
New Trier High School
385 Winnetka Avenue
Winnetka, IL 60093

July 15, 2019

Attn: Mr. Steve Linke

Re: Measurement of Dust Collector Noise

Dear Steve:

On the morning of July 12, 2019, we returned to the school to conduct additional acoustical testing. The purpose of this testing was to document any change in property line sound levels due to insulation of dust collector ductwork.

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 Friday, Jul 12, 2019 between 8:14 a.m. and 8:27 a.m. This time was chosen to be within normal school hours.

We used the following instrumentation for these measurements:

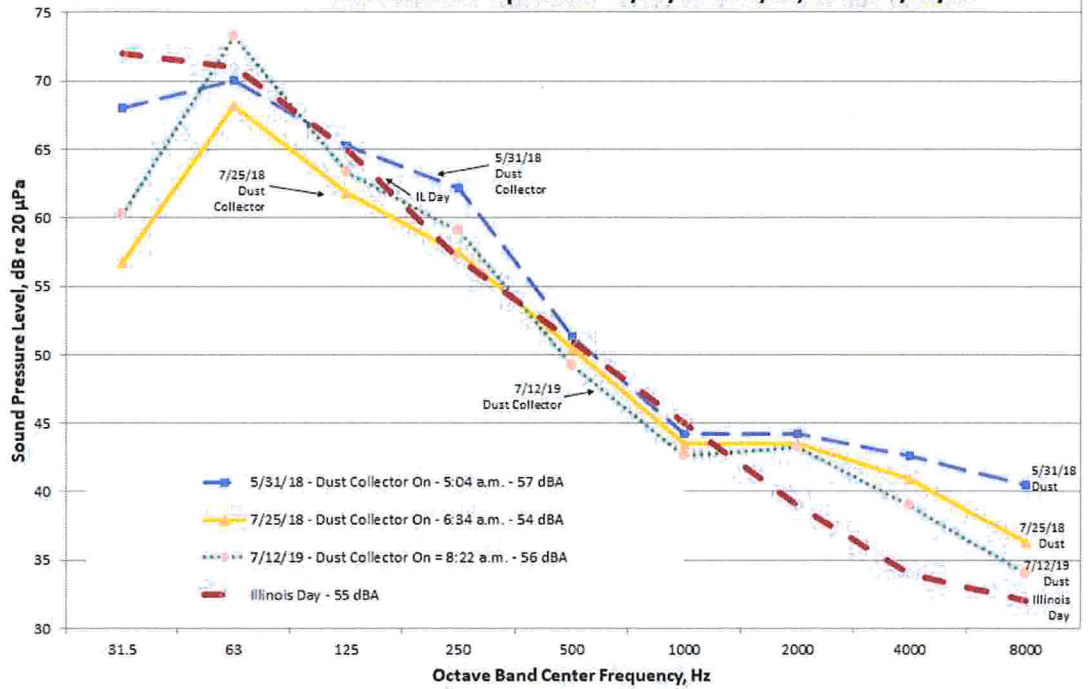
- Bruel & Kjaer 2270 integrating sound level meter/real time analyzer
- B&K 2541 1/2 inch condenser microphone
- B&K Z0032 preamplifier
- Nor 1251 Sound Calibrator
- Windscreen

The meter and measurement microphone were hand held at an approximate height of 4-1/2 ft above ground level. Pavement was dry, the temperature was 81° F and wind was calm.

Because of transportation noise in the area, 10 second readings were taken with the dust collector operating and with it off. We corrected data with the dust collector operating for ambient conditions. Although Illinois requires a measurement duration of one hour, we feel that the short measurement period represents a worst case situation, since the dust collector is typically operated on an as-needed basis, three to four times per day for periods up to 40 minutes.

When compared to the Illinois property line noise standards [Illinois Administrative Code, Title 35, Subtitle H, Chapter I, Sections 901.102(a)], Figure 1 and Table 1 below show that compliance is nearly met at 63 Hz (motor noise) and the blower blade pass frequency (250 Hz). Sound levels in the 4000 to 8000 Hz octave bands have been reduced by 2 dB, although the Illinois standards are still exceeded in the 2000 to 8000 Hz bands.

