APPENDIX D

NOISE

84 SANDFORD STREET
BROOKLYN, NY
NOISE ANALYSIS



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84 SANDFORD STREET NOISE ANALYSIS

SCOPE OF WORK

The purpose of the study is to determine the existing noise levels and identify the exterior to interior noise attenuation provided by the building construction materials on the first floor of the Yeshiva at 84 Sandford Street in Brooklyn, NY. Local traffic and the school buses are the primary sources of noise. The work was carried out in compliance with the guidelines in the NYC *CEQR Technical Manual*.

SITE DESCRIPTION

Figure 1 shows the site location at 84 Sandford Street in the Williamsburg neighborhood of Brooklyn, NY. It is located on the west side of Sandford Street between Park and Myrtle Avenues and is identified on the New York City Tax Maps as Lot 14, Block 1736. The school is a six-story building. Surrounding land uses are mixed and include a high proportion of industrial properties. The site is located wholly within an M1-1 zoning district. The Yeshiva is one block from an R6 zoning district, within which the use would be permitted as-of-right.

PROPOSED ACTION

The application seeks to legalize the existing use of the Yeshiva on the premises. The only change to the existing building is the addition of a stairwell to be constructed on the exterior of the existing building on the rear (western) side. For the purposes of the noise analysis, the existing and proposed conditions are identical.

