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Subject: ***Project Flex Data Center – Noise Study***
Lyon Township, Oakland County, Michigan

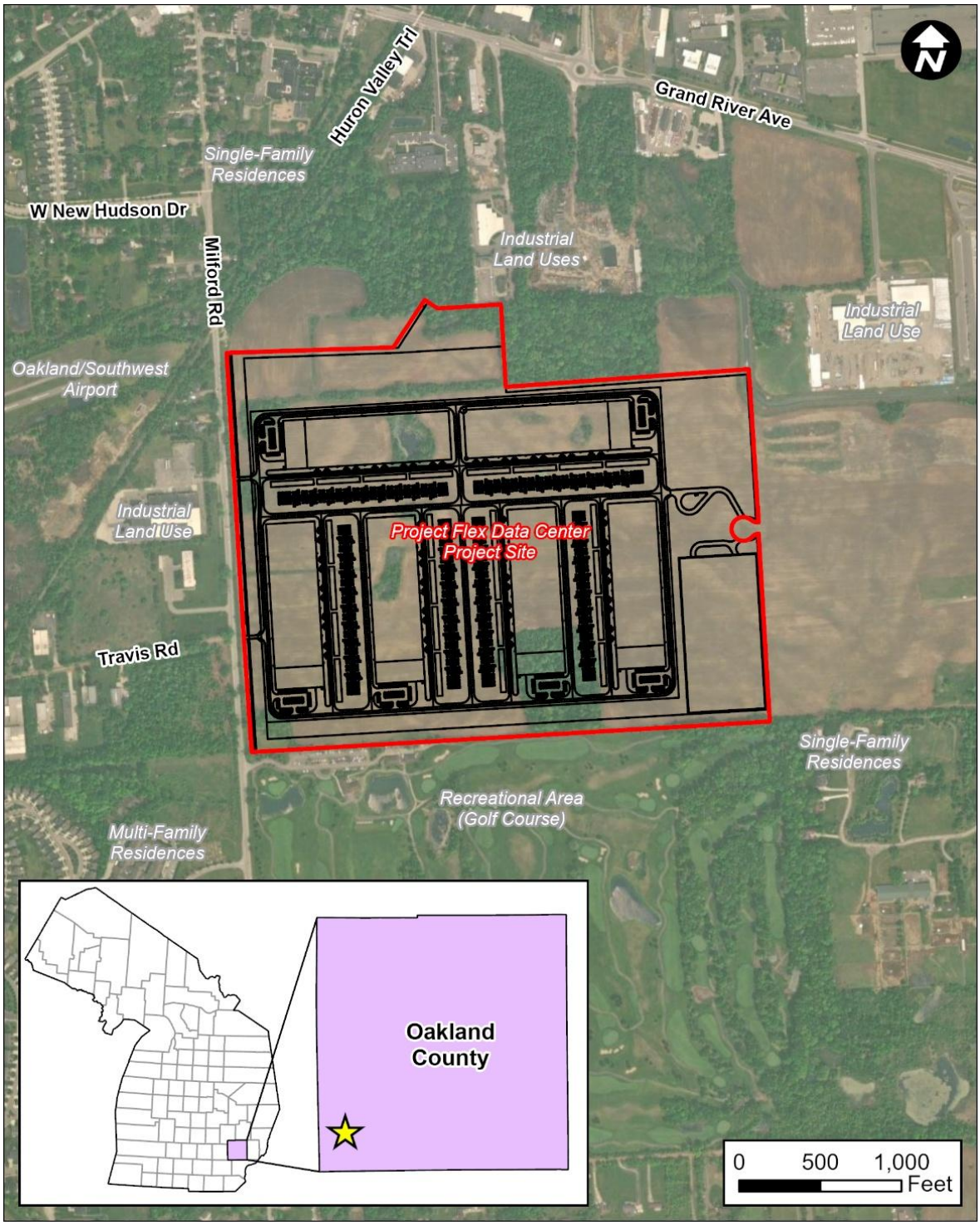
Executive Summary

The purpose of this technical memorandum is to summarize the evaluated noise levels associated with the operational equipment expected to be located at the proposed data center site in Lyon Township, Oakland County, MI. The proposed data center project site is just south of the jurisdiction of New Hudson, approximately 2 miles northeast of South Lyon, approximately 2.5 miles northwest of Novie, approximately 2.5 miles west of Wixom, and approximately 5 miles south of Milford. The site is located south of Grand River Avenue, east of Milford Road, west of South Hill Road, and north of 12 Mile Road. It should be noted that the Oakland/Southwest Airport is located directly west of the site. The proposed data center site will be located on undeveloped land, with residential land uses to the north, northwest, southwest, and southeast, with a recreational land use (i.e., a golf course) located on residentially-zoned land directly to the south, and commercial and industrial land uses surrounding the site. It should be noted that operational noise levels from the proposed data center site are anticipated to remain below the established daytime and nighttime maximum permissible noise level limits at the surrounding noise-sensitive land uses. The location of the proposed data center site is shown in **Figure 1**.

Analysis Findings

- *The proposed data center project will be located on undeveloped land, with residential land uses to the north, northwest, southwest, and southeast, and a recreational land use, which is zoned as residential, located directly south of the proposed site. Additionally, commercial and industrial land uses surround the site, and the Oakland/Southwest Airport is located directly west of the site. The Lyon Township Code of Ordinances establishes a noise level limit of 60 dB(A) during daytime hours and 50 dB(A) during nighttime hours. The primary sources of operational noise at the data center site are anticipated to be the ventilation/ chiller units at each data center building, exhaust fans for Battery Energy Storage System (BESS) units, and the transformers in the proposed substation. During typical mechanical operations, when only chillers, BESS units, and the substation are in operation, operational noise levels at the nearest noise-sensitive receptors are anticipated to remain near or below approximately 44 dB(A). Typical mechanical operational noise levels are anticipated to remain below the established maximum permissible daytime and nighttime noise level limits; therefore, noise mitigation is not recommended at this time.*

