



April 2, 2025

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Subject: *Clarkstown Road Solar – Sound Study*
Muncy Creek Township, Lycoming County, Pennsylvania

Executive Summary

The purpose of this technical memorandum is to summarize the evaluated sound levels associated with the operational equipment that will be located at the proposed Clarkstown Road Solar Site in Muncy Creek Township, PA. The proposed solar photovoltaic project site is just east of the jurisdiction of Muncy, approximately 3 miles southwest of Hughesville, approximately 5 miles northeast of Montgomery, and approximately 6 miles north of Turbotville. The site is generally located south of Clarkstown Road/SR 2061, east of Susquehanna Beltway/I-180 and Muncy Exchange Road, and west of Fogelman Road. The solar site will be located on agricultural land with residences surrounding the project area. Additionally, Lycoming Valley Railroad Company (LVRR) railroad tracks are located approximately 1.5 miles west of the project site. The location of the proposed Clarkstown Road Solar Site is shown in **Figure 1**.

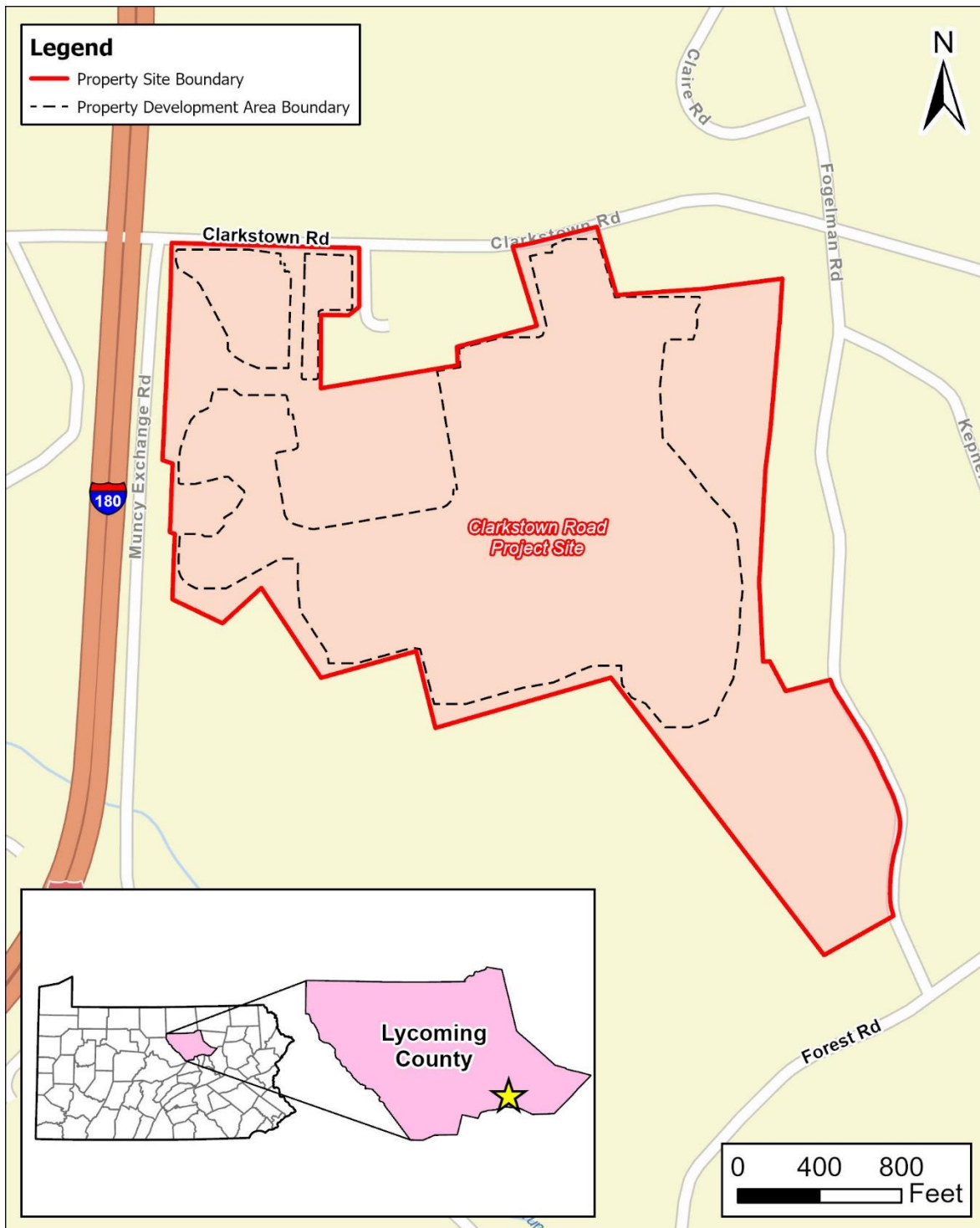
Analysis Findings

- The solar site will be located on agricultural land with residences surrounding the project area. Additionally, Lycoming Valley Railroad Company (LVRR) railroad tracks are located approximately 1.5 miles west of the project site. The Muncy Creek Township Conditional Use Conditions establish a maximum permissible noise level of 50 dB(A) at the property line of non-participating landowners during the daytime and nighttime. However, according to the Fogelman Solar Site Noise Management Plan, the lowest ambient noise levels measured at a nearby solar site were 51 dB(A) during the daytime and 47 dB(A) during the nighttime. Note that equipment is not anticipated to be operational during nighttime hours, so the daytime noise level standard was used for comparison purposes. Modeled operational noise levels at the closest noise-sensitive receptors are anticipated to be near or below approximately 45 dB(A); therefore, noise mitigation is not recommended at this time.*

