Exhibit 16
Sound Assessment

Executive Summary

Champlain Wind, LLC, has proposed construction of the Bowers Wind Project (Project), a utility-scale wind energy facility to be located in Carroll Plantation, Penobscot County, and in Kossuth Township, Washington County. The Bowers Wind Project will include up to 27 turbines, associated access roads, up to four permanent 80-meter meteorological towers, a 34.5-kilovolt electrical collector system, an electrical substation, and an Operations and Maintenance building.

Multiple turbine models are being evaluated for the civil and electrical design described in this permit application. This report considers the greatest impact aspects of the various candidate turbine models, providing analysis of the turbine type having the greatest sound power level. To aid in the evaluation, a set of receptor points were selected (receptors 1-3), which have the greatest potential to exceed the Maine DEP sound level.

Construction sound will occur during site leveling and grading, pile driving and blasting (if required), excavation, concrete pouring and steel and component erection, and is a temporary activity and therefore was assessed qualitatively in this Study.

The sound emissions related to the operational phase of the Project, however, will be longer in nature and therefore were assessed quantitatively by predicting the sound levels at each of the potentially sensitive receptors. Operational sound levels were predicted for each receptor using a sound propagation and attenuation modeling program, Cadna A, version 4.0, from Datakustik. Local meteorology and terrain were considered in the modeling and maximum sound power level information provided by the turbine manufacturerer was used for the model. The Maine Department of Environmental Protection Control of Noise (Chapter 375.10) regulation establishes the assessment guidelines and criteria pertaining to sound levels resulting from the operation of wind turbine developments in quiet areas. These guidelines were compared to the predicted levels from the model to determine Project compliance.

The modeling demonstrated that the sound levels predicted at each of the three receptor points were below the nighttime limit of 45 dBA, including an allowance for both sound power and modeling uncertainty.

1.0 INTRODUCTION

Champlain Wind, LLC, has proposed construction of the Bowers Wind Project (Project), a utility-scale wind energy facility to be located in Carroll Plantation, Penobscot County, and in Kossuth Township, Washington County. The Bowers Wind Project will include

- up to 27 turbines and associated access roads,
- up to four permanent 80-meter meteorological towers,
- a 34.5-kilovolt electrical collector system,
- an electrical substation, and
- an Operations and Maintenance building.

The project will be constructed on three ridges in the project area: Bowers Mountain and an unnamed ridge to the south ("South Peak") in Carroll Plantation, and Dill Hill in Kossuth Township. Access roads will connect each turbine location and will provide construction and maintenance access from Route 6. The electrical collector line will connect each turbine location and will then travel north for approximately 5 miles towards a proposed substation located adjacent to Line 56, an existing transmission corridor.

Multiple turbine models are being evaluated for the civil and electrical design described in this permit application. This permit application considers the greatest impact aspects of the various candidate turbine models and layouts, describing the potential effects from the combined operation of the Siemens 2.3 and Siemens 3.0 wind turbine generators.
This assessment addresses the temporary sound produced by the construction and the ongoing sound produced by operation of the Project. To aid in the evaluation, a set of receptor points were selected (receptors 1-3), which represent the locations in any direction from the proposed Project that have the greatest potential to exceed the Maine DEP sound level limits.

2.0 SOUND TERMINOLOGY

In support of the analysis and recommendations made in this report, a brief discussion of the technical terms is included below.

DEFINITIONS

<u>Attenuation</u>
The reduction of sound intensity by various means (e.g., air, humidity and porous materials).

<u>Audibility</u>
Audibility is the detectability of sound by animals with normal hearing, including humans. Audibility is affected by the hearing ability of the animal, other simultaneous interfering sounds or stimuli, and by the frequency content and amplitude of the sound.

<u>A-Weighting</u>
The weighting network used to account for changes in level sensitivity as a function of frequency. The A-weighting network de-emphasizes the high (6.3 kHz and above) and low (below 1 kHz) frequencies, and emphasizes the frequencies between 1 kHz and 6.3 kHz, in an established standard to simulate the relative response of the human ear. The A-weighting system is the most common network in use in environmental sound assessments and criteria.

<u>Ambient Noise</u>
All-encompassing sound that is associated with a given environment, usually a composite of sounds from many sources near and far.

<u>Background Noise</u>
All-encompassing sound of a given environment without the sound source of interest.

Decibel

A logarithmic measure of any measured physical quantity and commonly used in the measurement of sound. The decibel provides the possibility of representing a large span of signal levels in a simple manner as opposed to using the basic unit Pascal. The difference between the sound pressure for silence versus a loud sound is a factor of over a billion to one, therefore it is less cumbersome, and more convenient in analysis, to use a small range of equivalent values: 0 to 130 decibels. A tenfold increase in sound power is equal to +10 dB.

- Change representing doubling of sound energy = 3 dB
- Perceptible change in sound = 3 dB may be perceived in the case of relatively steady sounds, but in the case of variable sounds such as are found in nature, a perceptible change is typically of the order of 5 dB. Threshold of hearing = 0 dBA
- Quiet rural night = 35 dBA
- Normal conversation level = 50 dBA
- Arterial road traffic = 60 dBA
- Peak level of passing 18 wheeler at 50 feet = 85 dBA

Energy Equivalent Sound Level (Leq)

The Leq is the level of a constant sound over a specific time period that has the same sound energy as the actual (varying) sound over the same period. Leq is strongly influenced by intrusive sounds and will typically be higher than the steady state sound level. It is the metric most often used in regulatory applications, sound emission rating for turbines or other machinery, and environmental monitoring. Leq should be used carefully in quantifying natural ambient sound levels because occasional loud sound levels (gusts of wind, birds, insects) may heavily influence (increase) its value, even though the typical sound levels are lower.

