August 28, 2026

Klem Acoustic Consulting LLC
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[Client Info Redacted]

Re: HVAC Noise Assessment

Dear [Client Info Redacted],

The summary report for the HVAC noise measurement is below.

Problem and Background:

Klem Acoustic Consulting (KAC) was asked to provide an on-site acoustical assessment for intrusive noise emitting from neighboring residential HVAC units into the back yard of a neighboring home. The chief concern was to evaluate the noise and effectiveness of remediation efforts thus far.

Figure 1: Noise Source on Neighboring Property

Assessment:

An on-site assessment was conducted on August 14, 2026. Trees prevent an aerial map from clearly displaying the location of sound source and receiving areas (Fig. 1). The neighboring HVAC units were approximately 4-6' behind a wooden fence at the property line. Immediately behind this fence is a noise barrier with dimensions of 12' 6" width by 5' 4" height. The barrier is composed of a quilted fiberglass facing bonded to mass loaded vinyl (1 pound per square foot). Sound measurements were taken to help understand the level and composition of the HVAC noise as well as the background noise level. The effectiveness of the sound barrier was evaluated based on its size, composition, and location relative to source and receiving areas.

Sound Measurements:

A Class 1 sound level measurement system was used for all measurements and was calibrated directly prior to and after the measurement. The reported values are as follows: LAeq, LAFMin, LAFMax, LZeq, LZeq 90%.

> LAeq, or A-weighted equivalent continuous sound level, is a measure of the average sound level over a given period and adjusted to reflect the sensitivity of human hearing (A weighting). It is commonly used in noise assessments to represent overall sound levels. The time averaging allows sound measurements of different lengths of time to be comparable.
>
> LAFmin: A-weighted minimum sound level measured with a time window of 125ms in order to accurately represent sound with either a 'fast' onset (attack) or decay, such as a pencil dropping onto a table.

LAFmax: A-weighted maximum sound level measured with a time window of 125ms in order to accurately represent sound with either a ‘fast’ onset (attack) or decay, such as a gun shot or a single hand clap.

LZeq represents an equivalent continuous level without any weighting. It is useful to describe sound with a particular tonal quality, such as a low frequency hum from a motor. It can be further specified as to the range of frequencies (one third of an octave band) by noting the frequency value in the name, e.g., LZeq @ 125 Hz.

LZeq 90% refers to the unweighted sound level (at a given frequency band if specified) that is exceeded for 90% of the measurement period and representative of the background (or continuous) noise level.

Sound Measurement Equipment:

Sound Level Meter: NTi XL3, Serial No. A3A-02481-F0, FW1.56, KAC_XL3
Microphone: NTi Audio M2230 (MA220 preamplifier + MC230A microphone capsule), Serial No. 16192.
NTi Class 1 microphone calibrator (Larson Davis CAL200), Serial No. 24009
This Class 1 system was successfully calibrated by NTI on June 12, 2026, and field calibrated immediately prior to and following all field measurements on 2026-08-14 at 10:24 and 11:47; delta from initial calibration -0.0dB. Mic Sensitivity: 45.47 mV/Pa.

Measurement Locations:

The microphone capsule was positioned 63" above concrete pavers, 72" from the nearest wall, and 15’ 9” north of the sound barrier (Fig. 2). This location was chosen to approximate the sound received during normal usage of the space while also minimizing the influence of boundary reflections on the sound level measurements. As such, this measurement is not intended to be used in showing compliance or violation of any local noise ordinance.

Figure 2: Sound Measurement Location

Ambient Conditions:

Temperature 82 degrees F, relative humidity 50%, wind speed 0-5 MPH.

Sampling Period:

The sound measurement period lasted approximately 82 minutes and is shown in Figure 3. From this larger measurement a single machine operating cycle/period (AKA 'cycle on') was selected that contained the least amount of extraneous noise (Fig. 4). Periods of background noise were also selected for comparison (Figs. 5-7). Although three instances of overhead planes were selected (adequate to characterize one type of background sound), many more occurred during the measurement period. Table 1 shows measurement values per each event. Note that for airplanes, the average of the three individual sound events is shown in addition to their individual measurements.