Project Description

The proposed Clarkstown Road Solar Site will be developed on nearly 87 acres of an approximately 148-acre parcel of agricultural land in Muncy Creek Township, PA. The solar site will consist of solar arrays throughout the project area containing up to two-hundred seventy-six (276) string inverters and twelve (12) 2,500 kilo-volt-ampere (kVA) transformers.

Figure 1: Site Location and Vicinity



Characteristics of Noise

Noise is generally defined as unwanted sound. It is emitted from many natural and man-made sources. Sound pressure levels are usually measured and expressed in decibels (dB). The decibel scale is logarithmic and expresses the ratio of the sound pressure unit being measured to a standard reference level. Most sounds occurring in the environment do not consist of a single frequency, but rather a broad band of differing frequencies. The intensities of each frequency add together to generate sound. Because the human ear does not respond to all frequencies equally, the method commonly used to quantify environmental noise consists of evaluating all of the frequencies of a sound according to a weighting system. It has been found that the A-weighted decibel [dB(A)] filter on a sound level meter, which includes circuits to differentially measure selected audible frequencies, best approximates the frequency response of the human ear.

The degree of disturbance from exposure to unwanted sound – noise – depends upon three factors:

1. The amount, nature, and duration of the intruding noise
2. The relationship between the intruding noise and the existing sound environment; and
3. The situation in which the disturbing noise is heard