Existing Ambient

All sounds in a given area (includes all natural sounds as well as all mechanical, electrical and other human-caused sounds).

Hearing Range (human)

An average healthy young person can hear frequencies from approximately 20 Hz to 20,000 Hz, and sound pressure levels from 0 dB to 130 dB or more (threshold of pain). Adults hear a significantly reduced range of frequencies, often less than 10,000 Hz at the high end, and the threshold of hearing also increases with age. In terms of hearing differences in sound levels, the smallest perceptible change is 1 dB, but this would only be possible in controlled environments. Change of 3 dBA may be perceived, depending on how variable the sound is; changes of this magnitude in average levels during gusty wind conditions, for example, would generally not be noticeable, but changes in the fairly constant hum of an operating appliance would be perceived. In natural environmental sounds changes of 5 dBA would be detectible. Because of the logarithmic nature of human hearing, humans perceive a change of 10 dBA to be a doubling in volume although it represents a factor of 10 in sound energy.

Natural Ambient

Natural ambient sound is defined as all natural sounds in a given area, excluding all non-natural sounds. “Natural ambient” is considered synonymous with the term “natural quiet,” although natural ambient is more appropriate because nature is often not quiet.

Noise

Traditionally, noise has been defined as unwanted, undesired, or unpleasant sound. This makes noise a subjective term. Sounds that may be unwanted and undesired by some may be wanted and desirable by others.

Octave

An octave is the interval between two frequencies having a ratio of 2 to 1. For acoustic measurements, the octaves start at 1000 Hz center frequency and go up or down from that point, at the 2:1 ratio. From 1000 Hz, the next filter’s center frequency is 2000 Hz, the next is 4000 Hz, etc., or 500 Hz, 250 Hz, etc.

Octave filtering is used in measurement and analysisi, and can be full octave, one-third octave or greater subdivisions. The division of sound into frequency bands is done in analysis because the different frequencies behave differently in the atmosphere, higher frequency sound being absorbed more readily than low frequency sound.

Protected Location
Definition from DEP regulations, c. 375.10 (1989):

> Protected Location: Any location, accessible by foot, on a parcel of land containing a residence or planned residence or approved residential subdivision, house of worship, academic school, college, library, duly licensed hospital or nursing home near the development site at the time a Site Location of Development application is submitted; or any location within a State Park, Baxter State Park, National park, Historic Area, a nature preserve owned by the Maine or National Audubon Society or the Main Chapter of the Nature Conservancy, The Appalachian Trial, the Moosehorn National Wildlife Refuge, federally-designated wilderness area, state wilderness area designated by statute (such as the Allagash Wilderness Waterway) or locally-designated passive recreation area; or any location within consolidated public reserve lands designated by rule by the Bureau of Public Lands as a protected location.
>
> At protected locations more than 500 feet from living and sleeping quarters within the above noted buildings or areas, the daytime hourly sound level limits shall apply regardless of the time of day.
>
> Houses of worship, academic schools, libraries, State and National Parks without camping areas, Historic Areas, nature preserves, the Moosehorn National Wildlife Refuge, federally-designated wilderness areas without camping areas, state wilderness areas designated by statute without camping areas, and locally-designated passive recreation areas without camping areas are considered protected locations only during their regular hours of operation and they daytime hoarsely sound level limits shall apply regardless of the time of day.
>
> Transient living accommodations are generally not considered protected locations however, in certain special situations where it is determined by the Board that the health and welfare of the quests and/or the economic viability of the establishment will be unreasonably impacted, the Board may designate certain hotels, motels, campsites, and duly licenses campgrounds as protected locations.
>
> This definition does not include buildings and structures located on leased camp lots, owned by the applicant, used for seasonal purposes.
>
> For the purposes of this definition, (1) a residence is considered planned when the owner of the parcel of land on which the residence is to be located has received all applicable building and land use permits and the time for beginning construction under such permits had not expired, and (2) a residential subdivision is considered approved when the developer has received all applicable land us permits for the subdivision and the time for beginning construction under such permits has not expired.

Short Duration Repetitive Sound
Definition from DEP regulations, c. 375.10 (1989):

> A sequence of repetitive sounds which occur more than once within an hour, each clearly discernible as an event and causing an increase in the sound level of at least 6 dBA on the fast meter response above the sound level observed immediately before and after the event, each typically less than ten seconds in duration, and which are inherent to the process or operation of the development and are foreseeable.

Sound
Sound is a pressure fluctuation due to a wave motion in air, water, or other media that has the potential to be heard through the auditory mechanisms of humans or animals.

Sound Power Level (L_W)
The sound power level is the total sound energy radiated by a source per unit time. The unit of measurement is the decibel representing a ratio of acoustic watts to a reference level of watts. The acoustic power radiated from a given sound source as related to a reference power level (typically 10^{-12} watts) and expressed as decibels. A sound power level of 1 watt = 120 dB. Conventionally, the reference level = 10^{-12} watts.

