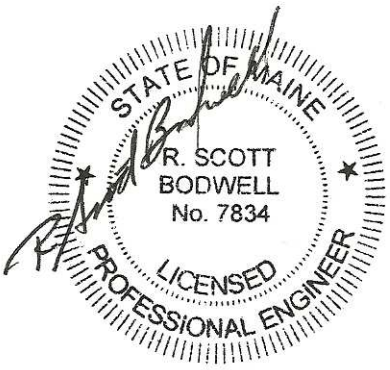
Supplement to Sound Level Assessment
Hancock Wind, LLC
Hancock Wind Project
Hancock County, Maine

Original Sound Level Assessment - January 2013
Supplement Date – June 2014



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1.0 Introduction

In a report dated January 2013, Bodwell EnviroAcoustics LLC (BEA) assessed sound levels expected to result from construction and operation of the Hancock Wind Project proposed for Hancock County, Maine. The original turbine layout evaluated for Hancock Wind consisted of up to 18 Siemens ST-113 or Vestas V112 wind turbines with a total generating capacity ranging up to 55 megawatts (MW). An additional turbine layout option is being proposed that consists of up to 17 Vestas V117 turbines with a generating capacity of 3.3 MW each for a total project capacity of up to 56 MW. All the proposed turbine locations for the V117 layout are the same as the permitted project layout except that the westernmost turbine site, located nearest to Spectacle Pond and the majority of protected locations, has been removed.

This Supplement presents the modified V117 turbine layout, a performance specification and sound warranty for the V117, and updated sound model predictions including sound contour maps and calculations for receptor points. As with the original Sound Level Assessment, this Supplement calculates predicted sound levels from simultaneous operation of all proposed V117 wind turbines at maximum rated sound power output and during nighttime stable atmospheric conditions. Predictive sound model calculations for the proposed V117 layout are presented both for Hancock Wind only and, although not required for regulatory purposes, for combined sound levels from Hancock Wind and Bull Hill Wind projects.

Predicted sound levels at noise sensitive land uses (protected locations) in the vicinity of Hancock Wind are compared to applicable sound standards as set forth in Maine Department of Environmental Protection (DEP) Site Location of Development regulations for Control of Noise (ref. 06-096 CMR c. 375.10). An analysis of model predictions for combined operation of Hancock and Bull Hill projects in relation to applicable state and relevant local limits is also provided in the Appendix III.

The following sections are referenced to the original Sound Level Assessment report dated January 2013. Sections not included in this Supplement remain unchanged from the original Sound Level Assessment. [1]