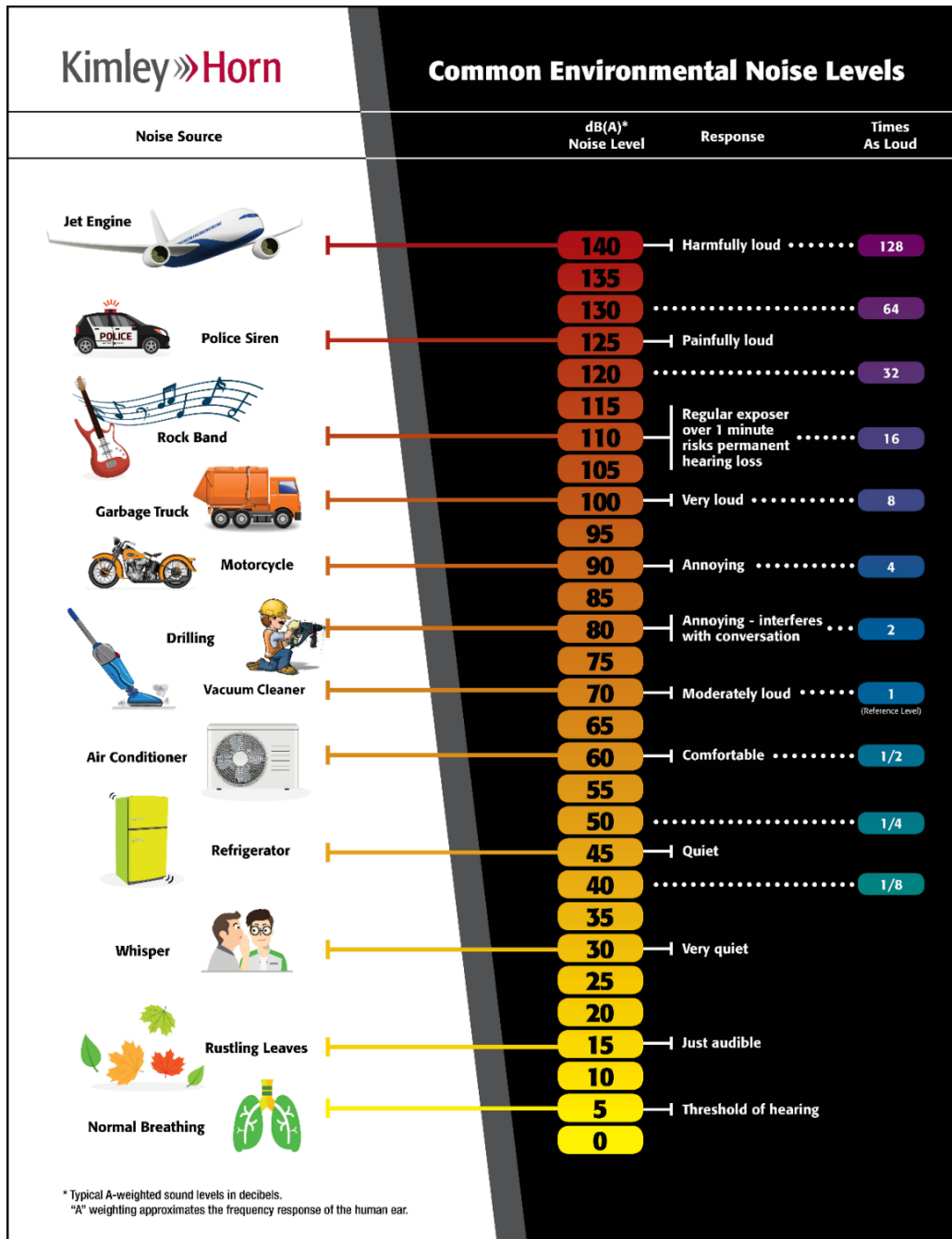
In considering the first of these factors, it is important to note that individuals have varying sensitivity to noise. Loud noises bother some people more than other people, and some individuals become increasingly upset if an unwanted noise persists. The time patterns and durations of noise(s) also affect perception as to whether or not it is offensive. For example, noises that occur during nighttime (sleeping) hours are typically considered to be more offensive than the same noises in the daytime.

With regard to the second factor, individuals tend to judge the annoyance of an unwanted noise in terms of its relationship to noise from other sources (background noise). A car horn blowing at night when background noise levels are low would generally be more objectionable than one blowing in the afternoon when background noise levels are typically higher. The response to noise stimulus is analogous to the response to turning on an interior light. During the daytime an illuminated bulb simply adds to the ambient light, but when eyes are conditioned to the dark of night, a suddenly illuminated bulb can be temporarily blinding.

The third factor – situational noise – is related to the interference of noise with activities of individuals. In a 60 dB(A) environment such as is commonly found in a large business office, normal conversation would be possible, while sleep might be difficult. Loud noises may easily interrupt activities that require a quiet setting for greater mental concentration or rest; however, the same loud noises may not interrupt activities requiring less mental focus or tranquility.

As shown in **Figure 2**, most individuals are exposed to fairly high noise levels from many sources on a regular basis. To perceive sounds of greatly varying pressure levels, human hearing has a non-linear sensitivity to sound pressure exposure. Doubling the sound pressure results in a three decibel change in the noise level; however, variations of three decibels [3 dB(A)] or less are commonly considered “barely perceptible” to normal human hearing. A five decibel [5 dB(A)] change is more readily noticeable. A ten-fold increase in the sound pressure level correlates to a 10 decibel [10 dB(A)] noise level increase; however, it is judged by most people as only sounding “twice as loud”.

Figure 2: Common Noise Levels



Over time, individuals tend to accept the noises that intrude into their lives on a regular basis. However, exposure to prolonged and/or extremely loud noise(s) can prevent use of exterior and interior spaces and has been theorized to pose health risks.

Local Regulations

The Clarkstown Road Solar Site is in Muncy Creek Township, PA. According to the Conditional Use Conditions for Muncy Creek Township, “Noise from the solar farm [s]hall not exceed 50 dBA, except during construction, as measured at the property line of non-participating landowners.”

