SOUND LEVEL MONITORING REPORT

EVERPOWER BARON WINDS PRE-CONSTRUCTION SOUND LEVEL MONITORING

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1.0 INTRODUCTION

As part of its anticipated filing for a permit application under Article 10 of the New York Public Service Law, RSG conducted background sound monitoring around the proposed Baron Winds Wind Project (the "Project").

The Project will be located in the Towns of Wayland, Dansville, Cohocton, Fremont, Avoca, and Howard in Steuben County, New York. The area around the facility is primarily farmland, with some residential land and forested areas. It is a proposed as an up to 300 MW facility, incorporating up to 120 wind turbines and supporting infrastructure.

Pursuant to the rules of the New York State Board on Electric Generation Siting and the Environment ("Siting Board"), applicants must include the results of pre-construction sound monitoring in the application. Under 16 NYCRR § 1011.19, the application must include an "Exhibit 19" on "Noise and Vibration". The section of Exhibit 19 that relates to pre-construction sound monitoring includes:

> "(b) An evaluation of ambient pre-construction baseline noise conditions, including A-weighted/dBA sound levels, prominent discrete (pure) tones, at representative potentially impacted noise receptors, using actual measurement data recorded in winter and summer and during day and night as a function of time and frequency using a suitable and suitably calibrated sound level meter (SLM) and octave band frequency spectrum analyzer, or similar equipment. The ambient pre-construction baseline sound level should be filtered to exclude seasonal and intermittent noise.
>
> …
>
> (f) A statement in tabular form of the A-weighted/dBA sound levels indicated by measurements and computer noise modeling at the representative external property boundary lines of the facility and related facilities and ancillary equipment sites, and at the representative nearest and average noise receptors, for the following scenarios:
>
> > (1) Daytime ambient noise level - a single value of sound level equivalent to the level of sound exceeded for 90% of the time during the daytime hours (7 am - 10 pm) of a year (L((90))).
> >
> > (2) Summer nighttime ambient noise level - a single value of sound level equivalent to the level of sound exceeded for 90% of the time during the nighttime hours (10 pm - 7 am) during the summer (L((90))).
> >
> > (3) Winter nighttime ambient noise level - a single value of sound level equivalent to the level of sound exceeded for 90% of the time during the nighttime hours (10 pm - 7 am) during the winter (L((90))).
> >
> > …
> >
> > (7) Daytime ambient average noise level - a single value of sound level equivalent to the energy-average ambient sound levels (L_{EQ}) during daytime hours (7 am - 10 pm); …"

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In support of these requirements, RSG carried out long-term monitoring at the Baron Winds site in the winter and summer of 2015. In advance of the submission of a Preliminary Scoping Statement for the Project, RSG is submitting this report of the monitoring results. It covers the methodology for sound monitoring, including the reasoning behind the selection of representative sites, and the results of the monitoring. Specifically, the report includes:

1) Site selection;
2) Sound monitoring methodology;
3) Meteorological data collection methodology;
4) Sound monitoring results for each site;
5) Results for all sites combined;
6) Summary and conclusions.

2.0 SITE SELECTION

A detailed monitoring program was developed to assess the ambient sound levels for the variety of soundscapes that exist within the Project area. A map of the project area is shown in Figure 1. The Project area contains working farms and farmland, rural homesteads, local roads, and the Village of Haskinville. A recreational area(Loon Lake) is located just outside the project area. Monitoring sites were distributed within and just outside the project boundary to be as representative as possible of the broader local soundscapes experienced in the region.

2.1 | DESCRIPTION OF PROJECT AREA

The Project area is surrounded by three major roadways, Interstate 86, Interstate 390, and State Route 36. Interstate 86 runs along the southern edge of the Project, Interstate 390 runs along the northeastern edge of the Project, and State Route 36 runs in the north/south direction just to the west of the Project. State Route 21 runs from southwest to northeast through the Project

Land within the project boundary is split between forested land and agricultural land. Most flatter sections of the project area (valleys or hill tops) are cultivated. Transitional areas, such as the sides of hills, are mostly forested. Loon Lake, a recreational area is located in the northern portion of the project.

The non-forested areas in the region are dominated by livestock agriculture, that is, the raising of cattle for milk and beef. Beef and milk operations include cornfields and hayfields for livestock feed, open fields for grazing, milking barns, and the operation of farm equipment on local roads and throughout the fields.

Rural residential homesteads are located throughout the region, mostly occupying cleared land and old farm fields. Seasonal hobby activities such as snowmobiling, operation of off-road ATV's, hunting, fishing, and gardening are widespread.

2.2 | REPRESENTATIVE MONITOR LOCATIONS

Seven monitoring locations, distributed within and just outside the Project boundary, were selected as representative of the different ambient soundscapes in the area. The various representative areas included rural residential, farming, small town, low and high traffic roads, and remote areas. Monitoring locations are shown in Figure 1

The seven selected monitoring locations that represent these areas are referred to as "Brasted Road", "Rex/Dye Road", "Haskinville Road", "Henkle Hollow", "Loon Lake", "Rose Road", and "Walter Kurtz Road". The monitoring locations are listed in Table 1, which also indicates the defining characteristics of each location. The geographical distribution of the sites is shown on the map in Figure 1. Each of the sites is discussed further below.

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TABLE 1: MONITORING LOCATION CHARACTERISTICS

Site Name	Rural Residential	Active Farm	Small Town	Low Traffic	Truck Traffic	High Traffic	Remote Area	Recreational Area
Brasted Road	X	X		X				
Loon Lake						X		X
Dye/Rex Road				X	X			
Haskinville Road			X			X		
Rose Road	X	X		X				
Henkle Hollow Road	X	X		X				
Walter Kurtz Road							X	

3.0 BACKGROUND SOUND LEVEL MONITORING

3.1 | OVERVIEW OF SCOPE

Long term sound level monitoring was carried out at the sites over two weeks during the winter, from February 24 through March 12, 2015 and two weeks during the summer, from July 15 to July 31, 2015. Monitoring was interrupted between March 3 and March 4, 2015, while batteries were changed and data were downloaded. Monitoring locations are shown as part of the project area in Figure 1.

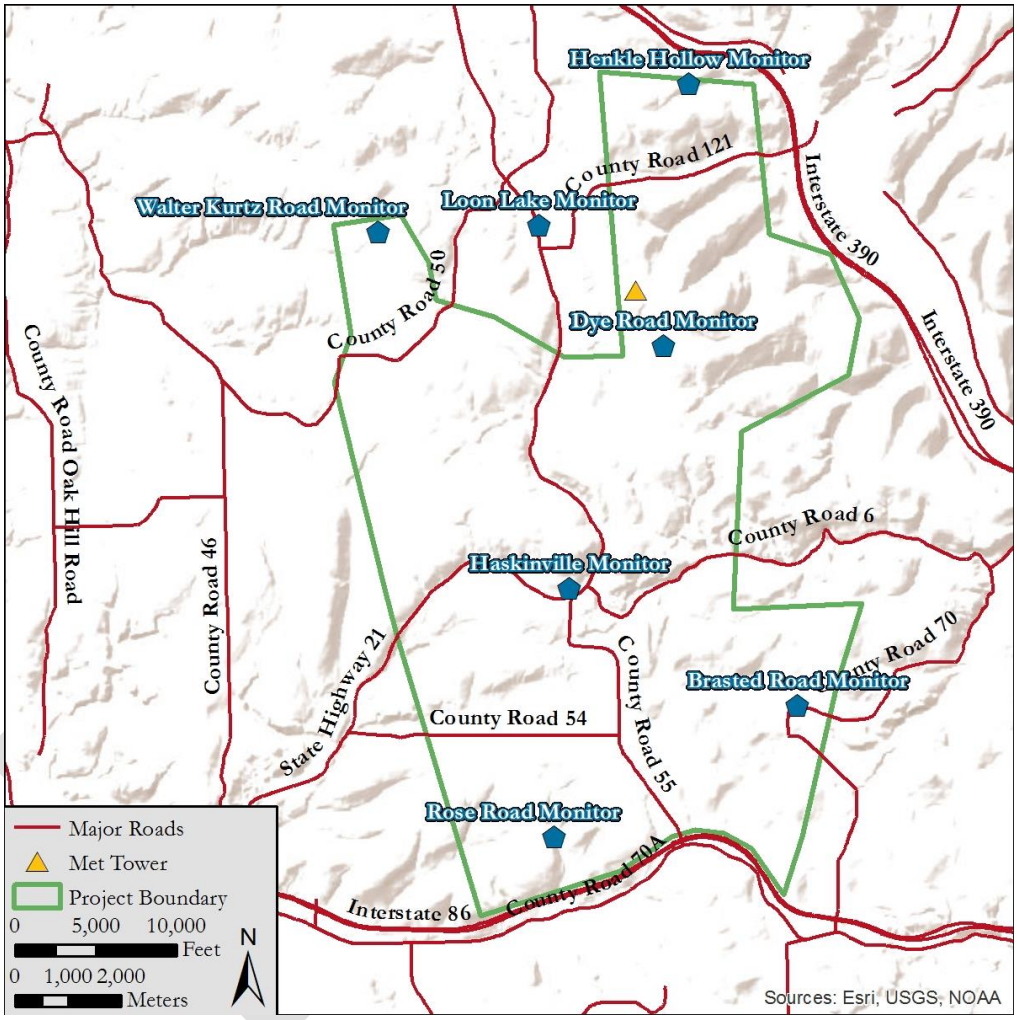

FIGURE 1: OVERVIEW OF MONITORING LOCATIONS FOR BARON WINDS

3.2 | METHODOLOGY

Sound level data were collected using six Cesva SC310 and one Svantek 979 sound level meters during the winter, and six Cesva SC310 and one Larson Davis LD831 sound level meters during the summer.[1] The meters continuously logged overall and 1/3-octave band sound levels once each second. Specific sound level meters used at each location, along with the specific metrics logged by each sound level meter are shown in Table 2. Each sound level meter microphone was mounted on a wooden stake at a height of approximately 1.2 m (4 ft) and protected by an ACO-Pacific hydrophobic windscreen (170 mm (7 in.) diameter). Audio signals from each microphone were recorded continuously throughout the monitoring period to allow for sound source identification. The Svantek meter was set to record digital audio internally, and the Cesva and Larson Davis meters were connected to Roland R-05 or R-09HR digital sound recorders.

Wind speeds were logged at four of the seven monitoring sites (Haskinville, Loon Lake, Rose Road, and Walter Kurtz Road). Precipitation and air temperature were logged at Loon Lake.

TABLE 2: SOUND LEVEL METER FREQUENCY RESPONSE AND SETTINGS

Monitor Location	Sound Level Meter Model	Serial Number	Frequency Range	Settings
Winter				
Brasted Road	Cesva SC-310	T220294	20 Hz to 10 kHz	1/3 Octave Bands
Loon Lake	Cesva SC-310	T224253	10 Hz to 20 kHz	1/3 Octave Bands, LZeq, LCeq, LAeq, LAfmax, LAI, LAImax, LASmax
Dye/Rex Road	Cesva SC-310	T221731	10 Hz to 20 kHz	1/3 Octave Bands, LZeq, LCeq, LAeq, LAfmax, LAI, LAImax, LASmax
Haskinville Road	Cesva SC-310	T224789	10 Hz to 20 kHz	1/3 Octave Bands, LZeq, LCeq, LAeq, LAfmax, LAI, LAImax, LASmax
Rose Road	Cesva SC-310	T231914	20 Hz to 10 kHz	1/3 Octave Bands
Henkle Hollow Road	Cesva SC-310	T235260	10 Hz to 20 kHz	1/3 Octave Bands, LZeq, LCeq, LAeq, LAfmax, LAI, LAImax, LASmax
Walter Kurtz Road	Svantek SV979	34091	20 Hz to 20 kHz	1/3 Octave Bands, LAeq, LApeak, LAfmax, LAfmin, LCeq, LCpeak, LCfmax, LCfmin, LZeq, LZpeak, LZfmax, LZfmin
Summer				
Brasted Road	Cesva SC-310	T220294	20 Hz to 10 kHz	1/3 Octave Bands
Loon Lake	Cesva SC-310	T224253	10 Hz to 20 kHz	1/3 Octave Bands, LZeq, LCeq, LAeq, LAfmax, LAI, LAImax, LASmax
Dye/Rex Road	Cesva SC-310	T231914	20 Hz to 10 kHz	1/3 Octave Bands
Haskinville Road	Cesva SC-310	T221731	10 Hz to 20 kHz	1/3 Octave Bands, LZeq, LCeq, LAeq, LAfmax, LAI, LAImax, LASmax
Rose Road	Cesva SC-310	T224789	10 Hz to 20 kHz	1/3 Octave Bands, LZeq, LCeq, LAeq, LAfmax, LAI, LAImax, LASmax
Henkle Hollow Road	Cesva SC-310	T235260	10 Hz to 20 kHz	1/3 Octave Bands, LZeq, LCeq, LAeq, LAfmax, LAI, LAImax, LASmax
Walter Kurtz Road	Larson Davis 831	02845	6.3 Hz to 20 kHz	1/3 Octave Bands, LAeq, LAS, LASmax, LAf, LAfmax

[1] These are Type 1 Sound Level Meters in conformance with standards ANSI S1.4-1983 and IEC 61672-1 (2002-05).

Sound level data from each monitor were averaged into 10-minute periods and summarized over the entire monitoring period. Data were excluded from the averaging under the following conditions:

- Wind gust speeds above 5 m/s (11 mph);
- Temperatures below -18° C (0° F)[2];
- Precipitation in the form of rain, sleet, or ice;
- Thunder;
- Anomalous sounds that were out of character for the area being monitored, such as snowmobiles passing immediately adjacent to the monitor; nearby chainsaws, lawn equipment, and nearby farm equipment;[3]
- Seasonal sound sources such as harvesting equipment, lawn mowers, and snow removal equipment; and
- During microphone calibration, when the levels are very high.

Particularly during summer monitoring, biogenic sounds including insects, amphibians, and birds were present. These are considered "seasonal" sounds. Under Article 10, these are required to be filtered out of the reported sound levels. To exclude these sounds, the "Ai" frequency-weighting network was applied to all logged data for which bird and insect sound was found. If tones[4] above 1.25 kHz were detected, then the A-weighted sound level was recalculated by summing 1/3 octave bands from 20 Hz to 1.25 kHz. This effectively removes the high-frequency portion of the sound.

3.3 | MONITORING RESULTS AT EACH SITE

TIME HISTORY GRAPHICS

For each monitor site, results are presented as graphs of sound level, temperature and gust wind speed as a function of time throughout the monitoring period. Each point on the graph represents data summarized for a single 10-minute interval. Equivalent continuous

---

[2] The sound level meters were certified to a temperature of -18° C (0° F) by repeated calibrations over two days while being held at that temperature, after an initial calibration at room temperature 20° C (68° F). Between room temperature and -18° C, the resulting calibration drifted by no more than 0.4 dB, providing confidence in the field data measured down to that temperature.

[3] An exception to this practice occurred for the data gathered at the Loon Lake site. The monitoring location was located 50 m (160 feet) from a well established snowmobile trail. Only vehicles that were operated very close to the monitor (those not on the trail) were excluded from the data.

[4] Sounds considered tonal that get the Ai weight applied are those for which a prominent discrete high frequency (>1.25 kHz) tone is found using either of the two methods:

1. If a 1/3 octave band exceeds the neighboring 1/3 octave band on either side by more than 5 dB (as in ANSI S12.9 Part 3 Annex B), or
2. If a 1/3 octave band exceeds the average of the two neighboring lower and two neighboring upper 1/3 octave bands on each side by more than 5 dB.

The latter method is used to capture complex bird harmonic sounds that would not be considered tonal under the first method.

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sound levels (L_{EQ}) are the energy-average sound level over 10 minutes. The tenth-percentile sound level (L_{90}) is the sound level that is exceeded 90% of the time during each 10-minute period. Edited data represent sound levels for those periods for which data have been excluded, as explained in Section 3.2. The reason for exclusion of data at a particular 10-minute interval (i.e., low temperature, wind gusts, or anomalous activity) is indicated in the lower portion of each figure. Sound level data during the excluded periods are shown in lighter shade for the L_{EQ} and L_{90}.

Wind data are presented as the maximum gust speed occurring at any time during each 10-minute interval: they are not averaged. However, since wind speed data were collected at only four out of the seven sites, wind data from some sites are applied to others nearby. The four northernmost locations had two sites measuring wind speed between them. Henkle Hollow data is shown with the other northern monitor (excluding Loon Lake) as the other monitors were also at higher elevations. For the three sites in the south, the Agricultural site was the only site without an anemometer. The wind gusts at the Haskinville site were typically stronger than those at Rose Road. Therefore, Haskinville wind data is shown for the Agricultural site, since it was in the middle of open fields.

MONITOR 1: BRASTED ROAD

The "Brasted Road" monitor was located at 8332 Connor Hill Road in Avoca, New York, near the intersection of Saxton Road and County Road 70. It was located near an active dairy operation. The site is located on the map in Figure 2. The monitor was installed near the fence dividing the lot containing a house and dairy barn from an adjacent pasture. Figure 3 and Figure 8 show the installed monitor in winter and summer conditions, with the microphone (in its windscreen) highlighted in red for the winter case.

Winter Monitoring

Long-term winter sound level results are plotted as time history graphs in Figure 4, Figure 5, and Figure 6, along with the gust wind speed (measured at Haskinville Road) and temperature (measured at Loon Lake). Higher sound levels during the day were caused by farming activity, which consisted of tractor operation and dairy barn equipment operation. Other contributing sources of sound were aircraft overflights (at least one per hour during the day and about one every two hours at night), dogs barking, and wind. The daytime and nighttime statistical sound levels are close, because farm operations sometimes began before 7AM and continued until after 10PM. When these sources are not present, sound levels at this site are low, leading to low overall nighttime L_{90} sound levels.

Tonality for the site is shown in Figure 7 as the number of tonal seconds per 10-minute period for each 1/3 octave band. At this site during the winter, tonality was not consistently found in any 1/3 octave band. Consistent tonality would be shown as tonality occurring for longer periods of time in Figure 7. Tonality in the 31.5 Hz 1/3 octave band was due to farm equipment.

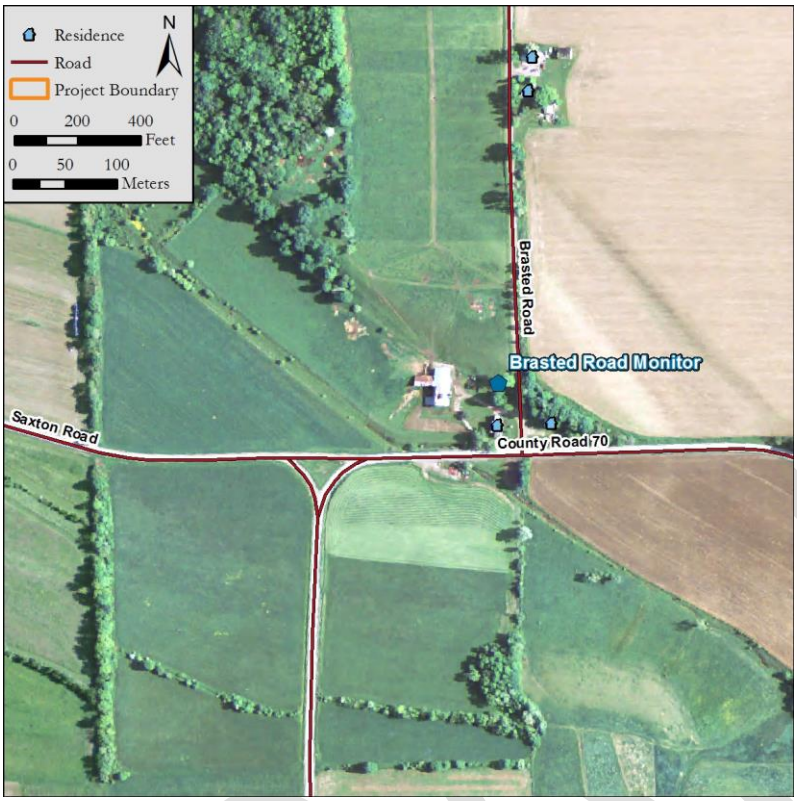

FIGURE 2: LOCATION OF THE AGRICULTURAL MONITOR

FIGURE 3: PHOTOGRAPH OF THE BRASTED ROAD MONITOR SITE IN WINTER, WITH MICROPHONE HIGHLIGHTED

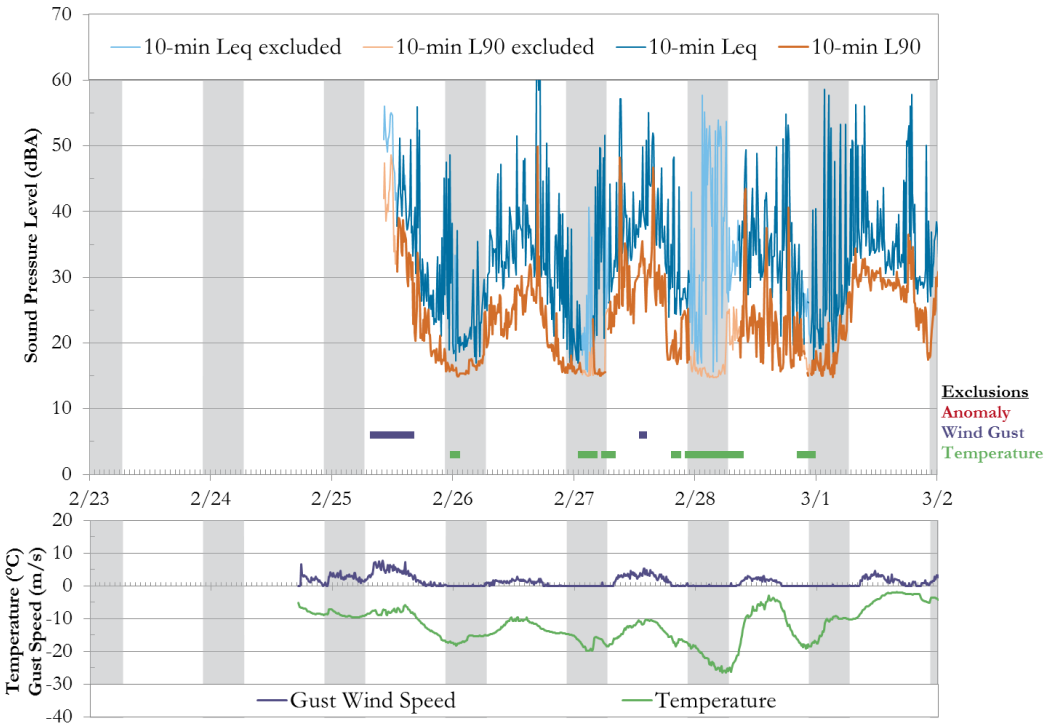

FIGURE 4: BRASTED ROAD MONITOR TIME HISTORY - FEBRUARY 25 TO MARCH 2, 2015

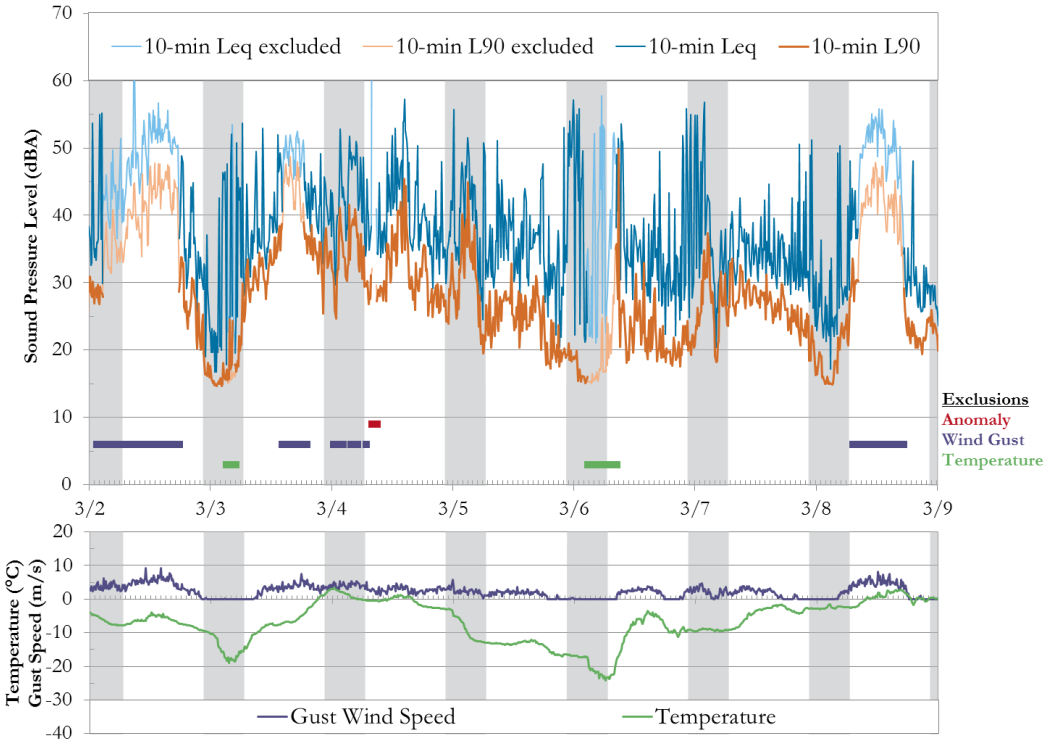

FIGURE 5: BRASTED ROAD MONITOR TIME HISTORY - MARCH 2 TO MARCH 9, 2015

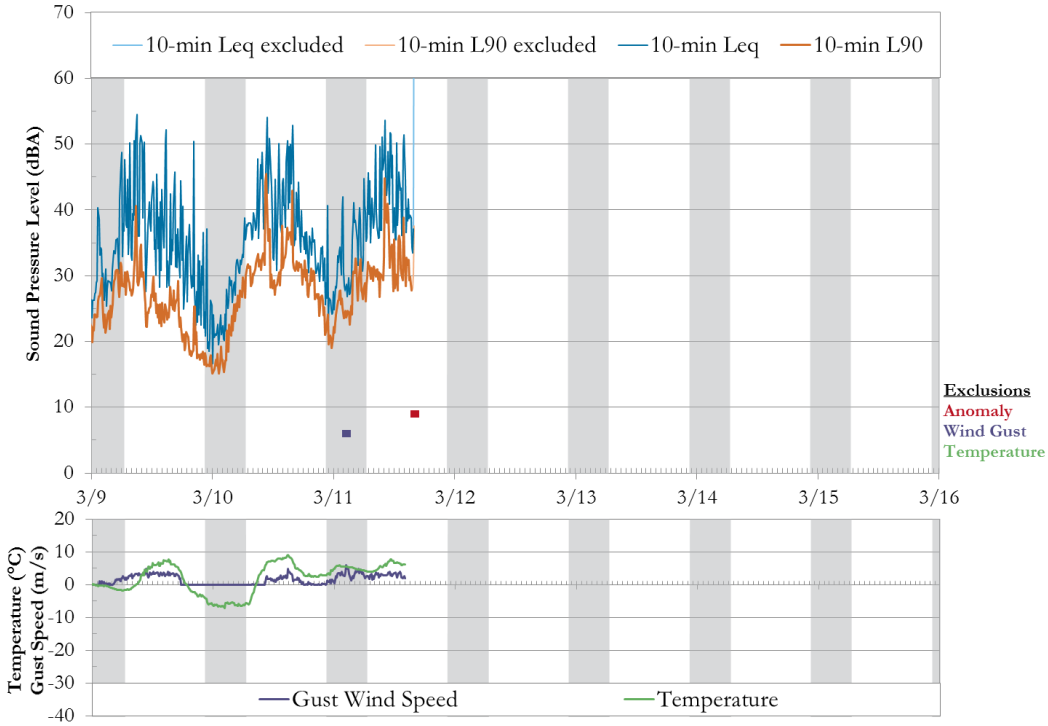

FIGURE 6: BRASTED ROAD MONITOR TIME HISTORY - MARCH 9 TO MARCH 11, 2015

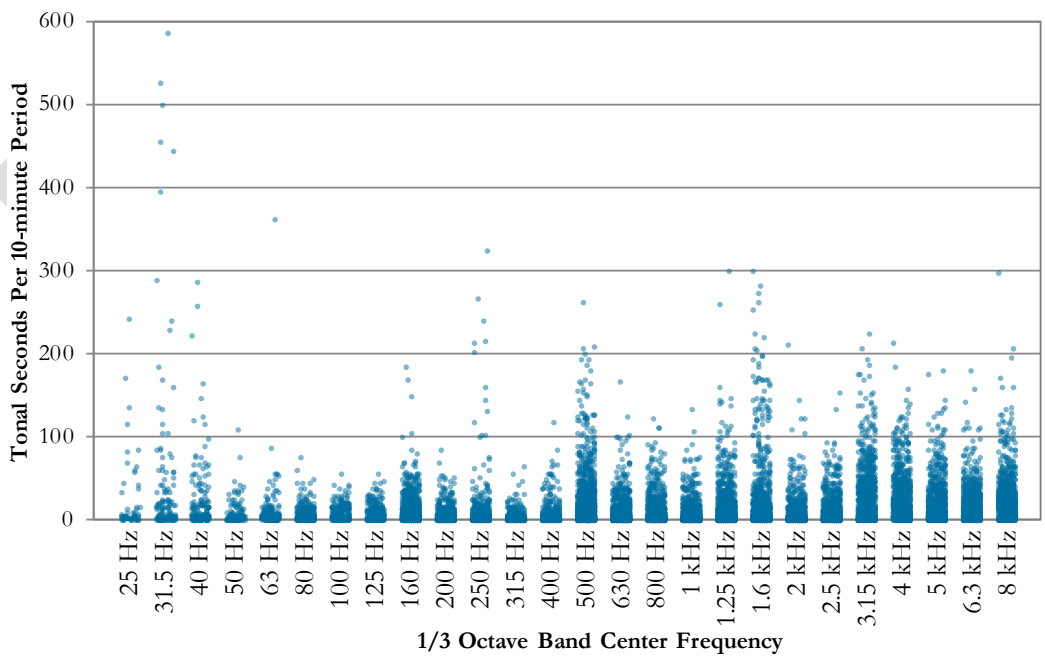

FIGURE 7: BRASTED ROAD WINTER MONITORING PERIOD – TONALITY

Summer Monitoring

Time history graphs for the summer monitoring period are shown in Figure 9, Figure 10, and Figure 11, along with the gust wind speed and temperature. Higher sound levels during the day were primarily caused by farm operations and vehicle pass-bys. Other sound sources included airplane overflights, dogs barking, voices, and wind. This site has a particularly high number of intermittent, loud sound sources in an area with low sound levels overall.

