

June 19, 2018

Mr. Erle Townsend
Policy Development Specialist
Maine DEP – Office of the Commissioner
17 State House Station
Augusta, ME 04333

Re: Peer Review of RoxWind Sound Assessment

Dear Erle:

Tech Environmental, Inc. (TE) has completed an independent peer review of the acoustic impacts of the 15-MW Number RoxWind Project in the Town of Roxbury with regard to Maine Site Location of Development (SLOD) Regulations. The Project will consist of four GE 3.8-130 wind turbines with a hub height of 85 meters; no new electrical substation is proposed for the Project. The Project is located in the Town of Roxbury, near the border of the Towns of Rumford and Mexico.

The document I received for this review is found in Section 5 of the SLOD Application:

- Epsilon Associates, Inc. “Sound Level Assessment Report, RoxWind Project, Town of Roxbury, Maine,” March 20, 2018 (the “Report”).

Review Standard and Receptors

The purpose of this peer review is to determine if the acoustic studies submitted with the Application are reasonable and technically correct according to standard noise assessment practices.

RoxWind is subject to the Department Regulations on Control of Noise (06-096 CMR 375.10I), referred to herein as the “Maine Noise Regulations”. The nighttime sound limit at a Protected Location is 42 dBA (1-hour L_{eq}) and applies on portions of a Protected Location within 500 feet of a residence or other sleeping quarters, or at the property boundary of the protected location, whichever is closer to the dwelling. Beyond 500 feet, the daytime limit of 55 dBA applies 24 hours per day, and a 75 dBA limit applies at the Project property line. There are also decibel penalties that apply when the sound generated by a wind energy development results in tonal or short duration repetitive sounds, as those terms are defined in the Maine Noise Regulations. Only the Town of Rumford has a local noise regulation, and it imposes a nighttime limit of 40 dBA on property within 4,000 feet of a wind turbine. There are some parcels of land within 4,000 feet of Project Turbine 4.

The Report identifies 47 Protected Locations within 1.5 miles of any of the four Project turbines. Five of these are in the Town of Rumford, none are in the Town of Mexico, and 42 are in the Town of Roxbury.

Sound Power Levels Assumed for the Turbines

The sound power level (L_w) on a decibel scale¹ is determined by the manufacturer through a series of prescribed field measurements using the International Standard IEC 61400-11 test method.² The IEC-reported sound power level for a given hub-height wind speed is an average value, meaning there is a scatter of values about the average and the actual sound power level emitted in the field may either be lower or higher. To quantify that variability in values of L_w , the IEC provides a method for assessing L_w measurement uncertainty and unit-to-unit turbine production uncertainty, combining both into a total uncertainty “K” factor (IEC Technical Specification 61400-14)³. The IEC method defines the “Declared Sound Power Level” as $L_w + K$, and the sum represents an upper-bound sound power level that, under the stated wind speed conditions, will not be exceeded 95% of the time. The Declared Sound Power Level should be used in acoustic modeling to ensure the predicted sound pressure levels are conservative estimates and reasonably account for known uncertainties.

The applicant followed this procedure in modeling sound power levels that are the IEC reported maximum value for the GE 3.8-130 turbine of 107.0 dBA plus an uncertainty K factor of 2.0 dBA. Octave band sound power levels are provided in Table 6-1 of the Report, and these were independently verified. It should be noted that the 1/3-octave band sound power levels presented in Table 6-2 of the Report have incorrect labels of unweighted decibels (dB); the listed values are in A-weighted units (dBA). The applicant used a 0 dBA discretionary uncertainty factor, which is in the range of 0 to 2 dBA allowed for this factor in the Maine Noise Regulations, Section 10I(7)(c)(9), and thus a total sound power level of 109.0 dBA was modeled for the GE wind turbines. Our experience is that a combined uncertainty factor of 2 dBA for an inland wind project will accurately predict turbine sound levels. Given the fact that one Protected Location, for Receptor 15, has predicted sound level at the 42 dBA limit, it is important that this parcel be one of the compliance test locations.

Turbine Acoustic Model and Assumptions

Sound levels from the wind turbines were predicted using the Cadna\A acoustic model, the International Standard ISO 9613-2 sound propagation method, and a conservative ground absorption factor of $G=0.5$ that represents winter frozen-ground conditions. Standard day values for temperature and relative humidity⁴ (as they affect air absorption) were employed. These are the proper tools for accurately evaluating sound impacts. While the ISO method provides estimates of accuracy for mean source and receiver heights up to 30 m and the RoxWind turbines are higher at 85 m, this acoustic modeling

¹ The sound power level is defined as $10 \cdot \log_{10} (W/W_0)$, where W is the sound power of the source in Watts and W_0 is the reference power of 10^{-12} Watts. The sound power level (energy density) and sound pressure level (what we hear) are not the same, yet both are reported using a decibel levels scale. An acoustic model uses the sound power level of a wind turbine along with other assumptions to calculate the sound pressure level heard at a receiver located a certain distance from the wind turbine.

² International Electrotechnical Commission, International Standard IEC 61400-11 Edition 2.1, “Wind turbine generator systems – Part 11: Acoustic noise measurement techniques,” Geneva, 2006.

