4.7.1 INTRODUCTION

This chapter analyzes the effects of the Preferred Alternative on ambient noise and vibration levels. The chapter is divided in two main sections: section 4.7.2, which examines the potential for airborne noise impacts; and section 4.7.3, which examines the potential for vibration and ground-borne noise impacts. In addition, a third section examines the potential for noise impacts from the proposed Project's mechanical equipment and emergency ventilation equipment. The noise and vibration analyses were performed using procedures consistent with practices of the FTA, which are followed by the FRA.

A quantitative analysis of the mobile source noise levels and potential for impacts from vibrations that would result from the Preferred Alternative was conducted. Based on this analysis, the Preferred Alternative would not result in significant adverse noise or vibration impacts, as was concluded in the 2006 FEIS.

4.7.2 AIRBORNE NOISE

NOISE FUNDAMENTALS AND TERMINOLOGY

Quantitative information on the effects of airborne noise on people is well documented. If sufficiently loud, noise may adversely affect people in several ways. For example, noise may interfere with human activities, such as sleep, speech communication, and tasks requiring concentration or coordination. It may also cause annoyance, hearing damage, and other physiological problems. Although these effects on people have been studied extensively on an average or statistical basis, it should be noted that all the stated effects of noise on people can vary greatly with each individual. Several noise scales and rating methods are used to quantify the effects of noise on people. These scales and methods consider such factors as loudness, duration, time of occurrence, and changes in noise level with time.

"A"-WEIGHTED SOUND LEVEL (dBA)

Noise is typically measured in units called decibels (dB), which are ten times the logarithm of the ratio of the sound pressure squared to a standard reference pressure squared. Because loudness is important in the assessment of the effects of noise on people, the dependence of loudness on frequency must be taken into account in the noise scale used in environmental assessments. Frequency is the rate at which sound pressures fluctuate in a cycle over a given quantity of time, and is measured in Hertz (Hz), where 1 Hz equals 1 cycle per second. Frequency defines sound in terms of pitch components. The dependence of perceived loudness on frequency is accounted for by using a weighting network that simulates the response of the human ear. For most noise assessments, the A-weighted sound pressure level, expressed in units of dBA, is used, due to its widespread recognition and its close correlation with perception. In this analysis, all measured noise levels are reported in dBA or A-weighted decibels. Common noise levels in dBA are shown in Table 4.7-1.

Table 4.7-1
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	
Busy city street, loud shout	80
Busy traffic intersection	
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	
Background noise in an office	50
Suburban areas with medium density transportation	
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.
Source: Cowan, James P. Handbook of Environmental Acoustics. Van Nostrand Reinhold, New York, 1994. Egan, M. David, Architectural Acoustics. McGraw-Hill Book Company, 1988.

COMMUNITY RESPONSE TO CHANGES IN NOISE LEVELS

The average ability of an individual to perceive changes in noise levels is well documented (see Table 4.7-2). Generally, changes in noise levels of less than 3 dBA are barely perceptible to most listeners, whereas 10 dBA changes are normally perceived as doublings (or halvings) of noise levels. These guidelines permit estimation of an individual's probable perception of changes in noise levels.

Table 4.7-2
Average Ability to Perceive Changes in Noise Levels

Change (dBA)	Human Perception of Sound
2-3	Barely perceptible
5	Readily noticeable
10	A doubling or halving of the loudness of sound
20	A “dramatic change”
40	Difference between a faintly audible sound and a very loud sound

Source: Bolt Beranek and Newman, Inc., *Fundamentals and Abatement of Highway Traffic Noise*, Report No. PB-222-703. Prepared for Federal Highway Administration, June 1973.

NOISE DESCRIPTORS USED IN IMPACT ASSESSMENT

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 over extended periods have been developed. One way of describing fluctuating sound is to describe the fluctuating noise 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 as $L_{eq(24)}$), 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 sometimes used to indicate noise levels that are exceeded 1, 10, 50, 90 and x percent of the time, respectively. Discrete event peak levels are given as L_1 levels.

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. 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 relationship between L_{eq} and exceedance levels has been used in this analysis to characterize the noise sources and to determine the nature and extent of their impact at all receptor locations.

A descriptor for cumulative 24-hour exposure is the day-night sound level, abbreviated as L_{dn}. This is a 24-hour measure that accounts for the moment-to-moment fluctuations in A-weighted noise levels due to all sound sources during 24 hours, combined. Mathematically, the L_{dn} noise level is the average of all $L_{eq(1)}$ noise levels over a 24-hour period, where nighttime noise levels (10 PM to 7 AM) are increased by 10 dBA before averaging.

