dBA, the result is a 3-decibel increase (or 53 dBA), not an arithmetic doubling of 100 dBA. The human ear does not sense changes in the sound pressure level as equal changes in perceived loudness.

Scientific research demonstrates that the following general relationships hold between sound level and human perception for two broadband sound levels with the same or similar frequency characteristics:

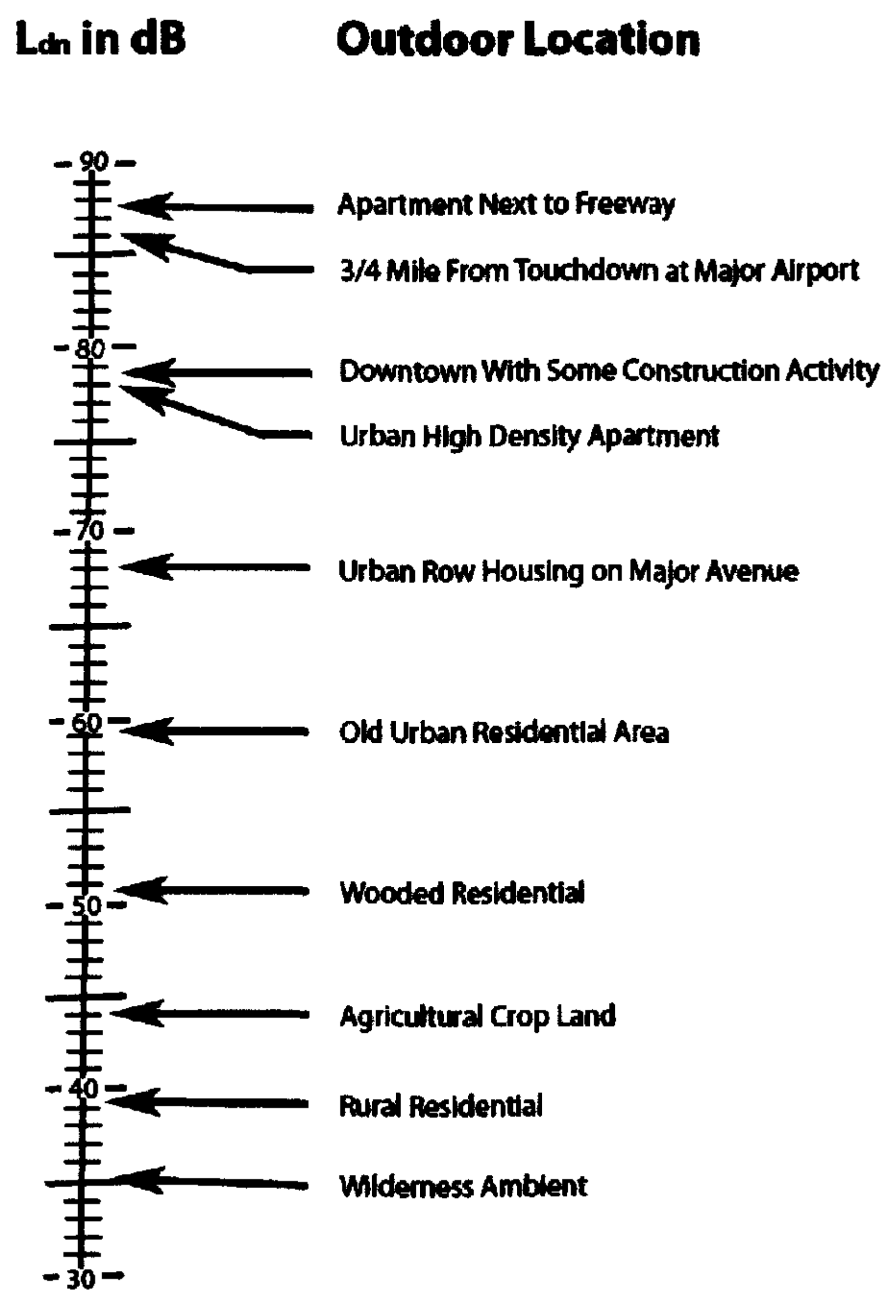
- 1 dBA is the practically achievable limit of the accuracy of sound measurement systems and corresponds to an approximate 10 percent variation in sound pressure. A 1 dBA increase or decrease is a non-perceptible change in sound.
- 3 dBA increase or decrease is a doubling (or halving) of acoustic energy and it corresponds to the threshold of perceptibility of change in a laboratory environment. In practice, the average person is not able to distinguish a 3 dBA difference in environmental sound outdoors.
- 5 dBA increase or decrease is described as a perceptible change in sound level and is a discernable change in an outdoor environment.
- 10 dBA increase or decrease is a tenfold increase or decrease in acoustic energy but is perceived as a doubling or halving in sound (i.e., the average person will judge a 10 dBA change in sound level to be twice or half as loud).

Sound can be measured, modeled, and presented in various formats, with the most common metric being the equivalent sound level (L_{eq}). The L_{eq} value is the energy averaged sound level and is defined as the steady, continuous sound level, over a specified time, which has the same acoustic energy as the actual varying sound levels over the same time. 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 of wind energy facilities. Community sound levels are also often described in terms of the day-night averaged sound level (L_{dn}), which accounts for the increased potential for annoyance that comes with elevated sound levels at night.

The statistical sound levels ($L_{\%}$) provide the sound level exceeded for that percentage of time over the given measurement period. An L_{10} level is often referred to as the intrusive noise level and is the A-weighted sound level that is exceeded for 10 percent of the time during a specified measurement period. The L_{90} level is the A-weighted sound level that is exceeded for 90 percent of the time during the measurement time period. The L_{90} can be thought of as the quietest 10 percent of any time period and is often referred to as the residual sound level. The L_{eq}, L_{dn} and $L_{\%}$ metrics and percentile statistical sound levels are broadband.

The United States Environmental Protection Agency (USEPA) has published estimates of various outdoor sound pressure levels and acoustic environments and are presented in Table 1 in terms of the yearly day-night averaged sound level (L_{dn}).

Table 1 Various Indoor and Outdoor Sound Pressure (LP) Levels



Notes:

µPa - Micropascals describe sound pressure levels (force/area).
dBA - A-weighted decibels describe sound pressure on a logarithmic scale referenced to 20 µPa.
Reference: USEPA, Protective Noise Levels. Condensed Version of EPA Levels Document. Publication EPA-550/9-79-100, November 1978.

Table 2 Acoustic Terms and Definitions

Term	Definition
Noise	Typically it is unwanted sound. This word adds the subjective response of humans to the physical phenomenon of sound. The implied use of the term noise is for when negative effects or responses 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 microPascals, the approximate threshold of human perception to sound at 1000 Hz.
Sound Power Level (L_W)	The total acoustic power of a noise source measured in decibels referenced to 10^{-12} watts. Sound power is independent of the environment. Wind turbine manufacturer noise specifications are provided in these terms as sound power is independent of environment.
A-Weighted Decibel (dBA)	Environmental sound is typically composed of acoustic energy across all frequencies (Hz). 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.
Unweighted Decibels (dBL)	Unweighted sound levels are referred to as linear. Linear decibels are used to determine a sound's tonality and to engineer solutions to reduce or control noise as techniques are different for low and high frequency noise. Sound levels that are linear are presented as dBL in this report.
L_{EQ}	The equivalent continuous sound level. The notional sound pressure level that would cause the same sound energy to be received as that due to the actual (fluctuating) sound over the same total duration.
L_{90}	The dBA level exceeded N % of the time, for example, L_{90}, the dBA level exceeded 90% of the time, is commonly used to estimate residual background noise levels.
L_{DN}	A 24-hour L_{eq}, except 10 dB is added to all levels measured between the hours of 2200 and 0700 to account for higher sensitivities to noise during nighttime.
Octave Bands	The audible range of humans spans from 20 to 20,000 Hertz and is typically divided into the octave band center frequencies (Hz) from 16 to 16,000 Hz.
Broadband Noise	Noise which covers a wide range of frequencies within the audible spectra, i.e. 200 to 2000 Hz.
Masking	Interference in the perception of one sound by the presence of another sound. At elevated wind speeds, wind generated noise and leaf rustle will mask wind turbine sound levels which remain relatively constant.
Frequency (Hz)	The rate of oscillation of a sound, measured in units of Hertz (Hz) or kilohertz (kHz). One hundred Hz is a rate of one hundred times 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.
Low Frequency Noise	The frequency range of 20 to 200 Hz is typically defined as low frequency noise. At sufficiently high levels, low frequency noise can cause vibrations in structures and physiological effects in humans. Low frequency noise is generally associated with older wind turbines with downwind rotor configurations.

Notes: Compiled by from multiple technical and engineering sources

4.0 OPSB Noise Rule and Requirements

The OPSB, which has jurisdiction over the installation of energy capacity and transmission infrastructure in the state, has developed rules applicable to all utility-scale wind energy facilities, which are codified in the Ohio Administrative Code. A regulatory review completed by Acentech Inc., did not identify any applicable ordinances or bylaws on the county or local level.

The OPSB §4906-17-08(A)(2) provides certification requirements for noise that must be adequately addressed during both project construction and operation. Subsection (A) Health and safety of Sec. 4906-17-08 Social and ecological data, require the applicant to be address the following:

- 4906-17-08(A)(2)(a): construction noise levels expected at the nearest property boundary including:

  (i) Dynamiting activities.
  (ii) Operation of earth moving equipment.
  (iii) Driving of piles.
  (iv) Erection of structures.
  (v) Truck traffic.
  (vi) Installation of equipment.

- 4906-17-08(A)(2)(b): For each turbine, evaluate and describe the operational noise levels expected at the property boundary closest to that turbine, under both day and nighttime conditions. Evaluate and describe the cumulative operational noise levels for the wind facility at each property boundary for each property adjacent to the project area, under both day and nighttime operations. The applicant shall use generally accepted computer modeling software (developed for wind turbine noise measurement) or similar wind turbine noise methodology, including consideration of broadband, tonal, and low-frequency noise levels expected at the nearest property boundary during both day and nighttime conditions

- 4906-17-08(A)(2)(c): Indicate the location of any noise-sensitive areas (NSAs) within one mile of the proposed facility.

- 4906-17-08(A)(2)(d): Describe equipment and procedures to mitigate the effects of noise emissions from the proposed facility during construction and operation.

The OPSB §4906-17-08(A)(2) does not provide quantitative numerical decibel limits that would be directly applicable to the Project. In the absence of decibel limits that define thresholds relative to existing conditions, there is no apparent OPSB requirement to conduct a baseline sound survey in support of permitting wind energy facilities in the state of Ohio. Hardin Wind has chosen to undertake the proactive step to complete a baseline survey to respond to possible future data requests and interrogatories during the permitting process.

5.0 Methodology

Following review and careful consideration of the wind turbine array and locations of NSAs, and direct consultation with Hardin Wind Farm Project Management, Tetra Tech completed a series of calibrated baseline sound measurements at four discrete NSAs. The baseline sound measurements were made for duration of three weeks, from November 10 to December 1, 2009. The primary goal of the baseline monitoring program is to collect data at multiple wind speeds and directions, ranging from calm to wind turbine operating at cut-in through full rotational speed. Tetra Tech has estimated that approximately 1,500 to 2,000 data points comprise a statistically sufficient dataset to characterize the existing acoustic environment across the project site. Extensive experience on many wind facilities in the U.S. and Canada indicates that an adequate sampling of ambient sound levels at all relevant wind speeds can reasonably be expected to be obtained during a given two week monitoring period, weather permitting.

5.1 Acoustic Measurement Instrumentation

All measurements were taken with a Larson Davis 831 real-time sound level analyzer equipped with a PCB model 377B02 1/2" precision condenser microphone. This instrument has an operating range of 5 dB to 140 dB, and an overall frequency range of 16 to 20,000 Hz and meets or exceeds all requirements set forth in the American National Standards Institute (ANSI) standards for Type 1 sound level meters for quality and accuracy (precision). Prior to, and immediately following the measurement session, the sound analyzers were calibrated (no level adjustment was required) with two ANSI Type 1 calibrators which have an accuracy traceable to the National Institute of Standards and Technology (NIST). The maximum observed calibration drift ranged from -0.1 dB to +0.2 dB, which is well within tolerances expected for a long term baseline sound survey.

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 sound level analyzer used was enclosed in a weatherproof case and equipped with a self-contained microphone tripod. The microphone and windscreen were tripod-mounted at an approximate height of 1.5 to 1.7 m (4.9 to 5.6 ft) above grade away from effects of ground level rustling vegetation and fallen leaves.

When sound measurements are attempted in the presence of elevated wind speeds, extraneous noise can be self generated across the microphone. Air blowing over a microphone diaphragm creates a pressure differential and turbulence. All sound level analyzer microphones were protected from wind-induced self-noise effects by an oversized 180 mm (7") diameter foam windscreen made of specially prepared open-pored polyurethane. By using this specialized environmental windscreen, the pressure gradient and turbulence is moved further away from the microphone, minimizing self-generated noise. Each sound analyzer was programmed to measure and log broadband A-weighted sound pressure levels in ten and one-minute time intervals, including a number of statistical parameters such as the average L_{eq} maximum L_{max}, and statistical $L_{\%}$ sound levels. Data was collected for 1/1 and 1/3 octave band data spanning 6.3 Hz to 20 kHz and immediately downloaded to a computer following the measurement session for the purposes of storage and further analysis. All instrumentation was laboratory calibrated within the previous 12 month period with calibration documentation provided in the Technical Appendix.

5.2 Meteorological Measurement Instrumentation

The long-term sound level monitoring stations were deployed on November 10th, 2009 with measurements and data collection extending through the end of the month of November. Regional temperature, wind speed/direction, and precipitation data were obtained from the National Weather Service meteorological station observed in nearby Lima, Ohio. These data helped confirm that weather conditions were conducive for the collection of accurate monitoring data with no prolonged precipitation events. Precipitation events were limited to approximately 15% of the total measurement period. Subsequently, sound data collected during these periods of inclement weather were systematically removed from the dataset.

Onsite meteorological towers measured site-specific wind speed and data logged for the entire baseline sound survey period. The meteorological towers were installed and are operated by DNV Global Energy Concepts Inc. (formerly Global Energy Concepts, LLC) to collect, quality control (QC), validate, summarize, and transmit data for three 60-m meteorological towers. One 60-m XHD tower, provided by NRG Systems, is identified as Site 4426. Wind Energy Services, Inc. of Westfield, Indiana, installed the tower on June 11, 2008, under contract with DNV-GEC. At site 4427, another 60-m XHD tower provided by NRG Systems, was installed by Hardin Wind Met Central on March 26, 2009. Lastly, at Site 4428 a final 60-m XHD tower provided by NRG Systems, under contract with Hardin Wind. A detailed summary of meteorological measurement equipment employed is provided in the Technical Appendix.

5.3 Monitoring Positions

At the time of the field survey, the number of wind turbines and their locations were not finalized. Reviewing the distribution of landowners who had optioned to become project participants, the general extent of the project area was known. Four monitoring stations were carefully sited to encompass all major geographical sectors within the project footprint. Long-term unattended baseline monitoring stations were deployed within 20 to 30 meters (66 to 98 feet) of a residential structure with their position secured by fastening the monitoring station to a fencepost or other stationary object. The measurement sites are representative of various residential homestead configurations including outbuildings and different types and amounts of vegetation in proximity to the residential structure. The monitoring positions (MPs) were located far from extraneous background noise such as busy highways, rail corridors, and industrial facilities. By comparing results at the four measurement sites, the objective is to analyze and employ the cumulative data set to accurately represent the overall acoustic environment across the entire project site.