Tonality is shown in Figure 12. Bird and insect activity appears as a higher incidence of tonality in the 5 kHz, 6.3 kHz, and 8 kHz 1/3 octave bands. Tonality in the 25 Hz, 31.5 Hz, and 250 Hz 1/3 octave band was caused by periodic farm equipment operation.

Figure 13 shows the 1/3 octave band median sound levels (L_{50}) by season and time of day. The most prominent difference between summer and winter sound levels, is the increase in mid-to-high frequency sound. This is caused by high frequency biogenic sound sources, such as leaf rustle, birds and insects. The 125 Hz tone visible during the summer at night is due to farm equipment. The mid-frequency "hump" (between 100 Hz and 1 kHz) in the winter sound level spectrum is due to increased wind during the winter or to a change in the way ground reflections are absorbed, caused by the different sound absorption properties of snow cover relative to grass, or dried types of ground cover.

FIGURE 8: PHOTOGRAPH OF THE BRASTED ROAD MONITOR SITE IN SUMMER, WITH MICROPHONE HIGHLIGHTED

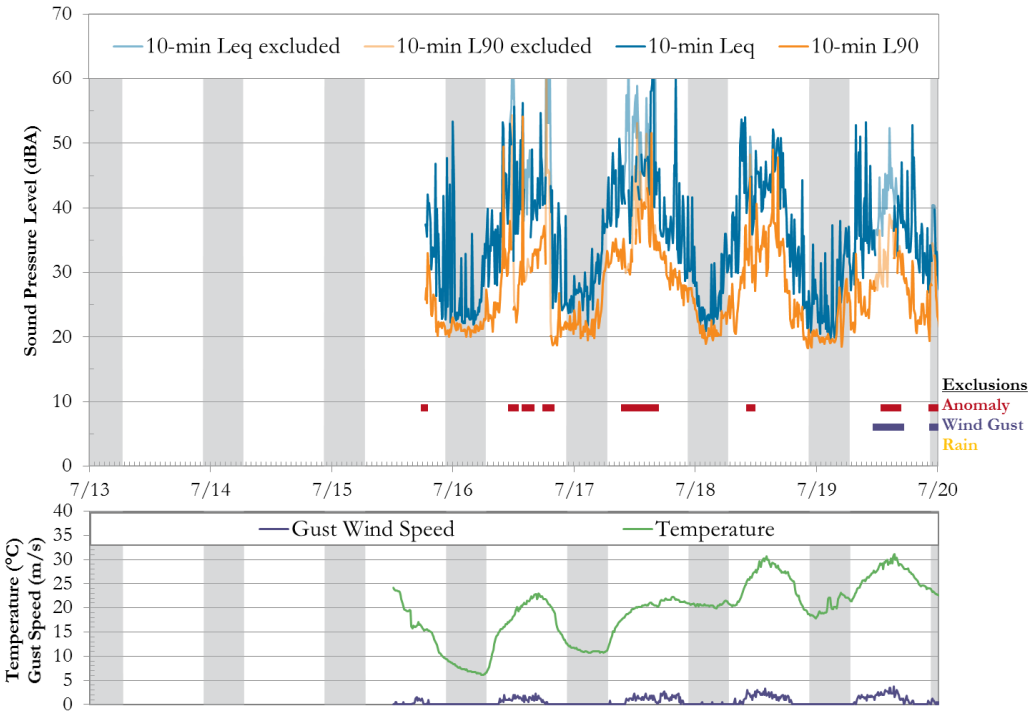

FIGURE 9: BRASTED ROAD MONITOR TIME HISTORY – JULY 13 TO JULY 20, 2015

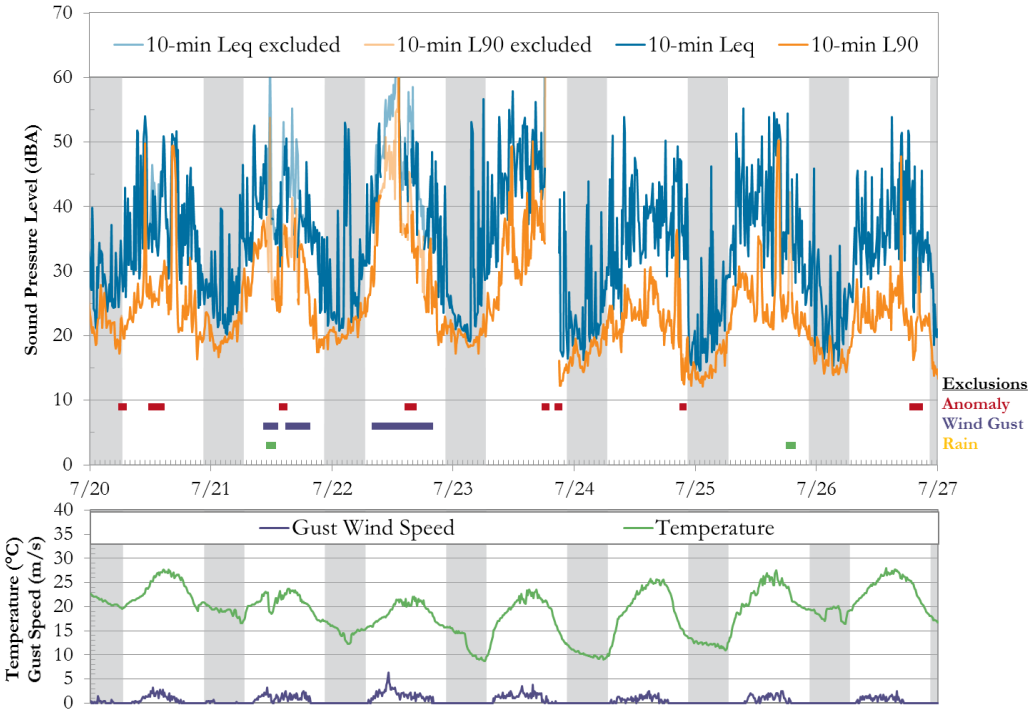

FIGURE 10: BRASTED ROAD MONITOR TIME HISTORY - JULY 20 TO JULY 27, 2015

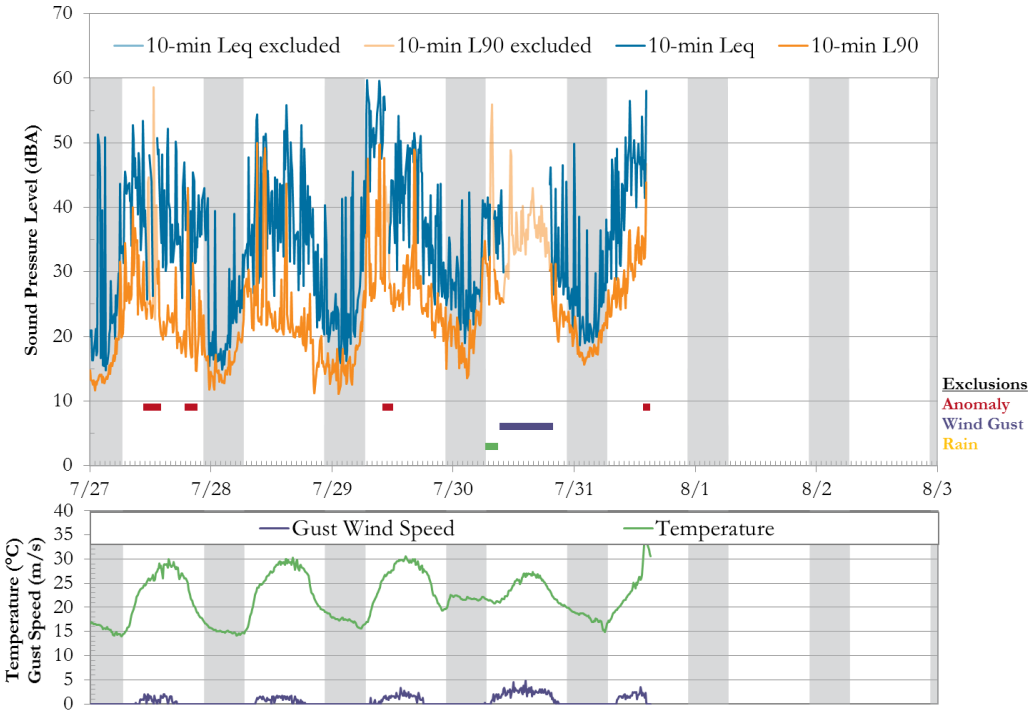

FIGURE 11: BRASTED ROAD MONITOR TIME HISTORY - JULY 27 TO AUGUST 3, 2015

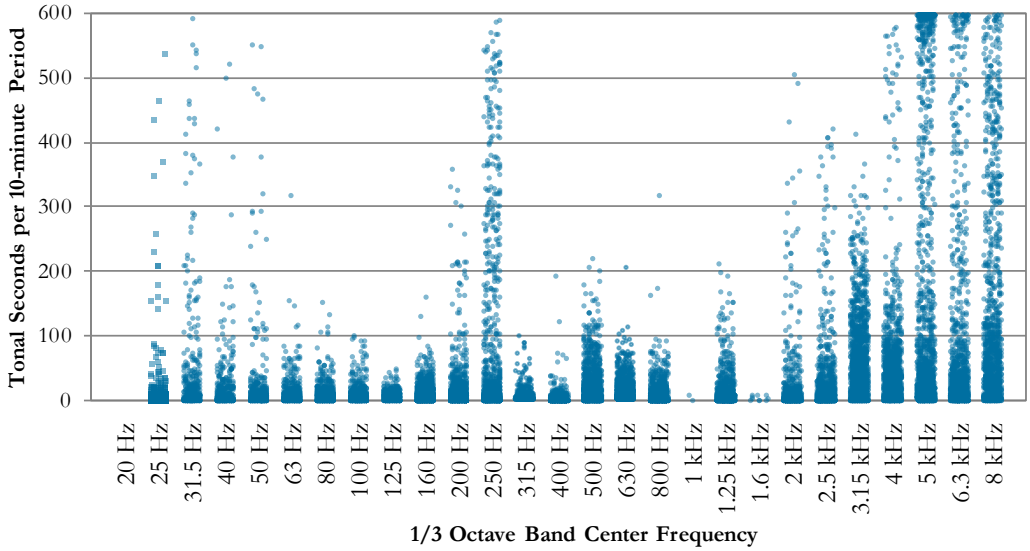

FIGURE 12: BRASTED ROAD SUMMER MONITORING PERIOD – TONALITY

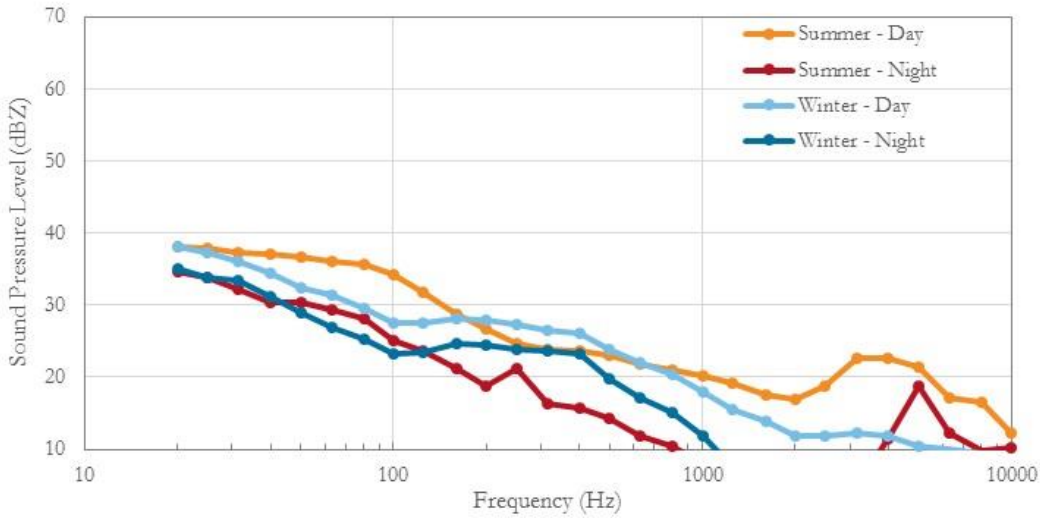

FIGURE 13: BRASTED ROAD 1/3 OCTAVE BAND MEDIAN (L_{50}) SOUND LEVELS BY SEASON AND TIME OF DAY

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MONITOR 2: REX/DYE ROAD

The "Dye Road" monitor was located near 3101 Rex Road, Cohocton, New York, in a wooded area approximately 48 m (157 ft) from the road. The site is located on the map in Figure 14 and Figure 15 shows the installation during the winter, looking southeast. The setup during the summer monitoring period is shown in Figure 20, looking northwest.

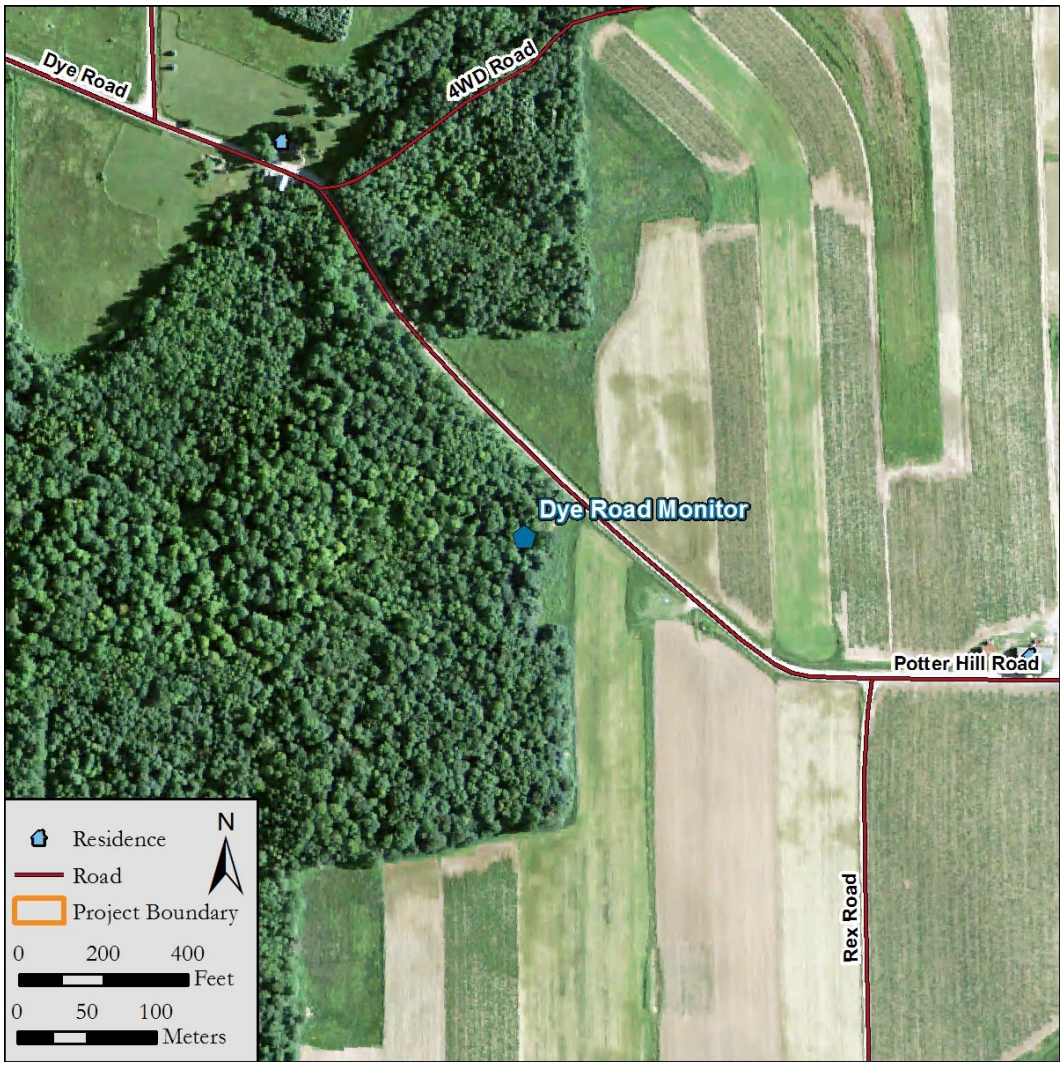

FIGURE 14: LOCATION OF THE REX/DYE ROAD MONITOR

Winter Monitoring

Winter long-term sound level results are plotted as time history graphs in Figure 16, Figure 17, and Figure 18. Background levels throughout the period were dominated primarily by wind blowing through surrounding trees. Many of the brief periods of high sound levels, visible throughout the plot, resulted from large trucks climbing Dye Road, adjacent to the site. There were also frequent jet aircraft flyovers at cruising altitude and some propeller driven aircraft at lower altitudes. Except for these transient events and wind noise in the trees, the Rex/Dye Road site is a quiet site typical of rural residential areas.

There were no nearby, consistent anthropogenic sources at this site, resulting in a lack of consistent tonality, as is shown in Figure 19. Tonal events were caused by the occasional car or truck pass-by and bird call.

FIGURE 15: PHOTOGRAPH OF THE DYE ROAD SITE, LOOKING SOUTHEAST

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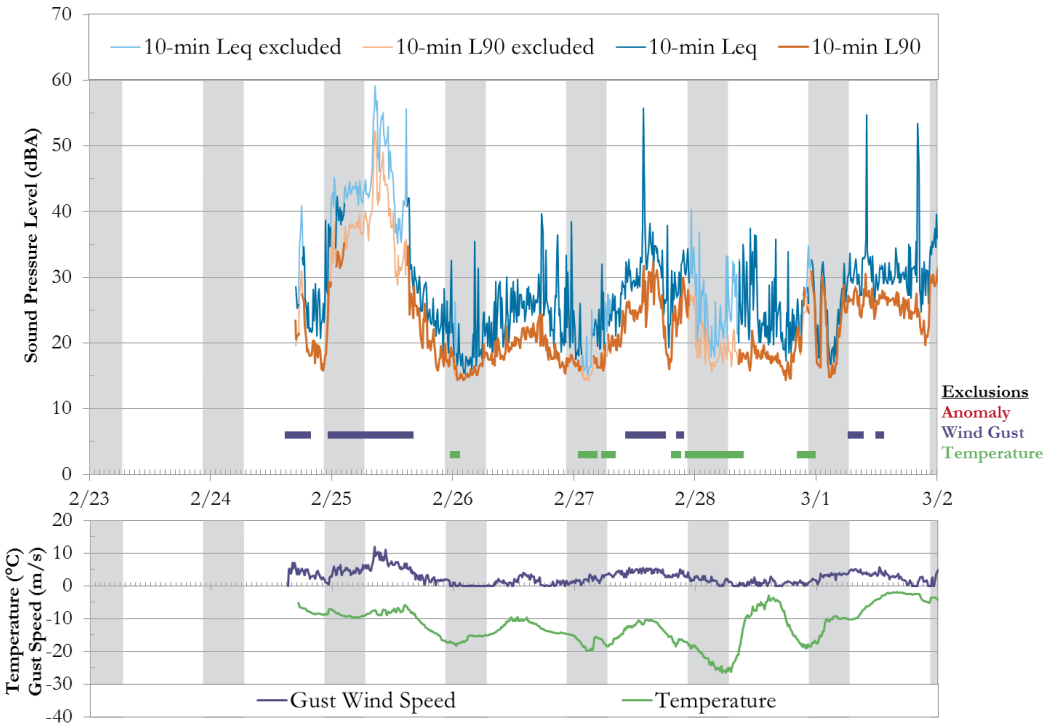

FIGURE 16: DYE ROAD MONITOR DATA, FEBRUARY 24 – MARCH 2, 2015

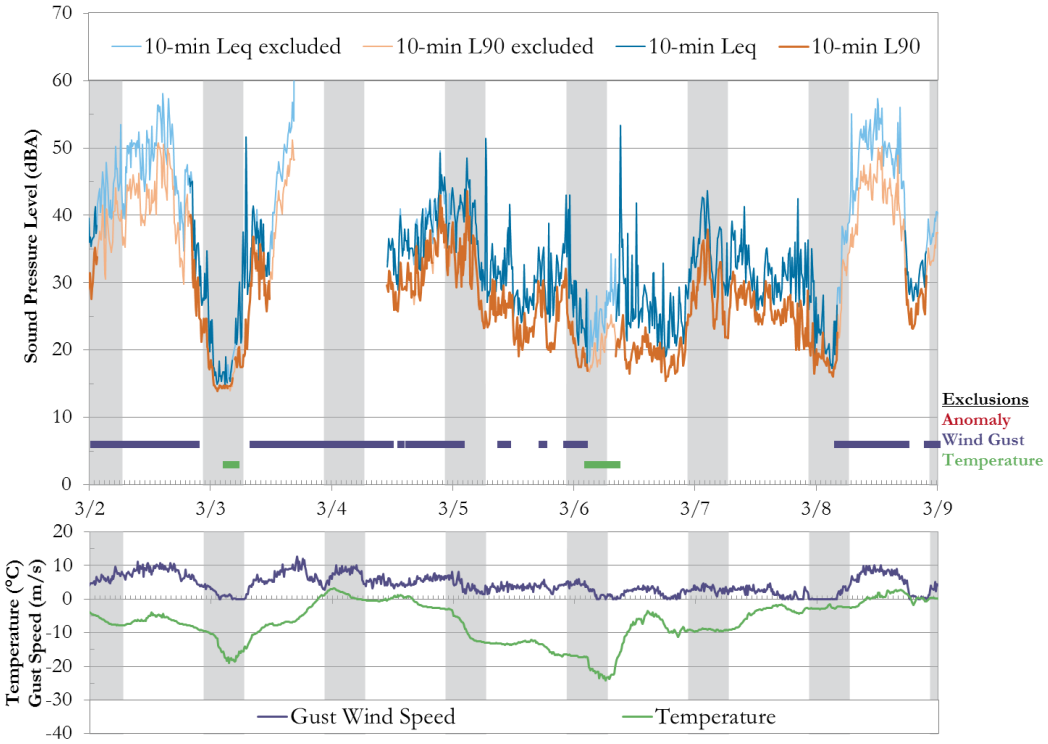

FIGURE 17: DYE ROAD MONITOR DATA, MARCH 2 – MARCH 9, 2015

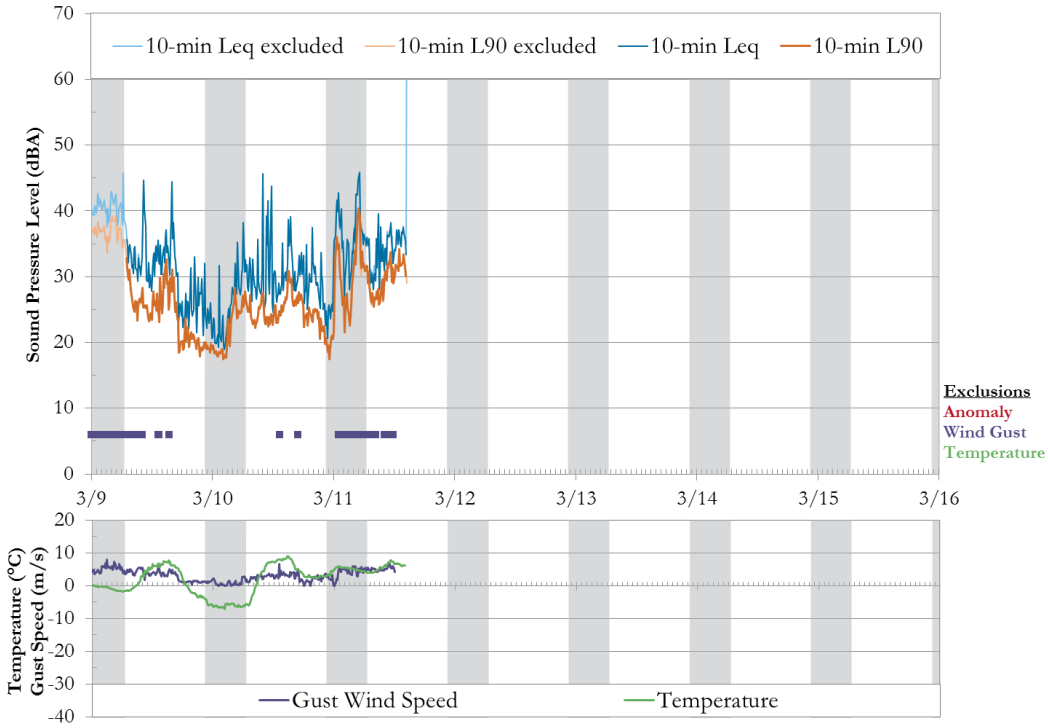

FIGURE 18: DYE ROAD MONITOR DATA, MARCH 9 – MARCH 11, 2015

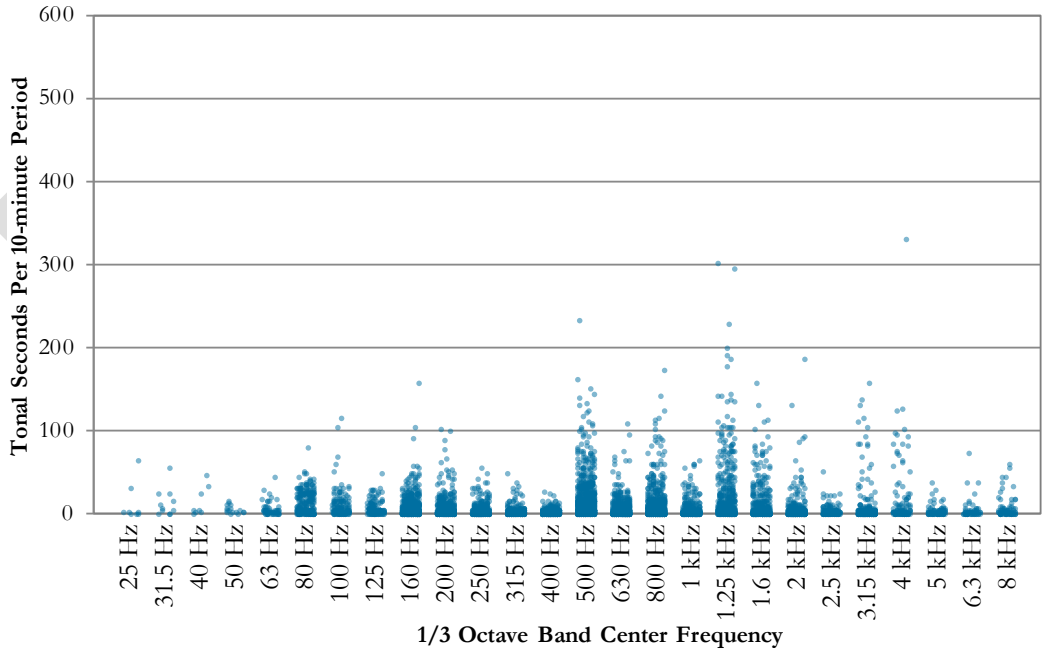

FIGURE 19: DYE ROAD WINTER MONITORING PERIOD – TONALITY

Summer Monitoring

Summer monitoring period time histories are shown in Figure 21, Figure 22, and Figure 23. Major sound sources during the summer period were similar to the winter period, with large increases in sound level caused by truck traffic and smaller increases in sound level caused by airplane flyovers. Other sound sources included wind blowing through the trees, which was particularly prominent at this site relative to other sites. During some periods, bird-calls were also present.

Tonality for this summer monitoring period is shown in Figure 24. Just as during the winter, there was minimal tonality due to anthropogenic sources. Tonality was primarily in the 5 kHz and 6.3 kHz 1/3 octave bands and is caused by birds and insects. A lower incidence of tonality is shown in the 1.25 kHz and 1.6 kHz 1/3 octave bands, caused by nearby birds.