For the purposes of this project, the maximum 1-hour equivalent sound level ($L_{eq(1)}$) or the day-night sound level (L_{dn}) have been selected as the noise descriptors to be used in the noise impact evaluation depending on land use category as described in the FTA guidance manual (which is described below) and Table 4.7-3.

FEDERAL TRANSIT ADMINISTRATION IMPACT NOISE CRITERIA

Noise levels associated with the operation of the Preferred Alternative are subject to the noise standards defined by the FTA. These standards are typically used for FTA, and FRA projects, as well as other projects where the primary noise sources are transit-related.

In May 2006, FTA issued its report, *Transit Noise and Vibration Impact Assessment*, as a guideline for the evaluation of noise and vibration levels resulting from mass transit projects, and the assessment of impacts that result. The noise analysis methodology in the FTA report determines operational noise impacts that result from mass transit projects based on peak-hour $L_{eq(1)}$ and 24-hour L_{dn} noise levels, depending on the land use category of the affected areas near the mass transit project. As described in Table 4.7-3, categories 1 and 3, which include land uses that are noise-sensitive, but where people do not sleep, require examination of a 1-hour L_{eq} for the noisiest peak hour. Category 2, which includes residences, hospitals, and other locations where nighttime sensitivity to noise is very important, use of L_{dn} is required.

Table 4.7-3
FTA's Land Use Category and Metrics for Transit Noise Impact Criteria

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor $L_{eq(h)}$	Tracts of land in which quiet is an essential element in the intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use.
2	Outdoor $L_{dn(h)}$	Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels, where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor $L_{eq(h)}$	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and churches, where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material. Buildings with interior spaces where quiet is important—such as medical offices, conference rooms, recording studios, and concert halls—fall into this category. Places for meditation or study associated with cemeteries, monuments, museums. Certain historical sites, parks, and recreational facilities are also included.

Note: L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity.
Source: *Transit Noise and Vibration Impact Assessment,* FTA, May 2006.

Using these noise descriptors, the FTA impact criteria are keyed to the noise level generated by the project (called "project noise exposure") in locations of varying ambient noise levels. As shown in Figure 4.7-1, two types of impacts are defined for each land use category, depending on existing ambient noise levels. Thus, where existing noise levels are 40 dBA, for land use categories 1 and 2, the respective L_{eq} and L_{dn} noise exposures from the project would create impacts if they were above approximately 50 dBA, and would create severe impacts if they were above approximately 55 dBA. For category 3, a project noise exposure level above approximately 55 dBA would be considered an impact, and above approximately 60 dBA would be considered a severe impact. The difference between "severe impact" and "impact" is that the former denotes a change in noise level that a significant percentage of people would find annoying while the latter is indicative of a change in noise level noticeable to most people but not necessarily sufficient to result in strong adverse reactions from the community.

NOISE ANALYSIS METHODOLOGY

A detailed noise analysis was performed to predict the effects of noise from vehicular traffic within the adjacent study area, using procedures consistent with FTA practices. Since existing and future no build traffic volumes were both higher (see Chapter 4.5: "Transportation"), the vehicular traffic conditions and vehicular traffic data in the 2006 FEIS were conservatively used for this analysis. The detailed analysis was performed as follows:

- Determine receptor locations on noise-sensitive land uses within the adjacent study area where the maximum project noise levels would be likely to occur;
- Noise measurements were taken at each receptor site to determine exiting ambient noise levels;
- Where necessary these measured values were supplemented by calculated values obtained using proportional modeling techniques;
- Existing L_{dn} values were calculated based upon existing $L_{eq(1)}$;

