Middletown Solar Farm Site

Background Sound Measurement Study

Middletown, Rhode Island

March, 2021

Prepared for:

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Executive Summary

A background noise monitoring study was completed at a Solar Farm site between Busher Drive and Amesbury Circle in Middletown RI during March 2021. Based on this study, we conclude the following:

Average measured background Leq levels during Solar Farm operational times were between 45 and 55 dBA across the site. On the south side along Amesbury Circle the average Leq levels were between 48 and 57 dBA during Solar Farm operational periods. On the north side along Busher Drive the average Leq levels were between 44 and 55 dBA during Solar Farm operational periods. Sound levels were dominated by sound from cars in the background, birds during the daytime, and insect and frog activity during the evening.

1 Introduction

Dr. Howard Quin was contracted by Green Development Inc. to perform a background noise study for Solar Farm operations at Busher Drive and Amesbury Circle in Middletown, RI. The report summarizes noise measurements made during March 22-24, 2021. In this report, we review applicable noise standards and criteria, and summarize the measurement noise data at the site. Appendix A provides a description of various noise metrics.

2 Noise Standards and Criteria

The Town of Middletown noise regulations are contained in town ordinance 130.75 to 130.91.

§ 130.80 MAXIMUM PERMISSIBLE SOUND LEVELS BY RECEIVING LAND USE.

(A) With the exception of sound levels elsewhere specifically authorized or allowed in this subcha at or within the real property boundary of a receiving land use:

SOUND LEVELS BY RECEIVING LAND USE		
Location of Receiving Land Use	**Time**	**Sound Limit**
Zoning District: Residential	7 a.m. to 10 p.m. 10 p.m to 7 a.m.	65 dBA 55 dBA
Zoning District: General Business, Office Business, Limited Business, Light Industrial, and Municipal Industrial Park	At all times	75 dBA
Other: Public Water	At all times	65 dBA
Other: Noise Sensitive Area	7 a.m. to 10 p.m. 10 p.m. to 7 a.m.	65 dBA 55 dBA

The relevant limit levels at the residences are 65 dBA, daytime, and 55 dBA nighttime from ordinance section 130.80. For the solar farm, the 65 dBA standard would apply for almost all times when the project is operational; during summer months, there would be a slight amount of noise production before 7:00 A.M. where the applicable level would be 55 dBA.

3 Measurement Program

A total two sites were chosen by Green Development Inc. for two day sound measurements near the Solar Farm site, one on the north and south side of the solar farm, marked as L1 and L2. Four sites were chosen for short term measurements, two to the north and two to the south, marked as S1 through S4. The short term measurements were conducted for a period of about a half hour at each location during daytime and evening under typical solar array operating conditions.

Figure 1.

Sound Monitoring Sites Near Middletown Solar Farm Site

The monitoring locations are as follows:

L1 - Located near the southeast end property line of the solar farm site

L2 - Located near the north end property line of the solar farm site on the end of Laura Road

S1 - Located at a residence on the east side of Amesbury Circle

S2 - Located at a residence on the west side of Amesbury Circle

S3 - Located at the cul-de-sac at the end of Laura Road

S4 – Located at a residence on the east side of Busher Drive

Long term noise measurements were conducted with Larson Davis Lxt octave band sound level meters/noise analyzers at locations L1 and L2. At each long term location, long term data was collected in one hour intervals, with the meter on "slow" setting. Field calibrations with acoustic calibrators were conducted for all of the measurements. All instrumentation components, including microphones, preamplifiers and field calibrators have current laboratory certified calibrations traceable to the National Institute of Standards and Technology. Microphones were fitted with environmental windscreens, which protected the microphones during windy conditions.