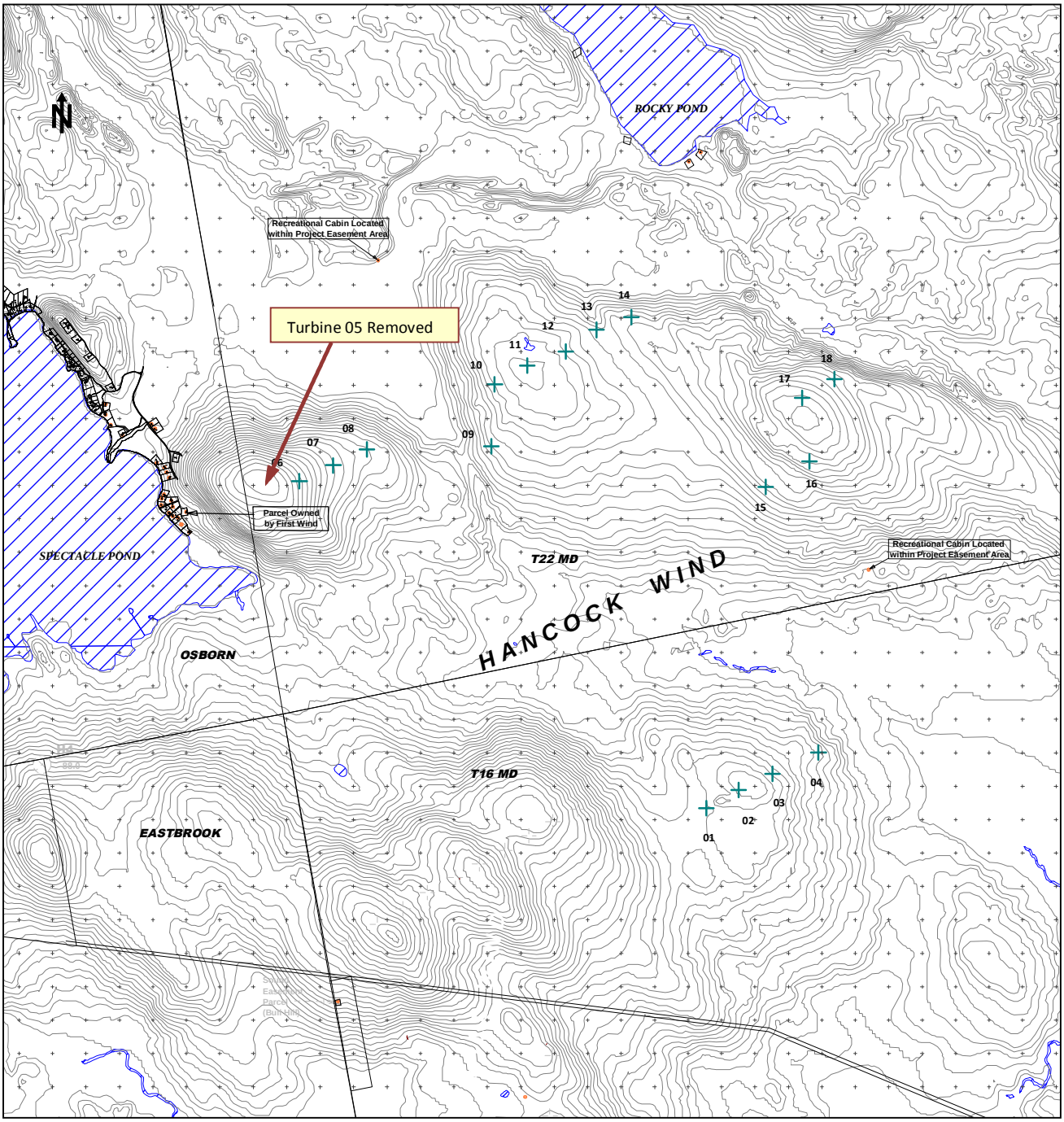
3.0 Project Description

The Hancock Wind Project is the same as described in the original Sound Level Assessment except that the proposed wind turbine is a Vestas V117 and the westernmost turbine location (Turbine 05) has been removed reducing the number of proposed turbine sites from 18 to 17 (see Figure 3-2). This change increases the distance between any turbine and the nearest dwelling on a protected location from

[1] The January 2013 Sound Level Assessment inadvertently presented an earlier turbine layout than was permitted for Hancock Wind. An Addendum to the original Sound Level Assessment dated June 2014 presents sound level predictions for the permitted layout. There were no significant changes to the predicted sound levels or findings of the original study.

approximately 2,520 feet to 3,620 feet. The proposed Vestas V117 turbine is rated at 3.3 MW, has a hub height of 116.5 meters and a rotor diameter of 117 meters, for a total height with the blade fully extended of 175 meters (574 feet).

Figure 3-2. Land Uses and Proposed Wind Turbines



Wind Turbine

Dwelling

Coordinate Grid Spacing = 1000 ft
Topographic Contour Interval = 3 meters (10 ft)

4.0 Wind Turbine Sound Levels

Hancock Wind LLC proposes use of a third turbine option, the Vestas V117, to generate electric power for Hancock Wind. IEC 61400-11 establishes detailed procedures for measurement of wind turbine sound and calculation methods for determining the sound power level of a wind turbine as a point source for the stated purpose of conducting community assessments of sound levels resulting from wind turbine operation. The following provides a brief description of the V117 turbine and its sound performance.

4.1 Vestas Wind Turbine Sound Levels

The Vestas V117 is a pitch-regulated upwind turbine with a rotor diameter of 117 meters and a rated capacity of 3.3 MW. The V117 would be mounted on a tower that puts the hub height at 116.5 meters above grade. The turbine operates at variable speeds ranging from 6.2 to 17.7 rpm depending on the wind speed acting on the turbine rotor and operational settings.

Vestas Wind Systems A/S has provided sound performance data as one-third octave band sound levels for the proposed V117 wind turbine. In its unrestricted operating noise mode 0, the overall sound power levels produced by the V117 range from 95 dBA at low rpm to 107 dBA at full rpm. Table 4-1 provides sound levels at various wind speeds calculated for each whole octave band ranging from 16 to 8,000 Hz.

