



DATE: June 9, 2017

TO: Gregory Lindstadt, PE – CDM Smith, Inc.

FROM: Justin Morgan, INCE – The Greenbusch Group, Inc.
Drew Savas – The Greenbusch Group, Inc.

RE: North Transfer Station –2017 Q2 Noise Monitoring Report

Transmitted by: Mail Delivery Fax E-mail

INTRODUCTION

The intent of this memorandum is to present the results of staffed sound level measurements conducted on May 3 and May 6, 2017 to document daytime and nighttime sound levels from operations at the North Transfer Station and to determine compliance with applicable regulatory criteria.

NOMENCLATURE

The auditory response to sound is a complex process that occurs over a wide range of frequencies and intensities. Decibel levels, or “dB,” are a form of shorthand that compresses this broad range of intensities with a convenient numerical scale. The decibel scale is logarithmic. For example, using the decibel scale, a doubling or halving of energy causes the sound level to change by 3 dB; it does not double or halve the sound loudness as might be expected.

The minimum sound level variation perceptible to a human observer is generally around 3 dB. A 5-dB change is clearly perceptible, and an 8 to 10 dB change is associated with a perceived doubling or halving of loudness. The human ear has a unique response to sound pressure. It is less sensitive to those sounds falling outside the speech frequency range. Sound level meters and monitors utilize a filtering system to approximate human perception of sound. Measurements made utilizing this filtering system are referred to as “A weighted” and are called “dBA”.

Common sound pressure levels are presented in Table 1.

Table 1. A-weighted Levels of Common Sounds

Sound	Sound Level (dBA)	Approximate Relative Loudness ¹
Jet Plane @ 100 feet	130	128
Rock Music with Amplifier	120	64
Thunder, Danger of Permanent Hearing Loss	110	32
Power Mower	100	16
Food Blender at 3 feet	90	8
Busy Street	80	4
Interior of Department Store	70	2
Ordinary Conversation at 3 feet	60	1
Quiet Car at Low Speed	50	1/2
Average Office	40	1/4
City Residence, Interior	30	1/8
Quiet Country Residence, Interior	20	1/16
Rustle of Leaves	10	1/32
Threshold of Hearing	0	1/64

1. As compared to ordinary conversation at 3 feet.

Source: US Department of Housing and Urban Development, *Aircraft Noise Impact Planning Guidelines for Local Agencies*, November 1972., California Department of Transportation

Metrics

- **Equivalent Sound Level, L_{eq}**

L_{eq} is the A-weighted level of a constant sound having the same energy content as the actual time-varying level during a specified interval. The L_{eq} is used to characterize complex, fluctuating sound levels with a single number. Typical intervals for L_{eq} are hourly, daily and annually.

- **Maximum Sound Level, L_{max}**

L_{max} is the maximum recorded root mean square (rms) A-weighted sound level for a given time interval or event. L_{max} “fast” is defined as a 125-millisecond time-weighted maximum, while L_{max} “slow” corresponds to a 1-second time-weighted maximum. All values in this report are “fast” time-weight, which corresponds closest to the typical response time of the human ear.

- **Sound Pressure Level, SPL**

Sound pressure level correlates with what is heard by the human ear. SPL is defined as the squared ratio of the sound pressure with reference to 20 μ Pa. Sound pressure is affected by distance, path, barriers, directivity, etc.

REGULATORY CRITERIA

The Seattle Municipal Code (SMC) Section 25.08 specifies permissible sound levels within the City of Seattle. SMC 25.08.410 defines allowable exterior sound level limits based on land use zoning, as listed in Table 2 below.

Table 2. Exterior Sound Level Limits, L_{eq}^1 (L_{max}^2)

District of Sound Source	District of Receiving Property		
	Residential	Commercial	Industrial
Residential	55 (70)	57 (72)	60 (75)
Commercial	57 (72)	60 (75)	65 (80)
Industrial	60 (75)	65 (80)	70 (85)

1. Measurement time is 1-minute minimum for a constant sound source, 1-hour for a non-continuous sound source.
 2. During measurement intervals, L_{max} may exceed L_{eq} limits by no more than 15 dBA.

Source: SMC 25.08.410 Exterior Sound Level Limits

Modifications to the exterior sound level limits set forth in Table 2 above are outlined in SMC 25.08.420. These modifications are for certain times of the day, classification of receiving properties, and the type of sound generated. These modifications to the exterior sound level limits include the following reductions:

- 10 dBA during the nighttime hours between the hours of 10:00 PM and 7:00 AM during weekdays and 10:00 PM and 9:00 AM on weekends and legal holidays when the receiving property is within a Residential district.
- 5 dBA for sources that carry a pure tone component.
- 5 dBA for impulsive sources not measured with an impulse sound level meter.

These modifications are cumulative and independent of one another. Therefore, the permissible nighttime exterior sound level in a Residential district for an impulsive, tonal source would be 20 dBA less than the exterior sound levels described in Table 2 above.

The area surrounding the Transfer Station is a mix of Residential (SF 5000) to the North and East, Commercial (C2) to the North, East and Southwest, and Industrial Commercial (IC-45) to the West and South. The Site is zoned Industrial Buffer, Industrial Commercial as well as Commercial, however the community agreement requires that for the evaluation of compliance with Noise Code, the entire site is considered a Commercial zone. The permissible daytime sound level limits for the Transfer Station at receiving property lines are summarized in Table 3 below.

Table 3. Transfer Station Sound Level Limits, L_{eq} (L_{max})

Time Period	Residential	Commercial	Industrial
Daytime	57 (72)	60 (75)	65 (80)
Nighttime	47 (62)	60 (75)	65 (80)

SOUND LEVEL MEASUREMENTS

Staffed sound level monitoring took place between 8:00 AM and 5:30 PM on Wednesday May 3, 2017 and from 8:00 AM to 9:00 AM on Saturday May 6, 2017. Measurements on May 3, 2017 were made for the duration of the station's operating hours and coincided with the facility's peak operating times based on information provided by SPU. The measurements on May 6, 2017 were conducted to assess compliance with nighttime SMC sound level limits while the station operates between 8:00 AM and 9:00 AM on weekends, when nighttime sound level limits apply.

During both measurement periods, sound levels were monitored concurrently near two residential properties north and east of the Transfer Station. Wind speed on May 3, 2017 averaged 1 mile per hour from the west-southwest and temperatures ranged between 58 and 73 degrees Fahrenheit. On May 6, 2017 winds were calm and temperatures ranged between 47 and 49 degrees Fahrenheit. No precipitation was recorded during the measurement periods. During these measurements, monitoring staff were stationed near the sound level meters to document specific on-site noise events. Measurements of operational noise were conducted in general accordance with the most recent version of ASTM E1503.

Measurement Equipment

Sound level measurements were conducted using ANSI Type 1 instrumentation calibrated by a certified laboratory within one year of the measurement date, summarized in the Table below.

