A. INTRODUCTION

The proposed actions would not generate sufficient traffic to have the potential to cause a significant noise impact (i.e., it would not result in a doubling of Noise Passenger Car Equivalents [Noise PCEs] that would be necessary to cause a 3 dBA increase in noise levels; see **Appendix D**). However, in order to address *City Environmental Quality Review (CEQR)* requirements and City of New York Department of Housing Preservation & Development (HPD) noise abatement guidelines—which are based on U.S. Department of Housing and Urban Development (HUD) criteria—for developments pursuant to the proposed actions, this chapter considers ambient noise levels adjacent to the project site. It also examines whether the publicly accessible open space proposed for Site 5 would meet CEQR noise level guidelines for open space.

PRINCIPAL CONCLUSIONS

The analysis concludes that, by adhering to specific design requirements (described below), development pursuant to the proposed actions would be expected to provide sufficient attenuation to achieve the CEQR interior noise level requirements and the HUD interior noise level guidelines.

B. NOISE FUNDAMENTALS

Sound is a fluctuation in air pressure. Sound pressure levels are measured in units called "decibels" ("dB"). The particular character of the sound that we hear (a whistle compared with a French horn, for example) is determined by the speed, or "frequency," at which the air pressure fluctuates, or oscillates. Frequency defines the oscillation of sound pressure in terms of cycles per second. One cycle per second is known as 1 Hertz ("Hz"). People can hear over a relatively limited range of sound frequencies, generally between 20 Hz and 20,000 Hz, and the human ear does not perceive all frequencies equally well. High frequencies (e.g., a whistle) are more easily discernable and therefore more intrusive than many of the lower frequencies (e.g., the lower notes on the French horn).

"A"-WEIGHTED SOUND LEVEL (DBA)

In order to establish a uniform noise measurement that simulates people's perception of loudness and annoyance, the decibel measurement is weighted to account for those frequencies most audible to the human ear. This is known as the A-weighted sound level, or "dBA," and it is the descriptor of noise levels most often used for community noise. As shown in **Table 16-1**, the threshold of human hearing is defined as 0 dBA; quiet conditions (as in a library, for example) are approximately 40 dBA; levels between 50 dBA and 70 dBA define the range of noise levels generated by normal daily activity; levels above 70 dBA would be considered noisy, and then loud, intrusive, and deafening as the scale approaches 130 dBA.

Table 16-1
Common Noise Levels

Sound Source	(dBA)
Military jet, air raid siren	130
Amplified rock music	110
Jet takeoff at 500 meters	100
Freight train at 30 meters	95
Train horn at 30 meters	90
Heavy truck at 15 meters	80–90
Busy city street, loud shout	80
Busy traffic intersection	70–80
Highway traffic at 15 meters, train	70
Predominantly industrial area	60
Light car traffic at 15 meters, city or commercial areas, or residential areas close to industry	50–60
Background noise in an office	50
Suburban areas with medium-density transportation	40–50
Public library	40
Soft whisper at 5 meters	30
Threshold of hearing	0

Note: A 10 dBA increase in level appears to double the loudness, and a 10 dBA decrease halves the apparent loudness.
Sources: Cowan, James P. *Handbook of Environmental Acoustics,* Van Nostrand Reinhold, New York, 1994. Egan, M. David, Architectural Acoustics. McGraw-Hill Book Company, 1988.

In considering these values, it is important to note that the dBA scale is logarithmic, meaning that each increase of 10 dBA describes a doubling of perceived loudness. Thus, the background noise in an office, at 50 dBA, is perceived as twice as loud as a library at 40 dBA. For most people to perceive an increase in noise, it must be at least 3 dBA. At 5 dBA, the change will be readily noticeable.