**Figure 1. New Trier High School - New Building
Dust Collector Operation - 7/12/19 vs. 5/31/18 and 7/25/18**



**Table 1. Results of Study – New Trier High School New Building – Dust Collector
124 Woodland Ave. – May 31, 2018, July 25, 2018 and July 12, 2019**

	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
7/12/19 Dust Collector	60	73	63	59	49	43	43	39	34	56
Illinois Daytime Limit	72	71	65	57	51	45	39	34	32	55

Conclusion

The most recent measurements show that the insulated ductwork resulted in a minor reduction in higher frequency sound levels. For full compliance, we recommend erection of an L-shaped barrier wall that shields Woodland Ave. from the dust collector as described in our August 15, 2018 report.

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

Respectfully submitted,

Shiner Acoustics, LLC



Brian L. Homans

BLH/mt/13

Robbins Schwartz
55 W. Monroe Street, Suite 800
Chicago, IL 60603

December 20, 2019

Attn: Mr. Kenneth Florey

Re: New Trier High School December 13, 2019 Environmental Noise Measurements

Dear Ken:

On the early morning of Friday, December 13, 2019, we returned to the school to conduct additional acoustical testing. The purpose of this testing was to reduce interference due to traffic noise and document property line sound levels due to New Trier rooftop and loading dock mechanical equipment operated during the nighttime and daytime hours. Previous dust collector readings were conducted on November 15, 2019, July 12, 2019, July 25, 2015 and May 31, 2018.

Acoustical Measurements

We again conducted sound level readings at the west edge of the public sidewalk at the north property line of 124 Woodland Ave. on Friday, December 13, 2019 between 4:20 a.m. and 5:20 a.m. This time was chosen to be a period when car traffic would be at a minimum.

We used the following instrumentation for these measurements:

- Norsonic 140 integrating sound level meter/real time analyzer
- Norr 1225 1/2 inch condenser microphone
- Norr 1209 preamplifier
- Nor 1251 Sound Calibrator
- Windscreen

A fiberglass mast was used to elevate the microphone to a height of 15 feet above ground level in order to simulate noise heard at the second floor of the 124 Woodland Avenue residence. Conditions were dry with no precipitation. Roadways were dry. The temperature decreased from 37° F to 36° F during the measurements. The wind was WSW at 6-7 mph. Traffic noise from the Edens Expressway, 2 miles to the west was audible. As the study progressed, noise from local and expressway traffic increased.

Because of experience with previous interference due to transportation noise in the area, 15 second readings were taken with various pieces of mechanical equipment operating. Ambient sound level readings were conducted at the beginning and end of the study (early morning and late morning ambient readings). Reported sound level data were corrected for ambient conditions. Although Illinois requires a measurement duration of one hour, noise from fans and blowers is steady state and does not vary with time.

The following mechanical equipment was measured:

- dock condensing unit,
 - rooftop energy recovery units (ERU's),
 - rooftop cafeteria fans (with normally operating nighttime equipment),
 - normally operating daytime equipment,
 - fume hoods (with normally operating daytime equipment) and
 - dust collector (with normally operating daytime equipment).
1. Dock Condensing Unit – This condensing unit periodically cycles on during the day and night. Although audible, we found the condensing unit to be in substantial compliance with the Illinois nighttime regulation limits. Sound levels in the 500 and 1000 Hz bands exceeded the Illinois limits but were at or below the early morning measured ambient.
 2. Energy Recovery Units (ERU's) – Energy recovery units operate continuously during the night. Sound levels in the 500 and 1000 Hz bands exceeded the Illinois limits but were at or below the early morning measured ambient. We believe that these units are in compliance with the Illinois limits.
 3. Cafeteria Fans (with ERU's operating) – Cafeteria fans run from approximately 4:30 a.m. to 9:30 a.m. when there is cooking in the kitchen. Sound levels measured at 4:40 a.m. in the 500 and 1000 Hz bands exceeded the Illinois nighttime limits but were below the late morning ambient.
 4. Fume Hoods and Normal Daytime Equipment - When measured at 4:59 a.m., fume hood equipment that operates normally during the daytime was below the Illinois limits in all frequency bands. We believe that fume hoods are in compliance with Illinois daytime limits.
 5. Normal Daytime Equipment – When measured at 4:55 a.m., corrected equipment that operates normally during the daytime was below the Illinois limits in all frequency bands.
 6. Dust Collector and Normal Daytime Equipment – With all normally operating daytime equipment running, dust collector noise exceeded the Illinois daytime limits by 3 dB and 2 dB in the 2000 and 4000 Hz octave bands.