Table 4. Measurement Equipment

Make and Model	Description	Serial
Svantek 971	Sound level analyzer	51818
Svantek SV18	Preamplifier	49561
Aco Pacific 7052E	Microphone	62522
Larson Davis CAL200	Acoustic calibrator	9512
Svantek SV200	Sound level analyzer	39777
MK250	Microphone	10978
Larson Davis CAL200	Acoustic Calibrator	9512

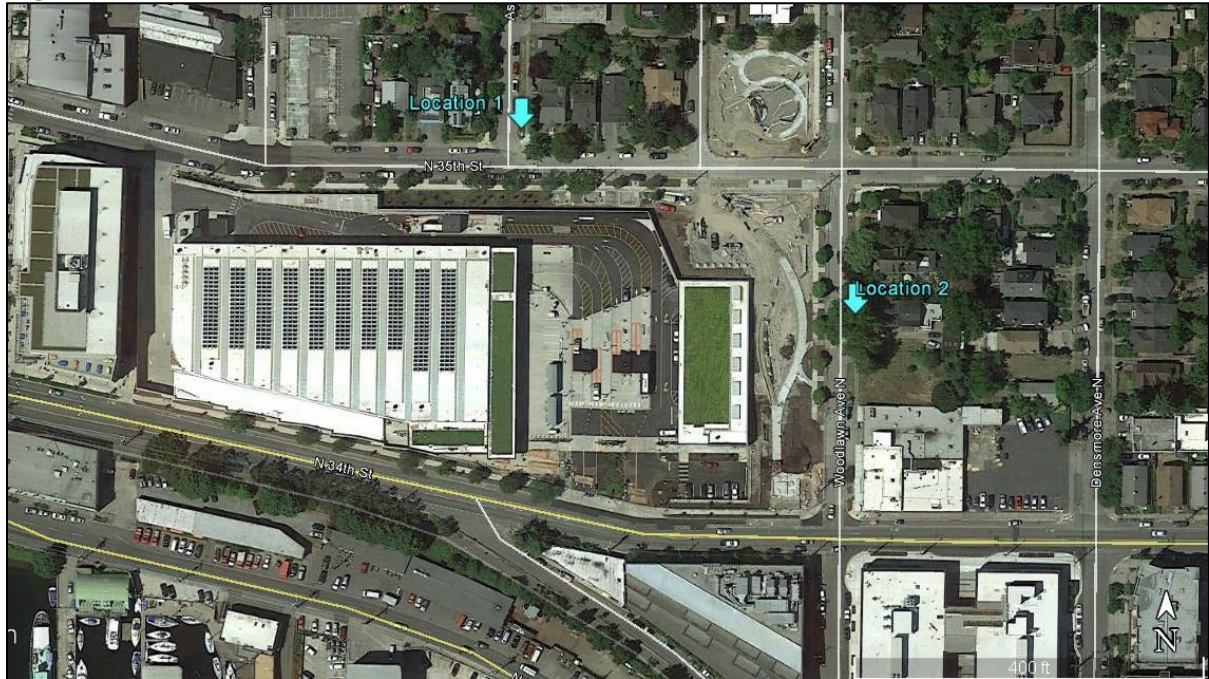
Field calibrations of monitoring equipment were performed immediately before the measurements and verified immediately after the measurements were completed. Continuous audio recordings were made at both monitoring locations to allow for sound source identification after the measurements were completed. One-second and hourly average (L_{eq}) and maximum (L_{max}) sound levels were collected during the monitoring.

Measurement Locations

Sound levels were measured at two residential properties near the Transfer Station. Continuous staffed monitoring took place between 8:00 AM and 5:30 PM on May 3 and 8:00 AM and 9:00 AM on May 6, 2017. Microphones were positioned as close to residential property lines as feasible at approximately ten feet above grade. A figure showing the measurement locations as well as the address closest to the monitoring locations are provided below.

- Location 1: 3512 Ashworth Avenue North (approximate)
- Location 2: 3420 Woodlawn Avenue North

Figure 1. Measurement Locations



Photos of the sound monitoring equipment at the two monitoring locations are provided in Photos 1 and 2 below.

Photo 1. Equipment at Location 1



Photo 2. Equipment at Location 2



RESULTS

After the measurements were completed, the data was reviewed to identify noise events associated with on-site operations at the Transfer Station. Due to the high number of off-site sound sources at the monitoring locations, average sound levels (L_{eq}) from the Transfer Station were not able to be determined, therefore the analysis is restricted to maximum sound levels (hourly L_{max}) only. Off-site sound sources included pedestrian and vehicle traffic, wildlife and aircraft. Figures illustrating the measured L_{max} sound levels and identifying all events above the SMC L_{max} sound level limit are provided in the Appendix.

Exceedances

Sound levels from Transfer Station operations exceeded SMC L_{max} sound level limits at Location 1 during the 12:00 PM hour on May 3, 2017 and twice during the 8:00 AM hour on May 6, 2017, as summarized in Table 5 below.

Table 5. L_{max} Sound Level Exceedances

Date	Time	SMC L_{max} Limit	Measured Sound Level	Event
May 3, 2017	12:37:22 PM	72 dBA	73 dBA	Dumping/moving debris
May 6, 2017	8:32:52 AM	62 dBA	63 dBA	Dumping/moving debris
	8:54:43 AM		63 dBA	Dumping/moving debris

One L_{max} exceedance was measured on May 3, 2017 at 12:37 PM. This exceedance is believed to be the result of trash or metal being dumped or moved by the loader while the residential haul doors were open and exceeded SMC limits by 1 dB. It should be noted that the accuracy of the measurement instrumentation is within ± 1 dB. During the measurements on May 3, 2017, monitoring staff noted that the residential haul doors remained open for extended periods of time. In particular, monitoring staff noted doors were open from approximately 12:50 PM until 2:10 PM. The commercial haul door was also open during the 4:00 PM hour; however it is our understanding that commercial haul vehicles do not use the transfer station after 3:00 PM.

Nighttime L_{max} sound level limits were exceeded twice the morning of May 6, 2017 during the 8:00 AM hour. These exceedances are believed to be the result of trash or metal being dumped or moved by the loader. Both events exceeded the nighttime SMC L_{max} sound limit by 1 dB. It is not known whether the residential haul doors were open during these exceedances.

All other on-site activities, including dumping and moving of debris were below the SMC L_{max} sound level limit.

Backup Alarms

With the exception of the three events described above the L_{max} sound levels from the Transfer Station were below the SMC L_{max} limits. However, at 9:30 AM on May 3, 2017 the loader drove outside the Transfer Station to the fueling station. When the loader backed into the fueling station the backup alarms were activated and resulted in L_{max} sound levels ranging between 60 dBA and 70 dBA at Location 1. After the loader had completed fueling the loader backed up in order to turn around and re-enter the Transfer Station, which resulted in an L_{max} sound level of 63 dBA at Location 1 at 9:41 AM. Although the backup alarm did not generate a noise exceedance because it was during daytime hours, the event

would have exceeded nighttime limits, which apply between 8:00 AM and 9:00 AM on weekends. A photo of the loader during fueling is provided below.

Photo 3. Loader at Fueling Station



Backup alarms were the most frequent audible sound source from the Transfer Station at Locations 1 and 2. Monitoring staff noted that the backup alarms were noticeably louder at both measurement locations when the commercial or residential haul roll-up doors were open, however because sound levels at the monitoring locations were below ambient conditions the actual reduction in sound levels could not be quantified.

Generator

The generator installed near the northwest corner of the Transfer Station property was exercised during the monitoring period on May 3, 2016. Monitoring staff noted it was running between 12:44 PM and 1:06 PM and had turned off sometime before 1:46 PM. Sound levels measured at Location 1 did not significantly increase during periods the generator was operating. Monitoring staff observed the generator was only audible during periods when other off-site sound sources were not present. Review of audio recordings indicates sound produced by the generator is approximately 52 dBA at Location 1. Although sound produced by emergency equipment, including generator testing is exempt from SMC sound level limits, the generator at the Transfer Station appears to comply with SMC daytime limits. A photo of the generator while it was being exercised is provided below.