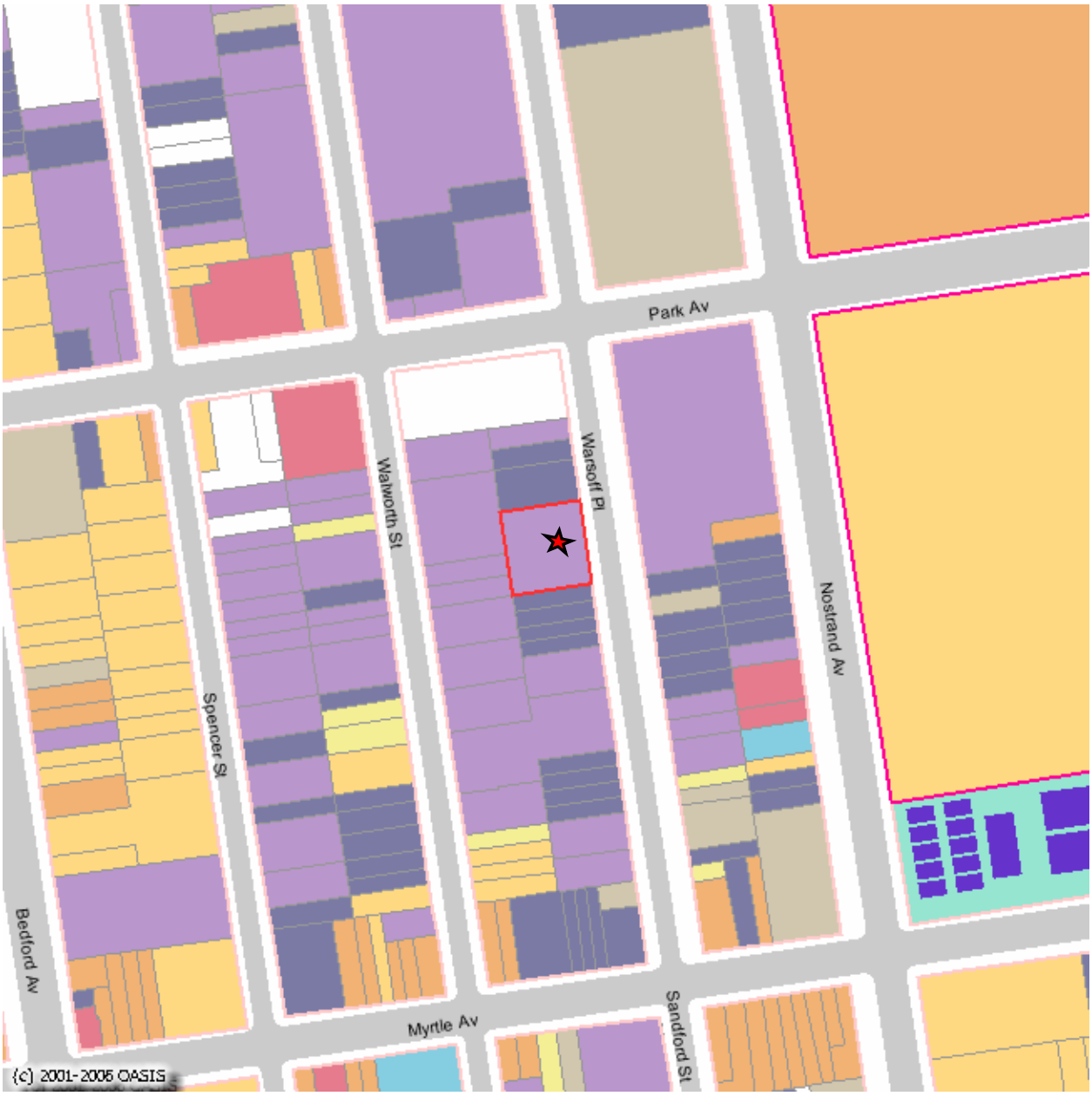
NOISE FUNDAMENTALS

Noise is measured in sound pressure level (SPL), which is converted to a decibel scale. The decibel is a relative measure of the sound level pressure with respect to a standardized reference quantity. Decibels on the A-weighted scale are termed “dBA.” The A-weighted scale is used for evaluating the effects of noise in the environment because it most closely approximates the response of the human ear. On this scale, the threshold of discomfort is 120 dB, and the threshold of pain is about 140. Table 1 shows the range of noise levels for a variety of indoor and outdoor noise levels.

Because the scale is logarithmic, a relative increase of 10 decibels represents a sound pressure level that is 10 times higher. However, humans don’t perceive a 10 dBA increase as 10 times or louder; they perceive it as twice as loud. The following is typical of human response to relative changes in noise level:

- 3 dBA change is the threshold of change detectable by the human ear,
- 5 dBA change is readily noticeable, and
- 10 dBA increase is perceived as a doubling of noise level.

Figure 1 – Project Location



= Site Location.

Table 1
Sound Pressure Level and Loudness of Typical Noises in Indoor and Outdoor Environments

Noise Level (dBA)	Subjective Impression	Typical Sources		Relative Loudness (Human Response)
		Outdoor	Indoor	
120-130	Uncomfortably Loud	Air raid siren at 50 feet (threshold of pain)	Oxygen torch	32 times as loud
110-120	Uncomfortably Loud	Turbo-fan aircraft at take-off power at 200 feet	Riveting machine Rock band	16 times as loud
100-110	Uncomfortably Loud	Jackhammer at 3 feet		8 times as loud
90-100	Very Loud	Gas lawn mower at 3 feet Subway train at 30 feet Train whistle at crossing Wood chipper shredding trees Chain saw cutting trees at 10 feet	Newspaper press	4 times as loud
80-90	Very Loud	Passing freight train at 30 feet Steamroller at 30 feet Leaf blower at 5 feet Power lawn mower at 5 feet	Food blender Milling machine Garbage disposal Crowd noise at sports event	2 times as loud
70-80	Moderately Loud	NJ Turnpike at 50 feet Truck idling at 30 feet Traffic in downtown urban area	Loud stereo Vacuum cleaner Food blender	Reference loudness (70 dBA)
60-70	Moderately Loud	Residential air conditioner at 100 feet Gas lawn mower at 100 feet Waves breaking on beach at 65 feet	Cash register Dishwasher Theater lobby Normal speech at 3 feet	2 as loud
50-60	Quiet	Large transformers at 100 feet Traffic in suburban area	Living room with TV on Classroom Business office Dehumidifier Normal speech at 10 feet	1/4 as loud
40-50	Quiet	Bird calls, Trees rustling, Crickets, Water flowing in brook	Folding clothes Using computer	1/8 as loud
30-40	Very quiet		Walking on carpet Clock ticking in adjacent room	1/16 as loud
20-30	Very quiet		Bedroom at night	1/32 as loud
10-20	Extremely quiet		Broadcast and recording studio	
0-10	Threshold of hearing			

Sources: Noise Assessment Guidelines Technical Background, by Theodore J. Schultz, Bolt Beranek and Newman, Inc., prepared for the US Department of Housing and Urban Development, Office of Research and Technology, Washington, D.C., undated; Sandstone Environmental Associates, Inc.; Highway Noise Fundamentals, prepared by the Federal Highway Administration, US Department of Transportation, September 1980; Handbook of Environmental Acoustics, by James P. Cowan, Van Nostrand Reinhold, 1994.