Third octave band median sound levels (L_{50}) for both the summer and winter monitoring periods, by time of day are shown in Figure 25. The spectra for the winter and summer are similar, as are the spectra for day and night. The biggest differences between the summer and winter spectra are the mid frequency hump in the winter spectra, and the elevated high frequency sound levels in the summer data. The former is due to higher overall winds or added sound attenuation caused by snow, and the latter is due to increased biogenic sounds in the summer.

FIGURE 20: DYE ROAD SITE DURING THE SUMMER - LOOKING NORTHWEST

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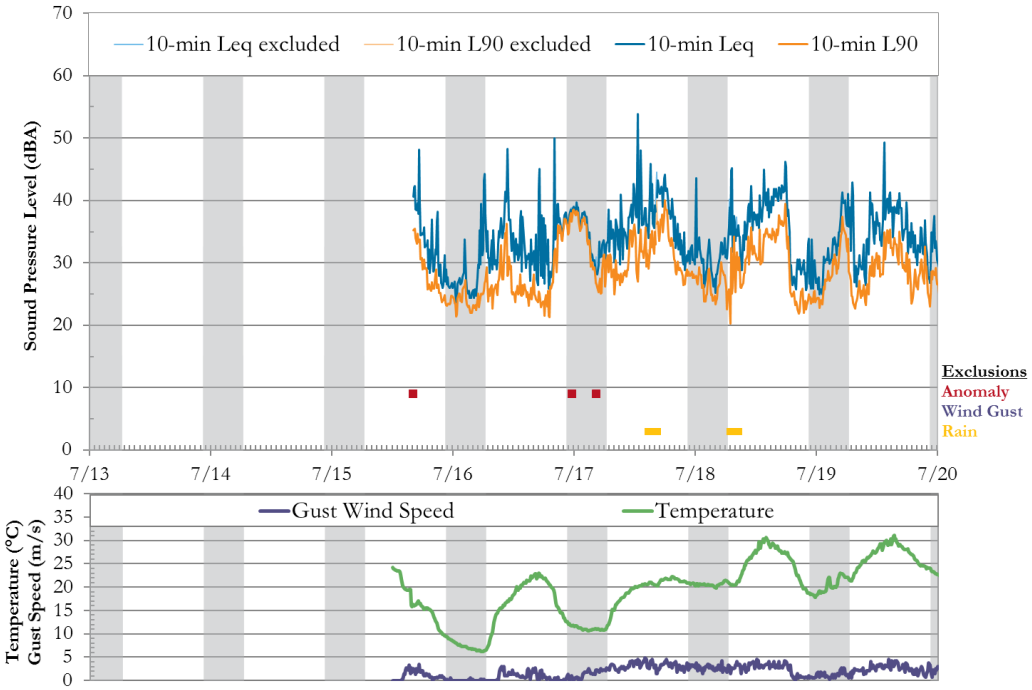

FIGURE 21: DYE ROAD MONITOR DATA, JULY 13 – JULY 20, 2015

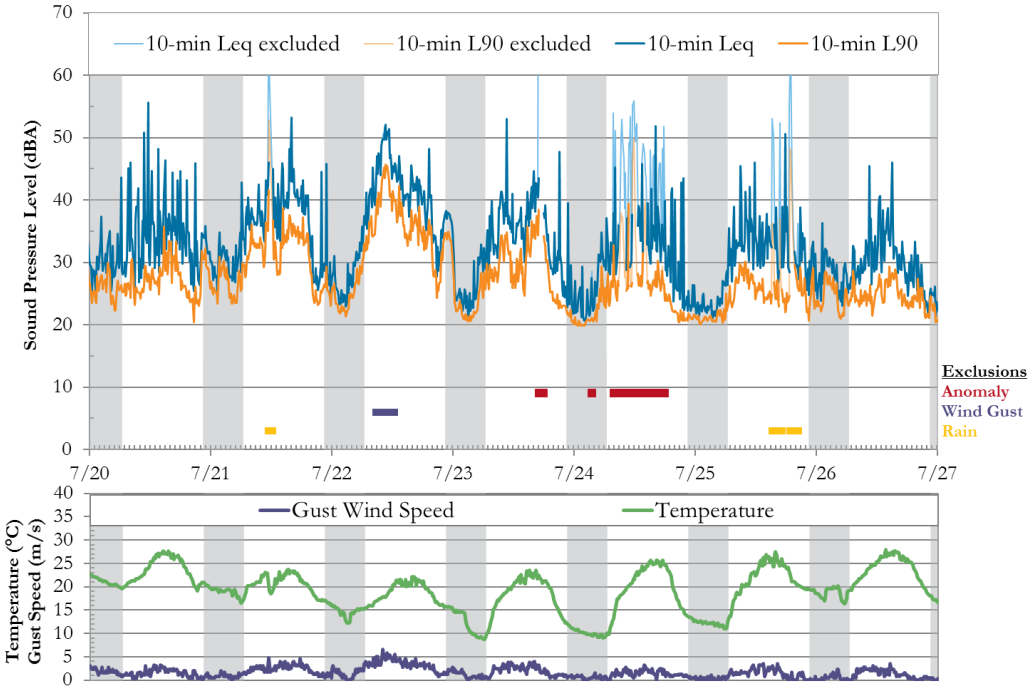

FIGURE 22: DYE ROAD MONITOR DATA, JULY 20 – JULY 27, 2015

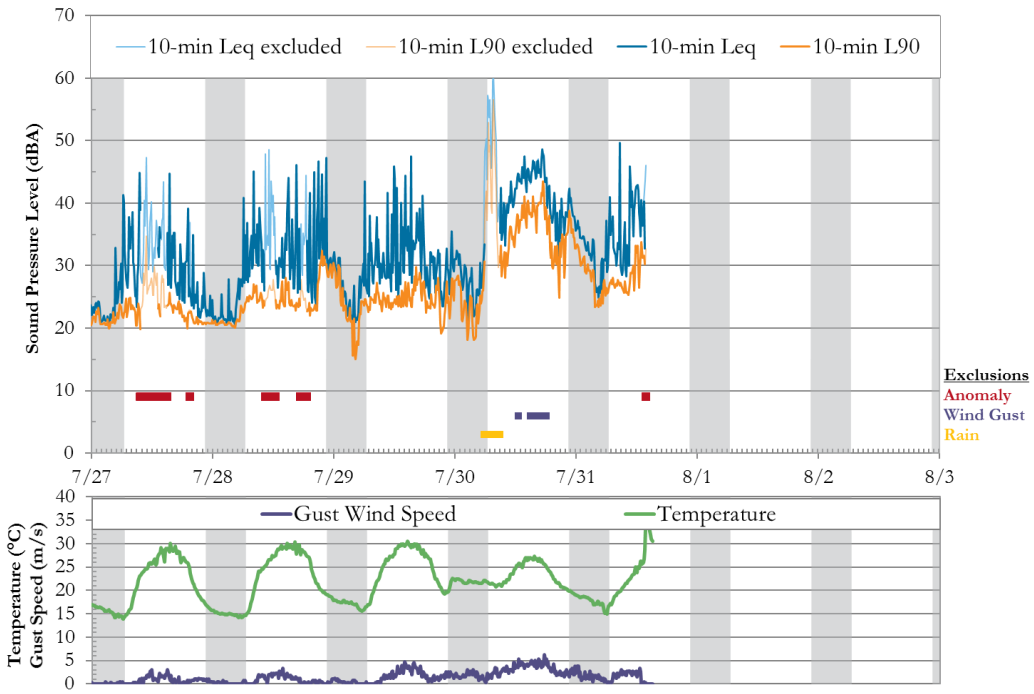

FIGURE 23: DYE ROAD MONITOR DATA, JULY 27 – AUGUST 3, 2015

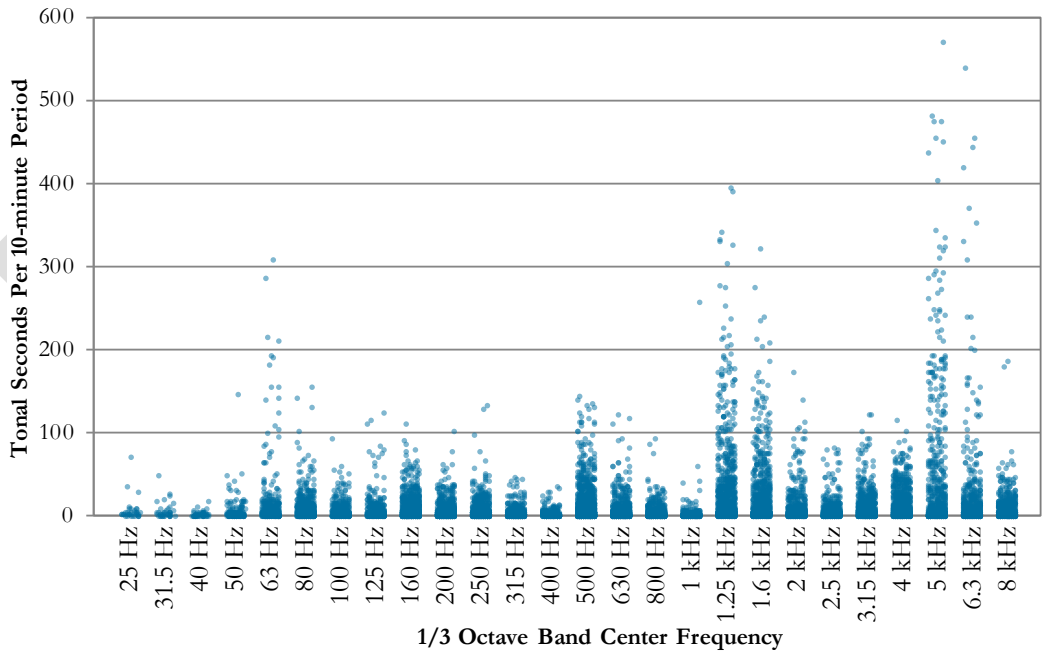

FIGURE 24: DYE ROAD SUMMER MONITORING PERIOD – TONALITY

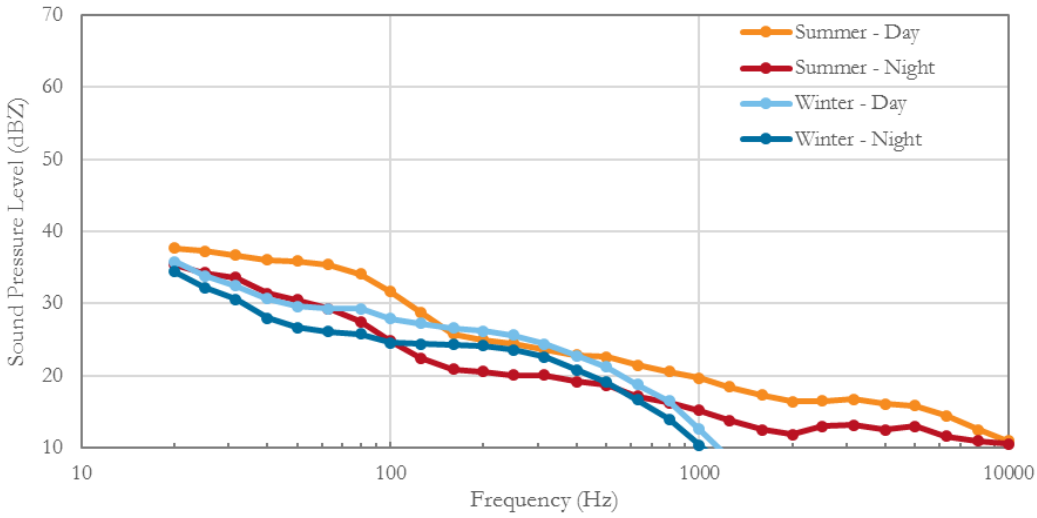

FIGURE 25: DYE ROAD 1/3 OCTAVE BAND MEDIAN SOUND LEVEL (L_{50}) BY SEASON AND TIME OF DAY

MONITOR 3: HASKINVILLE ROAD

The Haskinville Road monitor was located under an apple tree on the north side of a church parking lot at 8731 Haskinville Road, Cohocton, NY. The monitor location was approximately 100 m (328 ft) from Haskinville Road and about 150 m from the intersection of Highway 21, Haskinville Road, and County Road 55. The site is shown on the map in Figure 26, and a photograph of the monitor is displayed in Figure 27, looking to the northwest. This site also included an anemometer to measure wind speed, which is indicated in the photograph.

Winter Monitoring

The long-term sound level results are plotted as time history graphs in Figure 28, Figure 29, and Figure 30. As indicated in the corresponding figure, the sound level meter lost power from March 4 to March 11 and did not record any data. As a result, the meter was re-deployed on March 11, 2015 for an additional recording period until the next morning, March 12, 2015. Results show a diurnal pattern at the site that extends slightly beyond the typical daytime hours. This extended diurnal activity was due to car and truck passbys between the hours of 5AM and midnight. The data also show frequent propeller and commercial aircraft traffic.

Tonality during the winter period, shown in Figure 31, was irregular and not in a consistent frequency range. There were no major tonal sound sources at this location during the winter.

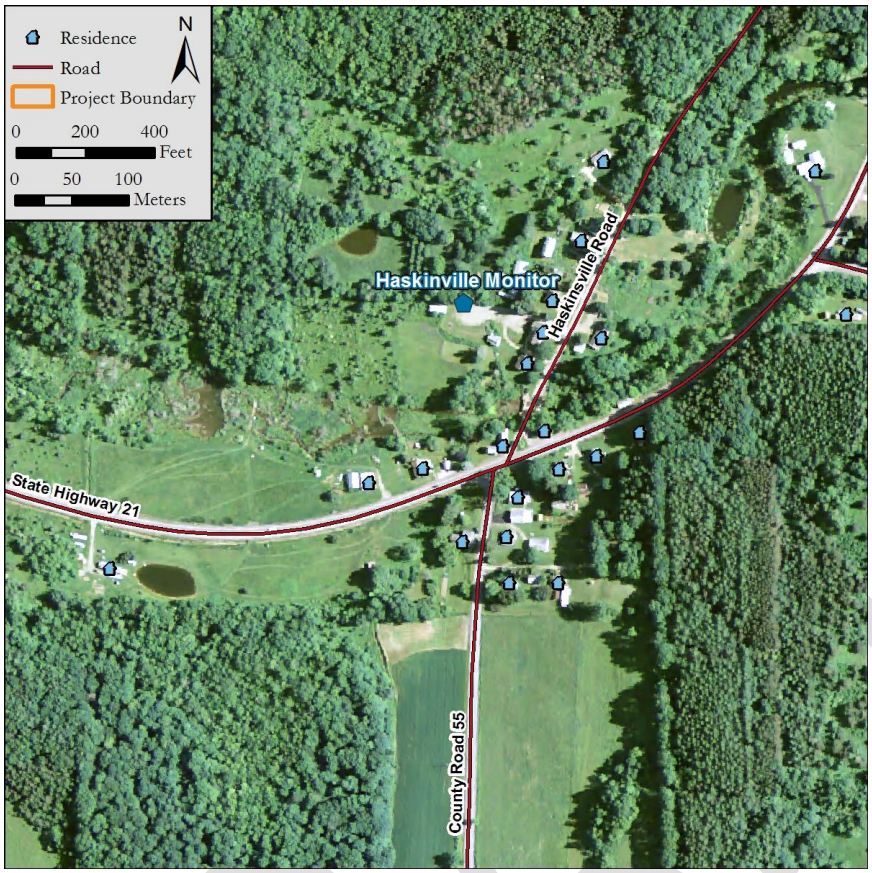

FIGURE 26: LOCATION OF THE HASKINVILLE ROAD MONITOR

FIGURE 27: PHOTOGRAPH OF THE HASKINVILLE ROAD SITE, LOOKING NORTHEAST

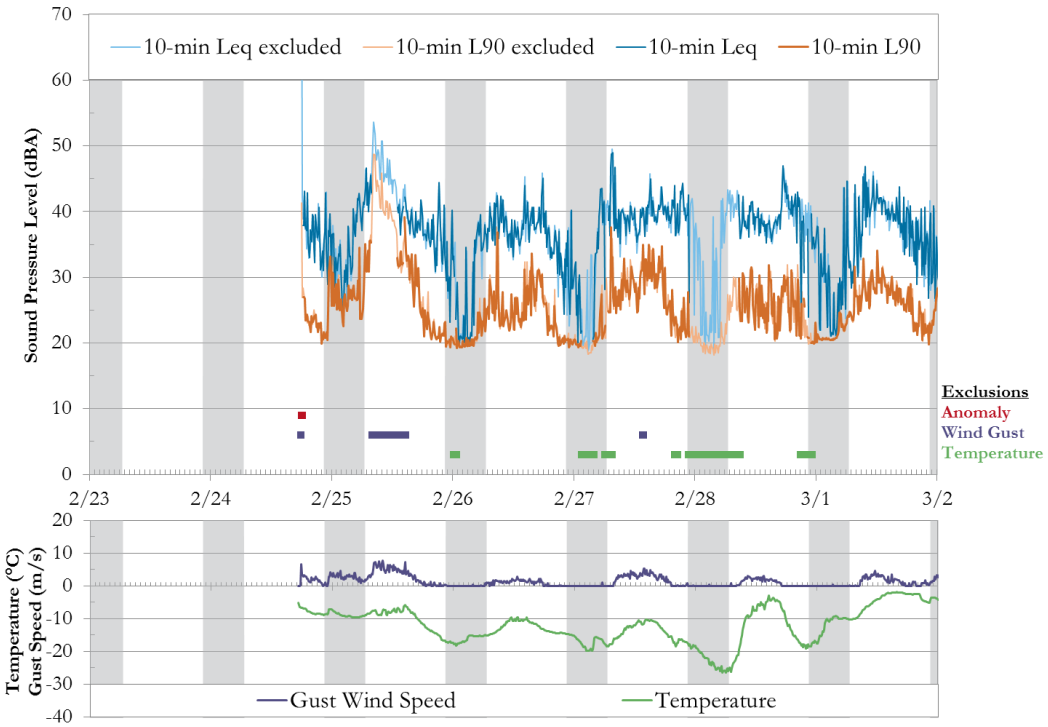

FIGURE 28: HASKINVILLE ROAD MONITOR DATA, FEBRUARY 24 – MARCH 2, 2015

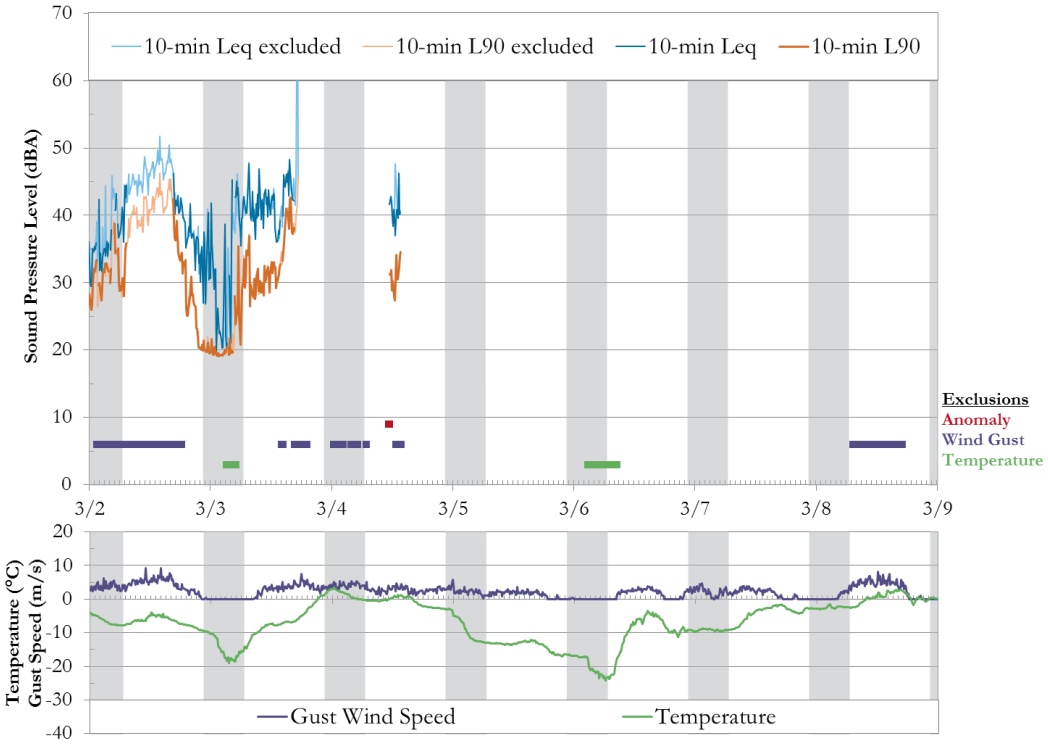

FIGURE 29: HASKINVILLE ROAD MONITOR DATA, MARCH 2 – MARCH 9, 2015

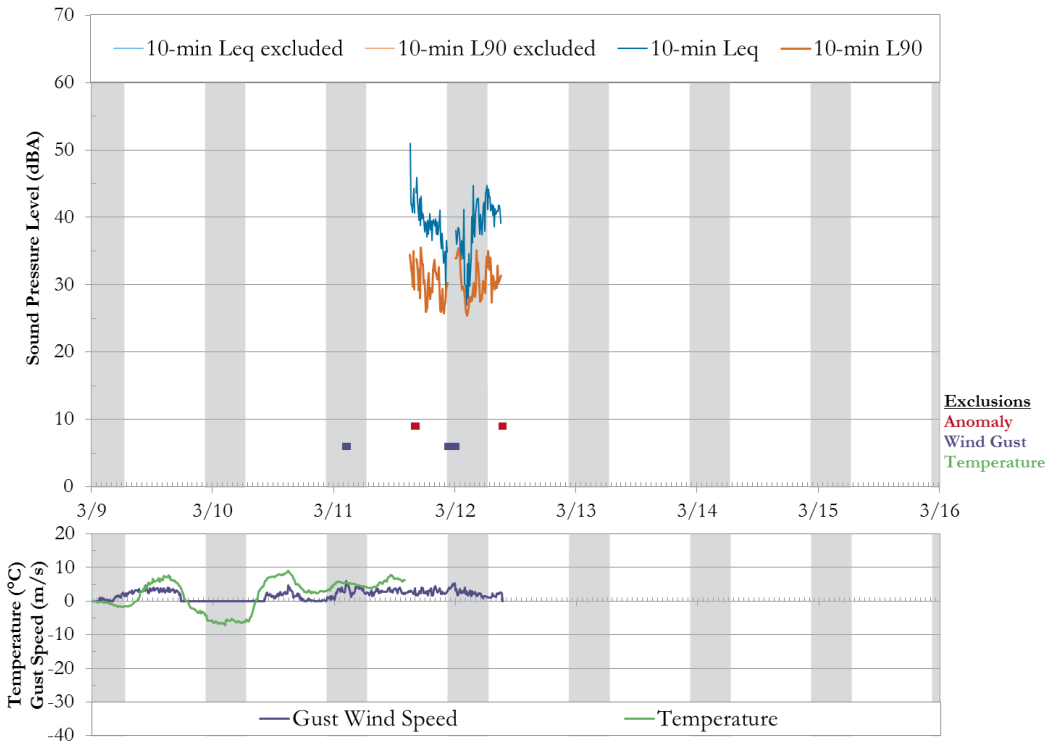

FIGURE 30: HASKINVILLE ROAD MONITOR DATA, MARCH 9 – MARCH 12, 2015

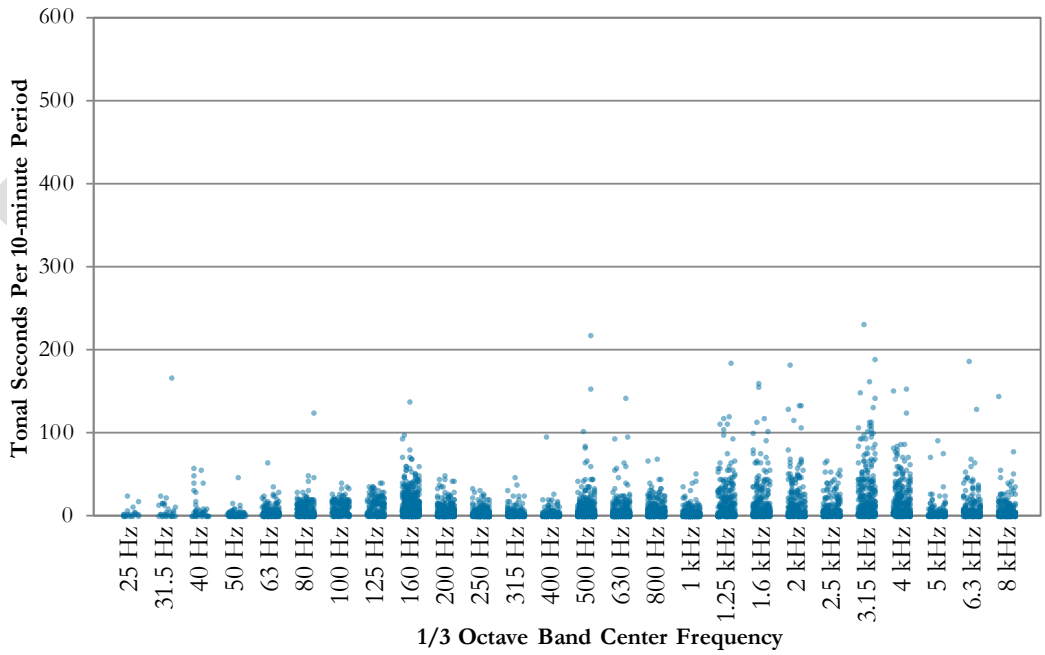

FIGURE 31: HASKINVILLE ROAD WINTER MONITORING PERIOD – TONALITY

Summer Monitoring

Summer long-term time history results are shown in Figure 33, Figure 34, and Figure 35. Results show a diurnal pattern at the site that extends slightly beyond the typical daytime hours. This was due to vehicle traffic on State Highway 21 and other anthropogenic sounds, such as building construction and yard work. Biogenic sounds such as birds and insects were also present. Propeller and jet aircraft were present throughout the day and night.

Tonality during the summer monitoring period was common in the higher frequency range from the 2.5 kHz to 8 kHz 1/3 octave bands, as is shown in Figure 36. The cause of this tonality was birds and insects. Less frequent tonality in the 500 Hz 1/3 octave band was due to dogs barking and tonality in the 160 Hz 1/3 octave band is due to machinery operation.

Figure 37 shows 1/3 octave band median sound levels (L_{50}) by time of day and season. Due to traffic on State Highway 21, there is an increase in sound levels between approximately 400 Hz and 2 kHz for the summertime spectra. Like other sites, there is a mid-frequency "hump" caused by the change in sound absorption due to winter snow cover or wind-induced sound and an increase in high frequency sound levels due to seasonal biogenic sounds.