EFFECTS OF DISTANCE ON SOUND

Sound varies with distance. For example, highway traffic 50 feet away from a receptor (such as a person listening to the noise) typically produces sound levels of approximately 70 dBA. The same highway noise measures 66 dBA at a distance of 100 feet, assuming soft ground conditions. This decrease is known as "drop-off." The outdoor drop-off rate for line sources, such as traffic, is a decrease of approximately 4.5 dBA (for soft ground) for every doubling of distance between the noise source and receiver (for hard ground the outdoor drop-off rate is 3 dBA for line sources). Assuming soft ground, for point sources, such as amplified rock music, the outdoor drop-off rate is a decrease of approximately 7.5 dBA for every doubling of distance between the noise source and receiver (for hard ground the outdoor drop-off rate is 6 dBA for point sources).

SOUND LEVEL DESCRIPTORS

Because the sound pressure level unit of dBA describes a noise level at just one moment and few noises are constant, other ways of describing noise that fluctuates over extended periods have been developed. One way is to describe the fluctuating sound heard over a specific time period as if it had been a steady, unchanging sound. For this condition, a descriptor called the "equivalent sound level," L_{eq}, can be computed. L_{eq} is the constant sound level that, in a given

situation and time period (e.g., 1 hour, denoted by $L_{eq(1)}$, or 24 hours, denoted by $L_{eq(24)}$), conveys the same sound energy as the actual time-varying sound. Statistical sound level descriptors such as L_1, L_{10}, L_{50}, L_{90}, and L_x, are used to indicate noise levels that are exceeded 1, 10, 50, 90, and x percent of the time, respectively.

The relationship between L_{eq} and levels of exceedance is worth noting. Because L_{eq} is defined in energy rather than straight numerical terms, it is not simply related to the levels of exceedance. If the noise fluctuates little, L_{eq} will approximate L_{50} or the median level. If the noise fluctuates broadly, the L_{eq} will be approximately equal to the L_{10} value. If extreme fluctuations are present, the L_{eq} will exceed L_{90} or the background level by 10 or more decibels. Thus the relationship between L_{eq} and the levels of exceedance will depend on the character of the noise. In community noise measurements, it has been observed that the L_{eq} is generally between L_{10} and L_{50}.

The day-night sound level (L_{dn}) refers to a 24-hour average noise level with a 10 dB penalty applied to the noise levels during the hours between 10 PM and 7 AM, due to increased sensitivity to noise levels during these hours.

For purposes of the proposed actions, the L_{dn} and the 1-hour L_{10} descriptor ($L_{10(1)}$) have been selected as the noise descriptors to be used in this noise impact evaluation. The 1-hour L_{10} is the noise descriptor used in the *CEQR Technical Manual* (January 2012 edition) noise exposure guidelines for City environmental impact review classification, and the L_{dn} is the descriptor used to determine HUD noise abatement requirements.

C. NOISE STANDARDS AND CRITERIA

NEW YORK CEQR NOISE STANDARDS

The *CEQR Technical Manual* sets external noise exposure standards; these standards are shown in **Table 16-2**. Noise exposure is classified into four categories: acceptable, marginally acceptable, marginally unacceptable, and clearly unacceptable.

The *CEQR Technical Manual* defines attenuation requirements for buildings based on exterior noise level (see **Table 16-3**, "Required Attenuation Values to Achieve Acceptable Interior Noise Levels"). Recommended noise attenuation values for buildings are designed to maintain interior noise levels of 45 dBA or lower for residential or hotel uses and 50 dBA for commercial uses and are determined based on exterior $L_{10(1)}$ noise levels.

HUD DEVELOPMENT GUIDELINES

HUD sets exterior noise standards for housing construction projects based on Day-Night Sound Level (i.e., L_{dn}) values (see **Table 16-4**, HUD Exterior Noise Standards). The L_{dn} refers to a 24-hour average noise level with a 10 dB penalty applied to the noise levels during the hours between 10 PM and 7 AM, due to increased sensitivity to noise levels during these hours. Noise attenuation values are designed to maintain an interior L_{dn} value of 45 dBA or lower for residential uses.

