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 passenger car equivalents [PCEs] which would be necessary to cause a 3 dBA increase in noise levels). Furthermore, the proposed school playground would not have a direct line-of-sight to any non-project buildings, and consequently would not be expected to result in a significant noise impact. However, ambient noise levels adjacent to the Project Site were examined in order to address CEQR noise abatement requirements for the Proposed Project based on existing ambient noise levels and noise levels expected to result from daily activities within the proposed school playground. Additionally a vibration study was performed to determine whether the vibration levels resulting from AMTRAK rail activity through the eastern edge of the Project Site are consistent with the proposed residential and school uses that are proposed adjacent to, as well as above (decked over) the rail cut.

PRINCIPAL CONCLUSIONS

The *CEQR Technical Manual* has set building attenuation levels for buildings, based on exterior $L_{10(1)}$ noise levels, in order to maintain interior noise levels of 45 dBA $L_{10(1)}$ or lower for residential and community facility (school) uses. Proposed building facades along West 45th Street, Tenth Avenue, and West 44th Street would require 30 dBA of window-wall attenuation, proposed building facades along the interior school courtyard would require 32 dBA of window-wall attenuation, and proposed building facades along Eleventh Avenue would require 35 dBA of window-wall attenuation.

The proposed buildings would be designed with a composite Outdoor-Indoor Transmission Class (OITC) to meet these attenuation requirements. New residential buildings would include well sealed double-glazed windows and an alternative means of ventilation (PTAC units) in all habitable rooms (i.e., living rooms, bedrooms, and dining rooms) to achieve a maximum interior noise environment of 45 dBA under closed window conditions. The new P.S. 51 would include well sealed double-glazed windows and central air conditioning. With these measures incorporated as part of the Proposed Project, the composite window/wall attenuation would provide sufficient attenuation to achieve the CEQR requirements. In addition, the building mechanical system (i.e., heating, ventilation, and air conditioning systems) would be designed to meet all applicable noise regulations and to avoid producing levels that would result in any significant increase in ambient noise levels. The attenuation requirements for the residential portion of the Proposed Project would be incorporated into the Land Disposition Agreement (LDA) between the New York City Department of Housing Preservation and Development (HPD) and 44th Street Development LLC. The School Construction Authority (SCA) is obligated to comply with the attenuation specifications for the new school per its environmental review requirements under the State Environmental Quality Review Act.

A vibration analysis was undertaken to identify the potential impacts of continued railroad operations through the Project Site on the future residents and students of the new P.S. 51. Vibration measurements were made at two receptor locations—one on West 45th Street between Tenth Avenue and Eleventh Avenue and one located at the center of the railroad overpass on West 44th Street between Tenth and Eleventh Avenues. Based on the measured vibration levels, a properly designed building would not be significantly impacted by vibration.

B. NOISE

CEQR NOISE STANDARDS

The *CEQR Technical Manual* defines attenuation requirements for buildings based on exterior noise level (see **Table 18-1**). Recommended noise attenuation values for buildings are designed to maintain interior noise levels of 45 dBA or lower for residential, community facility and hotel uses, and are determined based on exterior $L_{10(1)}$ noise levels.

Table 18-1
Required Attenuation Values to Achieve Acceptable Interior Noise Levels