Photo 4. On-Site Generator



Off-Site Sound Sources

During the measurements the two sound level meters recorded a combined total of 1,345 seconds of data above either the SMC daytime or nighttime L_{max} sound level limit. Of the 1,345 seconds of events above the L_{max} sound level limit, only three seconds can be attributed to the operation of the Transfer Station. The remaining 1,342 events were the result of off-site sound sources including: vehicle traffic (cars, busses, delivery trucks and off-site haul trucks), car horns, aircraft, pedestrians, dogs, and car doors. These off-site sound sources are summarized in Table 6 below and are presented graphically in the Appendix.

Table 6. Number of Seconds Off-Site Sound Sources Exceeded SMC L_{max} Limits

Event	May 3, 2017		May 6, 2017		Total Events
	Location 1	Location 2	Location 1	Location 2	
Vehicle	281	136	284	168	869
Car Horn	5	8	0	7	20
Plane	65	62	106	129	362
Pedestrian	5	3	2	71	81
Dog	0	5	0	3	8
Car Door	0	2	0	0	2

CONCLUSION

Operations at the Transfer Station exceeded daytime Seattle Municipal Code L_{max} sound level limits for one second during daytime hours and two seconds during nighttime hours. All exceedances were measured at the Location 1, north of the Transfer Station and were caused by dumping or moving of debris. All other on-site activities during the measurement period complied with Seattle Municipal Code sound level limits.

Respectfully submitted;



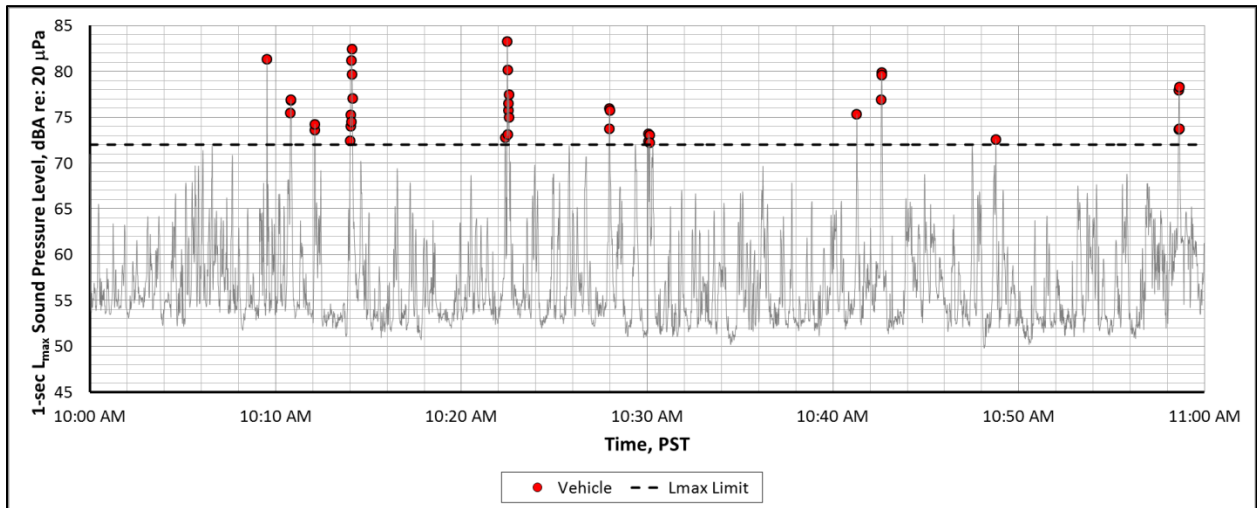
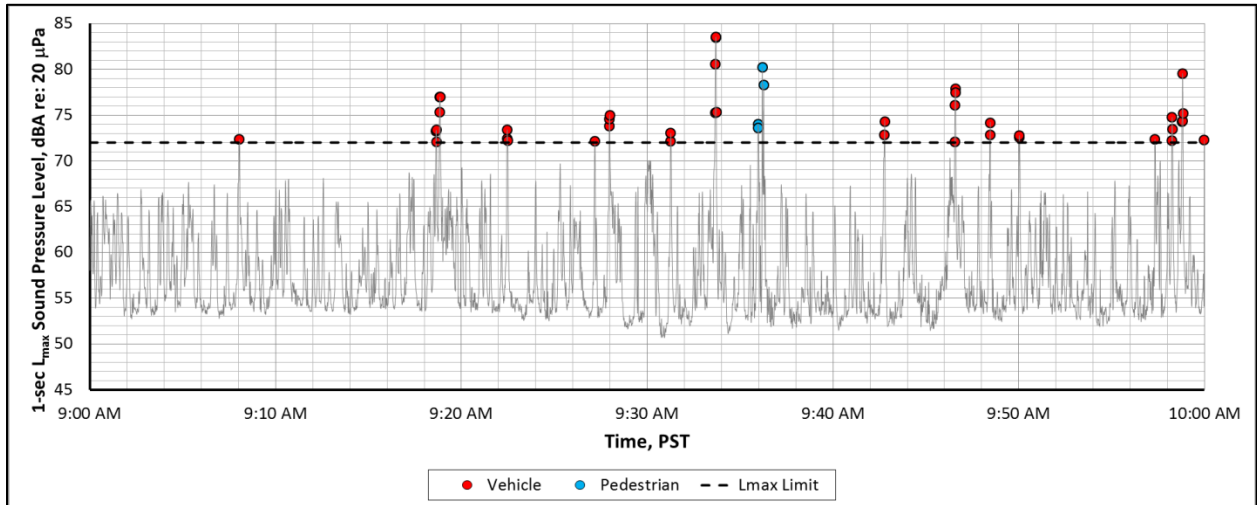
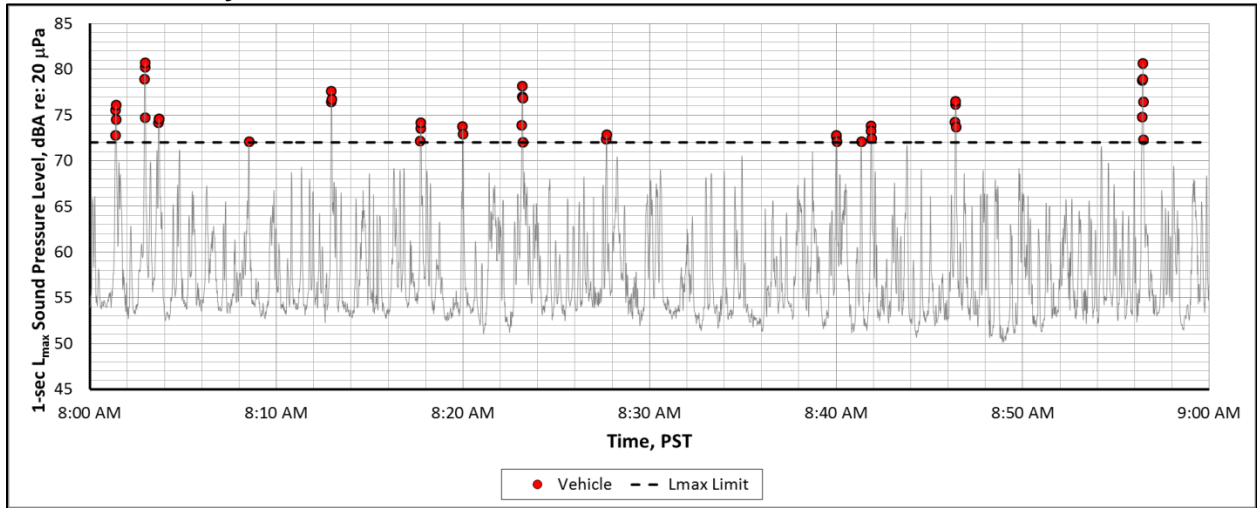
Justin B. Morgan, INCE