Figure 3: Sound Levels - Overall Measurement Period

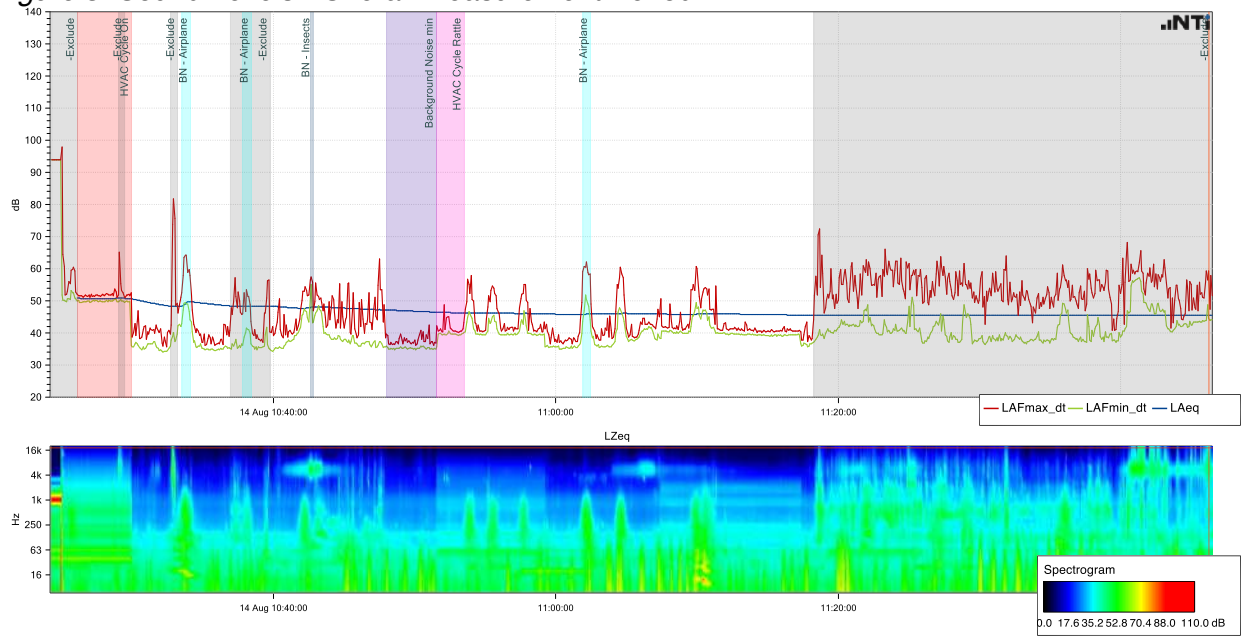


Table 1: Sound Levels by Event

Event	Start	Duration	LAFmax [dB]	LAFmin [dB]	LAeq [dB]
HVAC Cycle On	2026-08-14 10:26:01	0:03:29	53.8	44.0	50.7
Background Noise (BN)	2026-08-14 10:47:56	0:03:30	42.5	34.8	36.2
BN - Insects	2026-08-14 10:42:30	0:00:39	57.5	43.1	52.2
BN - Airplane (average of 3)		0:01:47	64.3	36.2	53.4
BN – Airplane 1 of 3	2026-08-14 10:33:30	0:00:35	64.3	44.1	55.9
BN – Airplane 2 of 3	2026-08-14 10:37:41	0:00:43	53.5	36.2	44.1
BN – Airplane 3 of 3	2026-08-14 11:01:54	0:00:29	62.1	46.8	54.7