Noise Mode 0	Wind Speed at 10 m (m/s)							
Frequency (Hz)	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
16	48.2	54.5	59.6	63.3	65.3	66.9	68.8	72.1
31.5	63.3	68.0	71.5	74.2	76.2	78.8	81.4	83.7
63	81.9	82.3	83.5	85.4	87.0	89.0	90.5	90.5
125	86.9	88.5	91.2	93.8	95.0	95.2	94.7	94.0
250	88.8	91.7	95.2	97.7	98.1	97.6	96.7	96.5
500	88.5	92.7	97.1	100.2	100.9	100.4	99.6	99.6
1000	88.6	92.3	96.5	99.8	101.3	101.9	102.0	101.9
2000	84.9	88.4	92.8	96.6	98.9	100.3	101.0	101.2
4000	81.4	84.1	87.8	91.1	93.1	94.5	95.4	95.7
8000	75.4	75.7	77.2	79.6	81.3	82.9	83.7	82.4
All	**95.2**	**98.4**	**102.3**	**105.4**	**106.6**	**107.0**	**107.0**	**107.0**

Hub Height: 116.5 m Wind Shear 0.16
Values in accordance with IEC 61400-11 Ed. 3
Maximum turbulence at 10 m height is 16%
Inflow angle is +/- 2 deg
These values are based on a combination of acoustic computer simulations and measurements from other wind turbines, are provided for informative purposes only, and are not guaranteed by Vestas.

Table 4-1. Sound Power Levels for Vestas V117 Wind Turbine 116.5 m Hub Height - Unrestricted Operation (Mode 0).

The sound power levels were derived by Vestas from acoustic testing of the similar V112 turbine in accordance with IEC 61400-11 and proprietary computer models developed by Vestas and are intended for use to calculate the measureable sound pressure levels at nearby community points and protected locations. At full unrestricted operation, the Vestas V117 wind turbine generates a sound power level of 107 dBA with an uncertainty of 2.0 dBA. Vestas has issued a Sound Level Performance Standard warranty for the V117, which is attached to this Supplement as Appendix I.

Sound power levels for unrestricted Mode 0 in relation to wind speed at a height of 10 meters and wind shear of 0.16, are shown graphically in Figure 4-1.