FIGURE 32: HASKINVILLE SITE DURING THE SUMMER - LOOKING NORTH

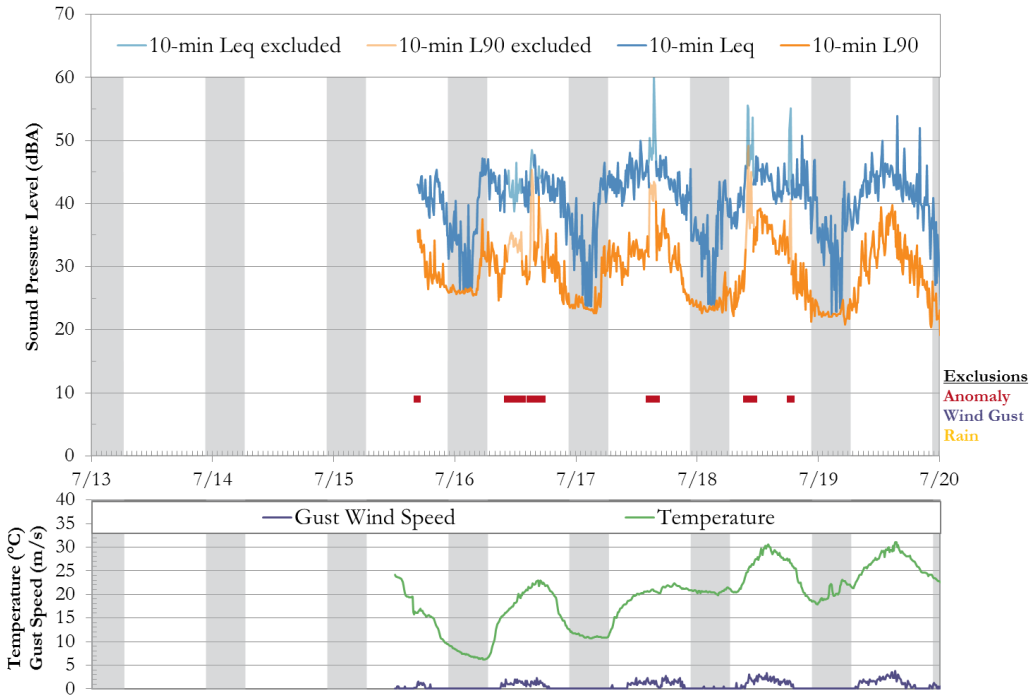

FIGURE 33: HASKINVILLE ROAD MONITOR DATA, JULY 13 – JULY 20, 2015

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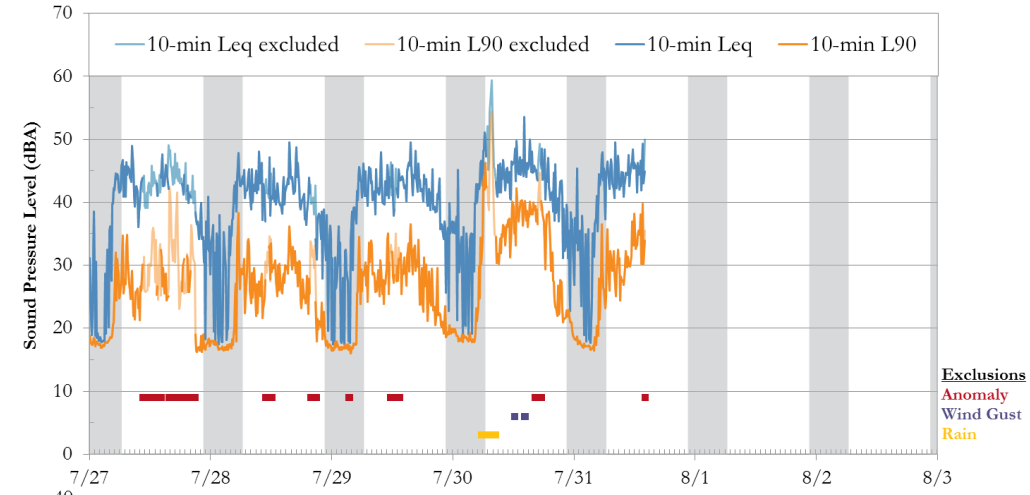

FIGURE 34: HASKINVILLE ROAD MONITOR DATA, JULY 20 – JULY 27, 2015

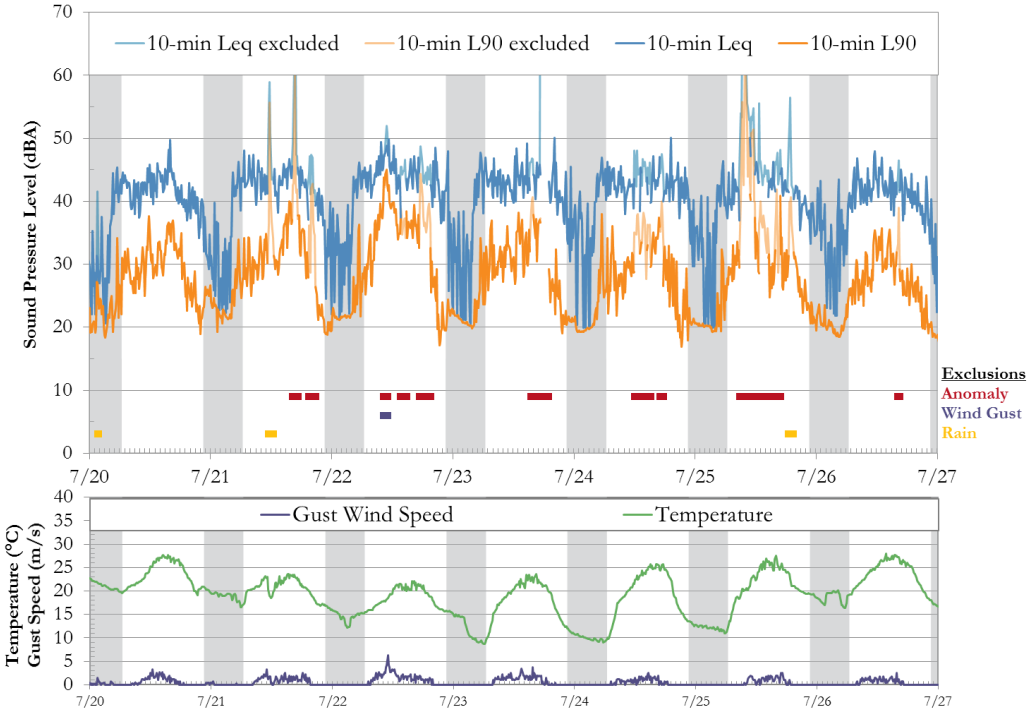

FIGURE 35: HASKINVILLE ROAD MONITOR DATA, JULY 27 – AUGUST 3, 2015

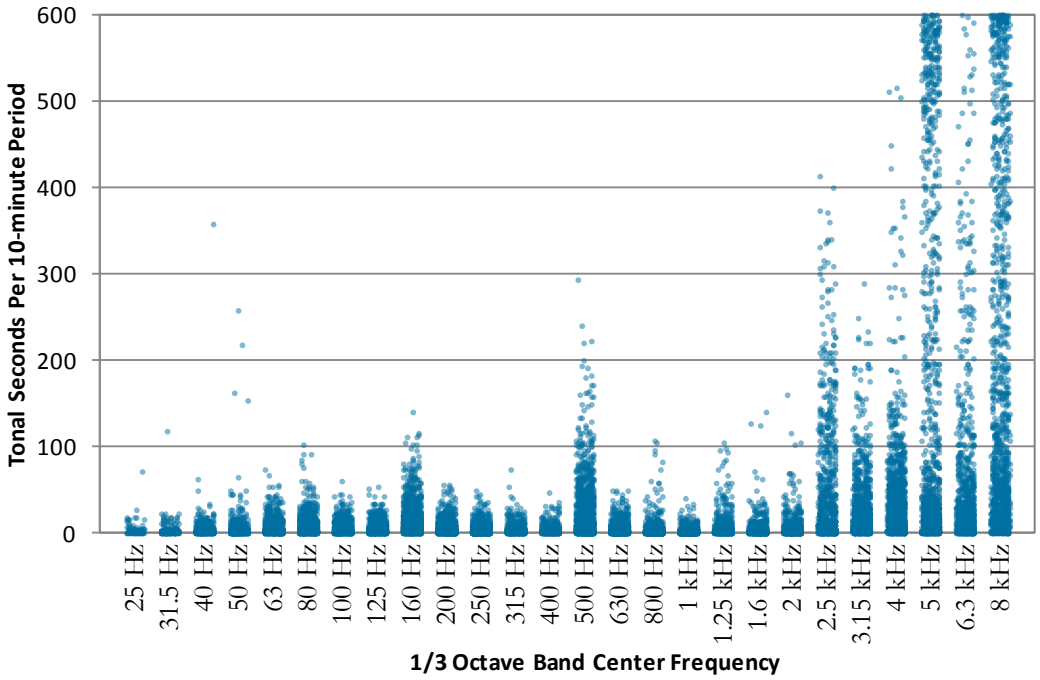

FIGURE 36: HASKINVILLE ROAD SUMMER MONITORING PERIOD – TONALITY

DRAFT

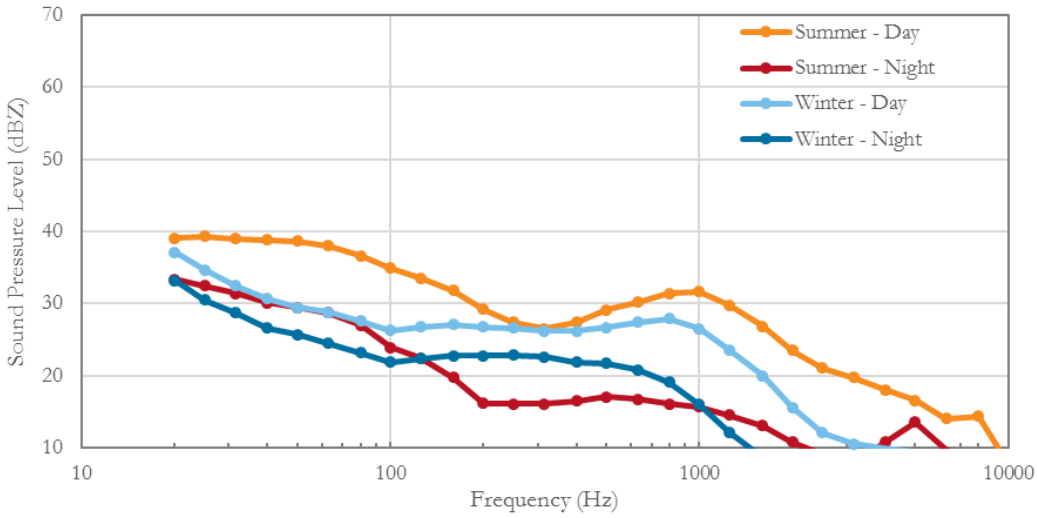

FIGURE 37: HASKINVILLE 1/3 OCTAVE BAND MEDIAN SOUND LEVEL (L_{50}) BY SEASON AND TIME OF DAY

MONITOR 4: HENKLE HOLLOW

The Henkle Hollow Monitor was located at 3323 Henkle Hollow Road in Cohocton, New York. The monitor was placed toward the top of a hill behind the residence, approximately 73 m (239 ft) from Henkle Hollow Road and 29 m (95 ft) from a house. The site is shown on the map in Figure 38. Figure 39 shows a photograph of the winter installation looking northeast and Figure 44 shows a view of the summer monitoring installation, looking directly north.

Winter Monitoring

The long-term sound level results are plotted as time history graphs in Figure 40, Figure 41, and Figure 42. The monitor was directly above the driveway of the residence that had a significant amount of activity, including cars coming and going (with doors opening and closing), a tractor operating throughout the property, and snowmobiles. Sounds from snowmobiles passing very close to the monitor were excluded from processing of statistical levels, but all other engine sources were retained. These frequent transient sources explain the separation between the 10-minute L_{EQ} and L_{90} levels at intervals throughout day and night. Although the time history appears to show a diurnal pattern, much of the noise can be attributed to the wind blowing through the trees. The wind was seldom calm at this site.

Figure 43 shows very little tonal activity at the site. Tonality in the 1.25 kHz 1/3 octave band was due to birds.

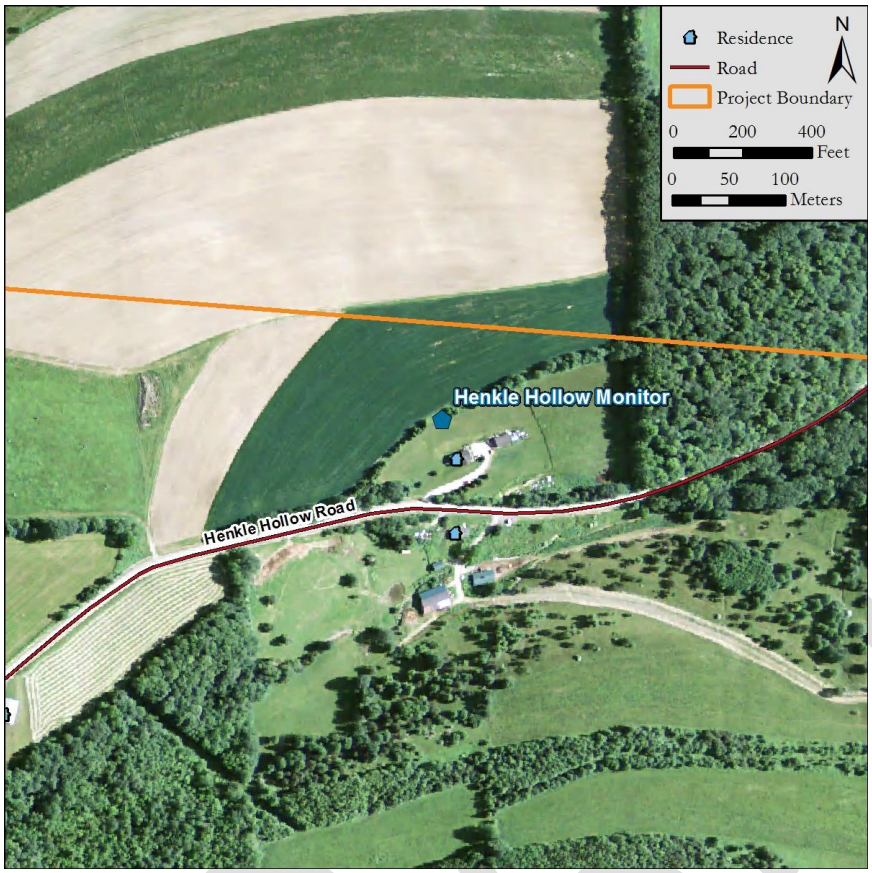

FIGURE 38: LOCATION OF THE HENKLE HOLLOW MONITOR

FIGURE 39: PHOTOGRAPH OF THE HENKLE HOLLOW SITE, LOOKING NORTH

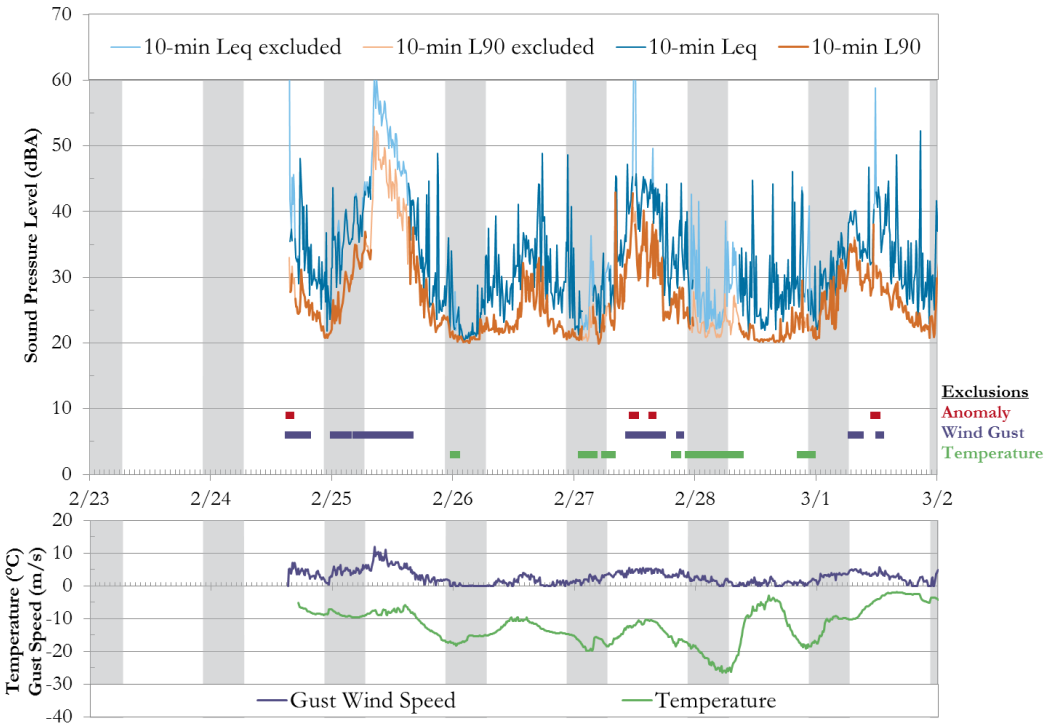

FIGURE 40: HENKLE HOLLOW MONITOR DATA, FEBRUARY 24 – MARCH 1, 2015

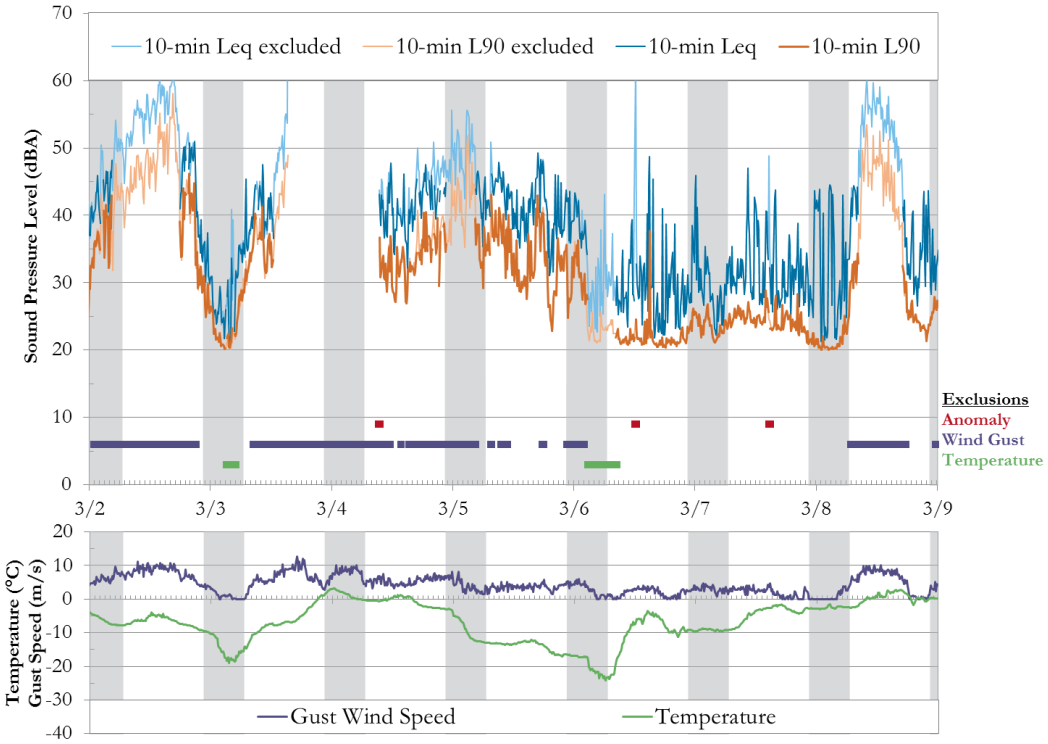

FIGURE 41: HENKLE HOLLOW MONITOR DATA, MARCH 1 – MARCH 8, 2015

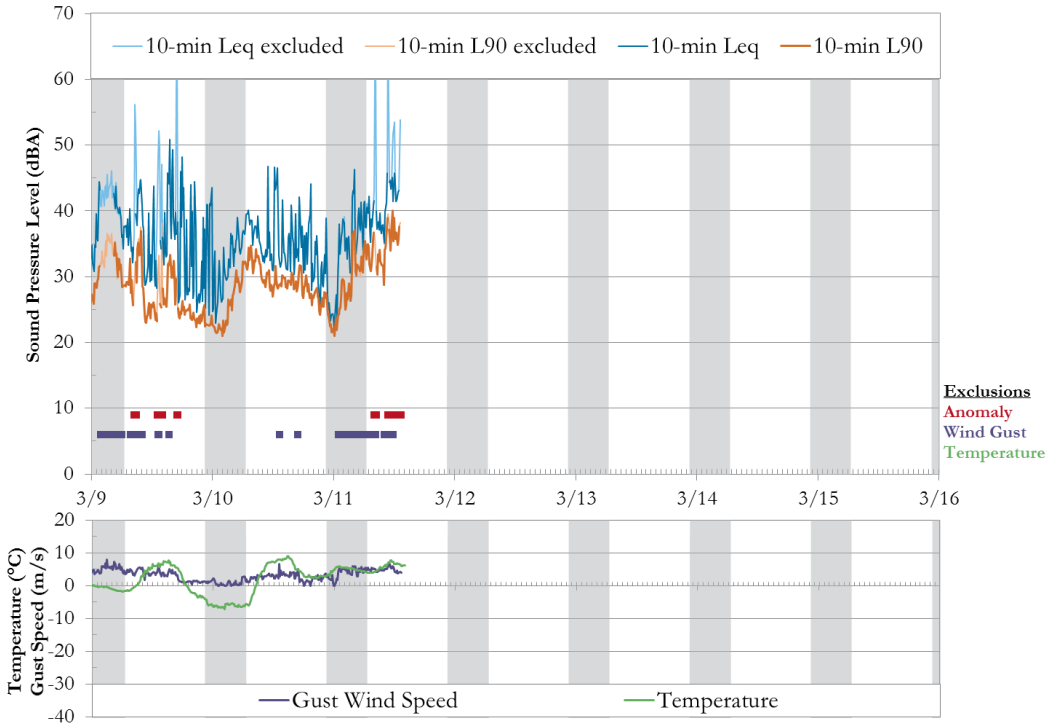

FIGURE 42: HENKLE HOLLOW MONITOR DATA, MARCH 8 – MARCH 11, 2015

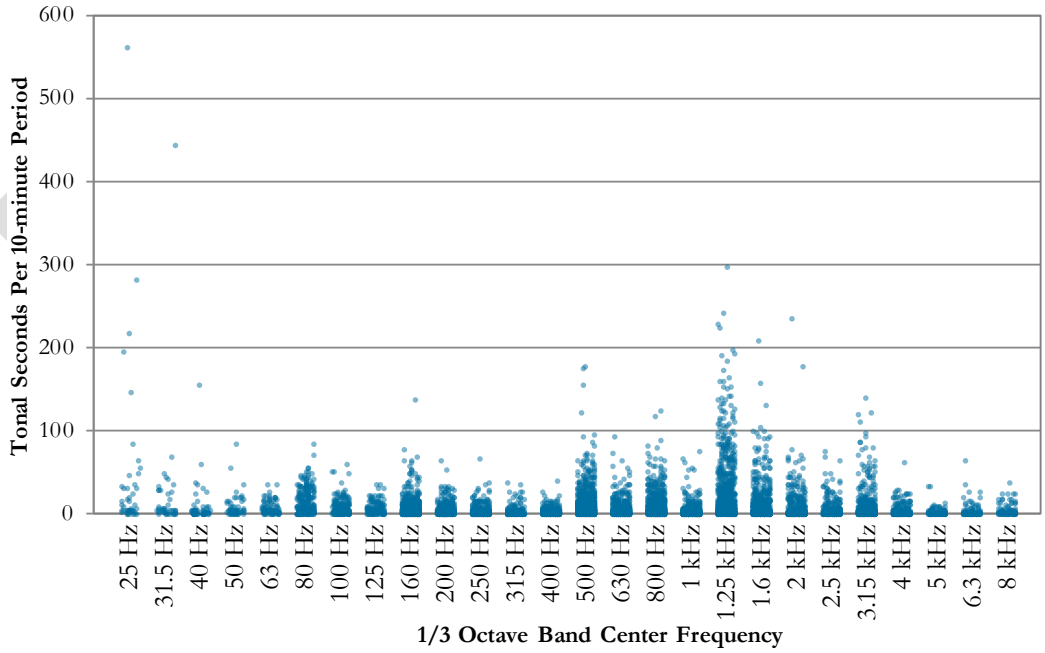

FIGURE 43: HENKLE HOLLOW WINTER MONITORING PERIOD - TONALITY

Summer Monitoring

Time history plots are presented in Figure 45, Figure 46, and Figure 47. Similar to winter monitoring, the site did not exhibit purely diurnal patterns. Sources in the summer at Henkle Hollow included wind through the trees, tractor operations, airplane overflights, truck traffic on the interstate, and a window air conditioning unit on the house. Since tractor operations were not seasonal, this source was retained in the data. However, when the tractor operated close to the monitor, and levels were very high, data were excluded. A window air conditioning unit was installed at the house in line of sight from the monitor. The air conditioning unit affected levels when it was on; this is evident in the sound level data, particularly the L_{90}. Since it was a seasonal source, periods when the unit was on were excluded from data processing. Traffic noise from the interstate can be heard during the quieter times in the morning.

The tonality chart in Figure 48 indicates the major tonal sources were from biogenic sound such as birds and insects, indicated by higher levels of tonal incidence in the 5 kHz, 6.3 kHz, and 8 kHz 1/3 octave bands.

Figure 49 shows 1/3 octave band median sound levels (L_{50}) by season and time of day. The overall shape of all four spectra is similar for this site, particularly below about 200 Hz. The winter spectra have relatively higher sound levels in the mid frequency range and the summer spectra have relatively higher overall sound levels in the upper frequency range due to biogenic sounds. There are apparent tones in both summer spectra, due to insects or amphibians at 5 kHz and 8 kHz.