The project area can be broadly described as rural agricultural and can be further characterized as consisting mostly of farms on larger tracts of land irregularly interspersed with scattered residences on smaller parcels. The distribution of residential uses is fairly sparse but there are several areas of modestly higher densities. The site topography is essentially flat with some rolling hills. There are croplands and patches of wooded areas throughout the site and the majority of homes and farmsteads have at least a few trees located in proximity to the residential structure. All properties immediately abut active cropland; however, with the exception of MP 3, harvesting was completed prior to equipment deployment.

Figures 2 through 9 present photographs of each of the monitoring stations. Aerial orthophotos show areas of vegetation in green hatching. The location of the monitoring station in the yard is shown in red. The figures present photographs of the monitoring station relative to the primary residential structure and the viewpoint from the monitoring station in the direction of the proposed project. The four MPs are further identified by address and acoustic measurement serial numbers below:

Monitoring Position 1:	# 7280 Township Road 120 Alger, OH 45812 Serial No. (S/N): 1708
Monitoring Position 2:	# 12074 Township Road 95 Kenton, OH 43326 S/N: 1580
Monitoring Position 3:	# 15757 Township Road 95 Kenton, OH 43326 S/N: 1496
Monitoring Position 4:	# 13657 Dodds Road (Township Road 130) Alger, OH 45812 S/N: 1670

Figure 2 Orthophoto of Monitoring Position 1.

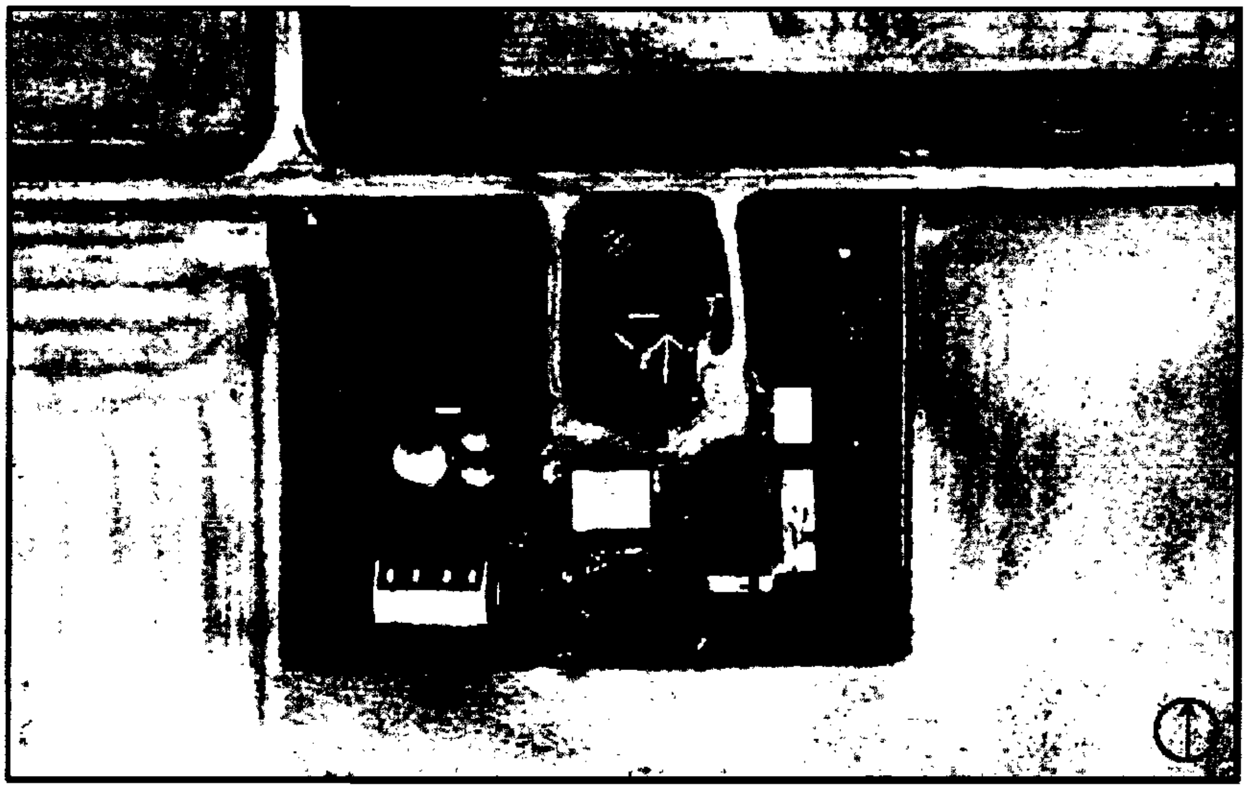
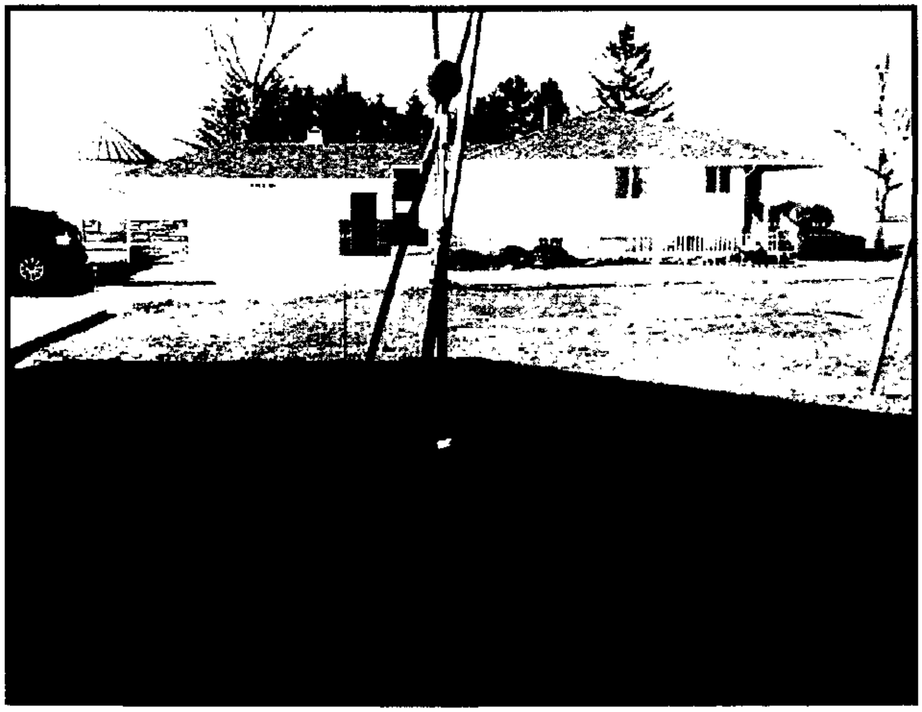


Figure 3 Photographs of Monitoring Position 1



Photograph in the direction of the primary residential structure. Sound monitoring station shown in foreground secured to a swing set (not in use during test measurements).

Photograph taken in the direction of the proposed Project.

Figure 4 Orthophoto of Monitoring Position 2.

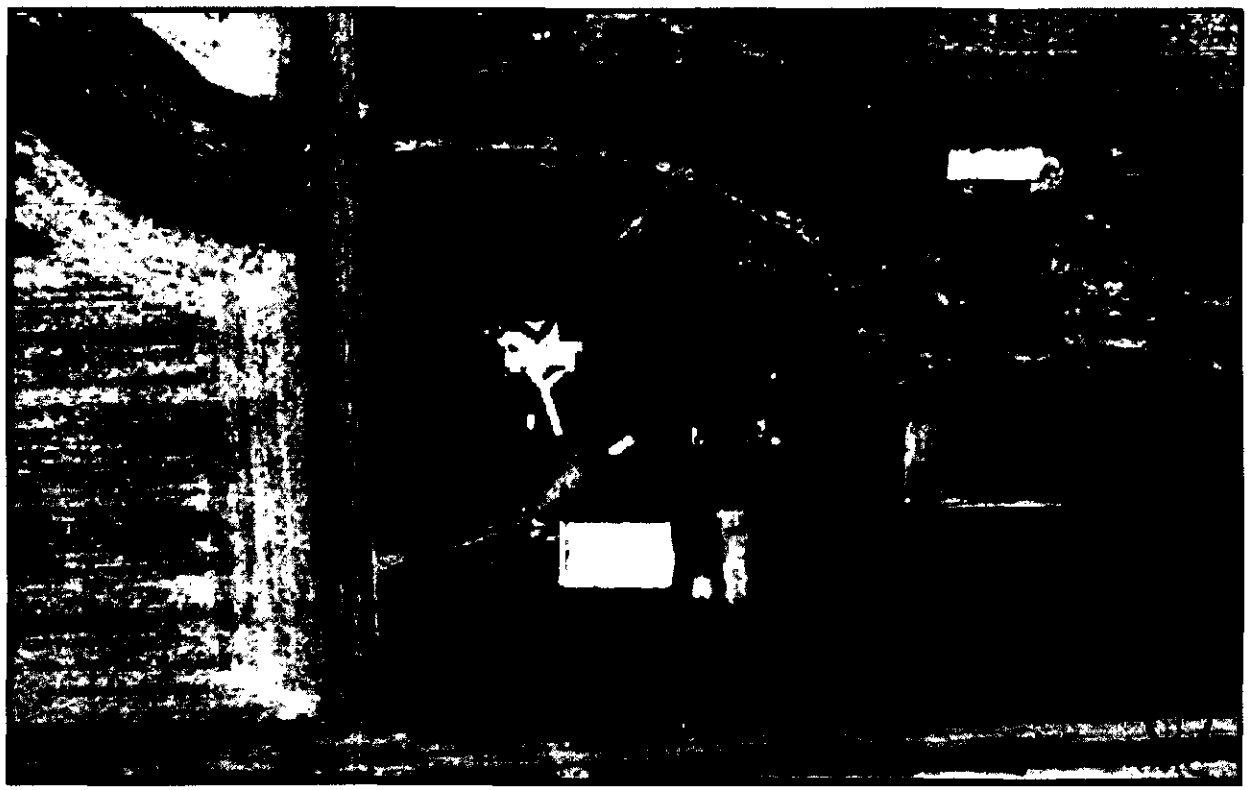
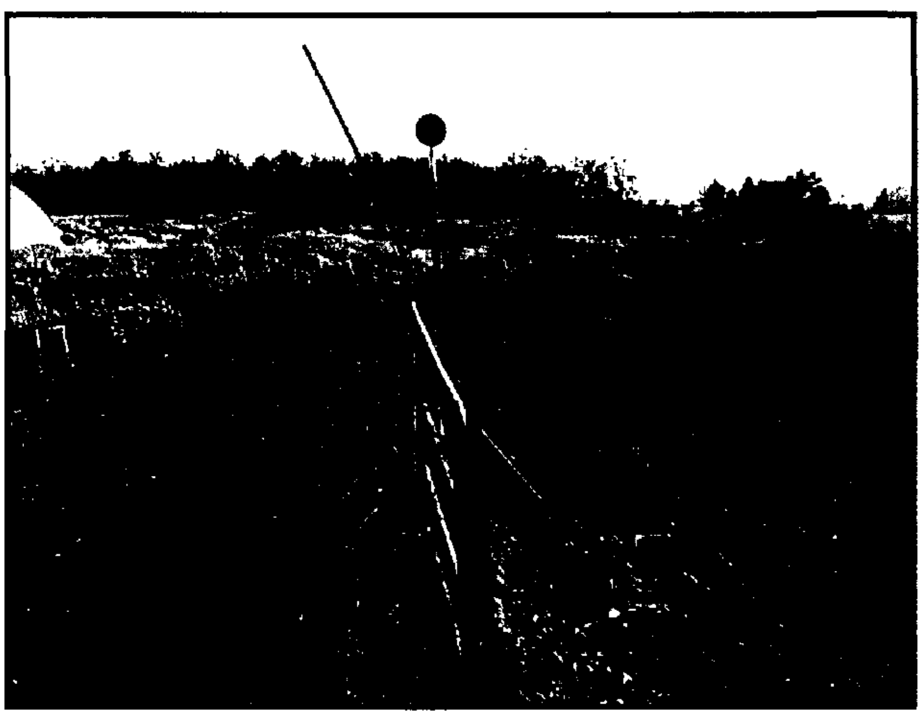


Figure 5 Photographs of Monitoring Position 2

Photograph taken in the direction of the primary residential structure. Sound monitoring station shown in foreground secured to fence section.



Photograph taken in the direction of the proposed Project.

Figure 6 Orthophoto of Monitoring Position 3.

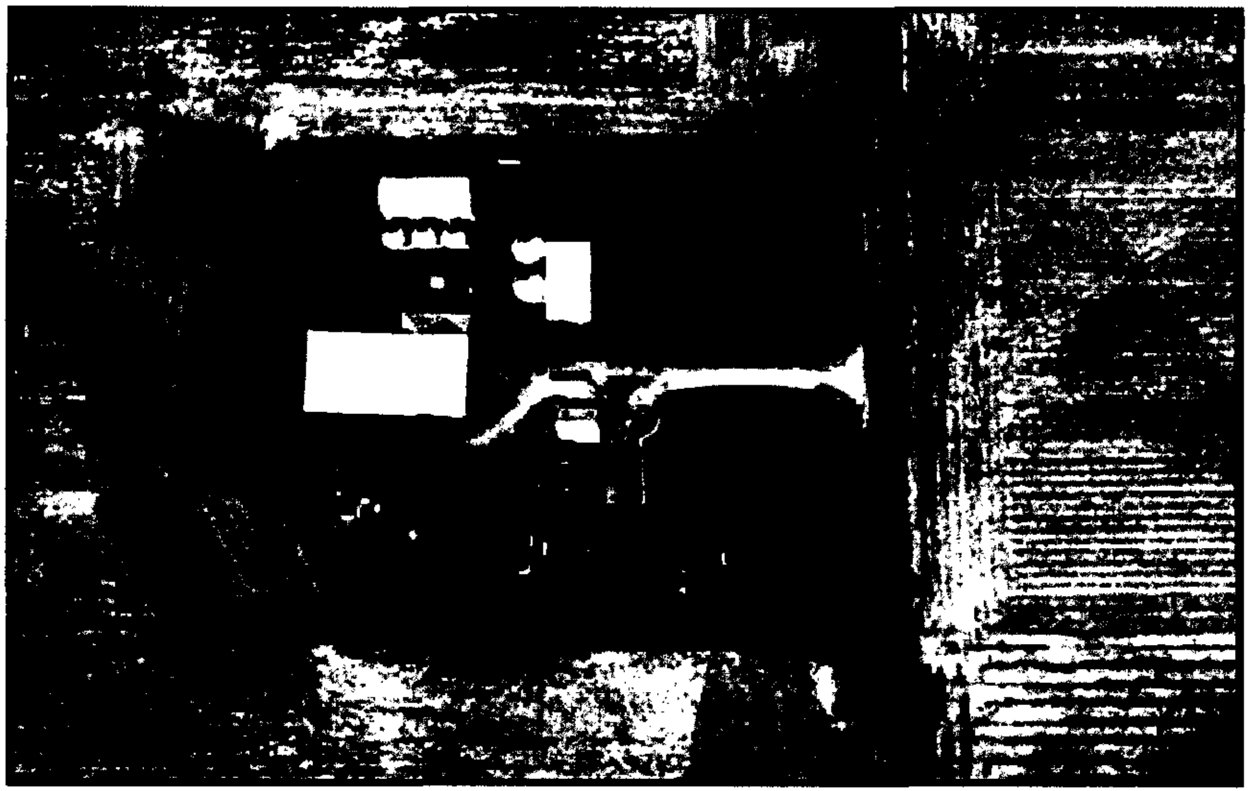


Figure 7 Photographs of Monitoring Position 3

Photograph taken in the direction of the primary residential structure. Sound monitoring station shown in foreground secured to a garden fence.

Photograph taken in the direction of the proposed Project.

Figure 8 Orthophoto of Monitoring Position 4.

