SOUND LEVEL ASSESSMENT REPORT

Medway Grid Energy Storage Project
Medway, Massachusetts

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1.0 EXECUTIVE SUMMARY

The Medway Grid Energy Storage Project (Project) is a proposed 250 megawatt (MW) battery energy storage facility proposed to consist of battery energy storage systems and a new electric substation on approximately 10.6 acres of land in the Town of Medway, Massachusetts. The proposed Project is being developed by Medway Grid, LLC (Medway Grid). Medway Grid has retained Epsilon Associates, Inc. (Epsilon) to conduct a pre-construction sound level assessment for the proposed equipment for this Project.

Existing condition sound levels were measured around the site, an operational sound level modeling analysis was conducted for the major sound producing elements of the Project, and noise controls necessary to meet the requirements of the Massachusetts Department of Environmental Protection (MassDEP) Noise Policy were implemented and are discussed in this analysis.

Existing condition sound levels were measured for eight days at four locations on the site. Two supplemental short-term measurements were also performed at additional locations near the site. The 8-day average sound level using the lowest hourly L_{90} sound level measured during each daytime and nighttime period of the program was used to establish a daytime and nighttime background at each location.

Mitigation was applied to the sound sources in the form of operational restrictions, sound barriers, and by utilizing low noise equipment. With the noise mitigation measures described in this report, or equivalent design changes, the proposed Project will meet the requirements set forth in the MassDEP Noise Policy at residential locations.

2.0 INTRODUCTION

The Project Site is approximately 10.6 acres in size and as per the Town of Medway Assessor's maps is composed of four parcels (Parcels 46-057, 46-056, 46-055, and 56-006). Figure 2-1 shows the locations of the Project Site over aerial imagery. The Project Site contains approximately 0.84 acres of previously developed areas associated with three existing single-family residences and an existing automotive facility, with the remaining approximately 9.76 acres predominantly forested upland and/or wetlands.

The proposed Project consists of a 250 megawatt (MW) / 500 megawatt-hour (MWh) standalone battery energy storage system (BESS), a new 345kV/34.5kV electric substation (the Project Substation), and other associated site features, on approximately 10.6 acres of land off Milford Street (Route 109) in Medway, Massachusetts. The Project also includes the construction of a new, approximately 1,325-foot long underground 345 kV transmission line from the proposed Project Substation to Eversource Energy's existing West Medway Substation to the south.

Of the 10.6-acre Project Site, approximately 4.5 acres will be developed for the BESS (3.2 acres) and its associated site features (1.3 acres), which include; a stormwater management system, retaining walls and site grading, security fencing, sound attenuation barriers, an access roadway system, and landscaping.

The BESS will consist of 140 Tesla Megapack ("Megapack") units located on the westernmost portion of the Project Site. The Megapack is a standalone modular system with integrated lithium-ion batteries, a bi-directional inverter, a thermal management system, and a Tesla Site Controller with intelligent controls software. Each Megapack is approximately 30 feet long (359 in.), 5.5 feet wide (65 ¼ in.) and 9 feet tall (110 ¼ in.) and will be shipped to the site pre-assembled with a maximum weight of 84,000 pounds. The Megapacks will be arranged throughout the site in a back-to-back orientation and spaced in compliance with the manufacturer's installation requirements. The coupled Megapacks are placed immediately adjacent to a medium voltage transformer. The site will have 70 medium voltage transformers. Each Megapack and the medium voltage transformers will be supported by concrete slabs and surrounded by crushed stone.

Once operational, the BESS will be controlled remotely and have internal sensors that continuously monitor system operation. As such, the facility will not be staffed on a regular basis and the only personnel required at the facility will be limited to periodic site inspections and maintenance visits.

This report presents the findings of an ambient measurement program and a sound level modeling analysis for the Project. The Project components were modeled in CadnaA using sound data from Tesla. The proposed substation was also included in the model. The results of this analysis are found within this report.

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

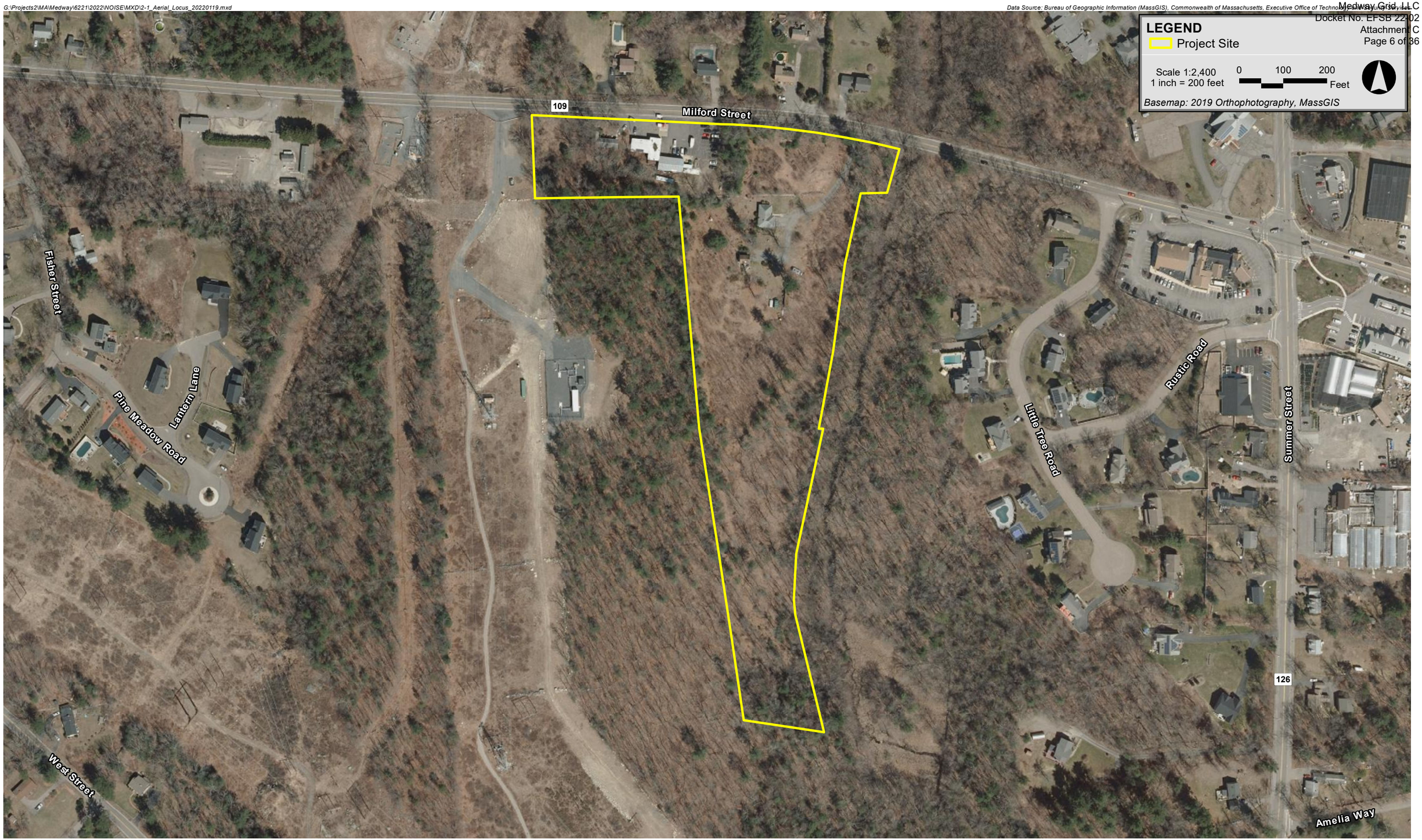

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Figure 2-1
Aerial Locus

3.0 SOUND TERMINOLOGY

There are several ways in which sound levels are measured and quantified. All of them use the logarithmic decibel (dB) scale. The following information defines the sound level terminology used in this analysis.

The decibel scale is logarithmic to accommodate the wide range of sound intensities found in the environment. A property of the decibel scale is that the sound pressure levels of two or more separate sounds are not directly additive. For example, if a sound of 50 dB is added to another sound of 50 dB, the total is only a 3-decibel increase (53 dB), which is equal to doubling in sound energy, but not equal to a doubling in decibel quantity (100 dB). Thus, every 3-dB change in sound level represents a doubling or halving of sound energy. The human ear does not perceive changes in the sound pressure level as equal changes in loudness. Scientific research demonstrates that the following general relationships hold between sound level and human perception for two sound levels with the same or very similar frequency characteristics[1]:

- 3 dBA increase or decrease results in a change in sound that is just perceptible to the average person,
- 5 dBA increase or decrease is described as a clearly noticeable change in sound level, and
- 10 dBA increase or decrease is described as twice or half as loud.

Another mathematical property of decibels is that if one source of sound is at least 10 dB louder than another source, then the total sound level is simply the sound level of the higher-level source. For example, a sound source at 60 dB plus another sound source at 47 dB is equal to 60 dB.