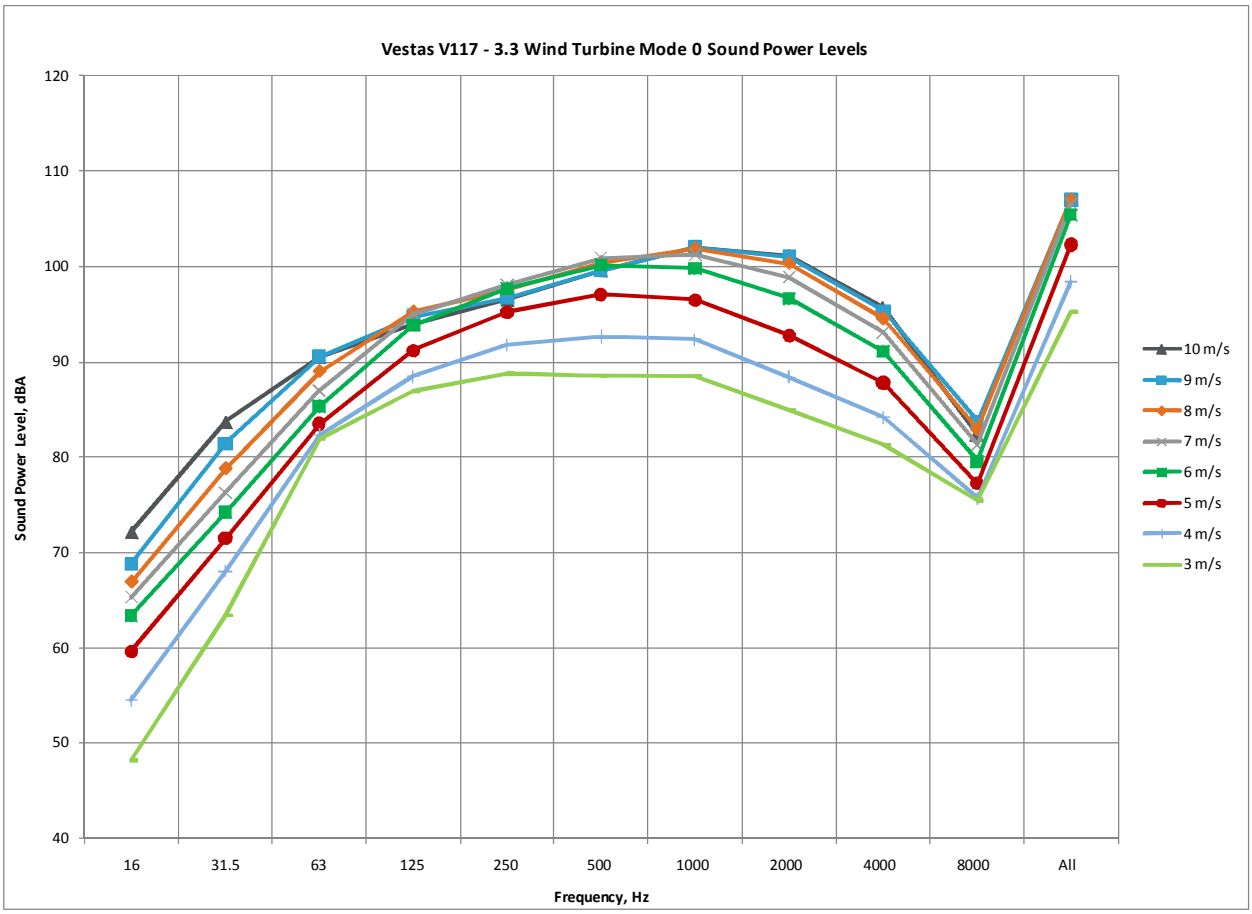


Figure 4-1. Sound Power Levels for Vestas V117 Wind Turbine 116.5 m Hub Height Mode 0 and Wind Speeds of 3 to 10 meters/second

6.2 Wind Turbine Sound Power Levels

As described in Section 4.1, wind turbine sound power levels were provided by Vestas Wind Systems A/S based on sound testing per IEC 61400-11 and proprietary computer models.

Vestas reports and warrants that the full rated sound power of the Vestas V117 is 107 dBA with an uncertainty of ±2.0 dBA. Adding the uncertainty to the full sound output yields a maximum continuous

sound power level of 109.0 dBA for modeling purposes. This is 0.5 dBA more than the maximum continuous sound power level of 108.5 for the Vestas V112 and Siemens ST-113. At a hub height of 116.5 meters (382.2 ft) above ground, the resulting elevations of the turbine hubs (modeled point sources) range from approximately 662 feet to 878 feet above msl (base elevations ranging from 280 to 496 feet).

Vestas provided one-third octave band sound levels for maximum rated turbine sound power that were used to calculate whole octave sound levels as show in Table 4-1 and Figure 4-1. From these results, octave band sound levels at a 10-meter wind speed of 8 meters per second were selected for use in the sound model as yielding the highest sound level predictions at regulated protected locations.

6.4 Tonal and Short Duration Repetitive Sounds

The Maine DEP regulation requires adding 5 dBA to the measured 10-minute equivalent sound level at a protected location if sound from a wind energy development generates either 1) a tonal sound or 2) more than five short duration repetitive (SDR) sound events over a ten-minute measurement interval.

6.4.1 Tonal Sounds

The Vestas V117 Sound Level Performance Standard (Appendix I) warrants the overall sound power level of the V117 and further warrants that the V117 will not produce a tonal sound as defined by Maine DEP 375.10. One-third octave sound data based on acoustic computer simulations by Vestas and measurements from other wind turbines also indicates that the V117 does not generate regulated tonal sounds. From the available sound test data for similar turbines and the Vestas V117 Sound Level Performance Standard, the proposed V117 wind turbines are not expected to generate regulated tonal sounds during routine operation.[2]

6.4.2 Short Duration Repetitive Sounds

As specified in Section I(5)(b) of MDEP 375.10, compliance is determined based on the arithmetic average of the sound levels of, at a minimum, twelve 10-minute measurement intervals in a given compliance measurement period. From available operations test data at wind projects in Maine[3], occurrences of SDR sounds from V117 turbines at Hancock Wind are expected to be minimal. In any event, post-construction monitoring per the Maine DEP test protocol will determine the occurrence of SDR sounds and the appropriate penalty, if any, will be applied to evaluate compliance.

6.5 Predicted Sound Levels

Wind turbine sound level predictions are calculated at a height of 5 feet above ground level as specified by Maine DEP 375.10. Sound levels were calculated at individual community receptor points to represent the locations in each direction from the project with the greatest potential to exceed the

[2] Delta, Measurement of Noise Emission from a Vestas V112 3.0 MW Wind Turbine, AV 161/11, March 26, 2011.
[3] Operations sound testing at Bull Hill Wind, Saddleback Wind, Rollins Wind and Stetson II Wind.