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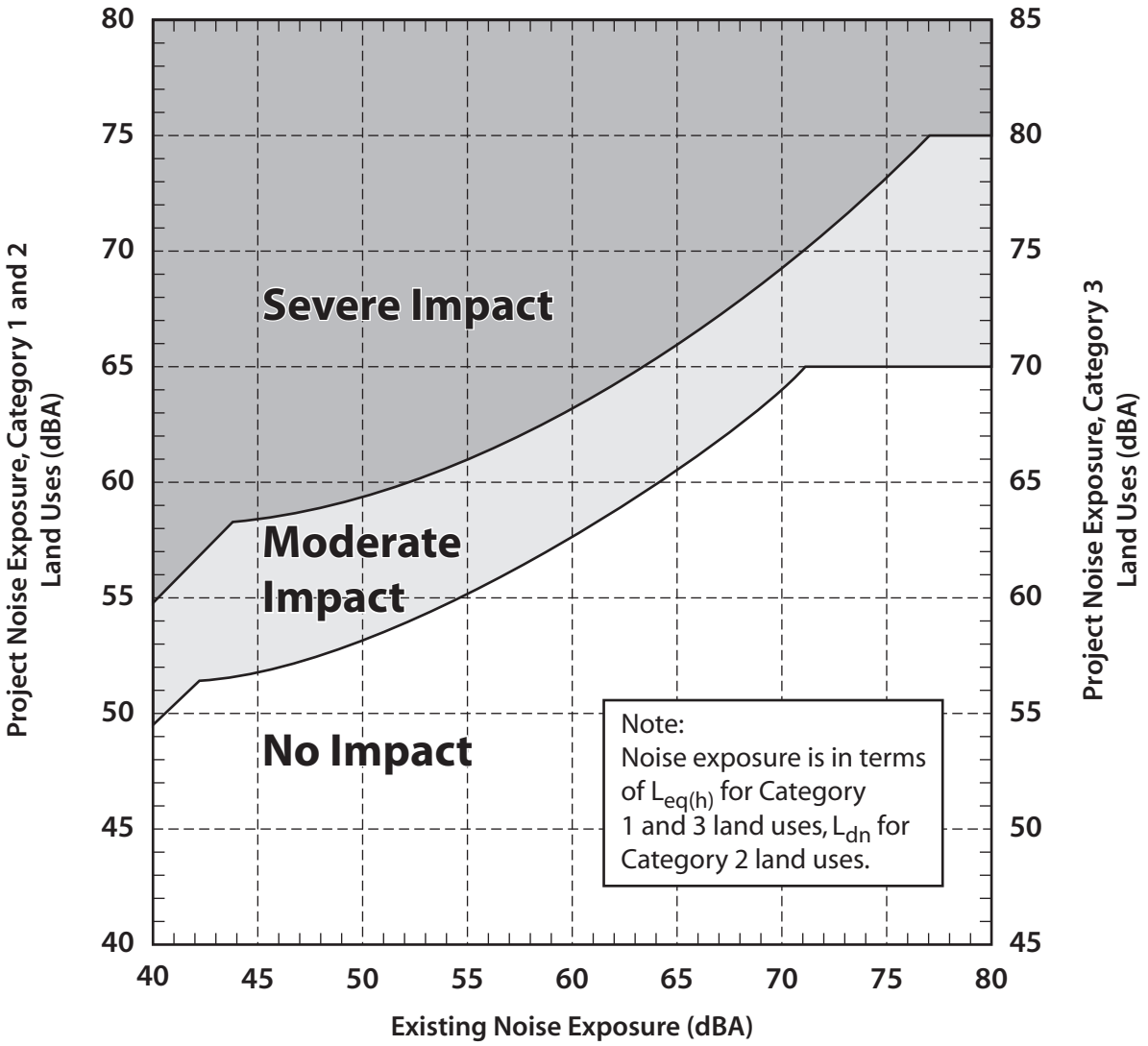

Source: Transit Noise and Vibration Impact Assessment, FTA-VA-90-1003-06, May 2006

FTA's Noise Impact Criteria for Transit Projects
Figure 4.7-1

- Project-generated noise levels for project alternatives were calculated using the equations contained in Table 6-6 of the FTA Manual;
- The future $L_{eq(1)}$ and L_{dn} noise levels were calculated by adding project-generated noise levels to existing noise levels at each receptor site location; and
- Project impacts at each receptor site were determined based upon the FTA impact criteria.

EXISTING CONDITIONS

PROJECT SITE DESCRIPTION

The Farley Complex is located in West Midtown, within the Special Hudson Yards District. The Farley Complex occupies a superblock over the Pennsylvania Station (Penn Station) rail yard between Eighth and Ninth Avenues from West 31st to West 33rd Streets. The project site also includes the Development Transfer Site, which is located on the western portion of the block between Seventh and Eighth Avenues from West 33rd to 34th Streets. The proposed Project is located in an area with predominantly commercial uses, with high traffic volumes. Many of the streets are feeder streets to and from the Lincoln Tunnel.