Figure 4: Sound Levels – HVAC Cycle On

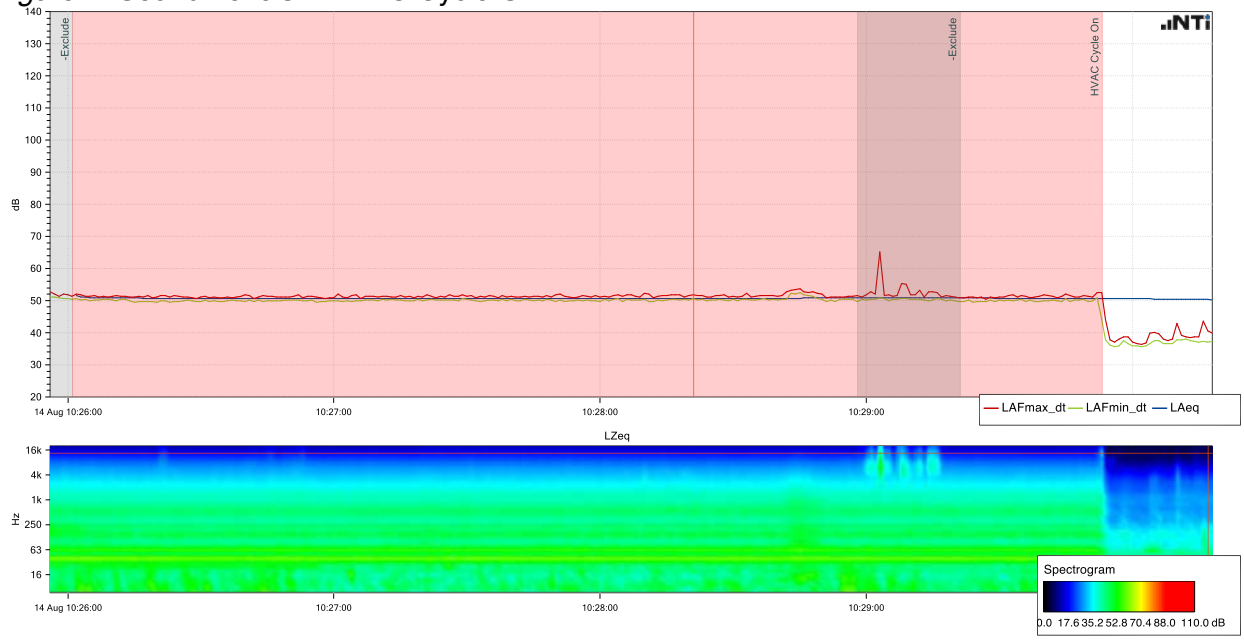


Figure 5: Sounds Levels - Background Noise - Minimal Level

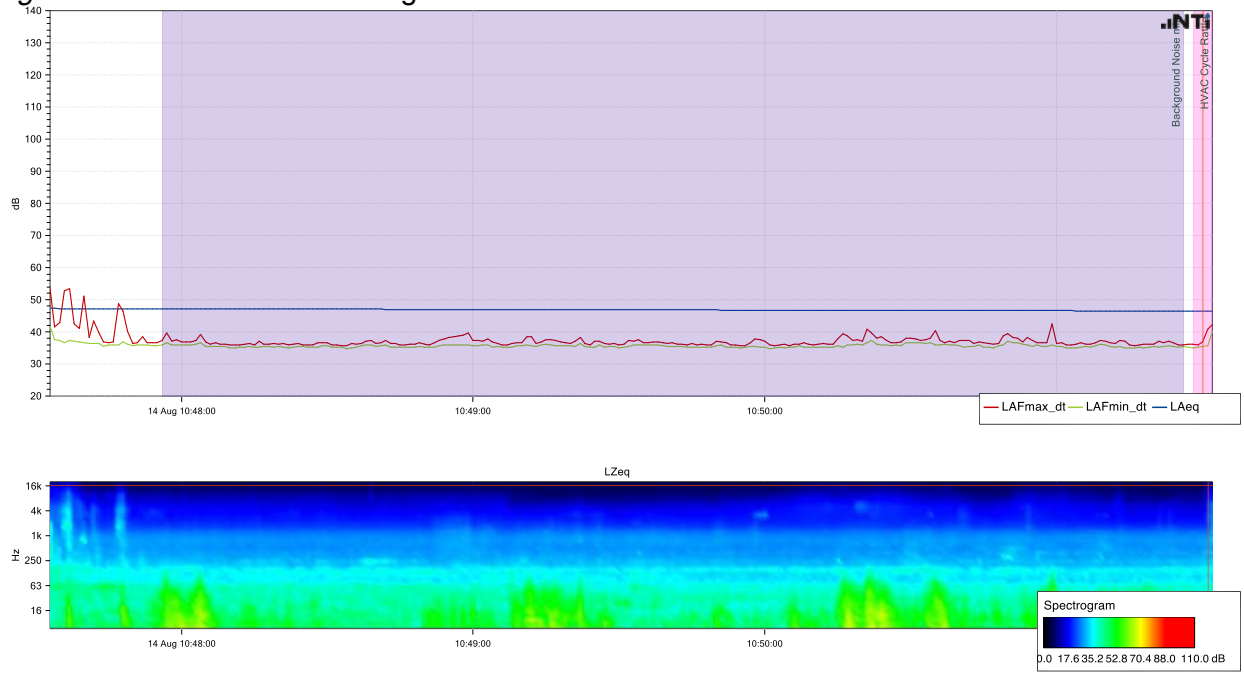