FIGURE 44: PHOTOGRAPH OF THE HENKLE HOLLOW SITE, LOOKING NORTH

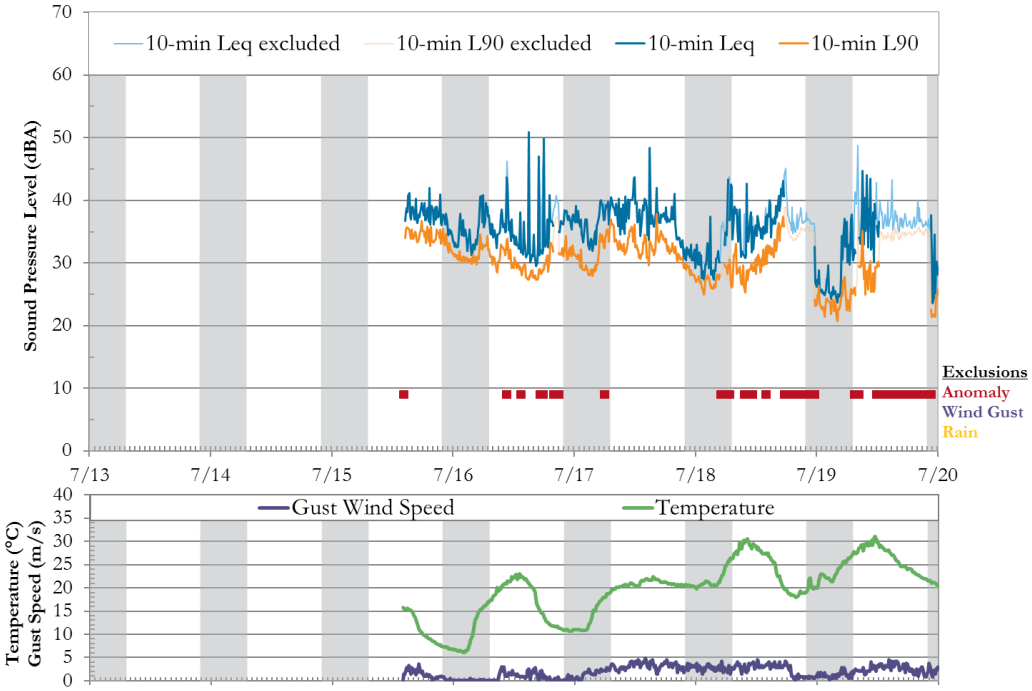

FIGURE 45: HENKLE HOLLOW ROAD MONITOR DATA, JULY 13 – 20, 2015

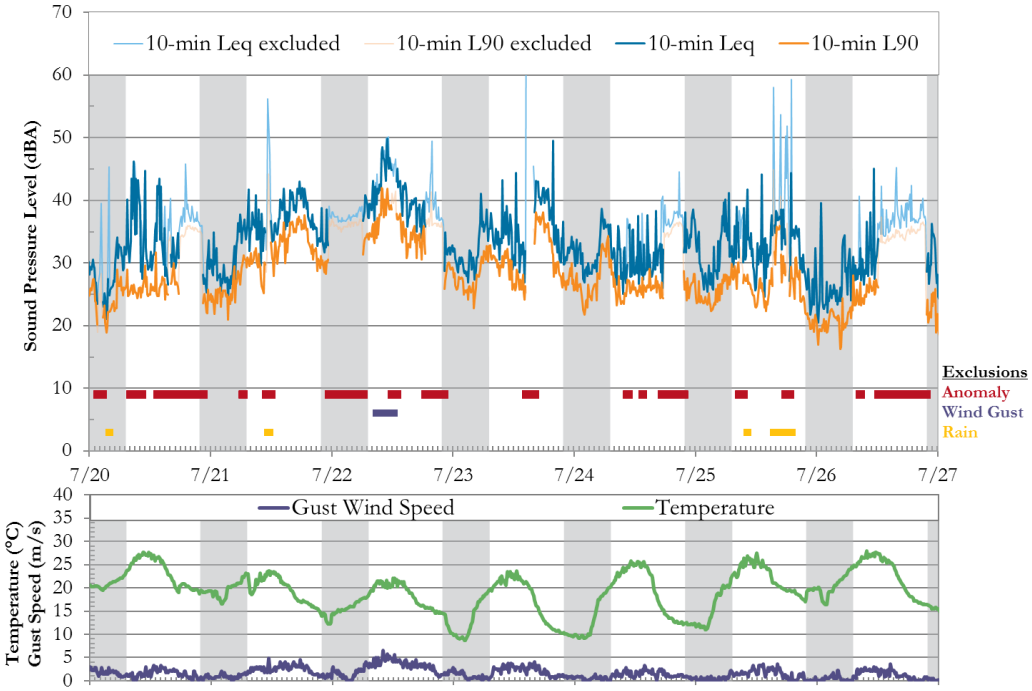

FIGURE 46: HENKLE HOLLOW ROAD MONITOR DATA, JULY 20 – 27, 2015

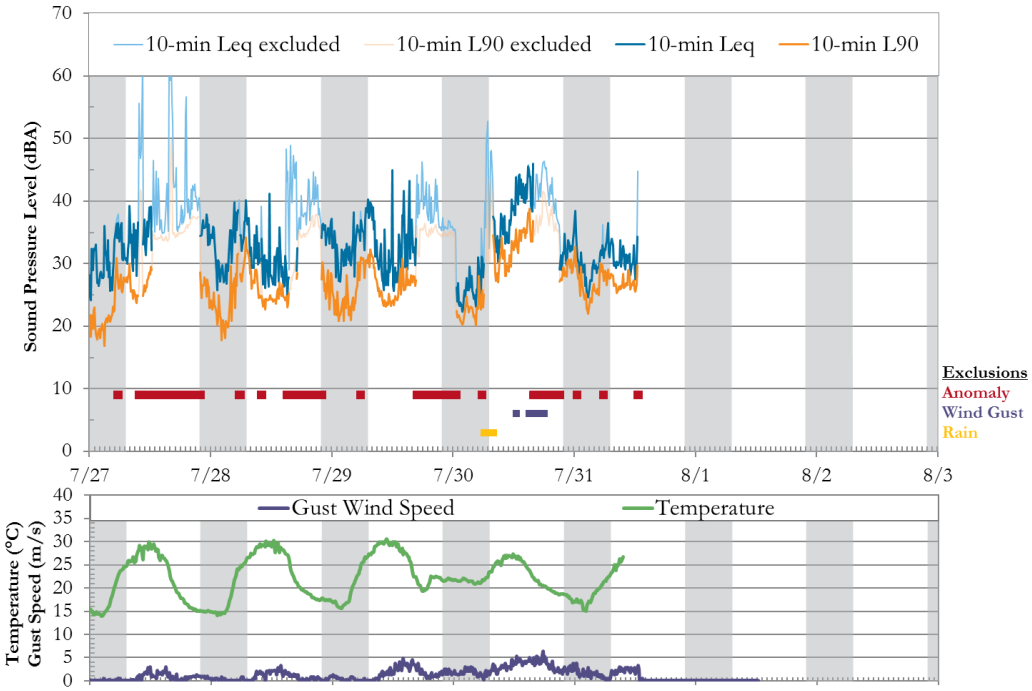

FIGURE 47: HENKLE HOLLOW ROAD MONITOR DATA, JULY 27 – AUGUST 3, 2015

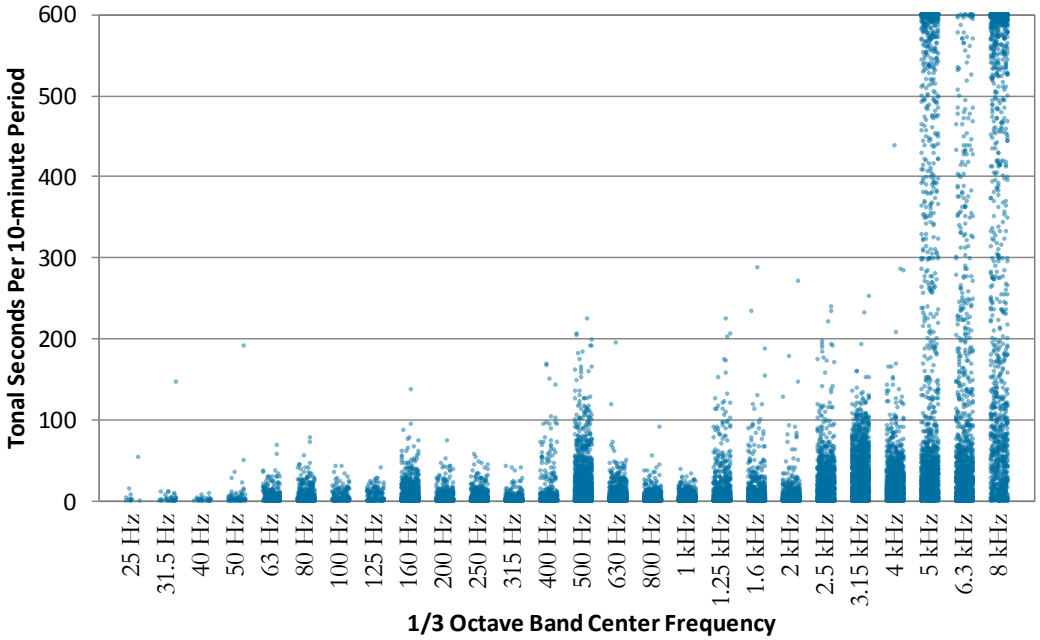

FIGURE 48: HENKLE HOLLOW SUMMER MONITORING PERIOD – TONALITY

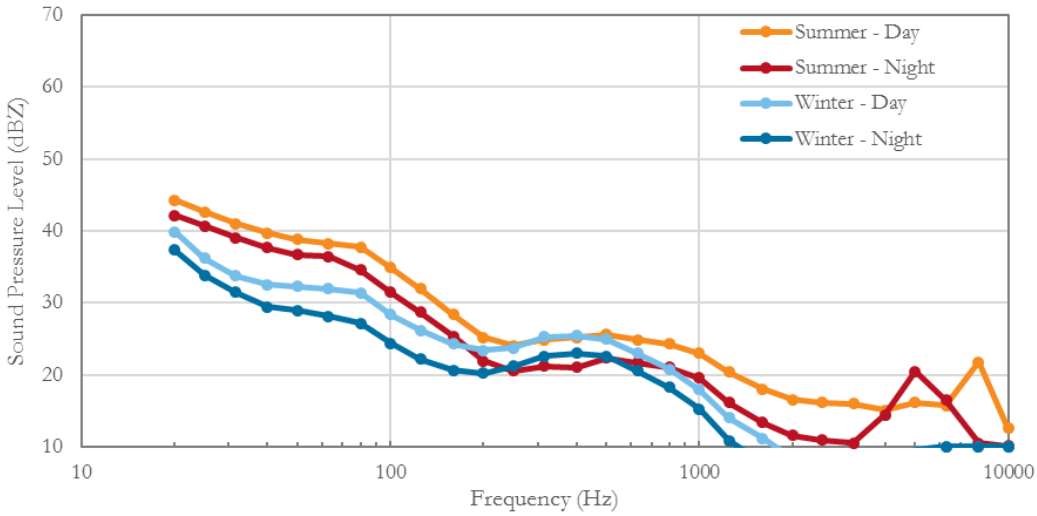

FIGURE 49: HENKLE HOLLOW 1/3 OCTAVE BAND MEDIAN SOUND LEVEL (L_{50}) BY SEASON AND TIME OF DAY

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MONITOR 5: LOON LAKE

The Loon Lake monitor was located at 9487 SR-21 in Wayland, New York, near the intersection of SR-21 and Chapel Road. The monitor was placed in an isolated clump of cedar trees with a clear view of the surrounding valley, approximately 29 m (131 ft) from SR-21 and 79 m (95 ft) from Chapel Road. The only structure on this portion of the property was a lightly used tractor barn. The location of the site is displayed on the map in Figure 50. Figure 51 shows a photograph of the installation looking northeast toward the lake. The monitor installation for summer monitoring is shown in Figure 56.

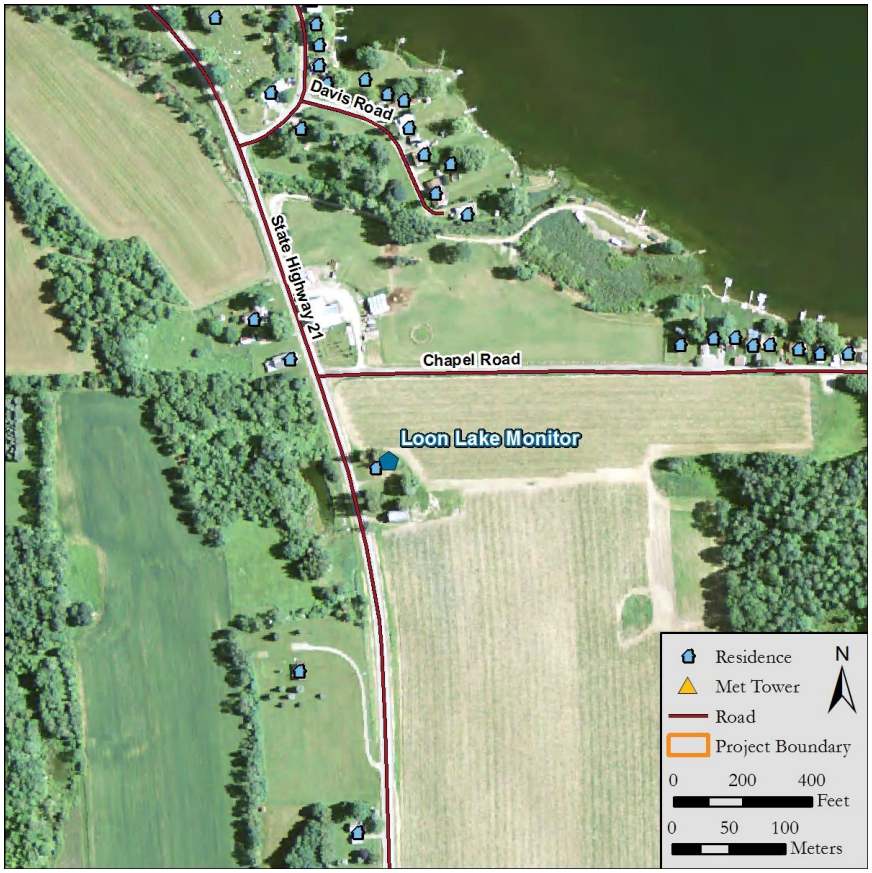

FIGURE 50: LOCATION OF THE LOON LAKE MONITOR

Winter Monitoring

Both an anemometer and a temperature gauge were included in the installation. The long-term sound level results are plotted as time history graphs in Figure 52, Figure 53, and Figure 54. The largest contributors to sound levels were car, truck, and snowmobile passbys, transient sound levels that contributed to the large difference between the L_{EQ} and L_{90}. An active snowmobile trail approached the monitoring location from the southeast and crossed SR-21 about 100 m south of the monitoring location. Several snowmobile pass-bys were excluded from the data when they veered off the trail and passed very close to the monitor. The data show a very regular diurnal pattern, indicating the influence of human activity in the area.

The tonality chart in Figure 55 indicates a moderate source of tonality at 1.25 kHz, which is attributable to the nearby snowmobiles.

FIGURE 51: PHOTOGRAPH OF THE LOON LAKE MONITOR, LOOKING NORTH

DRAFT

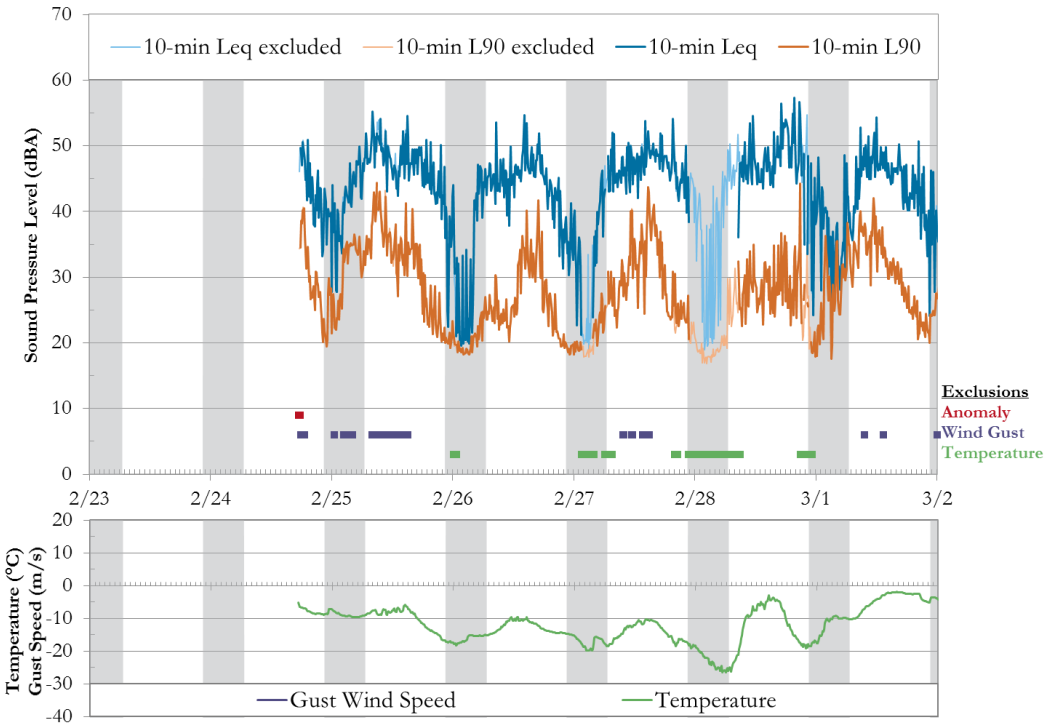

FIGURE 52: LOON LAKE MONITOR DATA, FEBRUARY 24 – MARCH 1, 2015

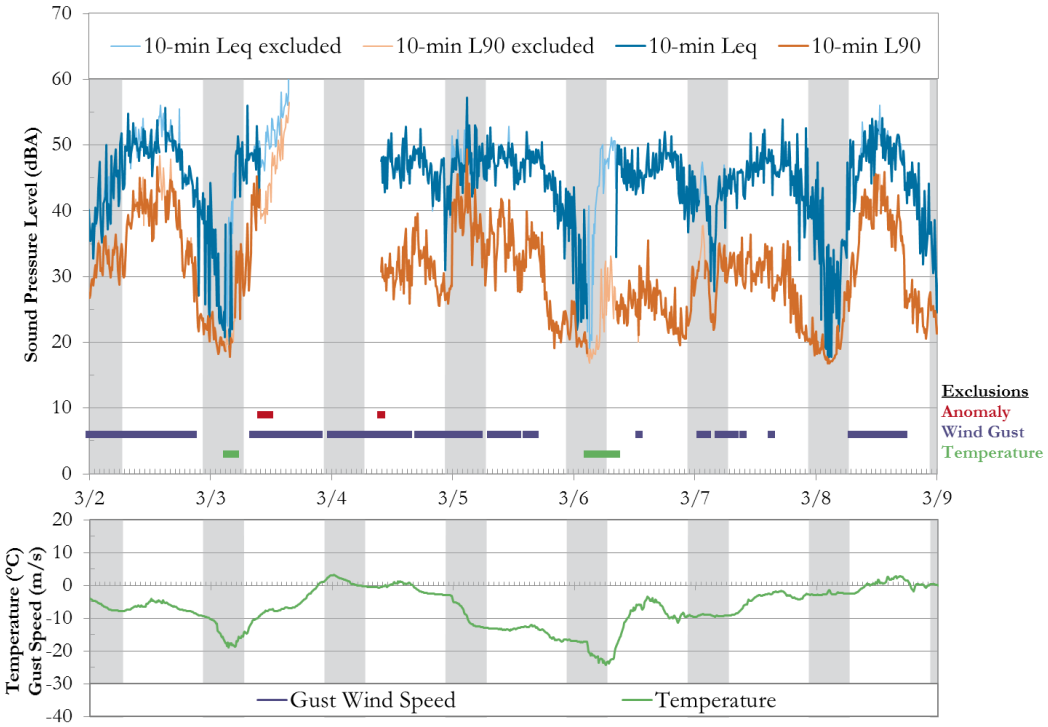

FIGURE 53: LOON LAKE MONITOR DATA, MARCH 1 – MARCH 8, 2015

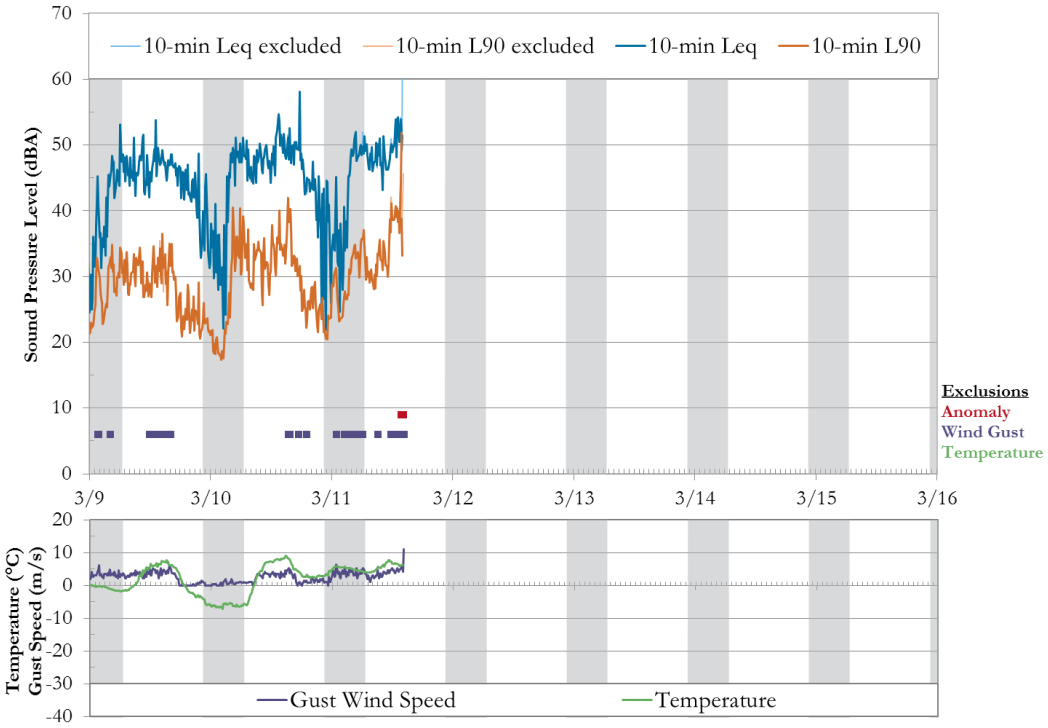

FIGURE 54: LOON LAKE MONITOR DATA, MARCH 8 – MARCH 11, 2015

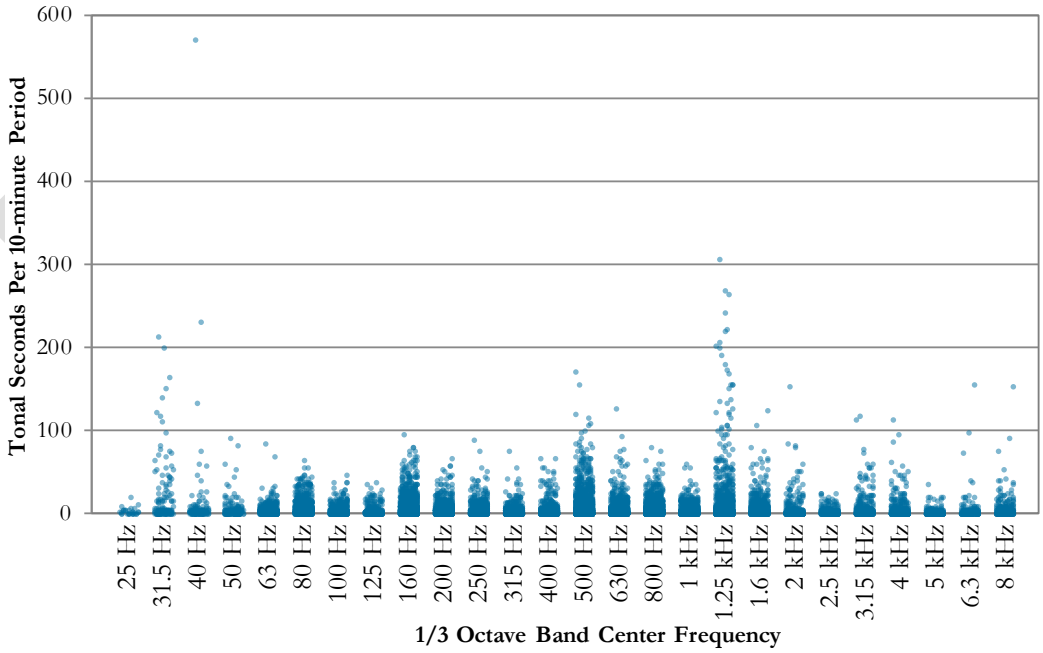

FIGURE 55: LOON LAKE WINTER MONITORING PERIOD – TONALITY

Summer Monitoring

Time history data from the summer monitoring period is presented in Figure 57, and Figure 58. Note that the power system for the equipment malfunctioned almost immediately after installation for the second week; sound level data was not acquired for the second half of summer monitoring at this site. The dominant sound source was traffic passbys on Rt. 21. The increased traffic volumes during the day caused a diurnal pattern. Also, tractor operations in the nearby fields were audible at times and were excluded from the data since they were seasonal in nature. One instance of church bells was excluded from the data as intermittent noise because they were prominent for 30 minutes at the monitoring site; the church was about 120 m (400 ft) from the monitor. Other events that were excluded from the data were a motorcycle idling nearby for over ten minutes, thunder, and lawn equipment.

As indicated in Figure 59, steady tonal sources were minimal at this site.

Figure 60 shows 1/3 octave band median sound levels by season and time of day. Due to the high level of traffic audible at this site (as with the Haskinville site, this monitor is near State Route 21), there is an increase in daytime sound levels between about 400 Hz and 2 kHz. An interesting feature of this site is that there is minimal summertime biogenic sound in the higher frequencies and a minimal mid frequency sound level increase during the winter. The increase in sound levels at approximately 63 Hz during the summer daytime period is likely due to truck engine noise.

FIGURE 56: PHOTOGRAPH OF THE LOON LAKE SITE

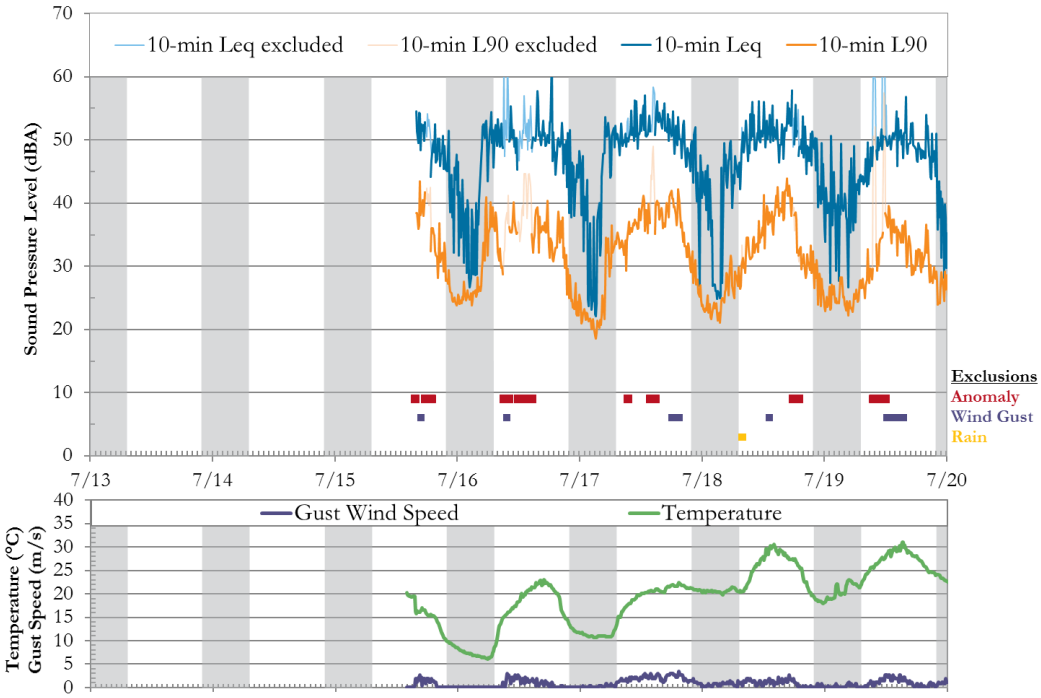

FIGURE 57: LOON LAKE MONITOR DATA, JULY 13 – 20, 2015

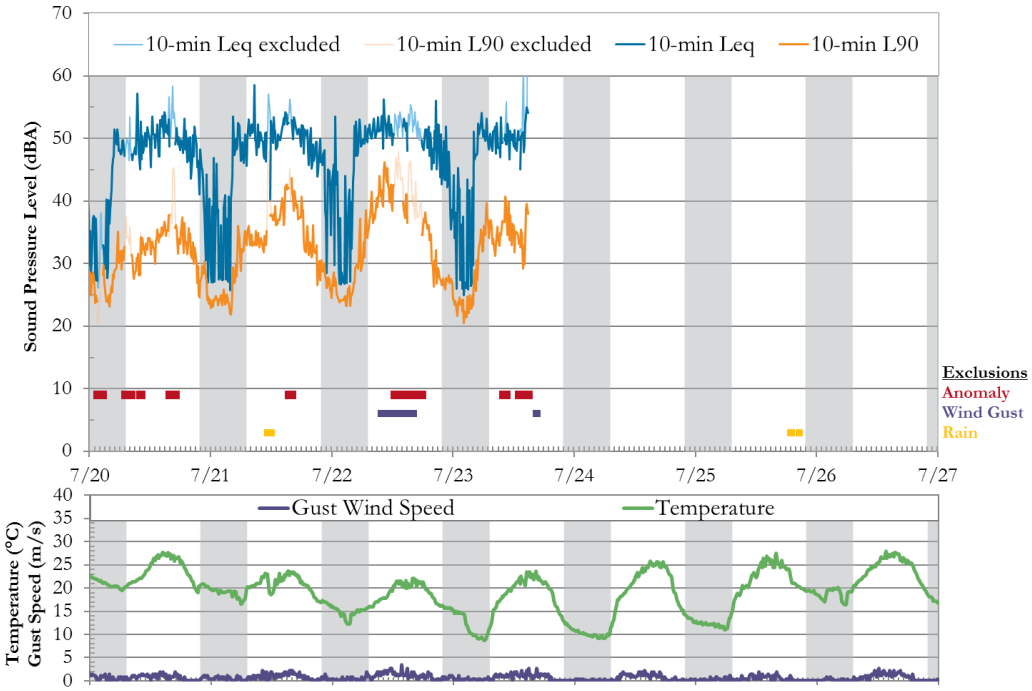

FIGURE 58: LOON LAKE MONITOR DATA, JULY 20 – 27, 2015

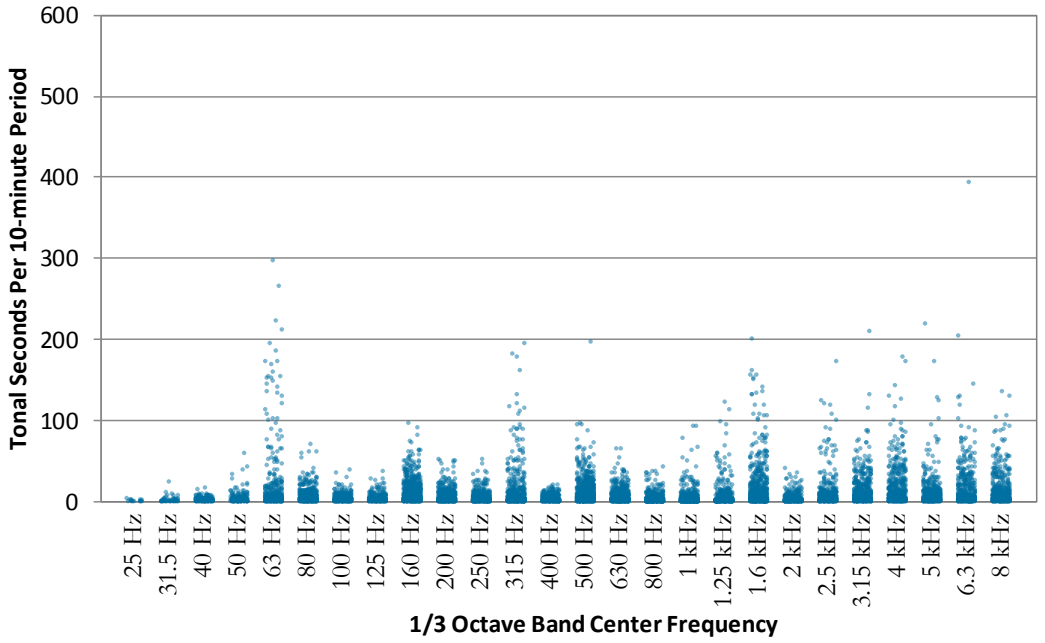

FIGURE 59: LOON LAKE SUMMER MONITORING PERIOD - TONALITY

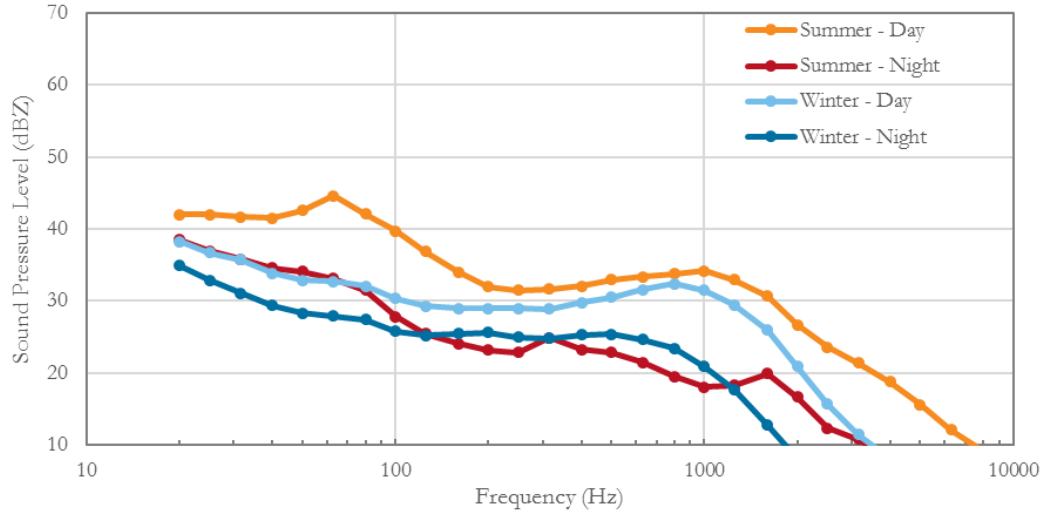

FIGURE 60: LOON LAKE 1/3 OCTAVE BAND SOUND LEVEL (L_{50}) BY SEASON AND TIME OF DAY

MONITOR 6: ROSE ROAD

The Rose Road monitor was located near 7731 Rose Road in Hornell, New York. The monitor was placed in the woods approximately 170 m (558 ft) across a cornfield from Rose Road and 82 m (266 ft) uphill through the woods from Tuttle Road. The site is located on the map in Figure 61. Figure 62 shows a photograph of the installation looking toward the southeast and the summer monitoring site is pictured in Figure 67.

