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Chapter 22: Noise and Vibration

A. INTRODUCTION

This chapter assesses the potential effects of the Proposed Action on noise and vibration, including (1) potential effects of introducing new noise-sensitive land uses (i.e., residences and community facilities) into an already noisy environment and (2) effects of noise-generating activities associated with the Proposed Action on existing noise-sensitive uses in the area. The chapter describes the existing noise and vibration conditions within the Project Area, predicts future changes that would occur in the Project Area with and without the Proposed Action in 2010 and 2025, and identifies potential significant adverse impacts based on CEQR Noise Exposure Guidelines, as well as Federal Transit Administration (FTA) Guidelines for subway operations. Following Section B, Principle Conclusions, this chapter is divided into two main sections:

- Section C, Airborne Noise – examines the potential for airborne noise impacts; and
- Section D, Vibration and Ground-borne Noise – examines the potential for vibration and ground-borne noise impacts.

Each of these sections includes a brief introduction to the subject matter and relevant terminology, provides a description of applicable regulations and impact criteria, describes the methodology followed in completing the assessment, describes existing and future noise or vibration conditions, assesses the operational effects of the Proposed Action with Traffic Mitigation, and identifies the measures proposed to avoid or mitigate potential significant adverse impacts. The construction impacts of the Proposed Action on noise and vibration are discussed in Chapter 23, "Construction Impacts."

The noise analysis included in this chapter is a refined version of that included in the DGEIS. It incorporates link-specific vehicle speed and vehicle classifications data, and is based on application of the most recent version of the CEQR-recommended, Federal Highway Administration noise prediction model (TNM 2.5). This state-of-the-art noise prediction model takes into account all relevant factors affecting traffic noise levels in New York City.

1. Factors Affecting Traffic Noise in New York City

Traffic-related noise levels in New York City streets are directly affected by vehicle type (i.e., automobiles, medium trucks and heavy trucks), vehicle speed and traffic volume.

a) Vehicle Type

Although there is no simple direct relationship between traffic flow and traffic related noise, a simple relationship does exist between vehicle type and noise. This relationship can be expressed in terms of the equivalent number of the equivalent number of automobiles ("passenger car equivalents" or PCEs) that would be required to emit the same noise level as one medium or heavy truck. Based on guidance in the *CEQR Technical Manual*, the noise emitted from one medium truck is equivalent to the noise emitted from approximately 13 PCEs, while the noise emitted from one heavy truck is equivalent to the noise emitted from approximately 47 PCEs.

b) Vehicle Speed

As vehicle speed increases in a traffic stream, noise levels generally increase. However, when vehicle speeds are approximately 10 mph or less (the average vehicle speed commonly observed along congested roadways in Manhattan), the noise level increases as vehicle speed decreases.

c) Traffic Volume

When traffic volumes are doubled (or halved) the noise level generally increases (or decreases) by approximately 3 dBA.

2. Noise

Airborne noise is the noise transmitted through the air from sources such as street traffic, air-conditioning units, and subway gratings. The principal potential airborne noise impacts from the Proposed Action would be from increased vehicular traffic in the study area. Increased noise levels may require implementation of stringent noise abatement requirements for noise sensitive land uses in the Project Area.

Noise impact assessments were conservatively completed for all five peak travel periods evaluated in Chapter 19, "Traffic and Parking": weekday AM, Midday, and PM peak traffic periods for assessment of weekday impacts, and weeknight (8:00 to 9:00 PM) and Sunday afternoon (4:00 to 5:00 PM) period for assessment of the potential for significant adverse impacts during Special Events at the Multi-Use Facility.

Operation of the Multi-Use Facility for Special Events in the open stadium configuration could also generate noise from spectators and audio reinforcement systems. A separate analysis is provided of the potential effect of these events.

All building mechanical and HVAC systems, including the wind turbines atop the Multi-Use Facility and emergency diesel power generator located on the lower level of the Multi-Use Facility, and MTA NYCT subway ventilation facilities, would be required to comply with New York City Building Code (NYCBC) and NYC Noise Control Code[1] requirements. The MTA NYCT ventilation buildings would also be required to conform to MTA NYCT ventilation noise control design specifications (both the NYCBC and the MTA mandate that community noise levels resulting from ventilation be no higher than 55 dBA at any adjacent residential or noise-sensitive receptor). These code requirements would avoid any significant adverse impacts occurring as a result of operation of HVAC or other equipment. These systems are, therefore, excluded from consideration in this analysis.

Since most operations of the No. 7 Subway Extension would occur deep below ground (between approximately 65 feet below Ninth Avenue to approximately 130 feet below West 34th Street), or in specially designed enclosures, no significant airborne noise is expected above ground from subway operation within the Project Area. However, increased noise levels may result from an increase in the frequency of subway service along the elevated portion of the No. 7 Subway alignment in Queens. The assessment of noise impacts from operations along elevated portions of the No. 7 Subway in Queens follows the methodology specified in the Federal Transit Administration (FTA) guidance manual, *Transit Noise and Vibration Impact Assessment* (April 1995, USDOT DOT-T-95-16).

Improvements at the Corona Yard in Queens would not be expected to result in significant adverse noise impacts since there would be no substantial change in the types of storage and maintenance operations at Corona Yard with the Proposed Action and since there are no noise-sensitive land uses in the vicinity of the facility that would be affected by operation of the facility. As a consequence, a separate analysis of the potential noise effects of improvements at Corona Yard was not warranted.

3. Vibration

Ground-borne noise is the noise that is "re-radiated" by the walls and floors of a structure set in motion by a vibration source; e.g., the low-frequency rumble that may occur within a building as a subway train passes beneath. The Proposed Action may have the potential to cause structural damage

[1] The Administrative Code and character of the City of New York, Volume 4A, Title 24-2.

on nearby buildings, or result in annoyance due to vibration generated from the No. 7 Subway Extension operation.

B. PRINCIPAL CONCLUSIONS

The Proposed Action would introduce additional noise-sensitive land uses, including a substantial amount of new residences, to an area with current noise levels that can be classified as "Marginally Unacceptable" and "Clearly Unacceptable" as defined under City Noise Exposure Guidelines. These noise levels are typical of the noise levels currently found in much of Manhattan. While this would constitute a significant adverse impact, building attenuation measures would be required as part of the Proposed Action to provide for interior noise levels of 45dBA (the acceptable interior noise level as defined by the City Noise Exposure Guidelines).

In addition, the Proposed Action would increase noise levels by more than 3 dBA in a number of areas of the Study Area, including along the West 34th Street, Ninth Avenue, Tenth Avenue, and Eleventh Avenue corridors. 3 dBA represents the change in noise levels that is perceptible to humans and considered significant. The Proposed Action would result in a perceptible change in noise levels at 6 of the 19 analysis locations in 2010 and at 8 of the 19 analysis locations in 2025 during at least one of the five periods for which estimates for noise levels were completed. This is due to increases in traffic volumes and intersection delays.

Noise levels would decrease as a consequence of the Proposed Action at a number of locations in the Study Area during one or more periods for which estimates were completed. This is due to the effect of changes in traffic conditions that would result from implementation of measures to mitigate traffic impacts associated with the Proposed Action, including turn restrictions, changes in curb use regulations, signal timing changes, roadway geometric changes, and use of traffic enforcement agents during Special Events.

The application of (E) Designations for new developments and implementation of a City-sponsored window replacement program and furnishing alternative means of ventilation for existing residences and community facilities would avoid or mitigate all potential significant adverse noise impacts.

The results of the noise analysis indicate that noise from Special Events at the Multi-Use Facility would not result in a significant adverse impact on noise levels in the Project Area. The contribution of noise emanating from the Multi-Use Facility when operating in open stadium mode to noise levels at sidewalk locations throughout the Study Area and at the nearest noise-sensitive land uses would be insignificant compared to noise levels from traffic sources.

The operation of the No. 7 Subway Extension is not expected to result in any increase in noise or vibration levels above ground in the Project Area, because subway operations would occur deep below ground or in specially designated enclosures with no significant airborne contribution to noise or vibration. Neither vibration nor ground-borne noise levels would exceed the FTA vibration criterion levels at sensitive receptors. The increase in the frequency of subway service along the elevated portion of the No. 7 Subway alignment would not result in a significant adverse impact on noise levels in Queens.

C. AIRBORNE NOISE

1. Introduction

Noise is generally defined as unwanted sound and is typically measured in A-weighted decibels (dBA), the noise metric best correlated to human hearing. Environmental noise is defined as the sound in a community emanating from man-made sources and activities at industrial facilities or

transportation systems, as well as natural sources such as insects and wind[2]. Since environmental noise is composed of sounds from mobile and stationary sources, it can vary greatly with time. As a consequence, a number of noise metrics that account for the variability of sound are used to quantify noise levels over a specified period. The measures adopted by both CEQR and the FTA for noise impact assessment include the Energy Equivalent Sound Level (L_{eq}) and the Day-Night Equivalent Sound Level (L_{dn}). The L_{eq} is the equivalent steady sound level that would contain the same sound energy as the time varying signal during a given time period; alternatively, it is the level corresponding to the averaged energy of sound over a given time period. The L_{dn} is the equivalent sound level during a 24-hour time period with a 10 decibel weighting applied to the equivalent sound level during the nighttime hours of 10 PM to 7 AM. Typical noise levels, in L_{dn}, which a person can encounter during daily activities, are presented in Figure 22-1.[3]

Other noise descriptors used in the CEQR Noise Exposure Guidelines include the L_1, L_{10}, L_{50}, and L_{90} percentile levels. The L_1 is the Sound Pressure Level (SPL) exceeded 1 percent of the time and is usually regarded as the average maximum noise level. The L_{10} is usually regarded as the intrusive noise level and is equivalent to the SPL exceeded ten percent of the time. The L_{50} is the median noise level, while the L_{90} is usually regarded as the residual or background noise level.

2. Methodology

As specified in the *CEQR Technical Manual*, the Proposed Action was first screened to determine whether a detailed noise analysis was necessary. The CEQR screening criteria are:

- For project-induced vehicular noise – if traffic volumes in Passenger Car Equivalent (PCE) values in the Future With the Proposed Action With Traffic Mitigation exceed existing volumes by 100 percent or more; and
- For the operation of the Multi-Use Facility – if the noise source is substantial and is located within 1,500 feet of a sensitive receptor, and if it would produce a L_{eq}(1 hour) of 45 dBA or greater at nearby noise-sensitive receptor sites.

Both of these screening criteria were satisfied. The noise level resulting from the operation of the Multi-Use Facility would be expected to exceed 45 dBA at the nearest residential land use. Detailed analysis was therefore performed to assess the effects of the Proposed Action on noise levels.

The noise analysis was completed through the following steps:

- Identify noise-sensitive receptor locations that have the greatest potential for being adversely affected by project-generated noise;
- Determine existing noise levels through field measurements and application of version 2.5 of the Federal Highway Administration (FHWA) Traffic Noise Model (TNM 2.5);
- Predict future noise levels using the TNM 2.5 noise model with projected future traffic conditions, in the Future With the Proposed Action With Traffic Mitigation and the Future Without the Proposed Action for both 2010 and 2025;
- Determine whether the Proposed Action has the potential to result in significant adverse impacts by comparing predicted Future With the Proposed Action With Traffic Mitigation noise levels with Future Without the Proposed Action noise levels against impact criteria; and
- Where necessary, recommend measures to avoid or eliminate potential significant adverse noise impacts.

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[2] USEPA. 1972. Report to the President and the Congress on noise. Senate Document No. 92-63.

[3] US EPA. 1974. Information on levels of environmental noise requisite to protect public health and welfare with an adequate margin of safety. 550/9-74-004.

Noise-sensitive locations for field measurement and analysis were identified based on guidance in the *CEQR Technical Manual*. These included the noise-sensitive locations with the greatest potential for being significantly adversely affected by project-generated noise (i.e., locations where the greatest percentage increases in traffic were forecast to occur or where new noise sources would be introduced). These included locations along West 42nd Street between Ninth and Twelfth Avenues, Tenth Avenue between West 30th and West 40th Streets, Eleventh Avenue between West 30th and West 40th Streets, West 34th Street between Ninth Avenue and Eleventh Avenue, and Lincoln Tunnel access areas. Sites in the Clinton District/42nd Street Corridor, in the portion of the Special Garment Center District within the Project Area, along the Route 9A corridor, and in West Chelsea were also included as monitoring and analysis locations.

Field measurements alone cannot be used to describe the existing or future noise environments of the Project Area. Consequently, the TNM 2.5 noise model, the CEQR-recommended tool for assessing the effects of mobile noise sources, was applied to predict future noise levels in the Study Area. FHWA has demonstrated that TNM 2.5 can accurately depict noise levels near roadways. To apply TNM 2.5 to the evaluation of the Proposed Action, the model was first used to estimate existing noise levels based on traffic data collected in 2003 and 2004. Noise levels estimated using the model were then compared against measured noise levels. The comparison indicated that noise levels predicted with the model were generally consistent with measured noise levels. Upon verification that the TNM 2.5 model was able to estimate existing noise levels with appropriate corrections was consistent with measured levels, it was then applied to estimate noise levels for the Future Without the Proposed Action and the Future With the Proposed Action With Traffic Mitigation for 2010 and 2025.

Noise levels in 2010 and 2025 With and Without the Proposed Action were estimated at 19 receptor locations using the validated TNM 2.5 model, based on link-specific vehicle speed and vehicle mix data.

In addition to the noise that would be generated by traffic in the Project Area, Special Events operations in the Multi-Use Facility would introduce a new noise source. A conservative procedure was applied to estimate noise levels resulting from Special Events at the Multi-Use Facility on the surrounding area. It was conservatively assumed that a total of 75,000 patrons (the maximum capacity of the Multi-Use Facility) would attend an event and that the Multi-Use Facility would be operating with its retractable roof in open position.

Attendees were divided into three height levels of 50 feet each, with 14 clusters at each level, and each with a speaker or an array of speakers aimed at the audience. The shell of the structure was assumed to be approximately 208 feet in height. Each of the 75,000 participants was assumed to be at a raised voice level of 74 dBA at 1 foot. Each speaker was assumed to be at 95 dBA at 1 foot. The two sources were assumed to be operating at these levels simultaneously with a total acoustic power level of 118 dB, equivalent to that of a rock band. The calculation of resultant noise levels was based on standard acoustic procedures that consider distance decay from a point source, atmospheric absorption, and diffraction by walls.[4] Noise levels were estimated at five locations in the immediate vicinity of the Multi-Use Facility. For receptors subjected to both mobile and Special Event noise sources, the noise contributions from both sources were added logarithmically to provide an assessment of the cumulative effect of the two sources on noise levels.