Table 16-2
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
Outdoor area requiring serenity and quiet[2]		$L_{10} \leq 55$ dBA	---------- Ldn ≤ 60 dBA ----------	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Hospital, nursing home		$L_{10} \leq 55$ dBA		$55 < L_{10} \leq 65$ dBA	---------- 60 < Ldn ≤ 65 dBA ----------	$65 < L_{10} \leq 80$ dBA	(I) 65 < Ldn ≤ 70 dBA, (II) 70 ≤ Ldn	$L_{10} > 80$ dBA	---------- Ldn ≤ 75 dBA ----------
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		$55 < L_{10} \leq 70$ dBA		$70 < L_{10} \leq 80$ dBA		$L_{10} > 80$ dBA	
School, museum, library, court, house of worship, transient hotel or motel, public meeting room, auditorium, outpatient public health facility		Same as Residential Day (7 AM-11 PM)		Same as Residential Day (7 AM-11 PM)		Same as Residential Day (7 AM-11 PM)		Same as Residential Day (7 AM-11 PM)	
Commercial or office		Same as Residential Day (7 AM-11 PM)		Same as Residential Day (7 AM-11 PM)		Same as Residential Day (7 AM-11 PM)		Same as Residential Day (7 AM-11 PM)	
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; (ii) *CEQR Technical Manual* noise criteria for train noise are similar to the above aircraft noise standards: the noise category for train noise is found by taking the L_{dn} value for such train noise to be an L^{y}_{dn} (L_{dn} contour) value.

Table Notes:

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 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 16-3
Required Attenuation Values to Achieve Acceptable Interior Noise Levels

	Marginally Acceptable				Clearly Unacceptable
Noise Level With Proposed Action	$70 < L_{10} \leq 73$	$73 < L_{10} \leq 76$	$76 < L_{10} \leq 78$	$78 < L_{10} \leq 80$	$L_{10} < 80$
Attenuation*	(I) 28 dB~~(A)~~	(II) 31 dB~~(A)~~	(III) 33 dB~~(A)~~	(IV) 35 dB~~(A)~~	$36 + (L_{10} - 80)^{B}$ dB~~(A)~~

Notes: [A] The above composite window-wall attenuation values are for residential dwellings. Commercial office spaces and meeting rooms would be 5 dB~~(A)~~ less in each category. All the above categories require a closed window situation and hence an alternate means of ventilation.

[B] Required attenuation values increase by 1 dB~~(A)~~ increments for L_{10} values greater than 80 dBA.

Source: New York City Department of Environmental Protection

Table 16-4
HUD Exterior Noise Standards

	Acceptable	Normally Unacceptable	Unacceptable
Noise Level With Proposed Project	$L_{dn} \leq 65$	$65 < L_{dn} \leq 75$	$75 < L_{dn}$
Source: U.S. Department of Housing and Urban Development			

For this analysis, L_{dn} levels were calculated using the following equation:

10*LOG[Energy sum of the 24 hourly equivalent sound levels with 10dB added between the hours of 10PM and 7AM] – 13.8

The equation listed above is used to calculate the L_{dn} when performing a continuous 24-hour measurement at the project site is feasible. First, 10 dB is added to the A-weighted sound levels measured between the hours of 10 PM and 7 AM (i.e., nighttime). The L_{dn} sound level is then computed from the adjusted nighttime sound levels along with the unadjusted daytime (i.e., 7 AM to 10 PM) values.