Results of our study are shown in the table below and graphed in Figures 1-6.

Conclusion

The December 13, 2019 dust collector measurements (test 6) were conducted during early morning hours when ambient sound levels were low. Property line sound level emissions exceeded the Illinois daytime limits in the 2000 and 4000 Hz frequency bands. As previous testing has shown, daytime operation of the dust collector will likely be at or below ambient sound levels in those frequencies due to increased transportation noise in the area.

The dust collector and associated duct work are partially enclosed by a barrier wall. There are minimal areas of sound absorptive treatment behind the barrier wall and on the east dock wall. In order to reduce the 2000 and 4000 Hz emissions further, we recommend increasing the area of sound absorptive treatment in the dock area to approximately 70% of available wall surface area on the east, north (behind the dust collector) and south walls.

Should sound absorptive treatment not result in the desired attenuation, we recommend treating radiated noise from the motor and associated ductwork. Lag the 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.

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

Respectfully submitted,

Shiner Acoustics, LLC



Brian L. Homans

BLH/mt/13

**Table 1. Results of December 13, 2019 Environmental Noise Measurements
(4:20 a.m. to 5:20 a.m.)**

	Octave Band Sound Pressure Level, dB re 20 μ Pa									
	31.5	63	125	250	500	1000	2000	4000	8000	Awt
All Off 4:27 a.m. (early ambient)	51	51	48	44	44	39	26	14	14	43
1. Condensing Unit 4:29 a.m.	49	52	53	46	43	39	27	16	14	45
2. Energy Recovery Units 4:37 a.m.	51	51	50	45	44	39	22	16	18	45
3. Cafeteria Fans 4:40 a.m.	54	43	53	48	45	41	26	17	17	46
Illinois Nighttime Limit	63	61	55	47	40	35	30	25	25	44
4. Normal day equipment 4:55 a.m.	51	53	53	48	45	41	27	16	13	46
5. Fume Hoods 4:59 a.m.	50	51	53	48	44	41	27	18	18	46
6. Dust Collector 5:04 a.m.	58	65	56	56	49	44	42	36	27	52
All Off 5:16 a.m. (late ambient)	51	54	53	48	46	43	34	25	15	47
Illinois Daytime Limit	72	71	65	57	51	45	39	34	32	55

Figure 1. Condensing Unit
New Trier High School - 124 Woodland Ave. - December 13, 2019

