July 1, 2025

Project Cardinal - Design Team
Pioneer Development

Re: Project Cardinal Preliminary Sound Study

Burns & McDonnell was retained by Pioneer Development ("Pioneer") to conduct a preliminary sound study (the "Study") for the proposed Project Cardinal Data Center Development (the "Project"). The objective of the Study was to estimate future noise impacts from operational equipment at the Project's property boundaries.

The Project is proposed to be located in Yorkville, Illinois. The current site plan is presented in Figure 1 and includes fourteen (14) two-story data center buildings. The design includes eleven (11) large (~680,600 square foot) buildings and three (3) smaller (~390,000 square foot) buildings. The large buildings were modeled with 108 rooftop chillers and 80 auxiliary generators at ground level. The smaller buildings include 54 rooftop chillers and 40 auxiliary generators. The buildings, barriers, layout, and equipment counts were provided by Pioneer for the current design. However, this design is preliminary and would likely evolve throughout the detailed design stages of the Project. This analysis included predictive modeling to estimate Project-generated sound levels in the surrounding community for two operational scenarios. A comparison to the local sound level limits was performed at the Project boundaries. Sound level impacts at the nearest noise sensitive receptors would be expected to be lower as Project-generated sound would attenuate as it moves offsite.

Acoustic Terminology

The term "sound level" is often used to describe two different sound characteristics: sound power and sound pressure. Every source that produces sound has a sound power level (PWL). The PWL is the acoustical energy emitted by a sound source and is an absolute number that is not affected by the surrounding environment. The acoustical energy produced by a source propagates through media as pressure fluctuations. These pressure fluctuations, also called sound pressure levels (SPL), are what human ears hear and microphones measure.

Sound is physically characterized by amplitude and frequency. The amplitude of sound is measured in decibels (dB) as the logarithmic ratio of a sound pressure to a reference sound pressure (20 micropascals). The reference sound pressure corresponds to the typical threshold of human hearing. To the average listener, a 3-dB change in a continuous broadband sound is generally considered "just barely perceptible"; a 5-dB change is generally considered "clearly noticeable"; and a 10-dB change is generally considered a doubling (or halving, if the sound is decreasing) of the apparent loudness.

Sound waves can occur at many different wavelengths, also known as the frequency. Frequency is measured in hertz (Hz) and is the number of wave cycles per second that occur. The typical human ear can hear frequencies ranging from approximately 20 to 20,000 Hz. Normally, the human ear is most sensitive to sounds in the middle frequencies (1,000 to 8,000 Hz) and is less sensitive to sounds in the lower and higher frequencies. As such, the A-weighting scale was developed to simulate the frequency response of the human ear to sounds at typical environmental levels. The A-weighting scale emphasizes sounds in the middle frequencies and de-emphasizes sounds in the low and high frequencies. Any sound level to which the A-weighting scale has been applied is expressed in A-weighted decibels, or dBA.

Sound in the environment is constantly fluctuating, as when a car drives by, a dog barks, or a plane passes overhead. Therefore, sound metrics have been developed to quantify fluctuating environmental sound levels. These metrics include the exceedance sound level. The exceedance sound level is the sound level exceeded during "x" percent of the sampling period and is also referred to as a statistical sound level. Common exceedance sound level values are the 10-, 50-,90-percentile exceedance sound levels, denoted by L_{10}, L_{50}, and L_{90}. The equivalent-continuous sound level (L_{eq}) is the logarithmic average (i.e., energy average) of the varying sound over a given time period and is the most common metric used to describe sound. The L_{90} is typically considered the "background" sound level since it excludes many short, intermittent sounds and captures the sound levels experienced most of the time (i.e., sound levels 90 percent of the time).

City of Yorkville Noise Ordinance

The Code of Ordinances of Yorkville, Illinois Title IV, Chapter 4 limits noise levels from the Project. The ordinance states, "No person shall operate or cause to be operated any source of sound in such a manner as to create a sound level which exceeds the sound level limits in table 1 of this section, as adjusted according to table 2 of this section." Table 1 is reproduced below.