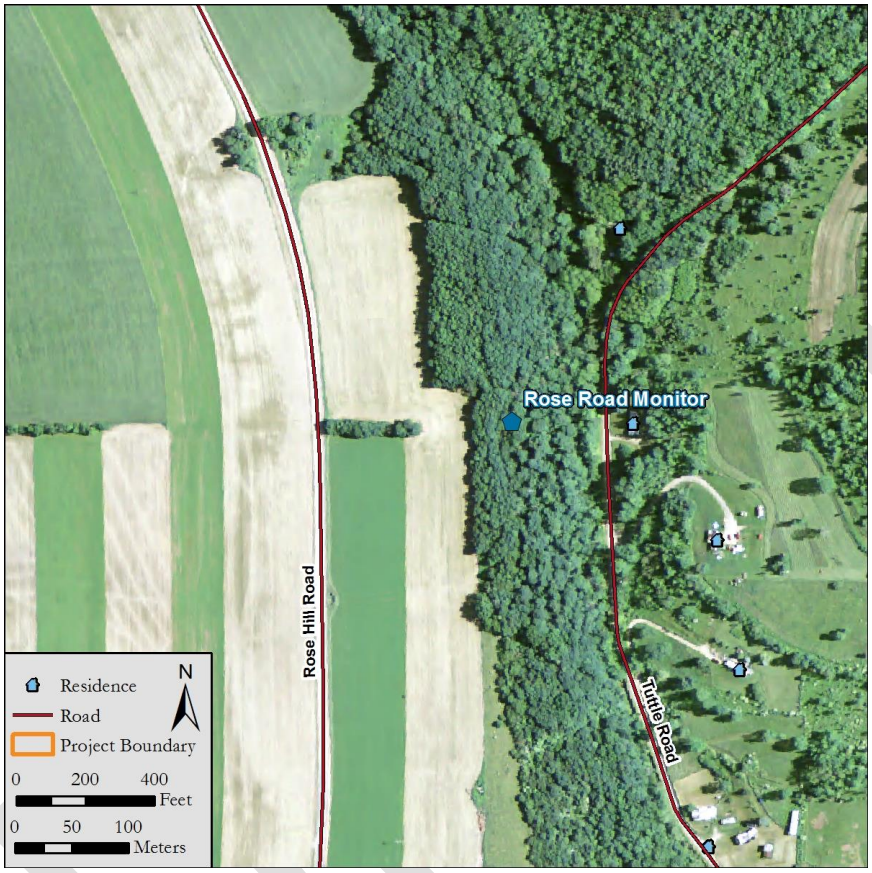

FIGURE 61: LOCATION OF THE ROSE ROAD MONITOR

Winter Monitoring

The long-term sound level results are plotted as time history graphs in Figure 63, Figure 64, and Figure 65. As there was no activity in the cornfield during the winter season, most of the sound measured at the monitor came from residential sites on Tuttle Road below. The residences below contributed sound in the form of engines, residential construction activities, and a chainsaw. One chainsaw event was excluded from statistical averaging of the data. Other sources of sound at the site were distant snowmobiles, trucks on the interstate, airplane overflights, wind through the trees, and birdsongs. Sound levels at the site were diurnal, as human activities contributed to the daytime levels.

Tonality incidence at this site, shown in Figure 66 is minimal. Higher tonality in the 1.25 kHz 1/3 octave band is due to birds and vehicle backup alarms.

Figure 72 shows spectral median sound levels (L_{50}) by season and time of day. This site has similar spectral changes between the summer and winter, with an increase in biogenic sound during the summer.

FIGURE 62: PHOTOGRAPH OF THE ROSE ROAD MONITOR

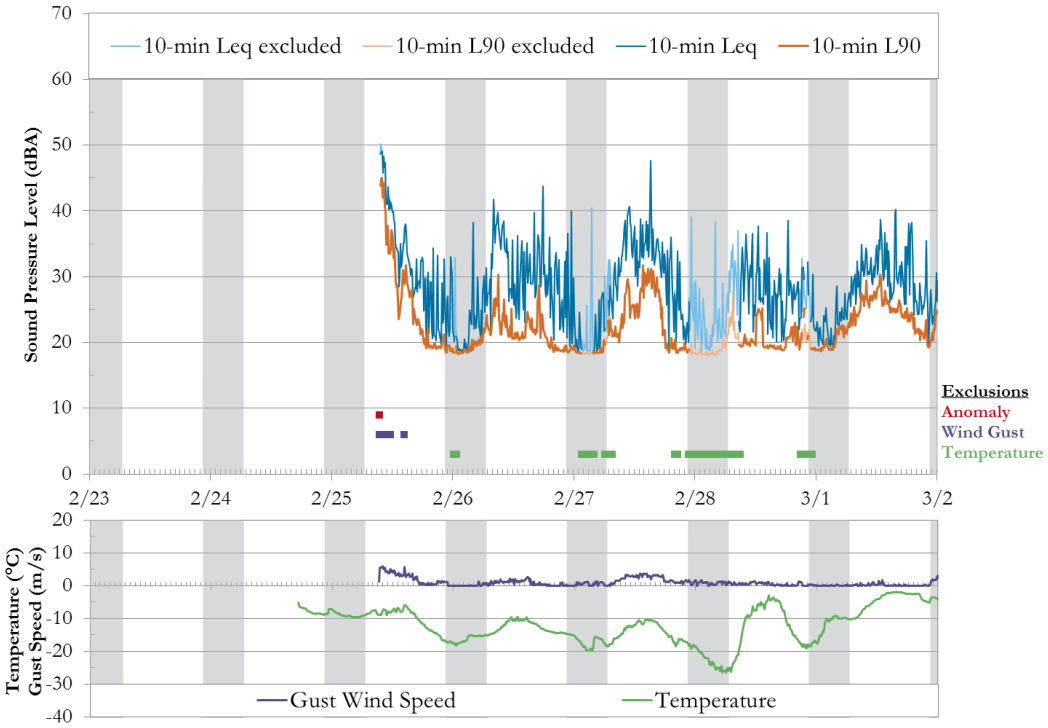

FIGURE 63: ROSE ROAD MONITOR DATA, FEBRUARY 25 – MARCH 1, 2015

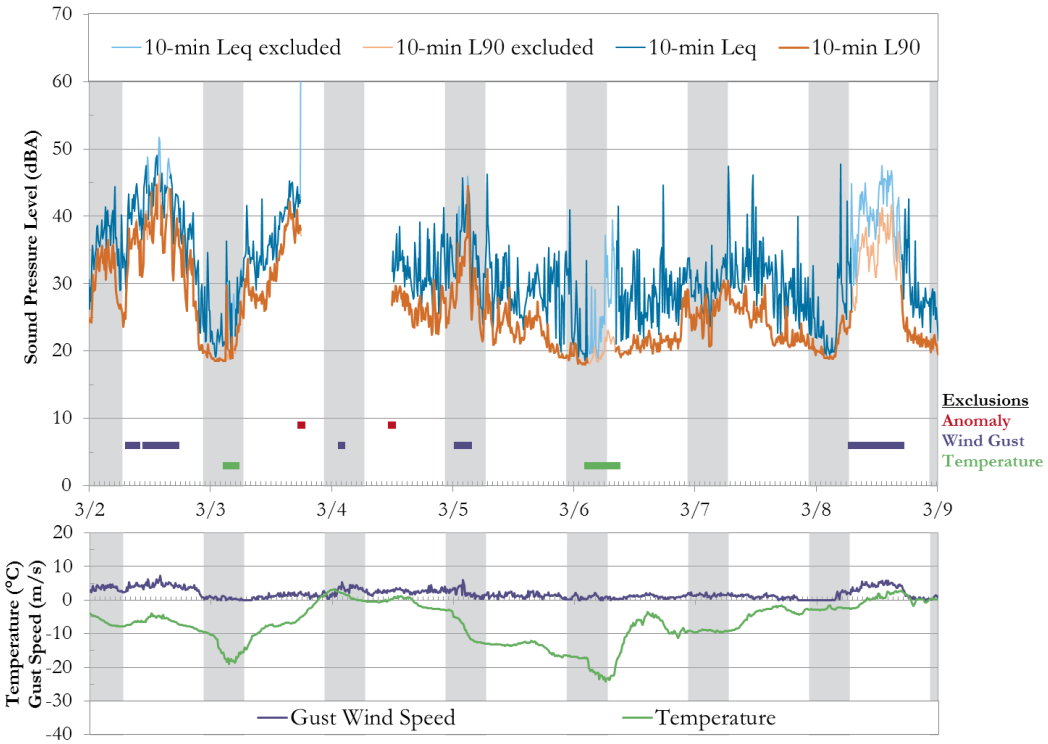

FIGURE 64: ROSE ROAD MONITOR DATA, MARCH 1 – MARCH 8, 2015

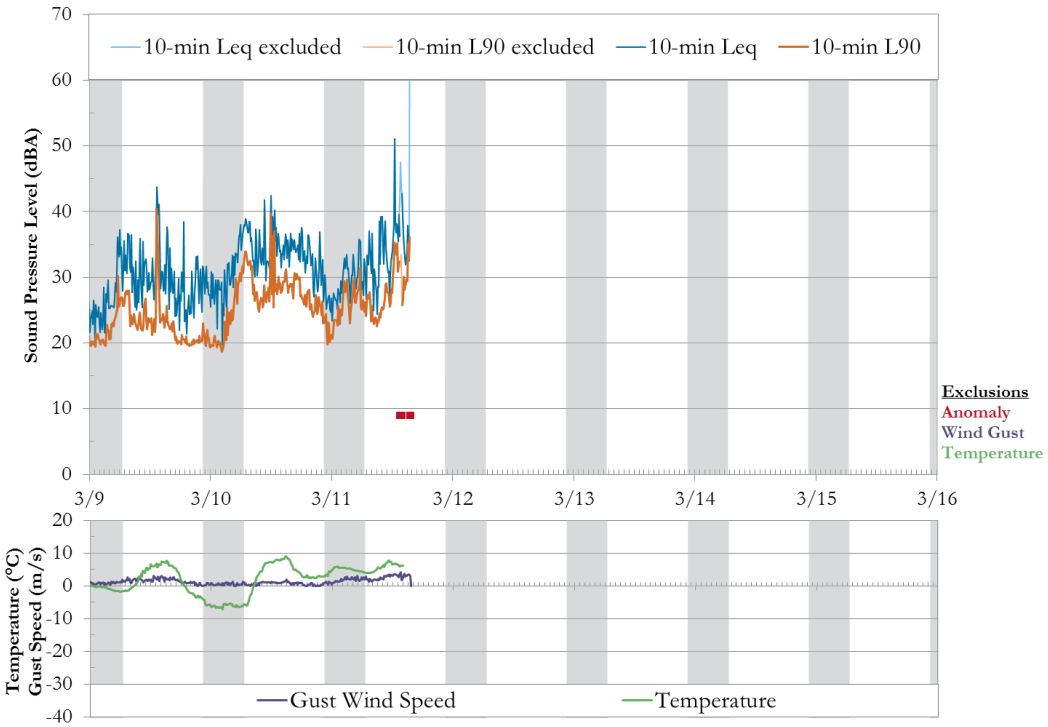

FIGURE 65: ROSE ROAD MONITOR DATA, MARCH 8 – MARCH 11, 2015

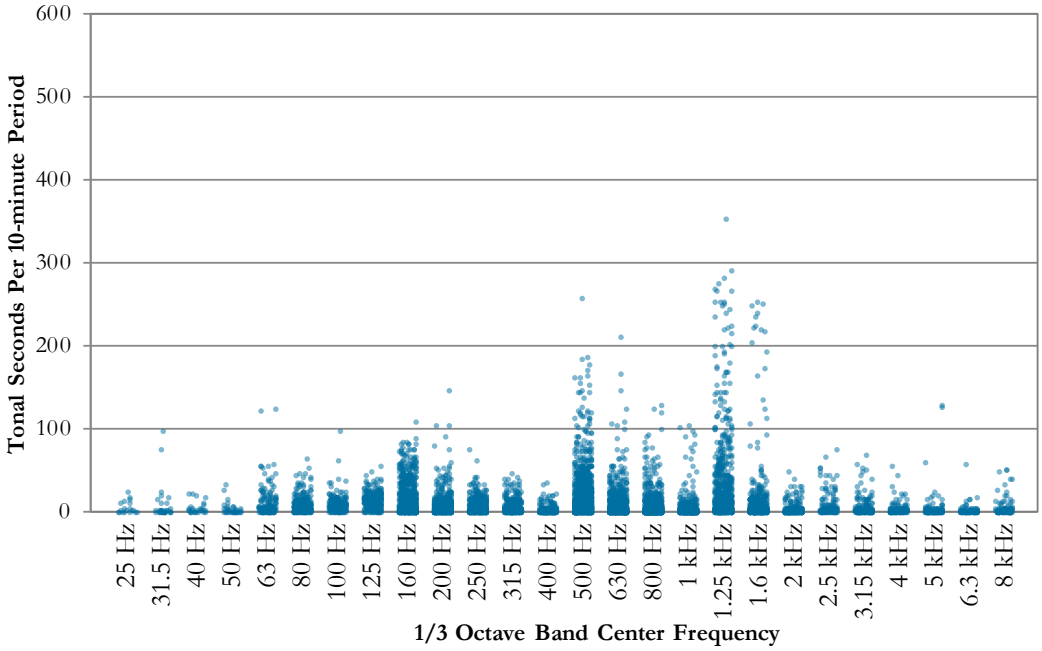

FIGURE 66: ROSE ROAD WINTER MONITORING PERIOD – TONALITY

Summer Monitoring

Time history plots from the summer monitoring period are presented in Figure 68, Figure 69, and Figure 70. Although wind speeds measured at the monitor location were low, wind-caused sound from leaf rustle was a prominent source at the monitor. Overall, sound levels at the site loosely adhered to a diurnal pattern but was a bit more crepuscular in nature, with activities starting before dusk and ending after sunset. Operations from the dairy barn were audible at the monitor, including daily tractor work and milk pumps. These events were likewise observed in the winter monitor data, although at lower levels due to the attenuation caused by snow cover on the ground. These operations were retained in the data. The cornfield directly to the west was planted with corn but no field operations took place during the monitoring period. Activities from residents down the hill on Tuttle Road were prominent at the monitor. Loud motorcycle passbys on Tuttle Road were common. A resident down the hill worked on motorcycles during the day and throughout the night. These activities were retained in the data as being "characteristic of the area."

Tonality for the period, summarized in Figure 71, shows a variety of anthropogenic sources at 500 Hz and below, as well as biogenic sources above 1 kHz (birds and insects). Human generated sound was mostly engine related.

Figure 72 shows spectral median sound levels (L_{50}) for the summer and winter periods at Rose Road. As at other sites during the winter, there is a mid-frequency hump that is not present during the summer. In the summer, higher frequency sound levels are higher, caused by increases in biogenic sound.

FIGURE 67: PHOTOGRAPH OF THE ROSE ROAD SITE

DRAFT

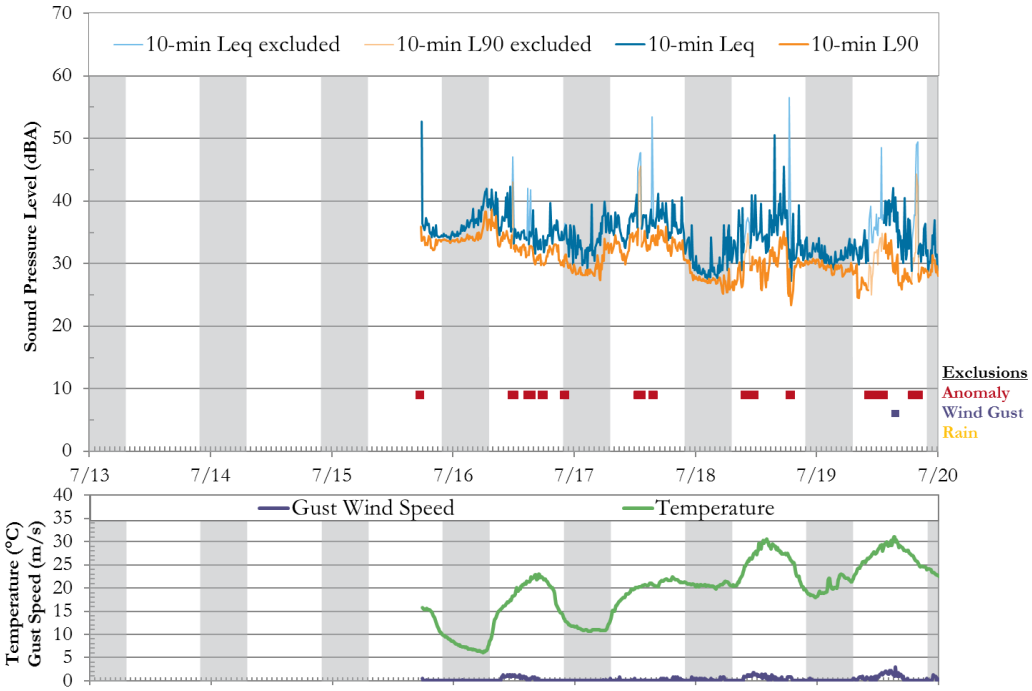

FIGURE 68: ROSE ROAD MONITOR DATA, JULY 13 – 20, 2015

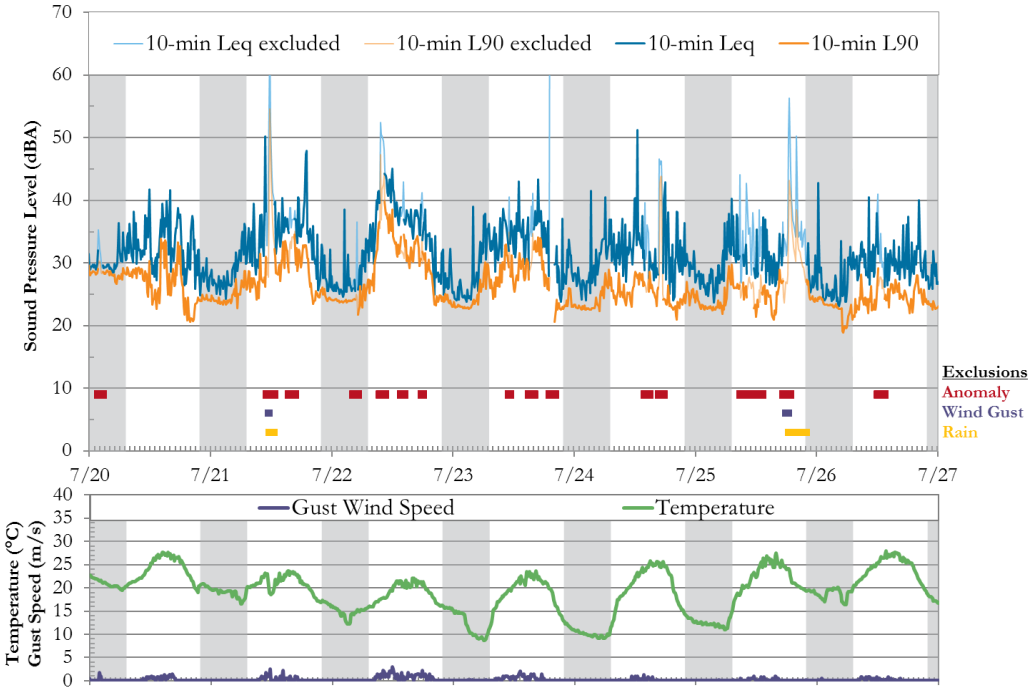

FIGURE 69: ROSE ROAD MONITOR DATA, JULY 20 – 27, 2015

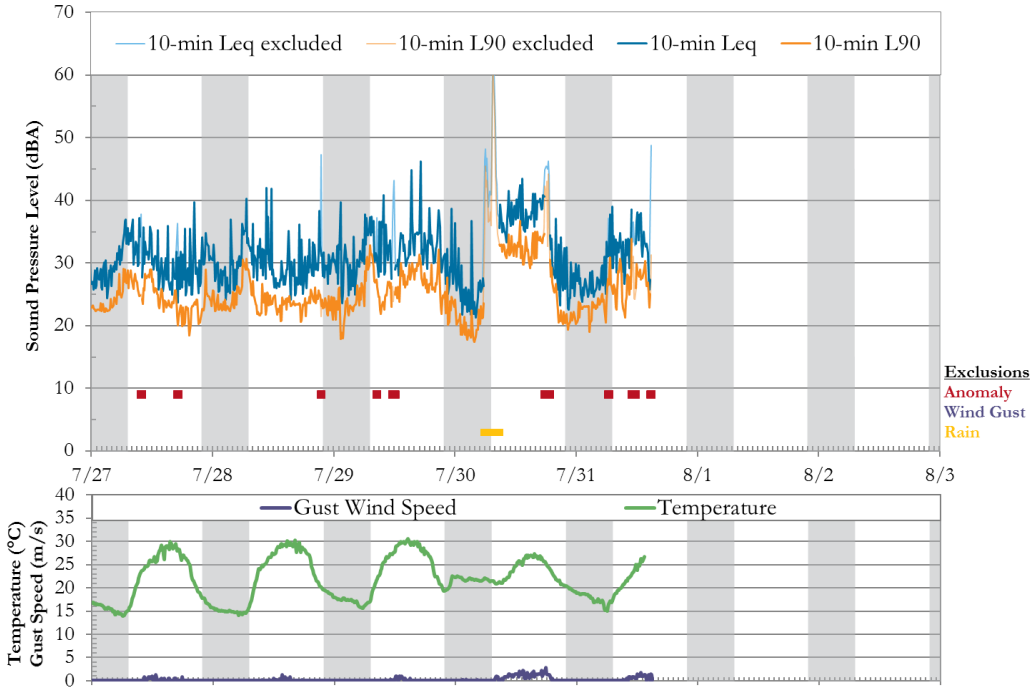

FIGURE 70: ROSE ROAD MONITOR DATA, JULY 27 – AUGUST 3, 2015

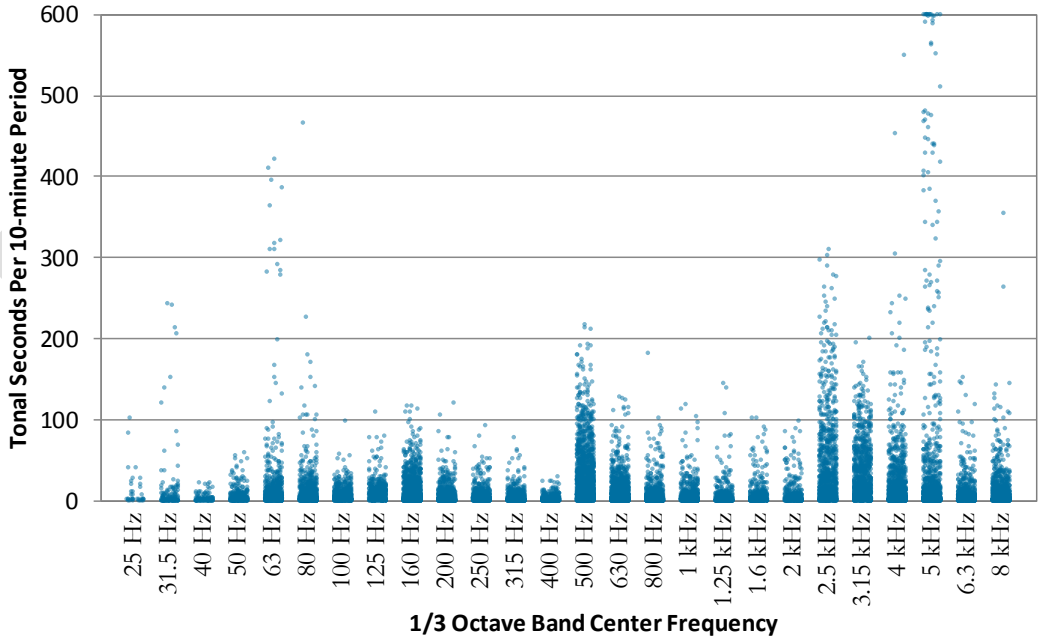

FIGURE 71: ROSE ROAD SUMMER MONITORING PERIOD – TONALITY

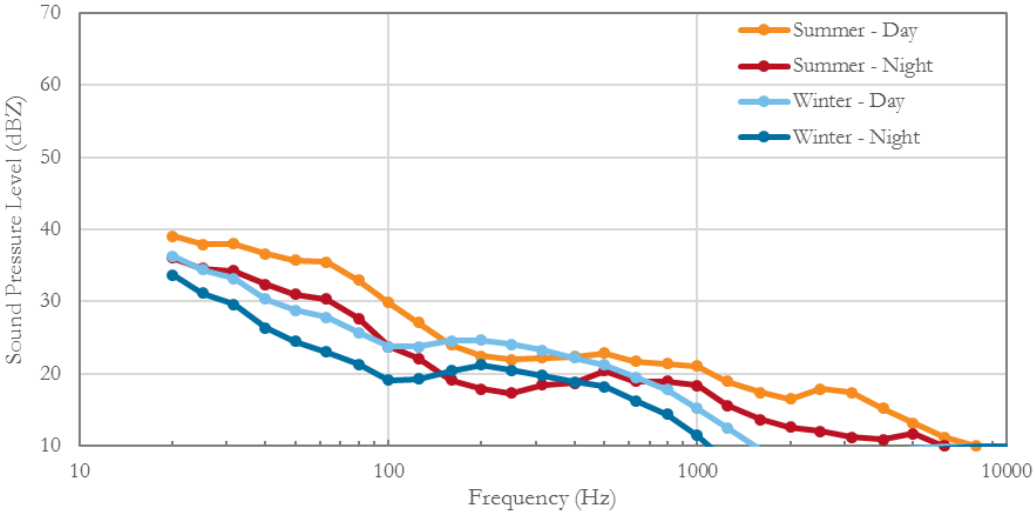

FIGURE 72: ROSE ROAD 1/3 OCTAVE BAND MEDIAN SOUND LEVEL (L_{50}) BY SEASON AND TIME OF DAY

MONITOR 7: WALTER KURTZ ROAD

The "Walter Kurtz Road Monitor" monitor was located near 2287 Walter Kurtz Road. The installation was well into the woods, approximately 100 m (328 ft) from a seasonal road. The site is shown in Figure 73. Figure 74 shows a photograph of the winter installation looking toward the southwest and Figure 79 shows the same view of the summer monitor.

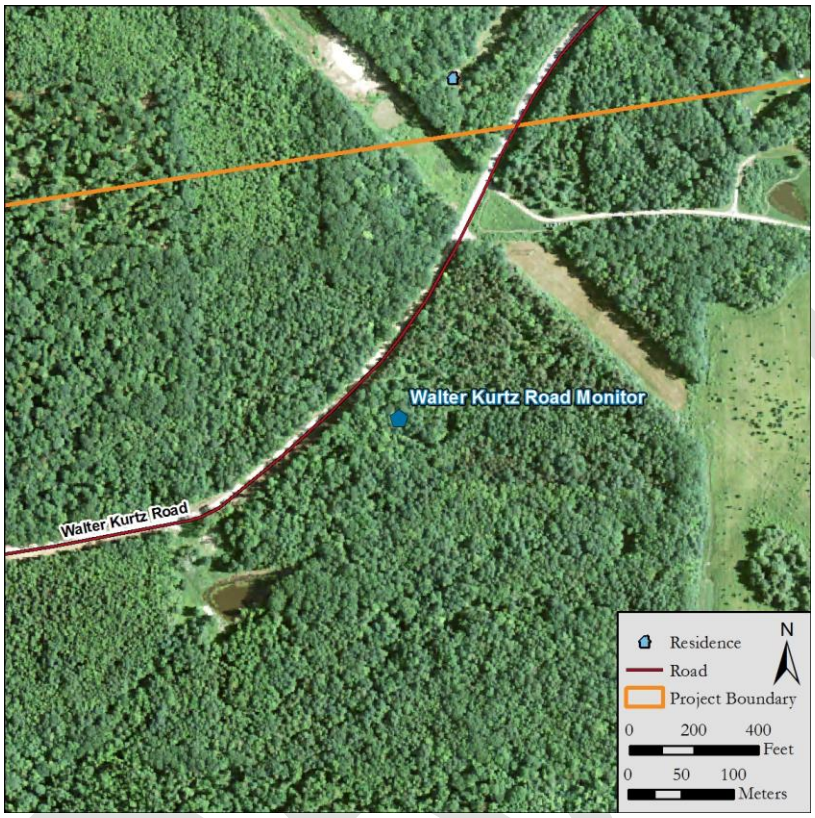

FIGURE 73: LOCATION OF THE WALTER KURTZ ROAD MONITOR

Winter Monitoring

The long-term sound level results are plotted as time history graphs in Figure 75, Figure 76, and Figure 77. As this portion of Walter Kurtz Road is seasonal (it is not plowed), there was very little traffic-related noise at the site. However, there sound from snowmobile traffic on the road appeared several times in the data. Other than the infrequent snowmobiles, the dominant sounds at the site were wind blowing through the trees, birdsong, and aircraft flyovers. Sound levels were seen to increase slightly at dawn and dusk with bird activity. On one occasion, a raven landed very close to the monitor and called for several minutes. Due to the uncharacteristically high sound levels this created, this period was excluded from the calculated statistical levels. The Walter Kurtz Road site was the quietest site monitored, with equal daytime and nighttime levels, a result of separation from human activity.