The potential for significant adverse noise impact was estimated by comparing noise levels in the future with the Proposed Action to noise levels in the Future Without the Proposed Action. The differences in these two noise levels were compared against the 3 dBA impact criteria defined in the *CEQR Technical Manual* for areas in the Future Without the Proposed Action with $L_{eq(1)}$ greater than 62 dBA.

[4] Beranek, L.L. et al. 1988. *Noise and Vibration Control*. Institute of Noise Control Engineering.

a) Applicable Noise Codes and Impact Criteria

Noise generated by construction and operation of the Proposed Action are generally subject to the provisions of the NYC Noise Control Code (the Code) and review on the basis of CEQR noise impact criteria. The noise impacts of the No. 7 Subway Extension were assessed on the basis of impact criteria set forth in the FTA guidance manual, *Transit Noise and Vibration Impact Assessment* (April 1995) since the CEQR noise impact criteria are not directly applicable to rail operations.

NYC Noise Control Code

The NYC Noise Control Code (the Code) establishes sound-level standards for motor vehicles, air compressors, and paving breakers; requires that all exhausts be muffled; and prohibits all unnecessary noise adjacent to schools, hospitals, or courts. The Code further limits construction activities to weekdays between 7 AM and 6 PM. In 1979, Section 1403.3-6.01 of the Code was re-enacted as Local Law No. 64, which established ambient noise quality criteria and standards based on existing land use zoning designations. Table 22-1 summarizes the ambient noise quality criteria established under Local Law No. 64.

TABLE 22-1
CITY OF NEW YORK AMBIENT NOISE QUALITY ZONE CRITERIA (DBA)

Ambient Noise Quality Zone (ANQZ)	Daytime Standards[1] (7AM – 10PM)	Nighttime Standards[1] (10PM – 7AM)
Low-Density Residential (R1 to R3) Land Uses (N1)	60	50
High-Density Residential (R4 to R10) Land Uses (N2)	65	55
Commercial (C1 to C8) and Manufacturing (M1 to M3) Land Uses (N3)	70	70

Source: City of New York Local Law No. 64.
1 $L_{eq(1\ hour)}$

Conformance to the noise level values contained in Local Law No. 64 is determined by considering noise emitted directly from stationary activities within the boundaries of a project. Construction activities and noise sources outside the boundaries of a project are not subject to the provisions of Local Law No. 64.

Section 24-241.1 of the Code controls noise from commercial music, and would be applicable if the facility were used for music events. This section states that no person shall make or cause, or permit to be made or caused, any music originating from or in connection with the operation of any commercial establishment or enterprise when the level of sound of such music, as measured inside any residential unit, is in excess of either 45 dBA or 45 dB in any octave band having a center frequency between 63 Hz and 500 Hz inclusive (ANSI band numbers 18 through 27, inclusive). This section of the Code would apply to musical events at the Multi-Use Facility.

CEQR Noise Criteria

The New York City Department of Environmental Protection (DEP), Division of Noise Abatement, has set noise exposure guidelines for use in City Environmental Impact review (Table 22-2). Under these guidelines, noise exposure is classified into four categories: Acceptable, Marginally Acceptable, Marginally Unacceptable, and Clearly Unacceptable. The guidelines are based on the need to maintain an interior noise level of 45 dBA for the "worst" noise hour based on L_{10} values (i.e., the hour at which noise levels would be at their highest).

TABLE 22-2
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]		L10 ≤ 55 dBA	---------- Ldn ≤ 60 dBA ----------						
Hospital, Nursing Home		L10 ≤ 55 dBA		55 < L10 ≤ 65 dBA	---------- 60 < Ldn ≤ 65 dBA ----------	65 < L10 ≤ 80 dBA	(1) 65 < Ldn ≤ 70 dBA, (II) 70 ≤ Ldn	L10 > 80 dBA	---------- Ldn ≤ 75 dBA ----------
Residence, residential hotel or motel	7 AM to 10 PM	L10 ≤ 65 dBA		65 < L10 ≤ 70 dBA		70 < L10 ≤ 80 dBA		L10 > 80 dBA	
	10 PM to 7 AM	L10 ≤ 55 dBA		55 < L10 ≤ 70 dBA		70 < L10 ≤ 80 dBA		L10 > 80 dBA	
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)	
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)	
Industrial, public areas only[4]	Note 4	Note 4		Note 4		Note 4		Note 4	

Source: DEP (adopted policy 1983).

(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 old-age homes.

3 The FAA-approved L_{dn} contours supplied by the Port Authority may be used, 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 referenced 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).

As described in the *CEQR Technical Manual*, DEP has established noise attenuation values required to maintain acceptable interior noise levels (i.e., interior noise levels in buildings at 45 dBA or lower, based on exterior L_{10} noise levels with a Proposed Action) (Table 22-3).

TABLE 22-3
CEQR EXTERIOR NOISE STANDARDS AND ATTENUATION VALUES

Noise Category	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

1 Different descriptors are used for each noise source: L_{10} for vehicular traffic; Ldn for train noise; and L_{dn}^{y} (Ldn Contour) for aircraft noise.*†

2 The various noise sources at a receptor location are measured and reported separately in accordance with generally accepted procedures for assessing an overall noise level. Cases where there is not a clearly dominant noise source require a judicious decision based on adequate field experience and analysis to determine the final noise category that is deemed appropriate for the overall noise exposure at each noise receptor site.

3 The above composite window-wall attenuation values are for residential dwellings. Commercial office spaces and meeting rooms would be 5 dBA less in each category. All the above categories require a closed window situation and hence an alternate means of ventilation.

* L_{dn} requires a 24-hour measurement or supportive analysis if a shorter period is employed.

† L_{dn}^{y} = "L_{dn} Contour" is an annual average of L_{dn} values ("y" indicates "yearly average").

The *CEQR Technical Manual* provides guidelines for determining whether a noise analysis is appropriate for developments that are proposed in high noise level areas. The screening would consider whether the action would generate any mobile or stationary sources of noise or be located in areas with high ambient noise levels. Areas with high ambient levels typically include those near highly trafficked thoroughfares, airports, rail or other loud activities.

The *CEQR Technical Manual* establishes criteria to determine whether a proposed action would result in a significant adverse noise impact, based on a comparison of Future With the Proposed Action With Traffic Mitigation noise levels in $L_{eq(1)}$ with Future Without the Proposed Action noise levels at receptors potentially affected by the Proposed Action.

Under the *CEQR Technical Manual*, increases in daytime noise levels as a result of a proposed action are not considered significant unless the resulting noise levels exceed 65 dBA. At night and during the day where noise levels exceed 65 dBA, an increase of 3 dBA is considered a significant adverse impact. In addition, the introduction of sensitive uses, such as residences or community facilities, into an area with noise levels above 70 dBA constitutes a significant adverse impact unless interior noise levels for buildings containing these uses are attenuated to 45 dBA.

New York City Zoning Resolution Performance Standards for Manufacturing Districts

The New York City Zoning Resolution contains performance standards regulating noise (§42-213) in Manufacturing Districts designated as M1, M2, and M3. The performance standards specify maximum permitted lot-line decibel levels in octave bands that may result from manufacturing activities. Operation of motor vehicles and transportation facilities are specifically excluded from the performance standards. As a consequence, the provisions of the Performance Standards are not applicable to the Proposed Action.

FTA Guideline for Transit Noise

FTA has published guidelines for the assessment of transit-related airborne noise. The noise impact criteria identified in these FTA guidelines are based on existing noise levels and land use categories (Table 22-4). Noise metrics used to define impact are determined by land use category and time of day; namely, $L_{eq(1\ Hour)}$ is applied for land uses involving predominantly daytime activities and L_{dn} is applied for land uses where nighttime sensitivity is a factor. Figure 22-2, excerpted from the FTA guidelines, illustrates the specific noise levels above which a rail project is considered to have significant adverse impacts. As the existing noise exposure increases from 45 dBA to 75 dBA in a Category 2 land use, the allowed transit noise exposure increases from 51 to 65 dBA, resulting in future ambient increases of 7 to 0 dBA. A cap of 65 dBA is set for the project noise exposure irrespective of the existing noise environment. The curves for Category 1 and 3 are 5 dBA higher, but L_{dn} noise metric will be used.

TABLE 22-4
FTA LAND USE CATEGORIES

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor $Leq_{(h)}$[1]	Tracts of land where 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}[2]	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 $Leq_{(h)}$[1]	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.

Source: Transit Noise and Vibration Impact Assessment, FTA, April 1995.
1 L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity.
2 Ldn for the 24-hour cumulative noise level.

Noise Assessment Standards and Guidelines

The average ability of an individual to perceive changes in noise levels[5] is shown in Table 22-5. Generally, changes in noise levels less than 3 dBA are barely perceptible to most listeners, whereas 10 dBA changes are normally perceived as doubling (or halving) in loudness. These guidelines permit estimation of an individual's probable perception of changes in noise levels.

TABLE 22-5
AVERAGE ABILITY TO PERCEIVE CHANGES IN NOISE LEVELS

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

Various government and research institutions have proposed criteria that attempt to relate changes in noise levels to community response. One commonly applied criterion for estimating community response is to change noise levels incorporated into the community response scale developed by the International Standards Organization (ISO)[6] (Table 22-6). This scale permits direct estimation of the probable response of a community to projected change in noise level.

[5] Bolt Beranek and Newman. 1973. *Fundamentals and Abatement of Highway Traffic Noise.* NTIS PB-222-703.

[6] ISO 150/TC43. 1969. *Noise Assessment with respect to Community Response.*

TABLE 22-6
ISO COMMUNITY RESPONSE TO INCREASES IN NOISE LEVELS

Change (dBA)	Category	Description
0	None perceptible	No observed reaction
5	Little noticeable	Sporadic complaint
10	Medium	Widespread complaints
15	Strong	Threat of community action
20	Very Strong	Vigorous community action

Noise Exposure Assessment Criteria

The noise environment of the Project Area was categorized according to the noise exposure guidelines using the highest 1-hour L_{10} in Table 22-21 and the attenuation values required to achieve an interior L_{10} level of 45 dBA per Table 22-3. The severity of any identified noise impact was gauged against the ISO Community Response criteria in Table 22-6 and Perceptibility to Change criteria in Table 22-5.

3. Existing Conditions

a) Noise-Sensitive Land Uses

A noise-sensitive location (known as a "receptor") is defined as an area where human activity may be adversely affected when noise levels exceed predefined thresholds of acceptability or when noise levels increase by an amount exceeding a predefined threshold of change. These locations can be indoors or outdoors. Indoor receptors include uses such as residences, hotels, motels, health care facilities, nursing homes, schools, houses of worship, public meeting facilities, and libraries. Outdoor receptors include uses such as parks, outdoor theaters and public open spaces.

Much of the Project Area is occupied by uses that are not considered to be noise-sensitive, including transportation uses such as the MTA LIRR John D. Caemmerer Westside Yard (Caemmerer Yard), MTA Michael J. Quill Bus Depot (Quill Bus Depot), the Port Authority Bus Terminal (PABT), the approaches to the Lincoln Tunnel, and Amtrak Empire Line. Other major land uses in the Project Area include the Convention Center, Madison Square Garden, Penn Station, and the Farley Building. The area west of Tenth Avenue contains mostly manufacturing and industrial land uses interspersed with commercial land uses. The area to the east of Tenth Avenue is mostly commercial interspersed with residential land uses.

Tracts of residential land uses can be found along West 42nd Street along Ninth Avenue, from West 24th to West 35th Streets, mid-block between Ninth and Tenth Avenues, and along West 34th Street between Eighth and Ninth Avenues. In addition, there are a number of institutional land uses in the Project Area, including schools and houses of worship. A detailed description and location of land uses in the Project Area is provided in Chapter 4: "Land Use, Zoning, and Public Policy." A review of this information indicates that the vast majority of uses in the Project Area can be characterized as not noise-sensitive.

b) Existing Noise Monitoring Program

Noise measurements were taken at 18 locations (N1-N18) to document the existing noise levels in the Project Area. The 18 monitoring locations and nearby land uses are shown in Figure 22-3 and listed in Table 22-7. Of the 18 monitoring locations, 14 were located in the vicinity of existing or proposed residential land uses, three were located in the vicinity of existing or proposed institutional land uses and open space resources, and one was located in the immediate vicinity of the Multi-Use Facility.

Monitoring sites included locations where the maximum effects of Special Events at the Multi-Use Facility would be expected to occur.

TABLE 22-7
NOISE MONITORING LOCATIONS AND ADJACENT LAND USE

Site	Site Location	Adjacent Land Use
N1	Route 9A and W. 41st St.	Residential/Commercial/Transportation
N2	Route 9A and W. 33rd St.	Transportation
N3	W. 42nd St. between Route 9A and Eleventh Ave.	Residential/Commercial/Transportation
N4	Eleventh Ave. and W. 41st St.	Commercial/Transportation
N5	Eleventh Ave. and between W. 35th and W. 36th St.	Open Space/Industrial
N6	Eleventh Ave. and W. 30th St.	Transportation/Commercial/Industrial
N7	Tenth Ave. and W. 37th St.	Residential/Commercial
N8	Tenth Ave. and W. 33rd St.	Residential/Commercial/Transportation
N9	Tenth Ave. and W. 30th St.	Residential/Commercial/Transportation/Industrial
N10	W. 42nd St. between Ninth and Tenth Aves.	Residential/Commercial/Transportation
N11	St. Michael's Church and Academy on W. 34th St. between Ninth and Tenth Aves.	Residential/Institutional/Commercial
N12	Ninth Ave. and W. 39th St.	Residential/Commercial
N13	W. 34th St. between Eighth and Ninth Aves. (across from West Side Jewish Center)	Residential/Institutional/Commercial
N14	Eighth Ave. and W. 30th St.	Residential/Commercial
N15	W. 39th St. between Eighth and Ninth Aves.	Residential/Commercial
N16	W. 38th St. between Eighth and Ninth Aves.	Residential/Commercial
N17	W. 37th St. between Ninth and Tenth Aves.	Residential/Commercial
N18	W. 38th St. between Tenth and Eleventh Aves.	Residential/Commercial

Location 1 (N1) was located on the east side of Route 9A, near West 41st Street. Residences are located between West 41st and West 42nd Streets, and the Quill Bus Depot is located immediately to the south. During lulls in traffic, the ventilation equipment at the Quill Bus Depot is audible from this location. The dominant noise source at Site N1 is traffic from Route 9A. As part of the Proposed Action, the Convention Center Expansion would require relocation of the Quill Bus Depot to a predominantly below-grade location between West 30th and West 31st Streets from Tenth to Twelfth Avenues. This site was selected since it would undergo substantial changes in traffic, such as the proposed closure of West 41st Street to through-traffic between Eleventh Avenue and Route 9A due to the Convention Center Expansion.

