STATE OF VERMONT
PUBLIC SERVICE BOARD

Wind Generation Facility Sound Standard Rulemaking	))	April 27, 2017

TECHNICAL COMMENTS OF THE VERMONT DEPARTMENT OF PUBLIC SERVICE REGARDING THE VERMONT PUBLIC SERVICE BOARD'S PROPOSED RULE ON SOUND LEVELS FROM WIND GENERATION FACILITIES

The Vermont Department of Public Service ("Department"), by and through undersigned counsel, hereby submits the following comments and attached memorandum concerning the technical aspects of the proposed Rule 5.700 on Sound Levels from Wind Generation Facilities, filled by the Vermont Public Service Board ("Board") with the Vermont Secretary of State on March 17, 2017. These comments identify issues the Department intends to discuss at the Board's workshop scheduled for May 4, 2017.

The Department and its retained sound experts from Aercoustics Engineering Ltd. ("Aercoustics") have reviewed the Board's proposed rule, and have identified concerns with respect to three technical aspects of the rule as currently drafted: 1) Sections 5.704 and 5.708 of the proposed rule contain no methodology for determining ambient background sound levels relative to overall sound levels when a wind facility is operating; 2) the rule proposes to use 10-minute monitoring intervals when calculating facility-only sound levels, increasing the risk of data contamination; and 3) compliance determinations will be difficult to make due to the requirement of § 5.704 that the loudest recorded measurement intervals be used to calculate facility-only sound levels. These concerns are discussed in further detail in the Aercoustics memorandum dated April 27, 2017 and attached hereto as Attachment 1.

The proposed rule should not only set appropriate limits on the sound emissions from wind generation facilities, but should also ensure that those sound emissions can be determined with as much accuracy as technically possible. The components of the proposed rule identified by the Department risk the inaccurate calculation of facility-only sound levels if the rule is implemented as currently drafted. Wind facility sound limit compliance determinations should be made based on methodologies that yield the most accurate facility-only sound level calculations possible. Gethering sound data that are free of contamination and reflect accurate facility-only sound levels is essential to creating a sound rule that creates clear expectations for developers and is enforceable by regulators. The concerns discussed in the Aercoustics memorandum seek to ensure that these critical goals of the sound rule are best achieved.

Dated at Montpelier, Vermont, this twenty-seventh day of April, 2017.

Respectfully submitted,

VERMONT DEPARTMENT OF PUBLIC SERVICE

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ATTACHMENT 1

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Subject: Rule on Sound Levels from Wind Generation Facilities - Aercoustics' Comments and Recommendations

Date: April 27, 2017

This document has been prepared by Aercoustics for the Department of Public Service ("DPS") in response to the latest draft of Rule 5.700 from the Vermont Public Service Board ("PSB").

1 Introduction

Aercoustics' main concern with the current form of the draft Rule is the lack of an assessment of ambient sound in the Post-Construction Sound Monitoring methodology (Section 5.706). The lack of an ambient sound correction in the compliance measurements is, in Aercoustics' opinion, a significant shortcoming in the current version of the Sound Rule. Excluding measurements of ambient noise leaves no means by which to separate facility-only noise in a given measurement. Assessing the noise from a wind farm without accounting for ambient sound will reduce the accuracy of the assessment, and will also tend to overestimate the sound level from the wind farm.

It is worth pointing out that while there is no background correction prescribed in the default methodology for determining compliance, a methodology for background correction is outlined in section 5.708(C)(3)(b)(vii), which specifically addresses responses to noise complaints. The inclusion of a background noise correction methodology (however limited) in this section, but not in the default methodology, could cause confusion regarding whether a background noise correction methodology is applicable or not for a given measurement campaign. Introducing a separate measurement and data-filtering methodology specifically for noise complaints may lead to different results with respect to compliance, depending on the methodology used.

This document is intended to provide information regarding the nature of ambient sound in rural environments, and provide justification for why the ambient sound must be quantified and accounted for in any assessment of wind turbine noise.