Figure 78 shows tonality incidence at the site. There were no consistent sources of tonal sound.

FIGURE 74: PHOTOGRAPH OF THE WALTER KURTZ ROAD MONITOR, LOOKING SOUTHEAST

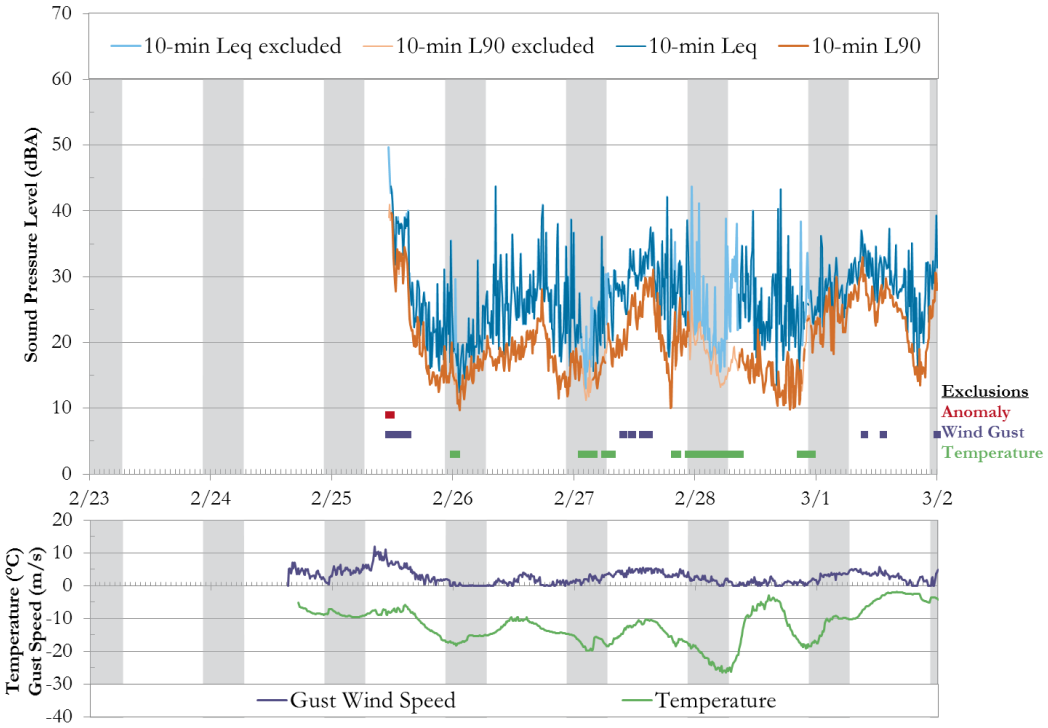

FIGURE 75: WALTER KURTZ ROAD MONITOR DATA, FEBRUARY 25 – MARCH 1, 2015

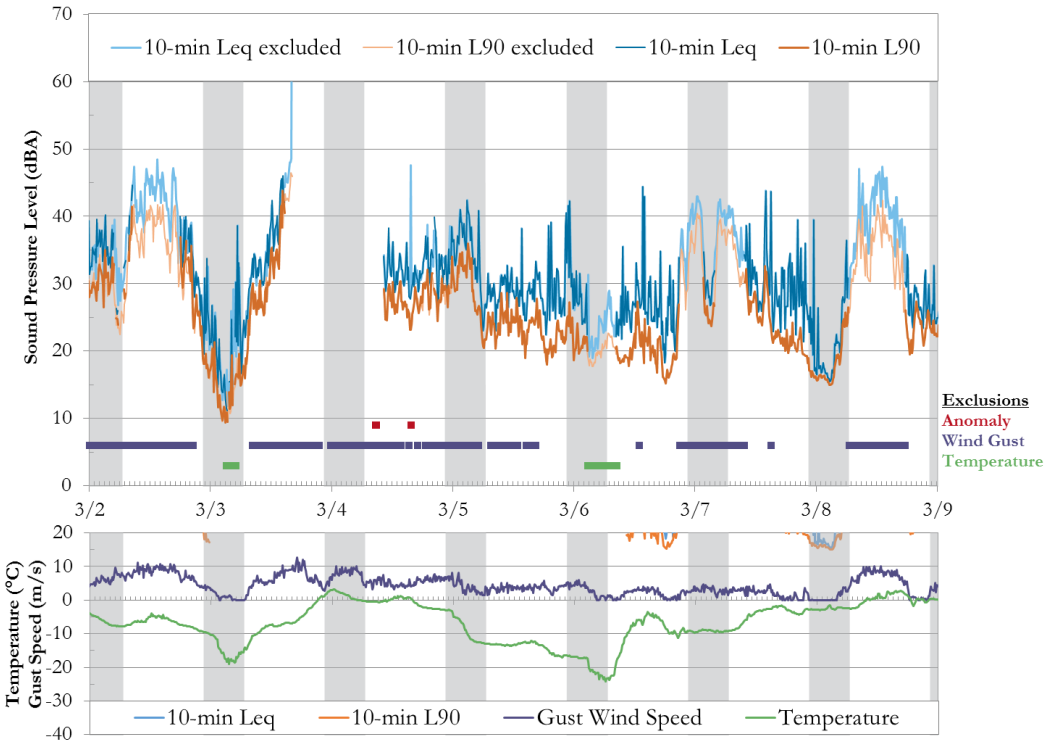

FIGURE 76: WALTER KURTZ ROAD MONITOR DATA, MARCH 1 – MARCH 8, 2015

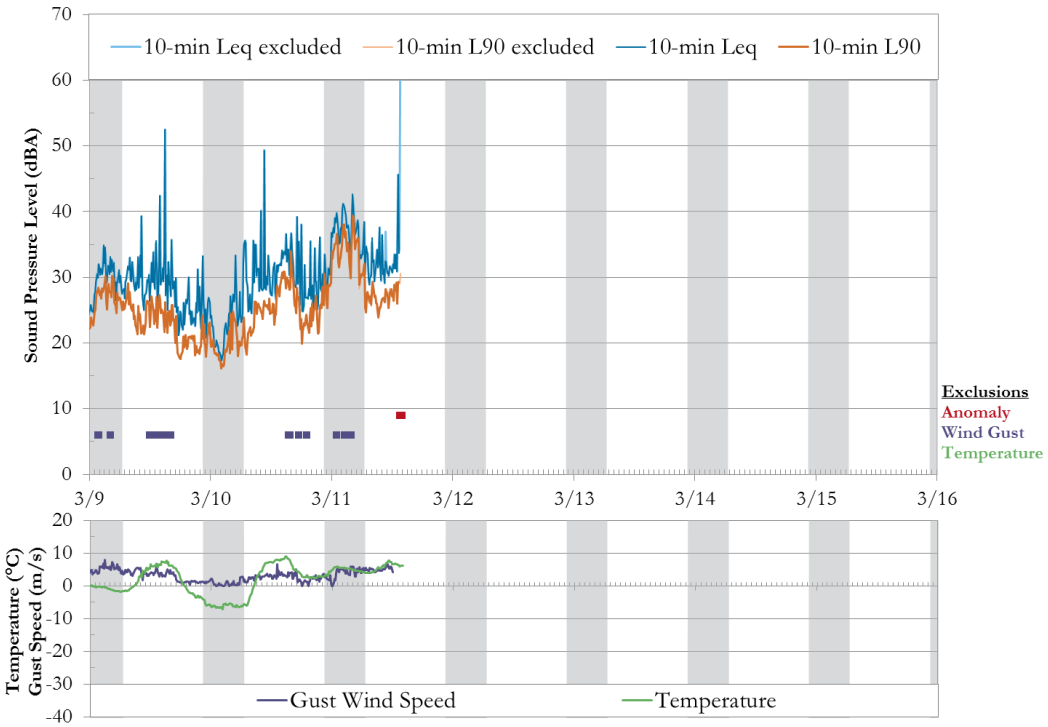

FIGURE 77: WALTER KURTZ ROAD MONITOR DATA, MARCH 8 – MARCH 11, 2015

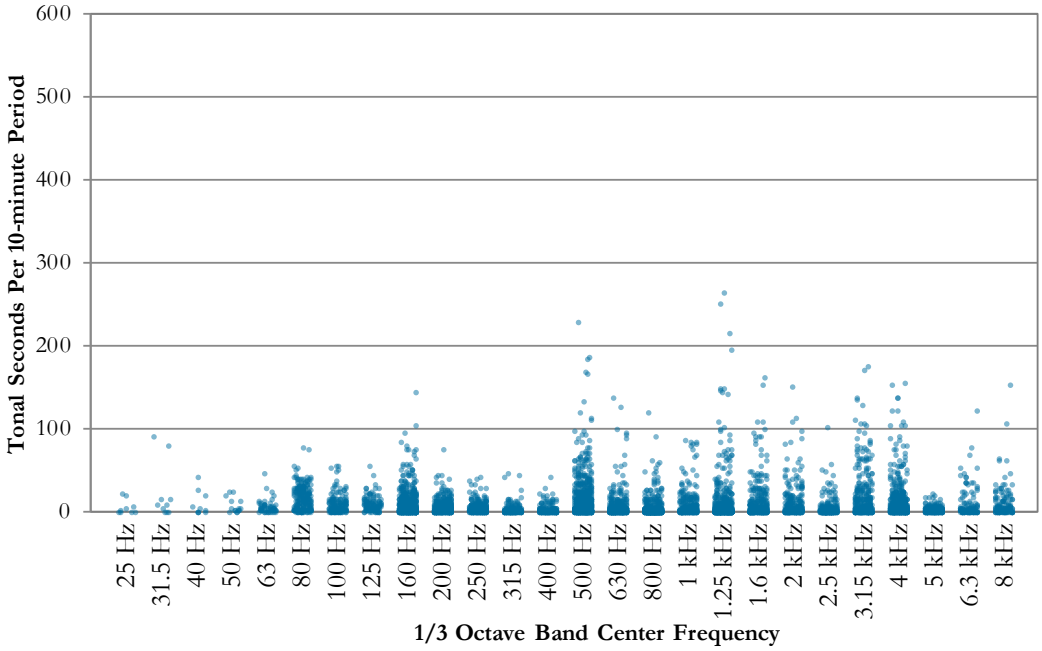

FIGURE 78: WALTER KURTZ ROAD WINTER MONITORING PERIOD – TONALITY

Summer Monitoring

The time history plots for this monitoring period are shown in Figure 80, Figure 81, and Figure 82. The seasonal road was well travelled in the summer, mostly by larger vehicles, such as work trucks and hauling trucks. Motorcycle and ATV passbys were also common. These passbys were retained in the data, but any work that occurred near the monitor, such as utility operations or logging activities, were excluded. Wind blowing through the leaves in the trees remained the dominant source of sound at this monitor and aircraft overflights were consistent throughout the monitoring period.

The majority of tonal activity at this site was from biogenic sources such as birds and insects, as is shown in the 2.5 kHz to 8 kHz 1/3 octave bands in in Figure 83.

Spectral median sound levels (L_{50}), by season and time of day are shown in Figure 84. Similar to other sites there is increased high frequency biogenic sound during the summer, and a mid-frequency sound level increase during the winter. Also at this site, the difference between the daytime and nighttime low frequency spectra is greater during the summer than during the winter. This may be due to vehicle traffic on the seasonal road.

FIGURE 79: PHOTOGRAPH OF THE WALTER KURTZ ROAD SITE, LOOKING SOUTHEAST

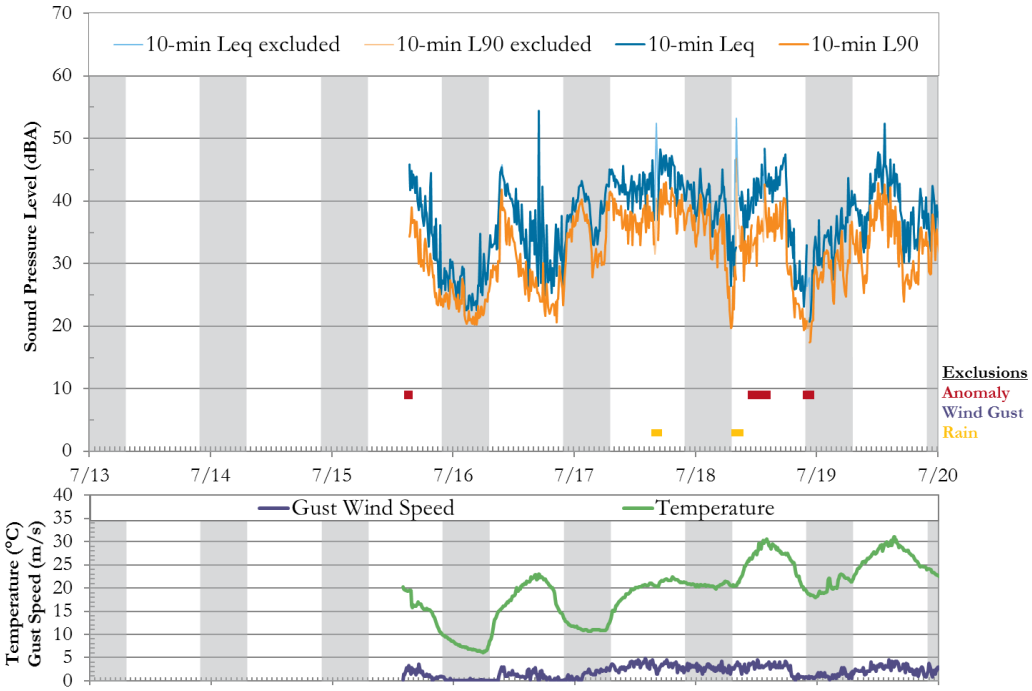

FIGURE 80: WALTER KURTZ ROAD MONITOR DATA, JULY 13 – 20, 2015

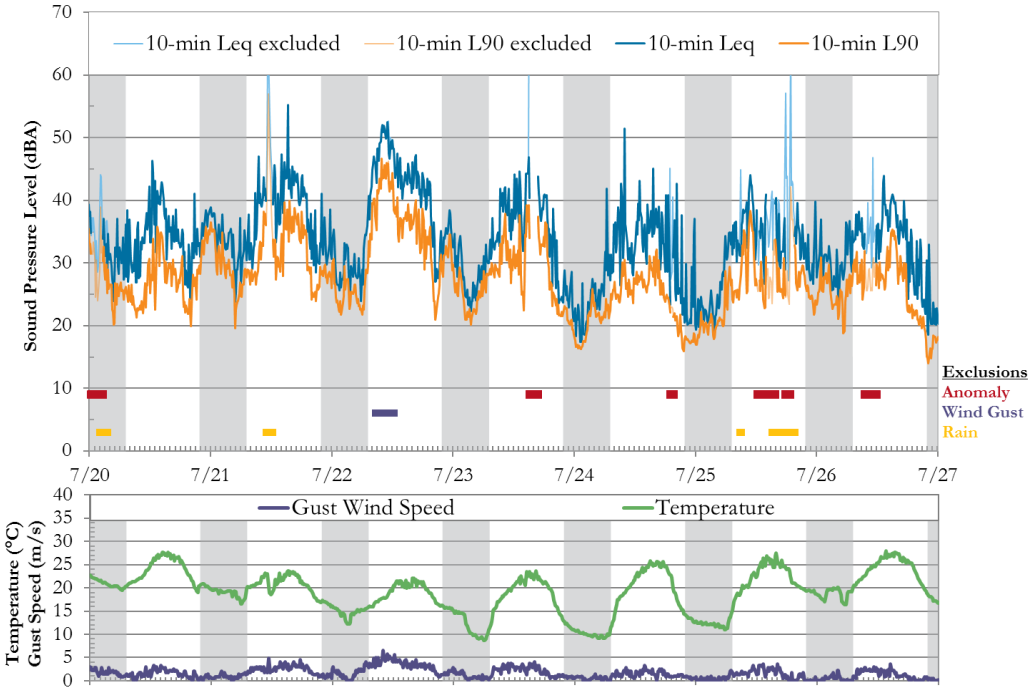

FIGURE 81: WALTER KURTZ ROAD MONITOR DATA, JULY 20 – 27, 2015

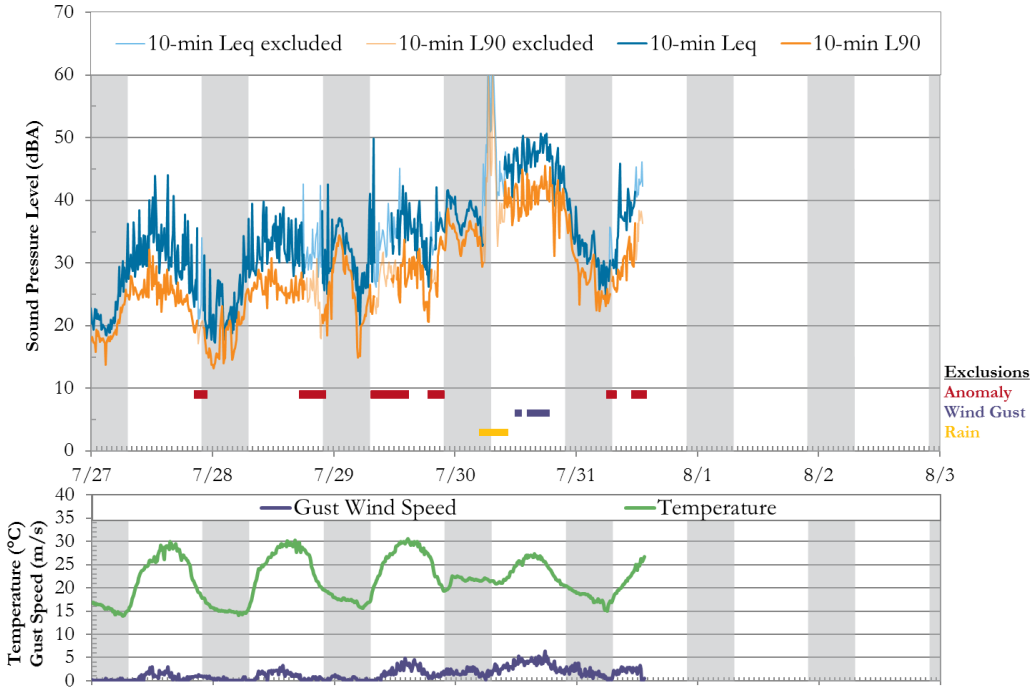

FIGURE 82: WALTER KURTZ ROAD MONITOR DATA, JULY 27 – AUGUST 3, 2015

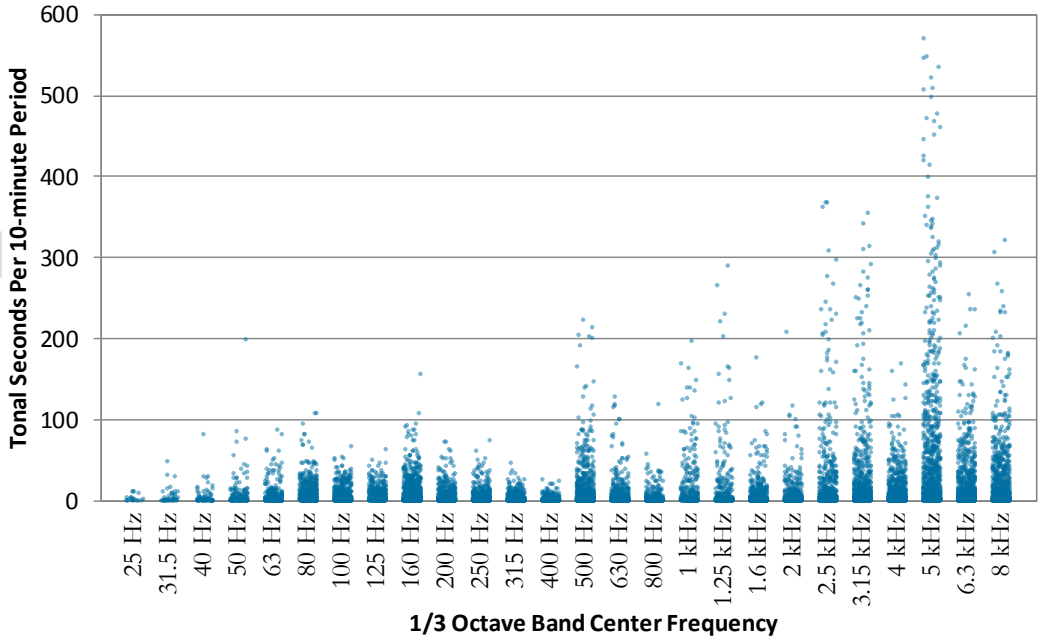

FIGURE 83: WALTER KURTZ ROAD SUMMER MONITORING PERIOD – TONALITY

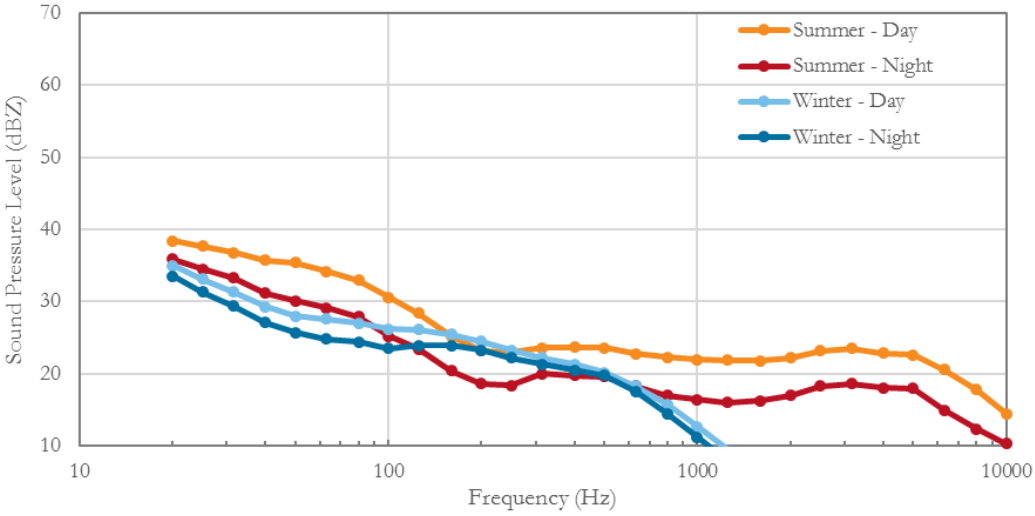

FIGURE 84: WALTER KURTZ ROAD 1/3 OCTAVE BAND MEDIAN SOUND LEVELS (L_{50}) BY SEASON AND TIME OF DAY

4.0 SUMMARY OF RESULTS

4.1 | SOUND PRESSURE LEVELS

The sound levels over the entire monitoring period are summarized for all seven sites for the winter, summer, and combined monitoring periods in Table 3.

During the winter, the equivalent continuous levels (L_{EQ}) at night are less than (or equal to) daytime levels at all sites, which is typical. At the Walter Kurtz Road monitor, the daytime and nighttime levels are similar, due to the lack of anthropogenic sounds. The large difference between equivalent continuous levels (L_{EQ}) and 10th-percentile levels (L_{90}) indicate that the soundscapes at all of the sites are dominated by transient or intermittent sounds (such as aircraft overflights or passing automobiles). The winter nighttime equivalent continuous level (L_{EQ}) averaged over all seven sites is 40 dBA.

During the summer, sound levels are typically higher than the winter. This is primarily caused by addition of foliage in the summer, along with water flow, and yard/farm equipment. The main exception is Rose Road, where anthropogenic sound sources were decreased during the summer, leading to lower overall sound levels. The Brasted Road monitoring has higher sound levels during the winter at night, due to equipment operation at the nearby dairy operation. During the summer, there is a wide spread between the L_{90} and L_{10} sound levels at all locations, indicating dominance by transient and intermittent sounds. Whether this difference increased or decreased from summer to winter, depends on the location. The summer nighttime L_{EQ} over all seven sites was 39 dBA.

Overall, most sites exhibit highly variable sound levels, with intermittent sounds dominating the equivalent continuous sound levels. There are no cases where there is a single, constant source dominating the soundscape. The overall nighttime L_{EQ} was 40 dBA averaged over all seven sites.

4.2 | METEOROLOGY

Temperatures during the winter monitoring period ranged from a low of -28° C (-17° F) to a high of 9° C (49° F). During the summer monitoring period temperatures ranged from a low of 6° C (42° F) to a high of 34° C (94° F). Winds varied widely among the four monitor sites and throughout the monitoring periods, ranging from calm to a maximum 1-minute average of 9 m/s (20 mph) at the Henkle Hollow monitor during the winter. This site also recorded the strongest winter gust at 13 m/s (28 mph). The summer was overall less windy, with a maximum 1-minute average wind speed of 4 m/s (8 mph) at Henkle Hollow and the maximum wind gust speed of 8 m/s (19 mph) at Rose Road. Maximum measured wind and gust speeds from all sites are shown in Table 4 and Table 5. The Henkle Hollow monitor was in an exposed location along the slope of a hill, while the Loon Lake monitor was located in an open, flat valley without much cover provided by the forest or geographical features. The Haskinville Road and Rose Road monitors were both in areas that were more protected from the wind by surrounding structures, trees, and topography. The Walter Kurtz Road Monitor was on higher ground, but in a more heavily forested area.

DRAFT

Precipitation in the form of snow fell during the monitoring period on February 26 and 27, 2015, as well as March 1-3, 5, 7, and 8, 2015. None of the precipitation events were significant; this minimal amount of snowfall did not affect the measurements or the data. During the summer, rain fell on July 15, 18, 21, 25, and 30.

TABLE 3: PRE-CONSTRUCTION MONITORING SUMMARY

	Location	Sound Level (dBA)											
		Overall				Day				Night			
		Leq	L90	L50	L10	Leq	L90	L50	L10	Leq	L90	L50	L10
Winter	Brasted Road	44	20	30	41	45	23	32	42	44	17	26	39
	Loon Lake	47	24	36	51	48	27	39	52	43	21	31	46
	Dye/Rex Road	37	19	27	38	37	20	28	37	36	17	26	40
	Haskinville Road	39	22	33	43	40	25	35	44	37	20	28	40
	Rose Road	35	20	27	38	36	21	28	39	33	19	25	35
	Henkle Hollow Road	39	22	30	41	39	23	30	42	37	22	28	39
	Walter Kurtz Road	32	18	26	34	32	19	27	34	32	17	25	35
	Location	Sound Pressure Level (dBA)											
		Overall				Day				Night			
		Leq	L90	L50	L10	Leq	L90	L50	L10	Leq	L90	L50	L10
Summer	Brasted Road	47	19	27	43	49	23	32	47	37	16	22	31
	Loon Lake	50	26	38	53	51	33	42	54	46	24	30	47
	Dye/Rex Road	38	23	29	40	40	25	31	42	32	21	27	35
	Haskinville Road	42	21	35	46	44	28	39	47	39	19	26	43
	Rose Road	35	24	30	37	36	25	31	38	32	23	28	34
	Henkle Hollow Road	36	25	31	39	38	26	33	40	33	23	29	36
	Walter Kurtz Road	40	23	32	43	41	25	34	45	35	20	29	39
	Location	Sound Pressure Level (dBA)											
		Overall				Day				Night			
		Leq	L90	L50	L10	Leq	L90	L50	L10	Leq	L90	L50	L10
Combined	Brasted Road	46	19	28	42	47	22	31	45	41	17	24	35
	Loon Lake	48	25	37	51	49	29	40	53	45	22	30	46
	Dye/Rex Road	37	21	28	38	38	22	29	39	34	20	27	36
	Haskinville Road	42	21	34	45	43	27	37	37	42	39	19	26
	Rose Road	35	22	29	37	36	23	30	38	32	20	27	35
	Henkle Hollow Road	38	23	30	40	39	24	32	41	35	22	29	37
	Walter Kurtz Road	38	20	29	41	39	22	30	42	34	19	27	38

TABLE 4: PRE-CONSTRUCTION WINTER MONITORING – WIND SPEED SUMMARY

Monitoring Location	Maximum 1-minute Wind Speed		Maximum Wind Gust Speed	
	m/s	mph	m/s	mph
Haskinville Road	4	9	9	21
Rose Road	4	10	7	16
Loon Lake	7	16	11	25
Henkle Hollow	9	20	13	28

TABLE 5: PRE-CONSTRUCTION SUMMER MONITORING – WIND SPEED SUMMARY

Monitoring Location	Maximum 1-minute Wind Speed		Maximum Gust Speed	
	m/s	mph	m/s	mph
Haskinville Road	2	5	6	14
Rose Road	3	6	8	19
Loon Lake	3	8	7	15
Henkle Hollow	4	8	7	15
Walter Kurtz Road	1	2	6	12

4.3 | COMPARISON OF SOUND LEVELS TO WIND SPEED

The hub height (90 meters or 295 feet) wind speed as measured at the Project's Sand Hill meteorological tower is shown in relation to L_{EQ} and L_{90} in Figure 85 and Figure 86, respectively. The purple area indicates the 80th percentile sound level, with the middle grey line indicating the median sound level. Wind speeds below 4 m/s, the wind turbine cut-in speed, were omitted. There is a correlation between sound level and hub-height wind speed, with the L_{90} providing a better correlation than the L_{EQ}, since the L_{90} will filter out intermittent anthropogenic sounds such as car pass-bys.