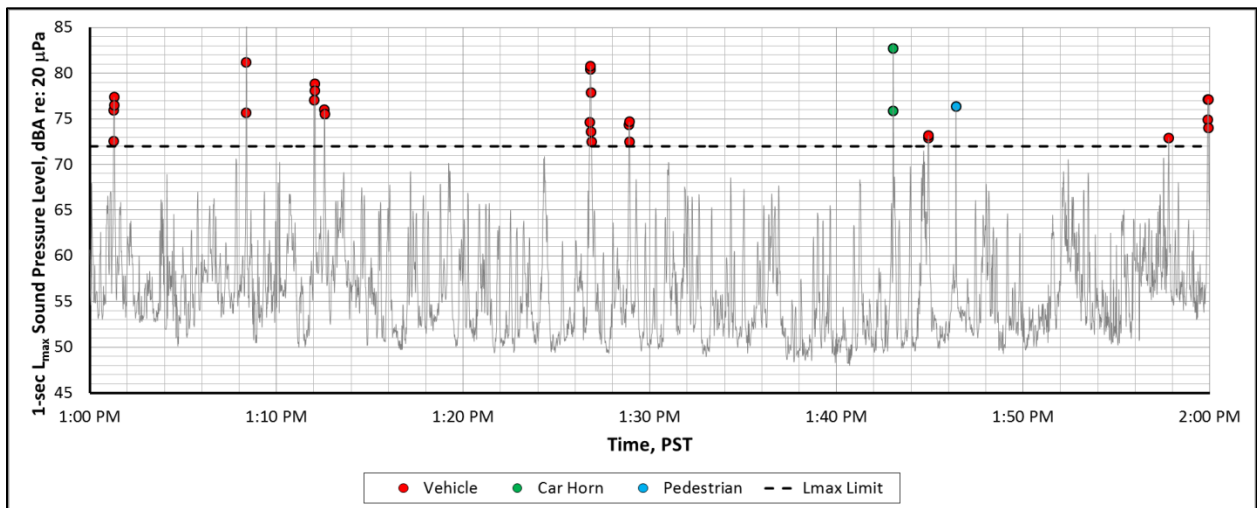
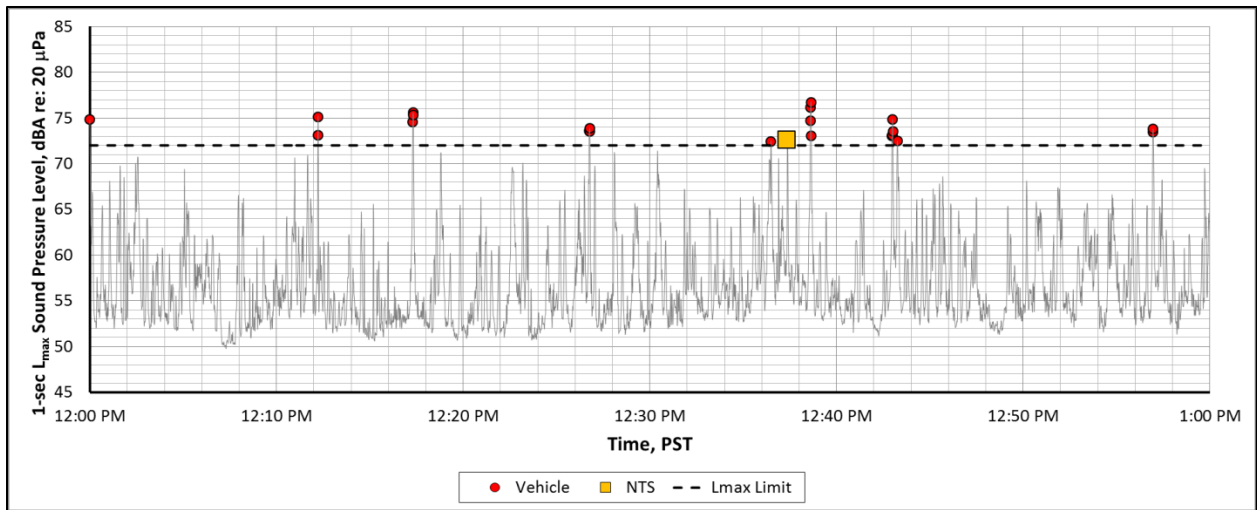
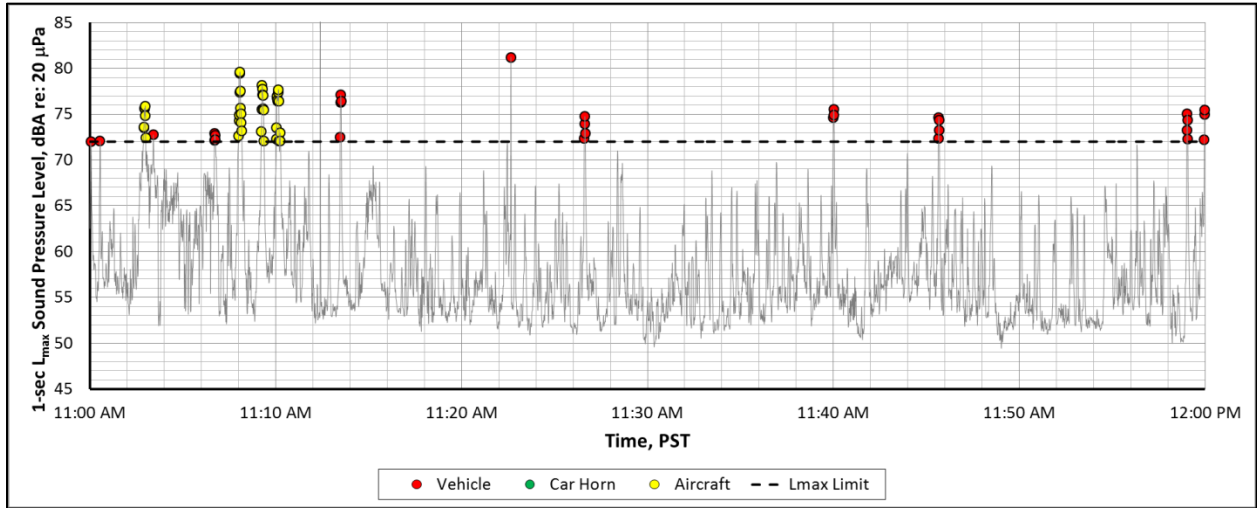