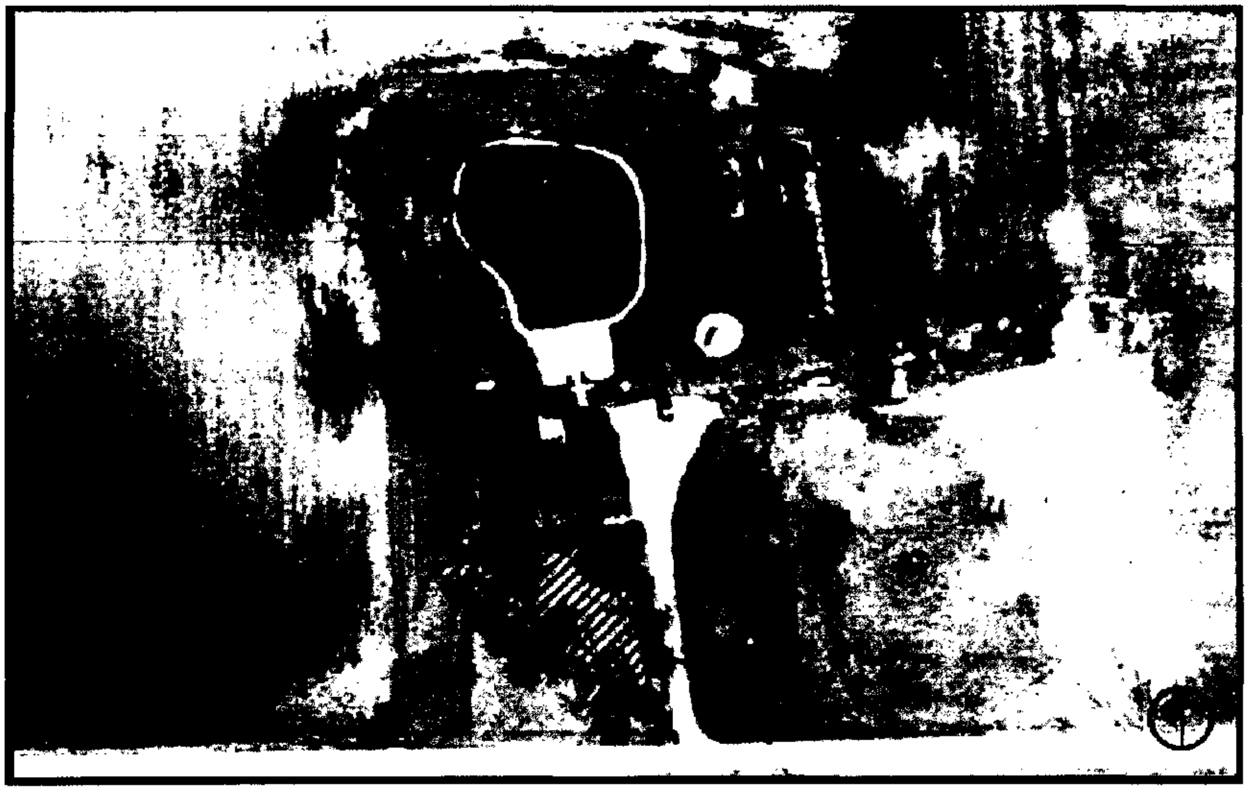
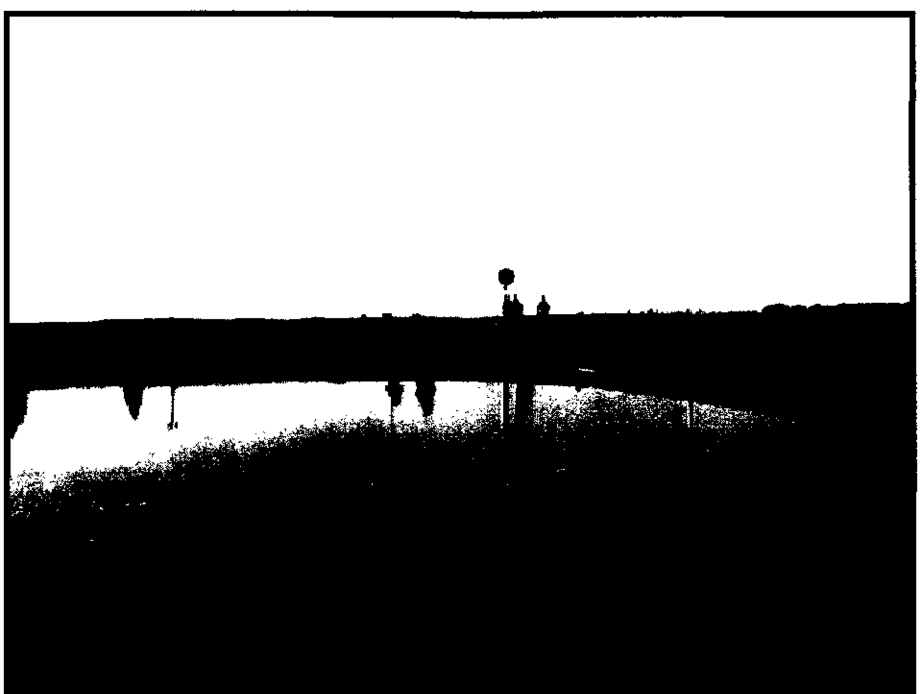


Figure 9 Photographs of Monitoring Position 4

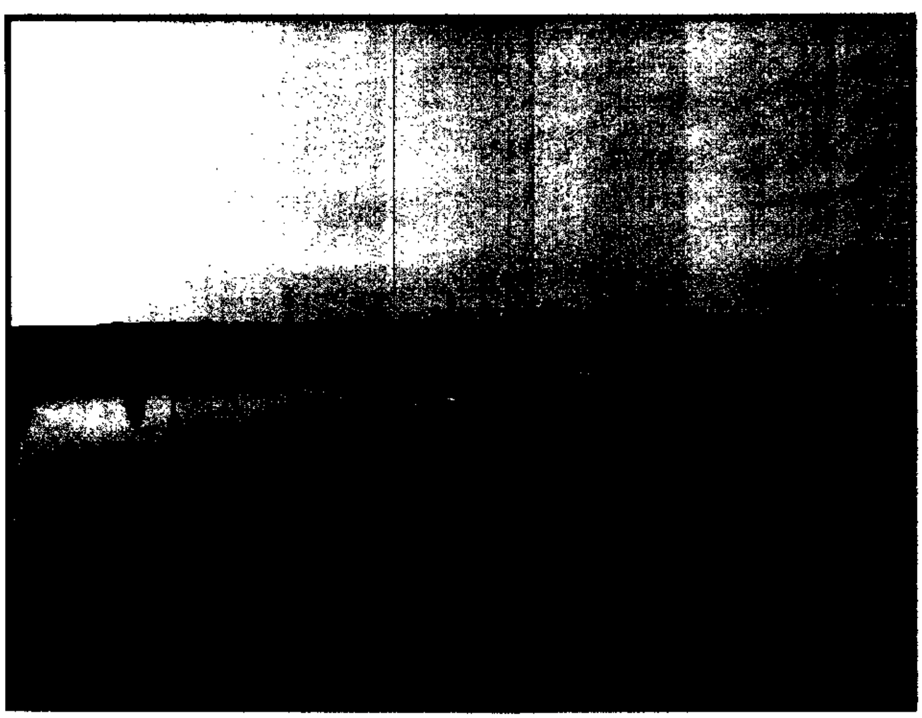
Photograph taken in the direction of the primary residential structure. Sound monitoring station shown in foreground with microphone extending above lamp post used as a support structure.



Photograph taken in the direction of the proposed Project.

Figure 9 Photographs of Monitoring Position 4

Photograph taken in the direction of the primary residential structure. Sound monitoring station shown in foreground with microphone extending above lamp post used as a support structure.



Photograph taken in the direction of the proposed Project.

6.0 Sound Survey Results and Conclusions

The purpose of a baseline sound survey is to determine the regularly occurring average and residual background sound levels that are consistently present in the project area. To accomplish this several sound metrics are measured during the long term baseline sound survey, which are then correlated with wind speed employing a statistical regression analysis.

The site for the Hardin Wind Farm is rural and largely an agriculturally based land use area. The principal source of anthropogenic and natural noise in the vicinity of the baseline monitoring stations was intermittent traffic on nearby roadways, wind generated noise during elevated wind conditions, periodic human activity, farming operations, and natural sounds. The field survey was carried out during the late fall and early winter season to avoid leaf rustle and insect noise (e.g., cicadas, crickets, etc.) as occurs during warmer periods, which can contribute to elevated environmental sound levels and negative correlation effects.

A somewhat unique acoustic characteristic of wind energy facilities, as compared to other types of commercial, industrial, and farming sound sources, is that wind turbines generate sound limited to time periods only with sufficiently high wind speeds at hub height to cause the rotor blades to rotate. This minimal wind speed condition is referred to as the cut-in wind speed. During other time periods when winds are calm, noise generated by wind energy facilities is minimal, generally limited to substation transformers, activity at the Operations and Maintenance building HVAC and support equipment, and project maintenance. A regression analysis correlating wind speeds to measured sound levels is completed to avoid invalid comparisons of wind turbine noise with ambient noise. For example, it would be incorrect to compare the maximum turbine noise level which occurs at elevated wind speeds with the minimum background noise level during calm wind conditions when a wind turbine would most likely not be operational and therefore not creating any noise.

This wind speed dependent sound source and background sound relationship is also of importance as worst case operational conditions in terms of incremental increase relative to ambient typically do not occur at maximum wind turbine rotational speeds, but at some operational wind speed between cut-in and maximum rotational. Therefore, when calculating an increase in ambient sound level resulting from project operations, the ambient sound level relative to wind speed should be considered in an acoustic modeling analysis to provide the most accurate comparative results. Comparisons of worst case operating conditions in terms of noise output to lower wind speed or L_{90} ambient sound, will likely overstate project impacts. At wind speeds higher than 8 m/s (18 mph), background sound levels continue to increase, but the wind turbine sound emissions will remain relatively constant (or decrease slightly) until the wind turbine reaches cut-out wind speeds.

Hardin Wind provided wind speed data from the three on-site meteorological towers (as described in Section 5.2) and a map showing roughness length values throughout the project area. The roughness length represents the surface friction imposed on boundary layer winds, in contact with the earth's surface, and is dependent on the unevenness of the terrain, the presence of obstacles, and the topography of the landscape. To accurately characterize the local meteorology, the wind velocity data were scaled up to hub height using site-specific roughness length, which was then incorporated into the regression analysis. Average wind speeds at hub height during the sound survey ranged from near calm to 14.5 m/s (32.4 mph).

Several statistical sound levels were measured in consecutive 10 minute intervals over the entire survey. Of these, the average (L_{eq}) and residual (L_{90}) levels are the most meaningful. Environmental noise is typically not steady and continuous, but constantly varies over time. The average, or equivalent energy sound level (L_{eq}), is the 'average' sound level over each measurement interval and is representative of the typical sound level most likely to be observed at any given moment. Periods commonly used to analyze L_{eq} sound level measurements and descriptors, including the calculation of L_{dn}, are daytime (07:00 to 22:00) and nighttime (22:00 to 07:00). The measurement data were segregated into daytime and nighttime periods to account for diurnal variation. The daytime L_{eq} is the 15-hour A-weighted energy equivalent sound level, denoted as L_{Day} and the 9-hour nighttime L_{eq} as L_{Night}. Figures 10, 11, 12, 13, and 14 present plots showing the time histories and regression analyses of ambient sound levels during daytime and nighttime monitoring periods for the four MPs and on a cumulative basis. The wind speed versus sound pressure level relationship shows that L_{eq} sound levels in the project study area are largely driven by natural, wind induced sounds.

The L_{90} statistical sound level is commonly used to conservatively quantify the regularly occurring background sound levels. The L_{90} is the sound level exceeded during 90% of the measurement interval and has the quality of filtering out short term noise events thereby describing residual background levels (i.e., it is the quietest 10% of a given measurement period). This consistently present background level may be used as conservative baseline for evaluating the audibility of a new source. The summary of L_{90} data analyses for the four MPs and cumulatively are provided in Figures 15 through 19.

The 10-minute L_{eq} and L_{90} sound levels were correlated to wind speed (m/s) at the reference 80 meter (262 feet) hub height using a regression analysis and the best fit correlation coefficient using a second order polynomial equation. The scattering and R^2 coefficient is expected and likely caused by noise associated with periodic aircraft flyovers, and short-term natural sounds such as wildlife and cattle, in addition to anthropogenic activity. Short term agricultural activities such as harvesting and the effect of diurnal wind shear may also act as contributing factors to the scatter seen at the monitoring sites.

The results reveal that L_{eq} sound levels range from a minimum of 32.8 dBA (nighttime) at 4 m/s representative of the approximate wind turbine cut-in wind speed and increase to 42.5 dBA (daytime) at 8 m/s representative of wind turbine full rotational speed at MP 1, for example. Similar results are shown for other MPs and using the L_{90} descriptor, indicating the relative acoustic homogeneity across the project site, with residences exposed to both similar noise sources and overall background sound levels. The results of the regression analysis equations and results for all descriptors including L_{10} and L_{50} for the four MPs are presented in Tables 3, 4, 5, and 6. Table 7 presents the regression equation and results for the project site on a cumulative basis.

The overall findings of the Hardin Wind Farm baseline sound survey are as follows:

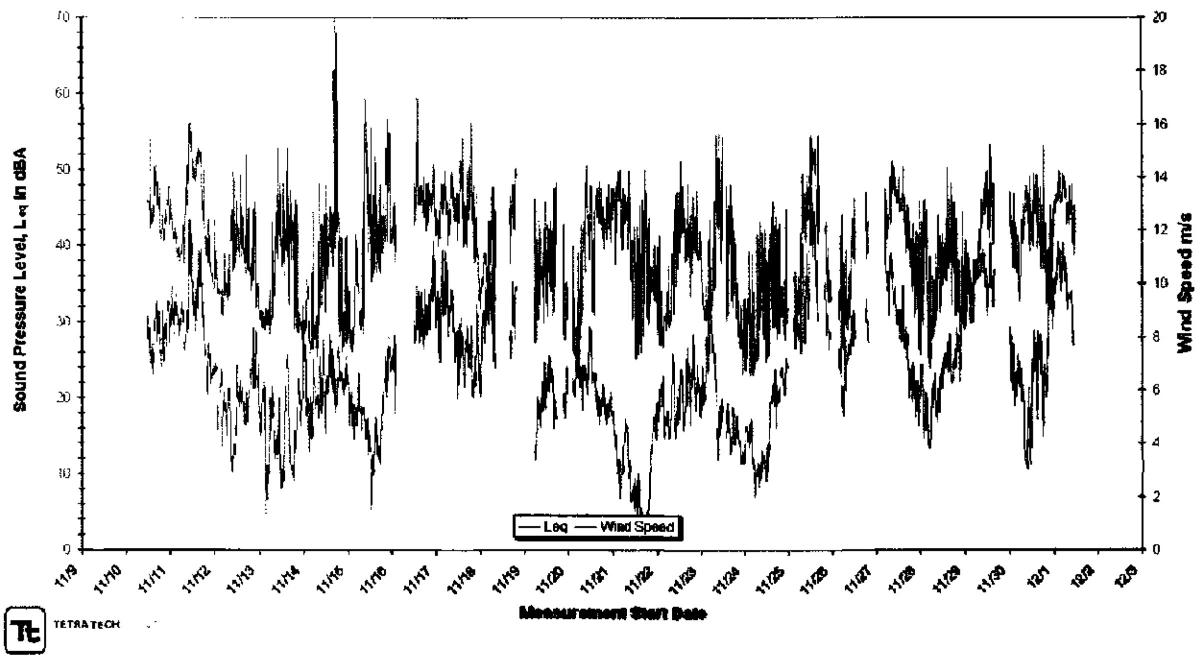
- The project site is generally characterized as rural agricultural and existing ambient sound levels are relatively low, although sound levels may be sporadically elevated in localized areas. Overall, sound levels across the entire project site were found to be largely homogenous.