D. EXISTING NOISE LEVELS

MEASUREMENT PROGRAM

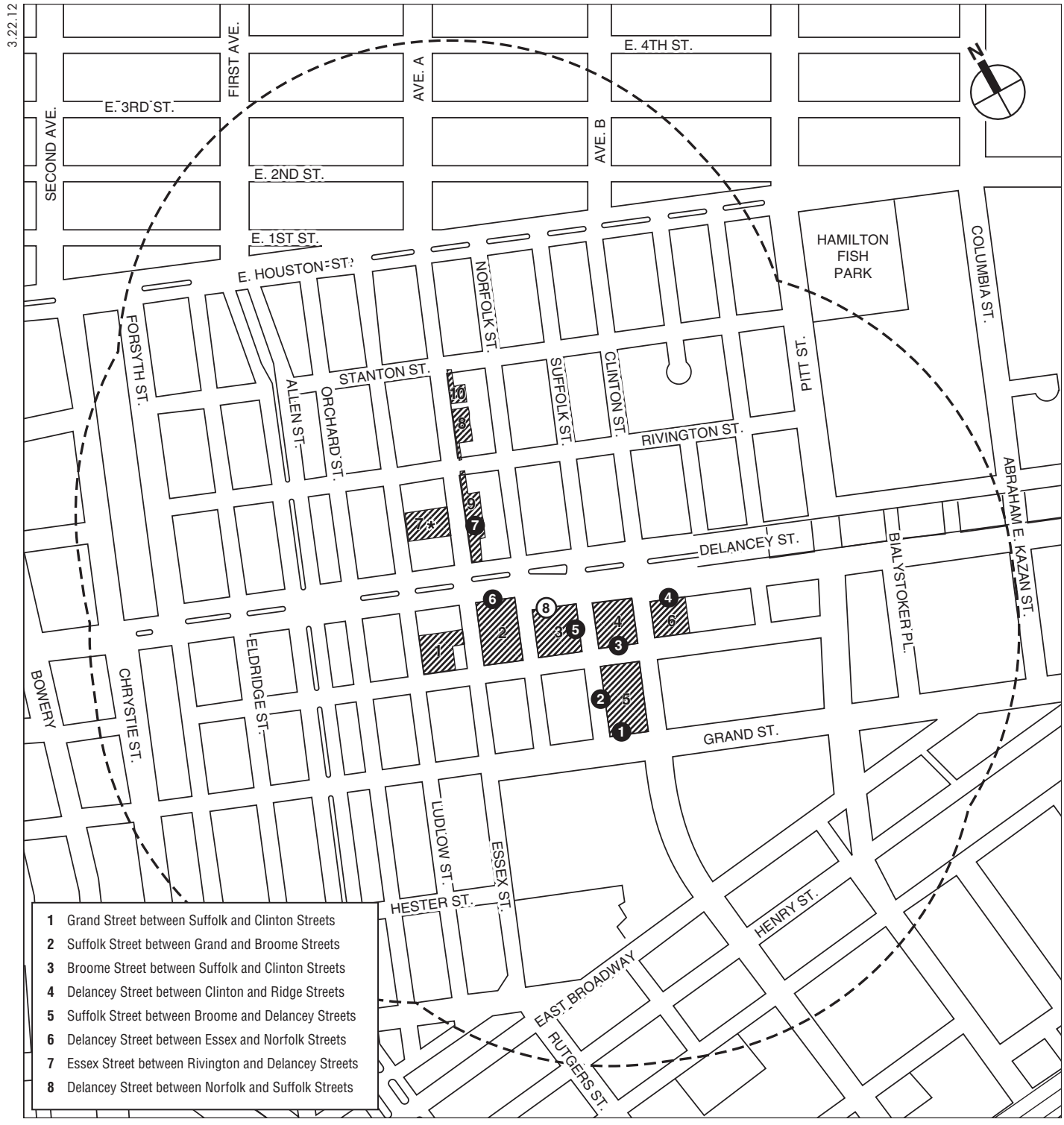
Existing noise levels at the project site were measured at eight locations (see **Figure 16-1**). At each location, noise levels were determined by either 20-minute spot measurements during four weekday time periods— AM (7:30 to 9:30 AM), midday (MD) (11:30 AM to 1:30 PM), PM (4:30 to 6:30 PM) peak periods, and a late-night period (10 PM to 7 AM)—or by a 24-hour continuous measurement. **Table 16-5** lists the receptor site locations and the type of measurement performed at each site.