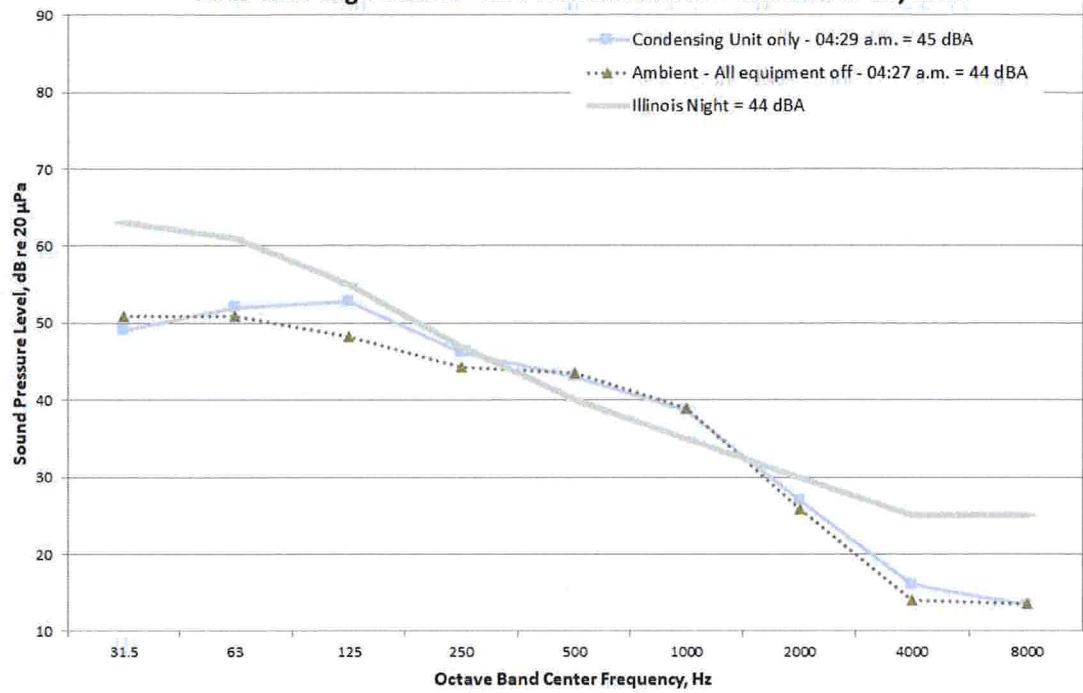


Figure 2. Energy Recovery Units
New Trier High School - 124 Woodland Ave. - December 13, 2019

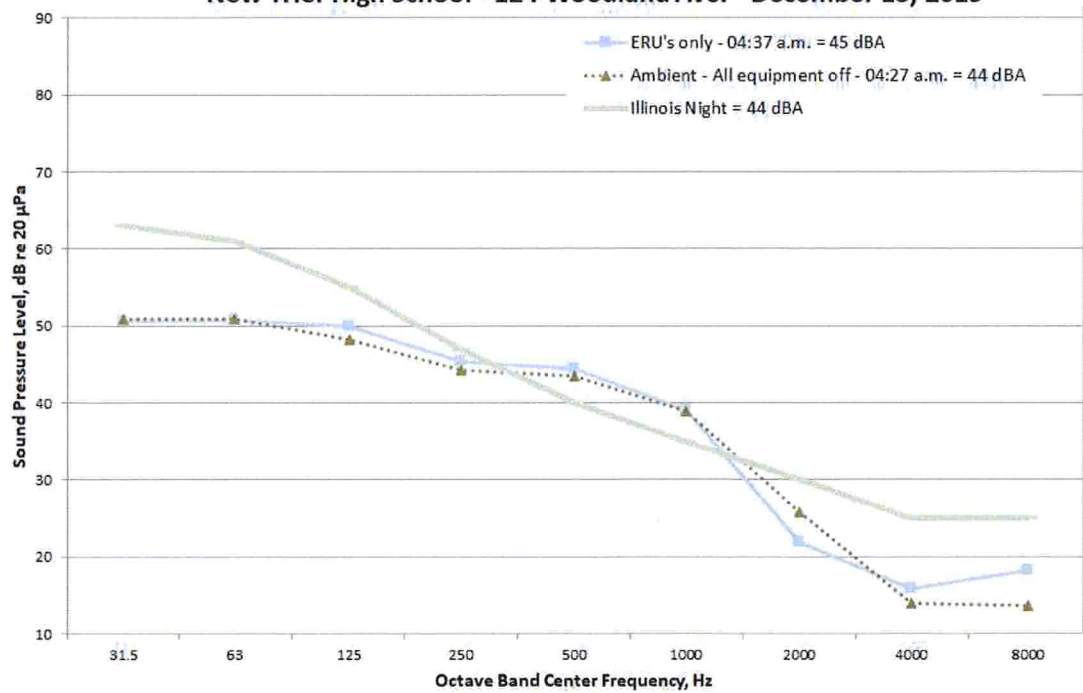


Figure 3. Cafeteria Fans and Night Equipment
New Trier High School - 124 Woodland Ave. - December 13, 2019