Attended short term monitoring was also made on-site. This was also done with a Larson Davis Lxt and a Quest SoundPro Type I sound meter for periods of 30 minutes at each location with the meter on "slow" setting. The short term monitoring was done to ensure that a technician was on-site to verify the actual relative contributions of sound from various sources. This is important, as it is not always readily evident from an examination of long term hourly measurements where sound sources come from. Two sets of short term monitoring data were collected at the short term locations shown above, one during the daytime and one during the evening. In this manner, we were able to examine sound from different time periods when the panels would be operating and people would be near their residences.

Figure 2.

Sound Monitoring Site Photos

Monitoring Locations L1 and L2

Short Term Monitoring Locations S1, S2, S3 and S4

4 Measurement Results

The short term data are shown in Table 1 at locations S1 to S4 for both the daytime and evening monitoring periods. There are significant differences in sound level between the sound recorded during the day and during the evening; the evening levels are considerably higher than the daytime ones. Daytime average (Leq) levels ranged from about 41 to 44 dBA, while the evening ones ranged from 44 to 48 dbA. The L90 (background) levels were also significantly higher in the evening; they ranged from 36 to 39 dA in the daytime to 42 to 45 dBA in the evening. This is primarily due to the presence of frogs and insects on the large solar lot during the evening, which were not prevalent during the daytime. It is possible that much of this sound will be reduced at the outset of the solar project as the very thick brush is cleared on site; however, as vegetation grows back in between the panels overt time, it is likely that much of this sound will return.. The daytime sound levels were primarily dominated by birds, with some background noise from state highway 114 located about 1000 feet away to the west. Peak sound during both periods came from car passbys and single engine plane overflights at the nearby airport, which landed about every 5 to 10 minutes.

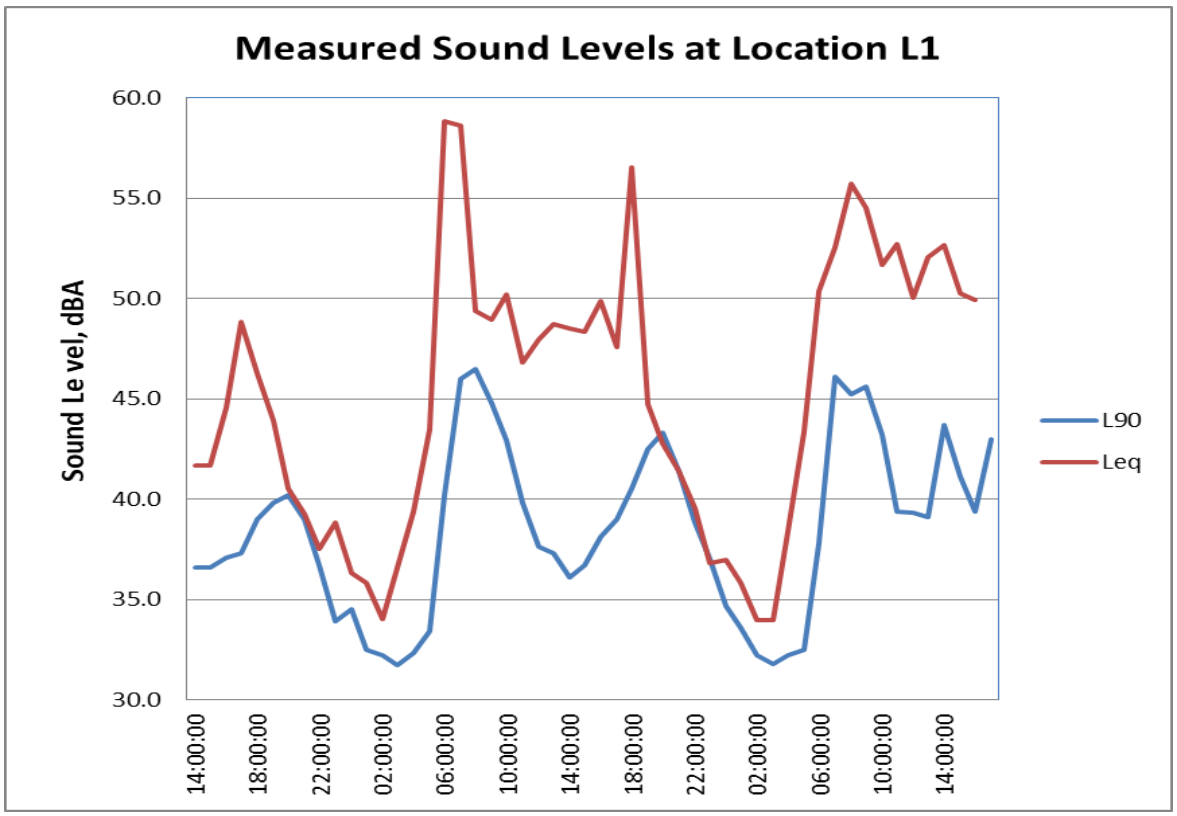
Table 1.