Table 16-5
Noise Receptor Locations

Receptor Location	Location	Measurement
1	Grand Street between Suffolk and Clinton Streets	20-minute spot measurements during AM, MD, PM, and late-night periods
2	Suffolk Street between Grand and Broome Streets	
3	Broome Street between Suffolk and Clinton Streets	
4	Delancey Street between Clinton and Ridge Streets	
5	Suffolk Street between Broome and Delancey Streets	
6	Delancey Street between Essex and Norfolk Streets	
7	Essex Street between Rivington and Delancey Streets	
8	Delancey Street between Norfolk and Suffolk Streets	24-hour continuous measurement

EQUIPMENT USED DURING NOISE MONITORING

Measurements were performed using Brüel & Kjær Sound Level Meters (SLMs) Type 2260 (S/Ns 2001692 and 2375602) and 2270 (S/N 2706757), Brüel & Kjær Sound Level Calibrators Type 4231 (S/Ns 2412436 and 1800102), Brüel & Kjær ½-inch microphones Type 4189 (S/Ns 2021267, 2378182, and 2675523). The Brüel & Kjær SLMs are Type 1 instruments according to ANSI Standard S1.4-1983 (R2006). For all receptor sites the instrument/microphone was mounted at a height of approximately 5 to 6 feet above the ground. Microphones were mounted at least approximately 5 feet away from any large reflecting surfaces. The SLMs were last



Proposed Development Sites

* *Site 7 Would Not Be Redeveloped Under the Proposed Actions*

Study Area Boundary (1/4-Mile Perimeter)

1 *Spot Noise Measurement Location*

8 *24-Hour Noise Measurement Location*

Noise Receptor Locations
Figure 16-1

factory calibrated on July 15, 2010, July 30, 2010, and February 23, 2011, respectively, which are valid for one year after the respective calibration dates. The calibration of the SLMs was field-checked before and after readings using the Brüel & Kjær Type 4231 sound level calibrator with the appropriate adaptors. Measurements at each location were made on the A-scale (dBA). The data were digitally recorded by the sound level meters and displayed at the end of the measurement period in units of dBA. Measured quantities included L_{eq}, L_1, L_{10}, L_{50}, and L_{90} levels. A windscreen was used during all sound measurements except for calibration. All measurement procedures were based on the guidelines outlined in ANSI Standard S1.13-2005.

NOISE SURVEY RESULTS

The results of the measurements of existing noise levels are summarized in **Table 16-6**. The L_{dn} values at receptor locations 1 through 7 were approximated based on the spot measured peak hour values.

Table 16-6
Summary of Measured Existing Noise Levels (in dBA)

Receptor Location	Measurement Location	Maximum L_{10} Value	L_{dn}
1	Grand Street between Suffolk and Clinton Streets	70.9	71.5[1]
2	Suffolk Street between Grand and Broome Streets	61.6	62.3[1]
3	Broome Street between Suffolk and Clinton Streets	65.4	65.5[1]
4	Delancey Street between Clinton and Ridge Streets	70.2	71.9[1]
5	Suffolk Street between Broome and Delancey Streets	65.7	65.8[1]
6	Delancey Street between Essex and Norfolk Streets	77.8	78.2[1]
7	Essex Street between Rivington and Delancey Streets	73.8	72.4[1]
8	Delancey Street between Norfolk and Suffolk Streets	71.9	73.8

Notes: Field measurements were performed on June 14, 15, and 16, 2011.
[1] The L_{dn} values at receptor locations 1 through 7 were approximated based on the spot measured peak hour values.

At all monitoring sites, traffic noise from adjacent streets was the dominant noise source. Measured noise levels are moderate to relatively high and reflect the level of vehicular activity on the adjacent streets. The highest L_{10} noise levels measured in the study area occurred along Delancey Street, ranging from the low to high 70s of dBA. These levels are not unusual for busy urban corridors, and are comparable to noise levels along other heavily trafficked multi-lane streets in New York City.