Sound Pressure Level (SPL)
Sound levels are represented by the energy in the sound pressure level as defined as ten times the base-10 logarithm of the square of the ratio of the mean-square sound pressure, in a stated frequency band (often weighted), and the reference mean-square sound pressure of 20 µPa, the threshold of human hearing.
$SPL = 10*\log_{10}(p^2 / p_{ref}^2)$ (dB)
where:

p = mean-square sound pressure; and
p_{ref} = reference mean-square sound pressure of 20 µPa.

Tonality
Definition from DEP regulations, c. 375.10 (1989):

> TONAL SOUND: for the purpose of this regulation, a tonal sound exists if, at a protected location, the one-third octave band sound pressure level in the band containing the tonal sound exceeds the arithmetic average of the sound pressure levels of the two contiguous one-third octave bands by 5 dB for center frequencies at or between 500 Hz and 10,000 Hz, by 8 dB for center frequencies at or between 160 and 400 Hz, and by 15 dB for center frequencies at or between 25 Hz and 125 Hz.

3.0 PROJECT OVERVIEW

3.1 STUDY AREA

The Project area is located in Carroll Plantation and Kossuth Township, Maine. The turbines are located in a band and are graphically presented in Figure 3.1. Ground cover in the area comprises significant areas of hardwoods, mixed brush, and some cultivated land. Acoustically, the surface will provide some sound absorption by vegetation in the warmer months and by snow cover during the winter. Maps and topographic data for the study area have been obtained from the USGS and associated databases.

3.2 CONSTRUCTION

Construction sound will occur during site leveling and grading, pile driving and blasting (if required), excavation, concrete pouring and steel and component erection, and is a temporary activity.
Construction of the proposed development will be conducted in such a manner such that activities will be in compliance as required with Section 2 of the Control of Noise Regulations (1989).

- Sound levels from construction activities conducted during the daytime period (daylight hours or 7:00 am to 7:00 pm, whichever is longer) are not subject to regulation.
- Sound emitted from nighttime construction activities is subject to nighttime operation sound level limit, 45 dBA (described below in Section 4.0);
- If construction activities are to be carried out during the same time as routine operation, then the combined sound level will be subject to the nighttime operations sound level limit, 45 dBA;
- All construction equipment in operation on the development site will comply with applicable federal noise regulations and include environmental noise control devices.