The sound pressure level (SPL) that humans experience typically varies from moment to moment. Therefore, a variety of descriptors are used to evaluate environmental noise levels over time. Some typical descriptors are defined below:

- L_{eq} is the continuous equivalent sound level. The sound energy from the fluctuating sound pressure levels is averaged over time to create a single number to describe the mean energy or intensity level. High noise levels during a monitoring period will have greater effect on the L_{eq} than low noise levels. The L_{eq} has an advantage over other descriptors because L_{eq} values from different noise sources can be added and subtracted to determine cumulative noise levels.

- L_{max} is the highest SPL measured during a given period of time. It is useful in evaluating L_{eq}s for time periods that have an especially wide range of noise levels.

- L_{10} is the SPL exceeded 10% of the time. Similar descriptors are the L_{50}, L_{01}, and L_{90}.

- L_{dn} is the day-night equivalent sound level. It is similar to a 24-hour L_{eq}, but with 10 dBA added to SPL measurements between 10 pm and 7 am to reflect the greater intrusiveness of noise experienced during these hours. L_{dn} is also termed DNL.

Vehicular traffic volumes can be converted into Passenger Car Equivalent (PCE) values, for which one medium-duty truck (having a gross weight between 9,900 and 26,400 pounds) is assumed to generate the noise equivalent of 13 cars, one bus (capable of carrying more than nine passengers) is assumed to generate the noise equivalent of 18 cars, and one heavy-duty truck (having a gross weight of more that 26,400 pounds) is assumed to generate the noise equivalent of 47 cars, as summarized below from the *CEQR Technical Manual*.

- $ autos and light trucks = 1 passenger car,
- $ medium trucks = 13 passenger cars,
- $ heavy trucks = 47 passenger cars, and
- $ public buses = 18 passenger cars.

Thus, Passenger Car Equivalents (PCEs) are the numbers of autos that would generate the same noise level as the observed vehicular mix of autos, medium trucks, and heavy trucks. PCEs are useful for comparing the effects of traffic noise on different roadways or for different future scenarios.

Although the SPL heard in the environment typically is composed of many different frequencies, it can be broken down into the numerous individual frequencies. These frequencies are grouped into octave bands. An octave band is a group of frequencies in the interval between a given frequency (such as 350 Hz) and twice that frequency (e.g., 710 Hz). The standard octave bands are each named by their center frequencies. Thus, each octave band will be represented by a single SPL. When the representative SPLs from the individual octave bands are added together, they are weighted so that the resulting total SPL will represent dBA. Octave bands are used in some noise models because the different components of a noise source will have different frequencies. For example, a truck traveling downhill will have a different set of frequencies than a truck traveling uphill.

ATTENUATION RATINGS

Window/wall attenuation can be described in terms of sound transmission class (STC), transmission loss (TL), and outdoor-indoor transmission class (OITC). Although these terms are sometimes used interchangeably, they are different from each other. Transmission loss refers to how many decibels of sound a wall or window can stop at a given frequency. The TL for a given construction material varies with the individual frequencies of the noise. To simplify the noise attenuation properties of a wall, the

STC rating was developed. It is a single number that describes the sound isolation performance of a given material for the range of test frequencies between125 and 4,000 Hz. These frequencies sufficiently cover the range of human speech. Higher STC values reflect greater efficiencies to block airborne sound. Table 2 describes the performance of sound attenuation along the STC scale.

Table 2: STC values and Attenuation Properties

STC rating	Acoustical Performance
25	Normal speech can be understood quite easily and distinctly through window
30	Loud speech can be understood fairly well, normal speech heard but not understood
35	Loud speech audible but not intelligible
40	Onset of "privacy"
42	Loud speech audible as a murmur
45	Loud speech not audible; 90% of statistical population not annoyed
50	Very loud sounds such as musical instruments or a stereo can be faintly heard; 99% of population not annoyed.
60+	Superior soundproofing; most sounds inaudible

Source: Harris, Cyrill M. "Noise Control in Buildings: A Practical Guide for Architects and Engineers." 1994.