SELECTION OF NOISE RECEPTOR LOCATIONS

Based upon a screening analysis, twelve noise receptor locations were chosen on the streets adjacent to the Project site (see Figure 4.7-2); these receptor locations are the same as those assessed in the 2006 FEIS. Site 1 was located on West 33rd Street between Eighth Avenue and Ninth Avenue, Site 2 was located on Ninth Avenue between West 31st Street and West 33rd Street, Site 3 was located on West 31st Street between Eighth Avenue and Ninth Avenue, Site 4 was located on West 33rd Street between Ninth Avenue and Tenth Avenue, Site 5 was located on the median of the Lincoln Tunnel access roadway between West 31st Street and West 33rd Street, Site 6 was located on 31st Street between Ninth Avenue and Tenth Avenue, Site 7 was located on Eighth Avenue between West 31st Street and West 33rd Street, Site 8 was located on West 33rd Street between Seventh Avenue and Eighth Avenue, Site 9 was located on Seventh Avenue between West 31st Street and West 33rd Street, Site 10 was located on West 31st Street between Seventh Avenue and Eighth Avenue, Site 11 was located on Eighth Avenue between West 33rd Street and West 34th Street, and Site 12 was located on West 34th Street between Seventh Avenue and Eighth Avenue. These sites are representative of other locations in the immediate area, and are generally the locations where maximum project impacts would be expected. These sites were used to assess the potential impacts due to project-generated traffic noise.

DETERMINING EXISTING NOISE LEVELS

Existing $L_{eq(1)}$ noise levels for four time periods on weekday and weekend (AM, midday [MD], PM, and late night [LN]) were determined and, where appropriate, L_{dn} values were calculated based upon these four values (see Appendix 4, Table 1.4 for weekday periods and Table 1.5 for weekend periods). With the exception of the weekend AM and PM analysis time periods, at each of receptors, $L_{eq(1)}$ noise levels were determined by field measurements (see Appendix 4.1). Weekday daytime noise measurements were made on November 26, 2002, January 30, 2003, April 14, 2005, and September 14, 2005. Weekday late-night noise measurements were made on June 7 and 8, 2007, and January 8 and 9, 2008. Weekend midday noise measurements were made on May 14, and September 17, 2005. Weekend late-night noise measurements were made on June 17, 2007, February 24, 2008, and March 9, 2008. Existing $L_{eq(1)}$ noise levels for the weekend AM and PM periods were calculated based upon existing levels measured during the

Farley Complex

Development Transfer Site

1 Noise Receptor Location

Noise Receptor Locations
Figure 4.7-2

weekend midday period and corresponding traffic data, using a proportional technique. This technique was used to convert temporal traffic volume data, along with measured midday noise levels into passenger car equivalents (PCEs) to determine noise levels during the weekend AM and PM periods, when no measured data was available.

At each of the 12 receptor sites, 20-minute spot measurements were taken during the four weekday periods and two weekend periods that reflect peak hours of trip generation: AM weekday (8 AM to 9 AM), midday (MD) weekday (12 Noon to 1:30 PM), PM weekday (5 PM to 6:30 PM), late-night (10 PM to 11:30 PM), and midday (MD) weekend (11:30 AM to 2:30 PM).

EQUIPMENT USED DURING NOISE MONITORING

The instrumentation used for the 20-minute noise measurements was a Brüel & Kjaer Type 4176/4189 ½-inch microphone connected to a Brüel & Kjaer Model 2260 Type 1 (according to ANSI Standard S1.4) sound level meter. This assembly was mounted at a height of 5 feet above the ground surface on a tripod and at least 6 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 & Kjaer 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. Only traffic related noise was measured; noise from other sources (e.g. emergency sirens, aircraft flyovers, etc.) was excluded from the measured noise levels. Weather conditions were noted to ensure a true reading as follows: wind speed under 12 mph; relative humidity under 90 percent; and temperature above 14°F and below 122°F. All measurement procedures were based on the guidelines of ANSI Standard S1.13.

EXISTING NOISE LEVELS AT NOISE RECEPTOR LOCATIONS

The existing $L_{eq(1)}$ noise levels for the twelve receptor locations are summarized in Table 4.7-4. Traffic was the dominant noise source at all twelve sites, and the relatively high noise levels shown in the Table 4.7-4 reflect the high level of vehicular activity on the adjacent streets in the area.