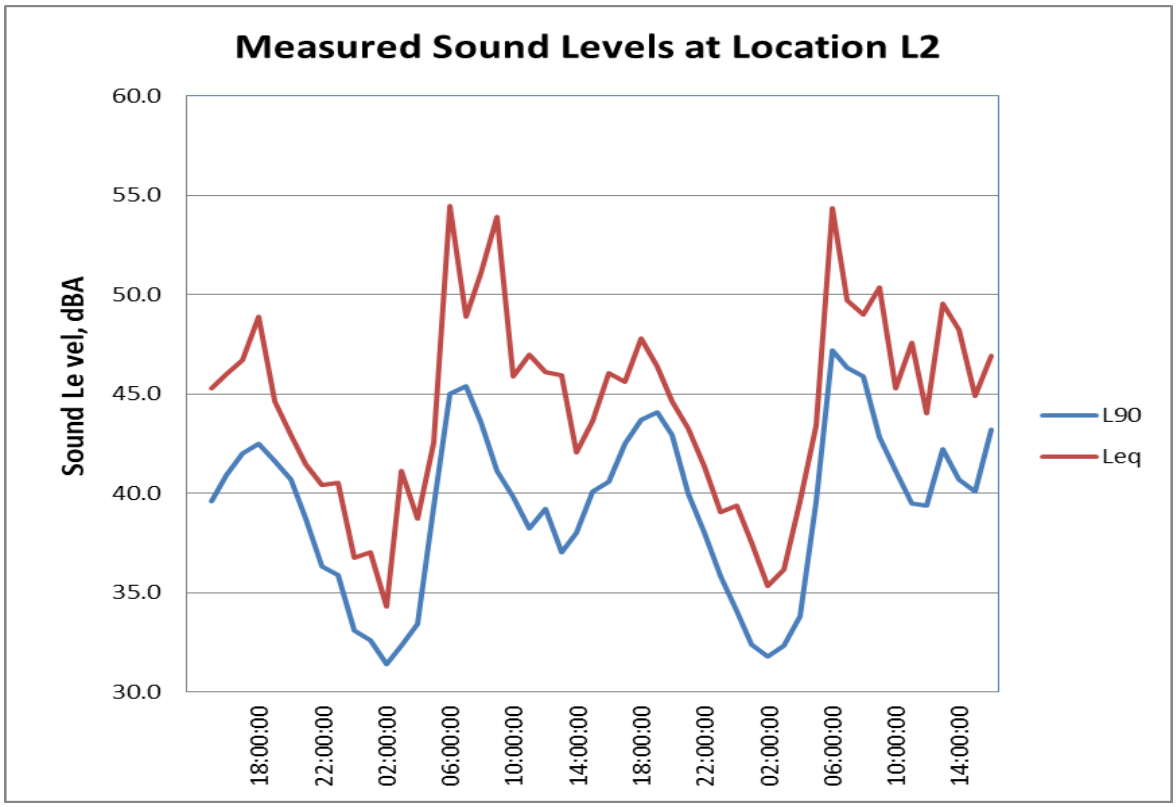
Short Term Monitoring Results

Number	Location	Date	Time	Laeq	L90	L10
S1	Southeast Corner	3/22	12:32 PM	41.4	35.7	43.2
S2	West End of Circle	3/22	1:25 PM	43.5	38.7	45.8
S3	North Cul-de-Sac	3/22	2:31 PM	43.1	38.8	45.0
S4	Northeast Corner	3/22	3:08 PM	43.9	37.7	44.6
S1	Southeast Corner	3/24	6:13 PM	47.7	44.6	49.9
S2	West End of Circle	3/24	6:46 PM	48.3	41.8	47.5
S3	North Cul-de-Sac	3/24	5:02 PM	46.1	43.6	47.1
S4	Northeast Corner	3/24	5:35 PM	44.3	42.8	45.6

Figure 3, represents graphs of the L90, and Leq at locations L1, and L2, for each one hour period over the two days when data was collected. Leq Sound