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New Trier High School
385 Winnetka Avenue
Winnetka, IL 60093

August 15, 2018

Attn: Mr. Steve Linke

Re: Measurement of Environmental Noise
New Building Rooftop Mechanical Equipment and Dock Dust Collector

Dear Steve:

We conducted environmental noise measurements on the early mornings of Thursday, May 31 and July 25, 2018. The purpose of these measurements was to quantify sound levels due to operation of mechanical equipment located on the roof and loading dock of the new building.

A new building was constructed on Winnetka Avenue that replaced the Music/Performing Arts Building, Cafeteria and Tech Arts Building. Demolition of the previous buildings started in June 2015 and the new building was completed in late 2017. Mechanical equipment installed on the roof of the four story building provides building ventilation and exhaust for kitchen, science, art, tech and other services. Additionally, dust collection equipment located in the loading dock area is used for a few hours each day.

Complaints have been received from a resident along Woodland Avenue regarding excessive noise. Winnetka addresses noise from mechanical equipment in the village code in section 15.44.050 (Freestanding Heating or Cooling Devices) and refers to the standards administered by the Pollution Control Board as set forth in the Illinois Administrative Code, Title 35, Subtitle H, Chapter I, Sections 901.102(a) and (b).

Acoustical Criteria

For commercial and residential land uses, Illinois permits the equivalent of 55 dBA during the day (7:00 a.m. to 10:00 p.m.) and 44 dBA at night (10:00 p.m. to 7:00 a.m.) The regulations apply at the residential property line, require readings energy-averaged over a one hour time period and call for sound level readings in each of nine octave (frequency) bands. The ambient (or background) sound level must be established, through measurement at the site. In the case where the Illinois limits are exceeded by the ambient environment, the limits do not have to be met.

The Illinois limits are stated in terms of octave band sound levels. Thus, for daytime and nighttime, the limits must be met in each of nine frequency bands. Octave band sound level measurements were conducted by Shiner in one-third octave bands which were converted to octave bands and A-weighted sound levels.

Acoustical Measurements

We conducted sound level readings at the west edge of the public sidewalk at the north property line of 124 Woodland Ave. on Thursday, May 31, 2018 between 4:20 a.m. and 4:36 a.m. These hours were chosen since noise from environmental sources (cars, trains, planes, etc.) is minimized and the Illinois Noise Regulations are most restrictive before 7:00 a.m.

We returned to the same location on Wednesday July 25, 2018 between 6:29 a.m. and approximately 7:00 a.m. to repeat dust collector measurements.

Figure 1 is an aerial photograph showing the microphone location. The photo has been cropped at the east edge since a current aerial photograph showing the new school building is not yet available.

Figure 1. Aerial Photo of Measurement Location – 124 Woodland Ave., Winnetka, IL

The following instrumentation was used on both dates:

- Norsonic 140 integrating sound level meter/real time analyzer
- Nor 1225 1/2 inch condenser microphone
- Nor preamplifier 1209/13239
- Nor 1251 Sound Calibrator
- Tripod, extension cable, windscreen