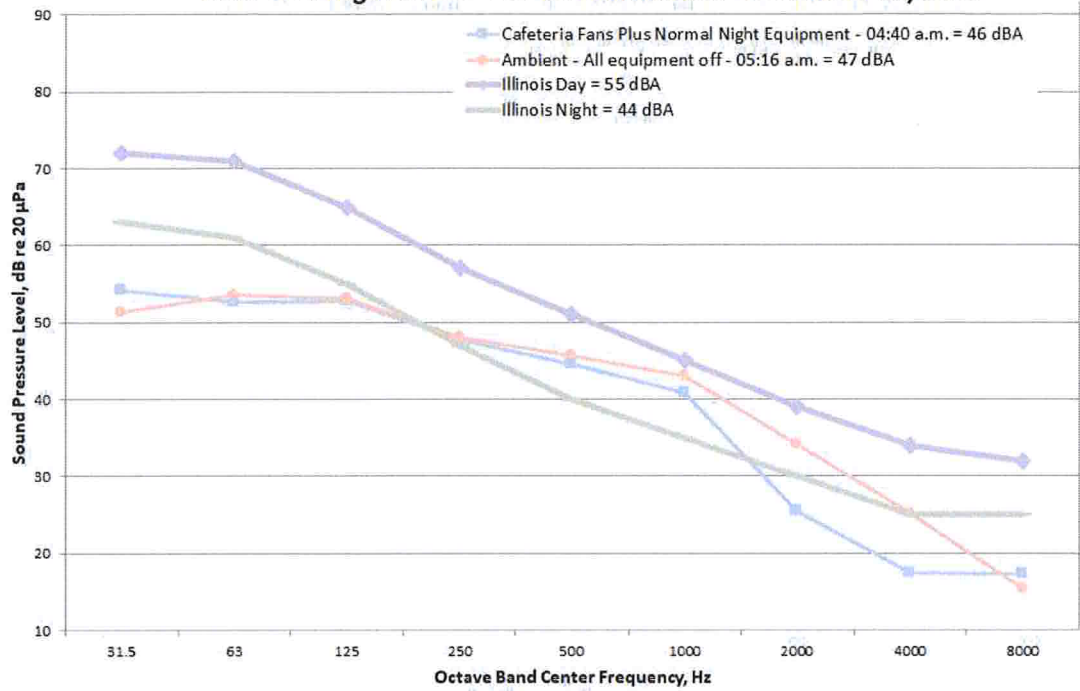
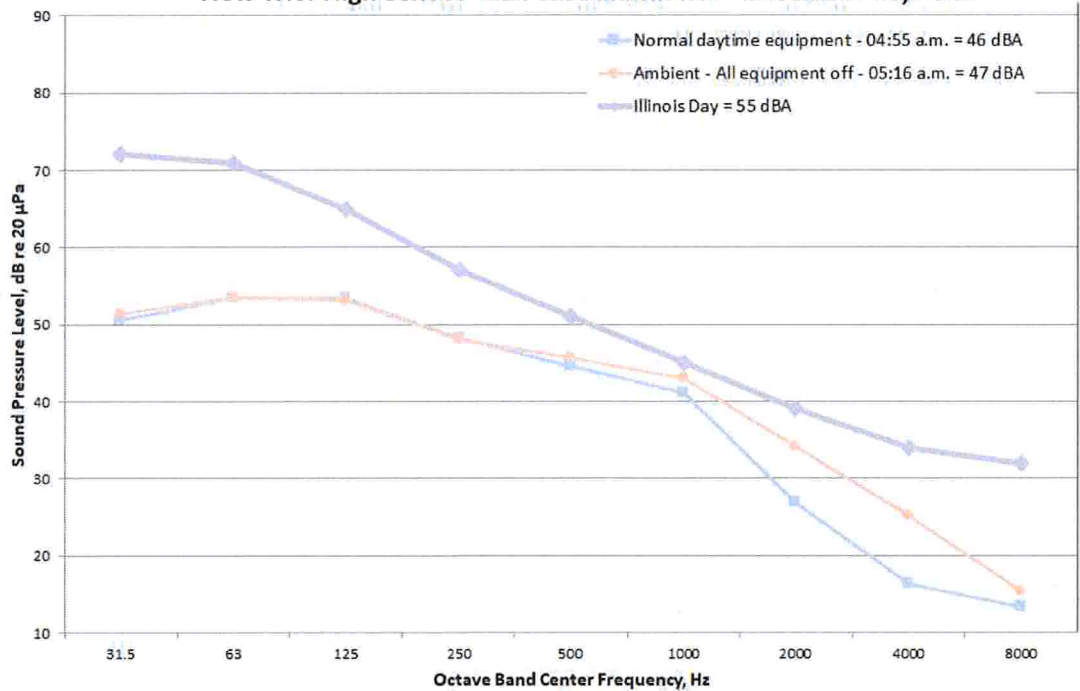
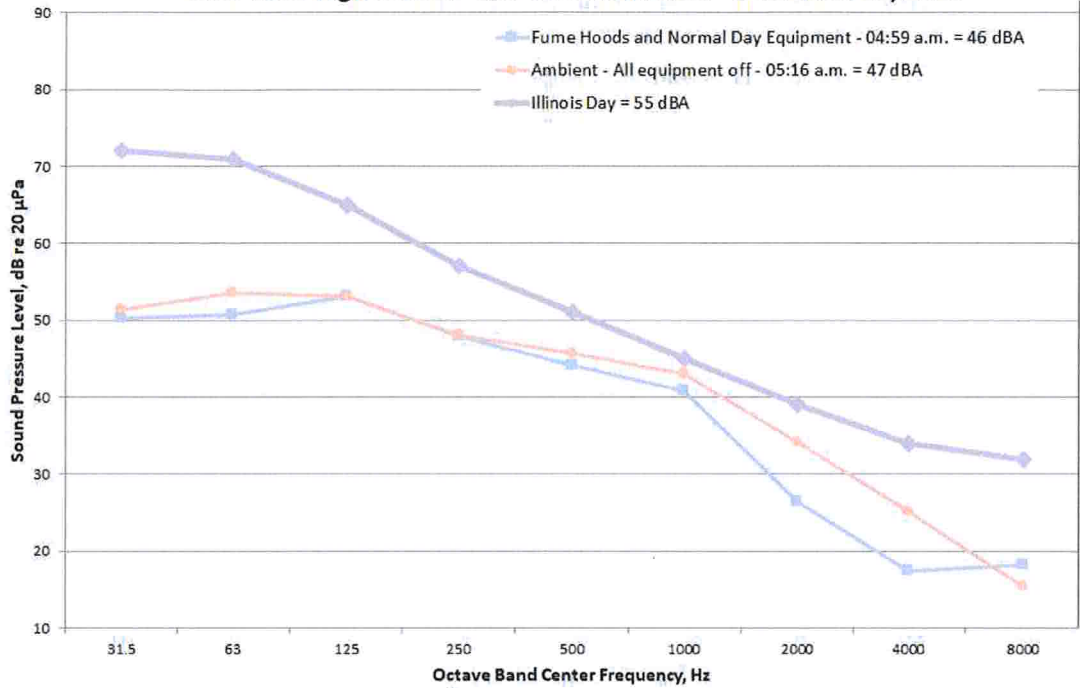