A sound level meter (SLM) that is used to measure sound is a standardized instrument.[2] It contains "weighting networks" (e.g., A-, C-, Z-weightings) to adjust the frequency response of the instrument. Frequencies, reported in Hertz (Hz), are detailed characterizations of sounds, often addressed in musical terms as "pitch" or "tone". The most commonly used weighting network is the A-weighting because it most closely approximates how the human ear responds to sound at various frequencies. The A-weighting network is the accepted scale used for community sound level measurements; therefore, sounds are frequently reported as detected with a sound level meter using this weighting. A-weighted sound levels emphasize middle frequency sounds (i.e., middle pitched – around 1,000 Hz), and de-emphasize low and high frequency sounds. These sound levels are reported in decibels designated as "dBA". The C-weighting network has a nearly flat response for frequencies between 63 Hz and 4,000 Hz and is noted as dBC. Z-weighted sound

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1 Bies, David, and Colin Hansen. 2009. *Engineering Noise Control: Theory and Practice*, 4th Edition. New York: Taylor and Francis.

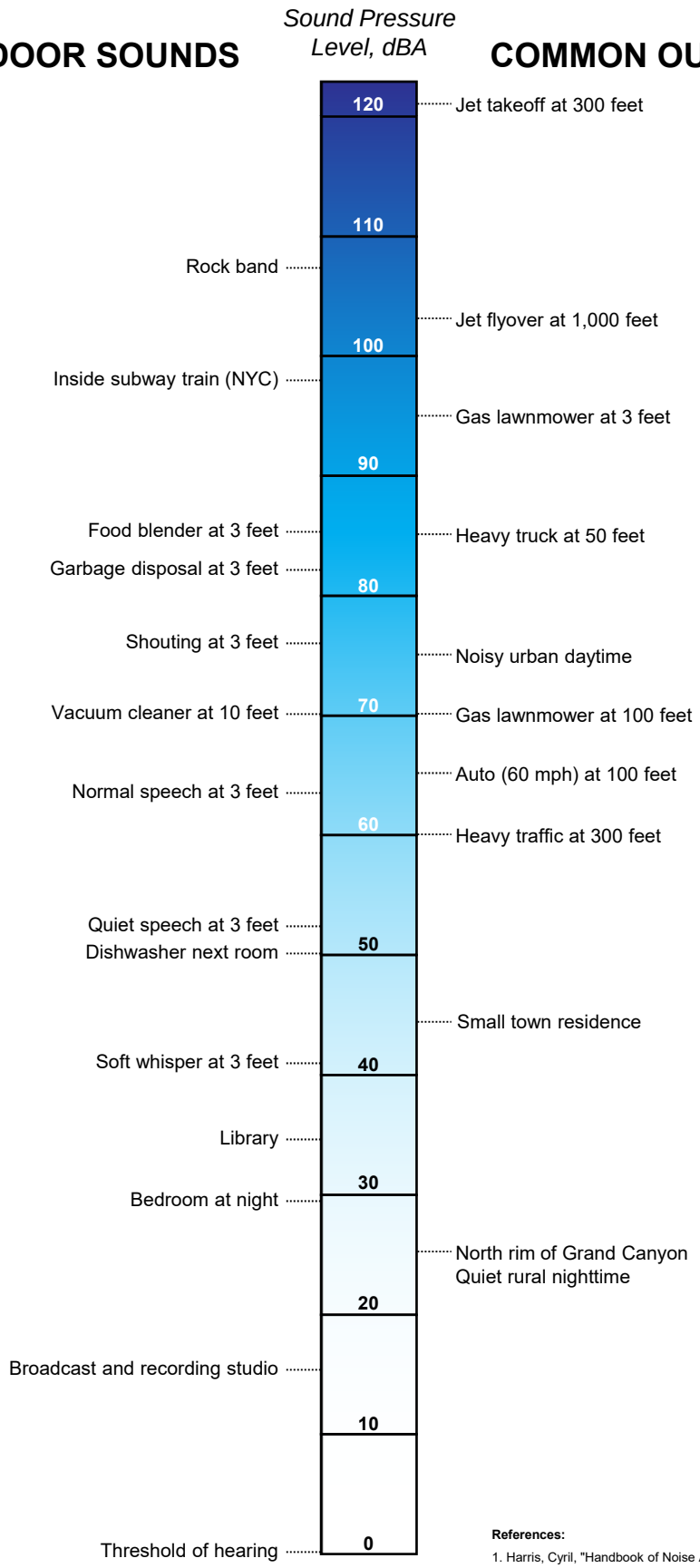
2 *American National Standard Specification for Sound Level Meters,* ANSI S1.4-2014 (R2019), published by the Standards Secretariat of the Acoustical Society of America, Melville, NY.

levels are measured sound levels without any weighting curve and are otherwise referred to as "unweighted". Sound pressure levels for some common indoor and outdoor environments are shown in Figure 3-1.

Because the sounds in our environment vary with time they cannot simply be described with a single number. Two methods are used for describing variable sounds. These are exceedance levels and the equivalent level, both of which are derived from some number of moment-to-moment A-weighted sound level measurements. Exceedance levels are values from the cumulative amplitude distribution of all of the sound levels observed during a measurement period. Exceedance levels are designated L_n, where n can have a value between 0 and 100 in terms of percentage. Several sound level metrics that are reported in community sound monitoring are described below.

- L_{90} is the sound level exceeded 90 percent of the time during the measurement period. The L_{90} is close to the lowest sound level observed. It is essentially the same as the residual sound level, which is the sound level observed when there are no obvious nearby intermittent sound sources. The L_{90} level is used to establish the "ambient" or "background" sound level as part of the MassDEP Noise Policy.

- L_{eq}, the equivalent level, is the level of a hypothetical steady sound that would have the same energy (*i.e.,* the same time-averaged mean square sound pressure) as the actual fluctuating sound observed. The equivalent level is designated L_{eq} and is typically A-weighted. The equivalent level represents the time average of the fluctuating sound pressure, but because sound is represented on a logarithmic scale and the averaging is done with linear mean square sound pressure values, the L_{eq} is mostly determined by loud sounds if there are fluctuating sound levels.



References:

1. Harris, Cyril, "Handbook of Noise Acoustical Measurements and Noise Control", p 1-10., 1998
2. "Controlling Noise", USAF, AFMC, AFDTC, Elgin AFB, Fact Sheet, August 1996
3. California Dept. of Trans., "Technical Noise Supplement", Oct, 1998

Figure 3-1

Common Indoor and Outdoor Sound Levels

4.0 NOISE REGULATIONS

4.1 Federal Regulations

There are no federal community noise regulations applicable to this Project.

4.2 Massachusetts State Regulations

The MassDEP regulates noise under its Air Pollution Control regulations. In these regulations, an "air contaminant" is defined to include sound, and a condition of "air pollution" includes the presence of an air contaminant in such concentration and duration as to "cause a nuisance" or "unreasonably interfere with the comfortable enjoyment of life and property." (310 CMR 7.00)

MassDEP's regulations at 310 CMR 7.10 prohibit "unnecessary emissions" of noise. MassDEP Division of Air Quality Control ("DAQC") Policy Statement 90-001 (February 1, 1990) (the "MassDEP Noise Policy") interprets a violation of this noise regulation to have occurred if the source causes either:

1) An increase in the broadband sound pressure level of more than 10 dBA above the ambient, or

2) A "pure tone" condition.

"Ambient" is defined as the background A-weighted sound level that is exceeded 90% of the time, measured during equipment operating hours (L_{90}). A "pure tone" condition occurs when any octave band sound pressure level exceeds both of the two adjacent octave band sound pressure levels by 3 dB or more.

These noise limits are MassDEP policy and are applicable both at the Property line and at the nearest residences. As a policy and not regulation, the MassDEP has waived these limits in certain cases at property line locations where the adjacent land uses are not considered noise sensitive, such as an adjacent industrial parcel.

4.3 Local Regulations – Town of Medway Noise Requirements

The Town of Medway recently revised and amended the Environmental Standards in Section 7.3 of their Zoning Bylaws. The revision to the Bylaws includes new Environmental Standards applicable to sound. Portions of the sound level requirements in these new Standards are more restrictive than the limits presented by the MassDEP Noise Policy. The Project is seeking a waiver from these newly adopted standards as part of the comprehensive zoning exemption petition submitted to the Department of Public Utilities.

5.0 EXISTING SOUND LEVELS

The Project is to be located on the south side of Milford Street, off Route 109 at Parcels 46-055, 46-056, 46-057 and 56-006 in the Town of Medway, Massachusetts. The property is bordered by residential neighborhoods to the north and east, an Eversource parcel to the west, and the Exelon Power West Medway Generating Station to the south.

5.1 Baseline Sound Environment

An existing sound level survey was conducted during the daytime and nighttime hours to characterize the existing "baseline" acoustical environment in the vicinity of the site. Four long-term continuous sound level monitoring stations were deployed for 8-days to:

1. Establish representative A-weighted broadband ambient sound pressure levels, for evaluating requirements of the MassDEP policy limit of a 10 dBA increase due to the proposed Project; and

2. Establish representative octave-band ambient sound pressure levels to identify any existing "pure tones," as defined by MassDEP, and evaluate whether the addition of modeled sound levels from the proposed Project to these background sound levels may introduce or exacerbate existing "pure tones" in the community.

Only measurement periods during, or affected by, precipitation were excluded from the analysis. This approach is consistent with ANSI Standard S12.18-1994 (R2009).

5.2 Sound Level Measurement Locations

The selection of the sound level measurement locations was based upon a review of the Project site plan and the land use in the vicinity of the Project. Four (4) long-term sound level measurement locations were selected as representative of the property lines in all four cardinal directions to obtain a sampling of the baseline sound environment. In addition, two (2) short-term sound level measurements were performed at additional locations near the site. Coordinates of the monitoring locations are presented in Table 5-1. These measurement locations are depicted in Figure 5-1 and described below.