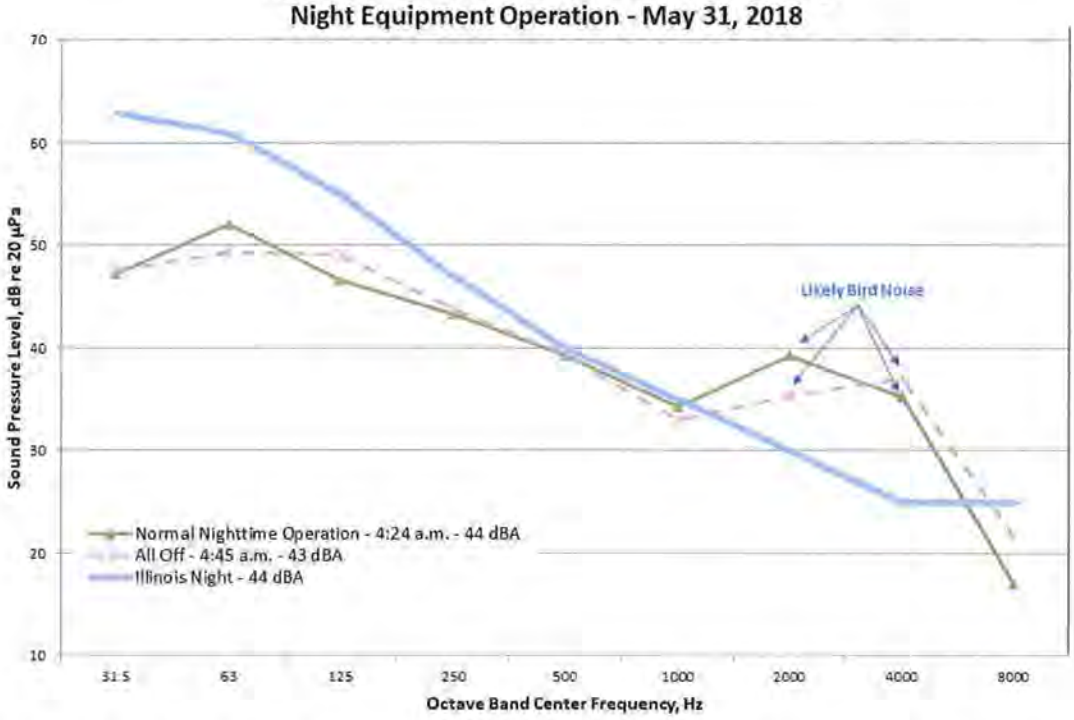
Rooftop Mechanical Equipment

On May 31, 2018, we used a fiberglass mast attached to a heavy duty tripod to elevate the microphone to a height of 18 feet above ground level in order to simulate noise heard at the second floor of residences. Conditions were dry on the night of Thursday, May 31, 2018 with no precipitation. Roadways were dry. The temperature remained constant at 71° F and the wind was calm. As the study progressed, noise from traffic and birds increased.

Since noise from fans and other rooftop mechanical sources is steady-state (does not vary with time), we conducted a series of 20 second-long readings under various equipment operating conditions in order to determine the energy average sound level (Leq). We conducted measurements when transportation noise was at its lowest. Readings were initially taken with equipment in normal nighttime operation and then then with all equipment briefly shut off. For reporting purposes, we chose the 20 second reading with the lowest overall sound level. In this way, the chosen reading was least influenced by transportation noise. It should be noted that readings taken with New Trier equipment operating also include contribution from transportation noise sources.

Figure 2 shows the results of our readings taken with equipment that normally operates during nighttime hours (ERU units 1, 3 and 4), the ambient or background (all equipment off) and the Illinois nighttime standards. The graph is plotted in terms of octave band sound level versus sound level. With equipment operating, the graph shows compliance with the Illinois standards except in the 2000 and 4000 Hz frequency bands. We believe that energy in these frequency bands is due to awakening birds. It should also be noted that noise from the ambient environment also exceeds the Illinois standards in these frequency bands. In fact in the 4000 Hz frequency band, measured environmental noise exceeds that taken with New Trier equipment on. We have found that this is a common occurrence when source sound levels are low.

Figure 2. New Trier Hight School - New Building
Night Equipment Operation - May 31, 2018