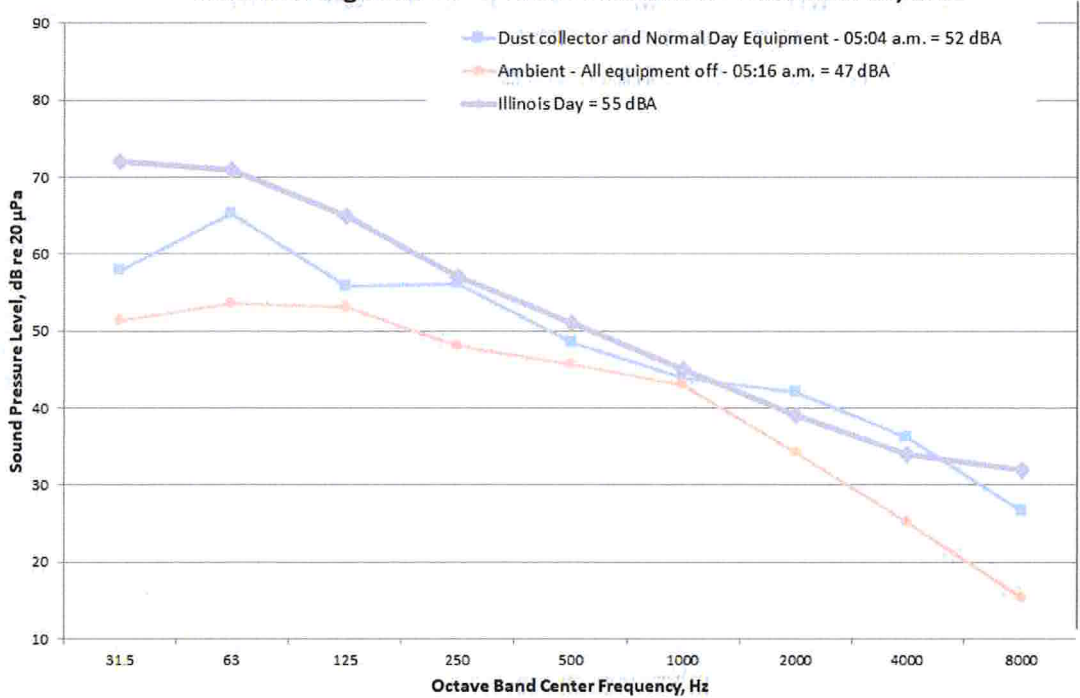
Figure 4. All Daytime Equipment
New Trier High School - 124 Woodland Ave. - December 13, 2019