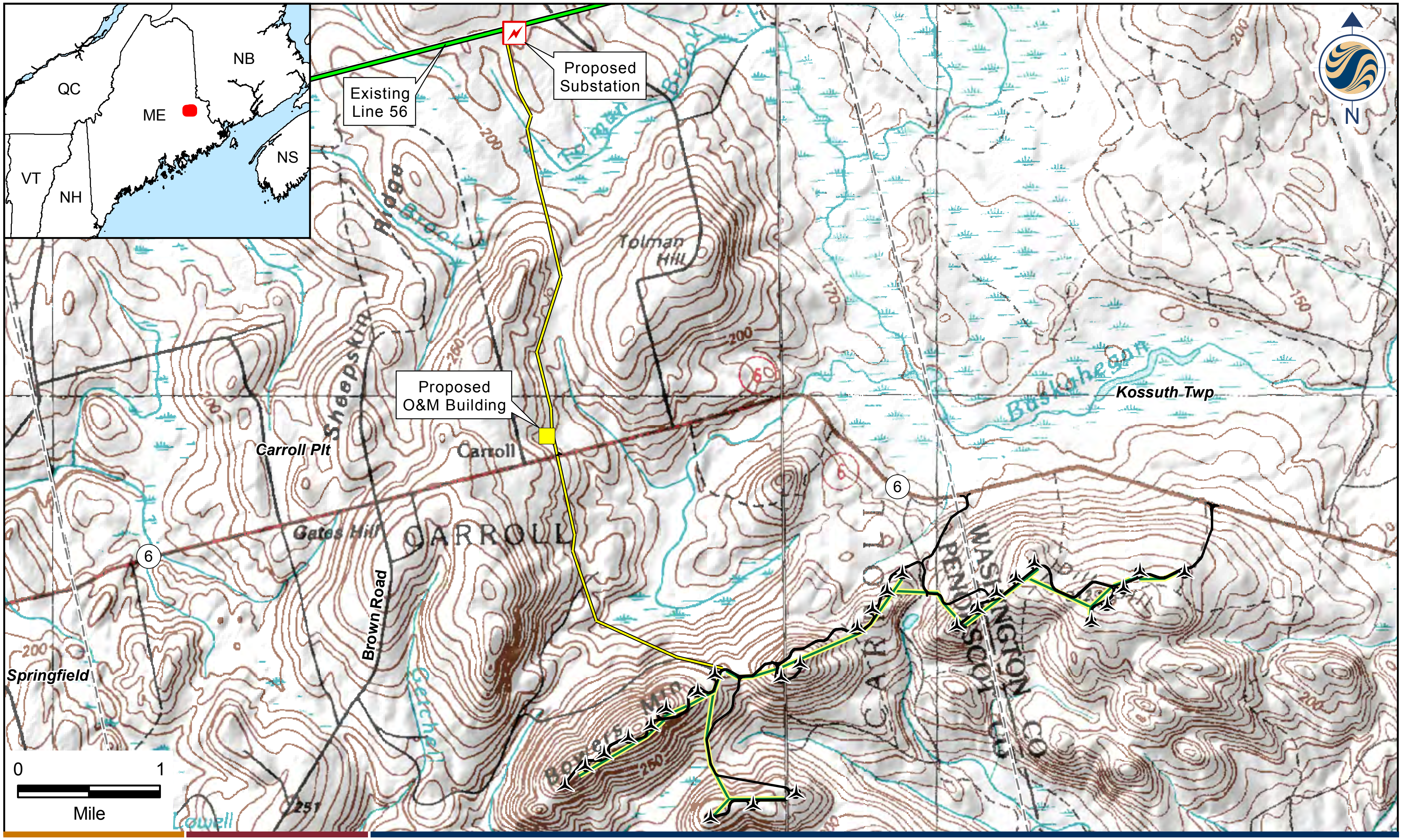
3.3 OPERATION

Wind turbine generators produce sound through a number of different mechanisms which can be categorized as either mechanical or aerodynamic sound sources. The major mechanical components including the gearbox, generator and yaw motors each produce their own characteristic sounds, including sound with tonal components. Other mechanical systems such as fans and hydraulic motors can also contribute to the overall sound emissions. Mechanical sound is radiated at the surfaces of the turbine, and by openings in the nacelle casing.

The interaction of air and the turbine blades produces aerodynamic sound through a variety of processes as air passes over and past the blades. The sound produced by air interacting with the turbine blades tends to be broadband sound, but is amplitude modulated as the blades pass the tower, resulting in a characteristic ‘swoosh’. Generally, wind turbines radiate more sound as the wind speed increases, eventually reaching a plateau of sound output.

To reduce sound impacts resulting from Project operations, routine maintenance of the wind turbines and associated equipment, as recommended by the manufacturer, will be conducted according to the guidelines in Section 3 of the Control of Noise Regulation and include:

- The sound emitted from routine maintenance activities will be considered part of the operation sound of the development and the combined total will be subject to the daytime and nighttime sound level limits; and
- The sound from major scheduled maintenance activities will be subject to construction sound level limits.



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Legend

- Proposed Turbine Layout
- Express Collector Corridor
- Mountain Top Collector Corridor
- Proposed Access Road

Client/Project
Bowers Mountain Wind Project
Carroll Plt. and Kossuth TWP, Maine

Figure No.
1

Title
Site Location Map
January 10, 2011

4.0 SOUND LEVEL CRITERIA

The Project is within the expedited wind permitting area in the jurisdiction of the Maine Land Use Regulation Commission (LURC). As such LURC requires that the project meet the provisions of the Department of Environmental Protection's noise control regulations, 06-096 C.M.R. 375.10.

The noise standards apply to areas that are defined as protected locations and to property lines of the proposed Project. For the purposes of this assessment the proposed development has accepted the "quiet area" standards, where the daytime and nightime pre-development hourly sound levels are equal to or less than 45 dBA and 35 dBA, respectively. Based on these pre-development values, the sound level criteria for the operation of the proposed development on protected locations shall not exceed 55 dBA between 7:00 am and 7:00 pm and 45 dBA within 500 feet of living or sleeping quarters between 7:00 pm and 7:00 am. Beyond 500 feet of living or sleeping quarters on a protected location the daytime limit of 55 dBA applies regardless of the time of day.

4.1 EXISTING SOUND LEVELS

As discussed above the proposed development is located within a "quiet" area, where existing sound levels are characterized by the noise emitted from sources such as wind in the trees and other aerodynamic obstacles, birds and animal sounds, occasional aircraft and road traffic, and local sounds specific to each receptor.

Therefore, this assessment relies on the values presented in the Control of Noise regulation, which states the following:

> "When a proposed development is to be located in an area where the daytime pre-development ambient hourly sound level at a protected location is equal to or less than 45 dBA and the nighttime pre-development ambient hourly sound level at a protected location is equal to or less than 35 dBA, the hourly sound levels resulting from routine operation of the development shall not exceed the following limits at that protected location: 55 dBA between 7:00 am and 7:00 pm and 45 dBA between 7:00 pm and 7:00 am"

5.0 Sound from Wind Turbines

The sound emitted during the routine operation of wind turbines is influenced by and may contain a number of factors including, but not limited to, local meteorology, masking effects, tonal sounds and short duration repetitive noise. Each of these factors are further described below.

5.1 METEOROLOGY

Wind turbines are designed to extract energy from the layer of atmosphere that passes through the swept disk of the rotor blades. The turbines described in this analysis have a rotor-swept diameter of 101 m (331 feet). The Siemens 2.3 MW turbines have a hub height of 80 m262 ft (80m) and the Siemens 3.0 MW turbines have a hub height of 79.5 m (260.7 feet). Typically the windspeed observed by the anemometer mounted on the nacelle approximately at hub height is used to control the wind turbine; windspeeds as reported by standard meteorological stations are nearer the surface at an elevation of 10 m (30.5 feet). The surface (i.e. 10 m) windspeed is the one reported by convention in the wind turbine performance specifications with respect to electrical power generation and sound energy production. Although the surface windspeed may underestimate the hub-height windspeed in some situations, this analysis is based only on the maximum sound power output from the turbines, regardless of windspeed.