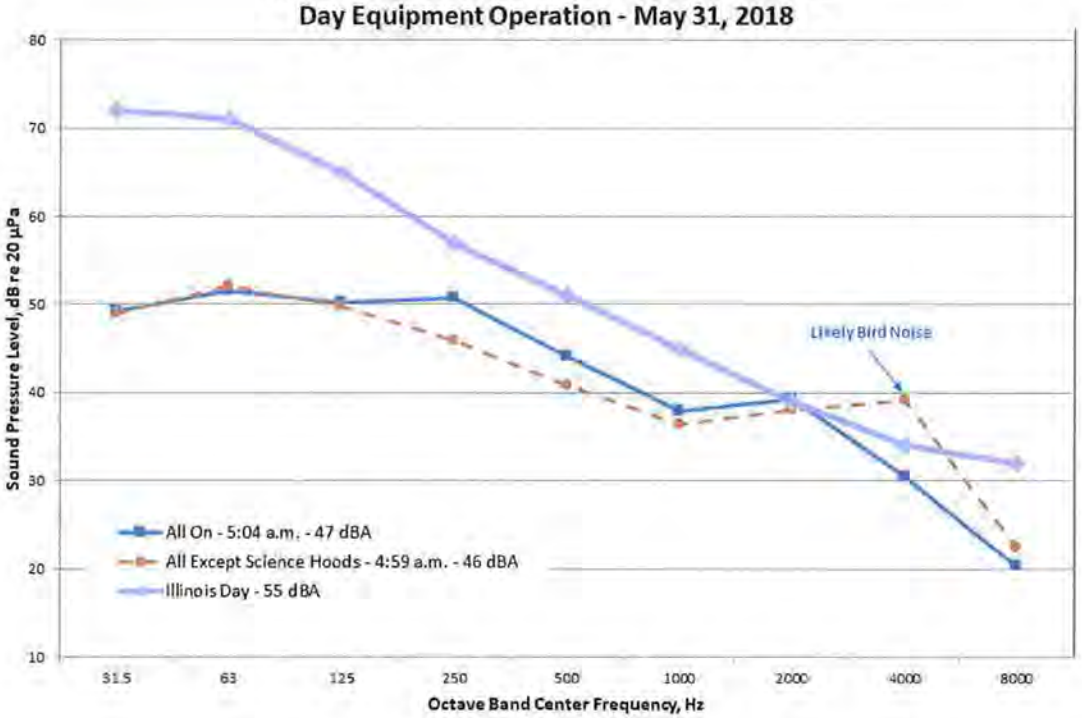


In order to investigate noise from equipment operating during the day, building personnel manually started rooftop mechanical equipment. Readings were taken during the early morning hours in order to minimize transportation noise, which would have made assessment of mechanical noise difficult or impossible during daytime hours.

Because the science fume exhaust fans (EF-FH1, FH2 and FH3) are located near the west edge of the building, separate readings were taken with all equipment operating (except these fans) and all equipment operating (including the science hoods). Figure 3 shows this comparison plotted against the daytime Illinois limits. Note that Illinois permits greater levels of noise during daytime hours.

Figure 3 shows substantial compliance with the Illinois standards when all equipment was operating. In the 2000 Hz band, noise with all equipment operating (including the science fans) is equal to the Illinois limit. Noise with all equipment except the science exhaust fans was lower than the standards in the 2000 Hz band and higher in the 4000 Hz band. Again, we believe that energy in this band is due to birds and is a common occurrence in environmental noise measurements when mechanical equipment level are low. Results of the studies are summarized in Table 1.

Figure 3. New Trier High School - New Building Day Equipment Operation - May 31, 2018



Dock Dust Collector

The dust collector is presently operated on as as-needed basis, three to four times per day for periods up to 40 minutes. Following our rooftop mechanical equipment noise testing at 124 Woodland Ave. on May 31, 2018, the microphone was positioned at a height of 4-1/2 ft above ground level and the dust collector was operated for a short period of time at 5:08 a.m. Figure 4 below is a plot of the measured 30 second average sound level versus octave band frequency. The figure indicates that Illinois daytime limits are exceeded in the 250 Hz and upper frequency bands. Results are summarized in Table 2.

On July 25, 2018, we returned to the school specifically to measure dust collector noise following installation of additional inlet ductwork inside the school. Readings were conducted at the same location as on May 31, 2018 but at 6:29 a.m. Results show a decrease noise at the blade pass frequency (250 Hz), upper frequency bands (4000 and 8000 Hz) and in the low frequencies. When compared to the Illinois standards, compliance was reached at 250 Hz, however noise in the 2000, 4000 and 8000 Hz bands is still in exceedance by several decibels.

Figure 4. New Trier High School - New Building
Dust Collector Operation - May 31 vs July 25, 2018