2 Ambient Sound Contamination

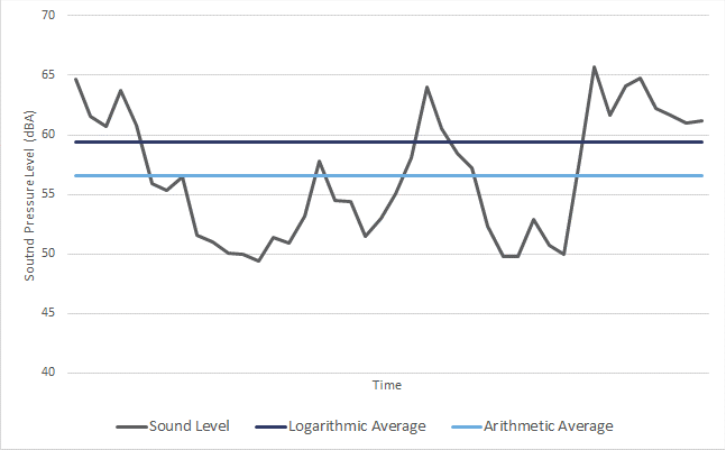
Ambient sound will contaminate post-construction measurements of wind farm noise by increasing the measured sound level. Without an assessment and correction for ambient sound to the measured sound levels, the measurement campaign will overestimate the sound level from the wind farm. There are two main sources of ambient sound: transient and persistent.

2.1 Transient Ambient Sound

Ambient sound can fluctuate dramatically over short time periods; loud, short-duration ambient events are not uncommon and are unpredictable. Examples of these ambient events include bird calls, dog barks, car pass-bys, doors slams, and gusts of wind.

"Leq" is typically the preferred method to describe environmental sound levels. It takes into account the vaiation within a measurement interval and produces a single number equivalent sound level for that interval. The "Leq" sound level for a given measurement interval is defined as the logarithmic average of the all the acoustic energy measured in that interval. Logarithmic averaging inherently gives more weight towards the higher values in the averaging interval. This is a property of the logarithmic averaging; a visual example of this effect is shown below in Figure 1.

Figure 1: Comparison of Logarithmic and Arithmetic Averaging

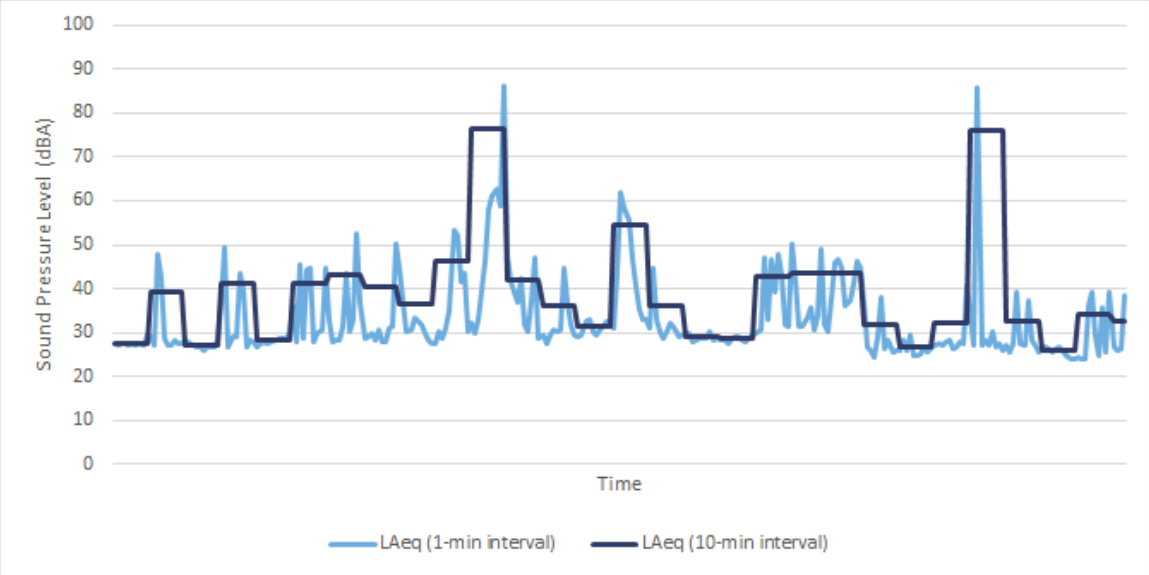


The consequence of this is that short-term ambient events can noticeably increase the average sound level, even over a 10-minute interval, despite being of short-duration.

Assessing whether a 10-minute measurement interval is contaminated with a car pass-by, for example, is difficult using only the analysis methodology prescribed in the draft rule. Furthermore, listening to each measurement interval to identify contamination may not be feasible, given that the measurement campaigns can often run for multiple weeks.

If a measurement interval contains contamination from transient ambient noise, the measurement interval should be excluded. However, longer measurement intervals make it more difficult to identify if a short term fluctuation in sound level from a transient event has unduely contaminated the entire 10-minute interval, due to the longer averaging period. An example of this is shown in Figure 2, where a 1-minute averaging time clearly isolates the transient events while the 10-minute averaging time does not. The contaminating transient events are the sharp peaks in sound level. When there are few transient events, the 10 minute intervals are able to identify them, however, when there are successive 10-minute intervals that include a contaminating event, it is unclear from looking only at the 10-minute intervals (dark blue) that a measurement interval is contaminated.