Location 2 (N2) was located on the east side of Route 9A, near West 33rd Street. The western portion of Caemmerer Yard is southeast of Site N2 and the Convention Center's open-air truck marshalling yard is northeast of Site N2. Liberty Heli Tours currently operates from the West 30th Street Heliport southwest of Site N2. The dominant noise source is traffic on Route 9A, with contribution from helicopter activities. As part of the Proposed Action, the Multi-Use Facility would be built above the western portion of Caemmerer Yard, and the Convention Center truck marshalling yard would be platformed over with Convention Center related uses and a publicly accessible open space.

Location 3 (N3) was situated mid-block on West 42nd Street, between Route 9A and Eleventh Avenue. Residential buildings with ground floor commercial and parking lots are found in this area. Traffic is the dominant source of noise at this location. As part of the Proposed Action, the Convention Center hotel and medium- to high-density residential buildings with ground floor commercial uses will surround Site N3.

Location 4 (N4) was located near the intersection of West 41st Street and Eleventh Avenue. A parking lot and a residential building with ground floor commercial are to the northwest of Site N4, to the southwest is the Quill Bus Depot, and to the east is a Federal Express package distribution center and a Mercedes Benz car dealership and offices. The dominant noise sources are traffic on Eleventh Avenue and heavy trucks queuing for the Lincoln Tunnel. As part of the Proposed Action, the Convention Center hotel would be developed on the northwest corner of this intersection, the Convention Center Expansion would require relocation of the Quill Bus Depot to a predominantly below-grade location between West 30th and West 31st Streets from Tenth to Twelfth Avenues. To the east, the Proposed Action envisions high-density commercial and residential buildings with ground floor commercial uses. This site was selected since it would experience changes in traffic, such as the proposed closure of West 41st Street to through-traffic between Eleventh Avenue and Route 9A due to the Convention Center Expansion.

Location 5 (N5) was located at the Convention Center open space which is located across from the Convention Center on the east side of Eleventh Avenue between West 35th and West 36th Streets. With the exception of the Convention Center and its related open space, the land uses in the surrounding area are auto-body shops, parking lots, and warehouses. Traffic is generally light southbound on Eleventh Avenue, but can be congested for several blocks northbound. Much of the traffic is trucks and buses queuing to gain entrance to the Lincoln Tunnel. Under the Proposed Action, the east side of Eleventh Avenue would be rezoned for high-density commercial office use. There is a potential for significantly increased traffic levels associated with the Proposed Action.

Location 6 (N6) was located near the intersection of West 30th Street and Eleventh Avenue. Caemmerer Yard is located north of West 30th Street. To the southwest of Site N6, the land uses are gas stations, warehouses, and Greyhound bus parking. A DSNY District 5 vehicle parking facility and a Greyhound bus yard are located on West 30th Street to the west. To the southeast are warehouse uses and the West Chelsea neighborhood. Traffic is the dominant source of noise at this location, including bus and truck traffic. Liberty Heli Tours operations can be heard at this location. As part of the Proposed Action, the Multi-Use Facility would be built on a platform over the western portion of Caemmerer Yard, the eastern portion of Caemmerer Yard would be platformed for the creation of an open space and office, hotel, residential, and community facility uses. The block to the southwest (Block 675) would be a multi-agency facility for the DSNY and NYPD Tow Pound operations with a public open space on the roof. To the southeast would be future residential buildings with ground floor commercial uses anticipated as a result of the rezoning of a portion of West Chelsea. There is a potential for significantly increased traffic levels associated with the Proposed Action.

Location 7 (N7) was located just east of the intersection of West 37th Street and Tenth Avenue. The area has a mix of residential and commercial land uses with several parking lots. The dominant noise source is traffic on Tenth Avenue queuing to gain entrance to the Lincoln Tunnel. Under the Proposed Action, this area would be zoned for medium- to high-density residential buildings with ground floor commercial.

Location 8 (N8) was located just west of the intersection of West 33rd Street and Tenth Avenue. To the northwest is a residential tenement building and a fast-food restaurant. To the southwest is the eastern portion of Caemmerer Yard, to the southeast is a commercial office building (the former Westyard Distribution building), and to the northeast is a commercial office building. The dominant noise source is traffic from Tenth Avenue. As part of the Proposed Action, the residential building to the northwest would be replaced by high-density commercial office uses, the areas to the east would be zoned for high-density residential and commercial uses, and to the southwest Caemmerer Yard would be platformed over for the creation of a open space and office, hotel, residential, and community facility uses. Traffic volumes and patterns could change with the Proposed Action due to the proposed closing of West 33rd Street between Eleventh Avenue and Route 9A.

Location 9 (N9) was located at the intersection of West 30th Street and Tenth Avenue. The eastern portion of Caemmerer Yard is located to the northwest. A U.S. Postal Service distribution center is located to the southeast. The land use to the southwest is manufacturing. Commercial and residential land uses are located to the northeast. Additionally, an entrance ramp to the Lincoln Tunnel Expressway is located at this location. The dominant noise source is traffic on Tenth Avenue and at the Lincoln Tunnel entrance. As part of the Proposed Action, the eastern portion of Caemmerer Yard would be platformed over for the creation of a open space and office, hotel, residential, and community facility uses. The area to the northeast would be rezoned for high-density commercial office use, and to the southeast would remain the U.S. Postal Service use. The area to the southwest would contain new residential buildings, generated as a result of the Special West Chelsea District Rezoning. The Proposed Action could significantly increase traffic to and from the Lincoln Tunnel.

Location 10 (N10) was located mid-block on West 42nd Street between Ninth and Tenth Avenues. Residential buildings with ground floor commercial can be found on the north side of West 42nd Street, while a mixed-use residential building with ground floor theaters and other commercial uses are found along the south side. Traffic is the dominant source of noise at this location, particularly to or from the Lincoln Tunnel. As part of the Proposed Action, the area would be rezoned for high-density, mixed-use buildings with predominantly residential uses. The Proposed Action could significantly increase traffic to and from the Lincoln Tunnel.

Location 11 (N11) was located in front of St. Michael's Church and Academy on West 34th Street between Ninth and Tenth Avenues. The area includes a mix of residential, commercial and community facility land uses. Traffic is consistently queued beyond the traffic lights with traffic to or from the Lincoln Tunnel. The dominant noise source is traffic on Eleventh Avenue. The Proposed Action will rezone this area for mixed-use development, similar to what exists today.

Location 12 (N12) was located at the intersection of West 39th Street and Ninth Avenue. The Port Authority Bus Terminal is located one block to the north. The area is predominantly residential, with ground floor commercial along Ninth Avenue and mixed industrial and commercial uses to the east. Additionally, an entrance to the Lincoln Tunnel is located one block to the southwest, with frequent queuing of traffic. The dominant noise source is traffic on Ninth Avenue. The Proposed Action will rezone the Ninth Avenue corridor for medium-density residential use, similar to existing uses. To the east the Proposed Action will rezone the area for medium- to high-density commercial and residential uses. The Proposed Action could significantly increase traffic to and from the Lincoln Tunnel.

Location 13 (N13) was located mid-block on West 34th Street, between Eighth and Ninth Avenues, across the street from the West Side Jewish Center. The area contains a mix of residential, commercial, and institutional land uses. Traffic is the dominant source of noise at this location, with frequent queuing of traffic beyond the intersections in both directions. The Proposed Action will rezone this area for medium- to high-density commercial and residential buildings.

Location 14 (N14) was located at the intersection of West 30th Street and Eighth Avenue. The area is predominantly residential with ground floor commercial along Eighth Avenue, and manufacturing and commercial uses in the mid-blocks to the east. Madison Square Garden is located one block to the north. Traffic is the dominant source of noise at this location. The Proposed Action will allow for medium-density residential use along Eighth Avenue, and medium- to high-density manufacturing and commercial uses in the mid-blocks to the east, similar to the existing conditions.

Location 15 (N15) was located on West 39th Street, mid-block between Eighth and Ninth Avenues. The location is predominantly manufacturing and commercial, with few residential land uses. Local traffic is the dominant noise source, as well as vehicular activities within the numerous parking lots in the area. A noticeable drone from multiple building ventilation systems can be heard during lulls in traffic. The Proposed Action will rezone the block to the north for high-density commercial office

use, and the block to the south medium- to high-density office and residential uses with ground floor commercial.

Location 16 (N16) was located mid-block on West 38th Street, between Eighth and Ninth Avenues. The area is predominantly manufacturing and commercial, with one residential land use. Traffic on West 38th Street is the dominant source of noise at this location. However, the high noise levels observed were due to the extremely poor road conditions, rather than the traffic volume, which was moderate. The Proposed Action will rezone this area for medium- to high-density office and residential uses with ground floor commercial.

Location 17 (N17) was located mid-block on West 37th Street, between Ninth and Tenth Avenues. The area contains a mix of residential, commercial, and parking uses. Traffic on West 37th Street is the dominant source of noise at this location. However, high noise level during the morning hours can be attributed to loading and unloading of Garment Center-related goods. As part of the Proposed Action, this area would be rezoned to permit medium-density residential buildings with ground floor commercial.

Location 18 (N18) was located mid-block, on West 38th Street between Tenth and Eleventh Avenues. The area contains auto-related uses, a hotel, nightclub, horse stable, warehouses, and parking lots. Heavy and medium trucks typically idle along the eastern half of the block. A 24-hour automobile repair and taxi dispatching/maintenance facility is the dominant noise contributor to this location, particularly the pneumatic impact-wrench equipment. Under the Proposed Action, the area is to be rezoned with a mix of commercial and residential uses, predominantly commercial to the west and residential to the east, as well as an open space in the mid-blocks between Tenth and Eleventh Avenues. Traffic is relatively light on West 38th Street at this location. However, traffic is expected to increase along this roadway as a result of the Proposed Action.

Twenty-minute noise samples were taken at 14 of the 18 monitoring locations during the AM, Midday, PM, and weeknight peak periods on Tuesday, May 13, Wednesday, May 14 and Thursday, May 15, 2003. Twenty-minute noise samples were taken at the four remaining locations during Thursday, February 4; Sunday, February 8; Wednesday, March 24; and Sunday, March 28, 2004. An additional Sunday period was monitored at 18 locations (N1-N18) on Sunday, June 8, 2003.

The following instruments were used:

- Larson-Davis 820 Precision Integrating Sound Level Meter
- Bruel & Kjaer 2260 Precision Sound Level Meter
- Larson-Davis 1/2 inch 2561 Condenser Microphone
- Bruel & Kjaer 1/2 inch 4189 Microphone with Preamp
- Larson-Davis 827 Precision Preamplifier
- Bruel & Kjaer 1/2 inch Wind Screens
- Metrosonics db-308 Metrologgers
- 1/2 inch Bruel & Kjaer Condenser Microphone
- Rion NC-73 Sound Level Calibrator
- Skymate Plus Meteorological Multi Meter

The instruments meet ANSI S1.4 Type I or II specifications and were calibrated before and after each measurement period and operated on slow response according to the manufacturer's instructions. The data were digitally recorded by the meters and displayed and tallied on a data sheet at the end of the 20-minute measurement period in units of dBA. Measured quantities included L_{eq}, L_1, L_{10}, L_{50}, L_{90}, L_{max}, and L_{min}. Measurements were taken in conformance with ANSI S1.13.

Weather conditions were noted as followed: wind speed under 18 mph, relative humidity under 71 percent, and temperatures above 50°F and under 70°F during the May and June monitoring periods;

wind speed under 15 mph, relative humidity under 60 percent, and temperatures above 20°F and under 50°F during the February monitoring periods; and wind speed under 15 mph, relative humidity under 70 percent, and temperatures above 40°F and under 60°F during the March monitoring periods.

Measured Noise Levels

Table 22-8 summarizes the results of the noise monitoring program on the basis of the L_{eq} noise descriptor. The results of this noise monitoring program indicate that Seventh, Eighth, Ninth, Tenth, and Eleventh Avenues and West 34th and West 42nd Streets generally have weekday daytime noise levels (dBA) in the mid to high 70s, while the cross-town streets, with the exceptions of West 34th and West 42nd Streets, have noise levels (dBA) in the high 60s to low 70s.

Table 22-9 summarizes the results of the noise monitoring program on the basis of the L_{10} noise descriptor. The L_{10} noise descriptor is commonly used for the assessment of intrusive noise such as from traffic. The *CEQR Technical Manual* procedures apply the L_{10} descriptor where traffic noise dominates, as it does in the study area. Noise levels varied from the high-60s dBA to the mid-80s dBA. These noise levels are typical of most areas in Manhattan.

The results of the existing noise level measurement program, in percentile and hourly L_{eq} levels, are shown in Table 22-10.

In addition, 24-hour continuous noise monitoring was conducted at the Quill Bus Depot and DSNY District 5 vehicle parking facility to determine whether the traffic-related peak noise hour at those two facilities coincided with the traffic-related peak noise hour for the other elements of the Proposed Action.

Figure 22-4 depicts the time history of hourly L_{eq} noise levels measured at the two facilities. Noise levels in the Quill Bus Depot were fairly constant throughout the day, with slight peaks around 9:00 AM and 6:00 to 8:00 PM, coinciding with the traffic peaks. At the DSNY vehicle parking facility, the peak noise levels occurred at 7:00 AM and 6:00 PM since its noise environment was governed by the highway traffic noise on Route 9A, the peaks coincide with the traffic peaks of the study area.

c) Existing Noise Environment

Based on the results of the noise monitoring program, the general noise environment of the Project Area can be characterized, based on the noise classifications defined in the City Noise Exposure Guidelines, as "Marginally Unacceptable", except along Route 9A, which can be characterized as "Clearly Unacceptable." Overall, the noise environment of the Study Area is typical of many areas in Manhattan, with $L_{eq(1)}$ noise levels ranging between 65 and 80 dBA, and with lower levels typically occurring at night and on weekends.