Table 1: Sound Level Limits

Time of Day	Receiving Property Land Use		
	Residential	Commercial	Public Parks and Other Public Open Spaces
Daytime (7:00 a.m. - 10:00 p.m.)	60 dBA	67 dBA	67 dBA
Nighttime (10:00 p.m. - 7:00 a.m.)	50 dBA	67 dBA	67 dBA

Table 2 of the ordinance provides adjustments for varying durations of noise within a given hour as well as penalties to apply for noise of an impulsive character or tonal. The specific equipment manufacturers and models for the Project have not been selected at this time. The type of equipment that generates noise as part of the Project (chillers and emergency generators) does not operate in an impulsive manner and the equipment can be specified and procured to not emit prominent discrete tones or tonal noise. Provided the developer of the Project selects non-tonal equipment for operations, the continuous noise generated by the Project would be limited to 60 dBA during the day and 50 dBA during the night at residential receptors. The City of Yorkville ordinance includes an exemption for "emergency short term operations." The City of Yorkville has confirmed that the operation of the emergency generators during a full blackout would be exempt from the noise limits according to the exemption.

Design goals have been developed for the Project boundary based on the City of Yorkville ordinance. For normal operation, which could generate noise at any time of the day, the design goal is 50 dBA at the receiving residential property boundaries to meet the nighttime sound level limits. For generator testing, which occurs during daytime hours, the design goal is 60 dBA to meet daytime limits when maintenance generator testing would occur.

Ambient Measurements

Variations in noise environments are typically due to existing land uses, population density, and proximity to transportation corridors. Elevated existing ambient sound levels in the region occur near major transportation corridors such as interstate highways and in areas with higher population densities. Principal contributors to the existing noise environment likely include motor vehicle traffic on local roadways, typical agricultural noise sources, and natural sounds such as birds, insects, and leaf or vegetation rustle during elevated wind conditions. Diurnal effects result in sound levels that are typically quieter during the night than during the daytime, except during periods when evening and nighttime insect noise dominates in warmer seasons.

Burns & McDonnell personnel conducted sound level measurements to establish the existing background sound levels in the area surrounding the Project site. Sound levels were measured using Larson Davis Model 821 sound level meters with associated preamplifiers and ½-inch free-field precision microphones meeting ANSI S1.4 Type 1 specifications. One-half inch random-incidence microphones were used on the meters. All measurement and field calibration equipment were certified by a traceable laboratory within 12 months prior to the measurement. Field calibration confirmations were performed before and after the long-term measurements and before and after each set of short-term measurements. The meter and calibrator were checked within a year prior of the measurements to verify compliance with the U.S. National Institute of Standards and Technology specifications. The calibration drift was within tolerance over the duration of the measurement survey.

The survey was undertaken continuously from June 17 to 18, 2025, during daytime and nighttime hours. Weather data was reviewed from a nearby weather station (Weather Station ID: KILYORKV81). Average wind speeds were within industry guidance and the only recorded precipitation recorded during the measurement period was at the very end of the measurement at 1:00 p.m. on June 18th. Continuous sound level measurements were collected at the boundaries of the proposed Project in the four cardinal directions. The measurement locations are provided in Figure 2 of Attachment 1. A summary of the ambient measurements is provided in Table 2 below and hourly average sound levels are provided in Attachment 2.

Table 2: Continuous Sound Leve Monitoring Summary

Measurement Location	Time of Day	L_{eq} (dBA)	L_{90} (dBA)
MP1	Daytime	69	52
	Nighttime	67	40
MP2	Daytime	61	44
	Nighttime	59	39
MP3	Daytime	69	48
	Nighttime	67	40
MP4	Daytime	59	37
	Nighttime	57	37

Sound levels in the Project area were variable; the major noise sources across the Project area included local traffic (passenger cars and large trucks) and typical sounds of nature (insects and bird calls). Transient noise levels were greater along local traffic thorough fairs (Highway 47 and Galena Road). Sound levels are provided in both L_{eq} and L_{90} to represent the background ambient sound levels for the Project. The L_{90} sound levels exclude the majority of the instantaneous and intermittent noise from occasional traffic. L_{90} is generally used to represent the typical background noise for a given area.

Sound Modeling Methodology

Sound modeling was performed using the industry-accepted sound modeling software Computer Aided Noise Abatement (CadnaA), version 2025. The software is a scaled, three-dimensional program that takes into account air absorption, terrain, ground absorption, reflections and shielding for each piece of sound-emitting equipment and predicts sound pressure levels. The model calculates sound propagation based on International Organization of Standardization (ISO) 9613-2:2024, General Method of Calculation. ISO 9613-2 assesses the sound level propagation based on the octave band center-frequency range.

The ISO standard considers sound propagation and directivity. The software calculates sound propagation using omnidirectional, downwind sound propagation and worst-case directivity factors. In other words, the model assumes that each piece of equipment propagates its worst-case sound levels in all directions at all times. Empirical studies accepted within the industry have demonstrated that modeling may over-predict sound levels in certain directions, and as a result, modeling results generally are considered a conservative measure of a project's actual sound level. The modeled atmospheric conditions were assumed to be calm, and the temperature and relative humidity were left at the program's default values. Reflections and shielding were considered for sound waves encountering physical structures.