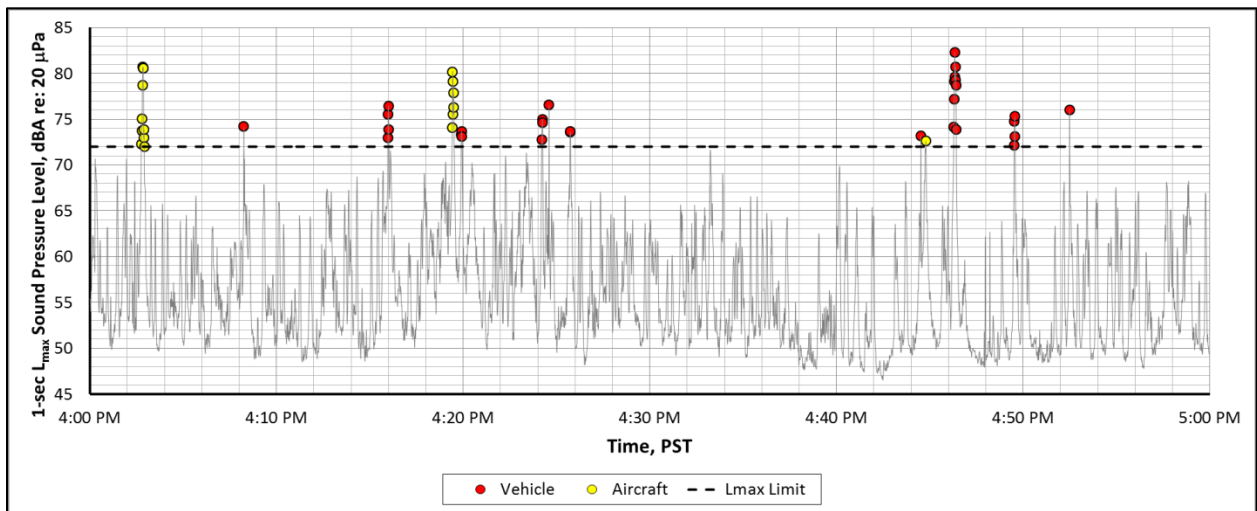
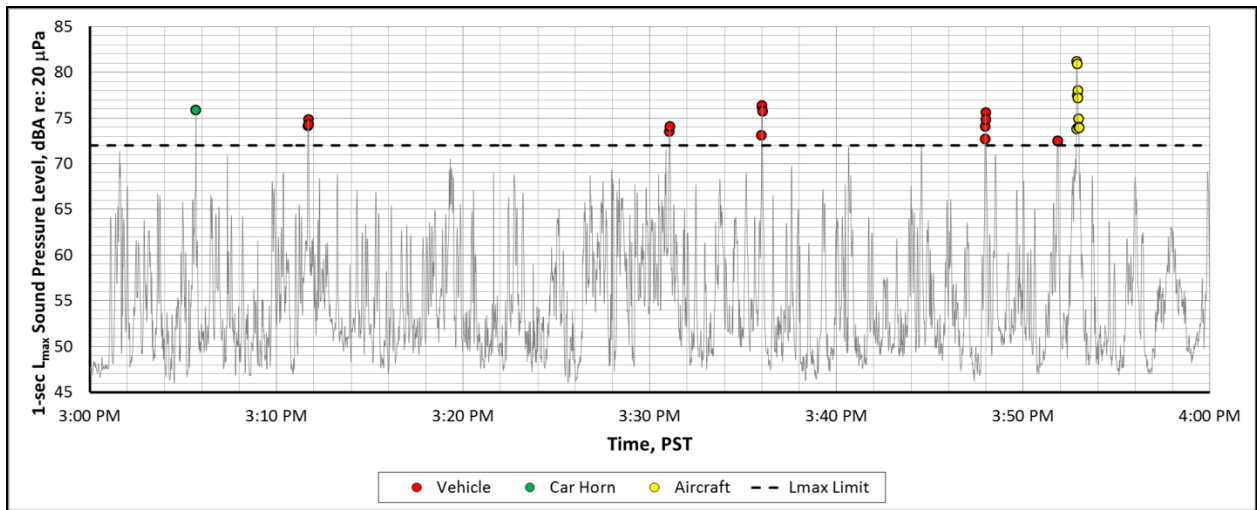
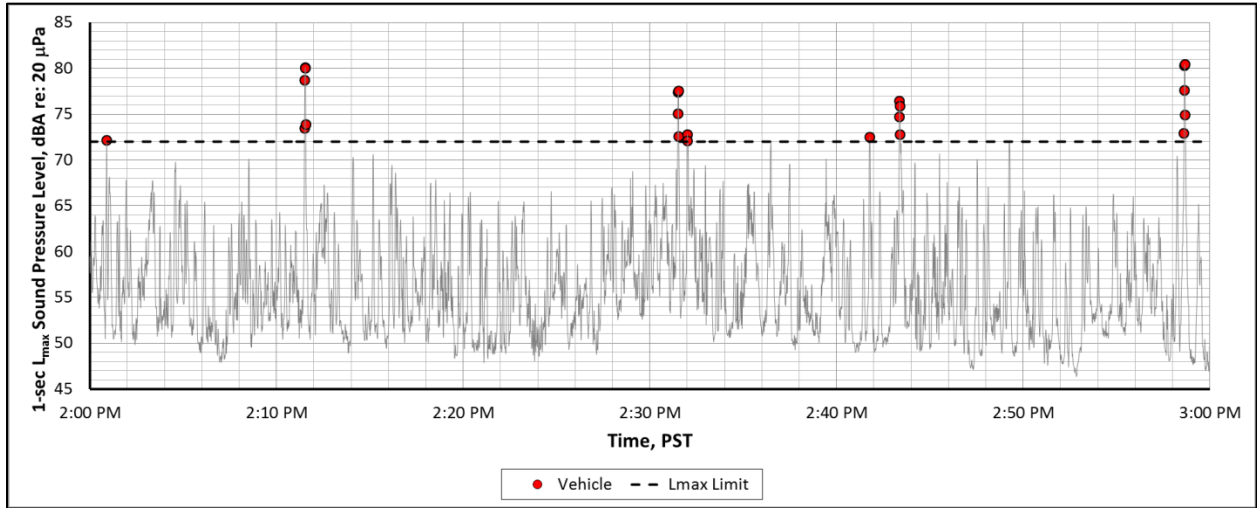
Drew Savas