- Using a standard statistical regression data analysis approach, background sound levels, defined by the L_{90} descriptor, were found to range from 27.5 dBA during wind turbines operating at cut in up to 36.8 dBA at wind speeds of sufficient strength for maximum rotational speeds at all monitoring positions. The energy average L_{eq} sound levels ranged from 30.7 dBA to 43.4 dBA under the same wind conditions.

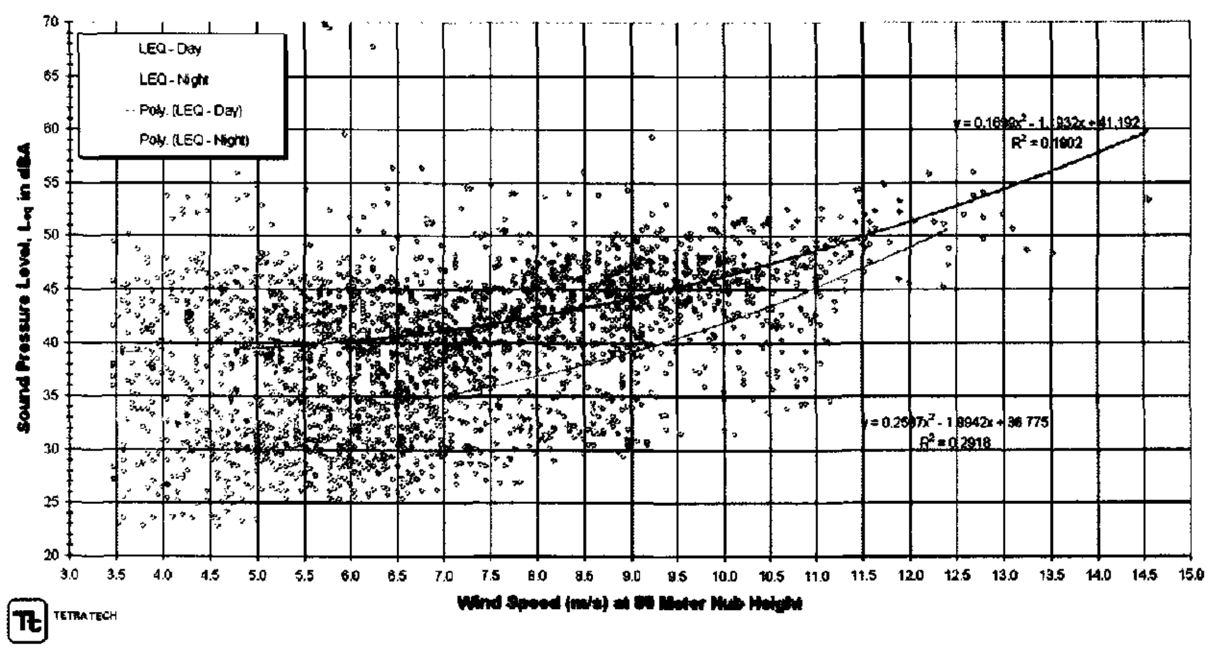
- For the worst case operational condition in terms of received sound levels, inclusive of both existing conditions and project wind turbine contributions, the measured baseline sound levels were lower than estimated values as provided in the Acentech acoustic assessment. This means that received sound levels at NSAs, as provided in the Acentech acoustic assessment, represent a conservative set of analysis results when compared to absolute noise thresholds. Therefore, no additional acoustic analysis is warranted unless substantial changes to the project layout were to occur.

END OF REPORT TEXT

Figure 10 Monitoring Station 1 - Summary of Analyses of Measured L_{EQ} Sound Pressure Levels

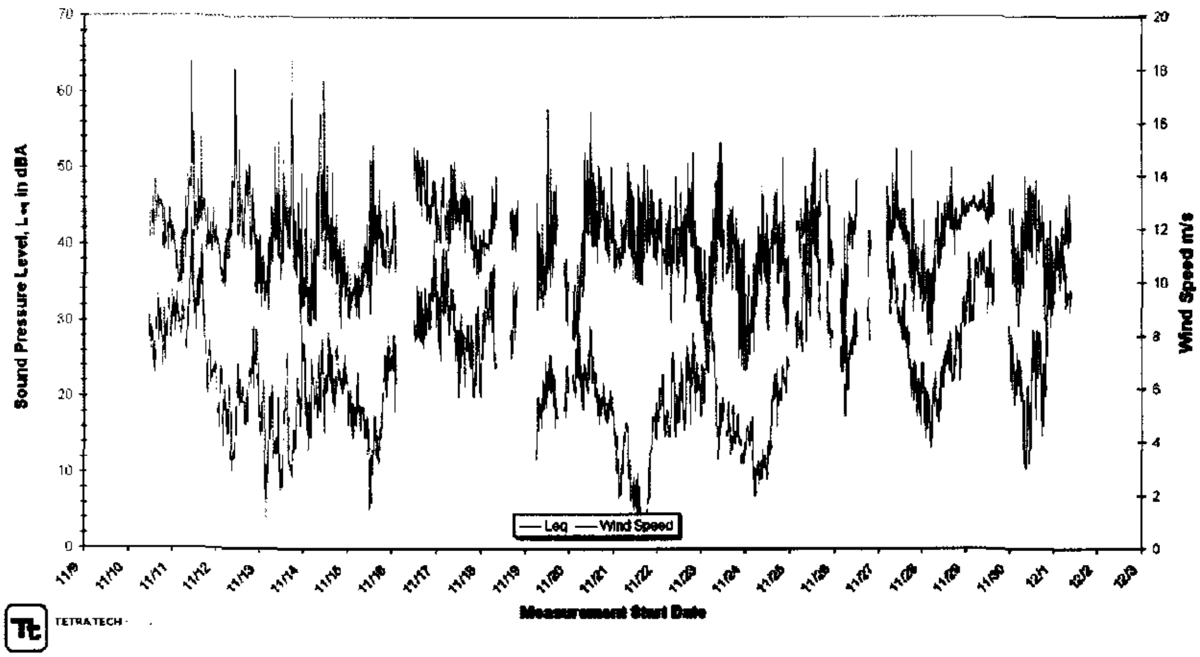


Time History L_{EQ} Sound Pressure Levels

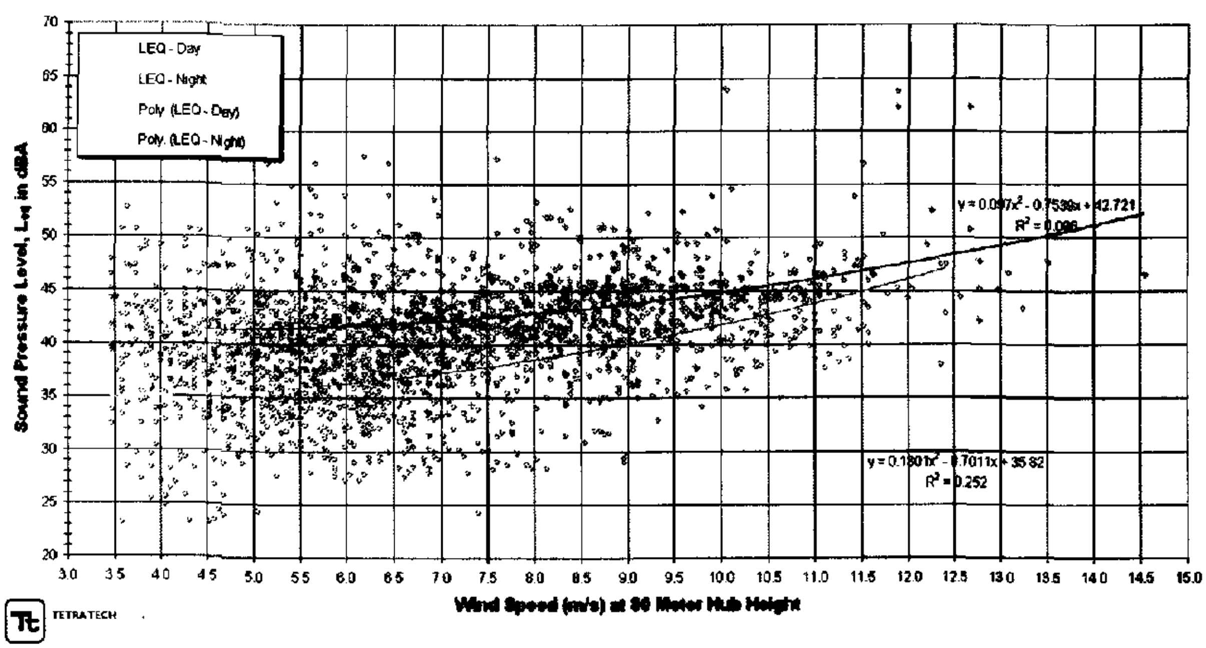


Regression Analysis of L_{EQ} Sound Pressure versus Wind Speed

Figure 11 Monitoring Station 2 - Summary of Analyses of Measured L_{EQ} Sound Pressure Levels

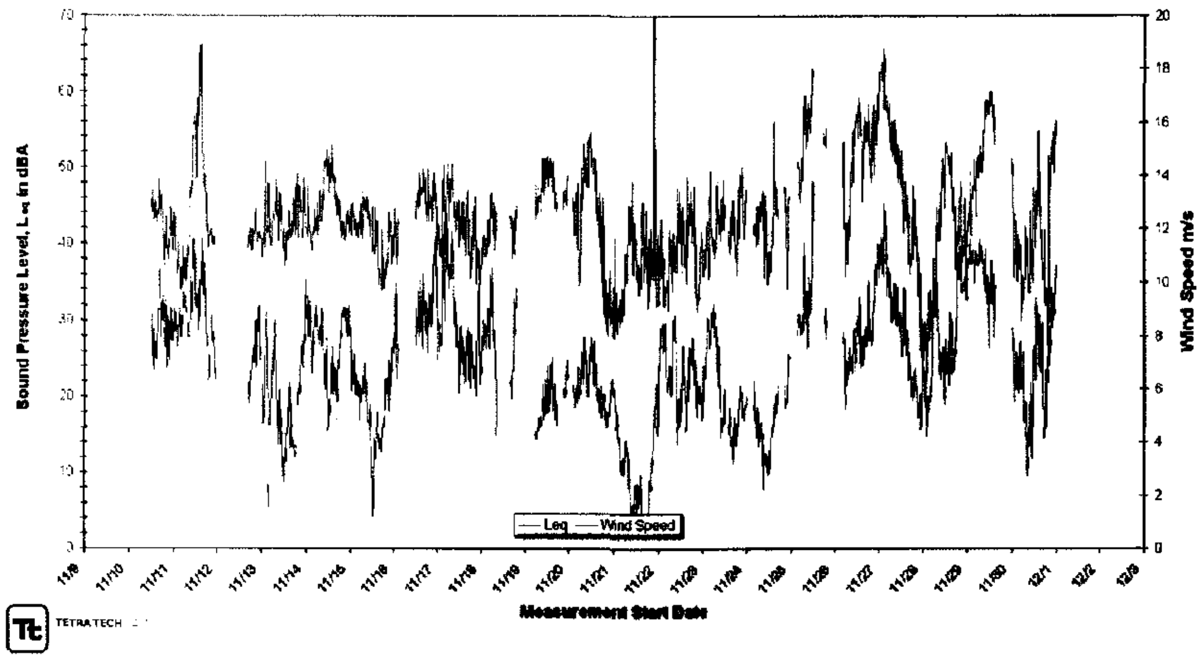


Time History L_{EQ} Sound Pressure Levels

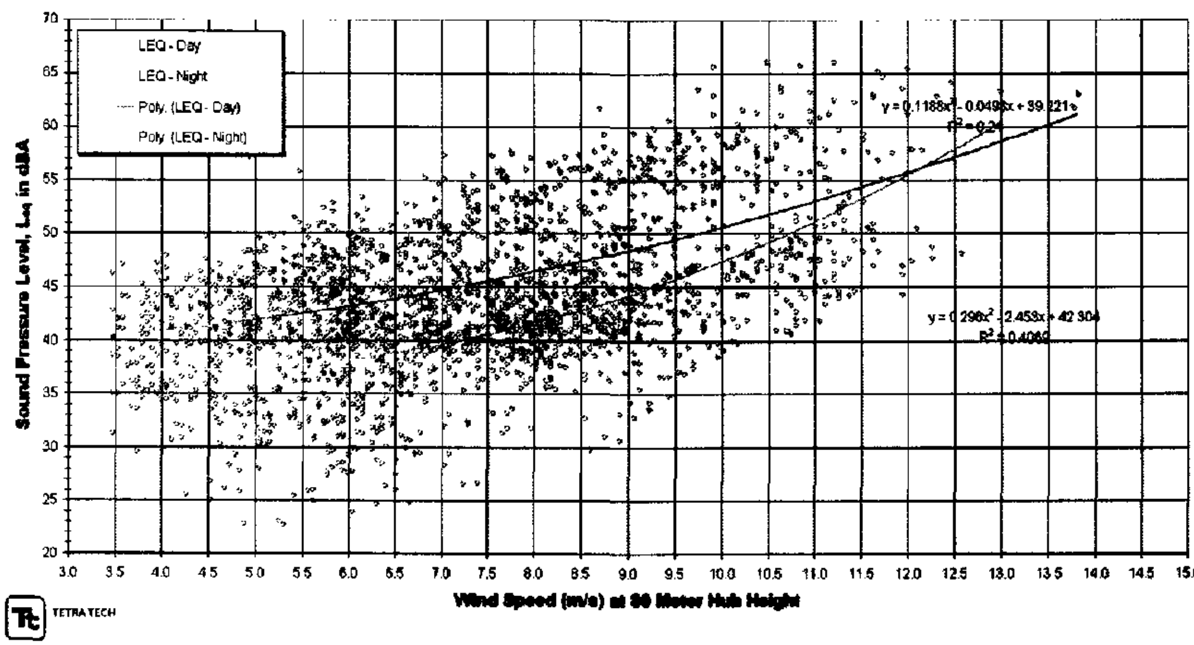


Regression Analysis of L_{EQ} Sound Pressure versus Wind Speed

Figure 12 Monitoring Station 3 - Summary of Analyses of Measured L_{EQ} Sound Pressure Levels