The OITC is similar to the STC, except that it is weighted more to the lower frequencies associated with aircraft, rail, and truck, traffic. It considers frequencies down to 80 Hz. In selecting suitable window material, the final attenuation level depends upon a variety of factors, among which include the type of material selected, the thickness of the panel, and quality of the installation. Table 3 shows some typical STC and OITC ratings for double-glazed windows.

Table 3: Representative Sound Performance of Glass Fabrications

Glass Type	Construction	STC Rating	OITC Rating
1/4 monolithic float		27	25
1/4 laminated	1/8-.030 PVB-1/8	35	32
1/2 laminated	1/4-.030-1/4	38	33
9/16 laminated	1/4-.060-1/4	39	35
1” insulating	1/4 flt-1/2 AS-1/4 flt	35	28
1” insulating	1/4 lami-1/2 AS -1/4 flt	39	32
1” insulating	1/4 lami-1/2 AS – 1/4 lami	42	33

Source: E.I. du Pont de Nemours and Company

The windows in the school were installed by Windows to the World. They are double-glazed windows with ¼” panes of glass separated by 0.03” of PVB. Based on the specifications provided by the manufacturer (see Appendix A), the windows have an STC rating of 35 and an OITC rating of 32.

NOISE STANDARDS AND GUIDELINES

In 1983, the New York City Department of Environmental Protection (NYCDEP) adopted the City Environmental Protection Order-City Environmental Quality Review (CEPO-CEQR) noise standards for exterior noise levels. These standards are the basis for classifying noise exposure into four categories based on the L_{10}: Acceptable, Marginally Acceptable, Marginally Unacceptable, and Clearly Unacceptable, as shown in Table 4. Table 5 shows the required attenuation for sensitive uses within the last three categories. For example, an L_{10} may approach 80 dBA provided that buildings are constructed of materials that reduce exterior to interior noise levels by at least 35 dBA.

Table 4: CEPO-CEQR Noise Exposure Guidelines for Use in City Environmental Impact Review [1]

Receptor Type	Time Period	Acceptable General External Exposure	Airport[3] Exposure	Marginally Acceptable General External Exposure	Airport[3] Exposure	Marginally Unacceptable General External Exposure	Airport[3] Exposure	Clearly Unacceptable General External Exposure	Airport[3] Exposure
1.Outdoor area requiring serenity and quiet[2]		$L_{10} \leq 55$ dBA							
2. Hospital, Nursing Home		$L_{10} \leq 55$ dBA		$55<L_{10}\leq 65$ dBA		$65<L_{10}\leq 80$ dBA		$L_{10}>80$ dBA	
3. Residence, residential hotel or motel	7 am to 10 pm	$L_{10}\leq 65$dBA		$65<L_{10}\leq 70$ dBA		$70<L_{10}\leq 80$ dBA		$L_{10}>80$ dBA	
	10 pm to 7 am	$L_{10}\leq 55$dBA	$L_{dn} \leq 60$ dBA	$55<L_{10}\leq 70$ dBA	$L_{dn} \leq 60$ dBA	$70<L_{10}\leq 80$ dBA	$L_{dn} \leq 60$ dBA	$L_{10}>80$ dBA	$L_{dn} \leq 75$ dBA
4. School, museum, library, court house of worship, transient hotel or motel, public meeting room, auditorium, out-patient public health facility		Same as Residential Day (7 AM-10 PM)		Same as Residential Day (7 AM-10 PM)		Same as Residential Day (7 AM- 10 PM)		Same as Residential Day (7 AM –10 PM)	
5. Commercial or office		Same as Residential Day (7 AM-10 PM)		Same as Residential Day (7 AM-10 PM)		Same as Residential Day (7 AM –10 PM)		Same as Residential Day (7 AM-10 PM)	
6. Industrial, public areas only[4]	Note 4	Note 4		Note 4		Note 4		Note 4	

Notes:

(i) In addition, any new activity shall not increase the ambient noise level by 3 dBA or more;

1 Measurements and projections of noise exposures are to be made at appropriate heights above site boundaries as given by American National Standards Institute (ANSI) Standards; all values are for the worst hour in the time period.

2 Tracts of land where serenity and quiet are extraordinarily important and serve an important public need and where the preservation of these qualities is essential for the area to serve its intended purpose. Such areas could include amphitheaters, particular parks or portions of parks or open spaces dedicated or recognized by appropriate local officials for activities requiring special qualities of serenity and quiet. Examples are grounds for ambulatory hospital patients and patients and residents of sanitariums and nursing homes.