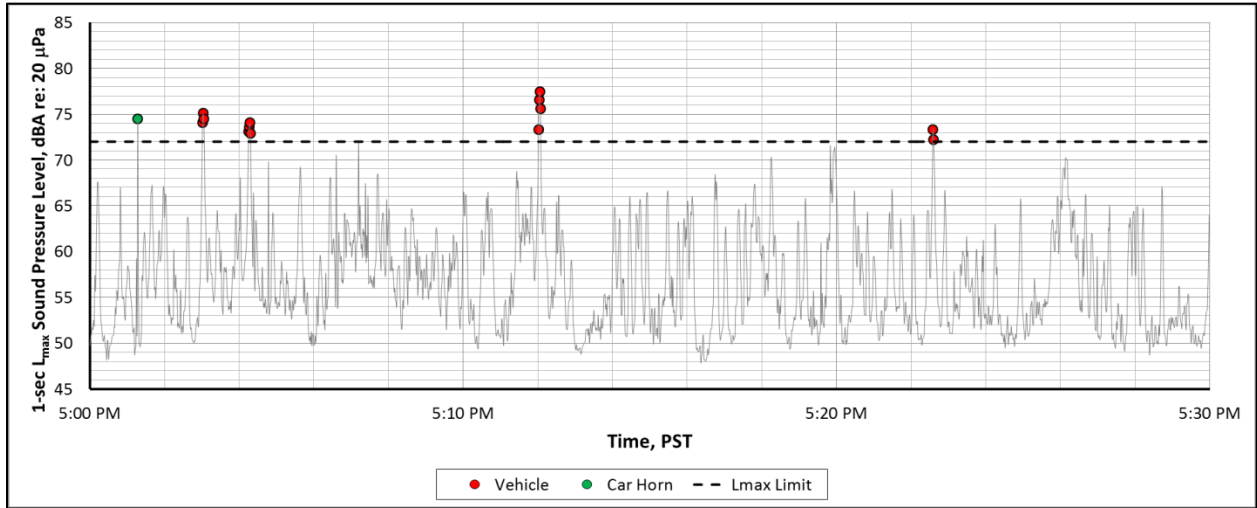
APPENDIX

Location 1 – May 3, 2017, L_{max} Sound Levels

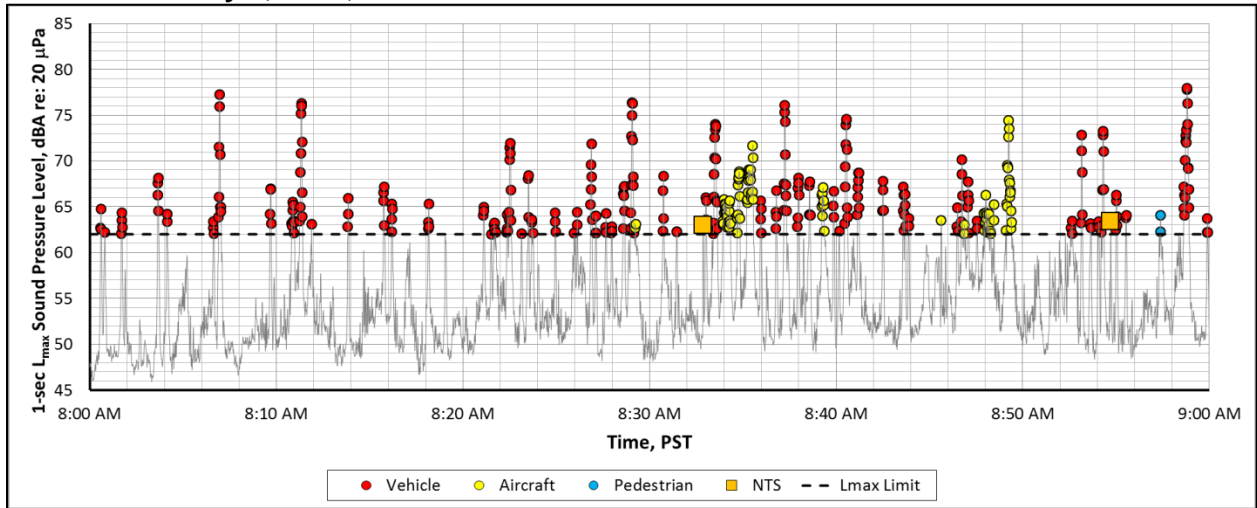




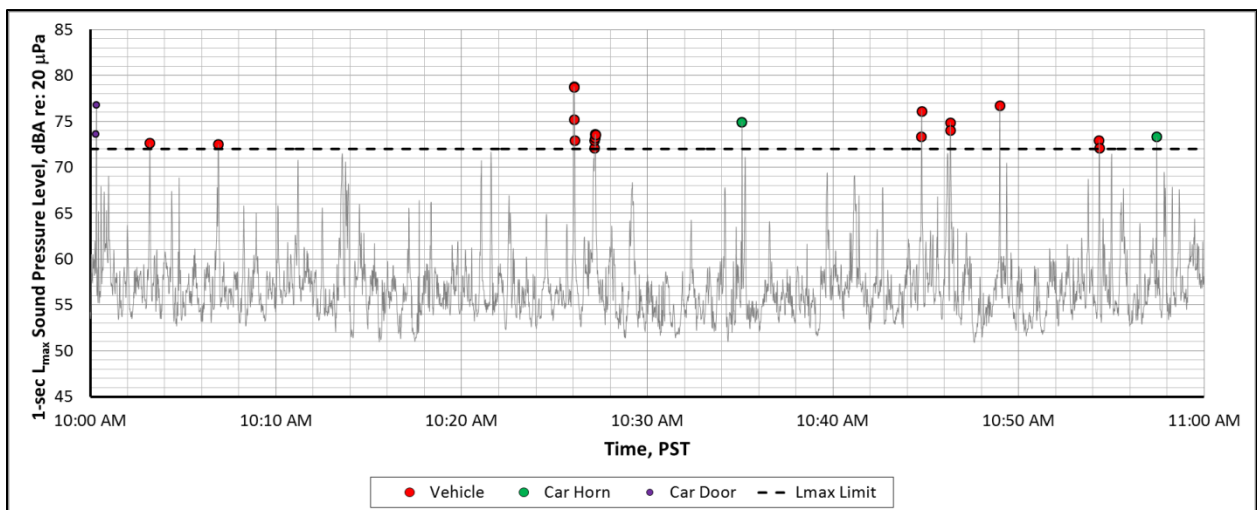
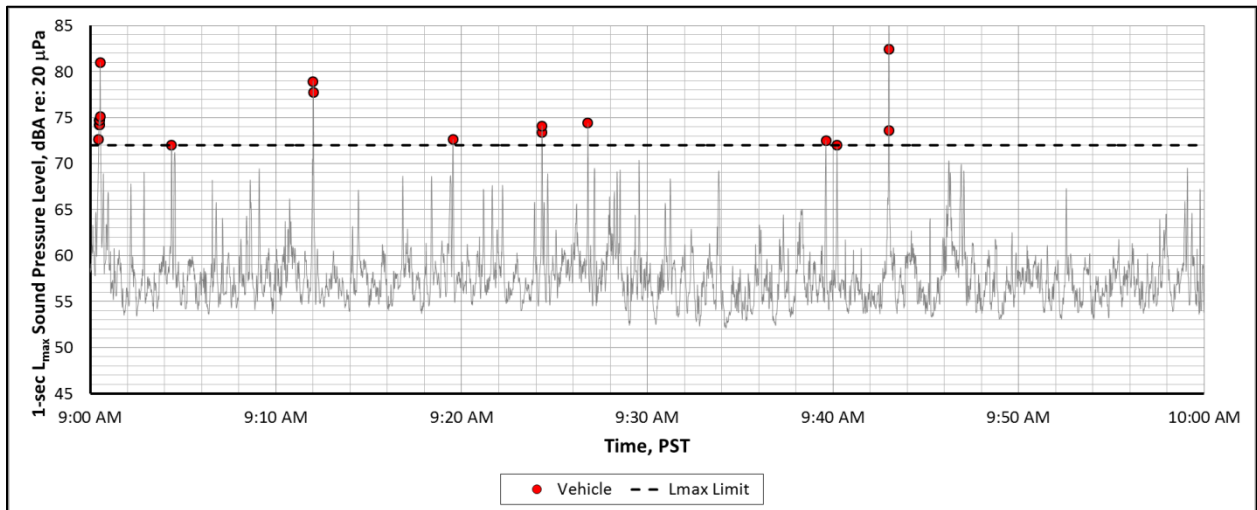
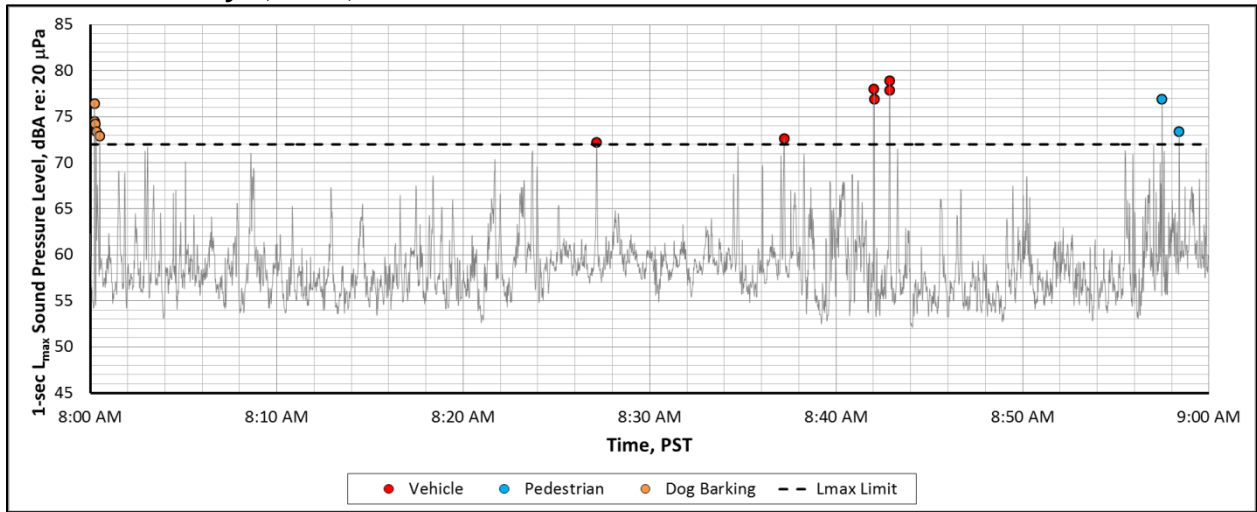