Figure 2: Comparison of 1-minute vs. 10-minute averaging



A 10-minute measurement interval is a long enough time that it is possible that a significant portion of all 10-minute intervals measured will have at least one contaminating transient sound event. This will significantly reduce the amount of useable measurement data from a noise measurement campaign, as well as decrease the reliability of the audit data.

2.2 Persistent Ambient Sound

Although some types of ambient contamination can be readily detected and separated from the data, there are other sources of ambient noise that are persistent, and cannot easily be removed. Two examples are provided below.

1. In the case of a ridgeline turbine layout, where the measurement location is in a valley, there can be times when the wind speed at the top of the ridge is sufficient

to cause significant amounts of vegetation noise from the ridgeline trees, despite the wind speed near the measurement location being low.

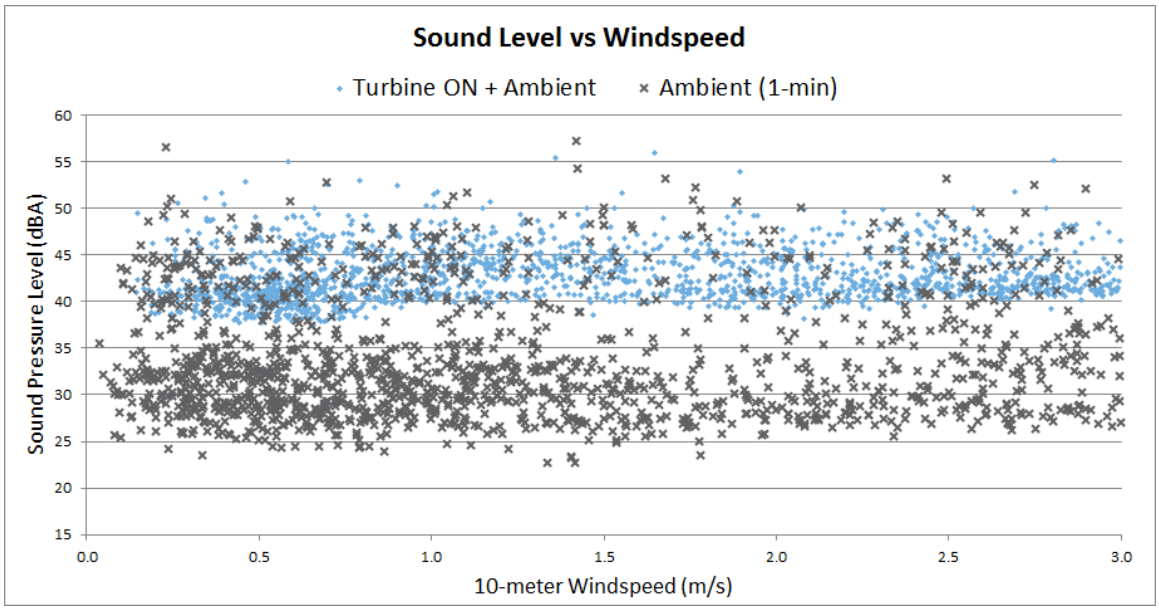
2. In the case of measurements conducted between late spring and early autumn, sound from insect activity can be a constant presence in the acoustic environment.

Failing to account for the excess ambient sound in these two examples would result in either the ambient sound being counted as a contribution from the wind facility erroneously, or all the measurement data being discarded. Considering that a minimum of two hours of data is required for an assessment of compliance, it is possible that situations arise where a measurement campaign cannot ever be completed. Employing a measurement methodology where the ambient can be determined and accounted for would help solve this issue, and increase the reliability and dependability of the method.