Traffic is the dominant source of noise in the Study Area. Other notable noise contributors include helicopters from Liberty Heli Tours southwest of the Convention Center, subway-related noise from the subway vents/emergency exits found along Eighth Avenue, sirens from police and other emergency vehicles, and the ubiquitous car/truck horns and squealing brakes characteristic of New York City streets.

TABLE 22-8
MEASURED HOURLY NOISE LEVELS (L_{EQ}) IN dBA AND HIGHEST HOUR L_{EQ}

Site	Weekday AM	Weekday Midday	Weekday PM	Weeknight	Sunday	Highest Leq[1]
N1	79	77	76	75	80	80
N2	77	77	77	75	78	78
N3	72	69	68	66	65	72
N4	74	76	72	76	72	76
N5	72	72	73	74	67	74
N6	74	74	75	73	72	75
N7	76	74	72	74	72	76
N8	74	73	74	70	71	74
N9	75	74	75	73	72	75
N10	76	75	76	73	71	76
N11	76	74	74	72	72	76
N12	75	74	74	72	73	75
N13	72	71	73	68	70	73
N14	72	73	74	70	70	74
N15	69	68	68	69	65	69
N16	74	70	72	67	66	74
N17	71	67	70	65	65	71
N18	68	69	66	65	67	69

1 Highest L_{eq} for the periods for which readings were taken.

TABLE 22-9
MEASURED HOURLY NOISE LEVELS (L_{10}) IN dBA AND HIGHEST L_{10}

Site	Weekday AM	Weekday Midday	Weekday PM	Weeknight	Sunday	Highest L_{10}[1]
N1	82	81	80	79	82	82
N2	82	81	81	78	82	82
N3	76	71	76	69	68	76
N4	78	78	77	80	75	80
N5	76	75	79	76	70	79
N6	78	77	78	77	74	78
N7	76	75	79	76	70	79
N8	78	76	78	73	74	78
N9	78	77	78	77	75	78
N10	79	77	77	76	73	79
N11	80	77	77	75	76	80
N12	78	76	77	75	76	78
N13	76	73	76	71	74	76
N14	75	76	75	73	73	76
N15	73	70	71	73	67	73
N16	77	72	75	70	69	77
N17	72	70	73	67	68	73
N18	71	71	68	67	68	71

1 Highest L10 for the periods for which readings were taken.

TABLE 22-10
MEASURED HOURLY PERCENTILE AND L_{EQ} NOISE LEVELS IN dBA

Location	Time Period	L_{eq}	L_1	L_5	L_{10}	L_{50}	L_{90}
N1	AM	79	84	83	82	78	69
	MD	77	84	81	81	76	68
	PM	76	84	81	80	76	68
	Weeknight	75	86	81	79	73	65
	Sunday	80	86	83	82	78	71
N2	AM	77	85	84	82	74	67
	MD	77	85	83	81	74	69
	PM	77	85	82	81	73	67
	Weeknight	75	81	80	78	73	68
	Sunday	78	84	83	82	73	66
N3	AM	72	81	79	76	69	63
	MD	69	77	73	71	65	62
	PM	68	84	78	76	67	62
	Weeknight	66	77	72	69	63	61
	Sunday	65	73	69	68	63	60
N4	AM	74	83	79	78	71	65
	MD	76	85	80	78	72	66
	PM	72	83	80	77	69	65
	Weeknight	76	85	81	80	72	65
	Sunday	72	79	76	75	70	65
N5	AM	72	81	78	76	67	61
	MD	72	80	77	75	68	63
	PM	73	83	81	79	71	64
	Weeknight	74	79	78	76	69	62
	Sunday	67	74	73	70	65	60
N6	AM	74	83	79	78	72	66
	MD	74	82	80	77	72	66
	PM	75	85	80	78	72	66
	Weeknight	73	83	79	77	71	65
	Sunday	72	80	76	74	70	64
N7	AM	76	81	78	76	67	61
	MD	74	80	77	75	68	63
	PM	72	83	81	79	71	64
	Weeknight	74	79	78	76	69	62
	Sunday	72	74	73	70	65	60
N8	AM	74	80	79	78	72	67
	MD	73	81	78	76	72	68
	PM	74	81	79	78	71	67
	Weeknight	70	78	75	73	67	64
	Sunday	71	79	77	74	68	63
N9	AM	75	82	79	78	74	69
	MD	74	80	78	77	73	69
	PM	75	81	79	78	73	67
	Weeknight	73	80	78	77	72	65
	Sunday	72	77	76	75	70	64
N10	AM	76	85	81	79	74	70
	MD	75	82	79	77	73	69
	PM	76	87	80	77	71	67
	Weeknight	73	82	78	76	69	65
	Sunday	71	78	74	73	69	67

TABLE 22-10 (CONTINUED)
MEASURED HOURLY PERCENTILE AND L_{EQ} NOISE LEVELS IN dBA

Location	Time Period	L_{eq}	L_1	L_5	L_{10}	L_{50}	L_{90}
N11	AM	76	85	81	80	74	71
	MD	74	84	79	77	73	69
	PM	74	82	79	77	72	67
	Weeknight	72	79	76	75	69	64
	Sunday	72	80	78	76	70	66
N12	AM	75	82	79	78	73	69
	MD	74	84	78	76	71	67
	PM	74	85	80	77	72	67
	Weeknight	72	84	78	75	69	64
	Sunday	73	81	78	76	70	66
N13	AM	72	78	77	76	71	67
	MD	71	78	74	73	70	67
	PM	73	82	77	76	70	66
	Weeknight	68	74	73	71	66	63
	Sunday	70	77	75	74	68	64
N14	AM	72	79	77	75	71	67
	MD	73	80	78	76	71	68
	PM	74	83	76	75	70	67
	Weeknight	70	79	75	73	69	64
	Sunday	70	77	74	73	69	64
N15	AM	69	77	75	73	68	65
	MD	68	76	72	70	66	64
	PM	68	75	72	71	66	64
	Weeknight	69	77	75	73	68	65
	Sunday	65	74	69	67	62	58
N16	AM	74	83	79	77	71	67
	MD	70	79	76	72	66	62
	PM	72	82	78	75	64	63
	Weeknight	67	74	72	70	68	61
	Sunday	66	74	71	69	62	58
N17	AM	71	80	75	72	68	66
	MD	67	77	72	70	63	59
	PM	70	79	77	73	65	60
	Weeknight	65	72	69	67	60	57
	Sunday	65	74	70	68	61	52
N18	AM	68	77	74	71	64	62
	MD	69	80	74	71	64	60
	PM	66	76	71	68	63	60
	Weeknight	65	73	69	67	61	58
	Sunday	67	78	69	68	63	60

d) Comparison of Measured and Model-Predicted Noise Levels

Use of the FHWA's TNM 2.5 model for the estimation of noise levels from roadways in the Project Area was validated by comparing measured noise levels to noise levels predicted by the Model using weekday AM, PM, Midday, weeknight, and Sunday traffic data. This is a standard practice in applying a generally accepted noise model to a specific urban location.

Table 22-11 presents the measured L_{eq} values for the existing weekday AM and PM peak hours, Midday, and weeknight, and Sunday Special Event peak traffic periods. The highest hourly L_{eq} levels of the 5 periods are listed under the "Highest L_{eq}" and "Highest L_{10}" columns of the table.

Table 22-12 compares noise levels predicted by the Model against measured noise levels. Generally, noise levels predicted by the Model were lower than measured noise levels at most receptor locations. The differences can be attributed to the general fluctuations in existing noise environment caused by other noise sources, including aircraft noise, ventilation noise and other non-vehicular noise sources within the study area that are –unaccounted for in the Model. Modeled noise level estimates were adjusted by the calibration factors shown in Table 22-12 to more accurately reflect measured noise levels. The calibrated Model was used in completing all estimates of future noise levels.

TABLE 22-11
MEASURED EXISTING HOURLY NOISE LEVELS (L_{EQ}) AND HIGHEST HOUR L_{EQ} AND L_{10} IN dBA
(SEE ALSO TABLE 22-12)

Site	Weekday AM	Weekday Midday	Weekday PM	Weeknight	Sunday	Highest L_{eq}[1]	Highest L_{10}[2]
N1	79	77	76	75	80	80	83
N2	77	77	77	75	78	78	81
N3	72	69	68	66	65	72	75
N4	74	76	72	76	72	76	79
N5	72	72	73	74	67	74	77
N6	74	74	75	73	72	75	78
N7	76	74	72	74	72	76	79
N8	74	73	74	70	71	74	77
N9	75	74	75	73	72	75	78
N10	76	75	76	73	71	76	79
N11	76	74	74	72	72	76	79
N12	75	74	74	72	73	75	78
N13	72	71	73	68	70	73	76
N14	72	73	74	70	70	74	77
N15	69	68	68	69	65	69	72
N16	74	70	72	67	66	74	77
N17	71	67	70	65	65	71	74
N18	68	69	66	65	67	69	72

1 Highest L_{eq} for the periods for which readings were taken.
2 Highest L_{10} for the periods for which readings were taken.

TABLE 22-12
COMPARISON OF MEASURED AND PREDICTED (TNM) NOISE LEVELS - (L_{eq}) IN dBA

Site	Weekday AM Measured	Predicted	Diff[1]	Weekday Midday Measured	Predicted	Diff[1]	Weekday PM Measured	Predicted	Diff[1]	Weeknight Measured	Predicted	Diff[1]	Sunday Meas-ured	Predicted	Diff[1]
N1	79	73.8	-5.2	77	74.5	-2.5	76	71.5	-4.5	75	69.3	-5.7	80	68.2	-11.8
N2	77	72.8	-4.2	77	72.2	-4.8	77	70.4	-6.6	75	69.6	-5.4	78	67.3	-10.7
N3	72	65.5	-6.5	69	63.7	-5.3	68	68.8	0.8	66	63.3	-2.7	65	63.7	-1.3
N4	74	68.5	-5.5	76	68.7	-7.3	72	68.1	-3.9	76	65.2	-10.8	72	64.8	-7.2
N5	72	69.7	-2.3	72	70.8	-1.2	73	70.4	-2.6	74	65.3	-8.7	67	65.4	-1.6
N6	74	73.1	-0.9	74	72.1	-1.9	75	69.8	-5.2	73	66.7	-6.3	72	66.3	-5.7
N7	76	73.3	-2.7	74	73.9	-0.1	72	72.7	0.9	74	67.3	-6.7	72	67.7	-4.3
N8	74	71.5	-2.5	73	72.5	-0.5	74	70.6	-3.4	70	67.3	-2.7	71	66.7	-4.3
N9	75	71.2	-3.8	74	71.4	-2.6	75	71.1	-3.9	73	66.8	-6.2	72	66.6	-5.4
N10	76	72.7	-3.3	75	68.3	-6.7	76	71.9	-4.3	73	67.7	-5.3	71	70.4	-0.6
N11	76	77.1	1.1	74	77.5	3.5	74	72.7	-1.3	72	72.2	0.2	72	70.1	-1.9
N12	75	72.4	-2.6	74	71.8	-2.2	74	71.7	-2.3	72	n/a	n/a	73	n/a	n/a
N13	72	71.6	-0.4	71	73.5	2.5	73	71.1	-1.9	68	68.4	0.4	70	68.5	-1.5
N14	72	74.9	2.9	73	75.4	2.4	74	68.2	-5.8	70	n/a	n/a	70	n/a	n/a
N15	69	66.9	-2.1	68	70.3	2.3	68	64.4	-3.6	69	n/a	n/a	65	n/a	n/a
N16	74	69.8	-4.2	70	69.9	-0.1	72	64.3	-7.7	67	n/a	n/a	66	n/a	n/a
N17	71*	66.5	-4.5	67	64.5	-2.5	70	68.9	-1.1	65	62.4	-2.6	65	59.4	-5.6
N18	68**	63.0	-5.0	69**	63.1	-5.9	66	62.0	-4.0	65	55.7	-9.3	67	54.4	-12.6

Diff[1] is the Difference = Predicted - Measured
Inc Traffic = Incomplete Traffic Data
* Trucks loading and unloading nearby
** Taxi garage maintenance with impact wrenches

e) CEQR Noise Exposure Classification of the Study Area

Based on the CEQR Noise Exposure classifications defined in Table 22-2, the current classifications of the noise receptors are summarized in Table 22-13. Locations N1 and N2, located along Route 9A, were classified as Clearly Unacceptable. All other locations were classified as Marginally Unacceptable. The Marginally Unacceptable classification is typical for areas in Manhattan with significant levels of traffic.

TABLE 22-13
EXISTING NOISE EXPOSURE AT NOISE SAMPLING LOCATIONS

Site	Receptor Type	Highest L_{10}	Classification
N1	Residential/ Commercial/ Transportation	83	C.U.
N2	Transportation	81	C.U.
N3	Residential/ Commercial/ Transportation	75	M.U.
N4	Commercial/ Transportation	79	M.U.
N5	Open Space/ Industrial	77	M.U.
N6	Transportation/ Commercial/ Industrial	78	M.U.
N7	Residential/ Commercial	79	M.U.
N8	Residential/ Commercial/ Transportation	77	M.U.
N9	Residential/ Commercial/ Transportation/ Industrial	78	M.U.
N10	Residential/ Commercial/ Transportation	79	M.U.
N11	Residential/ Institutional/ Commercial	79	M.U.
N12	Residential/ Commercial	78	M.U.
N13	Residential/ Institutional/ Commercial	76	M.U.
N14	Residential/ Commercial	77	M.U.
N15	Residential/ Commercial	72	M.U.
N16	Residential/ Commercial	77	M.U.
N17	Residential/ Commercial	74	M.U.
N18	Residential/ Commercial	72	M.U.
N19[1]	Residential/ Commercial	n/a	n/a

C.U. Clearly Unacceptable
M.U. Marginally Unacceptable
M.A. Marginally Acceptable
[1] Noise levels were not monitored at this location.