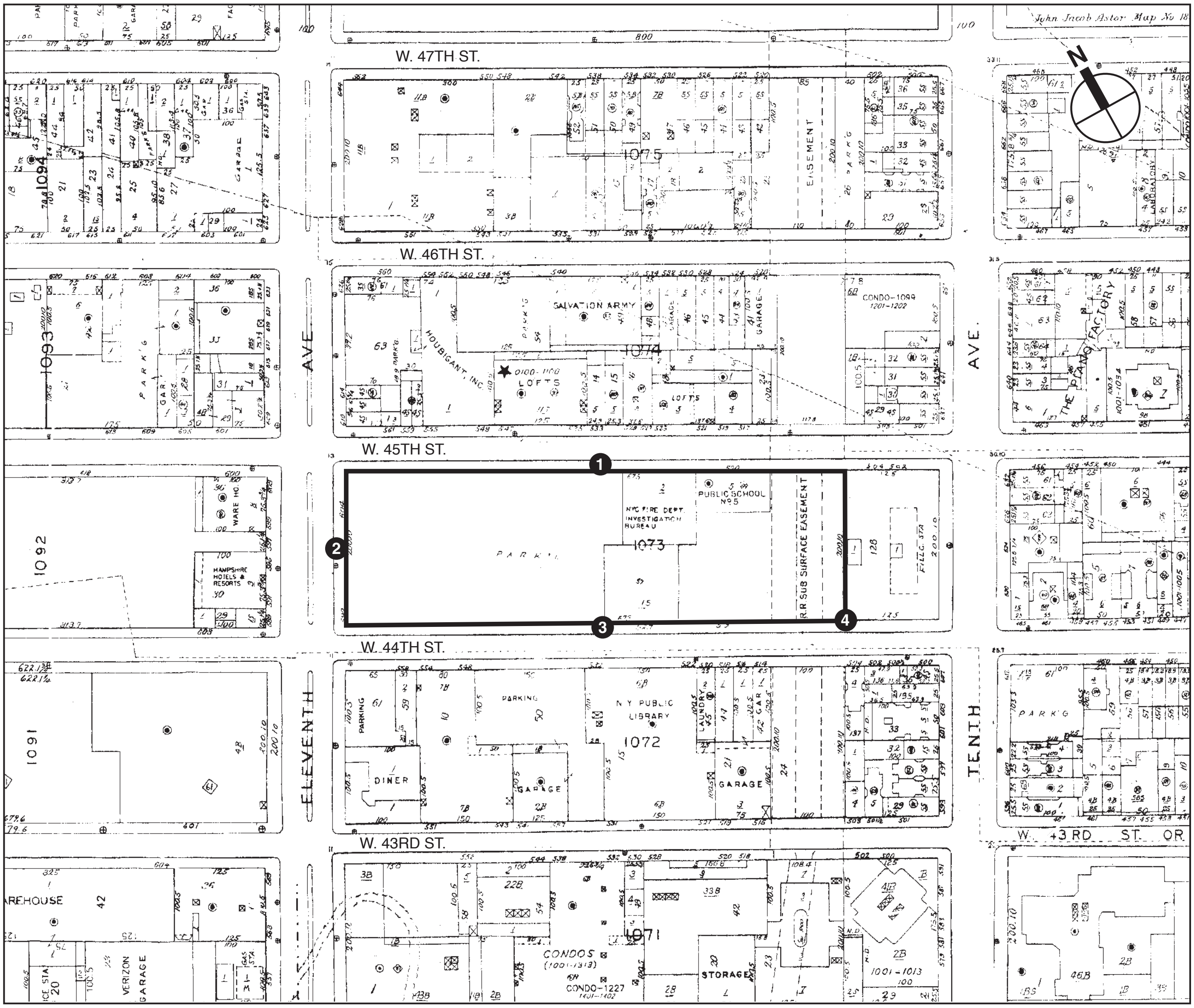
	Marginally Acceptable	Marginally Unacceptable		Clearly Unacceptable		
Noise Level With Proposed Action	$65 < L_{10} \leq 70$	$70 < L_{10} \leq 75$	$75 < L_{10} \leq 80$	$80 < L_{10} \leq 85$	$85 < L_{10} \leq 90$	$90 < L_{10} \leq 95$
Attenuation*	25 dB(A)	(I) 30 dB(A)	(II) 35 dB(A)	(I) 40 dB(A)	(II) 45 dB(A)	(III) 50 dB(A)

Note: ***** 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.
Source: New York City Department of Environmental Protection

EXISTING NOISE LEVELS

Existing noise levels were measured for 20-minute periods logged every 30 seconds during the three weekday peak periods—AM (7:30– 9:30 AM), midday (MD) (noon – 2:00 PM), and PM (4:30 – 6:30 PM) peak periods on November 18, 19, and 20, 2008 at four receptor sites adjacent to the Project Site. Site 1 was located on West 45th Street between 10th and 11th Avenues, Site 2 was located on 11th Avenue between West 44th and West 45th Streets, and Site 3 was located on West 44th Street between Tenth and Eleventh Avenues, and Site 4 was located on West 44th Street adjacent to the AMTRAK rail cut (see **Figure 18-1**).