According to the *Fogelman Solar Site Noise Management Plan* (dated February 20, 2024), ambient noise levels observed at a solar site located approximately half a mile north of the Clarkstown Road Solar were measured as follows:

Table 1: Measured A-Weighted Average Ambient Sound Levels (dBA)

Day	Daytime Leq Ambient Noise Levels (Filtered)	Nighttime Leq Ambient Noise Levels (Filtered)
1	51	47
2	54	47
3	53	48
Unfiltered Overall Leq	53	48
Filtered Overall Leq	53	48

It is to be noted that equipment is not anticipated to be operational during nighttime hours. Since the maximum permissible sound level limit established in the Muncy Creek Township Conditional Use Conditions is more stringent than the measured daytime ambient noise level, 50 dB(A) was used for comparison purposes.

Noise Analysis

Sound levels from the proposed Clarkstown Road Solar Site were evaluated using SoundPLAN. This program computes predicted sound levels at noise-sensitive areas through a series of adjustments to reference sound levels. SoundPLAN also accounts for topography, groundcover type, and intervening structures. Sound levels generated from string inverters are anticipated to be the main source of sound from the proposed solar photovoltaic project site.

It should be noted that noise from surrounding roadways was not modeled in this analysis although Clarkstown Road/SR 2061, Susquehanna Beltway/I-180, Muncy Exchange Road, Fogelman Road, and other roadways are anticipated to contribute to the ambient noise environment throughout the entire day. Furthermore, per the Federal Railroad Administration Crossing Inventory, approximately one (1) train pass-by event is anticipated to occur during the daytime from the LVRR rail line.

String Inverters

Photovoltaic (PV) inverter equipment can generate steady, unvarying sound that may create issues when located near noise-sensitive areas. It was assumed that two-hundred seventy-six (276) PV string inverters would be located throughout the solar site. Based on noise emission levels provided for the Chint Power Systems (CPS) SCH100/125KTL-DO/US-600 string inverter equipment, a reference sound level of 65 dB(A) at 1 meter for each string inverter was used. **Table 2** shows the

octave band emission levels for a typical string inverter used for reference. The sound from the simultaneous operation of the string inverters was calculated using SoundPLAN.

Table 2: Sound Emissions for String Inverter

Octave Band Center Frequency	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Frequency Sound Level	58	57	59	59	66	57	56	56	51

Sound generated by the string inverters is not anticipated to significantly contribute to the existing environmental sound levels surrounding the site. Also, sound generated by the string inverters is expected to be mitigated by providing offsets between the equipment and surrounding noise-sensitive land uses as well as by the physical presence of the solar arrays, which are anticipated to shield and disperse some of the sound generated by the inverters.

Transformers

Transformer equipment can also generate steady, unvarying noise that may create issues when located near noise-sensitive uses. It was assumed that twelve (12) 2,500 kVA transformers would be located throughout the proposed solar site. Based on the National Electrical Manufacturers Association (NEMA) average decibel ratings for a 2,500 kVA transformer, a reference sound level of 62 dB(A) at 1 meter for the transformers were used. **Table 3** shows the octave band emission levels for the proposed transformer. The sound from the operation of the transformers was calculated using SoundPLAN.

Table 3: Sound Emissions for a 2,500 kVA Transformer

Octave Band Center Frequency	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Frequency Sound Level	19	39	51	53	59	56	52	47	38

Sound generated by the transformers is not anticipated to significantly contribute to the existing environmental sound levels surrounding the site.

Results

The SoundPLAN-predicted maximum equivalent operational sound levels at the project property line in the northeast portion of the site are anticipated to remain near or below approximately 45 dB(A), which is below the maximum permissible sound level limit established by Muncy Creek Township Conditional Use Conditions and below the lowest average daytime ambient noise level measured at a nearby solar site; therefore, noise mitigation measures are not recommended at this time. See **Table**

4. The anticipated operational sound contours are shown in **Figure 3** and the anticipated sound levels at the closest noise-sensitive use property boundaries are shown in **Figure 4**.