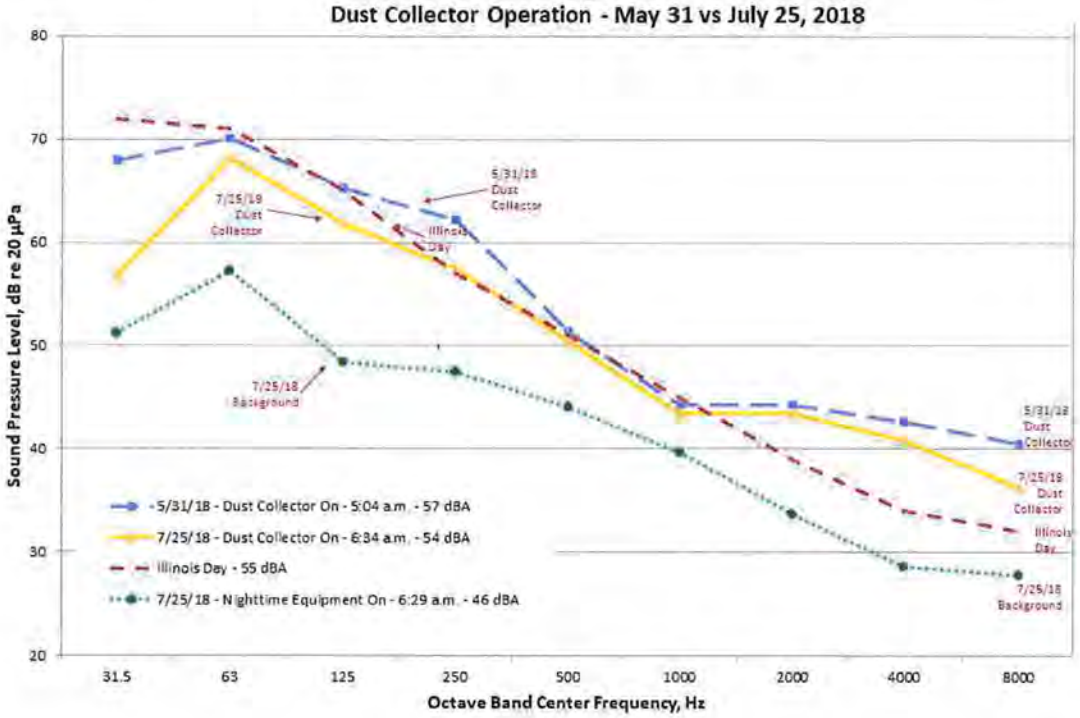


Table 1. Results of Study – New Trier High School New Building – Rooftop Equipment
124 Woodland Ave. – May 31, 2018

Octave Band Sound Pressure Level, dB re 20 µPa

	31.5	63	125	250	500	1000	2000	4000	8000	Awt
Normal Nighttime Operation	47	52	47	43	39	34	39*	35*	17	44
All Off	48	49	49	44	39	33	35*	37*	22	43
Illinois Nighttime Limit	63	61	55	47	40	35	30	25	25	44
Rooftop Equipment										
All Daytime Except Fume Exh	49	52	50	46	41	36	38	39*	22	46
Normal Daytime Operation	49	52	50	51	44	38	39	30	20	47
Illinois Daytime Limit	72	71	65	57	51	45	39	34	32	55

* Includes noise from birds

Table 2. Results of Study – New Trier High School New Building – Dust Collector
124 Woodland Ave. – May 31 and July 25, 2018

Octave Band Sound Pressure Level, dB re 20 µPa

	31.5	63	125	250	500	1000	2000	4000	8000	Awt
5/31/18 Dust Collector	68	70	65	62	51	44	44	43	41	57
7/25/18 Dust Collector	57	68	62	57	50	44	44	41	36	54
7/25/18 Nighttime Operation	51	57	49	48	44	40	34	29	28	46
Illinois Daytime Limit	72	71	65	57	51	45	39	34	32	55

Conclusions

Figure 2 shows that noise from rooftop ventilating equipment normally operating during nighttime hours likely does not exceed the nighttime Illinois standards which are administered by the Illinois Pollution Control Board. Since readings taken with equipment running also include noise from transportation noise sources, we expect that noise generated by the school's mechanical equipment is lower than was measured.

In the same fashion, Figure 3 shows that rooftop equipment operating during the daytime likely does not exceed the daytime Illinois limits. Based on near field sound level measurements later taken on the building roof, we expect that noise from the science exhaust fans may be identifiable from time to time during the day because of the character and frequency content of this noise.

Operation of the dust collector can exceed the daytime Illinois noise standards in the 2000, 4000 and 8000 Hz bands.

Recommendations

The school has already treated the dust collector motor with a 1-1/2" thick insulated sheet metal enclosure. Since only high frequency attenuation is now required, lagging of the motor enclosure and inlet/discharge may yield compliance. However, it should be realized that 7 dB of attenuation in the 4000 Hz band is required.

To address radiated noise from the motor and associated ductwork, we recommend lagging inlet and discharge round and rectangular ducts for a distance of 15-20 ft on each side of the motor enclosure. Wrap duct with 2" thick 5 pcf fiberglass and lag with 2 psf mass loaded vinyl (e.g., Kinetics KNM-200AL). Follow the manufacturer's instructions and tape or band all seams. The baghouse should also be treated in a similar manner.

Should lagging not provide the required reduction, then an L-shaped barrier wall should be constructed that shields Woodland Ave. from the dust collector and associated ductwork. At the west end of the generator, the barrier wall should extend south from the brick wall and then east to a point 3 ft beyond the dust collector motor housing and baghouse. The wall should exceed the highest point by 2 feet. The barrier wall should have a minimum sound transmission class of STC 30 and be sound absorptive on the inner face meeting NRC 0.85.

If you have questions concerning this report, please do not hesitate to contact us.

Respectfully submitted,

Shiner + Associates, Inc.

Brian L. Homans

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