The instrumentation used for the 20-minute noise measurements was a Brüel & Kjær Type 4189 ½-inch microphone connected to a Brüel & Kjær Model 2260 Type 1 (according to ANSI Standard S1.4-1983) sound level meter. This assembly was mounted at a height of five feet above the ground surface on a tripod and at least six feet away from any large sound-reflecting surface to avoid major interference with sound propagation. The meter was calibrated before and after readings with a Brüel & Kjær Type 4231 sound-level calibrator using the appropriate adaptor. Measurements at each location were made on the A-scale (dBA). The data were digitally recorded by the sound level meter 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}. A windscreen was used during all sound measurements except for calibration. All measurement procedures conformed to the requirements of ANSI Standard S1.13-2005. The results of the measurements of existing noise levels are summarized in **Table 18-2**.



Project Site Boundary

❶ *Noise Receptor*

Noise Receptor Locations

Figure 18-1

Table 18-2
Existing Noise Levels at Sites 1, 2, 3, and 4 (in dBA)

Site	Measurement Location	Time	L_{eq}	L_1	L_{10}	L_{50}	L_{90}
1	West 45th Street between 10th and 11th Avenues	AM	67.7	75.1	71.4	65.1	62.7
		MD	68.2	74.5	72.1	65.9	63.9
		PM	67.1	74.4	71.2	64.3	62.0
2	11th Avenue between West 44th and West 45th Streets	AM	72.7	78.6	76.7	70.7	67.6
		MD	70.6	76.6	73.7	69.1	66.4
		PM	69.4	74.0	72.1	68.4	66.4
3	West 44th Street between 10th and 11th Avenues	AM	67.6	74.0	71.0	65.6	63.4
		MD	68.9	74.2	71.8	67.2	65.6
		PM	66.0	70.6	68.0	65.3	63.8
4	West 44th Street Adjacent to Train Tracks	AM	68.2	73.5	71.2	67.0	64.3
		MD	67.1	72.9	70.3	65.7	63.1
		PM	66.7	71.9	69.5	65.6	63.9

Note: Field measurements were performed by AKRF, Inc. on November 18, 19, and 20, 2008.

At all monitoring sites, traffic noise was the dominant noise source. Although Site 4 is located adjacent to the rail cut, traffic noise was the dominant source at this location since rail activity was infrequent, of short duration, and partially buffered by the below-grade location of the rail cut. Measured noise levels are relatively high and reflect the level of vehicular activity on the adjacent streets. In terms of the CEQR criteria, the existing noise levels at Site 1, 2, 3, and 4 would be in the “marginally unacceptable” category.

ATTENUATION MEASURES

As shown in **Table 18-1**, 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 residential, community facility, and hotel uses. The maximum existing L_{10} value measured at any of the noise measurement sites was 76.7 dBA. According to measurements made at a series of comparable New York City school playgrounds for the New York City School Construction Authority (SCA)[1], the maximum expected L_{10} resulting from the proposed playground operations would be approximately 75 dBA at the playground boundary.

Proposed building facades bordering West 45th Street, Tenth Avenue, and West 44th Street would require 30 dBA of attenuation, proposed building facades bordering the interior school courtyard would require 32 dBA of attenuation, and proposed building facades bordering Eleventh Avenue would require 35 dBA of attenuation. **Figure 18-2** illustrates the attenuation requirements for the Proposed Project.

The proposed buildings would be designed with a composite Outdoor-Indoor Transmission Class (OITC) to meet these attenuation requirements. New residential buildings would include well sealed double-glazed windows and alternative means of ventilation (PTAC units). In addition, the building mechanical system (i.e., heating, ventilation, and air conditioning systems) would be designed to meet all applicable noise regulations and to avoid producing levels that would result in any significant increase in ambient noise levels. These attenuation measures would be incorporated into the LDA between HPD and 44th Street Development LLC.

[1] SCA Playground Noise Study, Allee King Rosen & Fleming, Inc., October 23, 1992.