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

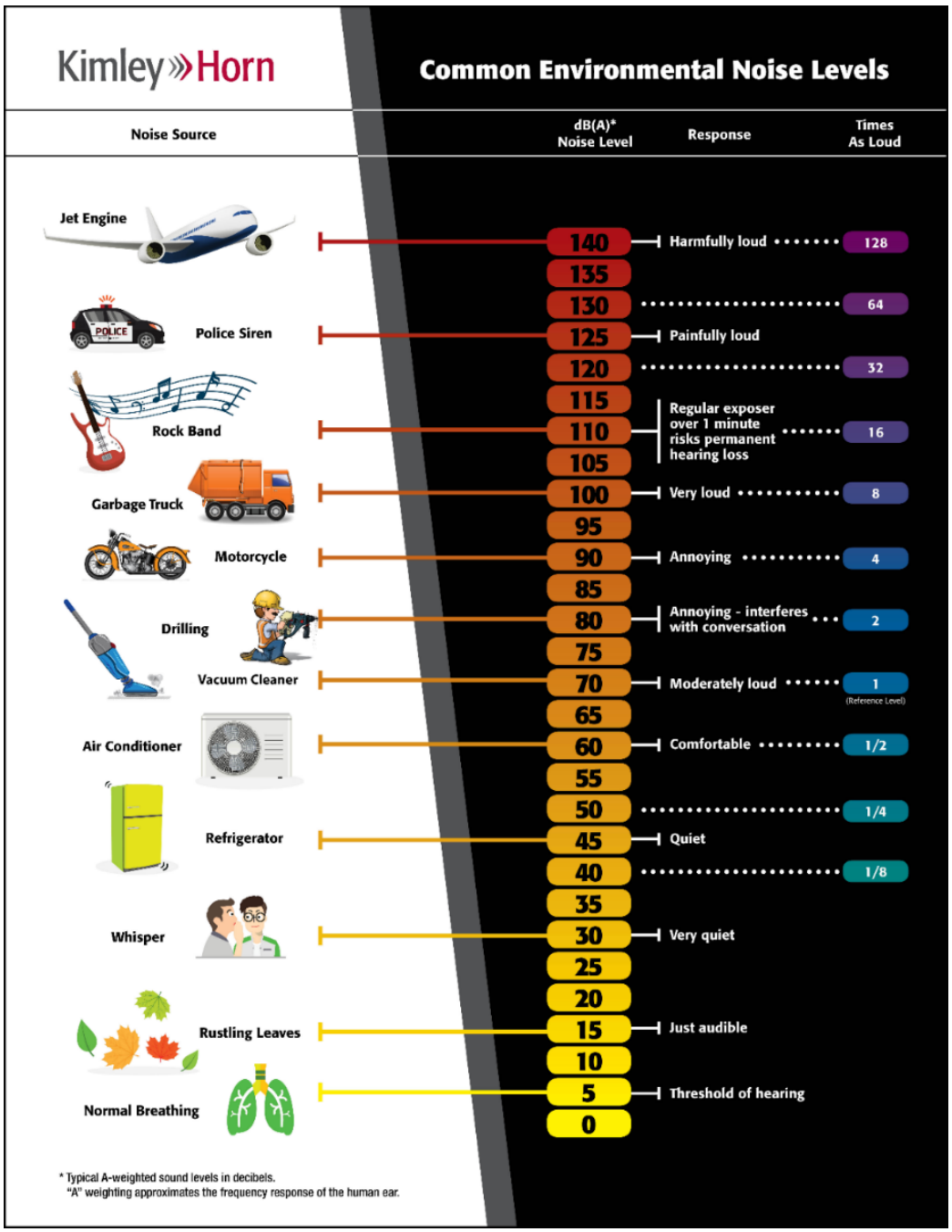
In considering the first of these factors, it is important to note that individuals have varying sensitivity to noise. Loud noises bother some people more than other people, and some individuals become increasingly upset if an unwanted noise persists. The time patterns and durations of noise(s) also 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.

Project Description

The proposed data center site will be developed on approximately 173 acres of land in Lyon Township, Oakland County, MI. The site will consist of six (6) 306,600 square-foot data center buildings. Each data center building is anticipated to have approximately forty-two (42) rooftop chillers and seventy-two (72) BESS units in each equipment yard. Additionally, one (1) substation is proposed in the southeast corner of the site. It should be noted that 10-foot-tall rooftop parapet walls and 14-foot-tall screening walls are anticipated to be located on each data center building.

Local Regulations

The Project Flex Data Center site is located in Lyon Township, Oakland County, MI. Chapter 18, Article III, Section 18-71 of the Lyon Township Code of Ordinances states that "it shall be unlawful for any person to make or continue, or cause to be made or continued, and loud, necessary or unusual noise or any noise which either annoys, disturbs, injures or endangers the comfort, repose, health, peace or safety of others in the township." Additionally, Chapter 48, Article 20.00, Section 20.02 of the Lyon Township Code of Ordinances states that "no person shall unreasonably make, continue, or cause to be made or continued, and disturbance." This section also states that "no person shall operate or cause to be operated, any source of sound at any location of all the creation of any noise on property owned, leased, occupied, or otherwise controlled by such person which causes the sound level when measured on any other property to exceed" the values in the following table.

Sound Level Limits by Receiving Land Use/District

Table A: Maximum Permitted Average A-Weighted Sound Levels		
Zoning District	**Time**	**Level, dB(A)**
Residential	7:00 a.m. to 10:00 p.m.	60
	10:00 p.m. to 7:00 a.m.	50
Commercial	7:00 a.m. to 10:00 p.m.	65
	10:00 p.m. to 7:00 a.m.	60
Industrial	Anytime	70

It should be noted that only noise contributions from typical data center operations, when the substation, BESS cabinets, and chillers are in operation, are anticipated to be required to meet these noise level limits.

Noise Analysis

Operational sound levels from the proposed Project Flex Data Center 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 chillers and BESS cabinets are anticipated to be the main sources of sound from the proposed data center buildings.