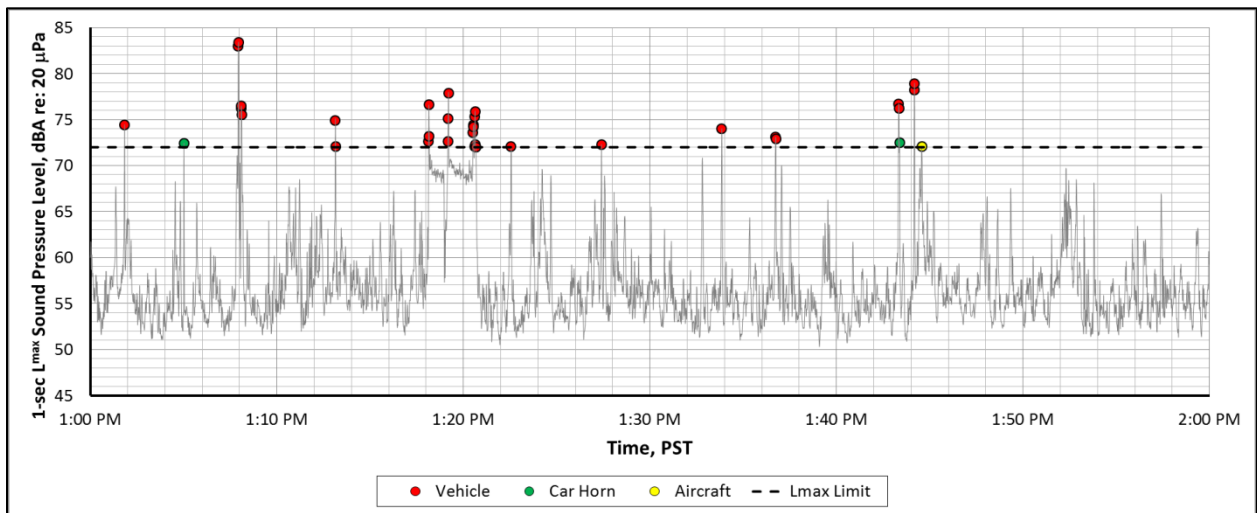
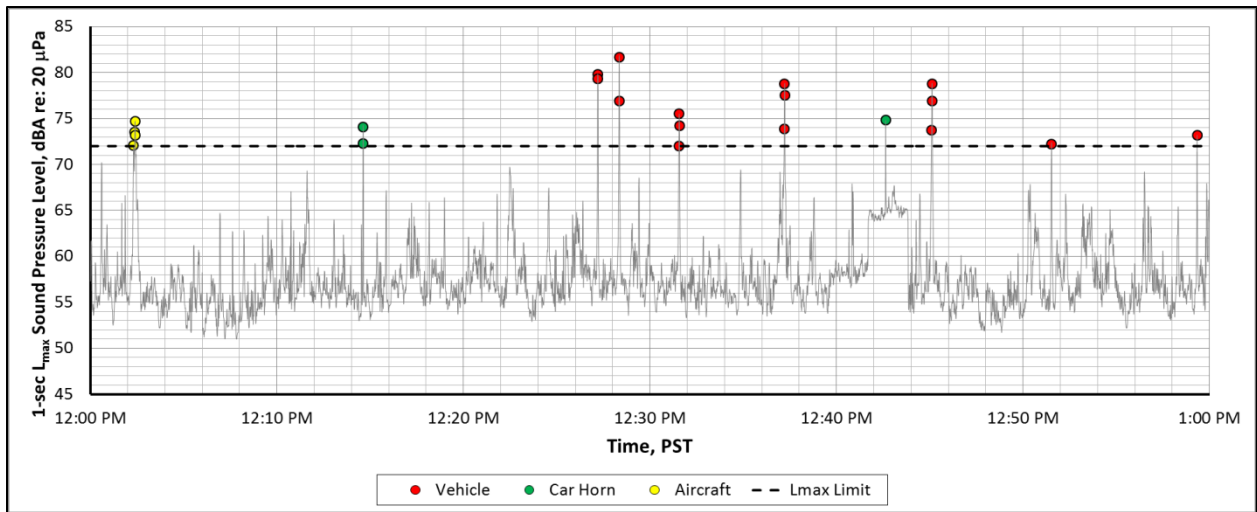
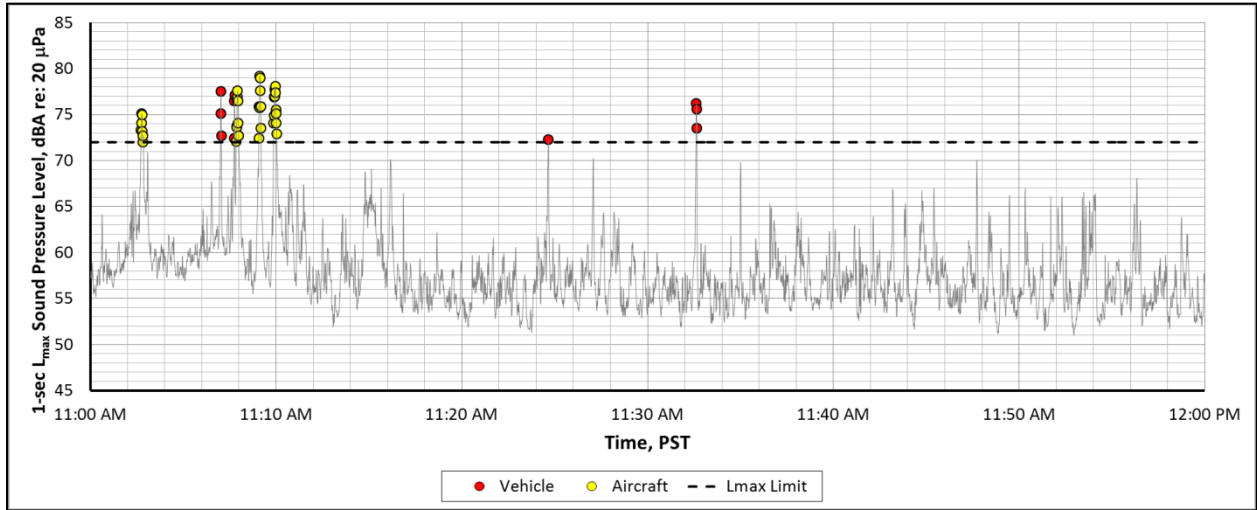