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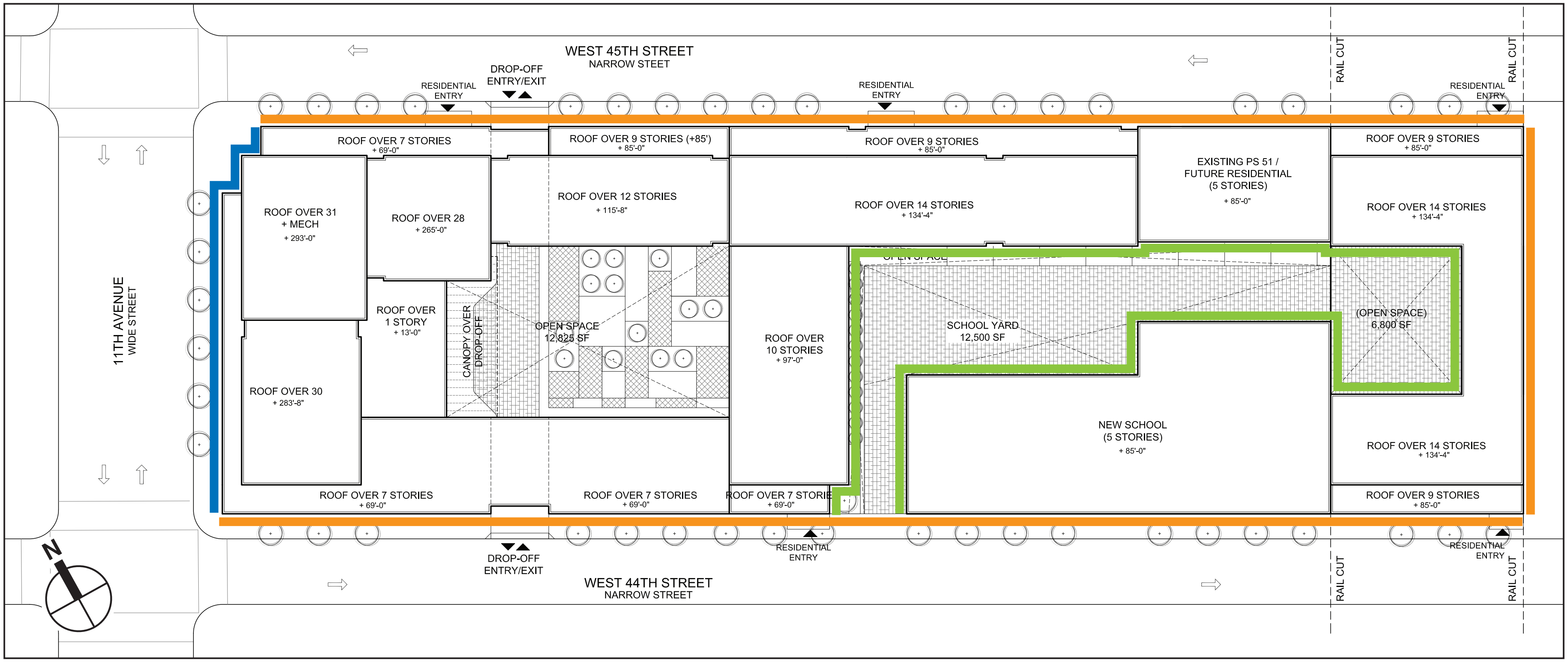


Composite Window/Wall Attenuation Required

30 dBA

32 dBA

35 dBA

Building Attenuation by Façade

Figure 18-2

The new P.S. 51 would contain well sealed double-glazed windows and central air conditioning. With these measures, the composite window/wall attenuation would provide sufficient attenuation to achieve the CEQR requirements. In addition, the building mechanical system (i.e., heating, ventilation, and air conditioning systems) would be designed to meet all applicable noise regulations and to avoid producing levels that would result in any significant increase in ambient noise levels. (SCA) is obligated to comply with the attenuation specifications for the new school per its environmental review requirements under the State Environmental Quality Review Act and would incroproate these measures into the design of the new school building.