- **Location LT1** is located approximately 125 feet south of Milford Street (Route 109) in the northeastern corner of the Project parcel. This location is representative of the homes north of the Project, along Milford Street.
- **Location LT2** is located near the middle of the western property line of the Project. This location is representative of the business and industrial facilities to the west of the Project.
- **Location LT3** is located near the middle of the eastern property line of the Project. This location is representative of the homes east of the Project, along Little Tree Road.

- **Location LT4** is located in the southern portion of the site. This location is representative of the residential and industrial facilities to the southeast and south of the Project respectively.
- **Location ST1** is located on the edge of the road near 8 Little Tree Road to the east of the Project. This location is representative of the homes to the east of the Project and along Little Tree Road.
- **Location ST2** is located on the edge of Pine Meadow Road near 1 Lantern Lane to the west of the Project. This location is representative of the homes to the west of the Project and along Pine Meadow Road and Lantern Lane.

Table 5-1 GPS Coordinates (WGS 84) – Sound Level Measurement Locations

Location	Coordinates	
	Latitude (N°)	Longitude (W°)
L1	42.1450	-71.4465
L2	42.1443	-71.4476
L3	42.1440	-71.4467
L4	42.1425	-71.4474
ST1	42.1436	-71.4526
ST2	42.1441	-71.4451

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

LEGEND

- Project Site
- Long-Term Monitoring Location
- Short-Term Monitoring Location

Scale 1:2,400
1 inch = 200 feet

0 100 200 Feet

Basemap: 2019 Orthophotography, MassGIS

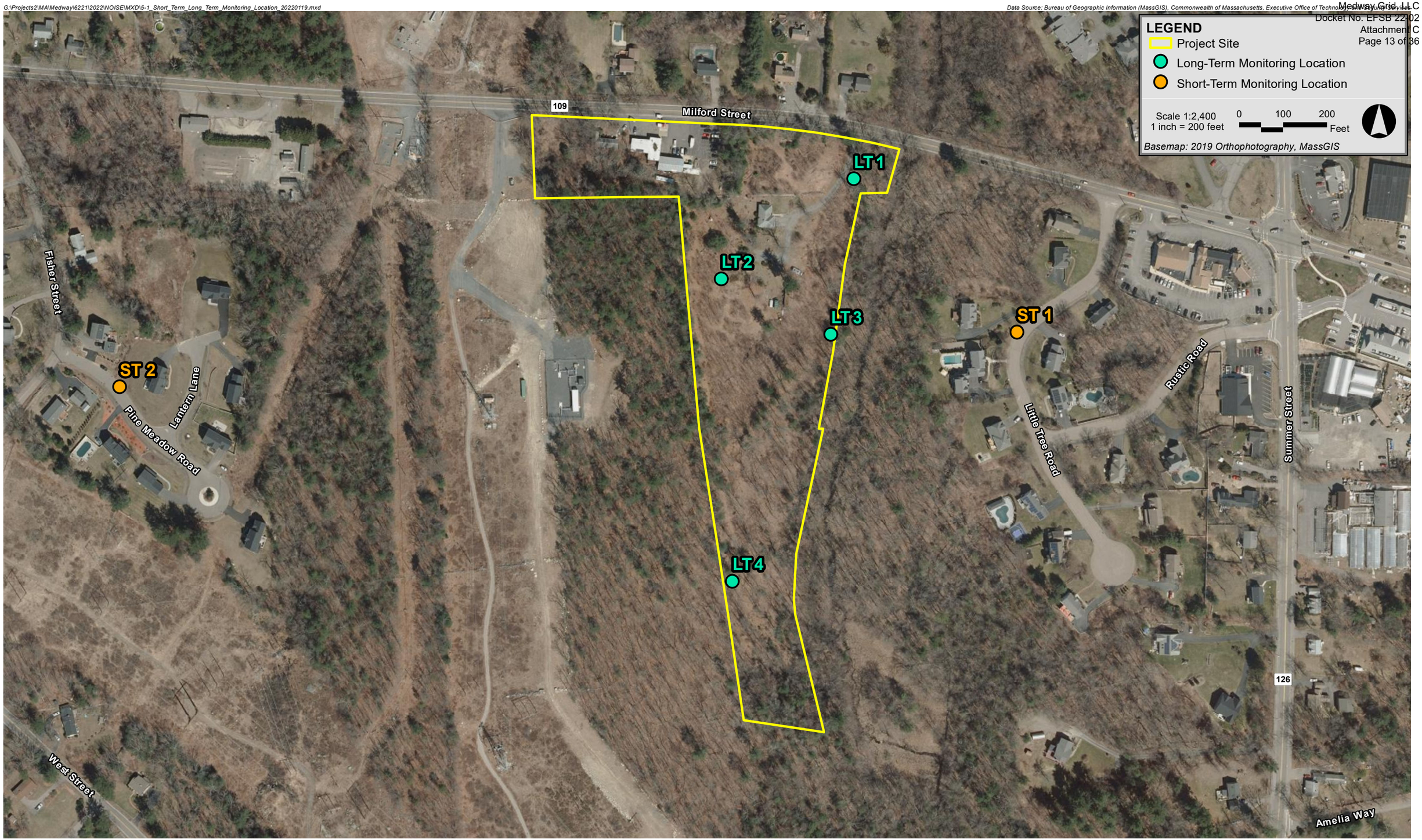

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Figure 5-1
Sound Level Measurement Locations

5.3 Measurement Methodology

A comprehensive sound level measurement program was developed to quantify the existing ambient sound levels around the proposed Project. The program consisted of four long-term monitoring stations as well as two short-term monitoring stations. The long-term monitoring stations collected continuous sound level data for approximately eight days from Thursday, July 29, 2021 to Friday, August 6, 2021. The long-term monitors were generally unattended, with personal observations made by a field technician during deployment, a nighttime site visit, and demobilization. Short-term sound level measurements were made on Thursday, July 29, 2021 during the daytime (12:36 p.m. to 1:24 p.m.) and on Tuesday, August 3, 2021 during nighttime hours (12:05 a.m. to 1:03 a.m.). All short-term measurements were 20 minutes in duration.

5.4 Measurement Equipment

Four Larson Davis (LD) 831 sound level meters, equipped with a LD PRM831 preamplifier and a PCB 377B20 or a PCB 377C20 half-inch microphone, along with an environmental protection kit were used to collect background sound pressure level data at the long-term measurement locations. The environmental protection kit included a manufacturer-provided wind screen to reduce wind-induced noise over the microphone. One LD 831 sound level meter, equipped with a PCB PRM831 preamplifier and a PCB 377C20 half-inch microphone, and a manufacturer-provided wind screen, was used to collect background sound pressure level data at the short-term measurement locations. Continuous hourly wind speed measurements were made on-site using a 2-meter above ground level (AGL) HOBO H21-USB micro-weather station (manufactured by Onset Computer Corporation) with tripod and data logger.

All instrumentation meets the "Type 1 - Precision" requirements set forth in ANSI S1.4 for acoustical measuring devices. The measurement equipment was calibrated in the field before and after the survey with a Larson Davis CAL200 acoustical calibrator which meets the standards of IEC 942 Class 1L and ANSI S1.40. Statistical descriptors (e.g., Leq, L90, etc.) were measured for each sampling period (20-minutes for short-term and 1-hour for long-term) with octave band sound levels corresponding to the same datasets.

5.5 Baseline Ambient Sound Levels

Current sound sources in the area surrounding the proposed project site include: vehicle traffic along local roads, wind, rustling vegetation, birds and other wildlife, insects, industrial activity, and occasional aircraft.

5.5.1 Short-term Sound Levels

Summaries of the existing condition sound levels are shown in Tables 5-2 and 5-3 with measured daytime and nighttime sound levels from the short-term measurements, respectively. Daytime L_{90} sound levels at the short-term locations ranged from 43 to 48 dBA and nighttime L_{90} sound levels ranged from 34 to 35 dBA.

Table 5-2 Daytime Short-Term Ambient Measurement Summary

Measurement Location ID	Start Date & Time	Broad-band L_{90}	L_{90} Sound Pressure Level (dB) by Octave-Band Center Frequency (Hz)									
			31.5	63	125	250	500	1k	2k	4k	8k	16k
		dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB
ST1	7/29/2021 12:36 PM	48	56	53	48	43	42	43	39	35	28	19
ST2	7/29/2021 2:29 PM	43	54	53	47	40	40	38	32	29	25	17

Table 5-3 Nighttime Short-Term Ambient Measurement Summary

Measurement Location ID	Start Date & Time	Broad-band L_{90}	L_{90} Sound Pressure Level (dB) by Octave-Band Center Frequency (Hz)									
			31.5	63	125	250	500	1k	2k	4k	8k	16k
		dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB
ST1	8/3/2021 12:05 AM	35	47	44	44	34	30	27	23	25	13	12
ST2	8/3/2021 12:43 AM	34	46	43	40	31	32	27	18	17	11	12

5.5.2 Long-term Sound Levels

A-weighted broadband (dBA) and un-weighted octave-band (dB) background sound levels from the long-term locations were used to evaluate Facility compliance with the MassDEP Noise Policy and are presented in Tables 5-4 and 5-5 for daytime (7AM - 10PM) and nighttime (10PM – 7AM) hours, respectively. Broadband L_{90} values represent the average of the daily minimum L_{90} sound pressure levels observed during the relevant daytime or nighttime operating periods throughout the measurement program. The octave-band values correspond to a representative time period where the broadband value equals the average of the daily/nightly minimum L_{90} sound levels. There were a total of 32 hours with recorded precipitation during the 8-day program. These hours were excluded from further processing in accordance with ANSI S12.18.