It should also be noted that noise from surrounding roadways was not included in this analysis, although Grand River Avenue, Milford Road, South Hill Road, 12 Mile Road, and other nearby roadways as well as adjacent industrial and commercial land uses and the Oakland/Southwest Airport are anticipated to contribute to the ambient noise environment throughout the entire day but were not modeled in this analysis.

Chillers

Chiller equipment can generate steady, unvarying sound that may create issues when located near noise-sensitive areas. According to the current site layout, forty-two (42) York YVFAM1650 chillers would be located on the roof of each data center building, totaling two hundred fifty-two (252) chillers. Based on the noise emission data provided for the York YVFAM1650 chiller equipment operating at 100% load, a reference sound power level of 94.5 dB(A) was used for the chillers during all operational scenarios.

Sound generated by the chillers is expected to be partially mitigated by the roof edge of the data center building, the proposed rooftop parapet walls, the proposed rooftop screening walls, and by providing sufficient offsets between the chillers and surrounding noise-sensitive land uses as well as by the positioning of the data center buildings, which are anticipated to shield and disperse some of the sound emitted by the chillers.

Battery Storage Cabinets

Battery storage cabinets contain exhaust fans which can also generate steady, unvarying sound that may create issues when located near noise-sensitive areas. According to the current site layout, seventy-two (72) battery storage cabinets would be located in the mechanical equipment yard for each data center building, totaling four hundred thirty-two (432) battery storage cabinets. Based on noise emission information for typical battery storage cabinet exhaust fans, a reference sound power level of 84 dB(A) was used for the exhaust fan for each battery storage cabinet. The sound from the simultaneous operation of the battery storage cabinets was calculated at the closest noise-sensitive receptors near the proposed battery storage cabinets using SoundPLAN.

Sound generated by the battery storage cabinets is expected to be partially mitigated by providing sufficient offsets between the battery storage cabinets and surrounding noise-sensitive land uses as well as by the physical presence of the data center buildings, which are anticipated to shield and disperse some of the sound emitted by the battery storage cabinets.

Substation/Transformers

Substations and their associated transformers can also generate steady, unvarying noise that may create issues when located near noise-sensitive uses. It was assumed that the one (1) substation would be located in the southeast corner of the site. Based on typical substation noise emissions, a reference sound pressure level for a transformer of 75 dB(A) at 1 meter (i.e., 3 feet) was used.