C. VIBRATION

Fixed railway operations have the potential to produce high vibration levels, since railway vehicles contact a rigid steel rail with steel wheels. Train wheels rolling on the steel rails create vibration energy that is transmitted into the track support system. The amount of vibration energy is strongly dependent on such factors as how smooth the wheels and rails are and the vehicle suspension system. The vibration of the track structure “excites” the adjacent ground, creating vibration waves that propagate through the various soil and rock strata to the foundations of nearby structures. As the vibration propagates from the foundation through the remaining structures, certain resonant, or natural, frequencies of various components of the structure may be excited.

The effects of ground-borne vibration may include discernable movement of structural floors, rattling of windows, and shaking of items on shelves or hanging on walls. In extreme cases, the vibration can cause architectural and/or structural damage. The vibration of floors and walls may cause perceptible vibration, rattling of such items as windows or dishes on shelves. The movement of structural surfaces and objects within a building can also result in a low-frequency rumble noise. The rumble is the noise radiated from the motion of the room surfaces, even when the motion itself cannot be felt. This is called ground-borne noise.

The vibration study consisted of the following elements:

(1) Vibration monitoring locations were selected at discrete locations on the Project Site;

(2) Field measurements were made at each of the vibration monitoring locations on a typical weekday to determine vibration levels occurring during and between train pass-bys;

(3) Appropriate criteria were selected for assessing whether vibration levels at the Project Site would be appropriate for residential and school uses;

(4) The results of the vibration monitoring program were compared to the aforementioned criteria to determine if the existing vibration levels due to normal train operations at the Project Site would result in conditions not suitable for the proposed uses.

VIBRATION FUNDAMENTALS

Vibrations consist of rapidly fluctuating motions in which there is no “net” movement. When an object vibrates, any point on the object is displaced from its initial “static” position equally in both directions so that the average of all its motion is zero. Any object can vibrate differently in three mutually independent directions; vertical, horizontal, and lateral. It is common to describe vibration levels in terms of velocity, which represents the instantaneous speed at a point on the object that is displaced.

EFFECT OF PROPAGATION PATH

Vibrations are transmitted from the source to the ground, and propagate through the ground to the receiver. Soil conditions have a strong influence on the levels of ground-borne vibration. Stiff soils, such as some clay and rock, can transmit vibrations over substantial distances. Sandy soils, wetlands, and groundwater tend to absorb movement and thus reduce vibration transmission. Because subsurface conditions vary widely, measurement of actual vibration conditions, or transfer mobility, at the site can be the most practical way to address the variability of propagation conditions.

VIBRATION DESCRIPTORS

Vibration consists of rapidly fluctuating motions with an average motion of zero. Several descriptors can be used to quantify vibration amplitude.

Peak Particle Velocity

Peak particle velocity (PPV) is expressed in units of inches per second (in/sec). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration signal. PPV is an appropriate descriptor for evaluating the potential for architectural damage due to vibration since it is often related to the stresses that are experienced by structures.

Vibration Decibels

In order to express vibration levels in such a way that they can be more easily used to evaluate the human response, the time-averaged root mean square (rms) amplitude metric is used. The rms is defined as the square root of the average of the squared amplitude of the vibration signal. The rms metric can also be expressed using decibel notation, with VdB representing vibration decibels. The reference vibration level used for this analysis was $1x10^{(-6)}$ in/sec, which is the accepted reference vibration level in the United States.

VIBRATION CRITERIA

Various governmental agencies have criteria regarding architectural and structural damage, as well as annoyance and acceptability of vibration.

In general, most of the criteria specify that for a PPV less than approximately 0.12 inches per second the potential for architectural damage due to vibration is unlikely, for a PPV from approximately 0.12 inches per second to 0.50 inches per second there is potential for architectural damage due to vibration, and for a PPV greater than approximately 0.50 inches per second the potential for architectural damage due to vibration is very likely.

With regard to human response and annoyance to vibration, **Table 18-3** contains criteria which provide a description of the human response to different levels of ground-borne vibration. As shown in the table, vibration levels of less than 65 VdB are generally below the level of human perception and would not be expected to result in any adverse impacts on occupants of buildings subject to vibrations.

