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Date: July 13, 2018

To: Millie Garcia-Serrano, Regional Director
MassDEP SERO
20 Riverside Drive
Lakeville, MA 02347

Ref: FGW Turbines Compliance Monitoring Sound Study, Tech Environmental, May 16, 2018

This advisory peer-review[1] has found significant errors and omissions that change FGW Study conclusions to substantial non-compliance:

Finding 1: *Atlantic Design Engineers (ADE), Tech Environmental (Tech), and Massachusetts Department of Environmental Protection (MassDEP) appear to agree that FGW exceeds permit noise limits.*

Finding 2: *Not providing referred to acoustic modeling results undermined Tech's compliance assurances.* Independent noise predictions show that turbines exceed regulatory noise limits, even when the 2-nearest neighbor turbines are turned off. (page 2)

Finding 3: *ADE sound monitoring measurements established the lowest ambient L90s: 24 to 29 dBA, which were c*orroborated with Tech's Table A-2: *outside > Rural Area at Night - 25 dBA.*

Finding 4: *Sound level measurements have no observer field logs*. Unattended measurements likely.

Finding 5: *MassDEP/Tech sound measurement protocol conflicts with acoustic standards:*

- ANSI/ASA S12.9: *Quantities and Procedures for Description and Measurement of Environmental Sound. Part 3: Short-Term Measurements with An Observer Present*,
- ANSI/ASA S12.100-2014: *Methods to Define and Measure the Residual Sound in Protected Natural and Quiet Residential Areas.*
- ISO-1996-2: *Acoustics - Description, measurement and assessment of environmental noise -- Part 2: Determination of sound pressure levels.*

Finding 6: *Turbine operations and electric power output levels are unknown without SCADA files.*

Finding 7: *Peer-review analysis of Appendix E wind turbine sound level time history charts correlate with noise predictions.* (example on page 4)

Conclusion:

This review finds FGW exceeds the MassDEP noise policy by 10 to 20 dB at all locations. Nighttime turbine noise curtailment does not work. All turbines should be turned off at night.

Forty-years' experience conducting and evaluating noise studies for adverse community impacts finds this Study reprehensible: novices pretending to be experts by misusing computer prediction models and making sound measurements without an observer. These are my professional opinions.

Respectfully,

Stephen E. Ambrose, ASA, INCE, *Board Certified* Emeritus

[1] Assessment is voluntary, unsolicited, without compensation, and open for public review.

Independent noise prediction:

Noise prediction strictly adhered to ISO 9613-2 methods and limitations[2]. Table 1 shows FGW exceeds MassDEP's noise policy: nighttime L90 + 10 dB = Lmax noise levels exceeded by 11 to 20 dB at all measurement locations (ML).

Table 1, Wind Turbine Predicted Lmax vs Measured Ambient L90 w/o Turbine
> Differences >10 dB Exceed MassDEP Noise Limits <

Location	Turbine > T1			Turbine > T3			Turbine > T4			Turbine > T5		
Elec-Pwr-Out	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High
ML1 > Lmax	38	43	47	40	45	49	44	49	53	49	54	58
L90 Measured	28	28	28	28	28	28	28	28	28	28	28	28
Difference	10	15	19	12	17	21	16	21	25	21	26	30
ML2 > Lmax	43	48	52	42	47	51	45	50	54	47	52	56
L90 Measured	24	24	24	24	24	24	24	24	24	24	24	24
Difference	19	24	28	18	23	27	21	26	30	23	28	32
ML3	49	54	58	43	48	52	43	48	52	40	45	49
L90 Measured	26	26	26	26	26	26	26	26	26	26	26	26
Difference	23	28	32	17	22	26	17	22	26	14	19	23
ML4	50	55	59	42	47	51	42	47	51	38	43	47
L90 Measured	27	27	27	27	27	27	27	27	27	27	27	27
Difference	23	28	32	15	20	24	15	20	24	11	16	20
ML5	50	55	59	44	49	53	42	47	51	37	42	46
L90 Measured	27	27	27	27	27	27	27	27	27	27	27	27
Difference	23	28	32	17	22	26	15	20	24	10	15	19

Turbine sound power levels are shown below, with prediction equations, tolerance, and MassDEP[3] conversion factor from Leq to Lmax.