3 One may use the FAA-approved L_{dn} contours supplied by the Port Authority, or the noise contours may be computed from the federally approved INM Computer Model using flight data supplied by the Port Authority of New York and New Jersey.

4 External Noise Exposure standards for industrial areas of sounds produced by industrial operations other than operating motor vehicles or other transportation facilities are spelled out in the New York City Zoning Resolution, Sections 42-20 and 42-21. The referenced standards apply to M1, M2, and M3 manufacturing districts and to adjoining residence districts (performance standards are octave band standards).

Source: New York City Department of Environmental Protection (adopted policy 1983).

Table 5: Required Attenuation Values to Achieve Acceptable Interior Noise Levels

	Marginally Acceptable	Marginally Unacceptable		Clearly Unacceptable		
Noise level with proposed action	$65<L_{10}\leq 70$	$70<L_{10}\leq 75$	$75<L_{10}\leq 80$	$80<L_{10}\leq 85$	$85<L_{10}\leq 90$	$90<L_{10}\leq 95$
Attenuation	25 dBA	(I) 30 dBA	(II) 35 dBA	(I) 40 dBA	(II) 45 dBA	(III) 50 dBA

Source: New York City Department of Environmental Protection.

NOISE MONITORING

Noise levels were monitored on: June 2, 2009 and July 9, 2009. The school day begins at 8:40 am and ends at 4:20 pm. School lunch starts at noon. Therefore the peak AM, Midday, and PM monitoring periods reflected this schedule. School is quiet indoors from 10 to 11 am, and indoor noise levels were monitored during this period to verify information on the windows' noise attenuation. However, the interior noise measurements are not useful because they were affected by uncontrollable factors such as automatic bells, employee footsteps, doors opening and closing, and employee conversations.

The sound level meters used were a Brüel & Kjær Noise Level Meter 2236 (Type 1 instrument) and a Brüel & Kjær Noise Level Meter 2250 (Type 1 instrument). Noise levels were monitored for 20 minutes per period (weather permitting) according to the procedures outlined in the NYC *CEQR Technical Manual*. Sound level meters were calibrated before and after use. Wind screens were used during all sound measurements except for calibration. All measurement procedures conformed to the requirements of ANSI Standard S1.13-1971 (R1976).

On June 2, a normal school day, outdoor noise levels were monitored during school hours. ~~monitored before and after the start of school.~~ Sources of noise included local traffic on Sandford Street as well as arriving and ~~idling~~ departing school buses in front of the premises. Weather conditions on June 2 included temperatures ranging from the mid 60s to high 70s (°F) with intermittent precipitation occurring throughout the day. Wind speeds throughout the measurement periods on June 2 ranged from calm conditions through 9 miles per hour. Noise monitoring during the peak PM period was cut short due to rain.

Indoor and outdoor readings were taken simultaneously between 10 and 11 am. The indoor noise monitor was placed 6 feet from the glass door and windows that face Sandford Street. Although this is the quietest period of the day, the indoor measurements were deemed unusable due to foot traffic and conversations by individuals in the lobby and receptionist's office. The noise levels resulting from these indoor activities would not provide an accurate representation of the true interior-exterior noise level attenuation. Therefore, Table 6 only shows the results of the exterior noise monitoring.

Table 6: Noise Monitoring Results (dBA), June 2, 2009

Site	Time of Day	L_{eq}	L_{10}	MinL	MaxL	L_{01}	L_{90}
Yeshiva Exterior	8:43 a.m. – 9:03 a.m.	68.2	68.5	55.3	87.1	81.5	57.0
Yeshiva Exterior	10:19 a.m. – 10:40 a.m.	64.5	67.0	55.6	81.6	74.5	57.5
Yeshiva Exterior	12:00 p.m. – 12:20 p.m.	63.3	64.0	54.7	83.2	73.5	56.0
	4:05 p.m. – 4:15 p.m.	70.7	72.5	58.3	87.2	83.0	61.0

~~* School not in session.~~

Source: Sandstone Environmental Associates, Inc.