IMPACT DEFINITION

For purposes of assessing the impact of vibrations caused by normal train operations on the Proposed Actions, the 65 VdB level was used as a guideline for evaluating the results of the vibration measurements. Vibrations levels less than 65 VdB would not be expected to be perceived by most humans.

Table 18-3
Human Response to Different Levels of Ground-Bourne Vibration

Vibration Level	Human Response
65 VdB	Approximate threshold of perception for most humans
75 VdB	Approximate dividing line between barely perceptible and distinctively perceptible; many people find vibration at this level annoying
85 VdB	Vibration acceptable only if there are an infrequent number of events per day
Sources: U.S. Dept of Transportation, FTA, *Transit Noise and Vibration Impact Assessment,* May 2006.	

EXISTING VIBRATION DETERMINATION METHODOLOGY

VIBRATION RECEPTOR LOCATIONS

Vibration measurements were made at two (2) receptor locations around the Project Site over the train tracks. The receptors were chosen to provide a comprehensive geographic coverage of vibration levels due to normal train operations on the tracks immediately below the Project Site. Receptor 1 was located at the center of the overpass on West 45th Street between Tenth and Eleventh Avenues. Receptor 2 was located at the center of the overpass on West 44th Street between Tenth Avenue and Eleventh Avenue. The location of these receptor sites is shown in **Figure 18-3**.

VIBRATION MONITORING

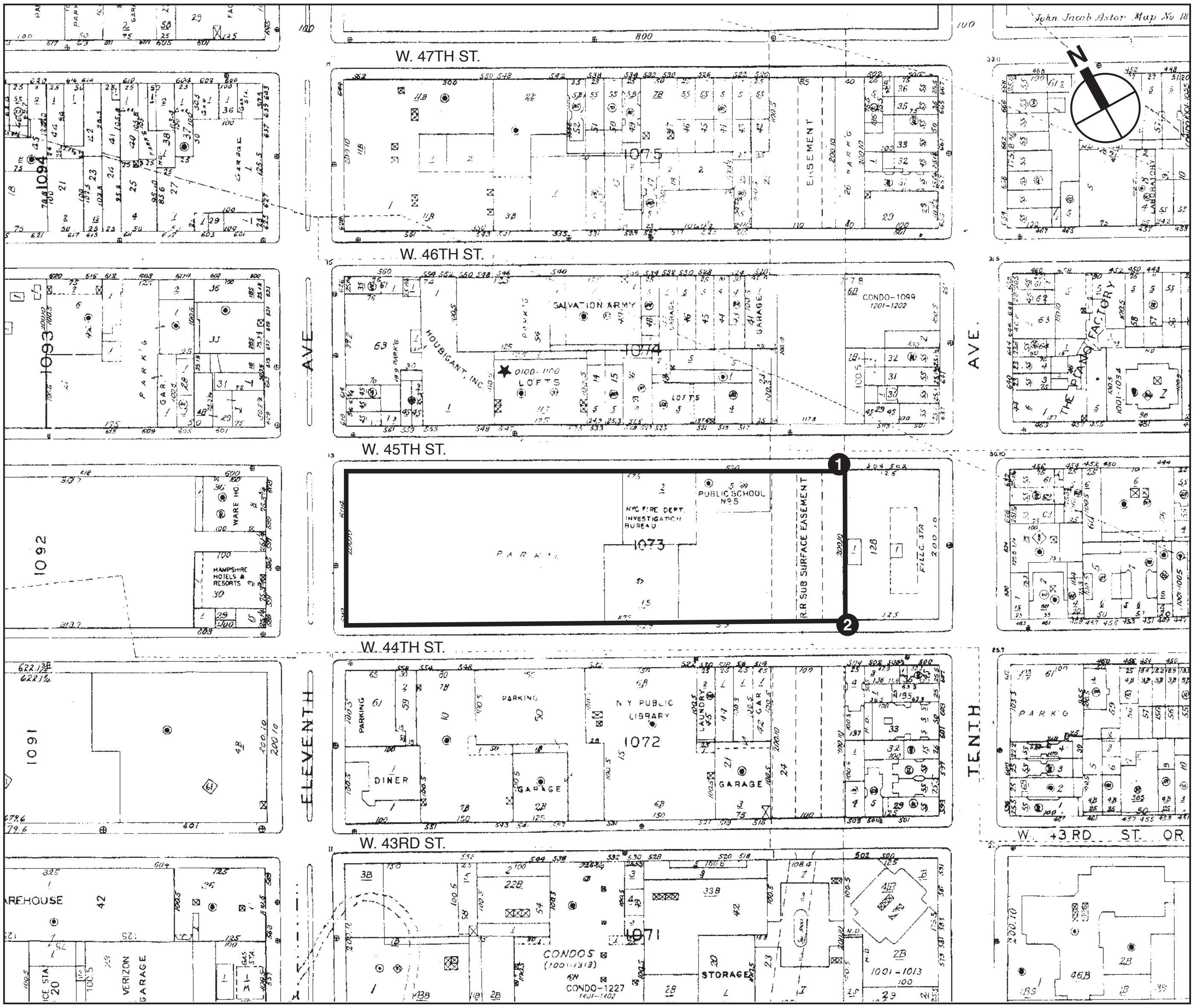
Measurements were made at both of the receptor locations indicated above. At each receptor, a measurement was performed during which no trains passed, in order to measure the background vibration, and a measurement was performed during which both a northbound train and a southbound train passed. The measurements were performed on December 3, 2008. Each of the vibration measurements were approximately between 10 and 20 minutes in duration, depending on train activity. For all measurements, the vibration transducer was placed on the sidewalk exactly over an overpass support column, roughly half-way between the street and the overpass fence. A sandbag was used to eliminate transducer slippage during the measurements.