4. 2010 Future Without the Proposed Action

Future noise levels in 2010 Without the Proposed Action were forecast using the TNM 2.5 model and link-specific traffic data for all monitoring locations. An additional analysis site, located at Ninth Avenue between West 36th and West 37th Streets, was added to permit an assessment of impacts of future conditions at that location. Table 22-14 presents the predicted hourly L_{eq} and L_{10} noise levels in 2010 Future Without the Proposed Action. 2010 Future Without the Proposed Action noise levels varied between a maximum $L_{eq(1)}$ of 80.5 dBA at N1 during the Sunday time period to a minimum $L_{eq(1)}$ level of 63.6 dBA at N17 during the weeknight time period. Noise levels based on the L_{10} descriptor varied from a peak level of 83.5 dBA at N1 to a low of 71.7 dBA at N15.

TABLE 22-14
2010 FUTURE WITHOUT THE PROPOSED ACTION: HOURLY NOISE LEVELS (L_{EQ}) AND HIGHEST HOURLY L_{EQ} AND L_{10} IN dBA

Site	Weekday AM	Weekday Midday	Weekday PM	Weeknight	Sunday	Highest L_{eq}[1]	Highest L_{10}[2]
N1	79.5	77.7	76.8	74.8	80.5	80.5	83.5
N2	77.3	77.4	77.5	75.0	77.5	77.5	80.5
N3	72.2	69.4	68.2	66.1	65.2	72.2	75.2
N4	74.1	76.1	72.2	76.1	72.1	76.1	79.1
N5	72.1	72.0	73.0	74.1	67.1	74.1	77.1
N6	74.3	74.5	75.1	74.3	71.3	75.1	78.1
N7	76.7	74.3	72.2	75.7	72.3	76.7	79.7
N8	74.4	73.7	74.2	70.1	71.3	74.4	77.4
N9	75.4	74.4	74.9	73.1	71.6	75.4	78.4
N10	77.0	80.2	77.0	73.3	72.0	80.2	83.2
N11	76.3	74.4	74.3	73.3	72.6	76.3	79.3
N12	75.2	74.5	74.3	n/a	n/a	75.2	78.2
N13	78.4	72.7	72.0	68.5	70.4	78.4	81.4
N14	72.9	73.4	78.4	n/a	n/a	78.4	81.4
N15	68.7	68.5	68.5	n/a	n/a	68.7	71.7
N16	76.6	70.5	72.3	n/a	n/a	76.6	79.6
N17	71.1	67.3	71.6	63.6	65.5	71.6	74.6
N18	67.9	69.1	66.0	65.1	67.3	69.1	72.1
N19	70.3	69.9	66.6	n/a	n/a	70.3	73.3

1 Highest L_{eq} for the periods for which readings were taken.
2 Highest L_{10} for the periods for which readings were taken.

TABLE 22-15
2010 FUTURE WITHOUT THE PROPOSED ACTION: CEQR NOISE EXPOSURE CLASSIFICATION

Site	Receptor Type	Highest L_{10}	Classification
N1	Residential/Commercial/Transportation	84	C.U.
N2	Transportation	81	C.U.
N3	Residential/Commercial/Transportation	75	M.U.
N4	Residential/Commercial/Transportation*	79	M.U
N5	Open Space/Industrial	77	M.U
N6	Transportation/Commercial/Industrial	78	M.U
N7	Residential/Commercial	80	M.U.
N8	Residential/Commercial/Transportation	77	M.U.
N9	Residential/Commercial/Transportation/Industrial	78	M.U.
N10	Residential/Commercial/Transportation	83	C.U.
N11	Residential/Institutional/Commercial	79	M.U
N12	Residential/Commercial	78	M.U.
N13	Residential/Institutional/Commercial	81	C.U.
N14	Residential/Commercial	81	C.U.
N15	Residential/Commercial	72	M.U.
N16	Residential/Commercial	80	M.U.
N17	Residential/Commercial	75	M.U.
N18	Residential/Commercial	72	M.U.
N19	Residential/Commercial	73	M.U.

C.U. Clearly Unacceptable
M.U. Marginally Unacceptable
M.A. Marginally Acceptable

The CEQR Noise Classifications for each receptor location in 2010 Future Without the Proposed Action are summarized in Table 22-15. The noise exposure classifications of the receptors in 2010 Future Without the Proposed Action are in the Clearly Unacceptable (C.U.) category at receptor sites N1, N2, N10, N13, and N14. The noise exposure classifications of the remaining 14 receptors are in the Marginally Unacceptable (M.U.) category.

5. 2010 Future With the Proposed Action

a) Traffic Related Noise

Predicted future noise levels in the Project Area in 2010 Future With the Proposed Action (with traffic mitigation) are summarized in Table 22-16. 2010 Future With the Proposed Action (with traffic mitigation) noise levels varied between a maximum $L_{eq(1)}$ of 81.1 dBA at N11 (West 34th Street between Ninth and Tenth Avenues) during the weeknight time period to a minimum $L_{eq(1)}$ level of 64.0 dBA at N17 (West 37th Street between Ninth and Tenth Avenues) also during the weeknight time period. The L_{10} descriptor varied from a peak level of 84.1 dBA at N11 to a low of 72.2 dBA at N15. Predicted future noise levels in the 2010 Future With the Proposed Action reflect the effects of implementing measures to mitigate traffic impacts in that year. These measures include turn restrictions, changes in curb use regulations, signal timing changes, roadway geometry changes, and use of traffic enforcement agents during Special Events at the Multi-Use Facility.

TABLE 22-16
2010 FUTURE WITH THE PROPOSED ACTION (WITH TRAFFIC MITIGATION): HOURLY NOISE LEVELS (L_{EQ}) AND HIGHEST HOURLY L_{EQ} AND L_{10} IN dBA

Site	Weekday AM	Weekday Midday	Weekday PM	Weeknight	Sunday	Highest L_{eq}[1]	Highest L_{10}[2]
N1	79.1	77.5	76.2	76.0	80.6	80.6	83.6
N2	77.1	77.0	77.0	75.5	79.7	79.7	82.7
N3	72.3	69.6	68.5	67.2	66.9	72.3	75.3
N4	74.0	76.0	72.1	76.0	72.4	76.0	79.0
N5	72.3	73.0	76.5	78.3	69.0	78.3	81.3
N6	74.4	74.2	75.2	73.5	71.3	75.2	78.2
N7	75.8	74.2	72.3	77.2	76.1	77.2	80.2
N8	74.9	75.1	74.9	76.1	78.8	78.8	81.8
N9	75.4	74.4	75.5	75.3	73.8	75.5	78.5
N10	76.2	77.4	76.2	74.3	73.7	77.4	80.4
N11	76.4	74.6	74.7	81.1	80.0	81.1	84.1
N12	75.3	74.5	74.5	n/a	n/a	75.3	78.3
N13	72.9	70.2	71.3	74.3	77.5	77.5	80.5
N14	71.4	73.3	75.3	n/a	n/a	75.3	78.3
N15	69.2	67.8	68.4	n/a	n/a	69.2	72.2
N16	74.0	70.3	72.4	n/a	n/a	74.0	77.0
N17	71.3	67.6	71.8	64.0	66.4	71.8	74.8
N18	68.1	69.4	66.2	69.4	72.2	72.2	75.2
N19	70.1	69.7	66.9	n/a	n/a	70.1	73.1

1 Highest L_{eq} for the periods for which readings were taken.
2 Highest L_{10} for the periods for which readings were taken.

Introduction of New Sensitive Receptors

As a result of the Proposed Action in 2010, new residential uses would be introduced into an area characterized by elevated noise levels typical of many areas in Manhattan.. Table 22-17 presents the highest L_{10} levels and the CEQR noise exposure classifications for each receptor location in 2010

Future With the Proposed Action. Table 22-17 also presents the L_{10} levels and the noise exposure classifications for each receptor location in 2010 Future Without the Proposed Action.

TABLE 22-17
2010 FUTURE WITH THE PROPOSED ACTION WITH TRAFFIC MITIGATION: NOISE EXPOSURE CLASSIFICATION AND ATTENUATION VALUES

Site	Location	Receptor Type	Highest L_{10}		Classification		Attenuation (dBA)	
			w/o PA	w/ PA	w/o PA	w/ PA	w/o PA	w/ PA
N1	Route 9A and W. 41st St.	Residential/ Commercial/ Transportation	84	84	C.U.	C.U.	40	40
N2	Route 9A and W. 33rd St.	Transportation/ Open Space	81	83	C.U.	C.U.	40	40
N3	W. 42nd St. btwn Route 9A and Eleventh Ave.	Residential/ Commercial/ Transportation	75.2	75.3	M.U.	M.U.	35	35
N4	Eleventh Ave. and W. 41st St.	Residential/ Commercial/ Transportation	79	79	M.U.	M.U.	35	35
N5	Eleventh Ave. and btwn W. 35th and W. 36th St.	Residential/Commercial	77	81	M.U.	C.U.	35	40
N6	Eleventh Ave. and W. 30th St.	Transportation/ Commercial/ Industrial/ Open Space	78	78	M.U.	M.U.	35	35
N7	Tenth Ave. and W. 37th St.	Residential/ Commercial	80	80.2	C.U.	C.U.	35	40
N8	Tenth Ave. and W. 33rd St.	Residential/ Commercial/ Transportation	77	82	M.U.	C.U.	35	40
N9	Tenth Ave. and W. 30th St.	Residential/ Commercial/ Transportation/ Industrial	78	79	M.U.	M.U.	35	35
N10	W. 42nd St. btwn Ninth and Tenth Aves.	Residential/ Commercial/ Transportation	83	80.4	C.U.	C.U.	40	40
N11	St. Michael on W. 34th St. btwn Ninth and Tenth Aves.	Residential/ Institutional/ Commercial	79	84.1	M.U.	C.U.	35	40
N12	Ninth Ave. and W. 39th St.	Residential/ Commercial	78	78	M.U.	M.U.	35	35
N13	W. 34th St btwn Eighth & Ninth Aves. (near W.S. Jewish Ctr.)	Residential/ Institutional/ Commercial	81	81	C.U.	C.U.	40	40
N14	Eighth Ave. and W. 30th St.	Residential/ Commercial	81	78	C.U.	M.U.	40	35
N15	W. 39th St. btwn Eighth and Ninth Aves.	Residential/ Commercial	72	72	M.U.	M.U.	30	30
N16	W. 38th St. btwn Eighth and Ninth Aves.	Residential/ Commercial	80	77	M.U.	M.U.	35	35
N17	W. 37th St. btwn Ninth and Tenth Aves.	Residential/ Commercial	75	75	M.U.	M.U.	30	30
N18	W. 38th St. btwn Tenth and Eleventh Aves.	Residential/ Commercial	72	75.2	M.U.	M.U.	30	35
N19	W. 34th – W. 38th Sts. and Ninth Ave.	Residential/Commerical	73.3	73.1	M.U.	M.U.	35	30

PA Proposed Action With Traffic Mitigation
C.U. Clearly Unacceptable
M.U. Marginally Unacceptable
M.A. Marginally Acceptable

At 15 of the 19 receptor locations, the noise exposure classifications of receptors in 2010 Future With the Proposed Action are the same as those in 2010 Future Without the Proposed Action. At three receptor locations the noise exposure classification changes from Marginally Unacceptable to Clearly Unacceptable category. At one receptor location the noise exposure classification changes from Clearly Unacceptable to Marginally Unacceptable. In all cases, the noise exposure classification would be either Marginally or Clearly Unacceptable.

Because the Proposed Action would introduce new additional noise-sensitive uses into an area characterized by high noise levels a significant impact would occur unless noise attenuation measures are implemented to provide a maximum 45 dBA interior noise level at such uses. (E) Designations would be placed on Projected and Potential Development Sites as part of the proposed rezoning to provide the required attenuation.

Table 22-17 identifies the level of noise attenuation that would be mandated under the (E) Designations to achieve acceptable interior noise levels at noise-sensitive uses in the 2010 Future With and Without the Proposed Action. No significant adverse noise impacts would occur as a consequence of the Proposed Action with implementation of these levels of attenuation.

Existing Sensitive Uses

In addition, as depicted on Figure 22-3, the Study Area is currently occupied by a number of noise-sensitive land uses, including a number of residences and community facilities. As described in Chapter 3, "Analytical Framework," a limited number of these uses are located on Projected Development Sites that are anticipated to be developed under the Proposed Action by 2010. However, the vast majority of these uses would remain in 2010 and could experience increased noise levels as a result of the Proposed Action.

Table 22-18 compares predicted noise levels in 2010 Future With the Proposed Action against predicted noise levels in 2010 Future Without the Proposed Action. As indicated in Table 22-18, the results of the analysis indicate that noise levels in the Study Area would increase by 3 dBA as a consequence of the Proposed Action at 6 of the 19 receptor locations in 2010. This is due to the increase in traffic volumes and intersection delays, and represents a significant adverse noise impact on existing sensitive land uses in the Proposed Action as defined under CEQR guidelines. The analysis also indicates that noise levels would decrease as a consequence of the Proposed Action at a number of locations, particularly during weekdays, due to implementation of measures needed to mitigate the traffic impacts of the Proposed Action, including turn restrictions, changes in curb use regulations, signal timing changes, roadway geometric changes, and use of traffic enforcement agents during Special Events at the Multi-Use Facility.

TABLE 22-18
2010 FUTURE WITH THE PROPOSED ACTION COMPARED TO 2010 FUTURE WITHOUT THE PROPOSED ACTION (L_{EQ}): CHANGE IN NOISE LEVELS

Site	Weekday AM	Weekday Midday	Weekday PM	Weeknight	Sunday
N1	-0.4	-0.2	-0.6	1.2	0.1
N2	-0.2	-0.4	-0.5	0.5	2.2
N3	0.1	0.2	0.3	1.1	1.7
N4	-0.1	-0.1	-0.1	-0.1	0.3
N5	0.2	1.0	3.5*	4.2*	1.9
N6	0.1	-0.3	0.1	-0.8	0.0
N7	-0.9	-0.1	0.1	1.5	3.8*
N8	0.5	1.4	0.7	6.0*	7.5*
N9	0.0	0.0	0.6	2.2	2.2
N10	-0.8	-2.8	-0.8	1.0	1.7
N11	0.1	0.2	0.4	7.8*	7.4*
N12	0.1	0.0	0.2	n/a	n/a
N13	-5.5	-2.5	-0.7	5.8*	7.1*
N14	-1.5	-0.1	-3.1	n/a	n/a
N15	0.5	-0.7	-0.1	n/a	n/a
N16	-2.6	-0.2	0.1	n/a	n/a
N17	0.2	0.3	0.2	0.4	0.9
N18	0.2	0.3	0.2	4.3*	4.9*
N19	-0.2	-0.2	0.3	n/a	n/a

* CEQR noise impact

b) Multi-Use Facility Noise

A separate analysis was completed to determine the effect of noise from the Multi-Use Facility during Special Events. The results of that analysis indicate that noise levels due solely from noise emanating

from the Multi-Use Facility under open roof conditions would range between 55 and 60 dBA (Leq) at the nearest potential development site (corner of Tenth Avenue and West 34th Street) at elevations between 50 feet and 300 feet above grade. This is a conservative estimate of noise impacts, which does not include atmospheric losses and shielding by other structures. Noise levels at-grade would be less than the levels at the elevated locations. Noise levels from the Multi-Use Facility under closed roof conditions would be substantially less than those under open roof conditions.