Project Sound Sources

The sound level design goal is applicable at the Project property line and the most impacted locations were identified surrounding the Project. Project sound sources were modeled in the locations shown in Figure 1 of Attachment 1. A summary of the modeling assumptions for each piece of equipment is provided in Table 3. Each chiller was estimated to have an overall sound power level of 91 dBA. This would likely be a low-noise option, or a model which may include mitigation in detailed design. Each emergency generator was estimated to have an overall sound power level of 105 dBA (sound pressure level of 65 dBA at 50 feet). The generators were modeled inclusive of both the generator enclosure and exhaust stack. Substation transformers have not yet been coordinated with the utility and can be updated in the model once information is received.

Table 3: Predictive Modeling Sound Level Inputs

Source	Number of Sources	Modeled Equipment Sound Level Assumption[a]
Chillers (Low-Noise)	1,350	L_w = 91 dBA
Emergency Generators	1,000	L_p = 65 dBA at 50 feet

(a) L_w = sound power level; L_p = sound pressure level; dBA = A-weighted decibels

Operational Scenario Assumptions

The model was evaluated for two operational scenarios: Normal Operation and Generator Testing. Normal Operation represents the condition where all campus chillers are at 100% load without the use of generators. Generator Testing represents the condition where all campus chillers are at 100% load and two generators per data center building are being tested at 100% load. Emergency operations would represent a condition during an emergency situation where all equipment is operation and running at 100% load. The emergency operation scenario was not modeled because it is not considered "normal conditions" and the City of Yorkville confirmed the emergency scenario is exempt from the limits. A summary of each modeled scenario is provided in Table 4.

Table 4: Summary of Operating Scenarios

Operating Scenario	Normal Operation	Generator Testing	Emergency Operation
Design Goal	50 dBA at property lines	60 dBA at property lines	--
Equipment in Operation for Each Scenario			
Chiller	All On at 100% Load	All On at 100% Load	All On at 100% Load
Generators	All Off	2 per Building at 100% Load	All On at 100% Load

Sound Modeling Results

The Project equipment was modeled using the provided sound level assumptions for Normal Operation and Generator Testing scenarios. A tabulated summary of the most impacted property line location is provided in Table 5.

Table 5: Modeled Project Sound Levels at Property Lines

Receiver	Modeled Sound Level (dBA)	
	Normal Operation	Generator Testing
Boundary NW	47	48
Boundary NE	50	50
Boundary E	49	49
Boundary SE	50	50
Boundary SW	49	49
Boundary NW	48	48

The most impacted property line receivers were modeled to be below the design goals during Normal Operation and Generator Testing. Sound level contours were generated for the two operating scenarios, in 5-dBA increments, at a height 5 feet above grade as shown in Figure 3 and Figure 4 of Attachment 1.

Conclusion

Burns & McDonnell provided an acoustic analysis for the proposed Project Cardinal data center based on representative equipment sound levels and the site plan provided. The modeling results show that the Project design can feasibly meet the City of Yorkville sound level limits through the use of low-noise chillers.