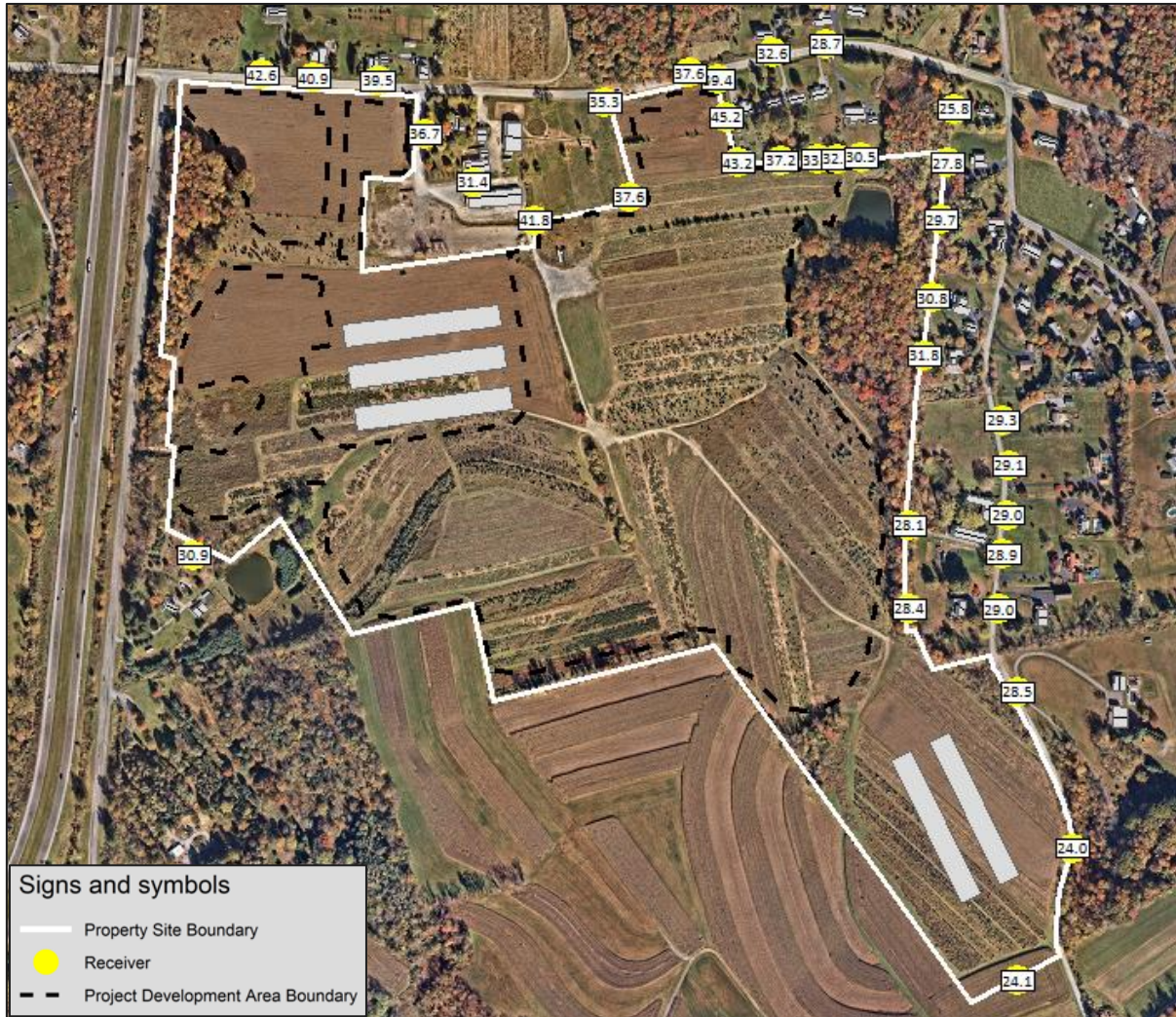
Table 4: Predicted Maximum Sound Emissions

Octave Band Center Frequency	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Maximum Octave Band SPLs from Inverters	1.0	19.2	33.4	32.0	33.7	38.3	39.6	40.2	28.0

Figure 3: Operational Sound Contours



Figure 4: Sound Levels at the Closest Noise-Sensitive Use Property Boundaries



Conclusions

The site is generally located south of Clarkstown Road/SR 2061, east of Susquehanna Beltway/I-180 and Muncy Exchange Road, and west of Fogelman Road. The solar site will be located on agricultural land with residences surrounding the project area. Additionally, Lycoming Valley Railroad Company (LVRR) railroad tracks are located approximately 1.5 miles west of the project site.

After modeling and analyzing the anticipated operational sound levels throughout the proposed solar site, it was determined that noise mitigation measures are not needed since the anticipated operational sound levels will be below the maximum permissible sound levels established by Muncy Creek Township Conditional Use Conditions and below the lowest average ambient noise levels measured at a nearby solar site at the closest noise-sensitive receptors.