3 Filtering of measurement data

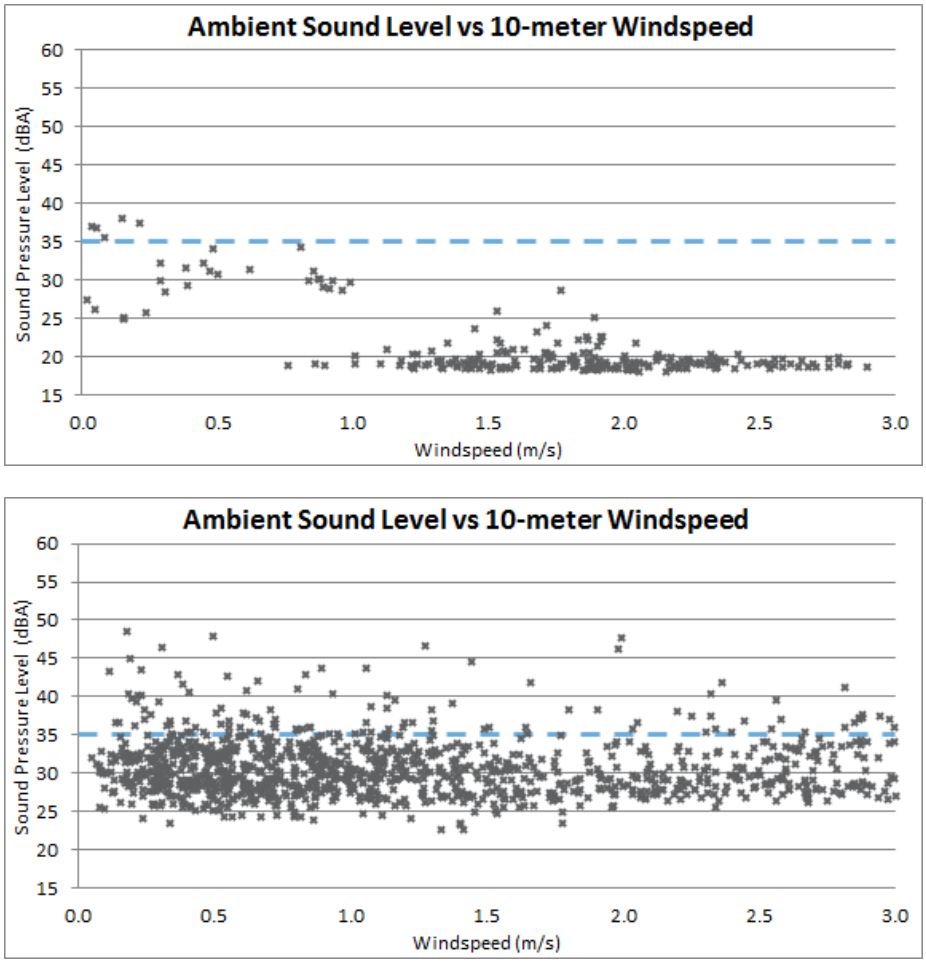
From Aercoustics' experience of over 100,000 hours of wind farm noise monitoring, it has been found that sound levels near a rural residence can vary significantly, and many steps need to be taken to vet and filter the data set when looking at measured levels of both facility noise and ambient noise. In some cases, the variation in sound levels can be quite significant, due to the presence of multiple contaminating ambient sound sources. Figure 3 provides a notable example of this. Here there is a great deal of overlap between the sound levels with the turbines running (light blue) and the turbines parked (dark grey).

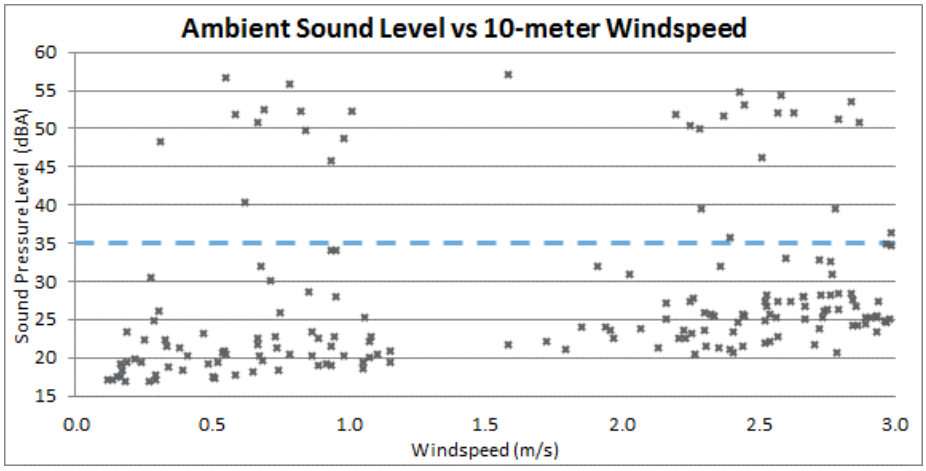
Figure 3: Example of an unfiltered dataset of wind turbine measurements



Most of the short-term variations in sound levels near a wind farm are due to fluctuations from ambient noise sources. The ambient environment can vary significantly between different sites. Figure 4 provides some examples of ambient noise measured near wind farms located in rural areas as a function of measured 10-meter height wind speed. The graphs have been developed using shorter term measurement intervals (1-minute).