In terms of the CEQR criteria, the existing noise levels at receptor location 2 would be in the "acceptable" category, the existing noise levels at receptor locations 3 and 5 would be in the "marginally acceptable" category, and existing noise levels at receptor locations 1, 4, 6, 7, and 8 would be in the "marginally unacceptable" category. According to HUD criteria, the existing noise levels at receptor location 2 would be in the "acceptable" category, the existing noise levels at receptor locations 1, 3, 4, 5, 7, and 8 would be in the "normally unacceptable" category, and the existing noise levels at receptor location 6 would be in the "unacceptable" category.

E. NOISE ATTENUATION MEASURES

As shown in **Table 16-3**, the *CEQR Technical Manual* has set noise attenuation quantities for buildings based on exterior $L_{10(1)}$ noise levels in order to maintain interior noise levels of 45 dBA or lower for noise sensitive land uses including residential or hotel uses and 50 dBA for commercial uses. HUD guidelines state that buildings must provide sufficient window/wall attenuation to result in L_{dn} values less than 45 dBA. Based on measured exterior noise levels and these CEQR and HUD criteria, the necessary attenuation for each façade of a development on

each of the proposed development sites has been calculated. For development sites not immediately adjacent to a measurement location, a comparable measurement location was selected to represent the site based on existing traffic volumes along the adjacent street, the size of the adjacent street, and character of the block. The required attenuation levels at each of the development sites are shown in **Table 16-7**.

Table 16-7
Building Attenuation Requirements (in dBA)

Dev. Site	Block	Lot	Facade	Governing Noise Receptor	Attenuation Required for CEQR[1]	Attenuation Required for HUD[1]
			North	6	33	34
			East	7	28	31
			South	3[43]	0[2]	23
1	409	56	West	7	28	31
			North	6	33	34
			East	7	28	31
			South	3[43]	0[2]	23
2	352	1, 28	West	7	28	31
			North	8	28	29
			East	4[43]	0[2]	23
			South	3[43]	0[2]	23
3	346	40	West	7	28	31
			North	8	28	29
			East	4[43]	0[2]	21
			South	3[43]	0[2]	23
4	346	40	West	4[43]	0[2]	23
			North	3[43]	0[2]	23
			East	2[43]	0[2]	20
			South	1[43]	28	27
5	346	40	West	7	28	31
			North	4	28	27
			East	4[43]	0[2]	23
			South	3[43]	0[2]	23
6	347	71	West	4[43]	0[2]	23
			North	3[43]	0[2]	23
			East	3[43]	0[2]	23
			South	3[43]	0[2]	23
8	354	1	West	7	28	31
			North	3[43]	0[2]	23
			East	3[43]	0[2]	23
			South	6	33	34
9	353	44	West	7	28	31
			North	3[43]	0[2]	23
			East	3[43]	0[2]	23
			South	3[43]	0[2]	23
10	354	12	West	7	28	31

Notes:
[1]The CEQR attenuation requirements shown are for residential uses; commercial uses would require 5 dBA less attenuation. HUD attenuation regulations would not apply to commercial uses.
[2]The maximum measured L_{10} is below 70 dBA, and the *CEQR Technical Manual* does not specify minimum attenuation guidance for exterior L_{10} values below this level.
~~[3]This is the minimum window/wall attenuation required to satisfy both CEQR and HUD requirements, where applicable.~~
[3][4]Attenuation requirements based on these locations are adjusted for future increases in traffic with the proposed project (see Appendix D). At all other locations future increases in traffic would be insubstantial.