EQUIPMENT USED DURING VIBRATION MONITORING

Measurements were performed using Nomis Seismometer Type Mini Supergraph X2-G. The Mini Supergraph consisted of a 3-axis velocity transducer, an air over-pressure transducer, and a data acquisition and storage device. The transducer can measure velocities on three mutually perpendicular axes (V_x, V_y, V_z) corresponding to a radial, vertical, and transverse component at a linear frequency response range from 2 Hz to 400 Hz. The Mini Supergraph was calibrated to meet ISO-9000 requirements on May 8, 2008.

RESULTS OF BASELINE MEASURMENTS

The maximum vibration levels due to background activity (i.e., traffic on the adjacent street, people on the sidewalk, etc.) and the maximum vibration levels due to normal train operations at the receptor locations are shown in **Table 18-4**. Based on the measured levels, peak background and train passby vibration levels are not significantly different; both activities produce relatively low vibration levels, and train operations do not seem to be a significant source of vibration at these locations.



Project Site Boundary

1 Vibration Receptor

0 200 400 FEET

SCALE

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Vibration Receptor Locations

Figure 18-3

Table 18-4
Vibration Monitoring Results

Receptor	Vibration Source	Maximum PPV (in/sec)	Ground Borne Vibration (VdB*)	Impact?
1	Background	0.040	41	No
	Trains	0.035	40	No
2	Background	0.020	39	No
	Trains	0.015	38	No

Notes:
* Vibration levels were converted from PPV to VdB using a crest factor of 4, which is consistent with rail operations. Though the measured PPV values show that the rail operations were not a significant source of vibration at these locations, these VdB values represent what would result if they had been.
Field measurements were performed by AKRF, Inc. on December 3, 2008.

The maximum measured PPV vibration level was 0.040 inches per second at receptor location 1, during a period with no train pass-bys. This demonstrates that the vibration caused by train pass-bys is less than the background vibration level and would thus be imperceptible. The maximum measured vibration level at the project site is well below the 0.12 in/sec threshold for architectural or structural damage at even the most vibration-sensitive buildings, which the Proposed Actions would not be. The maximum ground-borne vibration was measured as 41 VdB, which was also well below the 65 VdB threshold of human perception.

CONCLUSIONS

Based upon the measured vibration levels, a properly designed building constructed by modern methods and materials standards, would not be at risk of vibration-induced damage. Thus, vibration levels would not be expected to result in result in any significant adverse impacts on the Proposed Project. ✷