³ International Electrotechnical Commission, Technical Specification TS 61400-14, “Wind turbines – Part 14: Declaration of apparent sound power level and tonality values,” Geneva, 2005.

⁴ Temperature 10°C and relative humidity 70%.

approach has been found to be accurate for utility wind turbine sounds on several past projects with similar hub heights; the method is judged to be accurate for the RoxWind Project.

The majority of the 47 Protected Locations in the vicinity of the Project are dwellings located along Horseshoe Valley Road and Roxbury Notch Road (Route 120). These receptors are shown in Report Figures 6-1 and 6-2. Figure 6-2 is a decibel contour map that allows verification of predicted sound levels throughout the Project area.

The acoustic modeling results are conservative due to the following assumptions:

1. All wind turbines were assumed to be operating simultaneously and at the design wind speed, corresponding to maximum sound power.
2. All wind turbine sound power levels correspond to the IEC 61400-11 maximum rated sound power level plus a combined uncertainty factor of 2.0 dBA.
3. The acoustic model assumed the most favorable conditions for sound propagation, corresponding to a ground-based temperature inversion, such as might occur on a calm, clear night, or during a downwind condition with a moderate wind speed.
4. No attenuation from trees or other vegetation was assumed.
5. Winter frozen ground conditions were assumed for minimal ground absorption ($G=0.5$).
6. Excess attenuation from wind shadow effects and daytime air turbulence were ignored.

Turbine Acoustic Modeling Results

With all turbines operating at maximum sound power output, the modeling results in Table B-1 of the Report reveal RoxWind will produce maximum sound levels at the 47 receptors in the range of 22 dBA to 41 dBA, which comply with the daytime/nighttime limits of 55/42 dBA in the Maine Noise Regulations. The highest predicted level of 41 dBA occurs at Receptor 15, which is a residence on a parcel of land that sits on the north side of Route 120. The southern edge of that parcel, which is a Protected Location, is shown on the decibel contour map (Figure 6-2) to have a predicted sound level of 42 dBA.⁵ Thus, the highest predicted sound level at any Protected Location is 42 dBA and complies with the Maine Noise Regulations.

The decibel contour map confirms that sound levels on the Project boundaries are below 75 dBA, and that sound levels on the five Protected Locations in the Town of Rumford are all below 35 dBA, and thus comply with the Rumford nighttime sound limit of 40 dBA.

⁵ On Town Tax Map #2, this is Parcel 30, and the Tax Map confirms the parcel ends at Route 120.

Tonal Sounds

The Report (Appendix C) includes a tonality analysis for the three closest receptors to the Project using 1/3-octave band predicted sound levels. The results reveal no potential for creating a Tonal Sound, as defined in the Maine Noise Regulations.

Short Duration Repetitive Sound (SDRS)

The definition of SDRS in the section of the Maine Noise Regulations that pertains to Wind Energy Developments is an impulse sound that is 5 dBA or greater “on the fast meter response above the sound level observed immediately before and after the event.” Typically this modulation of the turbine mid-frequency sound (the audible “swish-swish”) has an amplitude range of 2 to 5 dBA, with occasional 6 dBA peaks. The 5-dBA penalty for SDRS is applied to each 10-minute period in which more than five SDRS events occur.

Sound testing at other Maine wind projects reveal SDRS events are uncommon and their effect on the averaged 10-minute LA_{eq} sound level used to assess compliance is typically less than 1 dBA. Given that there is no margin between projected maximum nighttime sound level at the Protected Location containing receptor 15 and the 42 dBA nighttime limit, compliance sound testing at that location will need to carefully document all SDRS events to verify full compliance.

Construction Noise

Construction of the RoxWind Project will produce sound levels similar to those generated during roadway construction, and much of the heavy equipment is similar. Construction activity will be limited to daytime hours and maximum construction noise will be below the limits set in Section 10(C)(2)(b) for Protected Locations.

Post-Construction Sound Level Testing

To ensure that the sound level predictions submitted by the applicant are accurate for the wind turbines actually installed, and to ensure compliance with the Maine Noise Regulations, including the provisions regarding SDRS and tonal sound, the Department will require post-construction sound monitoring for the project.

The Report suggests compliance testing be done at two receptor points, Locations 15 and 30, which are northwest and southeast of the turbines, respectively. Location 30 is one of the closest points downwind of RoxWind under prevailing northwest winds. This approach is acceptable if the monitoring station for Location 15 is placed on the south property boundary along Roxbury Notch Road so it is at the place where the acoustic model predicted 42 dBA.

Summary

The sound assessment for RoxWind is reasonable and technically correct according to standard noise assessment practices.

Recommendations

I recommend that any permit the Department may ultimately issue for RoxWind require compliance testing at two locations, one of which should be the parcel containing receptor 15 and that the sound monitor be placed on the south side of the parcel where it abuts Roxbury Notch Road to ensure monitoring is done at the location where the acoustic model predicted 42 dBA. In addition, compliance sound testing should carefully document all SDRS events and apply penalty factors where required by the Maine Noise Regulations.

Thank you for the opportunity to provide an independent peer review of the RoxWind Project application.

Sincerely yours,

TECH ENVIRONMENTAL, INC.



Michael T. Lannan, P.E
President
4372/Letter Report June 19 2018

TECH ENVIRONMENTAL, INC.



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