One-hour A-weighted broadband sound pressure level data plots from the continuous ambient monitoring stations at locations LT1 through LT4 are presented in Appendix A for the entire measurement period. The average daily minimum L_{90} (1-hour) sound levels ranged, by location, from 37 to 42 dBA during the day and from 31 to 32 dBA at night.

Table 5-4 Daytime[1] Background Sound Level Measurement Summary

Monitoring Location ID	L_{90}[2]	L_{90}[3] Sound Pressure Level (dB) by Octave-Band (Hz)								
		32 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz
	dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB
LT1	42	56	59	50	47	49	53	52	39	31
LT2	41	53	53	52	46	42	43	34	32	32
LT3	40	54	56	50	40	41	44	35	30	30
LT4	37	56	55	46	44	38	36	26	35	36

1. 'Daytime' defined to be between the operational hours of 7AM and 10PM.
2. Broadband L_{90} represents the average of the minimum L_{90} sound pressure levels observed each day of the measurement program during daytime hours.
3. Octave-band values correspond to a representative time period where the broadband value equals the average of the daily minimum L_{90} sound levels.

Table 5-5 Nighttime[1] Background Sound Level Measurement Summary

Monitoring Location ID	L_{90}[2]	L_{90}[3] Sound Pressure Level (dB) by Octave-Band (Hz)								
		32 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz
	dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB
LT1	32	47	49	39	37	38	41	34	30	25
LT2	32	47	49	40	40	32	29	25	27	24
LT3	31	48	49	40	36	35	34	25	26	16
LT4	31	47	48	37	39	33	25	25	26	14

1. 'Nighttime' defined to be between the operational hours of 10PM and 7AM.
2. Broadband L_{90} represents the average of the minimum L_{90} sound pressure level observed each day of the measurement program during nighttime hours.
3. Octave-band values correspond to a representative time period where the broadband value equals the average of the nightly minimum L_{90} sound levels.

6.0 MODELED SOUND LEVELS

6.1 Modeled Sound Sources

The primary sources of sound associated with the Facility will consist of:

- Tesla Megapacks (includes inverters and cooling equipment)
- Substation power transformer

The Project expects to place 140 Tesla Megapacks on the site. The substation associated with the Project will include one 300 MVA transformer. Table 6-1 summarizes the sound-producing equipment list for the Project.

Table 6-1 Summary of Sound Producing Equipment

Component	Manufacturer/model	Quantity
Tesla 11-Fan Megapack	Tesla	140
Power transformer (300 MVA)	TBD	1

6.2 Modeling Methodology

Noise impacts from mechanical equipment associated with the Facility were predicted using CadnaA noise calculation software (DataKustik Corporation, Version 2021). This software, which uses the ISO 9613-2 international standard for sound propagation (Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation), offers a refined set of computations accounting for local topography, ground attenuation, drop-off with distance, barrier shielding, diffraction around building edges, reflection off building facades, and atmospheric absorption of sound from multiple noise sources.

Inputs and significant parameters included in the model are described below:

- **Facility Layout:** The location of all proposed equipment was provided by Burns & McDonnell in a Site Plan drawing dated January 14, 2022.
- **Sensitive Receptors:** Sound levels were evaluated at fourteen residences, shown as R1 to R14 in Figure 6-1, representing the closest sensitive residences surrounding the Facility. In addition, sound levels were evaluated at nine property-line locations in various directions around the facility. The locations are shown as PL1 to PL9 in Figure 6-1. All receptors were modeled at a height of 1.5 meters above ground level to mimic the ears of a typical standing observer.

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Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

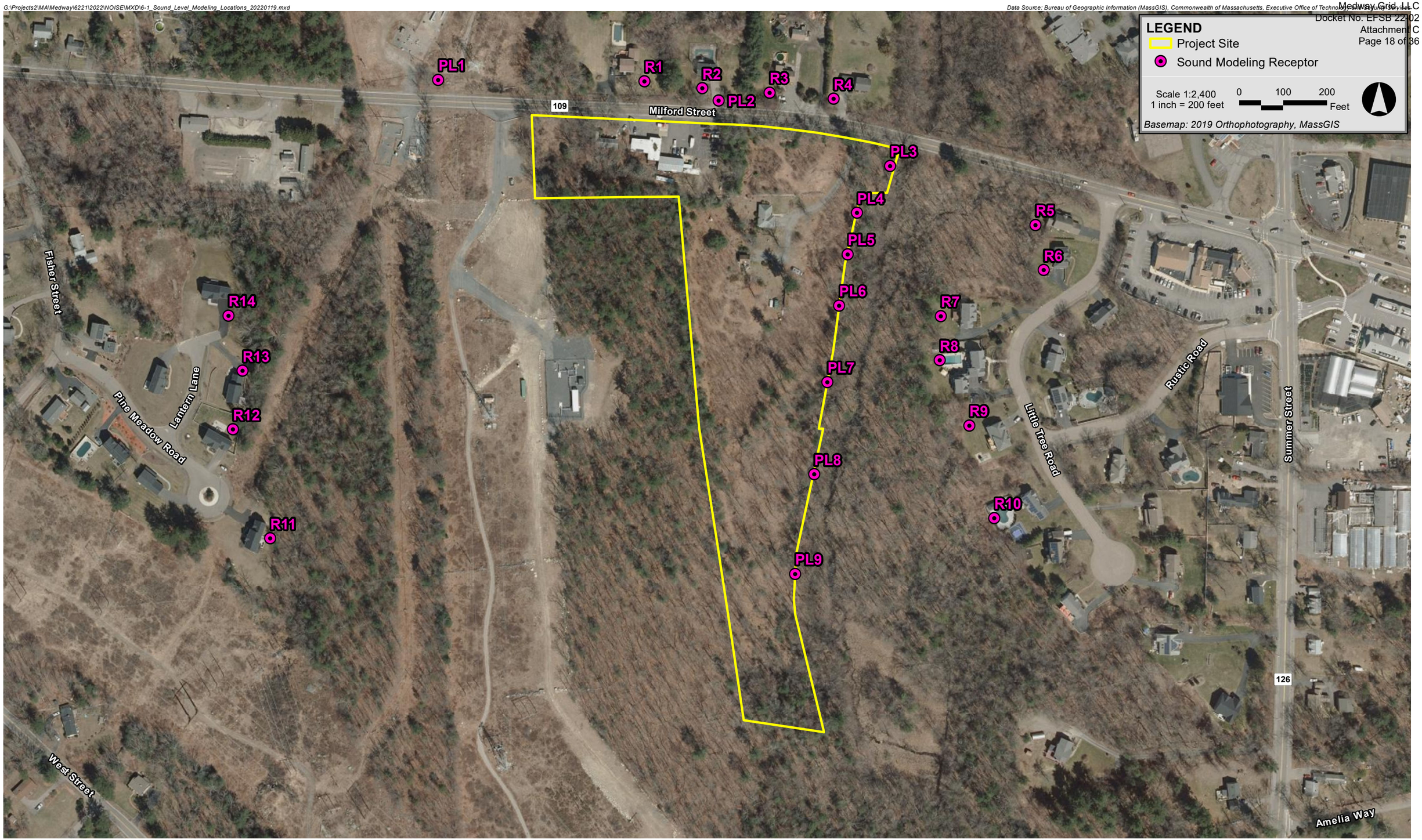

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Figure 6-1
Sound Level Modeling Locations

- **Terrain Elevation:** Elevation contours for the modeling domain derived from datasets supplied by MassGIS, along with future grading plans for the Facility Site, were directly imported into Cadna/A, which allowed for consideration of terrain shielding and differences in elevation between sources and receivers, where appropriate.

- **Source Sound Power Levels:** A tabular summary of the modeled equipment proposed for the Facility and sound power levels for each unit, as provided by the manufacturer or calculated from NEMA ratings, are presented below in Table 6-2. Octave band data were not provided by the manufacturers for their equipment, so octave band sound power levels were estimated based on similar or representative equipment, and the Edison Electric Institute Environmental Noise Guide.

- **Meteorological Conditions:** A temperature of 10ºC (50ºF) and a relative humidity of 70% were assumed in the model to minimize atmospheric attenuation in the 500 Hz and 1 kHz octave-bands where the human ear is most sensitive.

- **Ground Attenuation:** Spectral ground absorption was calculated using a global G-factor of 0.5 to represent a moderately reflective surface, except for the entire Project Site, which utilized a G-factor of 0 representing reflective surfaces (i.e., gravel, pavement).