THE NO ACTION ALTERNATIVE

Future noise levels without the Preferred Alternative (i.e., for the No Action Alternative) at 12 noise receptor sites were calculated using FTA guidance manual procedures and formulas. The results are shown in Table 4.7-5 (for detailed calculations see Appendices 1.6 & 1.7). To be conservative, at receptor sites for land use category 3 (i.e., sites 2, 3, 5, 7, 8 and 11) the analysis is based upon $L_{eq(1)}$ noise levels on the AM peak period. In general, this time period would have the maximum traffic increments and consequently produce the maximum increments and impacts in the No Action Alternative. At receptor sites for land use category 2 (i.e., sites 1, 4, 6, 9 and 12) L_{dn} noise levels were calculated based upon $L_{eq(1)}$ noise levels for the AM, MD, PM, and late night time periods.

As shown in Table 4.7-5, the maximum change in noise levels in the No Action Alternative would be less than 1 dBA compared to the existing noise levels. Changes of these magnitudes would be barely perceptible and insignificant. Based upon FTA impact criteria, these changes would not result in any impacts under the No Action Alternative at any of the 12 receptor sites.

Table 4.7-4
Existing Noise Levels (in dBA)

Receptor Site	Measurement Location	FTA Land Use[1]	Time	Weekday $L_{eq(1)}$	Weekend $L_{eq(1)}$
1	West 33rd Street between Eighth and Ninth Avenues	Category 2	AM	72.9	63.1
			MD	69.8	64.1
			PM	69.4	63.5
			LN	65.0	61.7
2	Ninth Avenue between West 31st and West 33rd Streets	Category 3	AM	76.0	68.8
			MD	73.5	69.8
			PM	73.5	69.2
			LN	67.5	68.3
3	West 31st Street between Eighth and Ninth Avenues	Category 3	AM	75.2	64.5
			MD	71.3	65.5
			PM	70.8	64.9
			LN	67.7	68.3
4	West 33rd Street between Ninth and Tenth Avenues	Category 2	AM	68.8	66.1
			MD	67.5	67.1
			PM	68.4	66.5
			LN	65.0	61.7
5	Tunnel access roadway (Medium of roadway) between West 31st and West 33rd Streets	Category 3	AM	76.1	75.9
			MD	76.6	76.9
			PM	82.6	76.3
			LN	69.3	66.4
6	West 31st Street between Ninth and Tenth Avenues	Category 2	AM	71.4	69.0
			MD	68.4	70.0
			PM	69.3	69.4
			LN	62.0	63.5
7	Eighth Avenue between West 31st and West 33rd Streets	Category 3	AM	71.7	68.1
			MD	72.4	69.1
			PM	70.7	68.5
			LN	66.8	66.2
8	West 33rd Street between Seventh and Eighth Avenues	Category 3	AM	66.9	65.0
			MD	66.9	66.0
			PM	68.8	65.4
			LN	64.7	65.6
9	Seventh Avenue between West 31st and West 33rd Streets	Category 2	AM	71.2	69.1
			MD	70.8	70.1
			PM	71.5	69.5
			LN	73.5	70.7
10	West 31st Street between Seventh and Eighth Avenues	Category 3	AM	68.4	66.4
			MD	68.2	67.4
			PM	68.3	66.8
			LN	65.0	61.7
11	Eight Avenue between West 33rd and West 34th Streets	Category 3	AM	72.5	71.5
			MD	73.3	72.5
			PM	72.8	71.9
			LN	73.6	71.7
12	West 34th Street between Seventh and Eighth Avenues	Category 2	AM	75.1	68.0
			MD	72.3	69.0
			PM	74.9	70.1
			LN	73.6	68.2

Note: Field measurements were performed by AKRF, Inc. on November 26, 2002, January 30, 2003, April 14, May 14, and September 14 and 17, 2005, June 7, 8 and 17, 2007, and January 9, February 24, and March 9, 2008. $L_{eq(1)}$ values for the weekend AM and PM periods were calculated from existing levels measured on the weekend midday period.

[1] Definition of land use categories based on FTA Manual, see Table 3-2.