Winds in the atmosphere generally increase in speed from the surface upward due to the frictional drag of the earth's surface. During the day, the surface is heated and the warmed air rises and cold air descends to replace it. The descending air has a higher horizontal velocity, therefore this descending cooler air is often noticeable as a gust. This is the fundamental reason why the windspeed at the surface is generally higher during the day than at night. At night, the temperature profile in the atmosphere becomes stable: that is, the atmosphere is generally warmer at height than at the surface. The cooler air at the surface tends not to rise, and the warmer air does not descend, so the higher velocity in the warmer air stays aloft. When the sky is clear at night, low windspeeds are often observed at the surface due to the stable atmosphere.

In terms of wind turbine sound analysis, the IEC 61400-11 standard for measuring sound power from a wind turbine uses a relationship between the velocity at the surface anemometer and the velocity at hub height that predicts the hub height speed to be 1.39 times the surface wind speed. When the atmosphere is very stable, the factor may be greater; when the atmosphere is very unstable, the factor may be smaller. It is important to note that at higher windspeeds, the wind induced turbulence limits the degree to which the atmosphere may be very stable or very unstable.

5.2 MASKING

The meteorological discussion above is relevant to the masking effect on wind turbine sounds. Natural ambient sounds are largely wind-driven and tend to increase with increasing wind speed. It was hypothesized that the higher masking sound of the wind at higher windspeeds meant that the wind turbine could emit higher sound levels without adverse effects (van den Berg 2003). However, as discussed in the previous section, the surface wind, which is what generates the masking sound, may be lower than expected during stable atmospheric conditions. In these situations, the wind turbine sound may emit higher sound levels at higher wind speeds, but the surface winds may not be mask sound from the turbines, making the turbine sound more noticeable. This phenomenon, widely publicized in a European development, has been recognized by regulators and is now taken into account in evaluating sound at receptors. The modeling criteria used in this assessment do not take into account the masking from wind that often occurs when turbines are operating.

5.3 TONAL SOUND

Broad band sounds may be considered less intrusive than tonal sounds. Tonal sounds are those that meet the applicable criteria:

> TONAL SOUND: for the purpose of this regulation, a tonal sound exists if, at a protected location, the one-third octave band sound pressure level in the band containing the tonal sound exceeds the arithmetic average of the sound pressure levels of the two contiguous one-third octave bands by 5 dB for center frequencies at or between 500 Hz and 10,000 Hz, by 8 dB for center frequencies at or between 160 and 400 Hz, and by 15 dB for center frequencies at or between 25 Hz and 125 Hz.

06-096 C.M.R. 375.10.
Based on review of octave band data for these turbines, no tonal sounds are expected.

5.4 SHORT DURATION REPETITIVE SOUND

The relevant sound regulations (06-096 C.M.R. 375.10.G.19), provide for further investigation “when routine operation of a development produces short duration repetitive sounds” (SDRS). SDRS is defined as:

> “A sequence of repetitive sounds which occur more than once within an hour, each clearly discernible as an event and causing an increase in the sound level of at least 6 dBA on the fast meter response above the sound level observed immediately before and after the event, each typically less than ten seconds in duration, and which are inherent to the process or operation of the development and are foreseeable.”

This regulation also states, “that for short duration repetitive sounds, 5 dBA shall be added to the observed sound levels of the short duration repetitive sounds that result from routine operation of the development for the purposes of determining compliance with the sound level limits” (06-096 C.M.R. 375.10.C.1.e.i.).

Based on measurements of operating wind projects in Maine, as well as published literature concerning amplitude modulation from wind turbines (Bodwell, 2010), the occurrence of these fluctuations are not expected to result in materially affect measured sound levels from the Project. Nonetheless, as the SDRS is a function of the characteristics of a grouping of turbines as well as those of the single turbine, its absence may not be confirmed until after commissioning. For these turbines, there is no evidence to expect that the SDRS will occur; an objective of post-construction testing will be to verify this.

6.0 PREDICTED SOUND LEVELS

6.1 MODEL DESCRIPTION

There are numerous software packages available for the modeling of transmission of sound in the atmosphere. Some use proprietary algorithms, and some are based on published methods that have international recognition. Cadna (Computer Aided Noise Abatement, version 4.0), produced by Datakustik in Germany, is a software program that is based on the propagation models in ISO 9613. This ISO standard is in two parts. ISO 9613-1 is concerned with the attenuation of sound by the constituents of air. ISO 9613-2 incorporates the atmospheric absorbtion component into a framework that models the attenuation of sound by the geometric spreading of sound in the free atmosphere. Although Cadna contains other sound models, the ISO 9613 is the one that is most commonly used for wind turbine studies, and is employed in this Study.

This computerized model is capable of predicting sound levels at specified receiver positions originating from a variety of sound sources. Applicable national or international standards can also be included in its analysis, as described above.