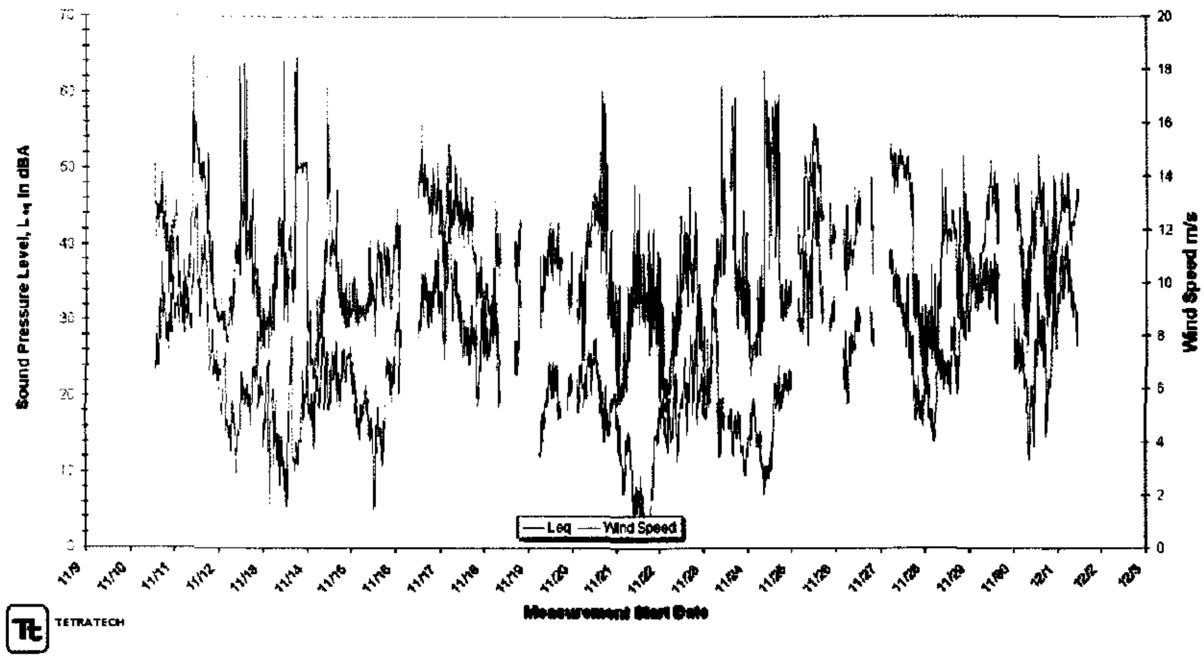


Time History L_{EQ} Sound Pressure Levels

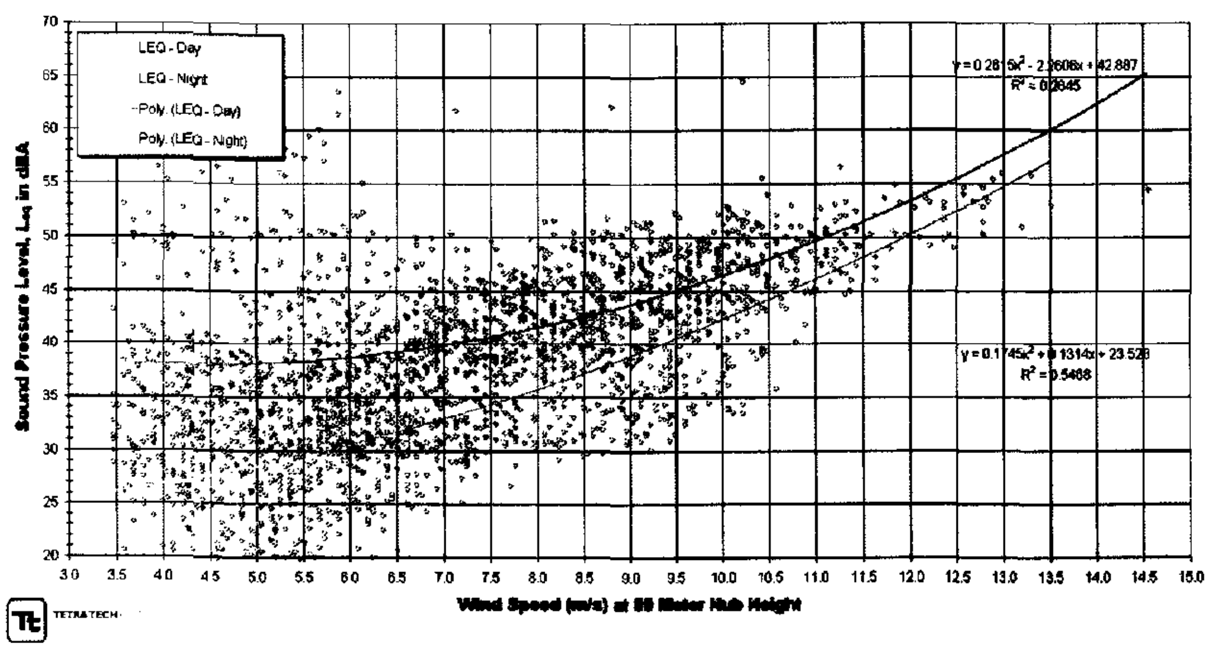


Regression Analysis of L_{EQ} Sound Pressure versus Wind Speed

Figure 13 Monitoring Position 4 - Summary of Analyses of Measured L_{EQ} Sound Pressure Levels

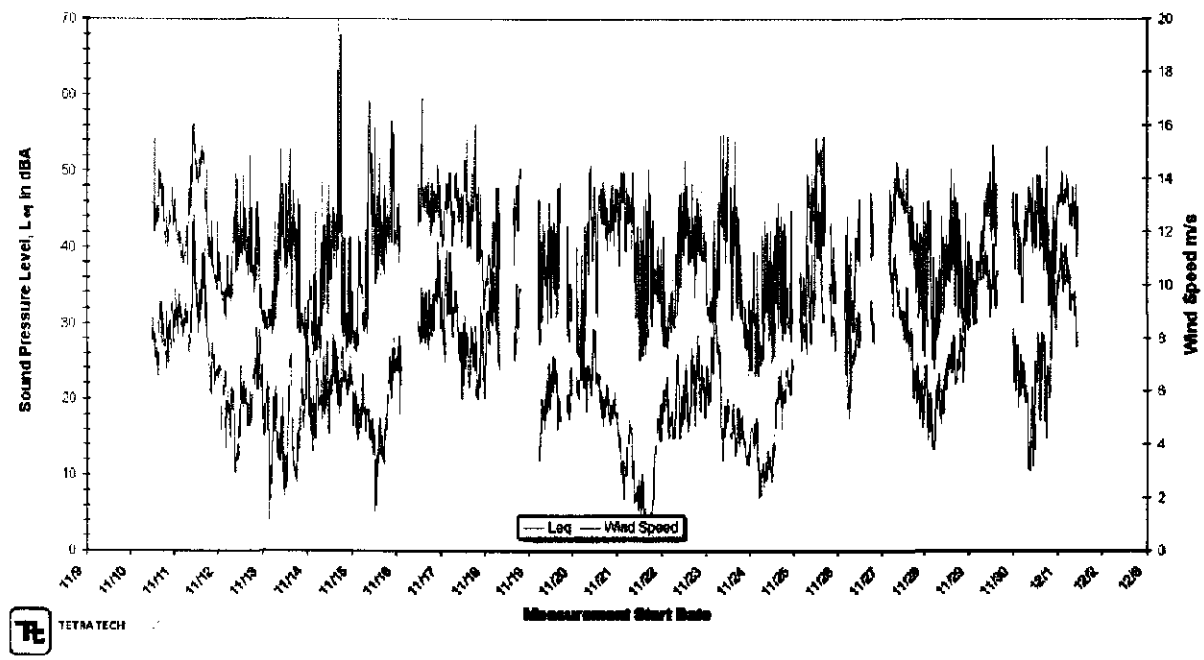


Time History L_{EQ} Sound Pressure Levels

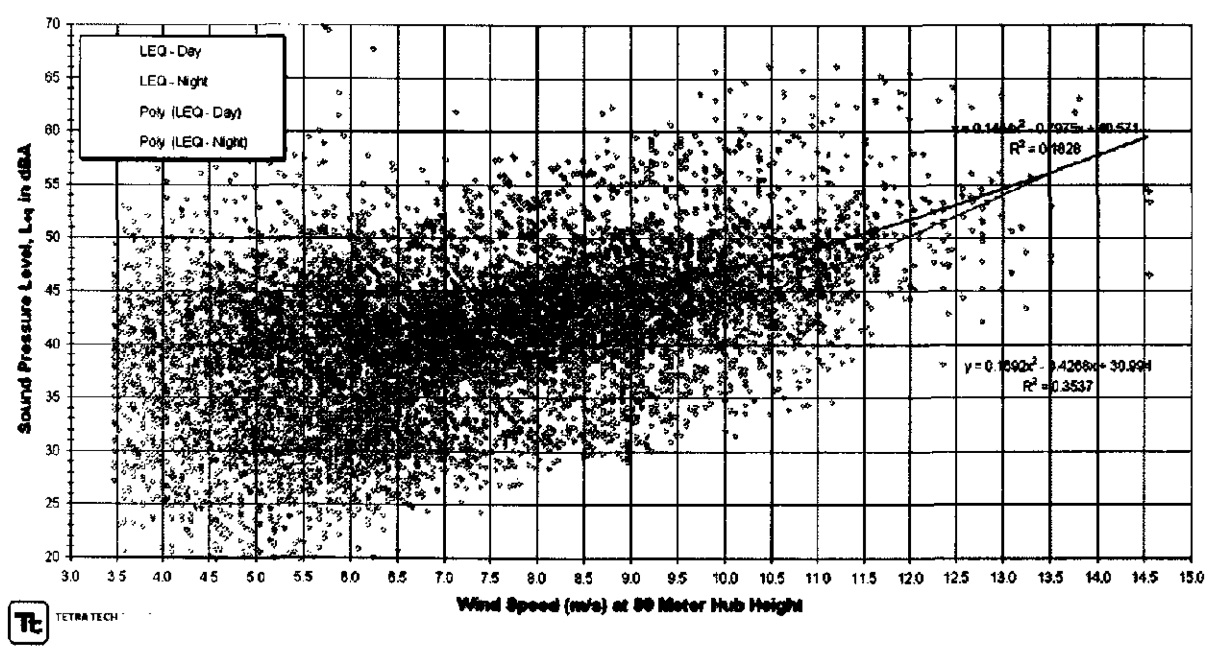


Regression Analysis of L_{EQ} Sound Pressure versus Wind Speed

Figure 14 Summary of Analyses of Measured L_{EQ} Sound Pressure Levels for All MPs

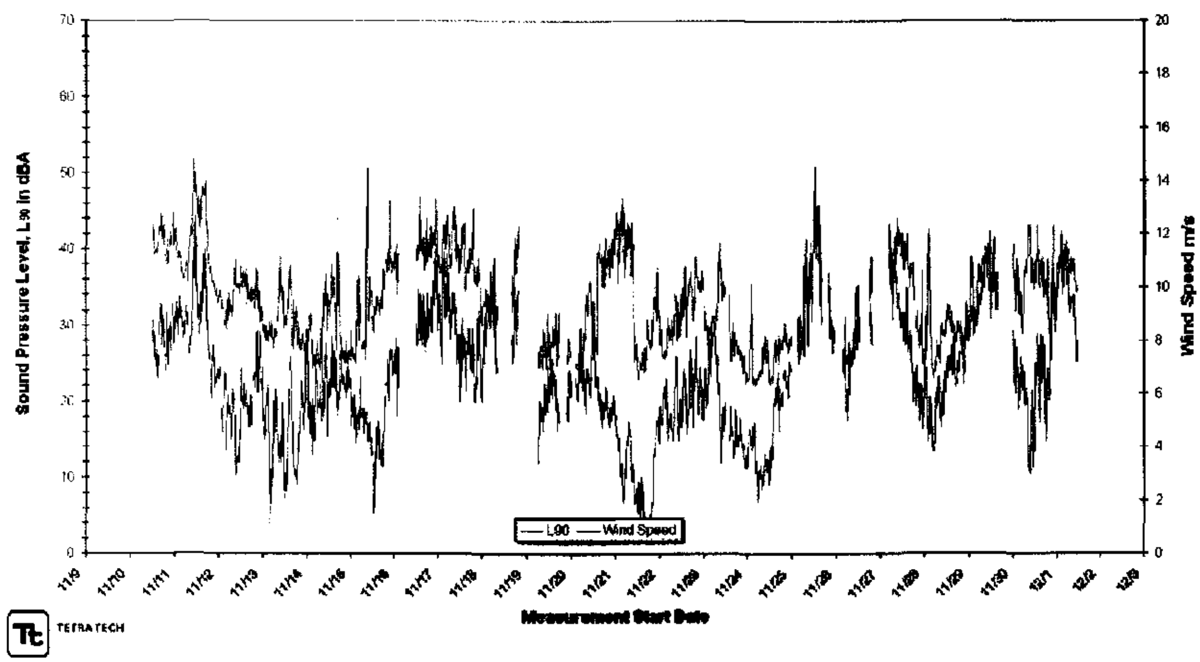


Time History L_{EQ} Sound Pressure Levels

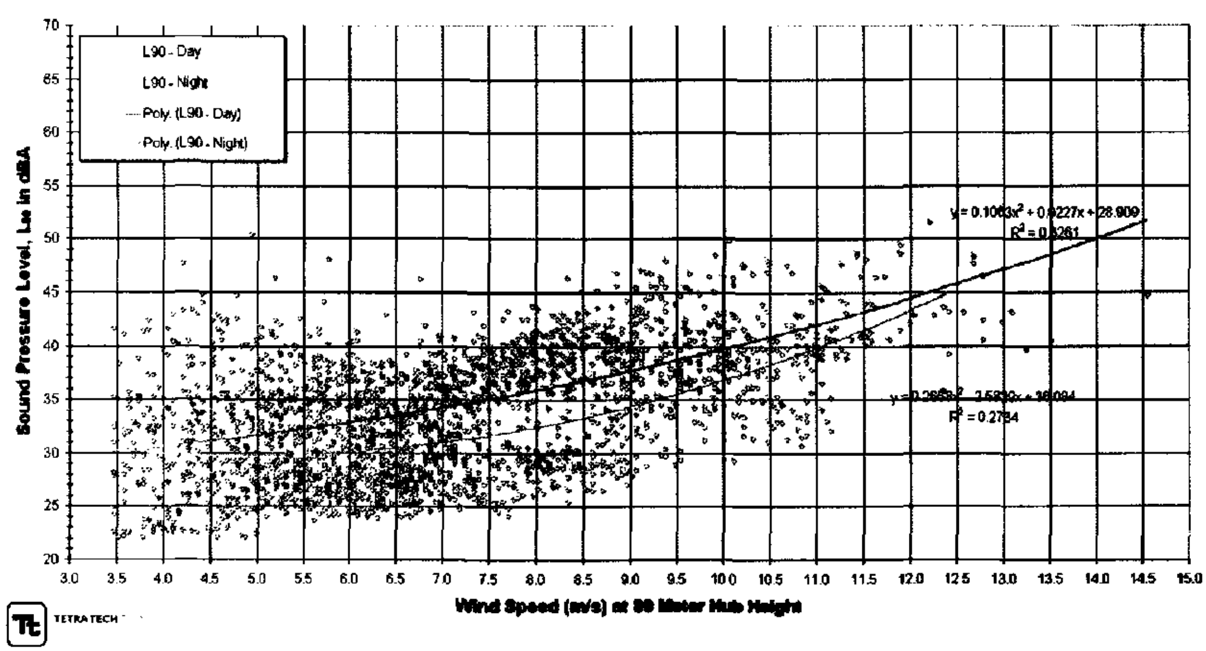


Regression Analysis of L_{EQ} Sound Pressure versus Wind Speed

Figure 15 Monitoring Station 1 - Summary of Analyses of Measured L_{90} Sound Pressure Levels