Figure 6: Background Noise - Maximum Levels – Airplane (1 of 3)

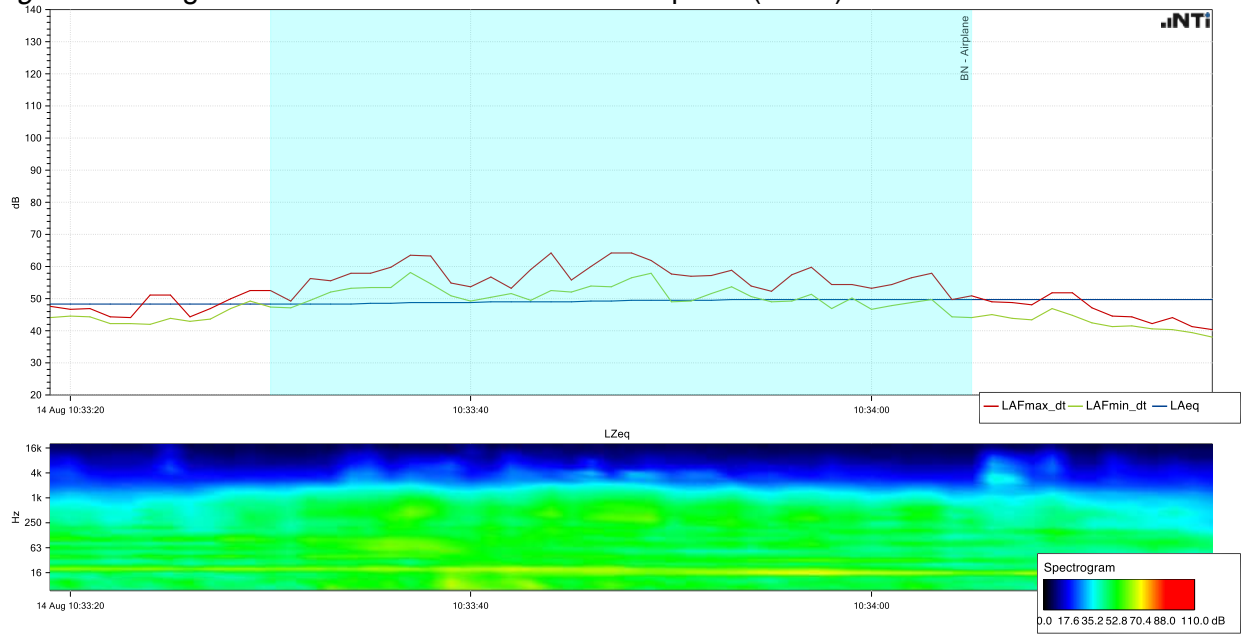
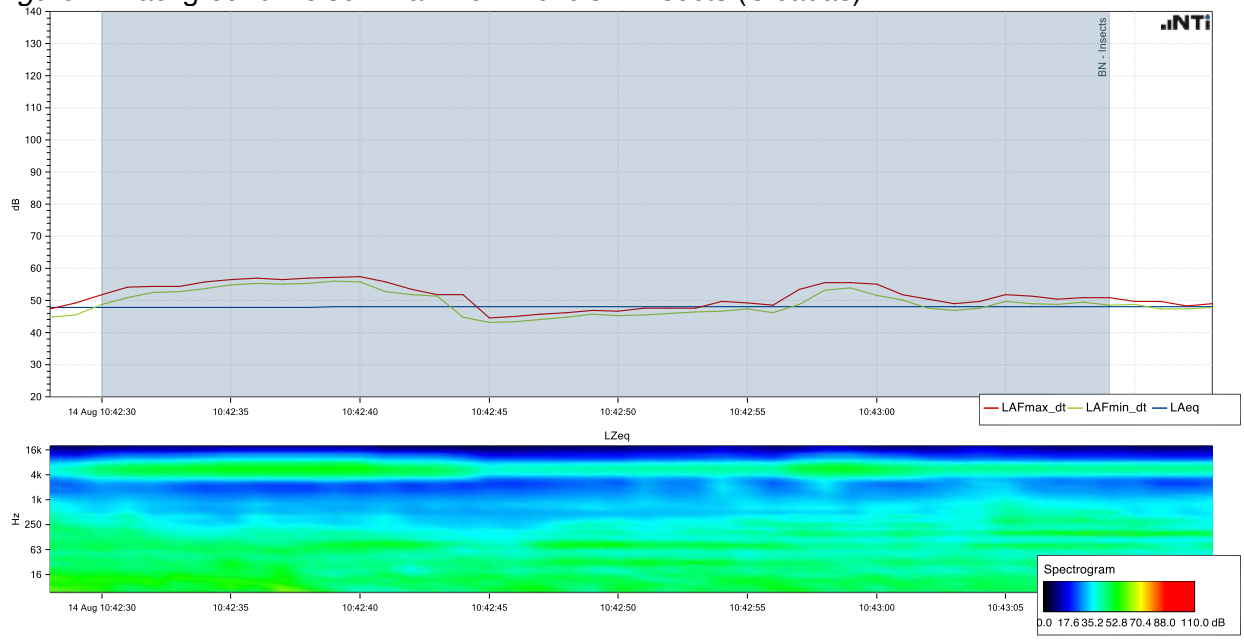