~~As shown in Table 6, the highest L10 of 79.5 dBA occurred from 8:16 to 8:36 am, a period that included 13 school buses arriving and idling on Sandford Street, as well as 3 medium trucks, and 2 heavy trucks using the loading dock across the street. This occurred prior to the start of school.~~ The L10 of 68.5 dBA~~,~~ occurred as two buses left the premises just after the start of the school day. Otherwise, noise levels during the school day varied from 63.3 to 67.0 dBA. The predominant sources of noise outside the building were traffic along Sandford Street, aircraft flyovers, and manufacturing activity associated with the surrounding buildings on Sandford Street. Shortly after 4 pm, the buses arrived to take students home, and the outdoor L10 noise level increased to 72.5 dBA, which was the highest L10 observed during school hours.

On July 9th, Yeshiva students were out of the building for summer session, and this absence provided a second opportunity to record ~~interior~~ exterior noise ~~attenuation~~ levels. Temperatures ranged from the mid

60s to low 70s (°F), and the conditions were partly sunny with little to light winds. ~~Again, one noise monitor was placed outdoors and a second noise monitor was placed indoors, 6 feet from the glass door and windows that face Sandford Street.~~ The peak AM noise levels were lower on June 9th because the school buses were not present. Exterior noise due to local traffic and industrial activity in the neighborhood fell within the range of L10 noise levels observed when school was in session.

~~Interior noise on July 9th was affected by an automated building alarm during the peak PM period. As a result, the interior noise levels recorded for this period are not useful. Custodial employees working inside the Yeshiva during the day also contributed to the overall interior noise levels as they walked through the hallway or opened and closed doors. For this reason, the noise levels monitored during the Midday period are not included in the analysis.~~ Table 7 shows the outdoor monitoring results for July 9, 2009.

Table 7: Noise Monitoring Results (dBA), July 9, 2009

Site	Time of Day	L_{eq}	L_{10}	MinL	MaxL	L_{01}	L_{90}
Yeshiva Exterior	9:15 a.m. – 9:45 a.m.	63.0	66.5	53.4	74.9	71.0	56.0
Yeshiva Exterior	12:17 p.m. – 12:47 p.m.	65.7	68.0	53.0	86.5	77.0	55.0
Yeshiva Exterior	4:01 p.m. – 4:27 p.m.	64.9	68.0	54.4	81.4	75.0	56.5

~~*NA – Not applicable. Reading influenced by an anomalous indoor source*~~

Source: Sandstone Environmental Associates, Inc.

ANALYSIS

~~During most of~~Outdoor noise levels monitored during the school day~~, the outdoor L10~~ range~~s~~ from 64.0 to ~~68.0~~72.5 dBA, as shown in Tables 6 and 7. ~~For a few minutes at the beginning and end of the school day, the L10 ranges from 68.5 to 72.5 dBA.~~ The noise attenuation provided by the window specifications was applied to the maximum outdoor L10 noise levels observed during the school day on June 2nd. Table 8 displays the results. With the existing windows, indoor noise ~~caused by~~attributable to outdoor sources ~~is~~ would be below NYCDEP's desired noise level of 45 dBA. Therefore, the windows provide suitable noise attenuation.~~In reality, the indoor noise levels would be higher due to indoor sources.~~

Table 8: Exterior-Interior Noise Attenuation ~~Results~~ (dBA)

~~Period~~June 2, 2009 Worst Case	L_{10}
~~**Typical school hours**~~	
~~Yeshiva worst-case exterior~~	~~68.0~~
~~Existing window specifications~~	~~32.0~~
~~Projected Yeshiva interior~~	~~36.0~~
~~**Beginning and end of school day**~~	
Yeshiva worst-case exterior	72.5
Existing window specifications	32.0
Projected Yeshiva interior	40.5

Source: Sandstone Environmental Associates, Inc.

CONCLUSIONS

~~Noise levels of 68.5 to 72.5 dBA occur at the beginning and end of the school day when buses are present.~~ The outdoor L_{10} of 72.5 dBA during the June 2nd PM period places the Yeshiva school in NYCDEP's Marginally Unacceptable (I) category of noise exposure, which requires 30 dBA of attenuation to ensure an indoor noise level of 45 dBA. The manufacturers' specifications in Appendix A show that the existing windows have an OITC rating of 32, which would comply with the required noise

attenuation. Therefore, no additional mitigation measures are recommended. The building has an alternate ventilation system permitting a closed window condition during warm weather.