CadnaA can also account for such factors as:
- Distance attenuation (*i.e.,* geometrical dispersion of sound with distance);
- Geometrical characteristics of the source and receivers;
- Atmospheric attenuation (*i.e.,* the rate of sound absorption by atmospheric gases in the air between sound sources and receptors);
- Ground attenuation (*i.e.,* effect of sound absorption by the ground as sound passes over various terrain and vegetation types between source and receptor);
- Screening effects of surrounding terrain; and
- Meteorological conditions and effects.

The application of the sound model requires a number of input variables. The most important variables are those that indicate the relative geometric position of the source and receiver. The source is taken to be the hub of the turbine, at the center of the disk swept by the rotation of the blades. The second important point is the location of the receiver. Like the source, the receiver coordinates are input as an x, y, and z value. The x value is the “easting” horizontal coordinate, and the y is the “northing” horizontal coordinate. The z value is the height above ground of the receiver. A height of 4 m, just over 13 feet, was used to represent the height of second story windows where sound levels are slightly higher than those at ground level.

Conservative modeling assumptions were applied when analyzing the sound impacts of the project. To allow for uncertainties in the sound power output from the turbine and the inherent uncertainties in mathematical modeling of the sound propagation, 3 dBA was added to the manufacturers sound power level of the turbine. This effectively multiplies the sound power by a factor of 2. It is the maximum sound power level, increased by the manufacturer’s uncertainty and the modeling uncertainty that is used as the source term in the sound propagation modeling.

The influences of meteorology and terrain and vegetation on sound attenuation in the Study Area are described in the following sub-sections.

6.1.1 Meteorological Factors

Meteorological factors, such as temperature, humidity, wind speed and direction, influence sound propagation. The effects of wind on outdoor sound propagation during different weather conditions could cause variations in Project-related sound levels measured at a receptor. If the receptor is upwind of the facility, the wind could cause greater sound attenuation, and lower sound levels at the residence. However, if the residence is downwind of the facility, the opposite effect could occur, resulting in higher sound levels at the residence. Crosswinds have less effect on outdoor sound propagation. The ISO algorithms in Cadna were designed to reflect a situation where there is a modest wind direct from the source to the receiver; that is, the receiver is always downwind. Physically, it cannot happen that every wind turbine is upwind of every receiver at the same time; however, this is another instance where the conservative, worst-case assumption is made with the intention that any errors associated with assumptions are biased toward a higher sound output, and a more protective evaluation.

The following meteorological elements that represent low air absorption of sound are customarily used and were assumed for the sound assessment:

- Temperature = 10°C (50 °F);
- Relative humidity = 70 percent; and
- Wind conditions = variable.

These meteorological parameters can be considered typical of night-time conditions in the spring and summer (when outdoor activities are more likely) and representative of the sound effects during these seasons.

6.1.2 Terrain and Vegetation

Psychologically, trees and thick brush are beneficial in isolating the sound source and receiver; however, the actual degree of sound attenuation is limited. A thick growth of trees and brush about 100 feet deep will achieve a noise reduction of 3 to 4 dBA. If the vegetation is deciduous, the loss of the leaves means a loss in the attenuation properties, and the vegetation must be in the line of sight to achieve a reduction. Note also that some part of the sound energy will refract over the bush, just as it can refract over hills, and doubling the depth of the forest will not necessarily double the reduction in sound transmission. The ground in the Project area is generally vegetated, or a soil surface that may be overlain with snow in the winter season yielding surface absorption of about 80%. This study takes a conservative approach, assuming that there is no intervening vegetation between the sources and receivers to reduce sound levels, although there will be some absorption in most cases. Factors such as terrain conditions, types of vegetation and ground cover can all affect the absorption that takes place when sound waves travel over land and may be reflected or absorbed by the ground surface. For example, if the ground is moist or covered in fresh snow or vegetation, it will be absorptive and aid in sound attenuation. In contrast, if the ground is hard-packed or frozen, it will be reflective and will not aid in sound attenuation. There are no water bodies of significant size between the sources and potentially affected receptors in this project. The ground in the Project area is generally vegetated, or a soil surface that may be overlain with snow in the winter season yielding moderately high surface absorption, assumed to be 0.8 in this case.

In countryside with substantial terrain relief, the height of the ground changes and the sound model uses a dense grid of terrain elevation values, typically at spacings of 50 to 100 feet, to internally construct a digital terrain model. As the program executes, it is able to calculate absolute heights of the source and receiver from the data that the user provides, and from the digital terrain model of ground height. The model also uses the digital terrain model to determine if there is a clear line-of-sight from the source to the receiver, or whether topographic features interrupt this path and provide some screening effect on the sound transmission. Where there is a barrier effect due to topography, the model calculates the attenuation loss according to the standards of ISO 9613-2; typically, this attenuation will be less than 5 dBA.

6.1.3 Summary of Model Assumptions

In summary, the following conservative assumptions have been incorporated into the modeling for this development:

- Receiver height of 4 m, which represents the height of a second floor bedroom;
- Source height is equal to the hub height of the wind turbine generators;
- Local terrain effects;
- No intervening vegetation between the source and receptor;
- Receptor points are simultaneously located downwind of all turbines; and
- Uncertainty factors of 3 dBA for modeling and 2 dBA for manufacturer's uncertainty for the Siemens 3.0 wind turbine generator, and a modeling uncertainty factor of 3 dBA and manufacturer's uncertainty of 0.5 dBA for the Siemens 2.3 wind turbine model (refer to Section 6.3).