**Figure 5. Fume Hoods and Daytime Equipment
New Trier High School - 124 Woodland Ave. - December 13, 2019**



**Figure 6. Dust Collector and Daytime Equipment
New Trier High School - 124 Woodland Ave. - December 13, 2019**



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

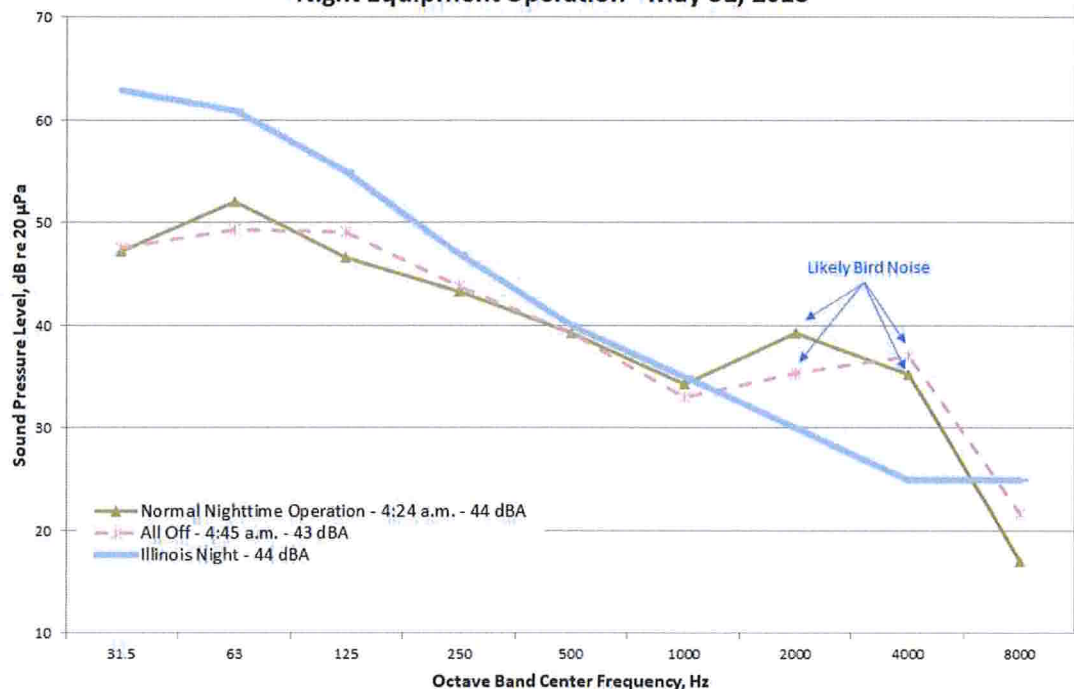
Rooftop Mechanical Equipment

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 High School - New Building
Night Equipment Operation - May 31, 2018**