APPENDIX A
WINDOW SPECIFICATIONS FROM WINDOWS TO THE WORLD

Sound transmission class

outside/inside transmission class

STC and OITC Values/Acoustical

Acoustical Performance

Acoustical Performance Glass Fabrications

TYPE OF GLASS	OVERALL THICKNESS IN.	OVERALL THICKNESS MM.	OUTBOARD LITE	FABRICATION INFO Interlayer/air space	INBOARD LITE	STC VALUE	OITC VALUE
Laminated Glass	1/4"	7.1	1/8"	0.030 PVB	1/8"	35	32
	1/4"	7.9	1/8"	0.060 PVB	1/8"	36	32
	3/8"	10.3	3/16"	0.030 PVB	3/16"	36	33
	3/8"	10.3	1/4"	0.030 PVB	1/8"	37	34
	3/8"	11	1/4"	0.060 PVB	1/8"	38	33
	1/2"	13.5	1/4"	0.030 PVB	1/4"	39	35
	9/16"	14.2	1/4"	0.060 PVB	1/4"	40	36
	5/8"	16.6	3/8"	0.030 PVB	1/4"	40	36
	3/4"	20.6	1/2"	0.060 PVB	1/4"	41	36
Monolithic Glass	1/8"	3.2	1/8"	0	0	26	25
	5/32"	4	5/32"	0	0	28	26
	3/16"	4.8	3/16"	0	0	29	27
	7/32"	5.6	7/32"	0	0	31	28
	1/4"	6.4	1/4"	0	0	31	29
	5/16"	7.8	5/16"	0	0	33	30
	3/8"	9.5	3/8"	0	0	34	32
	1/2"	12.7	1/2"	0	0	36	33
	5/8"	15.9	5/8"	0	0	38	35
	3/4"	19	3/4"	0	0	39	36
Laminated - Insulating Glass	1"	26.2	1/4" Lami	1/2" Airspace	1/4"	39	32
	15/16"	24.6	1/4" Lami	1/2" Airspace	3/16"	39	32
	1 1/8"	29.3	3/8" Lami	1/2" Airspace	1/4"	40	34
	1 1/4"	32.5	1/2" Lami	1/2" Airspace	1/4"	42	35
	1 1/4"	32.5	1/4" Lami	3/4" Airspace	1/4"	41	34
	1 7/16"	37.3	1/4" Lami	1" Airspace	3/16"	42	34
	1 1/2"	38.9	1/2" Lami	3/4" Airspace	1/4"	43	36
	1 1/2"	38.9	1/4" Lami	1" Airspace	1/4"	42	35
Non Laminated - Insulating Glass	1/2"	12.7	1/8"	1/4" Airspace	1/8"	29	25
	15/16"	23.8	1/4"	1/2" Airspace	3/16"	35	28
	1"	25.4	1/4"	1/2" Airspace	1/4"	35	28
	1 1/8"	28.6	3/8"	1/2" Airspace	1/4"	36	28
	1 1/4"	31.8	1/2"	1/2" Airspace	1/4"	37	28
	1 1/4"	31.8	1/4"	3/4" Airspace	1/4"	37	29
	1 7/16"	36.5	1/4"	1" Airspace	3/16"	38	30
	1 1/2"	38.1	1/2"	3/4" Airspace	1/4"	39	29
	1 1/2"	38.1	1/2"	1/2" Airspace	1/2"	37	28
	1 1/2"	38.1	1/4"	1" Airspace	1/4"	38	30
Double Laminated - Insulating Glass	1"	26.9	1/4" Lami	1/2" Airspace	1/4" Lami	42	33
	1 1/8"	30.1	3/8" Lami	1/2" Airspace	3/8" Lami	43	33
	1 3/4"	47.6	1/2" Lami	1" Airspace	5/16"Lami	44	35
Triple Laminated - Insulating Glass	1 3/4"	46.7	1/4" Lami	1/2" Airspace x 2	1/4" Lami x2	44	33
	2 1/4"	59.4	1/4" Lami	1" & 1/2" Airspace	1/4" Lami x2	49	39
Triple Non-Laminated Insulating Glass	1 3/4"	44.5	1/4"	1/2" Airspace x 2	1/4" x 2	39	31
	2 1/4"	57.2	1/4"	1" & 1/2" Airspace	1/4" x 2	46	37