Table 4.7-5
Noise Levels with the No Action Alternative(in dBA)

Receptor Site	FTA Land Use Category / Noise Descriptor[1]	Date	Existing Ambient Noise Level	FTA Allowable Project Noise Exposure Level		Predicted Project Noise Exposure Level[2]	Result	Build Noise Level[3]	Change
				Impact	Severe Impact				
1	Cat 2 / Ldn	Weekday	70.8	65.0	70.1	58.3	No Impact	71.0	0.2
		Weekend	66.5	61.8	67.1	54.6	No Impact	66.8	0.3
2	Cat 3 / Leq	Weekday	76.0	70.0	79.0	57.7	No Impact	76.1	0.1
		Weekend	68.8	68.5	73.6	54.2	No Impact	68.9	0.1
3	Cat 3 / Leq	Weekday	75.2	70.0	78.4	54.8	No Impact	75.2	0.0
		Weekend	64.5	65.5	70.9	50.5	No Impact	64.6	0.1
4	Cat 2 / Ldn	Weekday	69.9	64.3	69.4	56.2	No Impact	70.1	0.2
		Weekend	67.4	62.5	67.7	53.3	No Impact	67.6	0.2
5	Cat 3 / Leq	Weekday	76.1	70.0	79.1	45.8	No Impact	76.1	0.0
		Weekend	75.9	70.0	78.9	41.5	No Impact	75.9	0.0
6	Cat 2 / Ldn	Weekday	68.5	63.2	68.5	57.3	No Impact	68.8	0.3
		Weekend	69.7	64.1	69.3	57.5	No Impact	70.0	0.3
7	Cat 3 / Leq	Weekday	71.7	70.0	75.7	57.7	No Impact	71.9	0.2
		Weekend	68.1	67.9	73.2	53.0	No Impact	68.2	0.1
8	Cat 3 / Leq	Weekday	66.9	67.1	72.4	48.2	No Impact	67.0	0.1
		Weekend	65.0	65.8	71.2	47.7	No Impact	65.1	0.1
9	Cat 2 / Ldn	Weekday	77.6	65.0	75.0	60.8	No Impact	77.7	0.1
		Weekend	75.0	65.0	73.2	60.9	No Impact	75.2	0.2
10	Cat 3 / Leq	Weekday	68.4	68.2	73.4	54.9	No Impact	68.6	0.2
		Weekend	66.4	66.7	72.1	49.0	No Impact	66.5	0.1
11	Cat 3 / Leq	Weekday	72.5	70.0	76.3	54.7	No Impact	72.6	0.1
		Weekend	71.5	70.0	75.5	52.8	No Impact	71.5	0.0
12	Cat 2 / Ldn	Weekday	77.9	65.0	75.0	59.7	No Impact	78.0	0.1
		Weekend	74.4	65.0	72.7	58.5	No Impact	74.5	0.1

Notes:
[1] Definition of land use categories and noise descriptor based on FTA Manual, see Table 3-2.
[2] Total project-generated noise level.
[3] Based on logarithmic addition of existing ambient and predicted project noise exposure levels.

THE PREFERRED ALTERNATIVE

Future noise levels with the Preferred Alternative at the 12 noise receptor sites were calculated using the FTA guidance manual procedures and formulas, which are also used by the FRA for noise impact assessments. The results are shown in Table 4.7-6 (detailed calculations see Appendix 3.6 & 3.7). To be conservative, at receptor sites for land use category 3 (i.e., sites 2, 3, 5, 7, 8 and 11) the analysis is based upon $L_{eq(1)}$ noise levels in the AM peak period. In general, this time period would have the maximum traffic increments and consequently produce the maximum project increments and impacts. At receptor sites for land use category 2 (i.e., sites 1, 4, 6, 9 and 12) L_{dn} noise levels were calculated based upon $L_{eq(1)}$ noise levels for the AM, MD, PM, and late night time periods.

As shown in Table 4.7-6, the maximum change in noise levels would be less than 1 dBA compared to the existing noise levels. Changes of these magnitudes would be barely perceptible and insignificant. Therefore, based upon the FTA impact criteria, these changes would not result in any project impacts at any of the 12 receptor sites, as was also concluded in the 2006 FEIS.