Table 6-2 Reference Sound Power Level by Source (Proposed Equipment)

Proposed Source	Broadband Sound Power Level per Unit	Sound Level per Unit (dB) by Octave Band (Hz)								
		31.5	63	125	250	500	1k	2k	4k	8k
	dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB
Tesla Megapack @ 100%	95[1,2]	94	94	94	94	92	87	87	86	80
Tesla Megapack @ 40%	84[2,3]	83	83	83	83	81	76	76	75	69
Power transformer	88[4]	84	90	92	87	87	81	76	71	64

1. Sound power level per Megapack, with fan speeds at 100%.
2. Octave band data for Megapack calculated from comparable Sungrow 3150 kVA inverter with publicly available data.
3. Sound power level per Megapack, fan speeds throttled and limited to 40%.
4. Broadband and octave band data for power transformer calculated from Electric Power Plant Environmental Noise Guide, Edison Electric Institute, 2nd edition, 1984. Assumes National Electrical Manufacturers Association (NEMA) rating of 67 dBA.

6.3 Sound Modeling Results – Base Case

Modeled future sound levels from the Project are presented in Table 6-3 (daytime) and Table 6-4 (nighttime) respectively. These results do not include any mitigation. Sound level results are compared to the state (MassDEP) limits by presenting the increase over the quietest measured L_{90} background sound levels.

During the daytime hours of 7 AM to 10 PM, when the proposed Facility is operating at full capacity, sound level increases range from 8 to 28 dBA. During the nighttime hours of 10 PM to 7 AM, when the proposed Facility is operating at full capacity, sound level increases range from 13 to 38 dBA.

Table 6-3 Daytime[1] Compliance Evaluation – Base Case

Receptor ID	Land Use	Representative Long Term Sound Level Measurement Location	Measured Background Noise Level	Modeled Facility-Only Noise Level (Proposed)	Combined Facility + Background Noise Level	Increase Above Background[2]	Meets MassDEP Limit?
			dBA	dBA	dBA	dBA	
R1	Residence	LT1	42	68	68	26	No
R2	Residence	LT1	42	69	69	26	No
R3	Residence	LT1	42	68	68	26	No
R4	Residence	LT1	42	65	65	23	No
R5	Residence	LT1	42	58	58	16	No
R6	Residence	LT1	42	58	58	15	No
R7	Residence	LT3	40	60	60	20	No
R8	Residence	LT3	40	59	59	20	No
R9	Residence	LT3	40	57	57	18	No
R10	Residence	LT4	37	55	55	18	No
R11	Residence	LT4	37	44	44	8	Yes
R12	Residence	LT2	41	48	49	8	Yes
R13	Residence	LT2	41	49	50	9	Yes
R14	Residence	LT2	41	49	50	9	Yes
PL1	Property line	LT1	42	60	60	18	No
PL2	Property line	LT1	42	70	70	28	No
PL3	Property line	LT1	42	60	60	18	No
PL4	Property line	LT1	42	62	62	20	No
PL5	Property line	LT3	40	63	63	23	No
PL6	Property line	LT3	40	63	63	23	No
PL7	Property line	LT3	40	58	58	19	No
PL8	Property line	LT4	37	55	55	18	No
PL9	Property line	LT4	37	52	52	16	No

1. 'Daytime' defined as the operational hours between 7 AM and 10 PM
2. 'Increase Above Background' calculated from levels with greater precision than shown in this table, and then rounded to the nearest whole decibel.

Table 6-4 Nighttime[1] Compliance Evaluation – Base Case

Receptor ID	Land Use	Representative Long Term Sound Level Measurement Location	Existing Background Noise Level	Modeled Facility-Only Noise Level (Proposed)	Combined Facility + Background Noise Level	Increase Above Background[2]	Meets MassDEP Limit?
			dBA	dBA	dBA	dBA	
R1	Residence	LT1	32	68	68	36	No
R2	Residence	LT1	32	69	69	37	No
R3	Residence	LT1	32	68	68	36	No
R4	Residence	LT1	32	65	65	34	No
R5	Residence	LT1	32	58	58	26	No
R6	Residence	LT1	32	58	58	26	No
R7	Residence	LT3	31	60	60	29	No
R8	Residence	LT3	31	59	59	29	No
R9	Residence	LT3	31	57	57	27	No
R10	Residence	LT4	31	55	55	24	No
R11	Residence	LT4	31	44	44	13	Yes
R12	Residence	LT2	32	48	48	17	Yes
R13	Residence	LT2	32	49	49	17	Yes
R14	Residence	LT2	32	49	49	18	Yes
PL1	Property line	LT1	32	60	60	28	No
PL2	Property line	LT1	32	70	70	38	No
PL3	Property line	LT1	32	60	60	28	No
PL4	Property line	LT1	32	62	62	30	No
PL5	Property line	LT3	31	63	63	32	No
PL6	Property line	LT3	31	63	63	32	No
PL7	Property line	LT3	31	58	58	28	No
PL8	Property line	LT4	31	55	55	24	No
PL9	Property line	LT4	31	52	52	21	No

1. 'Nighttime' defined as the operational hours between 10 PM and 7 AM
2. 'Increase Above Background' calculated from levels with greater precision than shown in this table, and then rounded to the nearest whole decibel.

6.4 Sound Modeling Results – Mitigated Case

With the noise control features described in Section 7, modeled future sound levels from the project presented in Table 6-5 and Table 6-6, respectively, are predicted to increase the measured background L_{90} sound levels by no more than 9 dBA at all modeled receptor locations. Figure 6-2 presents the sound level contours for the daytime mitigated case with the facility operating at full capacity, and Figure 6-3 presents the nighttime mitigated case with the facility operating at a reduced capacity (details presented in Section 7).

During daytime hours, when the proposed Facility is operating at full capacity, sound level increases are predicted to be 5 dBA or less, well below the 10 dBA MassDEP criteria. During nighttime hours, when the proposed Facility will operate at reduced capacity, sound level increases are predicted to be 9 dBA or less, which is below the 10 dBA MassDEP criteria. The 9 dBA increase occurs at one property line north of the project, which is located within a power line easement area, and is not noise sensitive. At all other locations, increases are predicted to be 7 dBA or less.

Octave-band sound pressure level modeling indicates that the proposed Facility would not be anticipated to create any "pure-tone" conditions, as defined by MassDEP, when combined with existing background sound levels at any modeled receptor locations. A daytime and nighttime pure tone evaluation is presented in Tables 6-7 and 6-8 respectively.

Table 6-5 Daytime[1] Compliance Evaluation – Mitigated Case

Receptor ID	Land Use	Representative Long Term Sound Level Measurement Location	Measured Background Noise Level	Modeled Facility-Only Noise Level (Proposed)	Combined Facility + Background Noise Level	Increase Above Background[2]	Meets MassDEP Limit?
			dBA	dBA	dBA	dBA	
R1	Residence	LT1	42	42	45	3	Yes
R2	Residence	LT1	42	42	45	3	Yes
R3	Residence	LT1	42	42	45	3	Yes
R4	Residence	LT1	42	40	44	2	Yes
R5	Residence	LT1	42	37	43	1	Yes
R6	Residence	LT1	42	37	43	1	Yes
R7	Residence	LT3	40	38	42	2	Yes
R8	Residence	LT3	40	38	42	2	Yes
R9	Residence	LT3	40	37	42	2	Yes
R10	Residence	LT4	37	36	39	3	Yes
R11	Residence	LT4	37	35	39	2	Yes
R12	Residence	LT2	41	39	43	2	Yes
R13	Residence	LT2	41	40	43	2	Yes
R14	Residence	LT2	41	39	43	2	Yes
PL1	Property line	LT1	42	46	48	5	Yes
PL2	Property line	LT1	42	43	46	4	Yes
PL3	Property line	LT1	42	37	43	1	Yes
PL4	Property line	LT1	42	39	44	2	Yes
PL5	Property line	LT3	40	39	42	3	Yes
PL6	Property line	LT3	40	39	42	3	Yes
PL7	Property line	LT3	40	37	42	2	Yes
PL8	Property line	LT4	37	36	39	3	Yes
PL9	Property line	LT4	37	39	41	4	Yes

1. 'Daytime' defined as the operational hours between 7 AM and 10 PM
2. 'Increase Above Background' calculated from levels with greater precision than shown in this table, and then rounded to the nearest whole decibel.

Table 6-6 Nighttime[1] Compliance Evaluation – Mitigated Case

Receptor ID	Land Use	Representative Long Term Sound Level Measurement Location	Measured Background Noise Level	Modeled Facility-Only Noise Level (Proposed)	Combined Facility + Background Noise Level	Increase Above Background[2]	Meets MassDEP Limit?
			dBA	dBA	dBA	dBA	
R1	Residence	LT1	32	36	37	6	Yes
R2	Residence	LT1	32	37	38	6	Yes
R3	Residence	LT1	32	36	37	6	Yes
R4	Residence	LT1	32	33	36	4	Yes
R5	Residence	LT1	32	32	35	3	Yes
R6	Residence	LT1	32	32	35	3	Yes
R7	Residence	LT3	31	33	35	4	Yes
R8	Residence	LT3	31	33	35	4	Yes
R9	Residence	LT3	31	32	34	4	Yes
R10	Residence	LT4	31	30	34	3	Yes
R11	Residence	LT4	31	29	33	2	Yes
R12	Residence	LT2	32	34	36	5	Yes
R13	Residence	LT2	32	35	36	5	Yes
R14	Residence	LT2	32	33	35	4	Yes
PL1	Property line	LT1	32	40	41	9	Yes
PL2	Property line	LT1	32	37	38	7	Yes
PL3	Property line	LT1	32	32	35	3	Yes
PL4	Property line	LT1	32	33	35	4	Yes
PL5	Property line	LT3	31	33	35	4	Yes
PL6	Property line	LT3	31	33	35	5	Yes
PL7	Property line	LT3	31	32	34	4	Yes
PL8	Property line	LT4	31	32	34	3	Yes
PL9	Property line	LT4	31	35	37	6	Yes

1. 'Nighttime' defined as the operational hours between 10 PM and 7 AM
2. 'Increase Above Background' calculated from levels with greater precision than shown in this table, and then rounded to the nearest whole decibel.