The attenuation of a composite structure is a function of the attenuation provided by each of its component parts and how much of the area is made up of each part. Normally, a building façade is composed of the wall, glazing, and any vents or louvers for HVAC systems in various ratios of area. To ensure that there would be no potential for significant adverse noise impacts,

prospective developers would be notified of required attenuation measures ~~would be included in~~ through the Request for Proposals (RFPs) to be issued by the City and would be undertaken by the developer(s) selected pursuant to the RFP(s). For sites that may be under the jurisdiction of the City of New York Department of Housing Preservation & Development (HPD), these measures (including the provision for alternate means of ventilation) will be required by HPD through the Land Disposition Agreement (or loan agreements) between HPD and the selected developer(s). The RFP(s) and, for sites that may be under the jurisdiction of HPD, the LDA or loan documents would require that all buildings planned to be constructed on the nine development sites be designed to provide a composite Outdoor-Indoor Transmission Class (OITC) rating greater than or equal to the attenuation requirements listed in **Table 16-7**. The OITC classification is defined by the ASTM International (ASTM E1332-10) and provides a single-number rating that is used for designing a building façade including walls, doors, glazing, and combinations thereof. The OITC rating is designed to evaluate building elements by their ability to reduce the overall loudness of ground and air transportation noise.

By using these design guidelines and adhering to the measures in the RFP and, for sites that may be under the jurisdiction of HPD, the LDA or loan documents, development pursuant to the proposed actions would provide sufficient attenuation to achieve the CEQR interior noise level guideline of 45 dBA L_{10} for residential, community facility, or hotel uses and 50 dBA L_{10} for commercial uses and the HUD interior noise level guideline of 45 dBA L_{dn} for residential and community facility use.

For sites that may be under the jurisdiction of the New York City Economic Development Corporation (NYCEDC), provisions of a contract of sale or long-term lease or other legally binding agreement between NYCEDC and the developer(s) would require that all buildings planned to be constructed on the nine development sites be designed to provide a composite OITC rating greater than or equal to the attenuation requirements listed in **Table 16-7**. By using these design guidelines, development pursuant to the proposed actions would provide sufficient attenuation to achieve the CEQR interior noise level guideline of 45 dBA L_{10} for residential, community facility, or hotel uses and 50 dBA L_{10} for commercial uses and, if HUD project funding is used on a site and requires it, the HUD interior noise level guidance of 45 dBA L_{dn} for residential and community facility use.

F. NOISE LEVELS AT OPEN SPACE AREAS

Noise levels within the new publicly accessible open space proposed for Site 5 would be above 55 dBA $L_{10(1)}$ and slightly above 65 dBA L_{dn}. This exceeds the recommended noise level for outdoor areas requiring serenity and quiet contained in the *CEQR Technical Manual* noise exposure guidelines (see **Table 16-2**) and falls in the "normally unacceptable" category according to HUD exterior noise exposure guidance. In the future with the proposed action, $L_{10(1)}$ values and L_{dn} values at the proposed open space (located on Broome Street between Suffolk and Clinton Streets) would be in the mid 60s dBA. There are no practical and feasible mitigation measures that could be implemented to reduce noise levels to below the respective CEQR and HUD 55 dBA $L_{10(1)}$ and 65 dBA L_{dn} guidelines within the proposed open space. Although noise levels in these new area would be above the guideline noise levels, they would be comparable to noise levels in a number of existing open space areas that are located adjacent to heavily trafficked roadways, including Hudson River Park, Riverside Park, Bryant Park, Fort Greene Park, and other urban open space areas. The guidelines are a worthwhile goal for outdoor areas requiring serenity and quiet. However, due to the level of activity present at most New York City open space areas and parks (except for areas far away from traffic and other typical urban activities) such a relatively low noise level is often not achieved.

G. MECHANICAL EQUIPMENT

In addition, it is assumed that the building mechanical systems (i.e., HVAC systems) would be designed to meet all applicable noise regulations (i.e., Subchapter 5, §24-227 of the New York City Noise Control Code, the New York City Department of Buildings Code) and to avoid producing levels that would result in any significant increase in ambient noise levels. Therefore, the proposed actions would not result in any significant increase in ambient noise levels. ✷