Figure 7: Background Noise - Maximum Levels – Insects (Cicadas)



Findings from Baseline Measurements:

The average, time adjusted levels (LAeq) of the quietest section of background noise and HVAC cycle show the HVAC being louder by 14.5dB. However, when comparing two examples of loud background noise and the HVAC cycle, it is clear that the HVAC units are not the overall loudest background noise at the receiving area. Cicada insects in nearby trees have an average level (LAeq) of +1.5dB and a peak level (LAFmax) of +3.7dB above those of the HVAC noise, and the average of three passing airplanes similarly had an average level of +2.7dB and a peak level +10.5dB above the HVAC's noise. So, although the HVAC noise may be intrusive, it is surpassed by other types of noise which cannot be changed by a sound barrier such as the one in the present location.

There are, however, aspects of the HVAC noise are commonly associated with annoyance. Elevated tonal noise is present in the measured HVAC cycle primarily at the 1/3 octave bands 40 and 63Hz. The noise occurs at an elevated level from both background noise as well as the neighboring frequency bands that are part of the HVAC noise. Furthermore, the HVAC noise is somewhat unpredictable (cycles on dependent on both weather and neighbor's indoor temperature preferences), intermittent, and is primarily comprised of steady-state tonal low frequencies. These noise characteristics are all associated with human annoyance per ASTM E 1686-16 and ANSI S12.9.4.

Table 2: Excerpt of Tonal Noise Values of HVAC Cycle On

	LZeq @ 31.5 Hz	LZeq @ 40 Hz	LZeq @ 50 Hz	LZeq @ 63 Hz	LZeq @ 80 Hz
	90.0% [dB]	90.0% [dB]	90.0% [dB]	90.0% [dB]	90.0% [dB]
HVAC Cycle On	**49.6**	**60.6**	**46.2**	**56.3**	**45.0**

Summary of Potential Treatments

KAC discussed the following treatment types during the on-site visit to further decrease the HVAC noise from entering the client's back yard.

- END OF REPORT EXCERPT -

Should you have any questions or want to further discuss this project, please feel free to contact me.

Sincerely,

Patrick Klem, MPH, CPH
Owner, Klem Acoustic Consulting LLC