Table 6-7 Daytime "Pure Tone" Evaluation of the MassDEP Noise Policy

Receptor ID	Land Use	Sound Level (dB) per Octave-Band Center Frequency (Hz)[1]								
		31.5	63	125	250	500	1k	2k	4k	8k
PL1	Closest property line (west)	56	60[2]	52	49	50	53	52	41	31
PL2	Closest property line (north)	57	60[2]	52	50	50	53	52	40	31
PL6	Closest property line (east)	55	57	51	45	43	44	35	31	30
PL9	Closest property line (south)	56	55	48	46	41	38	31	36	36

1. Calculated from levels with greater precision than shown in this table, and then rounded to the nearest whole decibel.
2. Pure tone in the 63 Hz octave band is not attributable to the Project. This pure tone was present in the existing daytime ambient sound level and is likely due to distant traffic.

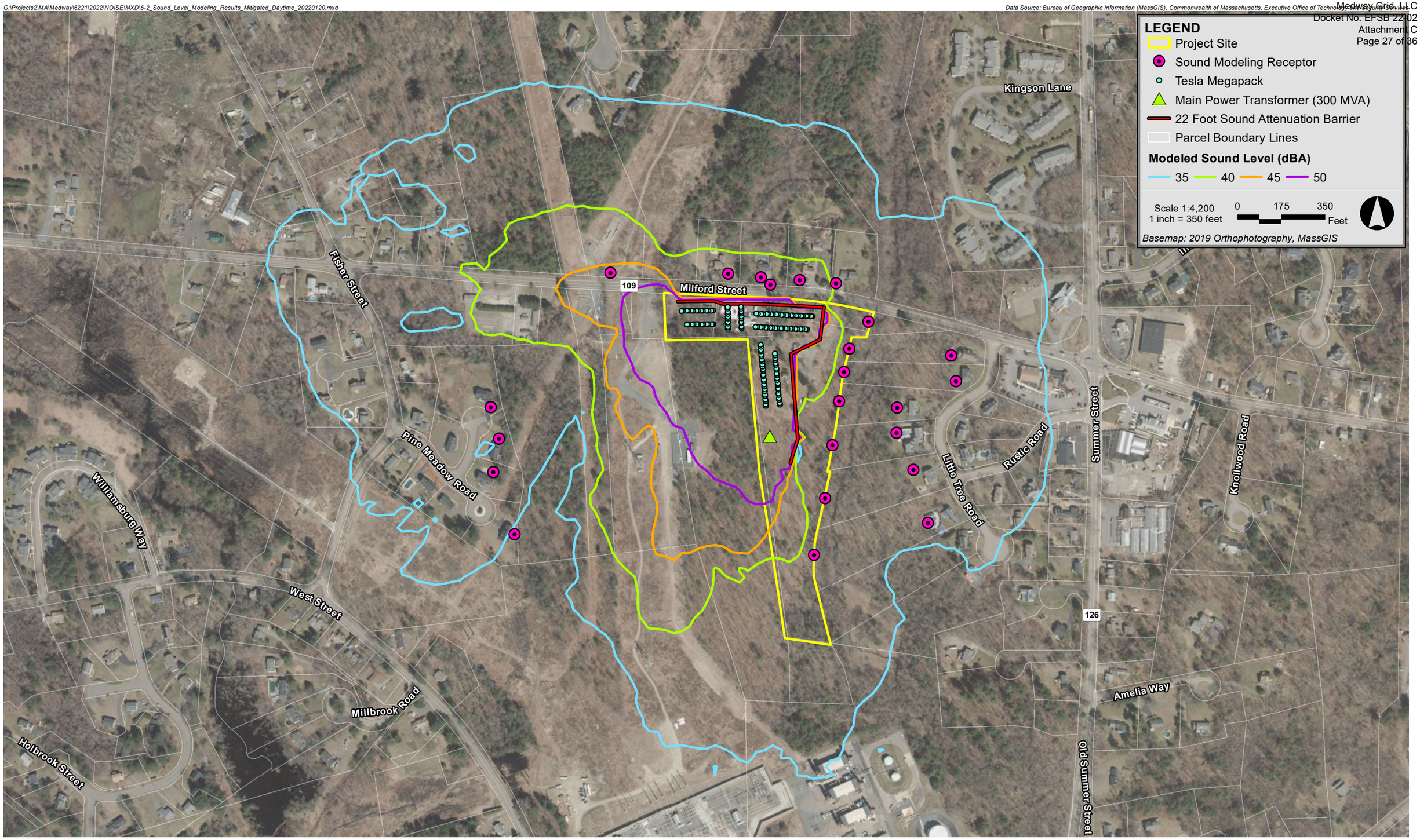
Table 6-8 Nighttime "Pure Tone" Evaluation of the MassDEP Noise Policy

Receptor ID	Land Use	Sound Level (dB) per Octave-Band Center Frequency (Hz)[3]								
		31.5	63	125	250	500	1k	2k	4k	8k
PL1	Closest property line (west)	48	51[4]	43	41	40	42	36	32	25
PL2	Closest property line (north)	49	51	44	42	40	41	35	31	25
PL6	Closest property line (east)	49	50	42	39	37	35	26	26	16
PL9	Closest property line (south)	47	49	41	41	36	31	28	27	14

3. Calculated from levels with greater precision than shown in this table, and then rounded to the nearest whole decibel.
4. Pure tone in the 63 Hz octave band is not attributable to the Project. This pure tone was present in the existing nighttime ambient sound level and is likely due to distant traffic.

G:\Projects2\MA\Medway\6221\2022\NOISE\MXD\6-2_Sound_Level_Modeling_Results_Mitigated_Daytime_20220120.mxd

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services



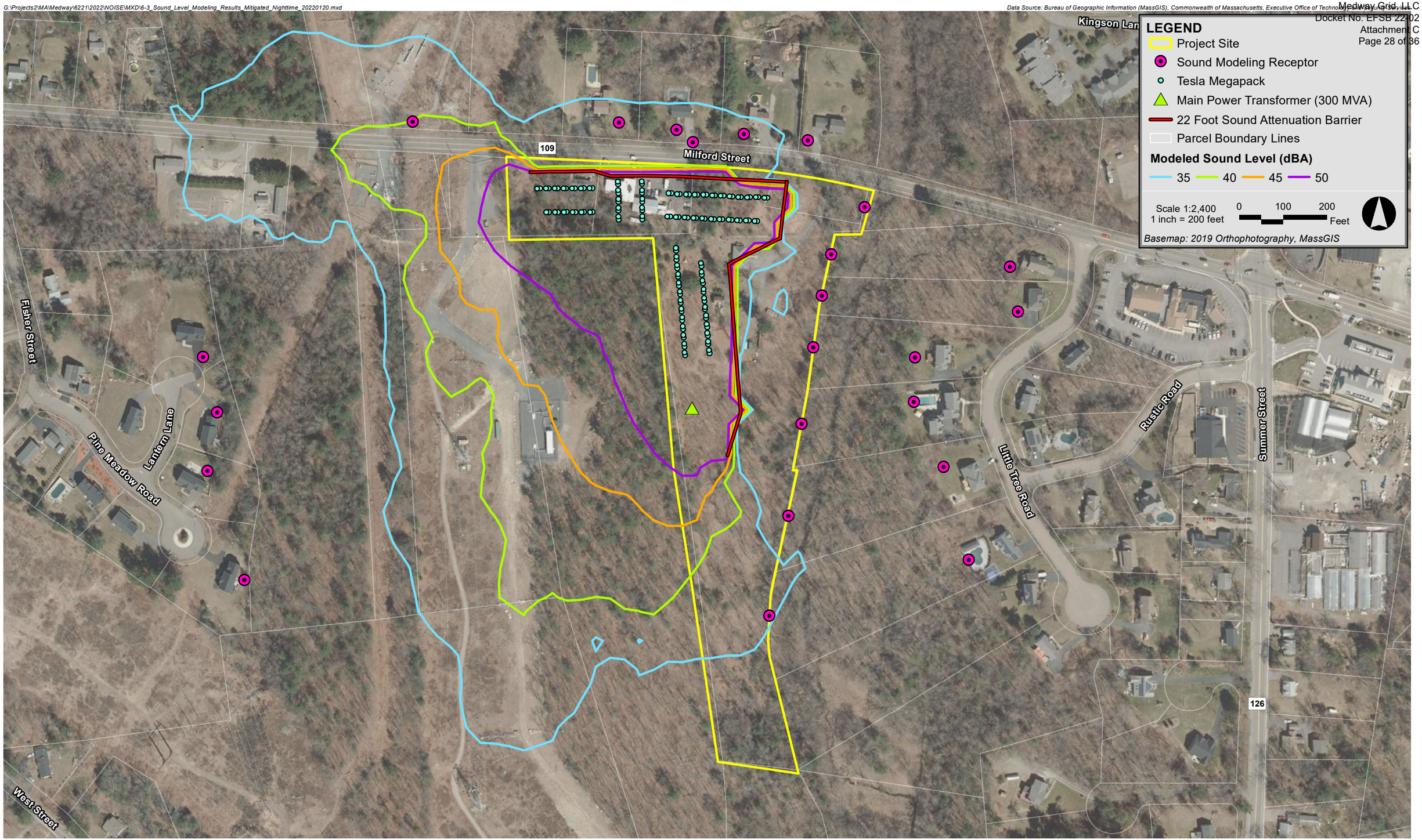
Medway Grid Energy Storage Project **Medway, Massachusetts**

Epsilon ASSOCIATES INC.