Maine DEP sound level limits. In addition, sound level contours were calculated to provide model predictions at all locations within the study area. A grid spacing of 20 meters by 20 meters was used to calculate the sound level contours. Appendix III provides additional model predictions of combined sound levels from Hancock Wind with the V117 turbine and Bull Hill Wind.

Sound level predictions for Hancock Wind were calculated with all proposed wind turbines operating at full rated sound power output (107 dBA) and the addition of 3.0 dBA for modeling V117 turbines based on turbine manufacturer uncertainty (2 dBA) and model uncertainty (1 dBA). Sound level isopleths at 1 dBA intervals calculated for the V117 option are presented in Figure 6-1 along with calculated sound levels at the selected receptor points. The sound level contours corresponding to Maine DEP daytime limit of 55 dBA and nighttime limit of 42 dBA are shown as bold lines. Figure 6-1 also shows the turbine locations, parcel boundaries, dwelling locations, public and private roads, water bodies, and parcels within the study area that are owned independently from lands purchased, leased or under easement by Hancock Wind LLC.

A summary of predicted sound levels at the receptor points for turbine operation at full rated sound output is provided in Table 6-1. The receptor points for the V117 sound analysis were adjusted from the original Sound Level Assessment as necessary to represent locations with the highest potential to exceed the applicable sound limits. Table 6-1 also provides distances from each of these receptor points to the nearest proposed V117 turbine and the applicable nighttime sound level limit. Predicted sound levels for both the proposed Vestas V117 layout with one turbine removed and the original Vestas V112 are shown in Table 6-1.

Receptor Point	Description and Approximate Distance to Nearest Hancock V117 Wind Turbine		Predicted Hourly Sound Level and Applicable Nighttime Limit, dBA		
	Description	Distance (ft)	V117	V112	Sound Level Limit
H1	Osborn - Protected Location	3,552	36.0	39.6	42
H2	Osborn - Protected Location	3,693	35.7	39.1	42
H3	T22 MD - Protected Location	4,749	36.5	36.0	42

Table 6-1. Predicted Sound Levels from Wind Turbine Operations at Receptor Points

With model factors and uncertainty included in the Hancock predictive model (i.e., 3.0 dBA added to the rated sound power level) and removal of turbine location 05 from the model, the resulting sound levels from the V117 are 3.6 dBA below the V112 turbine layout at H1, 3.4 dBA less at H2, and 0.5 dBA above the V112 sound level at H3. Predicted sound levels are well below the Maine DEP nighttime limit of 42 dBA at protected locations in both Osborn and T22 MD.