6.2 CONSTRUCTION

Typical construction activities that would create sound are presented in Table 7.1. The actual equipment used on site might differ from those listed below.

Table 6.1 Typical Sound Levels of Construction Equipment

Construction Equipment	Typical Sound Level at 15 m (dBA)
Earth Moving	
Loader	**85**
Bulldozer	**85**
Backhoe	**80**
Scraper	**89**
Grader	**85**
Materials Handling	
Crane (mobile)	**83**
Concrete mixer	**85**
Concrete pump	**82**
Concrete vibrator	**76**
Stationary Equipment	
Air compressor	**81**
Generator	**81**
Impact Equipment	
Jack hammer	**88**
Pile driver (impact)	**101**

SOURCE: US Department of Transportation (2006)

Any construction activity that occurs between 7:00 p.m. and 7:00 a.m. or within daylight hours, whichever is longer, is not regulated. Nighttime construction activities must meet the quiet standards of 45 dBA at protected locations. The level of sound will vary according to the type of construction activity and the number of pieces of equipment in operation at any given time and will be temporary in nature.
To reduce the sound pressure levels at the nearest residents a combination of mitigation measures will be employed, including but not limited to:

- Limiting the amount of construction equipment operating simultaneously;
- Ensuring all pieces of equipment have quality mufflers and are well maintained; and
- Respecting time activity and level limits of applicable guidelines and bylaws.

6.3 OPERATION

Sound modeling for the operation of the development was completed to predict the effects of the Project on the sound environment in the Study Area.

Sound associated with the operational phase of the Project was modeled excluding other existing sound sources. Modeling the sound generated from the operation of 10 Siemens 3.0 MW wind turbine generators and 17 Siemens 2.3 MW wind turbine generators was conducted by first obtaining the manufacturer's sound power level specifications (107dBA) and then including the manufacturers uncertainty and the modeling uncertainty. For the Siemens 3.0 MW wind turbine generator, a 2 dBA uncertainty factor was added to the manufacturer's certified maximum sound power level specification and another 3 dBA was added to account for the uncertainty in the predictive modeling, which resulted in an overall maximum sound power level for the Siemens 3.0 turbines of 112 dbA. For the Siemens 2.3 wind turbine generator, a 0.5 dBA uncertainty factor was added to manufacturer's certified maximum sound power level specification and another 3 dBA was added to account for uncertainty in the predictive modeling, which resulted in an overall maximum sound power level for the Siemens 2.3 turbines of 110.5 dBA. The use of the maximum power level and the use of an uncertainty factor makes the analysis conservative; that is, a reasonable worst-case.

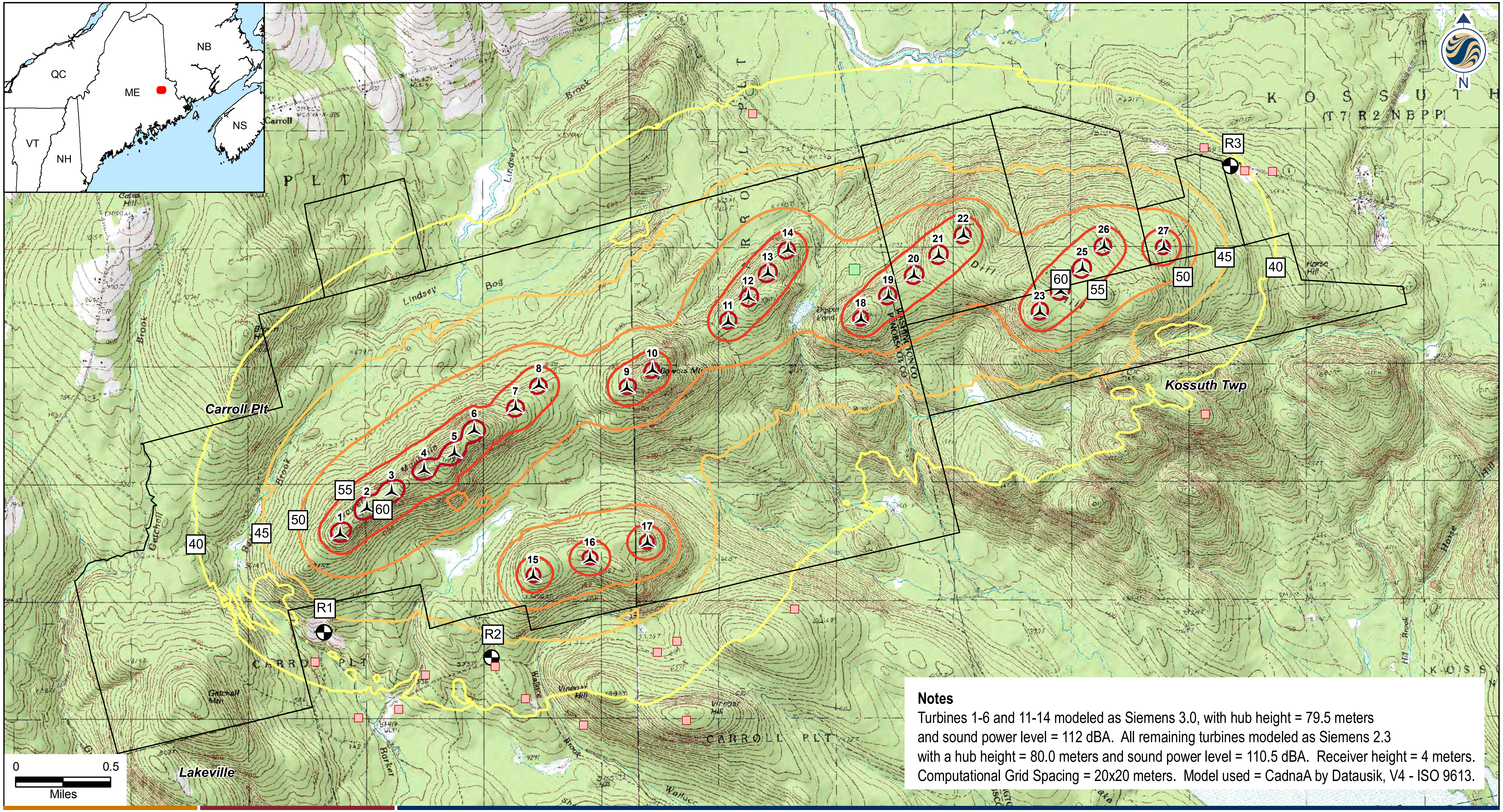
To aid in the evaluation of the operation of the development a set of receptor points were selected (receptors 1-3), which represent a point at 500 feet from the residences in any direction from the project with the greatest potential to exceed the Maine DEP sound level limits. These receptors were included in the model and their locations are summarized in the below table and are geographically presented in Figure 6.1.