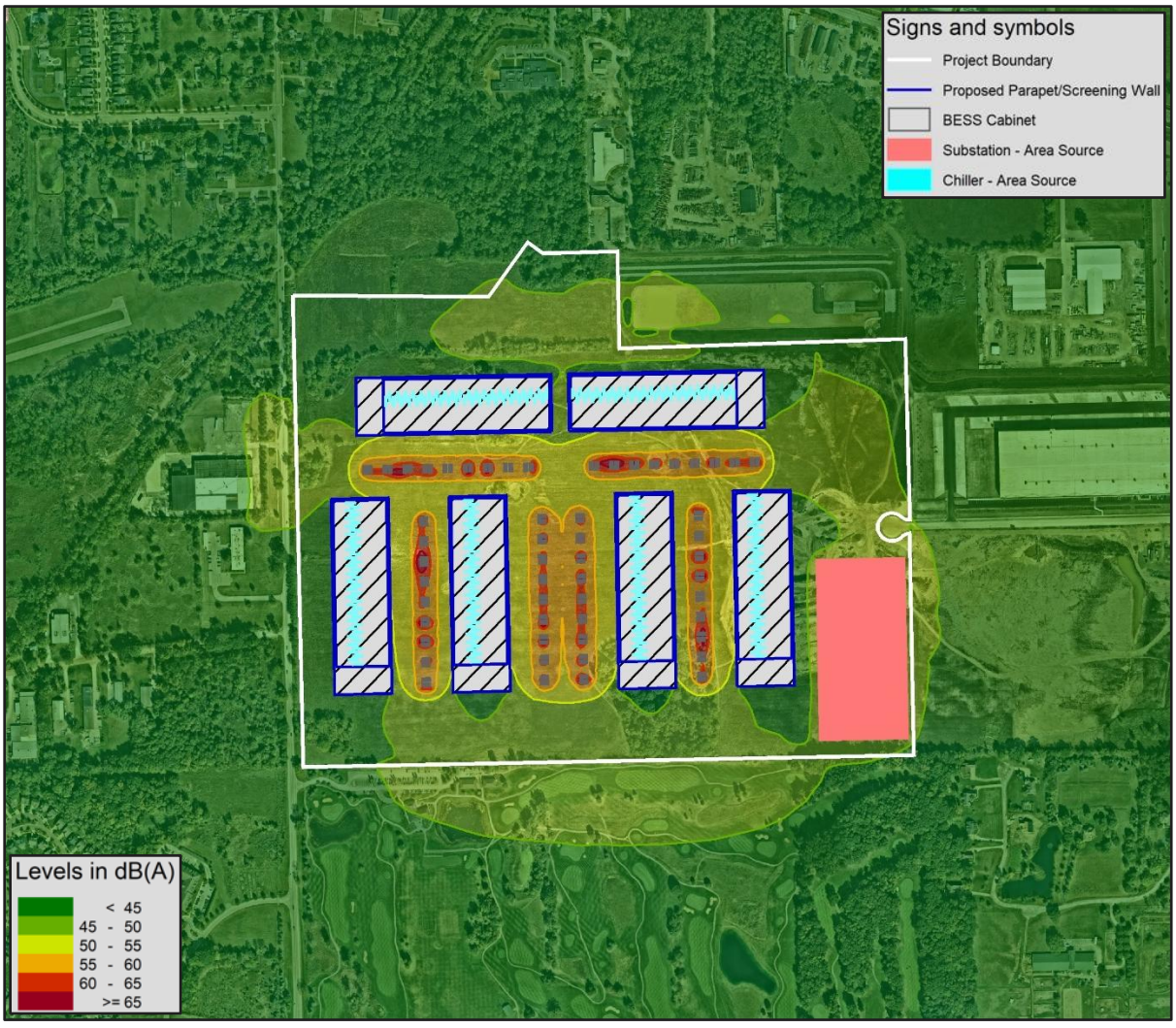
Noise generated from the substation is not anticipated to significantly contribute to the operational project noise and is expected to be kept under the noise limits by the distance provided to noise-sensitive receptors.

Results

The SoundPLAN-predicted maximum unmitigated equivalent operational sound levels when only chillers, BESS cabinets, and the substation are operating, are anticipated to remain near or below approximately 44 dB(A) at the nearest noise-sensitive land uses around the site. The typical mechanical operational noise levels are anticipated to remain below the daytime and nighttime noise level limits established in the Lyon Township Code of Ordinances. Therefore, noise mitigation measures are not recommended at this time.

The anticipated operational noise contours when chillers, BESS cabinets, and the substation are in operation are shown in **Figure 3**.

Figure 3: Anticipated Operational Noise Contours During Typical Mechanical Operations



Conclusions

The proposed data center site is located south of Grand River Avenue, east of Milford Road, west of South Hill Road, and north of 12 Mile Road. It should be noted that the Oakland/Southwest Airport is located directly west of the site. The proposed data center site will be located on currently undeveloped land, with residential land uses to the north, northwest, southwest, and southeast, with a recreational land use (i.e., a golf course) located on residentially-zoned land directly south, and commercial and industrial land uses surrounding the site

In accordance with the Lyon Township Code of Ordinances, a maximum operational noise level of 60 dB(A) was established for the daytime period and 50 dB(A) for the nighttime period at nearby noise-sensitive land uses.

After modeling and analyzing the anticipated operational noise levels using SoundPLAN, it was determined that maximum operational noise levels from typical mechanical operations are anticipated to remain near or below approximately 44 dB(A); therefore, noise abatement is not recommended at this time.