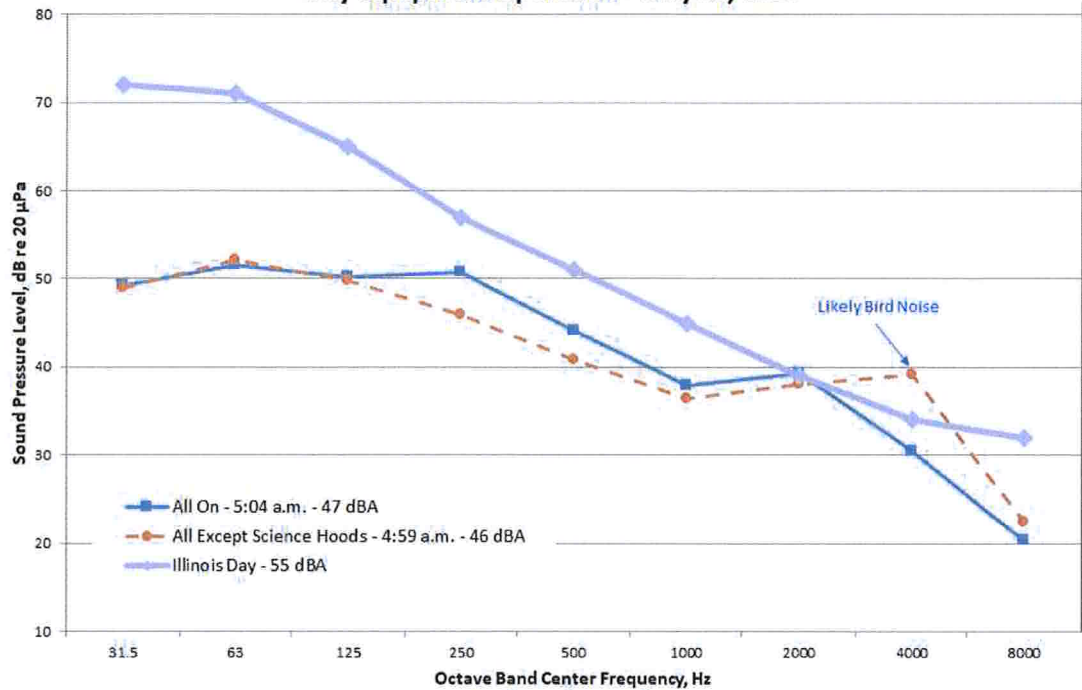


In order to investigate noise from equipment operating during the day, building personnel manually started rooftop mechanical equipment. Readings were taken during the early morning hours in order to minimize transportation noise, which would have made assessment of mechanical noise difficult or impossible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

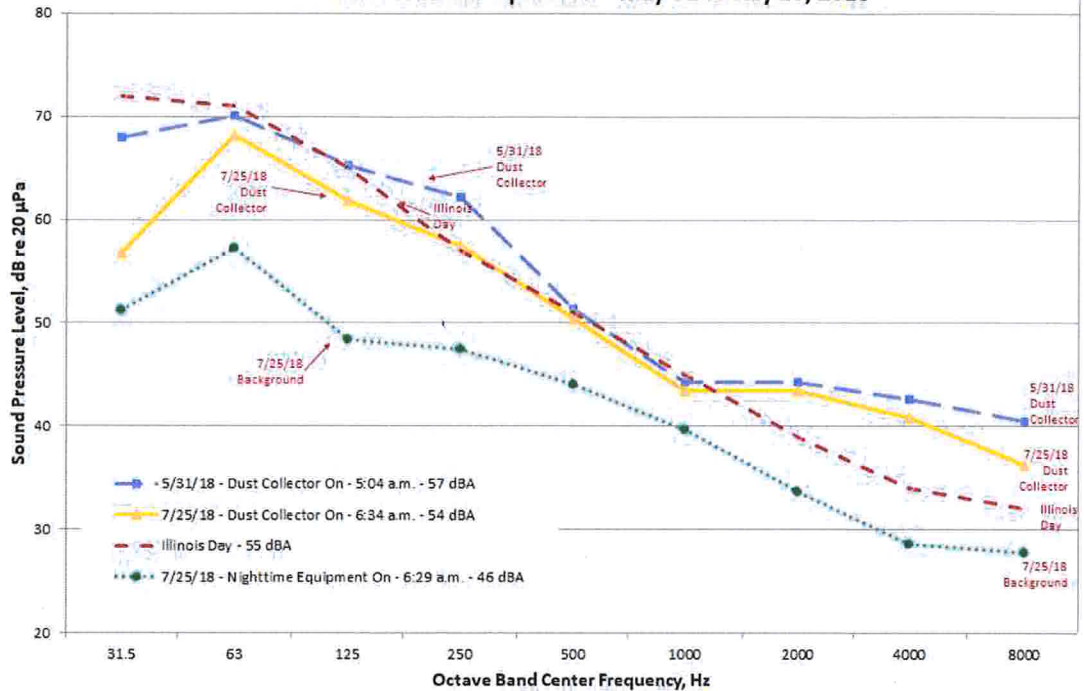


Dock Dust Collector

The dust collector is presently operated on an 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

BLH/mo/07
1180514

Metal Noise Barrier and Lagging Manufacturers

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Niles, IL 60714
John Grzeskowski
johng@imbortcorp.com
847-647-2393
www.kochllc.com/acoustical/barriers1/

Semco, Inc.
Hatchell & Associates, Inc.
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Elmhurst, IL 60126
Attn: Rob
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www.semcohvac.com/products/dap/acoustic/barriers/index.php

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<http://kineticsnoise.com/industrial/pdf/knm-100al.pdf>