The noise levels from the Multi-Use Facility would be at least 20 dBA below the traffic noise levels predicted at a representative site N11 (St. Michael's Church and Academy at West 34th Street between Ninth and Tenth Avenues: the receptor location at which noise levels would be highest during Special Event periods). As demonstrated below, the noise from the Multi-Use Facility would result in an insignificant increase in total noise levels when added to the contribution from traffic. At N11, where weeknight noise level from traffic is 80 dBA, and the noise from the Multi-Use Facility is 55-60 dBA, the cumulative noise level from traffic and Multi-use facility would be:

$$\text{Resultant (Leq) dBA} = 10 \log (10^{80/10} + 10^{60/10}) = 80 \text{ dBA}$$

Similar results would be found at all other receptor locations since the noise from the Multi-Use Facility would, in all cases, be substantially below that from traffic. The results of this analysis indicate that no significant adverse noise impacts would occur as a result of noise from the Multi-Use Facility.

6. 2025 Future Without the Proposed Action

Future noise levels in 2025 Without the Proposed Action were forecast using the TNM 2.5 model and link-specific traffic data. Table 22-19 presents the predicted hourly L_{eq} and L_{10} noise levels in 2025 Future Without the Proposed Action. 2025 Future Without the Proposed Action noise levels varied between a maximum $L_{eq(1)}$ of 82.3 dBA at N1 (Route 9A and West 41st Street) during the Sunday time period to a minimum $L_{eq(1)}$ level of 63.7 dBA at N17 (West 37th Street between Ninth and Tenth Avenues) during the weeknight time period. Noise levels based on the L_{10} descriptor varied from a peak level of 85.3 dBA at N1 to a low of 72.2 dBA at N18 (West 38th Street between Tenth and Eleventh Avenues).

The CEQR Noise Classifications for each receptor location in 2025 Future Without the Proposed Action are summarized in Table 22-20. The noise exposure classifications of the receptors in 2025 Future Without the Proposed Action are in the Clearly Unacceptable (C.U.) category at receptor sites N1 (Route 9A and West 41st Street), N2 (Route 9A and West 33rd Street), N10 (West 42nd Street between Ninth and Tenth Avenues), N13 (West 34th Street between Eighth and Ninth Avenues), and N16 (West 38th Street between Eighth and Ninth Avenues). The noise exposure classifications of the remaining 14 receptors are in the Marginally Unacceptable (M.U.) category. In all cases, the noise exposure classification would be either Marginally or Clearly Unacceptable.

TABLE 22-19
2025 FUTURE WITHOUT THE PROPOSED ACTION: HOURLY NOISE LEVELS (L_{EQ}) AND L_{10} IN dBA

Site	Weekday AM	Weekday Midday	Weekday PM	Weekday Evening	Sunday	Highest L_{eq}[1]	Highest L_{10}[2]
N1	80.2	79.1	78.3	75.3	82.3	82.3	85.3
N2	77.7	77.7	77.7	74.6	76.7	77.7	80.7
N3	72.5	69.8	68.4	66.3	65.5	72.5	75.5
N4	74.3	76.3	72.5	76.3	72.3	76.3	79.3
N5	72.1	72.0	73.2	74.1	67.1	74.1	77.1
N6	74.5	75.1	75.2	74.5	72.6	75.2	78.2
N7	77.3	74.7	72.6	74.5	72.5	77.3	80.3
N8	75.1	74.5	75.1	70.1	71.5	75.1	78.1
N9	75.8	74.9	75.8	73.5	71.8	75.8	78.8
N10	77.5	81.3	77.8	74.2	72.5	81.3	84.3
N11	77.1	75.2	74.7	73.5	72.9	77.1	80.1
N12	75.7	75.1	74.8	n/a	n/a	75.7	78.7
N13	80.6	74.6	72.9	70.1	70.7	80.6	83.6
N14	74.0	74.1	76.7	n/a	n/a	76.7	79.7
N15	69.4	69.4	68.5	n/a	n/a	69.4	72.4
N16	78.4	70.5	72.4	n/a	n/a	78.4	81.4
N17	71.2	67.5	71.7	63.7	65.6	71.7	74.7
N18	68.1	69.2	66.1	65.3	67.5	69.2	72.2
N19	70.7	70.3	67.0	n/a	n/a	70.7	73.7

1 Highest L_{eq} for the periods for which readings were taken. 2 Highest L_{10} for the periods for which readings were taken.

TABLE 22-20
2025 FUTURE WITHOUT THE PROPOSED ACTION: CEQR NOISE EXPOSURE CLASSIFICATION (L_{10}) IN dBA

Site	Receptor Type	Highest L_{10}[1]	Classification
N1	Residential/Commercial/Transportation	*85*	C.U.
N2	Transportation	*81*	C.U.
N3	Residential/Commercial/Transportation	*76*	M.U.
N4	Residential/Commercial/Transportation	*79*	M.U.
N5	Open Space/Industrial	*77*	M.U.
N6	Transportation/Commercial/Industrial	*78*	M.U.
N7	Residential/Commercial	*80*	M.U.
N8	Residential/Commercial/Transportation	*78*	M.U.
N9	Residential/Commercial/Transportation/Industrial	*79*	M.U
N10	Residential/Commercial/Transportation	*84*	C.U.
N11	Residential/Institutional/Commercial	*80*	M.U
N12	Residential/Commercial	*79*	M.U.
N13	Residential/Institutional/Commercial	*84*	C.U
N14	Residential/Commercial	*80*	M.U
N15	Residential/Commercial	*72*	M.U.
N16	Residential/Commercial	*81*	C.U
N17	Residential/Commercial	*75*	M.U.
N18	Residential/Commercial	*72*	M.U
N19	Residential/Commercial	*74*	M.U.

1 Highest L_{10} for the periods for which readings were taken.
C.U. Clearly Unacceptable
M.A. Marginally Acceptable
M.U. Marginally Unacceptable

7. 2025 Future With the Proposed Action (With Traffic Mitigation)

a) Traffic Related Noise

Predicted future noise levels in the Project Area in 2025 Future With the Proposed Action are summarized in Table 22-21. 2025 Future With the Proposed Action (With Traffic Mitigation) noise levels varied between a maximum $L_{eq(1)}$ of 82.3 dBA at N1(Route 9A and West 41st Street) during the Sunday time period to a minimum $L_{eq(1)}$ level of 64.5 dBA at N17 (West 37th Street between Ninth and Tenth Avenues) during the weeknight time period. The L_{10} descriptor varied from peak level of 85.3 dBA at N1 to low of 72.4 dBA at N15 (West 39th Street between Eighth and Ninth Avenues). Predicted future noise levels in 2010 Future With the Proposed Action reflected the effects of implementation of measures needed to mitigate traffic impacts in that year. These measures included turn restrictions, changes in curb use regulations, signal timing changes, roadway geometry changes, and use of traffic enforcement agents during Special Events at the Multi-Use Facility.

TABLE 22-21
2025 FUTURE WITH THE PROPOSED ACTION WITH TRAFFIC MITIGATION: HOURLY NOISE LEVELS (L_{eq}) AND L_{10} IN dBA

Site	Weekday AM	Weekday Midday	Weekday PM	Weeknight	Sunday	Highest L_{eq}[1]	Highest L_{10}[2]
N1	80.3	78.3	80.7	76.3	82.3	82.3	85.3
N2	77.5	77.4	77.9	74.8	78.5	78.5	81.5
N3	73.7	70.5	69.8	69.0	67.4	73.7	76.7
N4	74.8	75.6	73.2	77.0	72.5	77.0	80.0
N5	76.6	76.3	78.6	76.0	67.2	78.6	81.6
N6	77.0	77.6	76.0	71.9	71.5	77.6	80.6
N7	77.5	76.5	75.3	76.5	76.1	77.5	80.5
N8	78.6	76.6	77.6	74.2	72.1	78.6	81.6
N9	77.6	77.5	76.2	77.6	75.8	77.6	80.6
N10	78.3	80.8	79.0	74.0	71.9	80.8	83.8
N11	80.3	77.6	76.0	81.0	78.4	81.0	84.0
N12	77.3	76.4	75.8	n/a	n/a	77.3	80.3
N13	76.2	73.8	72.7	78.7	78.3	78.7	81.7
N14	73.2	75.2	76.5	n/a	n/a	76.5	79.5
N15	69.4	68.2	68.7	n/a	n/a	69.4	72.4
N16	74.1	70.4	72.8	n/a	n/a	74.1	77.1
N17	72.4	69.5	72.4	64.5	66.7	72.4	75.4
N18	69.7	72.1	76.8	65.5	69.8	76.8	79.8
N19	72.7	71.7	70.7	n/a	n/a	72.7	75.7

1 Highest L_{eq} for the periods for which readings were taken.
2 Highest L_{10} for the periods for which readings were taken.

Introduction of New Sensitive Receptors

As a result of the Proposed Action in 2025, new residential and community facility uses would be introduced into an area characterized by noise levels typical of many areas of Manhattan. Table 22-22 presents the highest L_{10} levels and the CEQR noise exposure classifications for each receptor location in 2025 Future With the Proposed Action. Table 22-22 also presents the L_{10} levels and the noise exposure classifications for each receptor location in 2025 Future Without the Proposed Action. At 13 of the 19 receptor locations, the noise exposure classifications of receptors in 2025 Future With the Proposed Action fall under the same category as in 2025 Future Without the Proposed Action. At five receptor locations the noise exposure classification changes from Marginally Unacceptable to Clearly Unacceptable category. At one receptor location the noise exposure classification changes from Clearly Unacceptable to Marginally Unacceptable. In all cases, the noise exposure classification would be either Marginally or Clearly Unacceptable.

Because the Proposed Action would introduce new sensitive uses (e.g., residences and community facilities), a significant impact would occur unless noise attenuation measures are implemented to provide a maximum 45 dBA interior noise level. As part of the Proposed Rezoning, (E) Designations would be placed on all Projected and Potential Development Sites to provide the required attenuation. With these measures, no significant adverse noise impacts would occur as a result new development.

TABLE 22-22
2025 FUTURE WITH THE PROPOSED ACTION WITH TRAFFIC MITIGATION: CEQR REQUIRED ATTENUATION VALUES

Site	Location	Receptor Type	Highest L10		Classification		Attenuation (dBA)	
			w/o PA	w/ PA	w/o PA	w/ PA	w/o PA	w/ PA
N1	Route 9A and W. 41st St.	Residential/ Commercial/ Transportation	85.3	85.3	C.U.	C.U.	45	45
N2	Route 9A and W. 33rd St.	Transportation/ Open Space	81	82	C.U.	C.U.	40	40
N3	W. 42nd St. between Route 9A and Eleventh Ave.	Residential/ Commercial/ Transportation	76	77	M.U.	M.U.	35	35
N4	Eleventh Ave. and W. 41st St.	Residential/ Commercial/ Transportation	79	80	M.U.	M.U.	35	35
N5	Eleventh Ave. and between W. 35th and W. 36th St.	Residential/ Commercial	77	82	M.U.	C.U.	35	40
N6	Eleventh Ave. and W. 30th St.	Transportation/ Commercial/ Industrial/ Open Space	78	81	M.U.	C.U.	35	40
N7	Tenth Ave. and W. 37th St.	Residential/ Commercial	80.3	81	C.U.	C.U.	40	40
N8	Tenth Ave. and W. 33rd St.	Residential/ Commercial/ Transportation	78	82	M.U.	C.U.	35	40
N9	Tenth Ave. and W. 30th St.	Residential/ Commercial/ Transportation/ Industrial	79	81	M.U.	C.U.	35	40
N10	W. 42nd St. between Ninth and Tenth Aves.	Residential/ Commercial/ Transportation	84	84	C.U.	C.U.	40	40
N11	St. Michael on W. 34th St. between Ninth and Tenth Aves.	Residential/ Institutional/ Commercial	80.1	84	C.U.	C.U.	40	40
N12	Ninth Ave. and W. 39th St.	Residential/ Commercial	79	80.3	M.U.	C.U.	35	40
N13	W. 34th St between Eighth & Ninth Aves. (near W.S. Jewish Ctr)	Residential/ Institutional/ Commercial	84	82	C.U.	C.U.	40	40
N14	Eighth Ave. and W. 30th St.	Residential/ Commercial	80	80	M.U.	M.U.	35	35
N15	W. 39th St. between Eighth and Ninth Aves.	Residential/ Commercial	72	72	M.U.	M.U.	30	30
N16	W. 38th St. between Eighth and Ninth Aves.	Residential/ Commercial	81	77	C.U.	M.U.	40	35
N17	W. 37th St. between Ninth and Tenth Aves.	Residential/ Commercial	75	75.4	M.U.	M.U.	30	35
N18	W. 38th St. between Tenth and Eleventh Aves.	Residential/ Commercial	72	80	M.U.	M.U.	30	35
N19	W. 34 – W. 38th Sts. and Ninth Ave.	Residential/ Commercial	74	76	M.U.	M.U.	30	30

PA Proposed Action with Traffic Mitigation
C. U. Clearly Unacceptable
M.U. Marginally Unacceptable
M.A. Marginally Acceptable

Existing Sensitive Uses

In addition, as depicted on Figure 22-3, the Study Area is currently occupied by a number of noise-sensitive land uses, including a number of residences and community facilities. While a limited number of these uses are located on Projected Development Sites that are anticipated to be developed under the Proposed Action by 2025. The majority of the uses will remain and will experience increased noise levels as a result of the Proposed Action.