levels are shown in red, while L90 levels are shown in blue. The graph shows that, typical Leqs varied from approximately 45 to 58 dBA at Location L1, and from 45 to 55 dBA at L2 during operational hours. Noise recorded includes all sound on site. The graph shows that, typical L90s varied from approximately 37 to 46 dBA at Location L1, and from 37 to 47 at L2 during operational hours.

Figure 3.

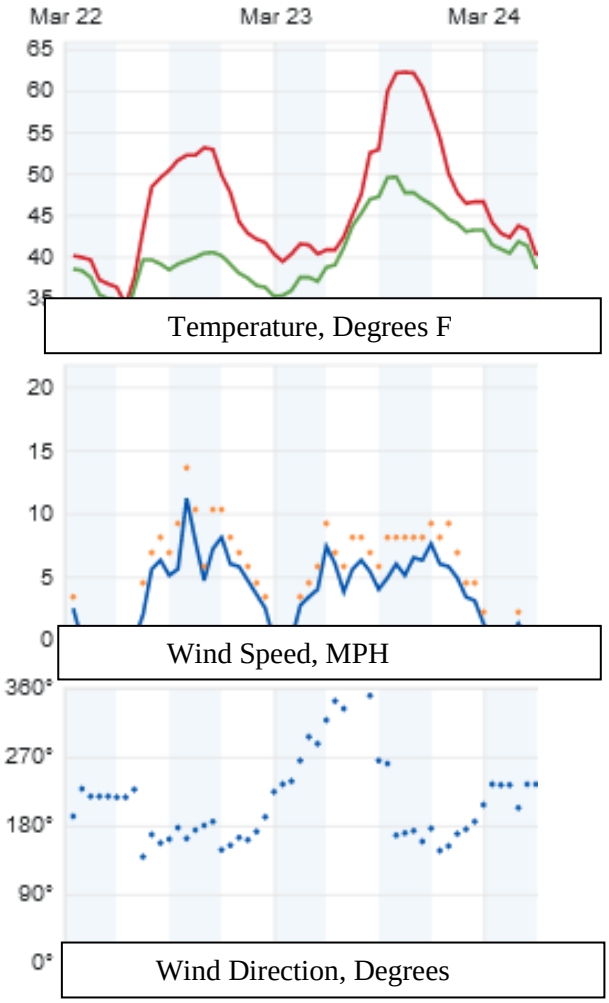

Measured Sound Levels at Location L1
Sound Le vel, dBA
60.0
55.0
50.0
45.0
40.0
35.0
30.0
14:00:00
18:00:00
22:00:00
02:00:00
06:00:00
10:00:00
14:00:00
18:00:00
22:00:00
02:00:00
06:00:00
10:00:00
14:00:00
L90
Leq