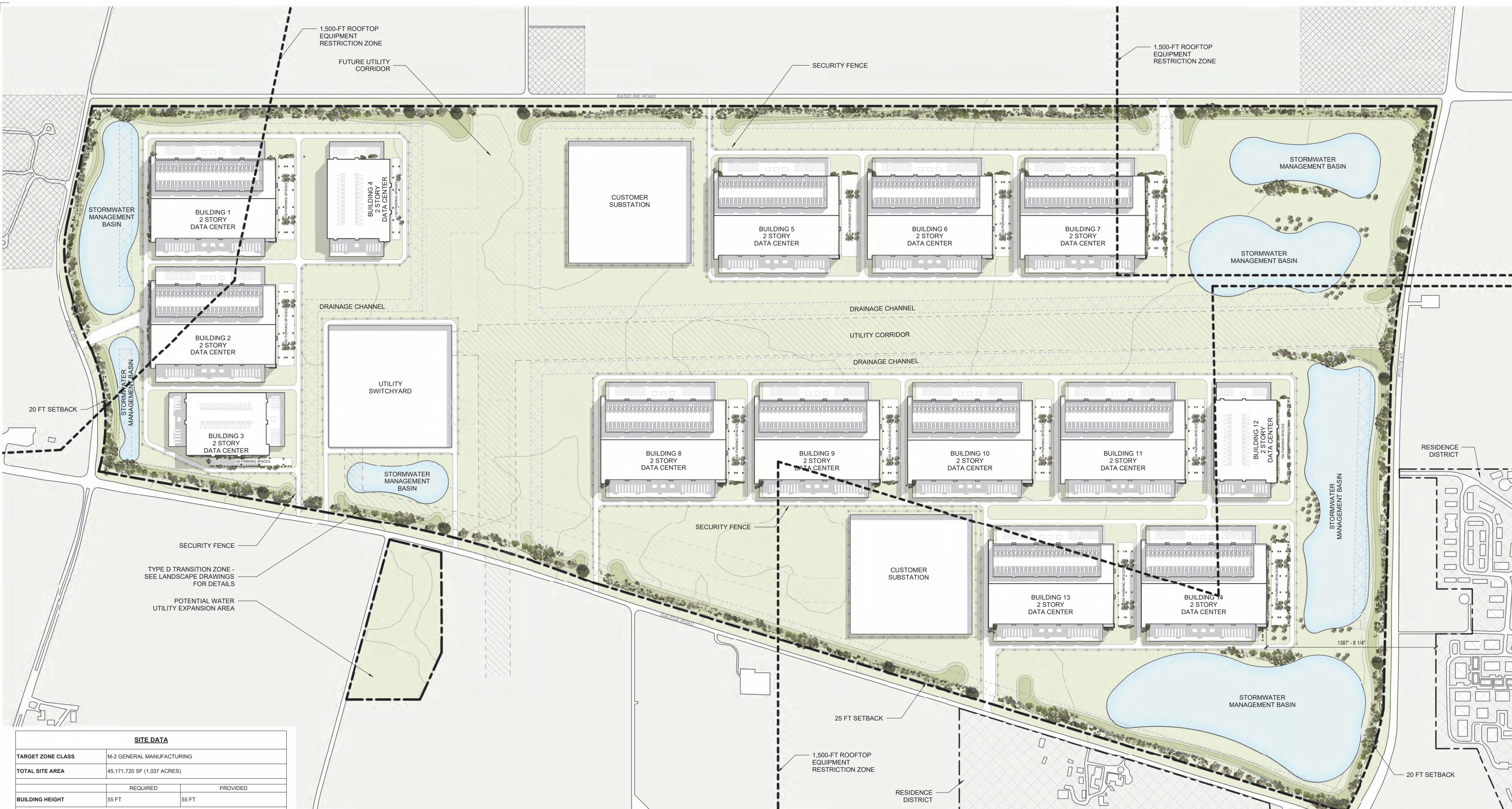
Sincerely,

Burns & McDonnell

Gabriel Weger
Section Manager – Acoustics

Attachments
- Attachment 1 – Figures
- Attachment 2 – Measurement Data

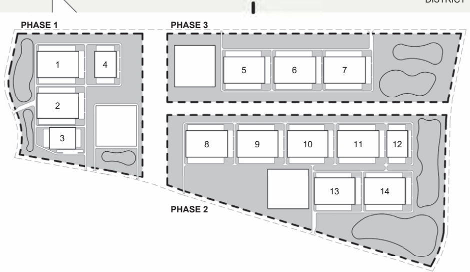
Attachment 1 – Figures



SITE DATA		
TARGET ZONE CLASS	M-2 GENERAL MANUFACTURING	
TOTAL SITE AREA	45,171,720 SF (1,037 ACRES)	
	REQUIRED	PROVIDED
BUILDING HEIGHT	55 FT	55 FT
SETBACKS		
FRONT	25 FT	25 FT
SIDE	MIN. 10% OF LOT DEPTH, MAX. 20FT	20 FT
REAR	0 FT	0 FT
*SETBACKS APPLY ONLY TO THE PERIMETER OF THE PROPERTY. IN THE EVENT THAT THE PROPERTY IS RESUBDIVIDED, THERE SHALL BE NO SETBACKS APPLICABLE TO INTERNAL LOT LINES.		
PARKING		
DATA CENTER PARKING RATIO	0.3 SPACES PER 1,000 SF	
	REQUIRED	PROVIDED
PARKING SPACES	5,194	3,750
ACCESSIBLE PARKING SPACES	114	92
COVERAGE		
MINIMUM LOT SIZE	N/A	N/A
MAXIMUM LOT COVERAGE	85% (38,395,962 SF)	41% (18,552,808 SF)
MAXIMUM F.A.R.	N/A	N/A