Figure 87 and Figure 88 show the hub height wind speed compared to the 10-minute sound level (L_{EQ} and L_{90} respectively) for each individual 10-minute period. As with the middle 80 percent data, this indicates that there is a correlation between sound level and wind speed, but the correlation is not very high, particularly during the day. The L_{EQ} shows a lower correlation than the L_{90}. For both the L_{EQ} and L_{90} datasets, there is a higher correlation at night than during the day. Note that while there is a correlation between sound level and hub height wind speed, there is still considerable variability in sound level at a given wind speed. Even at 14 m/s the 80 percent sound level (L_{90}) range is from 31 to 39 dBA, an 8 dB spread. At 4 m/s, the spread is 15 dB for the L_{90} and 18 dB for the L_{EQ}. In other words, there are many influences on sound level other than wind speed.

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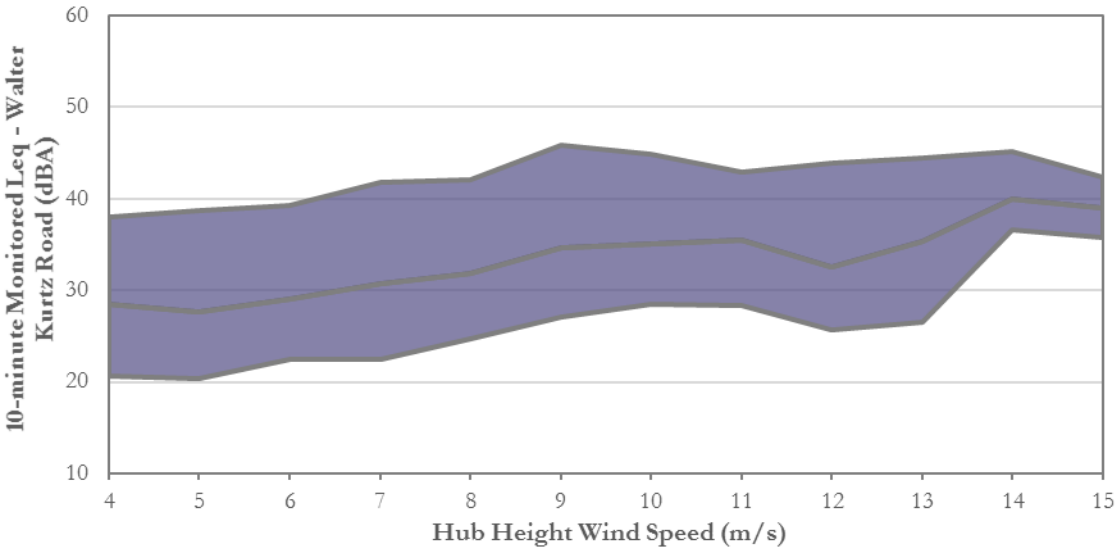

FIGURE 85: MEASURED 10-MINUTE L_{EQ} AT THE WALTER KURTZ ROAD MONITOR COMPARED WITH THE 90-METER WIND SPEED AS ESTIMATED FROM PROJECT MET TOWER

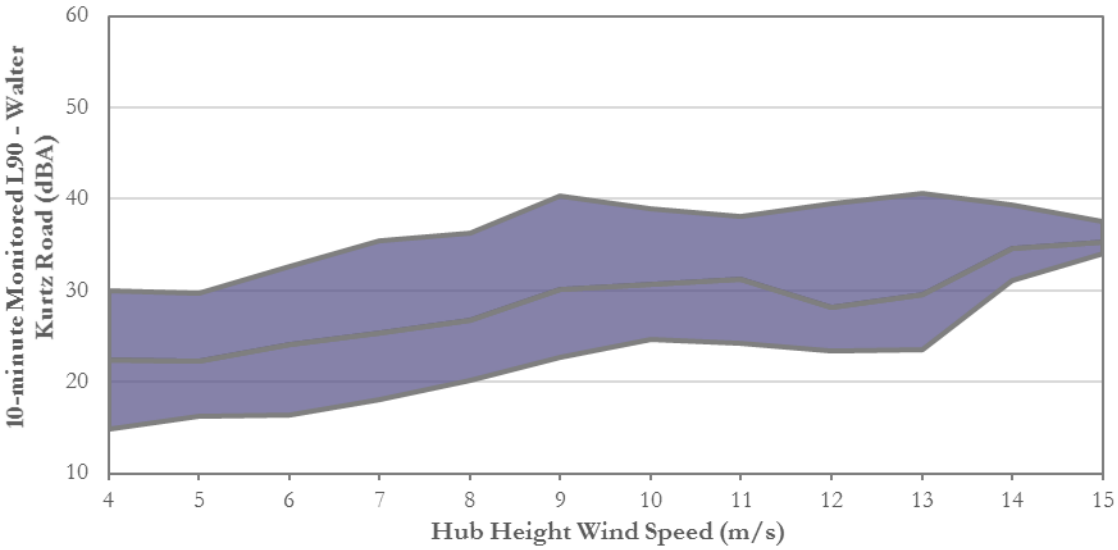

FIGURE 86: MEASURED 10-MINUTE L_{90} AT THE WALTER KURTZ ROAD MONITOR COMPARED WITH THE 90-METER WIND SPEED AS ESTIMATED FROM PROJECT MET TOWER

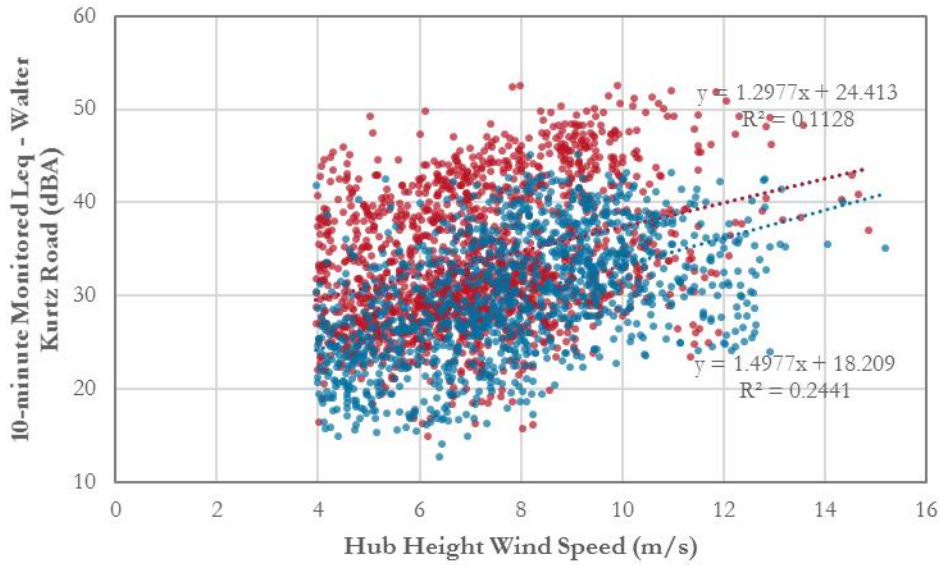

FIGURE 87: MEASURED 10-MINUTE L_{EQ} AS MEASURED AT THE WALTER KURTZ ROAD MONITOR COMPARED WITH THE 90 METER WIND SPEED AS ESTIMATED FROM PROJECT MET TOWER

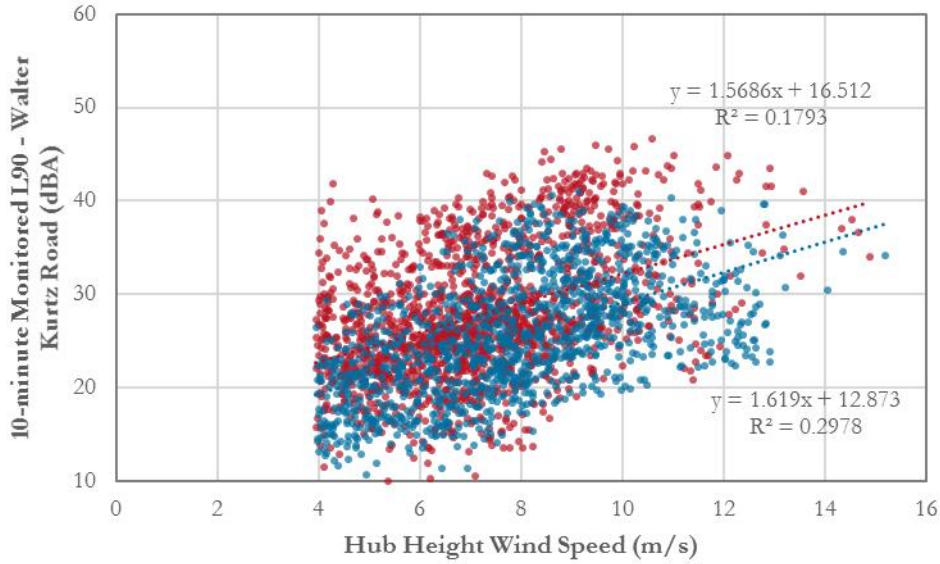

FIGURE 88: MEASURED 10-MINUTE L_{90} AS MEASURED AT THE WALTER KURTZ ROAD MONITOR COMPARED WITH THE 90 METER WIND SPEED AS ESTIMATED FROM PROJECT MET TOWER

4.4 | TEMPORAL ACCURACY

Temporal accuracy of the monitoring data was analyzed according to ANSI 12.9 Part 2. The standard analyzes the representativeness of the measurement data for a particular measurement location. This is accomplished through calculating the day-night average sound level (L_{DN}) for each day within the monitoring period and then determining the 95th percentile confidence interval for the data series. These confidence intervals are categorized into three classes. Class "A" is for precision measurements, with Class "B" and Class "C"

being less precise. Normality of the data set is then calculated using a Kolmogorov-Smirnov test.

Analysis results are shown in Table 6. All except one site meets the "A" status required for precision measurements, and all sites fit the criteria for normality. The site that did not meet criteria "A" precision is the Brasted Road site. The Brasted Road site is more exposed than most others and has a variety of intermittent sound sources (farm equipment, dog barks, etc.,) that may not occur equally on every day. As a results, the daily L_{DN}s are more variable.

Remote sites in the project area (Brasted Road, Rex/Dye Road, and Walter Kurtz Road) tend to have higher standard deviations than those near major roads (Haskinville Road or Loon Lake). This is due to dominance of the soundscape by road traffic. At rural sites, there is less likely to be a particular, consistent sound source that dominates the soundscape, providing a consistent day-to-day sound level. Instead, the sound level is driven by inconsistent sound sources such as dogs, farming activity, birds/insects, and weather that may be inconsistently present.

TABLE 6: MONITORING DATA TEMPORAL ACCURACY (ANSI 12.9 PART 2)

	Brasted Road	Rex/Dye Road	Haskinville Road	Henkle Hollow	Loon Lake	Rose Road	Walter Kurtz Road
Number of Samples	32	32	25	32	24	32	32
Upper Confidence Interval (dB)	2.0	1.8	0.9	1.49	0.97	1.08	1.9
Lower Confidence Interval (dB)	1.7	1.6	0.9	1.34	0.91	1.01	1.7
Measurement Class	B	A	A	A	A	A	A
Normality	Yes	Yes	Yes	Yes	Yes	Yes	Yes

5.0 CONCLUSIONS

RSG conducted pre-construction background sound level monitoring in Steuben County, New York for the Baron Winds wind project. Monitoring was performed in compliance with rules of the New York State Board on Electric Generation Siting and the Environment ("Siting Board") under 16 NYCRR § 1011.19. Monitoring was performed over two distinct periods, lasting at least 14 days each. The first period ran from February 24 to March 12, 2015, to measure sound levels at the site during the winter. The second period ran from July 15 to July 31, 2015 to capture sound levels at the site during the summer.

Measured sound levels were widely distributed, depending on the proximity to human activity and industry. Anthropogenic (human-caused) sounds dominated daytime sound levels at six of the seven monitoring locations. The seventh monitoring location was located on a seasonal road in a sparsely populated and wooded area, where biogenic and meteorological sources dominated the overall sound levels, although occasional aircraft, vehicle passbys, and other human activities were observed.

Overall equivalent average sound levels ranged from 36 to 49 dBA during the day and 32 to 45 dBA during the night. These equivalent averages include periods that were Ai-weighted to account for seasonal biogenic sound. The Ai-weighting was used when tonal, high frequency sound was present, but not other periods, so the "dBA" metric is specified. The L_{90} sound levels, which are sound levels exceeded 90 percent of the time, ranged from 19 to 25 dBA. The L_{10} sound levels, which are sound levels exceeded 10 percent of the time, ranged from 37 to 51 dBA.

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APPENDIX A. A PRIMER ON SOUND AND NOISE

Sound consists of tiny, repeating fluctuations in ambient air pressure. The strength, or amplitude, of these fluctuations determines the sound pressure level (SPL). "Noise" can be defined as "a sound of any kind, especially when loud, confused, indistinct, or disagreeable."

Expressing Sound in Decibel Levels

The varying air pressure that constitutes sound can be characterized in many different ways. The human ear is the basis for the metrics that are used in acoustics. Normal human hearing is sensitive to sound fluctuations over an enormous range of pressures, from about 20 micropascals (the "threshold of audibility") to about 20 pascals (the "threshold of pain").[5] This factor of one million in sound pressure difference is challenging to convey in engineering units. Instead, sound pressure is converted to sound "levels" in units of "decibels" (dB, named after Alexander Graham Bell). Once a measured sound is converted to dB, it is denoted as a level with the letter "L".

The conversion from sound pressure in pascals to sound level in dB is a four-step process. First, the sound wave's measured amplitude is squared and the mean is taken. Second, a ratio is taken between the mean square sound pressure and the square of the threshold of audibility (20 micropascals). Third, using the logarithm function, the ratio is converted to factors of 10. The final result is multiplied by 10 to give the decibel level. By this decibel scale, sound levels range from 0 dB at the threshold of audibility to 120 dB at the threshold of pain.

Typical sources of noise, and their sound pressure levels, are listed on the scale in Figure 89.

Human Response to Sound Levels: Apparent Loudness

For every 20 dB increase in sound level, the sound pressure increases by a *factor* of 10; the sound *level* range from 0 dB to 120 dB covers 6 factors of 10, or one million, in sound *pressure*. However, for an increase of 10 dB in sound *level* as measured by a meter, humans perceive an approximate doubling of apparent loudness: to the human ear, a sound level of 70 dB sounds about "twice as loud" as a sound level of 60 dB. Smaller changes in sound level, less than 3 dB up or down, are generally not perceptible.

Frequency Spectrum of Sound

The "frequency" of a sound is the rate at which it fluctuates in time, expressed in Hertz (Hz), or cycles per second. Very few sounds occur at only one frequency: most sound contains energy at many different frequencies, and it can be broken down into different frequency divisions, or bands. These bands are similar to musical pitches, from low tones to high tones. The most common division is the standard octave band. An octave is the range of frequencies whose upper frequency limit is twice its lower frequency limit, exactly like an

[5] The pascal is a measure of pressure in the metric system. In Imperial units, they are themselves very small: one pascal is only 145 millionths of a pound per square inch (psi). The sound pressure at the threshold of audibility is only 3 one-billionths of one psi: at the threshold of pain, it is about 3 one-thousandths of one psi.

octave in music. An octave band is identified by its center frequency: each successive band's center frequency is twice as high (one octave) as the previous band. For example, the 500 Hz octave band includes all sound whose frequencies range between 354 Hz (Hertz, or cycles per second) and 707 Hz. The next band is centered at 1,000 Hz with a range between 707 Hz and 1,414 Hz. The range of human hearing is divided into 10 standard octave bands: 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1,000 Hz, 2,000 Hz, 4,000 Hz, 8,000 Hz, and 16,000 Hz. For analyses that require finer frequency detail, each octave-band can be subdivided. A commonly-used subdivision creates three smaller bands within each octave band, or so-called 1/3-octave bands.

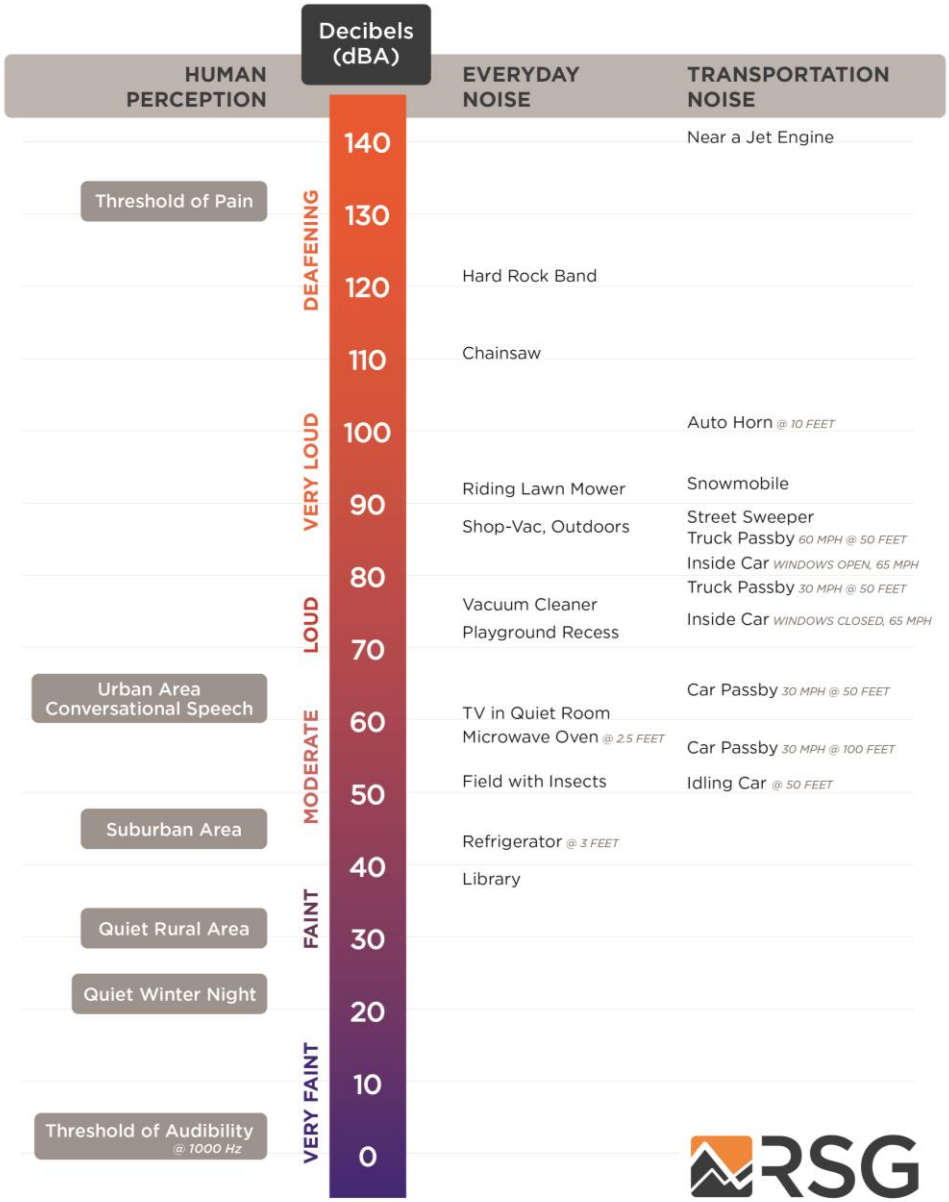

FIGURE 89: A SCALE OF SOUND PRESSURE LEVELS FOR TYPICAL NOISE SOURCES

Human Response to Frequency: Weighting of Sound Levels

The human ear is not equally sensitive to sounds of all frequencies. Sounds at some frequencies seem louder than others, despite having the same decibel level as measured by a sound level meter. In particular, human hearing is much more sensitive to medium pitches (from about 500 Hz to about 4,000 Hz) than to very low or very high pitches. For example, a tone measuring 80 dB at 500 Hz (a medium pitch) sounds quite a bit louder than a tone measuring 80 dB at 60 Hz (a very low pitch). The frequency response of normal human hearing ranges from 20 Hz to 20,000 Hz. Below 20 Hz, sound pressure fluctuations are not "heard", but sometimes can be "felt". This is known as "infrasound". Likewise, above 20,000 Hz, sound can no longer be heard by humans; this is known as "ultrasound". As humans age, they tend to lose the ability to hear higher frequencies first; many adults do not hear very well above about 16,000 Hz. Most natural and man-made sound occurs in the range from about 40 Hz to about 4,000 Hz. Some insects and birdsongs reach to about 8,000 Hz.

To adjust measured sound pressure levels so that they mimic human hearing response, sound level meters apply filters, known as "frequency weightings", to the signals. There are several defined weighting scales, including "A", "B", "C", "D", "G", and "Z". The most common weighting scale used in environmental noise analysis and regulation is A-weighting. This weighting represents the sensitivity of the human ear to sounds of low to moderate level. It attenuates sounds with frequencies below 1000 Hz and above 4000 Hz; it amplifies very slightly sounds between 1000 Hz and 4000 Hz, where the human ear is particularly sensitive. The C-weighting scale is sometimes used to describe louder sounds. The B- and D-scales are seldom used. All of these frequency weighting scales are normalized to the average human hearing response at 1000 Hz: at this frequency, the filters neither attenuate nor amplify. When a reported sound level has been filtered using a frequency weighting, the letter is appended to "dB". For example, sound with A-weighting is usually denoted "dBA". When no filtering is applied, the level is denoted "dB" or "dBZ". The letter is also appended as a subscript to the level indicator "L", for example "L_A" for A-weighted levels.

Time Response of Sound Level Meters

Because sound levels can vary greatly from one moment to the next, the time over which sound is measured can influence the value of the levels reported. Often, sound is measured in real time, as it fluctuates. In this case, acousticians apply a so-called "time response" to the sound level meter, and this time response is often part of regulations for measuring noise. If the sound level is varying slowly, over a few seconds, "Slow" time response is applied, with a time constant of one second. If the sound level is varying quickly (for example, if brief events are mixed into the overall sound), "Fast" time response can be applied, with a time constant of one-eighth of a second.[6] The time response setting for a sound level

[6] There is a third time response defined by standards, the "Impulse" response. This response was defined to enable use of older, analog meters when measuring very brief noises; it is no longer in common use.

measurement is indicated with the subscript "S" for Slow and "F" for Fast: L_S or L_F. A sound level meter set to Fast time response will indicate higher sound levels than one set to Slow time response when brief events are mixed into the overall sound, because it can respond more quickly.

In some cases, the maximum sound level that can be generated by a source is of concern. Likewise, the minimum sound level occurring during a monitoring period may be required. To measure these, the sound level meter can be set to capture and hold the highest and lowest levels measured during a given monitoring period. This is represented by the subscript "max", denoted as "L_{max}". One can define a "max" level with Fast response L_{Fmax} (1/8-second time constant), Slow time response L_{Smax} (1-second time constant), or Continuous Equivalent level over a specified time period L_{EQmax}. Note that, in the precedents set by the former Environmental Board under Vermont Act 250, the time response is not specified, but in the Barre Granite case which set the 55 dBA Lmax precedent the metric LSmax (a 1-second response time) was used. Since that time, maximum L_{EQ} 1-second has also been used as it is comparable to the LSmax.

Accounting for Changes in Sound Over Time

A sound level meter's time response settings are useful for continuous monitoring. However, they are less useful in summarizing sound levels over longer periods. To do so, acousticians apply simple statistics to the measured sound levels, resulting in a set of defined types of sound level related to averages over time. An example is shown in Figure 90. The sound level at each instant of time is the grey trace going from left to right. Over the total time it was measured (100 seconds in the figure), the sound energy spends certain fractions of time near various levels, ranging from the minimum (about 37 dB in the figure) to the maximum (about 68 dB in the figure). The simplest descriptor is the average sound level, known as the Equivalent Continuous Sound Level. Statistical levels are used to determine for what percentage of time the sound is louder than any given level. These levels are described in the following sections.

Equivalent Continuous Sound Level - L_{EQ}

One straightforward, common way of describing sound levels is in terms of the Continuous Equivalent Sound Level, or L_{EQ}. The L_{EQ} is the average sound pressure level over a defined period of time, such as one hour or one day. L_{EQ} is the most commonly used descriptor in noise standards and regulations. L_{EQ} is representative of the overall sound to which a person is exposed. Because of the logarithmic calculation of decibels, L_{EQ} tends to favor higher sound levels: loud and infrequent sources have a larger impact on the resulting average sound level than quieter but more frequent noises. For example, in Figure 90, even though the sound levels spends most of the time near about 47 dBA, the L_{EQ} is 53 dBA, having been "inflated" by the maximum level of 68 dBA.

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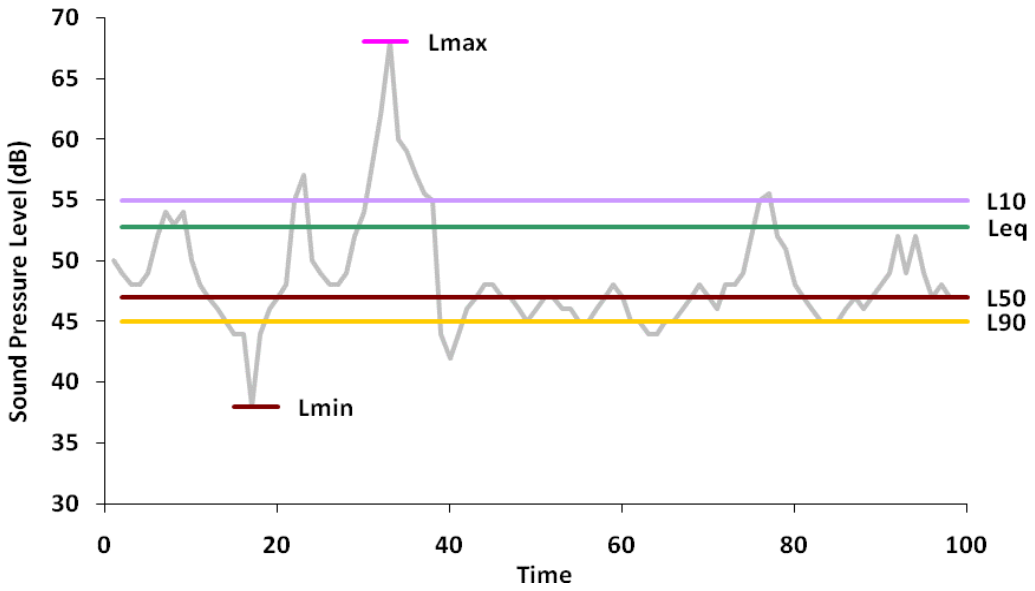

FIGURE 90: EXAMPLE OF DESCRIPTIVE TERMS OF SOUND MEASUREMENT OVER TIME

Percentile Sound Levels – L_N

Percentile sound levels describe the statistical distribution of sound levels over time. "L_N" is the level above which the sound spends "N" percent of the time. For example, L_{90} (sometimes called the "residual base level") is the sound level exceeded 90% of the time: the sound is louder than L_{90} most of the time. L_{10} is the sound level that is exceeded only 10% of the time. L_{50} (the "median level") is exceeded 50% of the time: half of the time the sound is louder than L_{50}, and half the time it is quieter than L_{50}. Note that L_{50} (median) and L_{EQ} (mean) are not always the same, for reasons described in the previous section.

L_{90} is often a good representation of the "ambient sound" in an area. This is the sound that persists for longer periods, and below which the overall sound level seldom falls. It tends to filter out other short-term environmental sounds that aren't part of the source being investigated. L_{10} represents the higher, but less frequent, sound levels. These could include such events as barking dogs, vehicles driving by and aircraft flying overhead, gusts of wind, and work operations. L_{90} represents the background sound that is present when these event noises are excluded.

Note that if one sound source is very constant and dominates the noise in an area, all of the descriptive sound levels mentioned here tend toward the same value. It is when the sound is varying widely from one moment to the next that the statistical descriptors are useful.