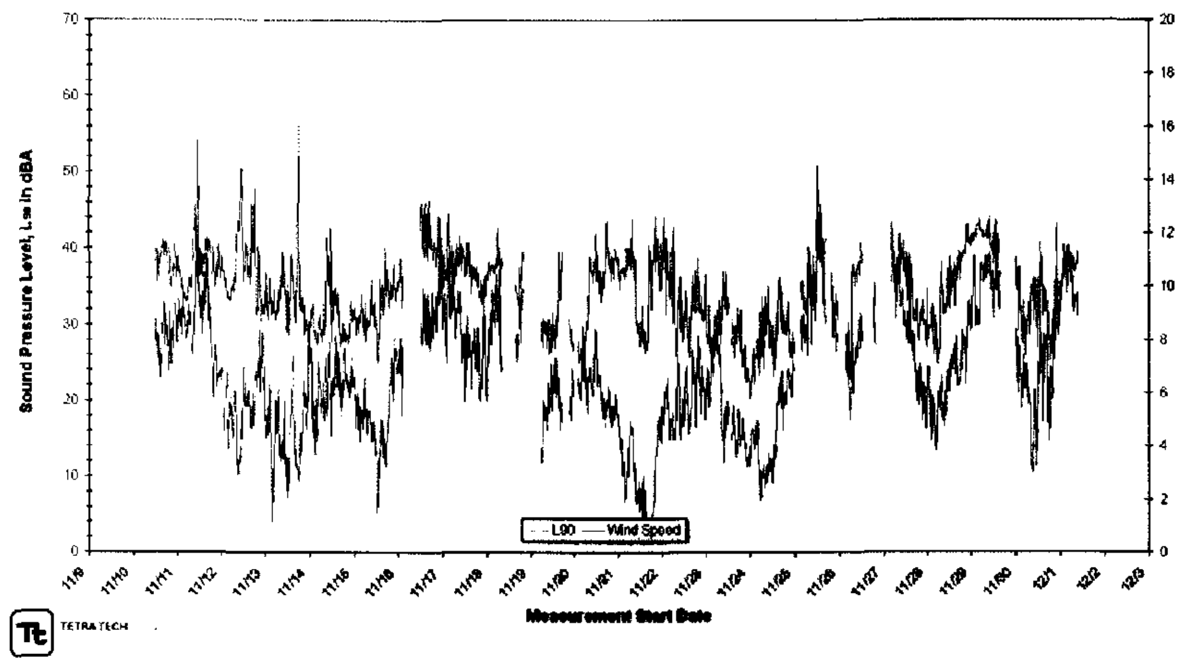


Time History L_{90} Sound Pressure Levels

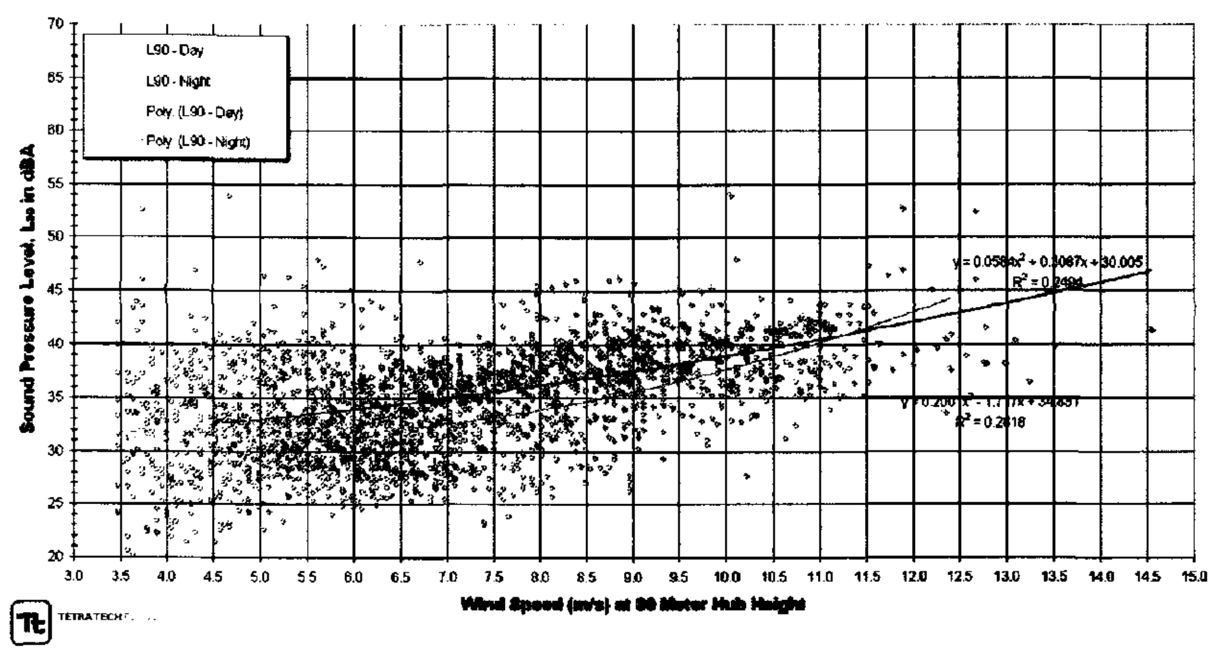


Regression Analysis of L_{90} Sound Pressure versus Wind Speed

Figure 16 Monitoring Station 2 - Summary of Analyses of Measured L_{90} Sound Pressure Levels

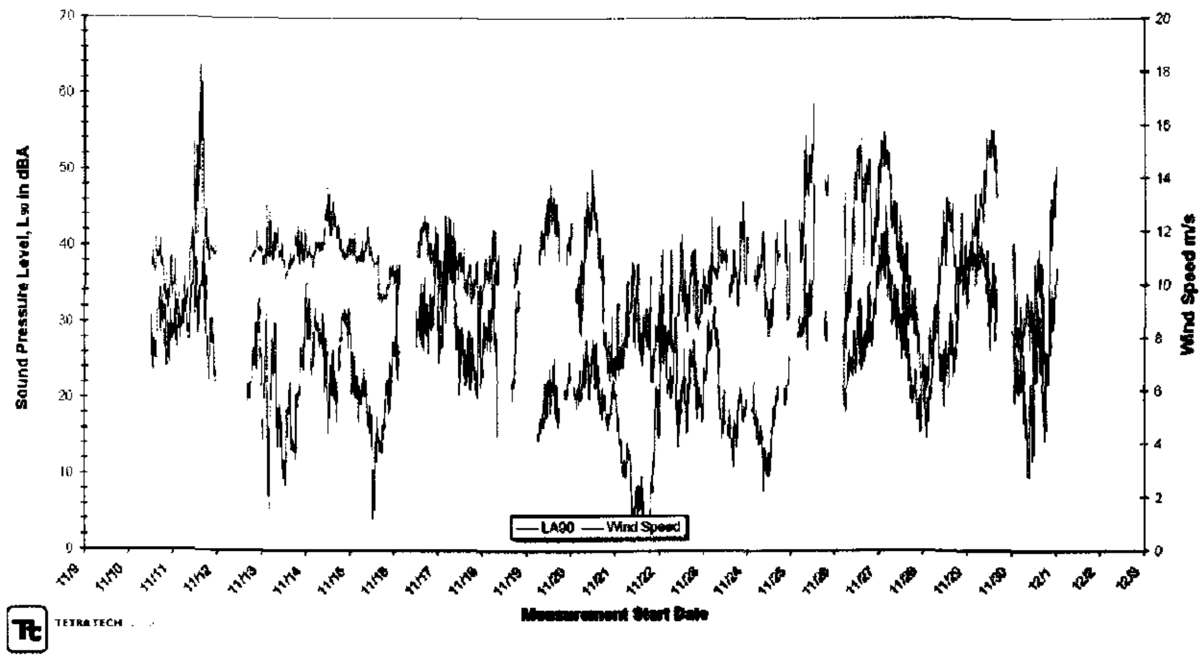


Time History L_{90} Sound Pressure Levels

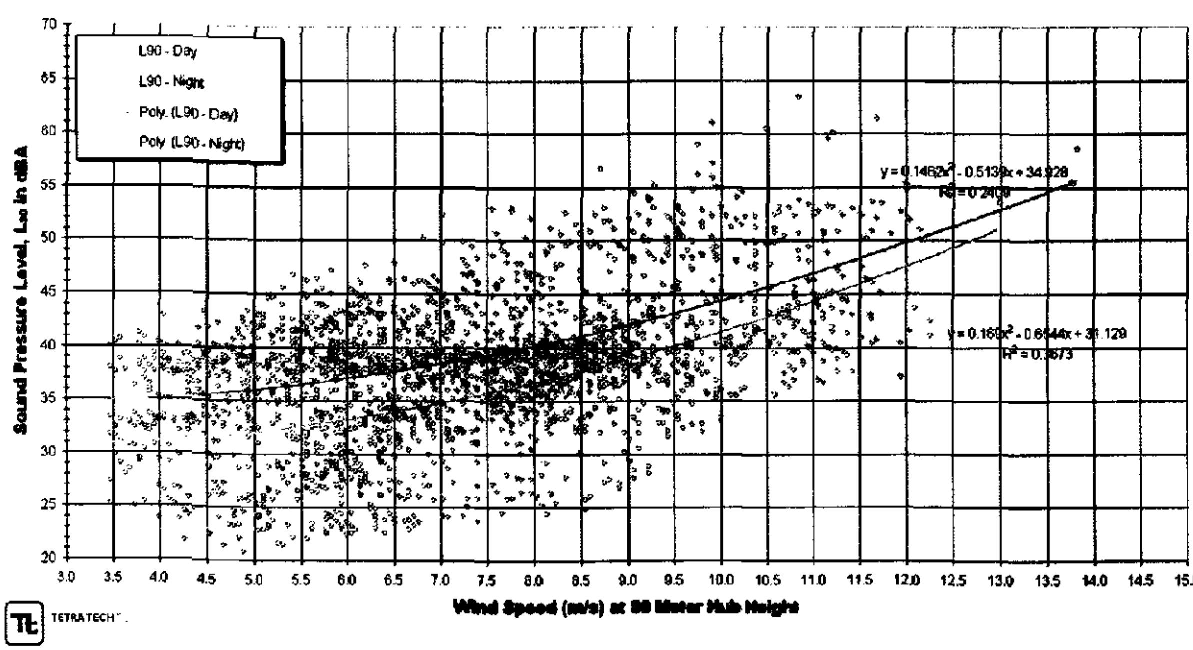


Regression Analysis of L_{90} Sound Pressure versus Wind Speed

Figure 17 Monitoring Station 3 - Summary of Analyses of Measured L_{90} Sound Pressure Levels

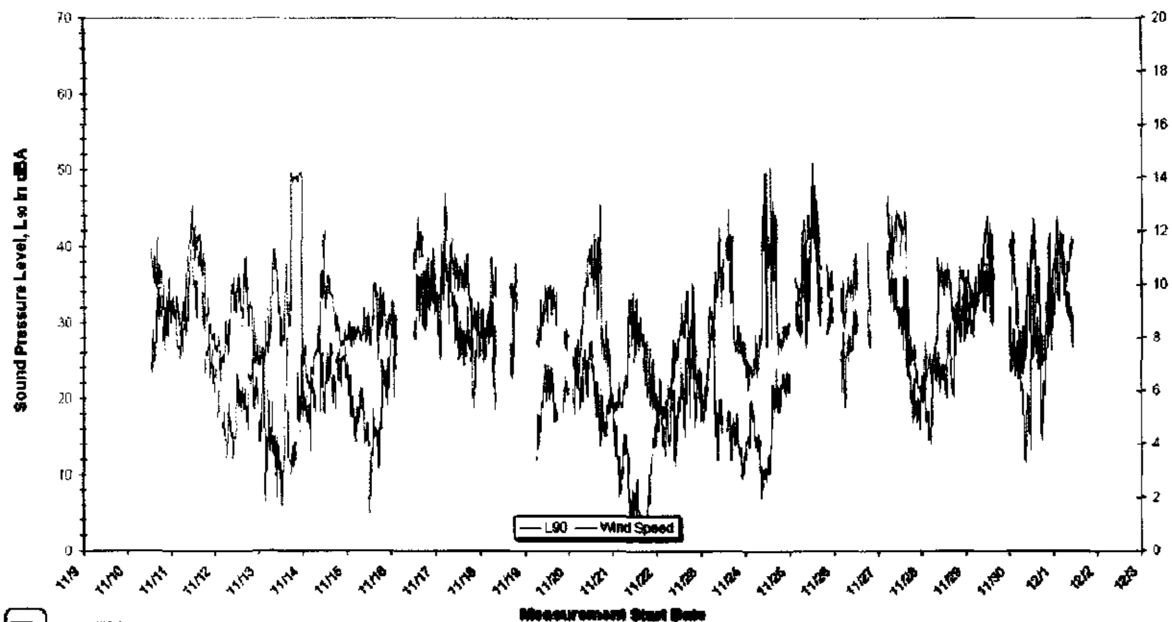


Time History L_{90} Sound Pressure Levels

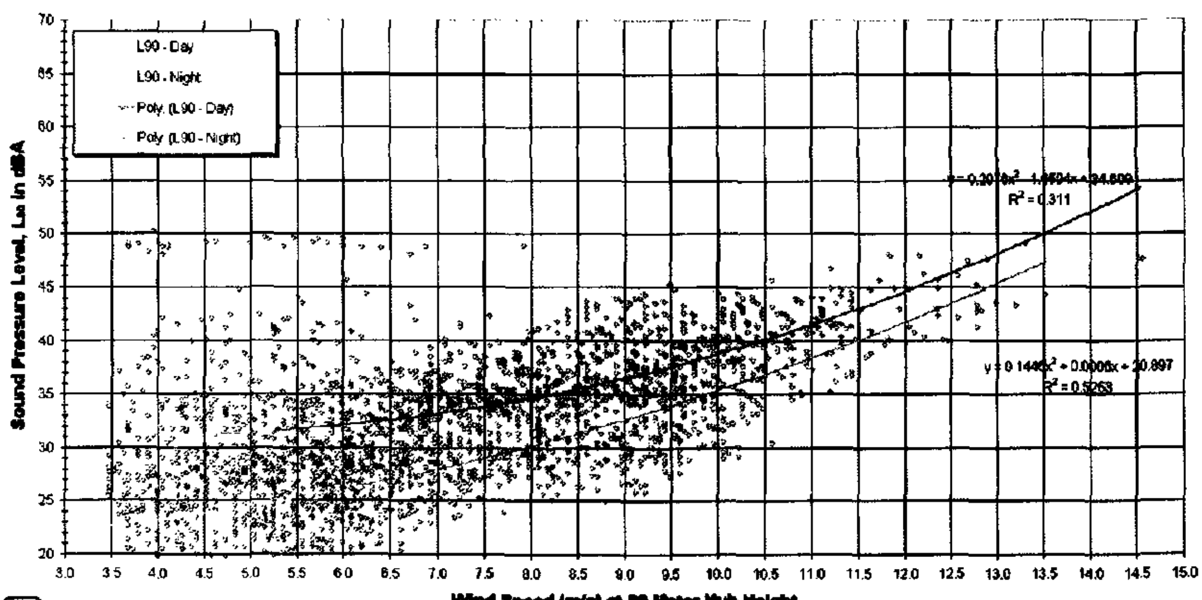


Regression Analysis of L_{90} Sound Pressure versus Wind Speed

Figure 18 Monitoring Station 4 - Summary of Analyses of Measured L_{90} Sound Pressure Levels