BUILDING AREAS

PHASE	BUILDING NUMBER	FOOTPRINT AREA	TOTAL FLOOR AREA	HEIGHT (TOP OF BUILDING)	HEIGHT (TOP OF EQUIPMENT)
P1	BUILDING 1	680,600 SF	1,361,182 SF	55 FT	78 FT
P1	BUILDING 2	680,591 SF	1,361,182 SF	55 FT	78 FT
P1	BUILDING 3	390,000 SF	780,000 SF	55 FT	78 FT
P1	BUILDING 4	390,000 SF	780,000 SF	55 FT	78 FT
P3	BUILDING 5	680,591 SF	1,361,182 SF	55 FT	78 FT
P3	BUILDING 6	680,591 SF	1,361,182 SF	55 FT	78 FT
P3	BUILDING 7	680,591 SF	1,361,182 SF	55 FT	78 FT
P2	BUILDING 8	680,591 SF	1,361,182 SF	55 FT	78 FT
P2	BUILDING 9	680,591 SF	1,361,182 SF	55 FT	78 FT
P2	BUILDING 10	680,591 SF	1,361,182 SF	55 FT	78 FT
P2	BUILDING 11	680,591 SF	1,361,182 SF	55 FT	78 FT
P2	BUILDING 12	390,000 SF	780,000 SF	55 FT	78 FT
P2	BUILDING 13	680,591 SF	1,361,182 SF	55 FT	78 FT
P2	BUILDING 14	680,591 SF	1,361,182 SF	55 FT	78 FT
	TOTAL	8,656,501 SF	17,313,002 SF	N/A	N/A



PROJECT CARDINAL

A-1

PIONEER DEVELOPMENT

FIGURE 1 - SITE PLAN

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MH Margulies Hoelzli Architecture

LEGEND

- Project Area
- Project Structures
- Measurement Points
- Barriers

REFERENCE

0 0.15 0.3
MILES

0 0.15 0.3
KILOMETERS

N

Figure 2
Monitoring Locations

LOCATION:	Yorkville, Illinois
PROJECT:	Pioneer Development - Project Cardinal
PROJ. NO.:	182671
CREATED:	06/27/2025

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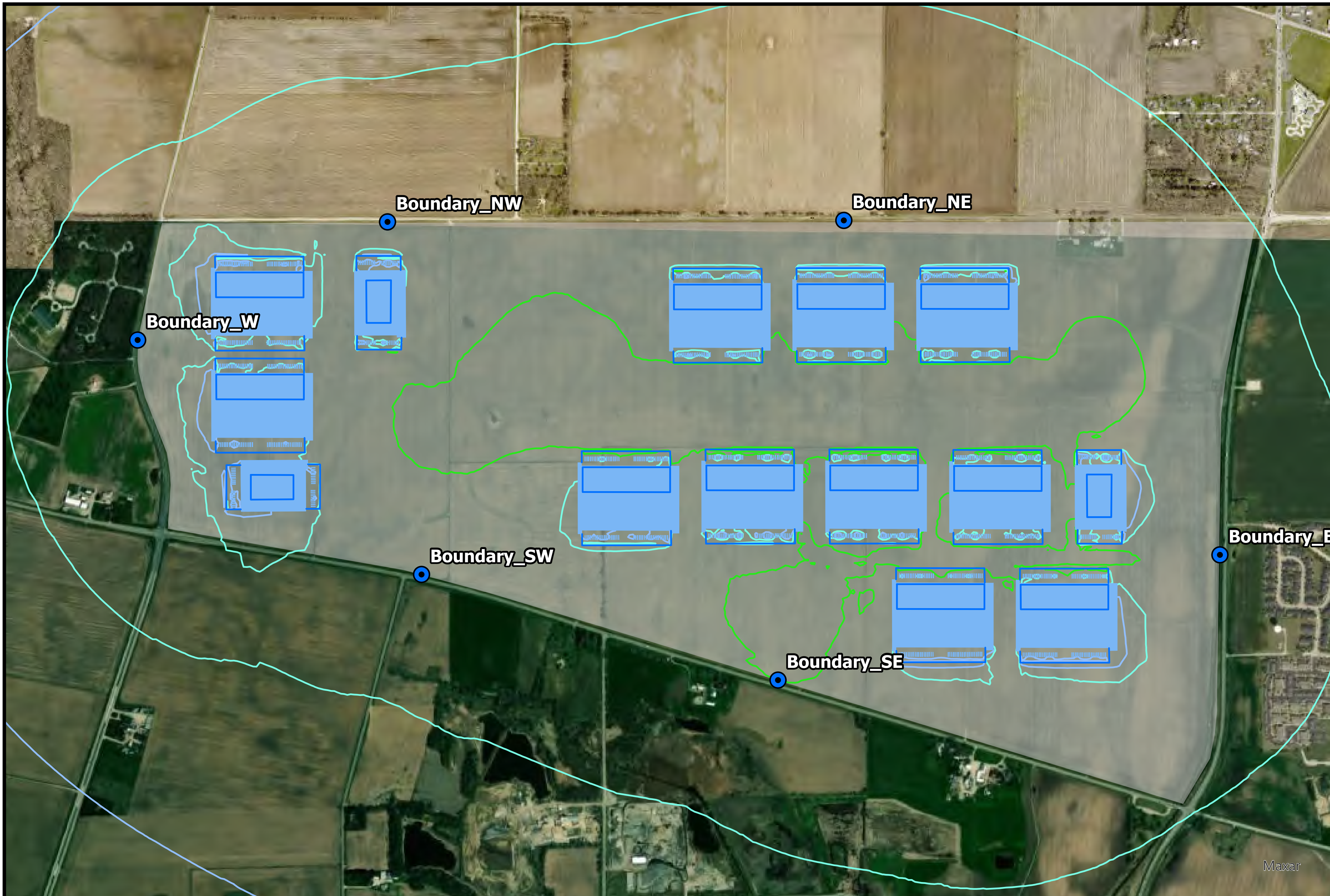
Path: G:\Projects\Air-Noise Dept\Project Files\PioneerDevel\182671_Cardinal-Rezone\GIS\Figures\Figures.aprx • Coordinate System: • Units:



LEGEND

- Project Area
- Project Structures
- Barriers
- 40 dBA
- 45 dBA
- 50 dBA
- 55 dBA
- 60 dBA
- 65 dBA
- NSA Receptors

REFERENCE

0 0.15 0.3
MILES

0 0.15 0.3
KILOMETERS

N

Figure 3
Operational Sound Level Contours (dBA)

LOCATION: Yorkville, Illinois
PROJECT: Pioneer Development - Project Cardinal
PROJ. NO.: 182671
CREATED: 07/01/2025

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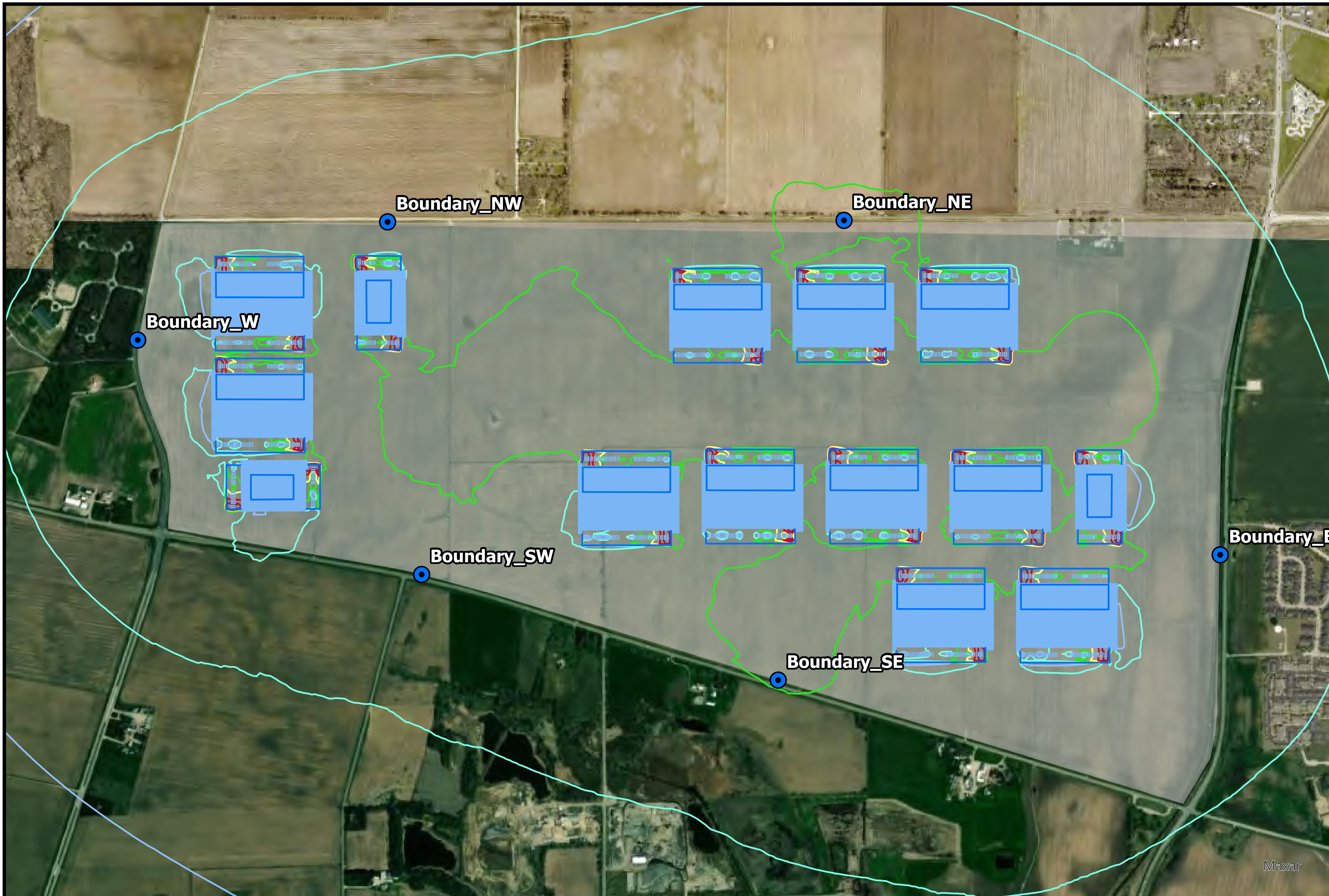
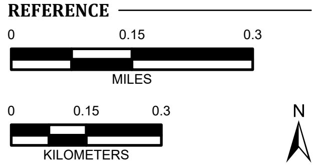