Figure 4: Three examples of ambient noise measured at different wind farms





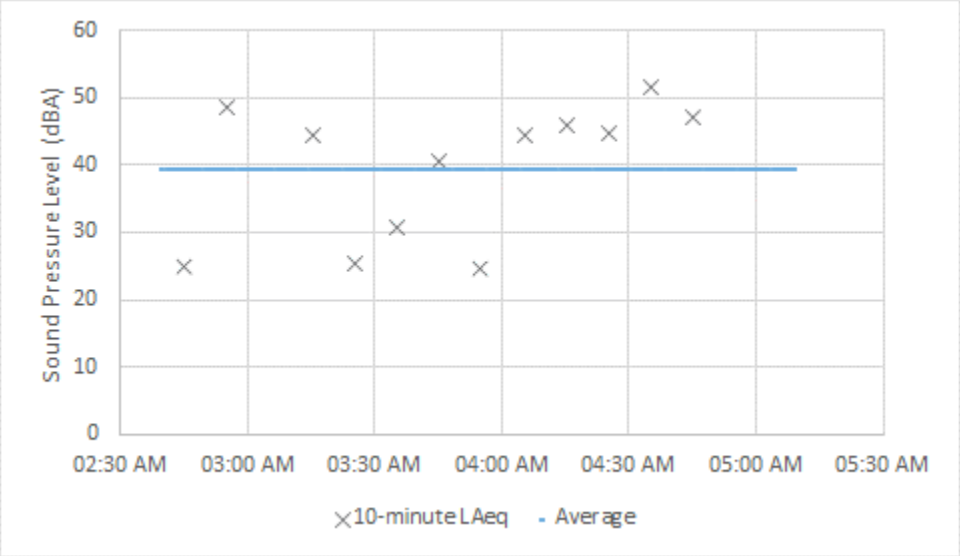
What is evident from the plots in Figure 4 is that even at low wind speeds – below 3 m/s (6.7mph) – there is a significant amount of variation in sound levels between measurement sites.

4 Ambient Noise compared to Wind Farm Noise Limit

Once sufficient valid measurements are acquired, Section 5.704(B) in the proposed PSB Sound Rule states that the sound level from the wind facility will be computed by arithmetically averaging a minimum of the highest twelve 10-minute measured valid intervals (i.e. the assessment is based on the aggregate highest 2 hours measured in a compliance period of one day). Because the absence of an ambient correction, there is a reasonable possibility that if the proposed PSB protocol is applied, the sound level limits would be exceeded by the ambient noise alone.

This point is especially relevant because in the draft Sound Rule rule, the proposed night-time sound level limit is 35 dBA. Although it is possible, and even common for outdoor ambient noise levels in rural environments to fall well below 35dBA (as low as 15dBA can be expected at times in rural Vermont), there can also be times when the ambient level exceeds 35dBA under otherwise 'valid' measurement conditions. If fact, Figure 5 shows the results of an assessment, per the draft Sound Rule, conducted on a measurement dataset that comprises only ambient noise. In this case, the wind farm could be assessed to be to be out of compliance when the turbines are parked! It is likely that for this case the steady state ambient noise is in the range of 25-30dBA, but if the protocol is forced only to consider the highest measured levels, it has the potential to be skewed to only consider intervals with the highest chance of contamination.

Figure 5: Results of draft noise rule, applied to an dataset of only ambient noise



The ability to adjust the measured levels to account for the expected ambient contribution becomes much more important in the context of a 35dBA sound level limit.

5 Conclusion

It is Aercoustics' opinion that legislating a rule for the assessment of compliance of wind farms using post-construction sound monitoring must include an assessment of the ambient noise as part of the measurement methodology. Without one, the results of the compliance testing may result in inaccurate or inconclusive results.

There may certainly be examples during which the ambient levels are low enough now to contaminate the measured levels beyond 35dBA. In such cases, compliance with the sound level limit would be definitive and defendable – the argument being that even with any contamination noise, if the measured sound level is at or below 35dBA, it demonstrates compliance. However, the corollary to that situation is much less certain. If the measurements based on the proposed methodology show levels of, say. 37dBA, it may be difficult to rule out the possibility that the excess is a result of ambient noise conditions. The Board's proposed rule creates a protocol that might work to determine compliance, but may have difficulty in determining a violation conclusively.

It is highly recommended that the draft Sound Rule put forth by the Vermont Public Service Board be amended to include an assessment of ambient noise in its standard compliance measurement methodology.