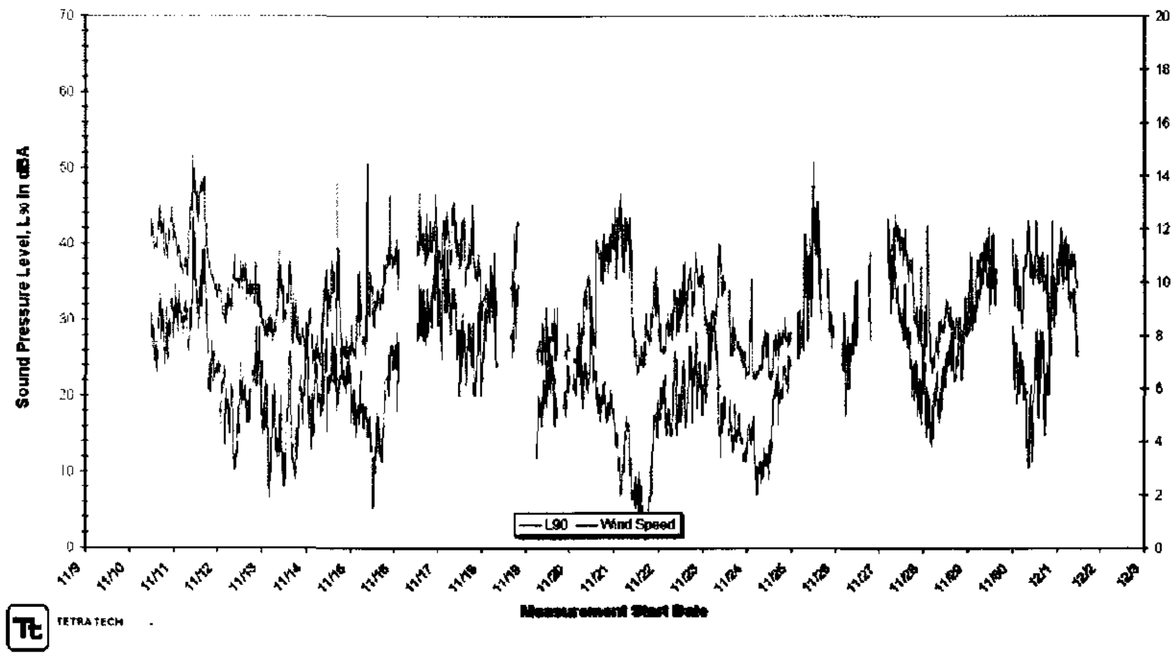


Time History L_{90} Sound Pressure Levels

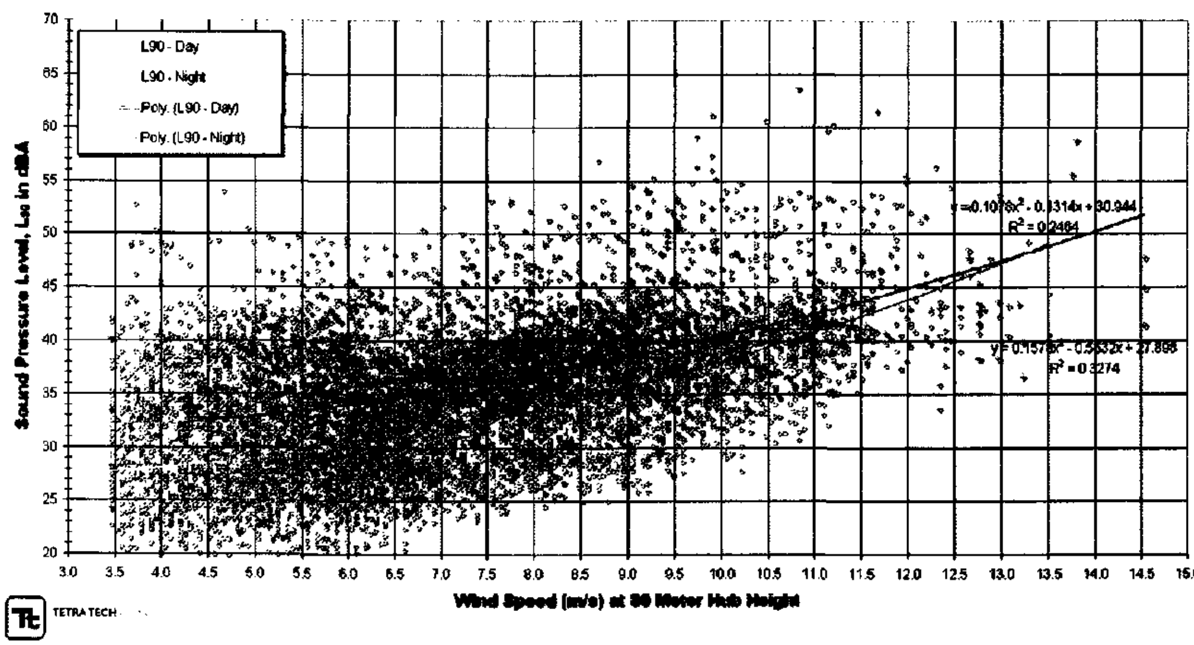


Regression Analysis of L_{90} Sound Pressure versus Wind Speed

Figure 19 Summary of Analyses of Measured L_{90} Sound Pressure Levels for All MPs



Time History L_{90} Sound Pressure Levels



Regression Analysis of L_{90} Sound Pressure versus Wind Speed

Table 3 Measured Sound Levels at Reference Wind Speeds - MP 1

Sound Metric	Regression Analysis Equation	Monitoring Period	Wind Speed at Hub Height					
			Calm	4 m/s (9 mph)	5 m/s (11.2 mph)	6 m/s (13.4 mph)	7 m/s (15.9 mph)	8 m/s (17.9 mph)
L_{eq}	y = 0.1444x2 - 0.7975x + 40.571	Day	40.2	39.1	39.5	40.1	41.2	42.5
	y = 0.1692x2 - 0.4268x + 30.994	Night	35.0	32.8	33.1	33.8	35.1	36.9
L_{10}	y = 0.147x2 - 0.683x + 41.9	Day	42.1	42.0	42.0	42.0	42.0	42.0
	y = 0.1861x2 - 0.5098x + 32.834	Night	37.6	34.5	34.6	35.4	36.7	38.7
L_{50}	y = 0.1266x2 - 0.2833x + 34.638	Day	33.0	33.9	34.8	36.0	37.4	39.2
	y = 0.1805x2 - 0.6374x + 29.867	Night	35.6	31.7	31.6	32.1	33.2	34.8
L_{90}	y = 0.1078x2 - 0.1314x + 30.944	Day	29.0	30.7	31.7	32.9	34.3	35.9
	y = 0.1578x2 - 0.5632x + 27.898	Night	33.8	30.0	29.8	30.2	31.0	32.4

Table 4 Measured Sound Levels at Reference Wind Speeds - MP 2

Sound Metric	Regression Analysis Equation	Monitoring Period	Wind Speed at Hub Height					
			Calm	4 m/s (9 mph)	5 m/s (11.2 mph)	6 m/s (13.4 mph)	7 m/s (15.9 mph)	8 m/s (17.9 mph)
L_{eq}	y = 0.097x2 - 0.7539x + 42.721	Day	42.1	41.3	41.4	41.7	42.2	42.9
	y = 0.1301x2 - 0.7011x + 35.82	Night	35.2	35.1	35.6	36.3	37.3	38.5
L_{10}	y = 0.1026x2 - 0.8031x + 45.125	Day	44.4	43.6	43.7	44.0	44.5	45.3
	y = 0.129x2 - 0.5455x + 36.694	Night	36.3	36.6	37.2	38.1	39.2	40.6
L_{50}	y = 0.0843x2 - 0.109x + 34.997	Day	35.0	35.9	36.6	37.4	38.4	39.5
	y = 0.1839x2 - 1.3641x + 35.618	Night	34.4	33.1	33.4	34.1	35.1	36.5
L_{90}	y = 0.0584x2 + 0.3087x + 30.005	Day	30.4	32.2	33.0	34.0	35.0	36.2
	y = 0.2001x2 - 1.717x + 34.831	Night	33.3	31.2	31.2	31.7	32.6	33.9

Table 6 Measured Sound Levels at Reference Wind Speeds - MP 3

Sound Metric	Regression Analysis Equation	Monitoring Period	Wind Speed at Hub Height: Calm	4 m/s (9 mph)	5 m/s (11.2 mph)	6 m/s (13.4 mph)	7 m/s (15.9 mph)	8 m/s (17.9 mph)
L_{eq}	y = 0.1188x2 - 0.0498x + 39.221	Day	39.3	40.9	41.9	43.2	44.7	46.4
	y = 0.296x2 - 2.453x + 42.304	Night	40.1	37.2	37.4	38.2	39.6	41.6
L_{10}	y = 0.0709x2 + 0.7939x + 38.493	Day	39.4	42.8	44.2	45.8	47.5	49.4
	y = 0.3417x2 - 3.087x + 46.945	Night	44.2	40.1	40.1	40.7	42.1	44.1
L_{50}	y = 0.1261x2 - 0.0399x + 36.561	Day	36.6	38.4	39.5	40.9	42.5	44.3
	y = 0.2712x2 - 2.051x + 38.792	Night	37.0	34.9	35.3	36.2	37.7	39.7
L_{90}	y = 0.1462x2 - 0.5139x + 34.928	Day	34.6	35.2	36.0	37.1	38.5	40.2
	y = 0.0536x2 - 0.4704x + 36.658	Night	36.2	35.6	35.6	35.8	36.0	36.3

Table 6 Measured Sound Levels at Reference Wind Speeds - MP 4

Sound Metric	Regression Analysis Equation	Monitoring Period	Wind Speed at Hub Height: Calm	4 m/s (9 mph)	5 m/s (11.2 mph)	6 m/s (13.4 mph)	7 m/s (15.9 mph)	8 m/s (17.9 mph)
L_{eq}	y = 0.2615x2 - 2.2606x + 42.887	Day	40.9	38.0	38.1	38.7	39.9	41.5
	y = 0.1745x2 + 0.1314x + 23.528	Night	23.8	26.8	28.5	30.6	33.0	35.7
L_{10}	y = 0.2706x2 - 2.2829x + 45.396	Day	43.4	40.6	40.7	41.4	42.7	44.5
	y = 0.1807x2 + 0.2678x + 24.618	Night	25.1	28.6	30.5	32.7	35.3	38.3
L_{50}	y = 0.2336x2 - 1.836x + 38.303	Day	36.7	34.7	35.0	35.7	36.9	38.6
	y = 0.1491x2 + 0.323x + 21.235	Night	21.7	24.9	26.6	28.5	30.8	33.4
L_{90}	y = 0.2076x2 - 1.6594x + 34.609	Day	33.2	31.3	31.5	32.1	33.2	34.6
	y = 0.1446x2 + 0.0006x + 20.897	Night	21.0	23.2	24.5	26.1	28.0	30.2

Table 7 Measured Sound Levels at Reference Wind Speeds – All MPs

Sound Metric	Regression Analysis Equation	Monitoring Period	Wind Speed at Hub Height					
			Calm	4 m/s (9 mph)	5 m/s (11.2 mph)	6 m/s (13.4 mph)	7 m/s (15.9 mph)	8 m/s (17.9 mph)
L_{eq}	y = 0.1444x2 - 0.7975x + 40.571	Day	39.9	39.7	40.2	41.0	42.1	43.4
	y = 0.1692x2 - 0.4268x + 30.994	Night	30.7	32.0	33.1	34.5	36.3	38.4
L_{10}	y = 0.147x2 - 0.683x + 41.9	Day	41.4	41.5	42.2	43.1	44.3	45.8
	y = 0.1861x2 - 0.5098x + 32.834	Night	32.5	33.8	34.9	36.5	38.4	40.7
L_{50}	y = 0.1266x2 - 0.2833x + 34.638	Day	34.5	35.5	36.4	37.5	38.9	40.5
	y = 0.1805x2 - 0.6374x + 29.867	Night	29.4	30.2	31.2	32.5	34.2	36.3
L_{90}	y = 0.1078x2 - 0.1314x + 30.944	Day	30.9	32.1	33.0	34.0	35.3	36.8
	y = 0.1578x2 - 0.5632x + 27.898	Night	27.5	28.2	29.0	30.2	31.7	33.5

Technical References

1. International Electromechanical Commission (IEC) 61400-11:2002(E) Wind Turbine Generator Systems – Part 11: Acoustic Noise Measurement Techniques, Second Edition 2002.

2. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), 1989 ASHRAE Handbook—Fundamentals, Atlanta, Georgia, 1989.

3. American National Standards Institute, ANSI S1.4-1983 American National Standard Specification for Sound Level Meters, (R 2006).

4. USEPA. 1978. Protective Noise Levels. Condensed Version of EPA Levels Document. Publication EPA-550/9-79-100, November.

FINAL REPORT AND ANY INFORMATION
REMOVED SHOULD BE CONSIDERED AS:

NON-INTERNET PUBLIC INFORMATION

APPENDIX

MEASUREMENT EQUIPMENT & LABORATORY CALIBRATION CERTIFICATIONS

Meteorological Measurement Instrumentation

Location Summary

Site Number	Tower Type	Installation Date	Tower Coordinates (WGS 84) Latitude	Longitude	Elevation
4426	NRG 60-m XHD	June 11, 2008	N 40° 37.006'	W 83° 44.186'	305 m (1,002 ft)
4427	NRG 60-m XHD	March 26, 2009	N 40° 40.130'	W 83° 44.174'	297 m (974 ft)
4428	NRG 60-m XHD	May 8, 2009	N 40° 39.273'	W 83° 47.607'	297 m (974 ft)

Sensor Summary - Site 4426

	Quantity	Nominal Sensor Height (m)	Actual Sensor Height (m)	Sensor Orientation (°)*	Boom Length (m)
NRG #40 Anem.	2	60	58	270, 180	1.5
NRG #40 Anem.	1	50	50	180	1.5
NRG #40 Anem.	1	40	40	180	1.5
NRG #40 Anem.	1	30	32	180	1.5
NRG #40 Anem.	1	20	20	180	1.9
NRG #200P Vane	2	55, 50	53, 47.5	0	1.5
NRG #110S Temp	1	3	3	0	

Sensor Summary - Site 4427

	Quantity	Nominal Sensor Height (m)	Actual Sensor Height (m)	Sensor Orientation (°)*	Boom Length (m)
NRG #40 Anem.	2	60	58	182, 270	2.4
NRG #40 Anem.	1	50	50	182	2.4
NRG #40 Anem.	2	40	40	182, 270	2.4
NRG #40 Anem.	1	25	25	182	2.4
NRG #200P Vane	2	56, 50	52, 47.5	0	2.4
NRG #110S Temp	1	3	3	0	

Sensor Summary - Site 4428

	Quantity	Nominal Sensor Height (m)	Actual Sensor Height (m)	Sensor Orientation (°)*	Boom Length (m)
NRG #40 Anem.	2	60	58	182, 269	2.4
NRG #40 Anem.	1	50	50	180	2.4
NRG #40 Anem.	2	40	40	180, 209	2.4
NRG #40 Anem.	1	25	25	182	2.4
NRG #200P Vane	2	56, 50	52, 47.5	0	2.4
NRG #110S Temp	1	3	3	0	

* An orientation of 180° means the sensor is due south of the tower.

Acoustic Measurement Instrumentation

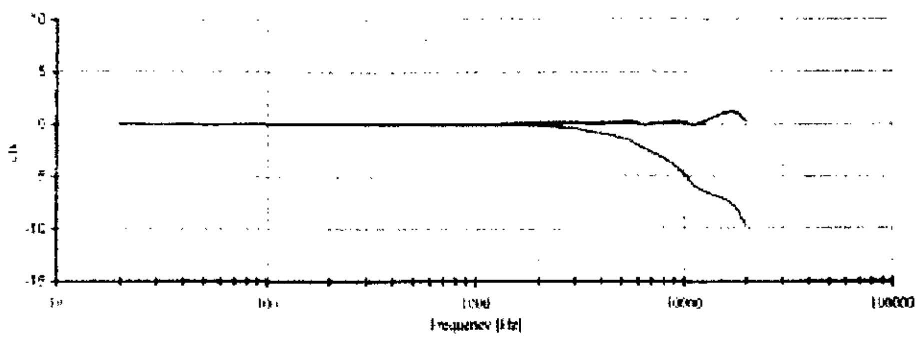
MODAL SHOP

3149 East Kemper Rd.
Cincinnati, OH 45241
Ph.: 513-351-9919
Fax: 513-458-2172
www.modalshop.com

~Calibration Certificate~

Description: Free-Field Microphone
Manufacturer: PCB
Model Number: 377B02
Serial Number: 109601

Customer : TMS Rental



Test Results:

Sensitivity:	**250 Hz**	**1kHz**	
	-26.68	**-26.76**	**dB re. 1V Pa**
	46.35	**45.90**	**mV Pa**
Cal. Results:	**In Tolerance**		

Frequency Response Characteristics : The upper curve is the free field characteristic for the microphone with protection grid. The lower curve is the pressure response recorded by electrostatic actuator.