Gamasa	ISO 61400			Turb Gen		Hub Windspeed		IEC 9613-2	
G97 2 MW	LwA	Uncert.	LwA	Pwr Out kW		Range (m/s)		Toler.	LwA
Low Power	97	2	99	400	1150	4.1	7.2	3	102
Mid Power	102	2	104	1200	1750	7.2	10.1	3	107
High Power	106	2	108	1800	2000	10.1	14.5	3	111

Geometric Divergence > LpA = LwA - [20 Log D meters +11]
Prediction Tolerance > +3 dB
MassCEC/DEP Research Study on Wind Turbine Acoustics: Lmax=Leq+11

[2] +3 dB for unknowns, maximum distance: 1000-m (3284-ft), and source to receiver median height: 30-meters (~100-ft) otherwise G=0 and Leq to Lmax (+11 dB)
[3] http://files.masscec.com/research/wind/MassCECWindTurbinesAcousticsStudy.pdf

Study Figure 3-1 (below left) provided wind turbine (T) and measurement (ML) locations. Google Earth was used for measuring separation distances.

Study Table 7.1 (below right) provided turbine operation schedule. Turbine noise curtailment for T1 NRO occurs between 6 pm and midnight, then both T1 and T5 are shutdown. At 5 AM, T5 is turned back on and at 6 AM, T1 NRO until 8 AM when all turbines are on. These were not considered because any one turbine exceeds Lmax noise limits.