Table 22-23 compares predicted noise levels in 2025 Future With the Proposed Action against predicted noise levels in 2025 Future Without the Proposed Action. As indicated in Table 22-23, the results of the analysis indicate that noise levels in the Study Area would increase by 3 dBA or more as

a consequence of the Proposed Action at 8 of the 19 receptor locations in 2025 during at least one of the five periods for which estimates for noise levels were completed. This is due to the increase in traffic volumes and intersection delays, and represents a significant adverse noise impact on existing sensitive land uses in the Proposed Action as defined under CEQR guidelines. The analysis also indicates that noise levels would decrease as a consequence of the Proposed Action at a number of locations, particularly during weekdays, due to implementation of measures needed to mitigate the traffic impacts of the Proposed Action, including turn restrictions, changes in curb use regulations, signal timing changes, roadway geometric changes, and use of traffic enforcement agents during Special Events at the Multi-Use Facility.

TABLE 22-23
CHANGE IN 2025 FUTURE WITH THE PROPOSED ACTION WITH TRAFFIC MITIGATION COMPARED TO FUTURE WITHOUT THE PROPOSED ACTION L_{eq} NOISE LEVELS (dBA)

Site	Weekday AM	Weekday Midday	Weekday PM	Weeknight	Sunday
N1	0.1	-0.8	2.4	1.0	0.0
N2	-0.2	-0.3	0.2	0.2	1.8
N3	1.2	0.7	1.4	2.7	1.9
N4	0.5	-0.7	0.7	0.7	0.2
N5	4.5*	4.3*	5.4*	1.9	0.1
N6	2.5	2.5	0.8	-2.1	-1.1
N7	0.2	1.8	2.7	2.0	3.6*
N8	3.5*	2.1	2.5	4.1*	0.6
N9	1.8	2.6	0.4	4.1*	4.0*
N10	0.8	-0.5	1.2	-0.2	-0.6
N11	3.2*	2.4	1.3	7.5*	5.5*
N12	1.6	1.3	1.0	n/a	n/a
N13	-4.4	-0.8	-0.2	8.6*	7.6*
N14	-0.8	1.1	-0.2	n/a	n/a
N15	0.0	-1.2	0.2	n/a	n/a
N16	-4.3	-0.1	0.4	n/a	n/a
N17	1.2	2.0	0.7	0.8	1.1
N18	1.6	2.9	10.7*	0.2	2.3
N19	2.0	1.4	3.7*	N/A	N/A

* 3 dBA CEQR noise impact

D. NOISE IMPACTS AVOIDANCE AND MITIGATION

1. Introduction of New Sensitive Uses

The Proposed Action would introduce new sensitive receptors – i.e., new residences and new community facilities – into areas with high noise levels. As part of the Proposed Rezoning, (E) Designations would be placed on Projected and Potential Development Sites where there is the potential for significant noise impacts to assure that the required attenuation is provided. Residential and community facility buildings on lots receiving (E) Designation would be required to provide sufficient noise attenuation to maintain interior noise levels of 45 dBA or lower. Table 22-24 identifies the level of attenuation required for Projected and Potential Development Sites.

The text of the (E) Designation would be as follows:

> "In order to ensure an acceptable interior noise environment, future residential/commercial uses must provide a closed window condition with minimum attenuation of [30], [35], or [40] dBA window/wall attenuation on all façades in order to maintain an interior noise level of 45 dBA. In order to maintain a closed-window

> condition, an alternate means of ventilation must also be provided. Alternate means of ventilation includes, but is not limited to, central air conditioning or air conditioning sleeves containing air conditioners or HUD-approved fans."

The Proposed Action would require noise attenuation in the range of 30 dBA to 40 dBA at Projected and Potential Development Sites for residential or community facility use. With implementation of the (E) Designation, significant adverse noise impacts would be avoided for new development.

2. Existing Sensitive Uses

Window treatments to improve the noise reduction qualities of residential window openings represent a proven successful means to implement receptor noise control. In general, window openings are the weak link in a structure's external facade allowing noise infiltration into the building. Window treatments, such as providing supplemental interior storm sash or replacement of the existing window with one designed specifically for noise control can provide for significantly quieter interior noise environment. In general, window treatments are cost-effective where only the windows facing the road side require mitigation. Window treatments have the added attraction of reducing all city noise contribution such as construction and aircraft noise in addition to reducing road traffic noise.

CEQR requirements for window attenuation were followed in recommending window/wall attenuation for affected sensitive receptor sites for this Project. Receptors registering future L_{10} noise levels of more than 80 dBA require windows with 40 dBA noise reduction. Such an overall noise reduction requirement can be achieved with a window capable of meeting a Laboratory Sound Transmission Class (STC) of 45 dBA or a field STC of 40 dBA. Receptors registering L_{10} noise levels of 75 to 80 dBA will require windows with 35 dBA noise reduction. Such an overall noise reduction requirement can be achieved with a window capable of meeting a Laboratory Sound Transmission Class (STC) of 40 dBA or a field STC of 35 dBA. Receptors registering L_{10} noise levels of 70 to 75 dBA will require windows with 30 dBA noise reduction. Such an overall noise reduction requirement can be achieved with a window capable of meeting a Laboratory Sound Transmission Class (STC) of 35 dBA or a field STC of 30 dBA.

As shown in Table 22-25, existing sensitive uses in the proximity of 5 of the 19 receptor locations would experience significant adverse impacts as a result of the Proposed Action. In order to mitigate these impacts, the City would implement a program to provide new windows and alternative means of ventilation in the locations identified in Table 22-25 to meet the interior noise levels required under the *CEQR Technical Manual*. The level of attenuation would be the same in 2010 and 2025.

With such mitigation measures, there would be no significant adverse impacts for the Proposed Action.

TABLE 22-24
(E) DESIGNATION FOR REQUIRED NOISE ATTENTUATION

30 dBA			35 dBA			40 dBA		
Site No.	Block	Lot(s)	Site No.	Block	Lot(s)	Site No.	Block	Lot(s)
38	762	61	12	710	1,6,11,58	1	702	1
74	762	46,48,49	14	1069	24,29,34,136	2	705	1,5,54,68
			15	1070	1	3	705	29,30,32,39,41,42,45,46,53
			17	1090	9,10,11,109	4	706	1,10,55
			18	1090	20,23,29,36,42	5	706	17,20,29,35,36
			26	734	16,18,52,55	6	707	1,13,56
			36	763	31,32,34,38,42-44	7	707	20,26,31,39,41,45,51
			37	762	6	8	708	1,62,65
			39	762	13,14,16,17,60	9	708	20,22,24,37,41-43,46
			40	761	62	10	709	1-3,7,13-15,17,60,61,63,66-68,70,71
			41	761	10,13,20,43	11	709	25,30,31,33,36,37,41,43,45,46
			42	760	7	13	710	20,22,27,29,42
			44	754	44	16	1070	49,50,54
			45	781	1	19	1051	1,49,50,51,53,57
			46	1069	1	20	1050	1,6,61,158
			47	711	1	21	736	1,73
			53	735	11,12,13,17,55,57-60	22	736	30-40
			54	734	6,7,8,62	23	735	1,6,7,8,9,65
			55	734	9,10,13	24	735	22,30
			56	733	59-66	25	734	1,5,66
			57	733	8,9,58	27	733	1,67,68,70
			58	733	23,24,43,44,45,46,47	28	733	25,28,30,31
			60	732	50	29	732	1,73
			63	728	60	30	731	39,40,41,43,44,48
			64	728	42	31	729	1
			68	763	8,12,14,17,60,65,67	32	729	60
			69	763	49,56,7502	33	729	50
			70	763	28,45,46,47	34	729	50,60,163
			72	762	11	35	1032	1,4,5,7,54,57,58,61,63,64,101,103,162
			73	762	19	43	758	1,5,7,14
			75	761	5,7,9	48	711	1
			76	761	41	49	1071	20,23,29
			77	761	28	50	1051	31-33,35,36,135,138
			78	760	67,68	51	737	30, 31, 32, 33
			79	760	63	52	736	1, 73
			80	760	58-62	59	732	70,72
			81	760	55	61	731	22
			82	760	51	62	728	4,67,69
			83	760	12	65	728	34
			84	760	16,18,20	66	1033	25,41
			85	760	21	67	763	72,73
			86	759	14	71	762	1,2
			87	759	61			
			88	759	23,24,25,26,27,29,54,55			
			89	759	49,52,53			
			90	754	63			
			91	754	51			
			92	780	15,17,19,26,45,60			
			93	779	7,8			
			94	779	25-28,53-56			
			95	778	7,13,16,18,66,70			
			96	778	52,55,57			
			97	778	25,27,28			
			98	778	29,30,31,32			
			99	778	33,34,46			

TABLE 22-25
EXISTING SENSITIVE RECEPTORS AT WHICH IMPACTS WOULD OCCUR

Block	Lot	Receptor	Receptor Location	Required Attenuation	
				35 dBA	40 dBA
706	35	8	Tenth Ave.		X
706	36	8	Tenth Ave.		X
732	72	8	Tenth Ave.		X
732	73	8	Tenth Ave.		X
733	1	8	Tenth Ave.		X
734	66	8	Tenth Ave.		X
728	4	9	Tenth Ave.	X	
731	50	11	W. 34th Street		X
731	58	11	W. 34th Street		X
731	60	11	W. 34th Street		X
731	65	11	W. 34th Street		X
732	7	11	W. 34th Street		X
732	16	11	W. 34th Street		X
732	25	11	W. 34th Street		X
757	1	13	W. 34th Street		X
757	66	13	W. 34th Street		X
760	3	19	Ninth Ave.	X	
760	4	19	Ninth Ave.	X	
760	76	19	Ninth Ave.	X	
760	77	19	Ninth Ave.	X	
761	1	19	Ninth Ave.	X	
761	2	19	Ninth Ave.	X	
761	3	19	Ninth Ave.	X	
761	4	19	Ninth Ave.	X	
761	64	19	Ninth Ave.	X	
761	66	19	Ninth Ave.	X	
759	1	19	Ninth Ave.	X	
735	30	19	Ninth Ave.	X	

Note: Although there would be perceptible (3dBA) increases in noise levels at Receptors 5, 7 and 18, there are no noise-sensitive land uses (i.e., residences or community facilities) that would require attenuation in the immediate vicinity of these three receptors.

E. VIBRATION AND GROUND-BORNE NOISE

1. Introduction

Ground-borne vibration can be a serious concern for people and buildings adjacent to a transit system route, and has the potential to cause buildings to shake and rumbling sounds to be heard. The FTA has published guidelines to assess the vibration impact of transit projects.

Ground-borne vibration from rapid transit systems originates from the wheel-rail interface and passes through the rail and rail fasteners and into the track (e.g., ballasted track, elevated track, etc.) and tunnel structure. The tunnel walls radiate vibration energy into the soil in the form of compression, shear, and surface waves. The nearest face of the foundation or underground building wall responds to the incident of ground-borne vibration and propagates the waves throughout the building. The resulting vibration is a function of the magnitude of the energy source, distance from the source, characteristics of the transmitting media (rock/soil), and response characteristics of the structural element (building).

The waves spread as they propagate away from the source, thus decreasing in intensity with distance; this is known as divergence or spreading loss. In addition to this spreading loss, the waves also lose

some of their energy through absorption by the soil particles; this is known as absorption loss. As these waves transmit from the soil to the supports or foundations of recipient buildings, there is a further reduction referred to as the coupling loss. Vibrations transmitted to building supports or foundations travel to other parts of the building and may excite the walls and the floors of the building, which radiate into the air as ground-borne noise.

Ground-borne vibration typically measures peak particle velocity (PPV) in inches per second as used by the U.S. Bureau of Mines and the construction industry. Decibel levels are also used as units of vibration measurements. The standard decibel level is VdB defined as:

$$VdB = 20 \log_{10} \left(\frac{v}{v_o} \right)$$

where v_o is the reference velocity at 10^{-8} in/sec. In addition to peak particle velocities, the root-square-mean (RMS) value of velocity is widely recommended as a descriptor for human comfort and task interference measures. Other reference values used are 10^{-6} in/sec or 1 micro-inch per second, used in FTA guideline levels. Some typical vibration velocity values are shown in Table 22-26.

For trains traveling on at-grade tracks, the vibration frequency range of interest is typically limited to below 200 Hz, and typical residential structure responds to and is most susceptible to damage by low-frequency excitations around 10 - 30 Hz.

TABLE 22-26
TYPICAL VIBRATION LEVELS

Description	Peak Velocity (in/sec)	VdB RMS (ref. micro-in/sec)
Bureau of Mines Blast Safety Limit		
Less than or Equal to 40 Hz.	2.0	126
Greater than 40 Hz.	0.5	114
Limit for Computer Installation	0.08	98
Inside Building with Equipment Outside 10 Meters Away		
Earthmovers	0.008	78
Sheet Piling	0.006	76
Truck Traffic	0.002-0.004	66-69

VdB = vibration decibels
RMS = Root-Square-Mean velocity

2. Methodology

The evaluation of the subway vibration and ground-borne noise impact followed the FTA guideline methodology. A heavy rail subway in rock-based tunnel was selected as the baseline, operating at the maximum speed of 35 mph and on continuously welded tracks with resilient fasteners with an ongoing wheel and track maintenance program. Only propagation loss in rock layer was accounted for to arrive at the vibration levels at any receptor. To provide a conservative evaluation, no other losses (e.g., coupling loss to building foundation) were assumed.

a) FTA Vibration and Ground-borne Noise Guidelines

The FTA vibration guideline is based on the maximum velocity levels by land use categories (Table 22-26). The criteria for vibration are expressed in terms of RMS velocity levels in decibels (VdB), referenced to 10^{-6} inch per second. The criteria for ground-borne noise are expressed in terms of A- weighted interior sound levels (dBA). Separate and more stringent levels are recommended for buildings such as concert halls, TV and recording studios, and theaters, which warrant special attention to noise and vibration.