Sensitivity : The stated sensitivity is the open-circuit sensitivity. When used with a typical preamplifier the sensitivity will be 0.2 dB lower.

Polarization Voltage : 0 V

Traceability : The calibration is traceable through NIST TN 822/274345-07.

Notes :
Calibration results relate only to the items calibrated.
This certificate may not be reproduced, except in full, without written permission.
This calibration is performed in compliance with ISO 9001, ISO 17025 and ANSI Z540.
Measurement uncertainty at 95% confidence level: 0.25 dB
Calibrated per procedure PRD-P204.

User Note : As Found / As Left: In Tolerance.

Cal Date:	16-Sep-2009	10:36:39	Temperature:	72 (22)	°F (°C)
Due Date:			Humidity:	42	%
Technician:	Ed Devlin		Pressure:	1021	mbar
Approval:					

Reference Equipment Used:

Manuf	*Model*	*Serial*	*Cal Date*	*Due Date*
G.R.A.S.	40AG	58093	9/1/2009	9/1/2010

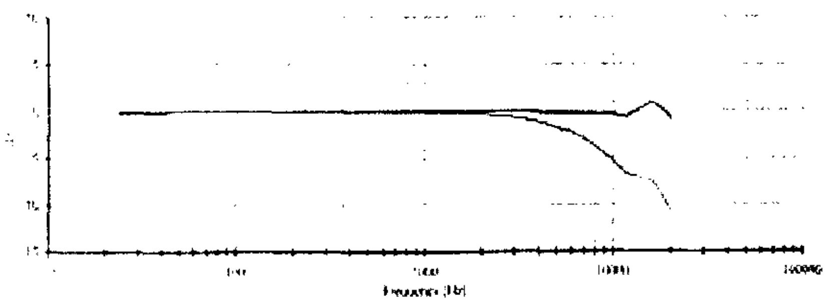
ACCREDITED
1949.01

Page 1 of 1

MODAL SHOP

~Calibration Certificate~

Description:	Free-Field Microphone	**Customer :** TMS Rental
Manufacturer:	PCB	
Model Number:	377B02	
Serial Number:	109597	



Test Results:

Sensitivity	**250 Hz**	**1kHz**	
	-26.37	-26.45	dB re. 1V/Pa
	48.01	47.58	mV/Pa
Cal Results:	In Tolerance		

Frequency Response Characteristics : The upper curve is the free field characteristic for the microphone with protective grid. The lower curve is the pressure response recorded by electrostatic actuator.

Sensitivity : The stated sensitivity is the open-circuit sensitivity. When used with a typical preamplifier the sensitivity will be 0.2 dB lower.

Polarization Voltage : 0 V

Traceability : This calibration is traceable through NIST SN 822/274045-07

Notes :
Calibration results relate only to the items calibrated.
This certificate may not be reproduced, except in full, without written permission.
This calibration is performed in compliance with ISO 9001, ISO 17025 and ANSI Z540.
Measurement uncertainty at 95% confidence level ±0.15 dB
Calibrated per procedure PRD-P554

User Note : As Found: As Left: In Tolerance

Cal Date:	16-Nov-2009	10:58:13	**Temperature**	72 (22)	°F (°C)
Due Date:			**Humidity**	47	%
Technician:	Ed Devlin		**Pressure:**	1021	mbar
Approved:					

Reference Equipment Used:

Manuf	Model	Serial	Cal Date	Due Date
G.R.A.S.	40AG	59065	4/1/2009	4/1/2010

ACCREDITED

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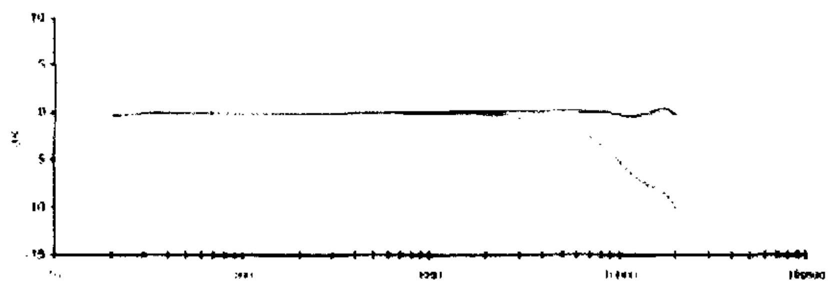
MODAL SHOP

~Calibration Certificate~

[illegible]

Description: Free-Field Microphone
Manufacturer: PCB
Model Number: 377B02
Serial Number: 160806

Customer: [illegible] Rental



Test Results:

Sensitivity:	**250 Hz**	**1kHz**	
	-25.54	-25.61	dB re 1V/Pa
	52.82	52.41	mV/Pa
Cal. Results:	In Tolerance		

Frequency Response Characteristics: The upper curve is the free field characteristic for the microphone with protection grid. The lower curve is the pressure response recorded by electrostatic actuator.

Sensitivity: The stated sensitivity is the open-circuit sensitivity. When used with a typical preamplifier the sensitivity will be 0.2 dB lower.

Polarization Voltage: 0 V

Traceability: The calibration is traceable through NIST [illegible]

Notes
Calibration results relate only to the items calibrated.
This certificate may not be reproduced, except in full, without written permission.
This calibration is performed in compliance with ISO 9001, ISO 17025 and ANSI Z540.
Measurement uncertainty at 95% confidence level: 0.25 dB
Calibrated per procedure PRD-P304

User Note: As Found / As Left: In Tolerance

Cal Date:	16-Sep-2009	10:13:05	Temperature:	72 (22)	°F (°C)
Due Date:			Humidity:	37	%
Technician:	Ed Devlin		Pressure:	1020	mbar
Approval:					

Reference Equipment Used:

Manuf.	Model	Serial	Cal. Date	Due Date
G.R.A.S.	40AG	[illegible]	9/3/2009	9/3/2010

2548.01

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~Calibration Certificate~

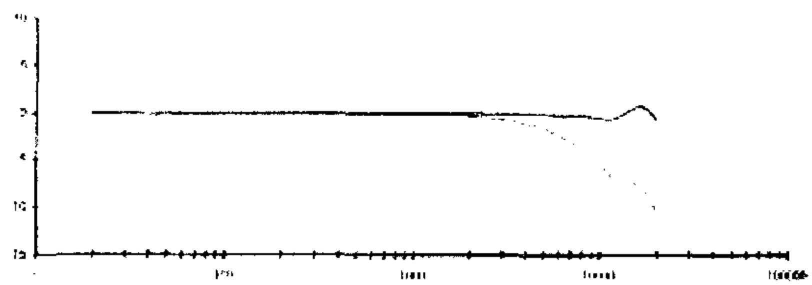
Description: Free-Field Microphone

Manufacturer: PCB

Model Number: 377B02

Serial Number: 109198

Customer : TMS Rental



Frequency (Hz)

Test Results:

Sensitivity	**250 Hz**	**1kHz**	
	-26.32	-26.40	**dB re 1V/Pa**
	48.31	47.89	**mV/Pa**
Cal Results	**In Tolerance**		

Frequency Response Characteristics : [illegible]

Sensitivity : [illegible]

Polarization Voltage : [illegible]

Traceability : [illegible]

Notes :

[illegible]

Cal Date	16-Sep-2009	10:34:11	**Temperature**	72 (22)	°F (°C)
Due Date			**Humidity :**	42	%
Technician	Ed Devlin		**Pressure**	1023	mbar
Approval					

Reference Equipment Used:

Name	Model	Serial	Cal Date	Due Date
[illegible]	[illegible]	58093	[illegible] 2009	[illegible] 2010

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PCB

Certificate of Calibration and Conformance

Certificate Number [illegible]

[illegible] Serial Number 0001496 was calibrated on 14AUG2009. The instrument [illegible] Procedure [illegible] ANSI S1.4 1983 (R 2006) Type 1 [illegible] Type 1 S1.11-2004 Octave Band Class 0 [illegible] IEC 61672-2002 [illegible] 2001 Type 1 60804-2000 Type 1 61260-2001 Class 0 61252 2002

Instrument found to be in calibration as received: YES
Date Calibrated: 14AUG2009
[illegible]

Calibration Standards Used

[illegible]

Relative Humidity: 34 %

[illegible]

Signed: Ron Harris
Technician: Ron Harris

[illegible]

Certificate of Calibration and Conformance

This document certifies that the instrument referenced below meets published specifications per Procedure PRD-P263 ANSI S1.4-1983 (R 2006) Type 1 S1.4A-1985 S1.43-1997 Type 1, S1.11-2004 Octave Band Class 0, S1.25-1991, IEC 61672-2002 Class 1 60651-2001 Type 1, 60804-2000 Type 1, 61260-2001 Class 0, 61252-2002

Manufacturer	Larson Davis	Temperature	70.7	°F
Model Number	831		25	°C
Serial Number	1670	Rel. Humidity	40	%
Customer	TMS Rental	Pressure	1024	mbars
Description	Sound Level Meter			hPa

Note: As Found / As Left: In Tolerance

Upon receipt for testing, this instrument was found to be

Within the Stated tolerance of the manufacturer's specification

Calibration Date: 8/14/2009 Calibration Due

Calibration Standards Used:

Manufacturer	Model	Serial Number	Cal Due	Traceability No.
Larson Davis	LDSigGen/2239	0780O109	3/11/2009	2009-114978

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at The Modal Shop and/or Larson Davis Corporate Headquarters. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

This calibration complies with ISO 17025 and ANSI Z540. The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. Calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of The Modal Shop.

Technician: Ed Devlin Signature

THE MODAL SHOP INC.

The Modal Shop, Inc.
3149 East Kemper Road
Cincinnati, OH 45241
Phone: (513) 351-9919
(800) 860-4867
www.modalshop.com

PRD-F242 revNR December 7, 2006 Page 1 of 1

Certificate of Calibration and Conformance

Instrument Model **831**, Serial Number **1880**, was calibrated on April 17, 2009. The instrument meets factory specifications per draft Procedure PRD-P263, ANSI S1.4-1983 (R 2006) Type 1; S1.4A-1985; S1.43-1997 Type 1, S1.11-2004 Octave Band Class 0, S1.25-1991; IEC 61672-2002 Class 1, 60651-2001 Type 1, 60804-2000 Type 1, 61260-2001 Class 0, 61252-2002.

Instrument found to be in calibration as received: YES
Date Calibrated: April 17, 2009
Calibration due:

Calibration Standards Used

Manufacturer	Model	Serial Number	Interval	Cal Due	Traceability No.
Larson Davis	LDSigGn/2239	0760 / 0109	12 Months	3/16/2010	2009-114793

Certified Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Ambient Temperature: 75.2 F   Relative Humidity: 34%

Notes

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE). Standards traceable to the National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at The Modal Shop and/or Larson Davis Corporate Headquarters. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

This calibration complies with ISO 17025 and ANSI Z540. The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. Calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of The Modal Shop.

Technician: Ed Devin
Service Center: The Modal Shop, Inc

Signature ______________________

THE MODAL SHOP INC.
The Modal Shop
[illegible] Road
Cincinnati, OH [illegible]
[illegible]
www.modalshop.com

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Certificate of Calibration and Conformance

This document certifies that the instrument referenced below meets published specifications per Procedure PRD-P263 ANSI S1.4-1983 (R 2006) Type 1 S1.4A-1985, S1.43-1997 Type 1; S1.11-2004 Octave Band Class 0, S1.25-1991; IEC 61672-2002 Class 1, 60651-2001 Type 1, 60804-2000 Type 1, 61260-2001 Class 0 61252-2002.

Manufacturer	Larson Davis	Temperature	70.7	°F
Model Number	831		25	°C
Serial Number	1708	Rel. Humidity	25	%
Customer	TMS Rental	Pressure	1032	mbars
Description	Sound Level Meter			hPa

Note As Found / As Left: In Tolerance

Upon receipt for testing, this instrument was found to be:

Within the Stated tolerance of the manufacturer's specification

Calibration Date 11/6/2008 Calibration Due:

Calibration Standards Used:

Manufacturer	Model	Serial Number	Cal Due	Traceability No.
Larson Davis	LDSigGen/2239	0760/0109	3/13/2009	2009-114978

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at The Modal Shop and/or Larson Davis Corporate Headquarters. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

This calibration complies with ISO 17025 and ANSI Z540. The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. Calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of The Modal Shop.

Technician Ed Devlin Signature

THE MODAL SHOP

The Modal Shop, Inc.
3149 East Kemper Road
Cincinnati, OH 45241
Phone (513) 351-9919
(800) 860-4867
www.modalshop.com

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~Calibration Certificate~

Description:	**Larson Davis Acoustic Calibrator**
Model:	**CAL200**
Serial Number:	**5056**
Asset Number:	
Customer:	**TMS Rental**

The subject instrument was calibrated to the indicated specification using standards stated below or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the customer.

This calibration is traceable through **NIST TN 822/275722-08**

Calibration Results: **Measured SPL: 93.98 dB re. 20µPa**
Measured Frequency: 1000.26 Hz

Measurement uncertainty at 95% confidence level: 0.25 dB

The calibration was performed under operating procedures intended to implement the requirements of ISO 9001, ISO 17025 and ANSI Z540. This calibration was performed per procedure PRD-P204. Unless otherwise noted, the reported value is both "as found" and "as left" data. Calibration results relate only to the items calibrated. This certificate may not be reproduced, except in full, without written permission.

Upon receipt for calibration, the instrument was found to be:
☑ Within ☐ Outside the stated tolerance of the manufacturer's specification.

Note: As Found As Left In Tolerance

Test Conditions:

Temperature	**74 (24) °F (°C)**	Cal Date:	**11-6-2009 12:21:33**
Humidity:	**26%**	Due Date:	
Pressure:	**1028.0mbar**	Technician:	**Ed Devlin**
		Approval:	

Reference Equipment Used:

Name	Model	Serial	Cal. Date	Due Date
G.R.A.S.	40AG	58093	6-5-2009	6-5-2010

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MODAL SHOP

~Calibration Certificate~

Description	**Larson Davis Acoustic Calibrator**
Model	**CAL200**
Serial Number	**5056**
Asset Number	
Customer	**TMS Rental**

The subject instrument was calibrated to the indicated specification using standards stated below or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the customer.

This calibration is traceable through **NIST TN 822/275722-08**

Calibration Results: **Measured SPL: 114.02 dB re. 20µPa**
Measured Frequency: 1000.25 Hz

Measurement uncertainty at 95% confidence level: 0.25 dB

The calibration was performed under operating procedures intended to implement the requirements of ISO 9001, ISO 17025 and ANSI Z540. This calibration was performed per procedure PRD-P204. Unless otherwise noted, the reported value is both "as found" and "as left" data. Calibration results relate only to the items calibrated. This certificate may not be reproduced, except in full, without written permission.

Upon receipt for calibration, the instrument was found to be:
☑ Within ☐ Outside the stated tolerance of the manufacturer's specification

Note: As Found / As Left: In Tolerance.

Test Conditions:

Temperature	**74 (24) °F (°C)**	Cal Date	**11-6-2009 12:24:48**
Humidity	**26%**	Due Date	
Pressure	**1028.0mbar**	Technician	**Ed Devlin**
		Approval	

Reference Equipment Used:

Manuf	Model	Serial	Cal Date	Due Date
GRAS	40AG	58093	9-9-2009	9-9-2010

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Legend

- Proposed 1.5 XLE Turbine Location
- NonParticipating Land Owner House
- Participating Land Owner House
- Hardin County Parcels
- Project Study Area

Noise Contour

- 45 dB
- 50 dB

Notes:
1. Ohio State Imagery Program (OSIP), March/April 2006
2. Hardin County, State of Ohio
3. Noise contours created by Acentech, revised by Tetra Tech

N

4,000 0 4,000

Feet

Hardin Noise Map for Proposed 1.5 XL Layout

Hardin Wind Farm, Hardin County, Ohio

December 2009

hardin wind