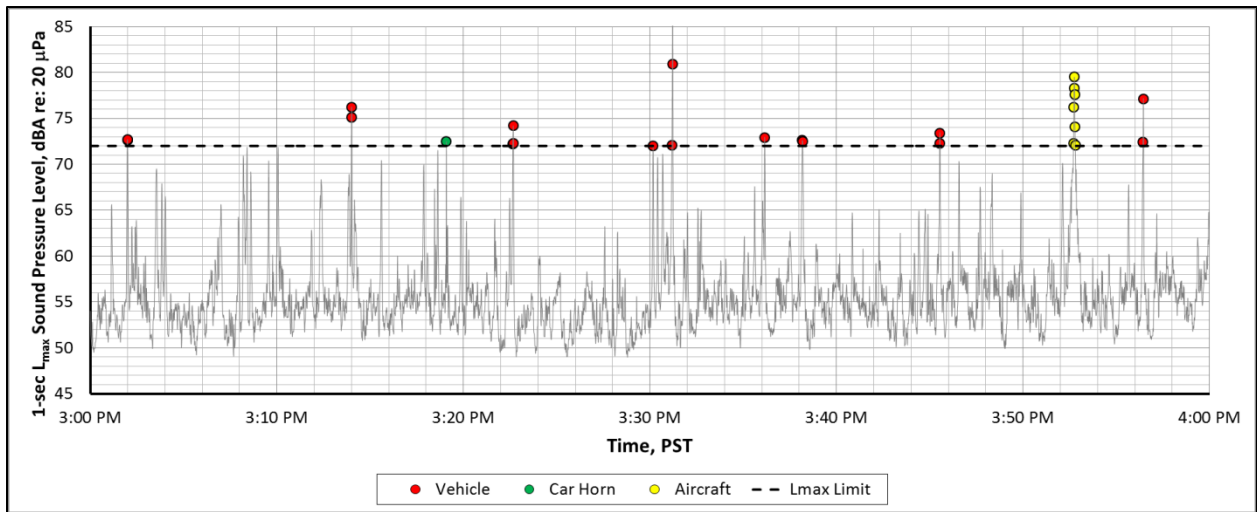
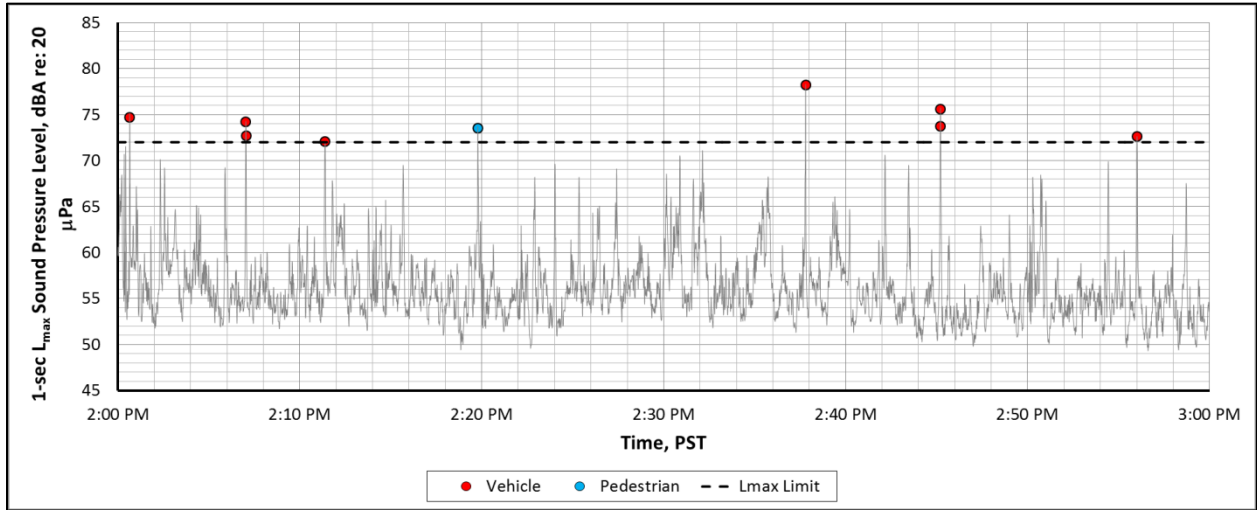
Location 1 – May 6, 2017, L_{max} Sound Levels

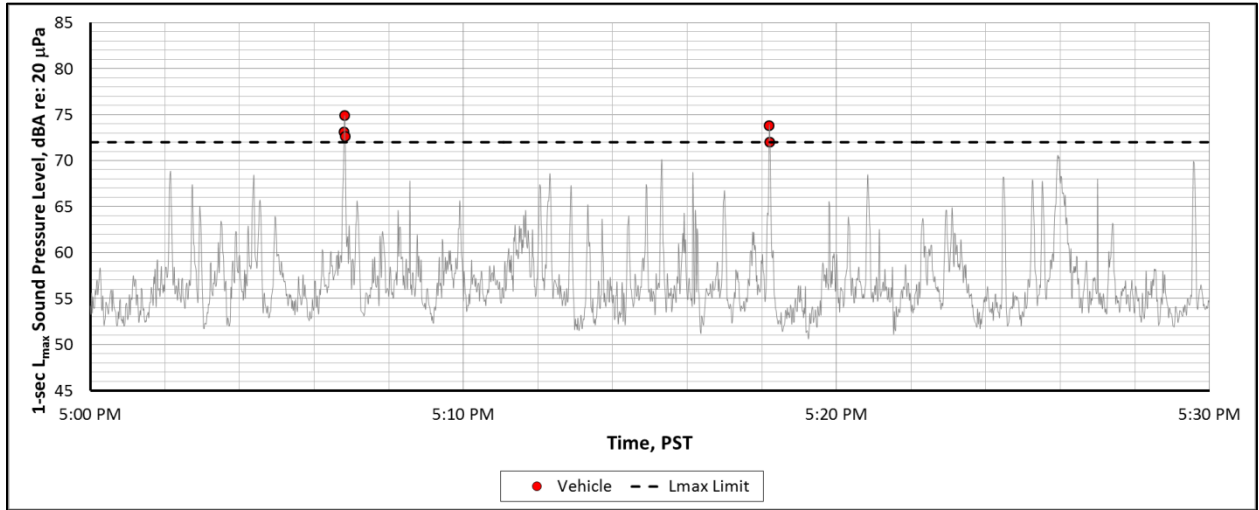


Location 2 – May 3, 2017, L_{max} Sound Levels









Location 2 – May 6, 2016, L_{max} Sound Levels