LEGEND

- Project Area
- Project Structures
- Barriers
- 40 dBA
- 45 dBA
- 50 dBA
- 55 dBA
- 60 dBA
- 65 dBA
- NSA Receptors

REFERENCE



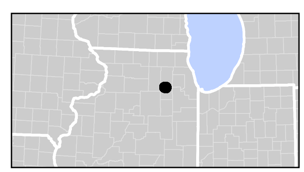


Figure 4
Maintenance Sound Level Contours (dBA)

LOCATION:	Yorkville, Illinois
PROJECT:	Pioneer Development - Project Cardinal
PROJ. NO.:	182671
CREATED:	07/01/2025

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Attachment 2 – Measurement Data

Table 1 - Hourly Average Sound Levels - MP01

Time	MP01 [dBA]			
	Leq	L10	L50	L90
6/17/25 11:00 AM	70	73	65	54
6/17/25 12:00 PM	69	73	65	55
6/17/25 1:00 PM	69	73	65	53
6/17/25 2:00 PM	68	72	65	50
6/17/25 3:00 PM	69	72	65	54
6/17/25 4:00 PM	69	71	65	55
6/17/25 5:00 PM	68	71	65	54
6/17/25 6:00 PM	67	71	65	52
6/17/25 7:00 PM	66	69	61	48
6/17/25 8:00 PM	65	68	59	47
6/17/25 9:00 PM	67	68	58	46
6/17/25 10:00 PM	66	71	58	45
6/17/25 11:00 PM	64	66	48	38
6/18/25 12:00 AM	63	63	45	35
6/18/25 1:00 AM	60	60	40	32
6/18/25 2:00 AM	63	62	43	33
6/18/25 3:00 AM	66	66	49	40
6/18/25 4:00 AM	66	69	53	42
6/18/25 5:00 AM	70	73	63	48
6/18/25 6:00 AM	70	74	66	51
6/18/25 7:00 AM	70	73	66	52
6/18/25 8:00 AM	69	73	65	52
6/18/25 9:00 AM	70	74	65	53
6/18/25 10:00 AM	70	74	65	50
6/18/25 11:00 AM	71	75	67	54
6/18/25 12:00 PM	70	73	65	51
6/18/25 1:00 PM	65	76	69	56
Average Daytime:	69	72	64	52
Average Nighttime:	67	67	52	40

**Note: The average Leq daytime and nighttime sound levels shown are the logarithmic energy average of the 1-hour sound levels measured. The L10, L50, and L90 are the arithmetic averages of the 1-hour values*