Figure 6-2
Sound Level Modeling Results – Mitigated, Daytime

G:\Projects2\MA\Medway\6221\2022\NOISE\MXD\6-3_Sound_Level_Modeling_Results_Mitigated_Nighttime_20220120.mxd

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services



Medway Grid Energy Storage Project **Medway, Massachusetts**

Epsilon ASSOCIATES INC.

Figure 6-3
Sound Level Modeling Results – Mitigated, Nighttime

7.0 MITIGATION MEASURES

7.1 Tesla Megapack Fan Throttling

The Megapack manufacturer (Tesla) was contacted about possible noise control options for their equipment. Information from Tesla confirmed that the Megapacks could be programmed to limit the cooling fan speeds based upon thermal characteristics of the proposed site. For the Medway Grid project site, Tesla has confirmed the cooling fans for each Megapack can be safely throttled to 40% of their nominal speed. Limiting the fan speeds of the Megapacks to 40% reduces the sound level of each unit by approximately 11 dBA.

7.2 Sound Attenuation Barriers

In addition to throttling the Megapack units, the Project will also utilize sound attenuation barriers along the northern and eastern sides of the site. Under current design, these barriers will be 22 feet tall and will need to be constructed of materials with adequate thickness and density to provide appropriate sound level reductions. This is typically achieved by using pre-constructed metal panels, commonly 4 inches thick. The proposed barrier locations, shown in Figures 6-2 and 6-3, are situated as close as possible to the equipment while maintaining adequate ventilation and accessibility. Egress areas in the barriers will be designed to achieve adequate transmission loss approximately equivalent to the barrier itself. The contractor selected would be responsible for the design, detailing, and adequacy of the framework, supports, and attachment methods required for the proper construction of the sound attenuation barriers.

Acoustic modeling was also performed to evaluate the effectiveness of barriers taller than 22 feet. Results of the modeling revealed that no perceptible acoustic benefit would be achieved by using taller barriers.

7.3 Low Noise Substation Transformer

The Project will utilize a low noise power transformer at the substation. The proposed substation will feature one 300 megavolt-ampere (MVA) transformer. As described in Section 6.2, Epsilon estimated the octave band sound power levels of the transformer using methods outlined in the Electric Power Plant Environmental Noise guide (EEI Noise Guide) assuming the transformer will have a National Electrical Manufacturers Association (NEMA) noise rating of 67 dBA.

7.4 Operational Restrictions

The Tesla Megapacks generate maximum sound when the batteries are being charged or discharged and the corresponding cooling equipment (fans) are running that emit the highest sound level. Based on ambient noise levels recorded at the Project site, the Project's maximum sound levels meet the MassDEP noise requirements between 6am and 10pm. Between the hours of 10pm and 6am, the Project's maximum sound levels would exceed the MassDEP noise requirements without an operational restriction. The Project will adopt an operational restriction

that limits the number of Megapacks that simultaneously charge or discharge to 25% of the total Megapacks. With this operational restriction in place between 10pm and 6am the Project meets the MassDEP noise requirements.

It is possible that based upon ongoing technology innovations to the Tesla Megapack and ongoing research and development from inverter, transformer and other equipment manufacturers, final Project design and/or other mitigation measures could eliminate the need for this operational restriction. For now, this mitigation measure is being included to ensure that the Project meets MassDEP requirements. Notwithstanding the operational restrictions noted above, the Project shall be allowed to charge or discharge at maximum power if ISONE implements any of Actions [2-11] under Operating Procedure 4 of the Tariff, or when a Capacity Scarcity Conditions, as defined in the tariff, exists in the Project's Capacity Zone, or any other Capacity Zone in the ISONE region.

8.0 CONCLUSIONS

In conclusion, substantial noise mitigation measures have been incorporated into the design of the proposed facility to minimize noise impacts in the community. These mitigation measures include low noise equipment, sound attenuation barriers, and nighttime operational restrictions. Results of a complete sound level assessment demonstrate that the sound levels from the facility will comply with the requirements set forth in the MassDEP Noise Policy.

This report was prepared to address the 140 Tesla Megapacks that are proposed and would be operational within the site for the foreseeable future. The site plan does however provide augmentation areas for the installation of additional batteries units. Additional units would be installed as the system degrades, in order to maintain capacity if the existing units are no longer sufficient to meet the Project's 500 MWh capacity. If site augmentation is required, a new sound level analysis is recommended prior to the installation and operation of the augmented system.

Appendix A

Long-Term Sound Level Measurement Data

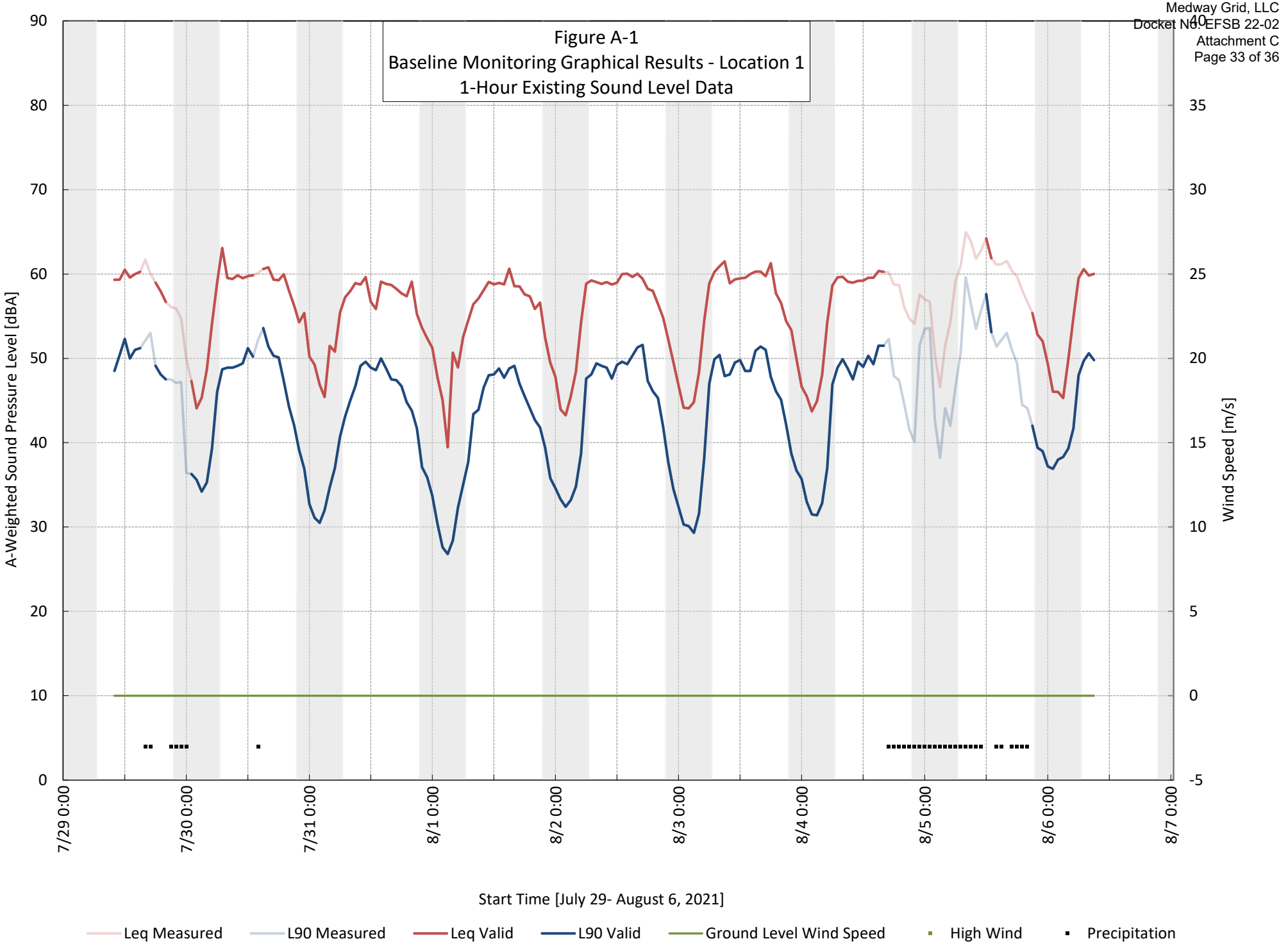


Figure A-1
Baseline Monitoring Graphical Results - Location 1
1-Hour Existing Sound Level Data
A-Weighted Sound Pressure Level [dBA]
Wind Speed [m/s]
90
80
70
60
50
40
30
20
10
0
40
35
30
25
20
15
10
5
0
-5
7/29 0:00
7/30 0:00
7/31 0:00
8/1 0:00
8/2 0:00
8/3 0:00
8/4 0:00
8/5 0:00
8/6 0:00
8/7 0:00
Start Time [July 29- August 6, 2021]
Leq Measured
L90 Measured
Leq Valid
L90 Valid
Ground Level Wind Speed
High Wind
Precipitation