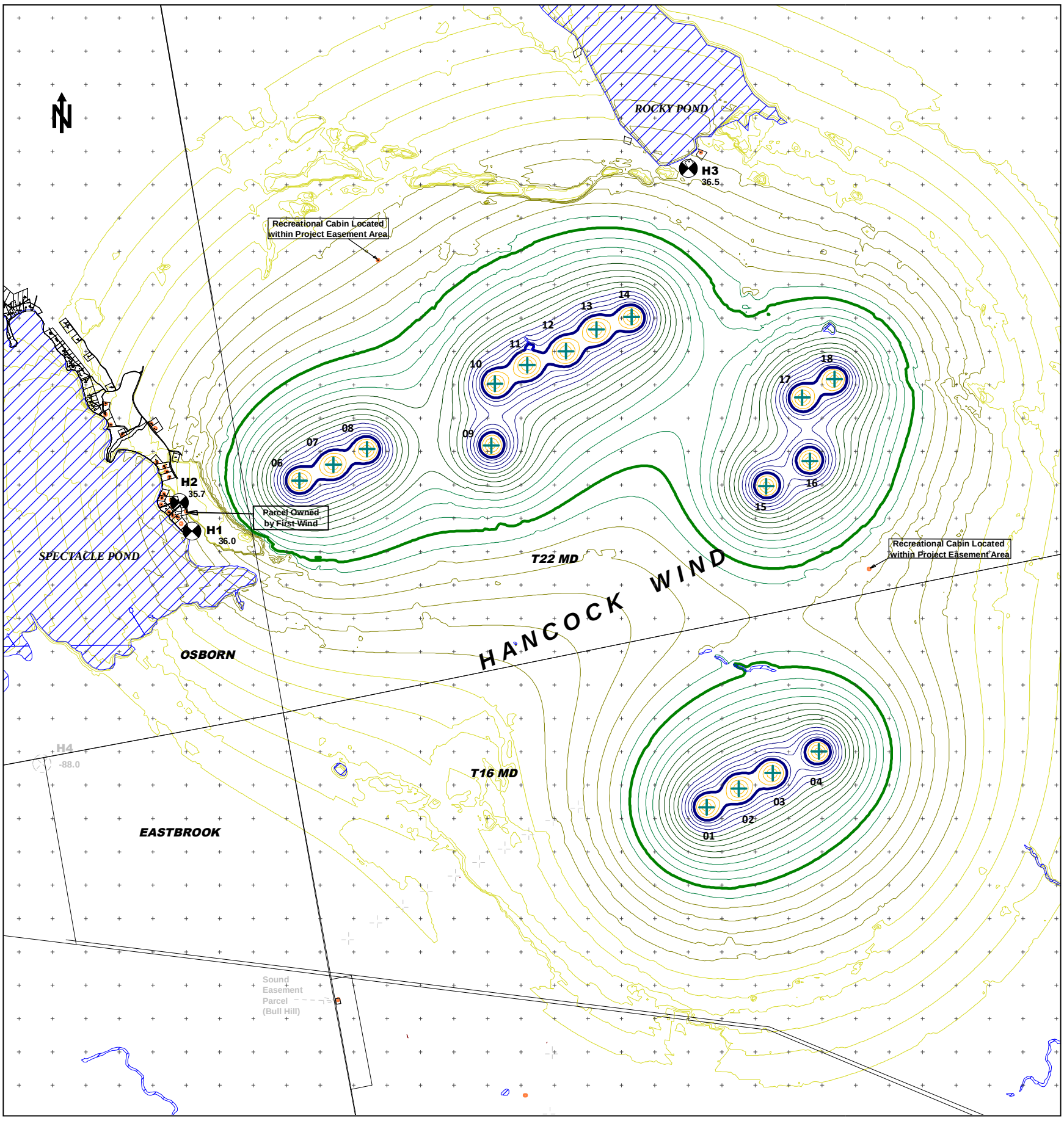
A review of predicted sound levels indicates that when operating at full rated sound output, the Vestas V117 option at Hancock Wind will comply with all applicable Maine DEP sound level limits. As noted in

Section 1.0 of the original Sound Level Assessment, the closest proposed turbine for Hancock Wind is located approximately 4,000 feet from the closest existing turbine at Bull Hill Wind. Although not required, see Maine DEP 375.10 Section B (Applicability), and for informational purposes only, Appendix III of this Supplement provides an analysis of the predicted combined sound levels from the existing Bull Hill project and the proposed Hancock Wind project. As demonstrated in Appendix III, the combined sound levels will comply with the Maine DEP sound level limits using the V117 turbine option.

9.0 Summary of Findings

This Supplement to the Hancock Wind Sound Level Assessment provides sound level predictions for daytime and nighttime turbine operations for the proposed Vestas V117 turbine option layout using a terrain-based computer model. Model settings reflect Section I of Maine DEP 375.10 and results of turbine sound level testing of similar wind energy facilities in Maine. Sound level predictions indicate that with all V117 wind turbines operating simultaneously at full rated sound output, Hancock Wind LLC will meet applicable Maine DEP daytime sound level limit of 55 dBA and nighttime limit of 42 dBA at all regulated protected locations.

Figure 6-1. Predicted Sound Levels from Full Routine Operation of Hancock Wind with V117 Turbine



55 dBA (Daytime Limit)

42 dBA (Nighttime Limit)

Wind Turbine

Dwelling

44.2
500 ft

Receptor Point & Predicted Sound Level

Coordinate Grid Spacing = 1000 ft

Sound Level Contour Interval = 1 dBA

APPENDIX I: VESTAS SOUND LEVEL PERFORMANCE STANDARD

Sound Level Performance Standard and Testing Procedure

Warranted Sound Power Level V117 – 3.3 MW WTG

When measured in accordance with these testing procedures the **V117 – 3.3 MW WTG IEC Class 2A** warranted maximum Sound Level Performance Standard is as follows;

Mode 0 Operation: Lwa = 107.0 dB(A).

This warranted sound level is subject to a tolerance for measurement uncertainties of the greater of (i) the actual measurement uncertainty determined in accordance with the Sound Level Test Standard and (ii) ± 2dB(A). If the measured sound power level is at or below the warranted sound power level plus the uncertainty, the standard has been met.