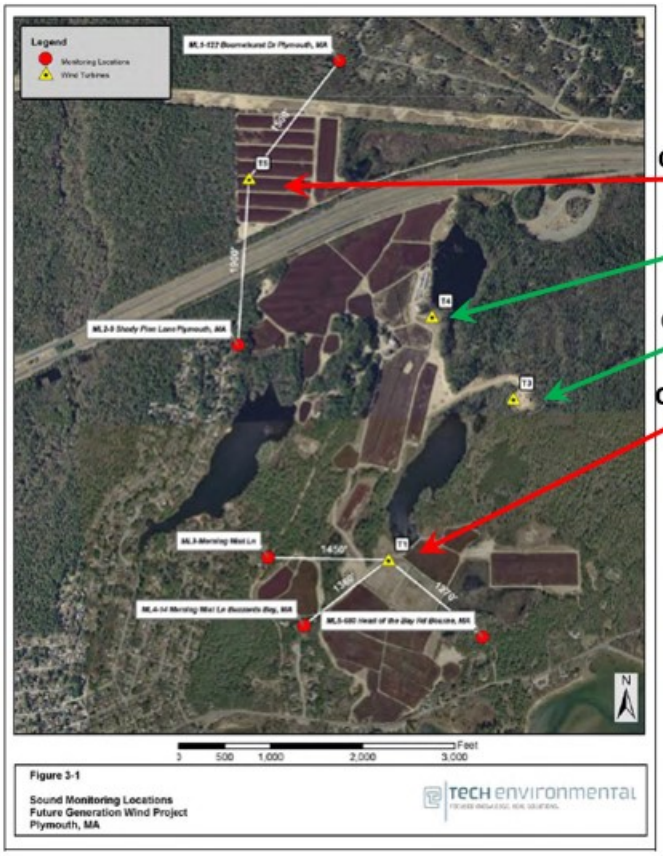

TABLE 7-1

ENACTED CURTAILMENT PROGRAM
FGW WIND TURBINES, PLYMOUTH, MA

Start Time	T1	T3	T4	T5
12:00 AM	OFF	NORMAL	NORMAL	OFF
1:00 AM	OFF	NORMAL	NORMAL	OFF
2:00 AM	OFF	NORMAL	NORMAL	OFF
3:00 AM	OFF	NORMAL	NORMAL	OFF
4:00 AM	OFF	NORMAL	NORMAL	OFF
5:00 AM	OFF	NORMAL	NORMAL	NORMAL
6:00 AM	NRO 102	NORMAL	NORMAL	NORMAL
7:00 AM	NRO 103	NORMAL	NORMAL	NORMAL
8:00 AM	NORMAL	NORMAL	NORMAL	NORMAL
9:00 AM	NORMAL	NORMAL	NORMAL	NORMAL
10:00 AM	NORMAL	NORMAL	NORMAL	NORMAL
11:00 AM	NORMAL	NORMAL	NORMAL	NORMAL
12:00 PM	NORMAL	NORMAL	NORMAL	NORMAL
1:00 PM	NORMAL	NORMAL	NORMAL	NORMAL
2:00 PM	NORMAL	NORMAL	NORMAL	NORMAL
3:00 PM	NORMAL	NORMAL	NORMAL	NORMAL
4:00 PM	NORMAL	NORMAL	NORMAL	NORMAL
5:00 PM	NORMAL	NORMAL	NORMAL	NORMAL
6:00 PM	NRO 103	NORMAL	NORMAL	NORMAL
7:00 PM	NRO 102	NORMAL	NORMAL	NORMAL
8:00 PM	NRO 102	NORMAL	NORMAL	NORMAL
9:00 PM	NRO 102	NORMAL	NORMAL	NORMAL
10:00 PM	OFF	NORMAL	NORMAL	NORMAL
11:00 PM	OFF	NORMAL	NORMAL	NORMAL

T4 predicted 51 dBA high power noise level correlates with time history sound level measurements:

Study Table 1-4 shows high power production noise levels shown for ML5 on 11/3/2017.

- Tech analysis: ambient L90 off 34.6 dBA, turbine on Lmax 43.8 dBA, diff. 9 dB.
- Independent: ambient L90 off 27 dBA (Table 8-4), turbine on Lmax 51 dBA, diff. 23 dB for levels that consistently repeat.
- ISO-1996-2 estimated short-term measurement tolerance for ML5 ±5 dB shown on chart below.

TABLE 1-4

SUMMARY OF COMPLIANCE SOUND MONITORING RESULTS (dBA)
TURBINES OPERATING AT HIGH POWER PRODUCTION

Monitoring Location	Date[2]	Sampling Time (Turbine-ON)[1]	Average Power Production (kW)	Average Hub Height Wind Speed (m/s)	Five-minute Ambient L_{90} Level (Turbine-OFF)	One-second L_{max} Level (Turbine-ON)[1]	Net Increase[2]
ML1	8/23/2017	12:05 AM-12:20 AM	1,613	12.0	46.9	48.8	2
		1:30 AM-1:45 AM	1,870	10.8	44.4	46.6	2
ML2	9/20/2017	1:30 AM-1:45 AM	1,442	7.5	48.9	49.5	1
		3:00 AM-3:15 AM	1,648	9.7	48.9	50.3	1
ML3	9/20/2017	1:30 AM-1:45 AM	1,442	7.5	41.2	45.1	4
		3:00 AM-3:15 AM	1,648	9.7	41.2	44.8	4
		3:15 AM-3:30 AM	1,893	9.2	41.2	44.5	3
		3:30 AM-3:45 AM	1,404	9.0	41.2	44.7	4
ML4	9/20/2017	3:00 AM-3:15 AM	1,636	9.9	43.6	47.4	4
		3:15 AM-3:30 AM	1,913	10.6	43.6	47.3	4
	3/5/2018-3/6/2018	11:00 PM-11:15 PM	1,646	9.4	34.7	44.2	10
		11:30 PM-11:45 PM	1,445	8.8	34.7	44.5	10
		11:50 PM-12:05 AM	1,464	8.8	34.7	44.6	10
ML5	11/3/2017	11:35 PM-11:50 PM	1,540	9.0	34.6	43.8	9
	3/5/2018-3/6/2018	11:30 PM-11:45 PM	1,445	8.8	35.4	44.3	9
		11:50 PM-12:05 AM	1,464	8.8	35.4	43.8	8
		1:10 AM-1:25 AM	1,414	8.6	35.4	43.7	8

[1]During these compliance tests, three five-minute samples were taken with the turbine-ON, and each monitoring location was located downwind of the nearest turbine
[2]The increase of L_{max} over L_{90} ambient is rounded to a whole decibel value for proper comparison to the MassDEP Noise Policy limit- see text.