The predicted sound levels at 500 feet from the receptors resulting from this scenario are shown in Table 6.2. Other sound sources contributing to baseline sound levels were not included when predicting sound levels. A contour map of predicted sound levels is also presented below in Figure 6.1.

Table 6.2 Receptor Locations - Predicted Sound Levels and Criteria

Receptor ID	Distance to Nearest Turbine m (feet)	Modeled Results (dBA)	Sound Level Criteria	
			Day	Night
R1	700 (2297')	44.8	55	45
R2	650 (2133')	44.7	55	45
R3	725 (2379')	42.4	55	45

The Project not only meets the most stringent limits at the nearest protected locations, but also meets the 75 dBA limit at the Project boundary.



Notes

Turbines 1-6 and 11-14 modeled as Siemens 3.0, with hub height = 79.5 meters and sound power level = 112 dBA. All remaining turbines modeled as Siemens 2.3 with a hub height = 80.0 meters and sound power level = 110.5 dBA. Receiver height = 4 meters. Computational Grid Spacing = 20x20 meters. Model used = CadnaA by Datausik, V4 - ISO 9613.

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Legend

- **Proposed Turbine Layout (7/25/10)**
- Project Parcels
- Receptor Location
- Protected Location Within 1 Mile
- Camp Owned By Participating Landowner

Sound Contour (dBA)

- 40
- 45
- 50
- 55
- 60

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Carroll Plt. & Kossuth TWP, Maine

Figure No.
6.1

Title

Sound Contour Map

January 11, 2011

00522-F6.1-USGS-SoundMap-11x17.mxd

7.0 SOUND COMPLIANCE ASSESSMENT PLAN

Prior to commercial operation, a detailed wind turbine sound compliance assessment plan will be submitted for review and approval by the Land Use Regulation Commission (LURC) . Specifically, the plan will:

- Provide testing methodology, including locations and equipment information consistent with the requirements set out in Chapter 375.10.
- Comprise sound level testing for intervals and conditions sufficient to demonstrate compliance with the sound level limits applicable to the project.
- Include one-third octave band testing to be used in the protocol of Chapter 375.10 to determine the presence of tonal sounds in the sound emissions from the wind turbines.
- Include representative periods of fast-response measurement to determine the presence of Short Duration Repetitive Sounds (SDRS) as defined by the criteria of Chapter 375.10.
- Provide audio recordings of test records for tonal sounds, SDRS, and such other periods as agreed upon with DEP and LURC.
- Contain sample calculations of each type of analysis to demonstrate the data processing that will be applied to the monitoring results.

8.0 SUMMARY AND CONCLUSIONS

To evaluate the potential sound impacts resulting from the Project, Stantec Consulting Ltd (Stantec) conducted a sound level assessment. The key issues examined in this assessment were sound produced by the construction and operational phases of the Project. To aid in the evaluation, a set of receptor points were selected, which represent the locations with the greatest potential to exceed the applicable sound level limits.

Operational sound levels were predicted for each receptor using a sound modeling program called Cadna A, version 4.0. Meteorology conditions and local terrain were considered in the modeling and maximum sound power level data was used for each wind turbine generator type. The Maine Department of Environmental Protection Control of Noise (Chapter 375.10) regulation provided assessment guidelines and criteria pertaining to sound levels resulting from the operation of wind turbine developments in quiet areas. These guidelines were compared to the predicted levels from the model to determine Project compliance.

The modeling demonstrated that the sound levels predicted at each of the three receptor points were below the nighttime limit of 45 dBA.

9.0 REFERENCES

U.S. Department of Transportation, Federal Highway Administration. 2006. *Effective Noise Control during Nighttime Construction*.

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