Supplier also warrants that the sound generated by any Wind Turbine shall not produce a Tonal Sound during operation in any mode when measured in accordance with the Sound Level Test Standard and on the linear scale for one-third octave bands with center frequencies ranging from 20 to 12,500 Hz. A Tonal Sound is defined to exist if the one-third (1/3) octave band sound pressure level in the band, including the tone, exceeds the arithmetic average of the sound pressure levels of the two (2) contiguous one-third (1/3) octave bands by five (5) dB for center frequencies between five hundred (500) Hz and ten thousand (10,000) Hz, by eight (8) dB for center frequencies between one hundred and sixty (160) Hz and four hundred (400) Hz, or by fifteen (15) dB for center frequencies twenty-five (25) Hz between one hundred and twenty-five (125) Hz.

"Sound Level Test Standard" means the test protocol as defined in IEC 61400-11-ed2:2002.

Source: Hancock Turbine Supply Agreement, Exhibit D.2, Vestas Wind Systems A/S

Vestas Confidential Exhibit D.2 1 of 1

APPENDIX III: SOUND MODEL PREDICTIONS FOR COMBINED OPERATION OF HANCOCK WIND WITH VESTAS V117 TURBINES AND BULL HILL WIND AND EVALUTION OF EASTBROOK NOISE ORDINANCE

This Appendix presents sound level predictions for the combined operation of Hancock Wind and Bull Hill Wind. The combined predicted sound levels are calculated at receptor points as selected for both Hancock Wind and Bull Hill Wind. The model assumptions for Hancock Wind with Vestas V117 turbines are as described in Section 6.0 of this Supplement. The original model assumptions for Bull Hill Wind are applied to the Vestas V100 turbines currently in operation at the Bull Hill. These Vestas V100 turbines at Bull Hill have a rotor diameter of 100 meters, a hub height of 95 meters, and a rated sound power output of 105.0 dBA. The Bull Hill model assumptions increase this sound power level by 2 dBA for turbine uncertainty and 3 dBA for model accuracy.[4] Figure III-1 presents a sound level contour map of the combined model predictions from the two projects.

Results of Operations Sound Testing conducted at Bull Hill Wind in 2012 and 2013 indicate that turbine sound levels are well below sound model predictions using the original model assumptions. The highest measured equivalent sound levels under operating conditions closely aligning with the Maine DEP test protocol were 4.8 dBA and 6.8 dBA below the model predictions, in 2012 and 2013 respectively. The test protocol requires nearby turbines to be operating at full sound output with light surface winds at the sound test location. Further, occurrences of SDR sound events as defined by Section I of MDEP 375.10 were minimal during both rounds of testing. The Operations Sound Test reports for Bull Hill dated May 2013 and February 2014 were reviewed and approved by Maine Land Use Planning Commission (LUPC).

Table III-1 summarizes the combined model predictions at the receptor points and compares the results to applicable Maine DEP sound limits and to relevant sound limits contained in the Eastbrook Noise Ordinance as applied in Development Permit 4886 for Bull Hill Wind issued by the LUPC. Table III-1 provides the distance from each receptor point to the nearest turbine. The receptor points include H4 located two miles from wind turbines and the nearest receptor point P2 evaluated for Bull Hill Wind. The model predictions indicate that the combined sound levels will be below both Maine DEP sound limits and Eastbrook noise standards as applied in the Bull Hill permit.

[4] Bodwell EnviroAcoustics LLC, Bull Hill Wind Project, Sound Level Assessment, Exhibit 17, LUPC Development Permit Application, February, 2011.

Receptor Point	Description and Approximate Distance to Nearest Hancock Wind Turbine		Predicted Hourly Sound Level and Nighttime Limit, dBA	
	Description	Distance (ft)	V117	Sound Level Limit
H1	Osborn - Protected Location	3,552	36.9	42[a]
H2	Osborn - Protected Location	3,693	36.5	42
H3	T22 - Protected Location	4,749	36.6	42
H4	Eastbrook – 2 miles from nearest turbine	10,560	31.9	35[b]
P2	Eastbrook - Protected Location	3,700 (from Bull Hill turbine)	39.7	40[c]