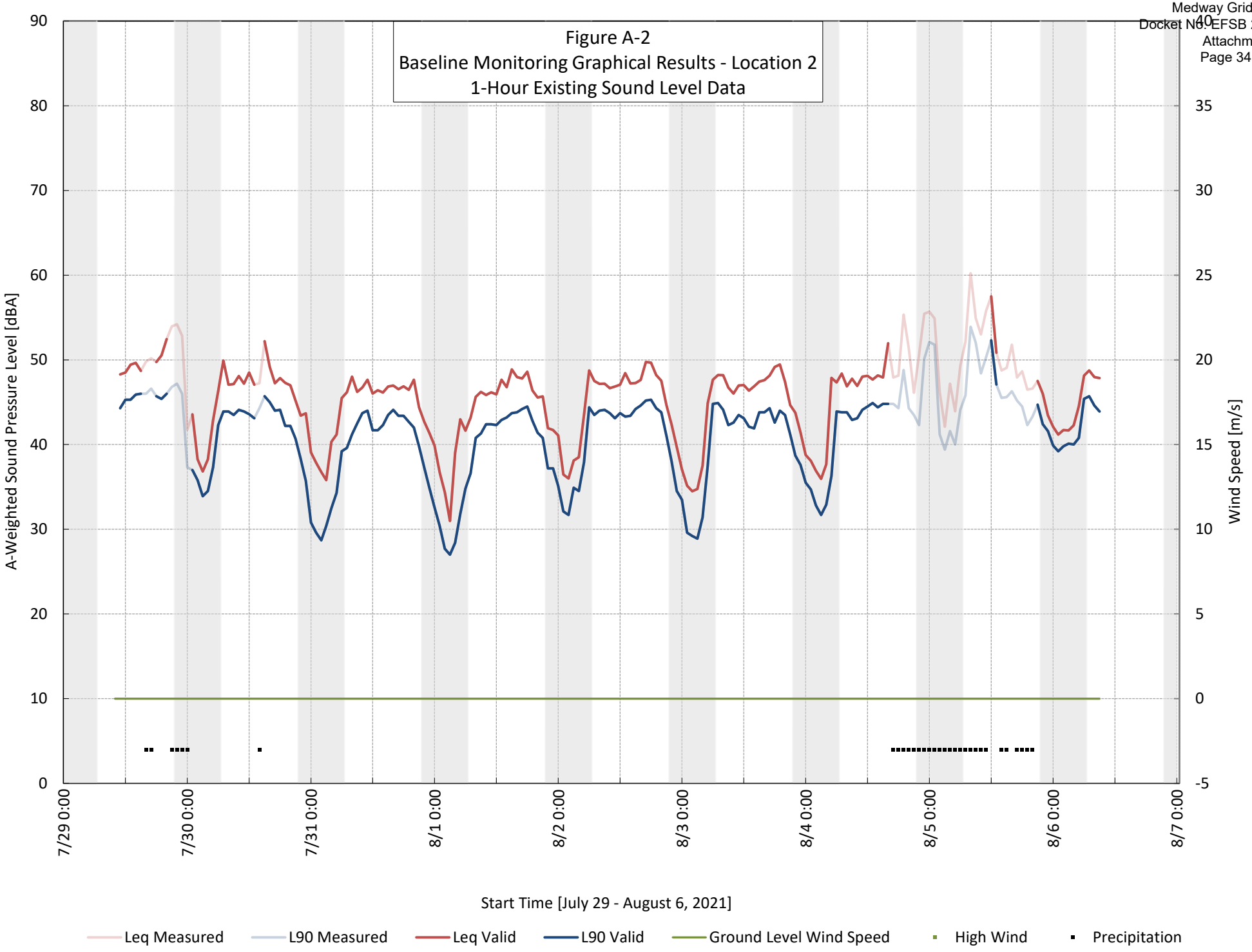


Figure A-2
Baseline Monitoring Graphical Results - Location 2
1-Hour Existing Sound Level Data
A-Weighted Sound Pressure Level [dBA]
Wind Speed [m/s]
90
80
70
60
50
40
30
20
10
0
40
35
30
25
20
15
10
5
0
-5
7/29 0:00
7/30 0:00
7/31 0:00
8/1 0:00
8/2 0:00
8/3 0:00
8/4 0:00
8/5 0:00
8/6 0:00
8/7 0:00
Start Time [July 29 - August 6, 2021]
Leq Measured
L90 Measured
Leq Valid
L90 Valid
Ground Level Wind Speed
High Wind
Precipitation

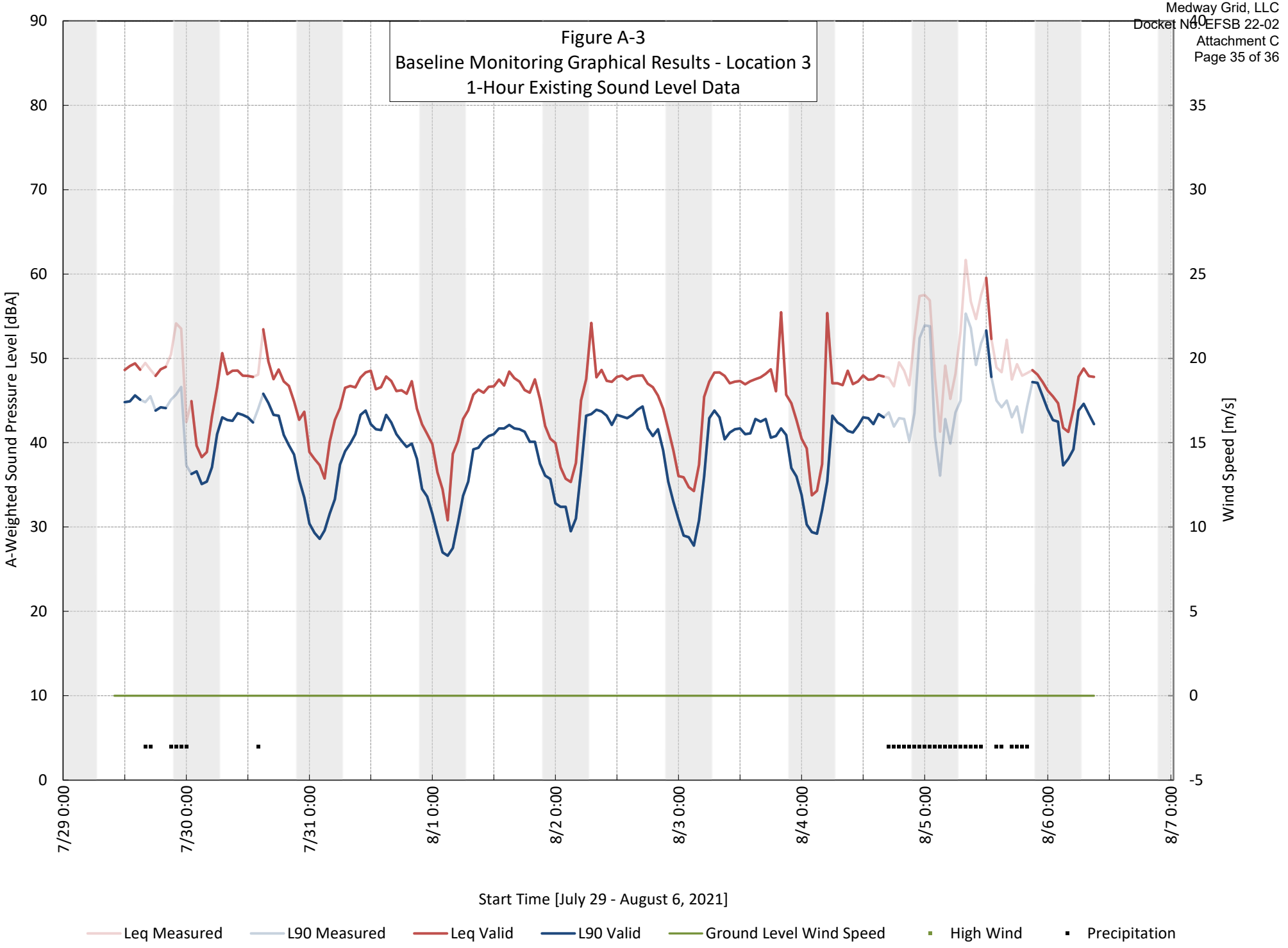


Figure A-3
Baseline Monitoring Graphical Results - Location 3
1-Hour Existing Sound Level Data
A-Weighted Sound Pressure Level [dBA]
Wind Speed [m/s]
90
80
70
60
50
40
30
20
10
0
40
35
30
25
20
15
10
5
0
-5
7/29 0:00
7/30 0:00
7/31 0:00
8/1 0:00
8/2 0:00
8/3 0:00
8/4 0:00
8/5 0:00
8/6 0:00
8/7 0:00
Start Time [July 29 - August 6, 2021]
Leq Measured
L90 Measured
Leq Valid
L90 Valid
Ground Level Wind Speed
High Wind
Precipitation

Figure A-4
Baseline Monitoring Graphical Results - Location 4
1-Hour Existing Sound Level Data