Table 4.7-6
Noise Levels with the Preferred Alternative (in dBA)

Receptor Site	FTA Land Use Category / Noise Descriptor[1]	Date	Existing Ambient Noise Level	FTA Allowable Project Noise Exposure Level		Predicted Project Noise Exposure Level[2]	Result	Build Noise Level[3]	Change
				Impact	Severe Impact				
1	Cat 2 / Ldn	Weekday	70.8	65.0	70.1	59.9	No Impact	71.1	0.3
		Weekend	66.5	61.8	67.1	57.0	No Impact	67.0	0.5
2	Cat 3 / Leq	Weekday	76.0	70.0	79.0	59.1	No Impact	76.1	0.1
		Weekend	68.8	68.5	73.6	55.4	No Impact	69.0	0.2
3	Cat 3 / Leq	Weekday	75.2	70.0	78.4	57.4	No Impact	75.3	0.1
		Weekend	64.5	65.5	70.9	52.0	No Impact	64.7	0.2
4	Cat 2 / Ldn	Weekday	69.9	64.3	69.4	57.6	No Impact	70.1	0.2
		Weekend	67.4	62.5	67.7	55.3	No Impact	67.7	0.3
5	Cat 3 / Leq	Weekday	76.1	70.0	79.1	50.7	No Impact	76.1	0.0
		Weekend	75.9	70.0	78.9	45.1	No Impact	75.9	0.0
6	Cat 2 / Ldn	Weekday	68.5	63.2	68.5	59.1	No Impact	69.0	0.5
		Weekend	69.7	64.1	69.3	58.5	No Impact	70.0	0.3
7	Cat 3 / Leq	Weekday	71.7	70.0	75.7	58.2	No Impact	71.9	0.2
		Weekend	68.1	67.9	73.2	54.0	No Impact	68.2	0.1
8	Cat 3 / Leq	Weekday	66.9	67.1	72.4	54.1	No Impact	67.1	0.2
		Weekend	65.0	65.8	71.2	51.3	No Impact	65.2	0.2
9	Cat 2 / Ldn	Weekday	77.6	65.0	75.0	61.4	No Impact	77.7	0.1
		Weekend	75.0	65.0	73.2	61.3	No Impact	75.2	0.2
10	Cat 3 / Leq	Weekday	68.4	68.2	73.4	55.4	No Impact	68.6	0.2
		Weekend	66.4	66.7	72.1	50.2	No Impact	66.5	0.1
11	Cat 3 / Leq	Weekday	72.5	70.0	76.3	55.7	No Impact	72.6	0.1
		Weekend	71.5	70.0	75.5	53.7	No Impact	71.5	0.0
12	Cat 2 / Ldn	Weekday	77.9	65.0	75.0	61.0	No Impact	78.0	0.1
		Weekend	74.4	65.0	72.7	59.4	No Impact	74.5	0.1

Notes:
1 Definition of land use categories and noise descriptor based on FTA Manual, see Table 3-2.
2 Total project-generated noise level.
3 Based on logarithmic addition of existing ambient and predicted project noise exposure levels.

4.7.3 VIBRATION AND GROUND-BORNE NOISE

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 can create vibration energy that is transmitted into the track support system. The amount of vibrational 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 buildings. As the vibration propagates from the building foundation through the remaining structure, certain resonant, or natural, frequencies of various components of the building may be excited. Similarly, ground-borne noise, or the audible rumble of moving trains, is when this vibration reaches an outer surface such as in a room (i.e., walls or floors) or other surfaces such as a sidewalk or barrier.

However, it is not expected that the Preferred Alternative would result in any significant vibration or ground-borne noise impacts. No new tracks are being created and there would only be a marginal increase in the number of trains using the Moynihan and Penn Station platforms with the Preferred Alternative. Sensitive land uses in the surrounding area are already subject to rail activity comparable to what would occur under the Preferred Alternative. Based upon the FTA methods, the Project would need a substantial increase in the number of trains for there to be an impact. The increase in the number of trains resulting from the Project would be far below the magnitude of increase that would result in a significant adverse vibration or ground-bourne noise impact. As a result, it can be expected that the vibration levels at these locations would be similar to what currently exists. Consequently, the Preferred Alternative would not result in adverse impacts.

4.7.4 MECHANICAL EQUIPMENT

The building mechanical system (i.e., heating, ventilation, and air conditioning systems, emergency ventilation equipment) should be designed to meet all applicable noise regulations (ex: Subchapter 5, §24-227 of the New York City Noise Control Code and the New York City Department of Buildings code) and to avoid producing levels that would result in any significant increase in ambient noise levels.

4.7.5 CONCLUSION

The quantified analysis concluded that Project-related noise would be less than the project noise exposure limits specified by FTA to determine adverse impacts. In addition, the analysis concluded that vibration levels at adjacent sensitive locations would be similar to what currently exists. Therefore, the Preferred Alternative would not result in significant adverse impacts for noise and vibration. ✷