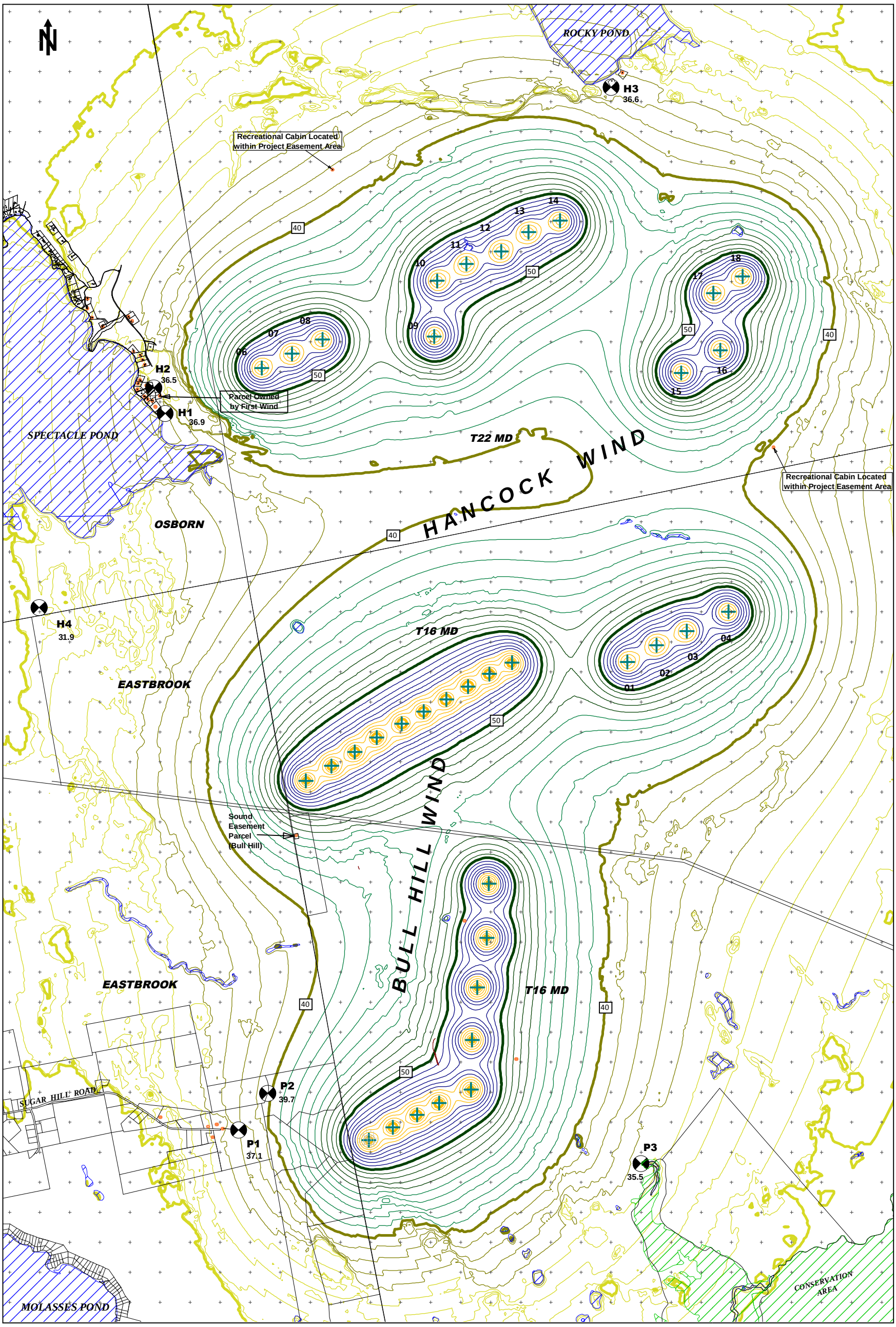
[a]Maine DEP nighttime sound limit at protected locations.

[b]Eastbrook two mile limit applied in Eastbrook to Bull Hill Wind.

[c]Eastbrook nighttime limit applied to Bull Hill Wind at protected locations in Eastbrook.

Table III-1. Predicted Sound Levels at Receptor Points from Combined Operation of Hancock Wind with V117 Turbine and Bull Hill Wind.

FIGURE III-1: SOUND LEVEL MAP OF COMBINED OPERATION OF HANCOCK WIND WITH V117 TURBINES AND BULL HILL WIND.



Wind Turbine

Dwelling

39.7
500 ft
Receptor Point & Predicted Sound Level

Coordinate Grid Spacing = 1000 ft

Sound Level Contour Interval = 1 dBA