Table 2 - Hourly Average Sound Levels - MP02

Time	MP02 [dBA]			
	Leq	L10	L50	L90
6/17/25 12:00 PM	61	73	55	47
6/17/25 1:00 PM	61	73	54	46
6/17/25 2:00 PM	62	73	53	44
6/17/25 3:00 PM	60	72	53	45
6/17/25 4:00 PM	59	72	55	45
6/17/25 5:00 PM	59	71	54	43
6/17/25 6:00 PM	58	71	52	39
6/17/25 7:00 PM	65	71	49	37
6/17/25 8:00 PM	57	69	50	39
6/17/25 9:00 PM	60	68	52	42
6/17/25 10:00 PM	60	68	51	41
6/17/25 11:00 PM	56	71	48	38
6/18/25 12:00 AM	54	66	41	36
6/18/25 1:00 AM	53	63	39	35
6/18/25 2:00 AM	54	60	41	35
6/18/25 3:00 AM	57	62	44	39
6/18/25 4:00 AM	60	66	48	42
6/18/25 5:00 AM	62	69	54	45
6/18/25 6:00 AM	61	73	54	44
6/18/25 7:00 AM	61	74	53	44
6/18/25 8:00 AM	61	73	54	44
6/18/25 9:00 AM	60	73	53	44
6/18/25 10:00 AM	61	74	53	43
6/18/25 11:00 AM	62	74	56	47
6/18/25 12:00 PM	60	75	53	41
6/18/25 1:00 PM	61	73	59	54
Average Daytime:	61	72	53	44
Average Nighttime:	59	66	46	39

**Note: The average Leq daytime and nighttime sound levels shown are the logarithmic energy average of the 1-hour sound levels measured. The L10, L50, and L90 are the arithmetic averages of the 1-hour values*

Table 3 - Hourly Average Sound Levels - MP03

Time	MP03 [dBA]			
	Leq	L10	L50	L90
6/17/25 12:00 PM	68	72	56	43
6/17/25 1:00 PM	68	72	56	44
6/17/25 2:00 PM	69	73	60	46
6/17/25 3:00 PM	70	74	66	51
6/17/25 4:00 PM	70	74	67	54
6/17/25 5:00 PM	71	74	66	53
6/17/25 6:00 PM	68	73	61	49
6/17/25 7:00 PM	67	72	57	46
6/17/25 8:00 PM	66	71	56	45
6/17/25 9:00 PM	66	70	56	42
6/17/25 10:00 PM	67	71	58	45
6/17/25 11:00 PM	64	66	50	42
6/18/25 12:00 AM	61	61	44	35
6/18/25 1:00 AM	61	59	41	35
6/18/25 2:00 AM	64	58	41	33
6/18/25 3:00 AM	61	60	44	37
6/18/25 4:00 AM	68	72	55	43
6/18/25 5:00 AM	71	75	61	49
6/18/25 6:00 AM	71	76	63	50
6/18/25 7:00 AM	71	75	63	50
6/18/25 8:00 AM	70	75	62	47
6/18/25 9:00 AM	69	74	58	46
6/18/25 10:00 AM	69	73	56	44
6/18/25 11:00 AM	71	75	61	48
6/18/25 12:00 PM	70	74	61	46
6/18/25 1:00 PM	72	78	65	56
Average Daytime:	69	73	60	48
Average Nighttime:	67	65	49	40

**Note: The average Leq daytime and nighttime sound levels shown are the logarithmic energy average of the 1-hour sound levels measured. The L10, L50, and L90 are the arithmetic averages of the 1-hour values*

Table 4 - Hourly Average Sound Levels - MP04

Time	MP04 [dBA]			
	Leq	L10	L50	L90
6/17/25 12:16 PM	57	59	47	39
6/17/25 1:00 PM	56	59	45	38
6/17/25 2:00 PM	55	60	44	37
6/17/25 3:00 PM	57	61	44	36
6/17/25 4:00 PM	56	61	43	36
6/17/25 5:00 PM	57	62	42	35
6/17/25 6:00 PM	56	61	41	33
6/17/25 7:00 PM	55	59	42	34
6/17/25 8:00 PM	55	60	45	33
6/17/25 9:00 PM	59	64	45	37
6/17/25 10:00 PM	63	69	46	38
6/17/25 11:00 PM	52	53	44	38
6/18/25 12:00 AM	50	50	38	33
6/18/25 1:00 AM	51	49	37	33
6/18/25 2:00 AM	55	46	40	35
6/18/25 3:00 AM	50	48	40	35
6/18/25 4:00 AM	55	56	43	39
6/18/25 5:00 AM	59	63	48	42
6/18/25 6:00 AM	60	64	48	41
6/18/25 7:00 AM	58	62	45	40
6/18/25 8:00 AM	58	62	45	39
6/18/25 9:00 AM	55	59	44	37
6/18/25 10:00 AM	56	60	42	36
6/18/25 11:00 AM	58	62	48	39
6/18/25 12:00 PM	57	62	46	33
6/18/25 1:00 PM	60	64	53	49
Average Daytime:	59	61	45	37
Average Nighttime:	57	54	42	37

**Note: The average Leq daytime and nighttime sound levels shown are the logarithmic energy average of the 1-hour sound levels measured. The L10, L50, and L90 are the arithmetic averages of the 1-hour values*