Measured Sound Levels at Location L2
Sound Le vel, dBA
60.0
55.0
50.0
45.0
40.0
35.0
30.0
18:00:00
22:00:00
02:00:00
06:00:00
10:00:00
14:00:00
18:00:00
22:00:00
02:00:00
06:00:00
10:00:00
14:00:00
L90
Leq

Weather conditions reported during the monitoring period (Figure 4) are typical of those expected in early spring, with temperatures between 35 and 60 degrees F. with wind speeds of 5-10 mph, typical of what would occur under daytime equipment operating conditions. The sound data at the two long term locations show very similar attributes despite the fact that they are located nearly 700 feet apart on different parts of the site. The data show two peaks at either end of the daytime period between about 54 and 57 dBA. These are due to peak insect and frog activity on site during the morning and evening. During the daytime hours when the solar array would be operational and generating peak levels from the solar inverters and transformers, the Leq levels range from about 45 to about 52 dBA. We therefore expect that during equipment operational times in the spring and summer there would be a considerable amount of noise on site masking sound from the transformers and inverters. The daytime background L90 levels of 37 to 46 dBA are closer to what would be expected during winter operational times without significant insect or frog noise, but would still mask transformer and inverter sound as well.

Figure 4

Weather History for KRIMIDDL36 on March 22-24, 2021



Appendix A: Description of Noise Metrics

This Appendix describes the noise metrics used in this report.

1. A-weighted Sound Level, dBA

Loudness is a subjective quantity that enables a listener to order the magnitude of different sounds on a scale from soft to loud. Although the perceived loudness of a sound is based somewhat on its frequency and duration, chiefly it depends upon the sound pressure level. Sound pressure level is a measure of the sound pressure at a point relative to a standard reference value; sound pressure level is always expressed in decibels (dB), a logarithmic quantity.

Another important characteristic of sound is its frequency, or "pitch." This is the rate of repetition of sound pressure oscillations as they reach our ears. Frequency is expressed in units known as Hertz (abbreviated "Hz" and equivalent to one cycle per second). Sounds heard in the environment usually consist of a range of frequencies. The distribution of sound energy as a function of frequency is termed the "frequency spectrum."

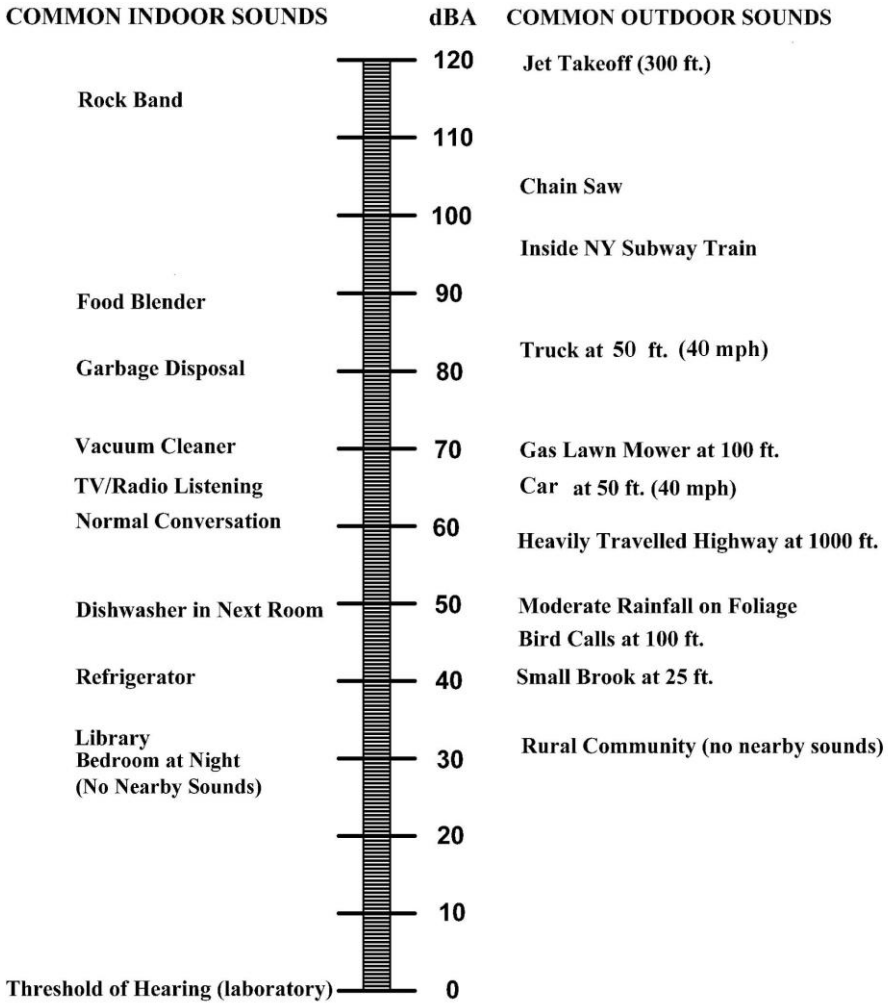
The human ear does not respond equally to identical noise levels at different frequencies. Although the normal frequency range of hearing for most people extends from a low of about 20 Hz to a high of 10,000 Hz to 20,000 Hz, people are most sensitive to sounds in the voice range, between about 500 Hz to 2,000 Hz. Therefore, to correlate the amplitude of a sound with its level as perceived by people, the sound energy spectrum is adjusted, or "weighted."

The weighting system most commonly used to correlate with people's response to noise is "A-weighting" (or the "A-filter") and the resultant noise level is called the "A-weighted noise level" (dBA). A-weighting significantly de-emphasizes those parts of the frequency spectrum from a noise source that occurs both at lower frequencies (those below about 500 Hz) and at very high frequencies (above 10,000 Hz) where we do not hear as well. The filter has very little effect, or is nearly "flat," in the middle range of frequencies between 500 and 10,000 Hz. A-weighted sound levels have been found to correlate better than other weighting networks with human perception of "noisiness", including C weighting, which is why C weighting is not usually used for wind turbine compliance analysis One of the primary reasons for this is that the A-weighting network emphasizes the frequency range where human speech occurs, and noise in this range interferes with speech communication. The figure below shows common indoor and outdoor A-weighted sound levels and the environments or sources that produce them.

2. Equivalent Sound Level, Leq

The Equivalent Sound Level, abbreviated L_{eq}, is a measure of the total exposure resulting from the accumulation of A-weighted sound levels over a particular period of interest -- for example, an hour, an 8-hour school day, nighttime, or a full 24-hour day. However, because the length of the period can be different depending on the time frame of interest, the applicable period should always be identified or clearly understood when discussing the metric. Such durations are often identified through a subscript, for example L_{eq1h}, or $L_{eq(24)}$.

L_{eq} may be thought of as a constant sound level over the period of interest that contains as much sound energy as (is "equivalent" to) the actual time-varying sound level with its normal peaks and valleys. It is important to recognize, however, that the two signals (the constant one and the time-varying one) would sound very different from each other. Also, the "average" sound level suggested by L_{eq} is not an arithmetic value, but a logarithmic, or "energy-averaged" sound level. Thus, the loudest events may dominate the noise environment described by the metric, depending on the relative loudness of the events.



3. Statistical Sound Level Descriptors

Statistical descriptors of the time-varying sound level are often used instead of, or in addition to L_{eq} to provide more information about how the sound level varied during the time period of interest. The descriptor includes a subscript that indicates the percentage of time the sound level is exceeded during the period. The L_{50} is an example, which represents the sound level exceeded 50 percent of the time, and equals the median sound level. Another commonly used descriptor is the L_{10}, which represents the sound level exceeded 10 percent of the measurement period and describes the sound level during the louder portions of the period. The L_{90} is often used to describe the quieter background sound levels that occurred, since it represents the level exceeded 90 percent of the period.