TABLE 22-27
FTA GROUND-BORNE VIBRATION AND NOISE IMPACT CRITERIA

Land Use Category	Vibration Impact Levels (VdB re 1 micro inch/sec)		Ground-Borne Noise Impact Levels	
	Frequent Events[1]	Infrequent Events[2]	Frequent Events[1]	Infrequent Events[2]
Category 1: Buildings where low ambient vibration is essential for interior operations	65 VdB[3]	65 VdB[3]	--[4]	--[4]
Category 2: Residents and buildings where people normally sleep	72 VdB	80 VdB	35 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use	75 VdB	83 VdB	40 dBA	48 dBA

1 "Frequent Events" is defined as more than 70 vibration events per day. Most rapid transit projects fall into this category.
2 "Infrequent Events" is defined as fewer than 70 vibration events per day. This category includes most commuter rail systems.
3 This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research processes require detailed evaluation to define acceptable vibration levels.
4 Vibration-sensitive equipment is not sensitive to ground-borne noise.

3. Existing Conditions

The vibration environment in Manhattan is complex. Unlike most locations where one can assume the vibration medium to be nearly homogeneous, the Manhattan underground environment is a complex maze of basements, tunnels, sewers, utility ducts, bedrock, and fill. Existing vibration sources in the study area include subways near street level, poor road conditions, and repairs and constructions. Vibrations from the subway lines are typically localized to within a hundred feet of the line.

a) Vibration Sampling Program

Vibration samplings were conducted at sixteen selected locations within the area, fourteen at street level and two on No. 7 Subway boarding platforms. The purpose of the sampling program was to document existing vibration levels in the study area and at those vibration-sensitive locations closest to the proposed subway alignment with the greatest potential for having significant impacts. The street-level sampling locations are listed in Table 22-28 and shown in Figure 22-5. The accelerometer was typically affixed to the sidewalk at the locations depicted unless otherwise noted.

A state-of-the-art digital vibration data acquisition system was deployed to acquire and to process the vibration data. An Instrumented Sensor Technology, Inc. Vibration Data Recorder with a PCB model Piezotronics Accelerometer was used, along with mounting studs and beeswax. The equipment was factory-calibrated prior to field application.

There are many historical and architectural resources, and other land uses in the Project Area, that are vibration-sensitive. However, the ground vibration effects of the Subway Extension would be strictly localized to those immediately adjacent to the alignment. In addition, since the No. 7 Subway Extension tracks would be deep underground (approximately 60 to 110 feet), no vibration and ground-borne noise levels exceeding the FTA guideline criterion levels are expected at street level or above. Vibration monitoring was therefore limited to locations immediately adjacent to the new alignment. Other locations in the Project Area were sampled to document existing vibration levels.

TABLE 22-28
LOCATION AND LAND USE AT VIBRATION SAMPLING SITES

Site	Site Location	Immediate and Adjacent Land Use
V1	Eighth Avenue between W. 31st and W. 33rd Streets	Commercial/Transportation
V2	Eighth Avenue and W. 38th Street	Commercial/Manufacturing
V3	Eighth Avenue and W. 41st Street	Commercial/Transportation
V4	Port Authority Bus Terminal on Eighth Avenue and W. 42nd Street	Commercial/Transportation
V5	W. 42nd Street and Dyer Avenue	Residential/Institutional/Commercial/Transportation
V6	W. 41st Street and Dyer Avenue	Residential/Institutional/Transportation
V7	St. Raphael's RC Church at W. 41st Street between Tenth and Eleventh Avenues	Residential/Commercial/Transportation/ Manufac-turing
V8	Quill Bus Depot at Eleventh Avenue and W. 41st Street	Commercial/Transportation
V9	Eleventh Avenue and W. 36th Street	Commercial/Transportation/Open Space
V10	Eleventh Avenue between W. 30th and W. 33rd Streets	Transportation
V11	W. 33rd Street and Route 9A	Transportation
V12	W. 34th Street and Route 9A	Transportation
V13	Eleventh Avenue and W. 30th Street	Commercial/Transportation/Manufacturing
V14	St. Michael's Church and Academy at W. 34th Street between Ninth and Tenth Avenues	Residential/Institutional/Commercial
V15	Times Square Station No. 7 Subway Platform	Transportation
V16	Fifth Avenue Station No. 7 Subway Platform	Transportation

Location 1 (V1) was located in front of the Farley Building, on the curb edge of Eighth Avenue, just north of West 31st Street. The Penn Station subway station vents are located along the sidewalk. Subway trains can be heard and felt at street level. Traffic was stop-and-go, typical of Eighth Avenue and much of Manhattan during midday. The road surface was in fair condition. While there were idling heavy trucks generating low frequency airborne sounds, few ground-borne vibrations were registered. The location would be representative of an area with a shallow (approximately 25 to 30 feet) subway tunnel.

Location 2 (V2) was located at West 38th Street and Eighth Avenue. A metal plate on West 38th Street was located just before the intersection. Traffic was heavy, with vehicles generally moving slowly over the metal plate. This location is representative of an area with a deeper subway tunnel.

Location 3 (V3) was located just inside the bus entrance to the Port Authority Bus Terminal at West 41st Street and Eighth Avenue. The accelerometer was affixed about one foot from the curb edge of the bus entrance (West 41st Street). During the sampling period, one bus came to within one foot of the curb. The proposed No. 7 Subway is expected to extend beneath this location.

Location 4 (V4) was located at the northeast corner of the Port Authority Bus Terminal at West 42nd Street and Eighth Avenue. Both West 42nd Street and Eighth Avenue are major thoroughfares with heavy truck and automobile traffic. The accelerometer was affixed to the sidewalk, approximately 10 feet from the curb on West 42nd Street. One of the westbound lanes on West 42nd Street was closed for repairs, although roadwork was not in progress during the vibration sampling at this location.

Location 5 (V5) was situated near the Lincoln Tunnel entrance at Dyer Avenue and West 42nd Street between Ninth and Tenth Avenues. Traffic in and out of the Lincoln Tunnel was heavy, as was the traffic on West 42nd Street. Residences and theaters are present in this area.

Location 6 (V6) was located near the entrance to the Theater Row Studios at the intersection of West 41st Street and Dyer Avenue. Road conditions were fair, with traffic moving to and from the Lincoln

Tunnel. Diesel generators were located in the southeast corner of the intersection, beneath the flyover ramp, which was undergoing repairs. Residential and institutional buildings are located to the west of this intersection.

Location 7 (V7) was located near another Lincoln Tunnel entrance on West 42nd Street between Tenth and Eleventh Avenues. Vibration samples were taken adjacent to St. Raphael's RC Church. Vehicles would periodically hit the curb while turning into the tunnel entrance. Furthermore, there were several potholes in the roadway. However, traffic speeds were generally low.

Location 8 (V8) was located at the southwest corner of West 41st Street and Eleventh Avenue. The accelerometer was affixed to the sidewalk approximately a foot from the northeast corner of the Quill Bus Depot building. An HVAC system was clearly audible at this location, although vibration was not perceptible. Road conditions at this intersection were good.

Location 9 (V9) was located in the open space across from the Convention Center, on Eleventh Avenue between West 35th and West 36th Streets. Truck traffic to the Lincoln Tunnel was backed up northbound on Eleventh Avenue. Traffic southbound was relatively light.

Location 10 (V10) was located on the Caemmerer Yard overpass, between West 32nd and West 33rd Streets on Eleventh Avenue. Measurements were taken while a train passed beneath the overpass. Trucks hitting the expansion joints were clearly audible, although vibration was barely perceptible and of very low frequency.

Location 11 (V11) was sited at the southeast corner of Route 9A and West 33rd Street. The maintenance facility for Caemmerer Yard is located immediately behind the concrete wall along Route 9A. Road condition was fair, with heavy truck traffic occasionally traveling at the speed limit.

Location 12 (V12) was located in the median of Route 9A at West 34th Street. A stop light was located at this location. Traffic was moving well in both directions (northbound and southbound). This location was selected to identify any vibration attributable to Route 9A.

Location 13 (V13) was located at the northeast corner of Eleventh Avenue and West 30th Street. Caemmerer Yard is located immediately to the north, and numerous trains serving Penn Station were evident. Road conditions were poor, with heavy bus and truck traffic from the bus depot and the DSNY garage facilities situated to the west.

Location 14 (V14) was located at the steps of St. Michael's Church and Academy at West 34th Street between Ninth and Tenth Avenues. Traffic was heavy and slow, due to the Lincoln Tunnel entrance to the west.

Locations 15 and 16 (V15 and V16) were located on the No. 7 Subway platforms at the Times Square and Fifth Avenue stations, respectively. Vibration samples at these locations were taken only as a validation of the FTA transit vibration prediction model; these locations were selected to avoid crowd-induced vibrations as much as possible. At V15, the accelerometer was affixed near the east end of the platform, approximately 10 feet from the platform edge. Vibration samples at V16 were also taken at the east end of the platform, approximately 5 feet from the platform edge. A subway track joint was located nearby, and the sound was readily audible as the train ran over the joint.

b) <u>Measured Vibration Levels</u>

Results of the vibration levels sampled are summarized in Table 22-29. Of the 16 locations, 14 measurements were made where the only readily identifiable vibration source was vehicular traffic. Of these 14 measurements, vibration levels greater than 60 VdB were recorded at 3 sites: V3, V4, and V5. Locations V3 and V4 are located at the Port Authority Bus Terminal. Maximum vibration levels measured were 72 VdB and 77 VdB, respectively. A bus entering the facility that passed within 2 feet of the accelerometer had a vibration level of 80 VdB. While traffic on Eighth Avenue and traffic on West 42nd Street were the only potential vibration sources observed, the Bus Terminal

is a major intermodal transit hub with several levels of interstate bus, local bus, and subway lines. Consequently, the vibration levels measured cannot be attributed solely to street traffic. The accelerometer at Location V5 was affixed to the sidewalk adjacent to the building. At Location V5, there was evidence that the sidewalks were hollow. Generally, ground-borne vibration from street traffic is not an environmental concern beyond a short distance from the roadway. Only when heavily loaded trucks travel at high speeds over improperly maintained pavement surface (Present Serviceability Rating of 2.0 or less) would the vibration generated be of concern. A case in point includes a large pothole within 20 feet of location V7, where a medium truck passing over the pothole registered a vibration level of 72 VdB. At the same location, a bus going over a corner curb as it was negotiating a turn registered 95 VdB.

TABLE 22-29
VIBRATION LEVELS IN VdB

Site	Activity	Vibration Level	Site
V1	Passing Subway, Passing Trucks	94	53
	Idling Trucks	<60	-
	Passing Subway	93	40
V2	Moving Traffic over Steel Plate	<60	-
V3	Moving Traffic	72	30
	Bus entering Terminal	77	30
V4	Moving Traffic	77	50
V5	Stop-and-Go Traffic	66	100
V6	Moving Traffic, Distant Generators	<60	-
V7	Moving Traffic over Pothole	72	8
	Bus Hits Curb	95	10
	Traffic at Idle	<60	-
V8	Moving Traffic, nearby HVAC Systems	60	63
V9	Moving Traffic and Idling Trucks	60	80
V10	Moving Traffic	<60	-
V11	Traffic Gridlocked	60	14
V12	Moving Traffic and Idling Trucks	<60	-
V13	Moving Traffic	<60	-
	Train Movement in Yard	82	16
V14	Stop-and-Go Traffic	<60	-
V15	Subway Enters Station	89	18
V16	Subway Enters Station, near Track Joint	96	88

Other major vibration sources measured include train passbys at location V1, with vibration levels in the mid-90s VdB. The subway train noise and vibration were readily perceptible through the subway gratings. The subway lines are located close to the surface at this location. A vibration level of 82 VdB from train movements in Caemmerer Yard was captured at location V13.

Measurements were taken at subway boarding platforms as trains enter and leave the station. At the No. 7 Train Times Square Station platform, maximum vibration levels of 89 VdB were recorded. This vibration level is in fair agreement with the FTA vibration model. A vibration level of 96 VdB was recorded at the No. 7 Fifth Avenue Station platform. However, higher vibration levels at the Fifth Avenue Station are likely the result of an existing nearby track joint.

The existing vibration levels were compared to the FTA criteria in Table 22-30. Of the 16 vibration sampling sites, vibration levels exceeding the FTA Vibration Impact Criteria were recorded at two locations, V1 and V4. In the case of site V1, the vibration occurred at a loosely situated grating above the Eighth Avenue Subway Line. Site V4 was at the Port Authority Bus Terminal. Several sites are not considered existing vibration-sensitive land uses. However, these sites, with the

exception of V15 and V16, would be located on or near vibration-sensitive land uses under the Proposed Action.

The V15 and V16 sites on subway platforms were intended to characterize vibration levels in close proximity to the source. With the FTA model for rapid transit at 40 mph with jointed track, the vibration level is estimated to be 86 VdB at 10 feet from the track centerline. This compared favorably to 89 VdB measured at V15. The measurement at V16, however, was dominated by the acoustic frequency (88 Hz) higher than the lower "ground" or structural vibration frequencies, and is therefore not suitable to use for comparison with the FTA ground-borne vibration prediction model.

TABLE 22-30
EXISTING VIBRATION ENVIRONMENT COMPARED TO FTA CRITERIA

Site	Vibration Level (VdB)	FTA Land Use Category	FTA Impact Criteria	Existing Exceedance
V1	94	3	75	Yes
V2	<60	3	75	No
V3	72	NA	NA	No
V4	77	3	75	Yes
V5	66	2	72	No
V6	<60	2	72	No
V7	72	2	72	No
V8	60	3	75	No
V9	60	NA	NA	No
V10	<60	NA	NA	No
V11	60	NA	NA	No
V12	<60	NA	NA	No
V13	82	NA	NA	No
V14	<60	2	72	No
V15	89	NA	NA	No
V16	96	NA	NA	No

4. 2010 Future Without the Proposed Action

The vibration and ground-borne noise environment in the 2010 Future Without the Proposed Action is expected to remain the same as that under the existing condition. The most significant change between the 2010 Future Without the Proposed Action and today would be traffic growth. However, the peak vibration levels are expected to remain the same.

5. 2010 Future With the Proposed Action With Traffic Mitigation

Preliminary plans for the operation of the proposed subway propose a maximum operating speed of 35 mph along the proposed extension and more than 600 train trips per day in service. Based on the FTA methodology, vibration levels at the closest receptors, V6 and V9, were estimated to be 51 VdB without accounting for any coupling loss, and ground-borne noise levels were estimated to be 31 dBA. These levels are well below the FTA criterion levels for any impact.

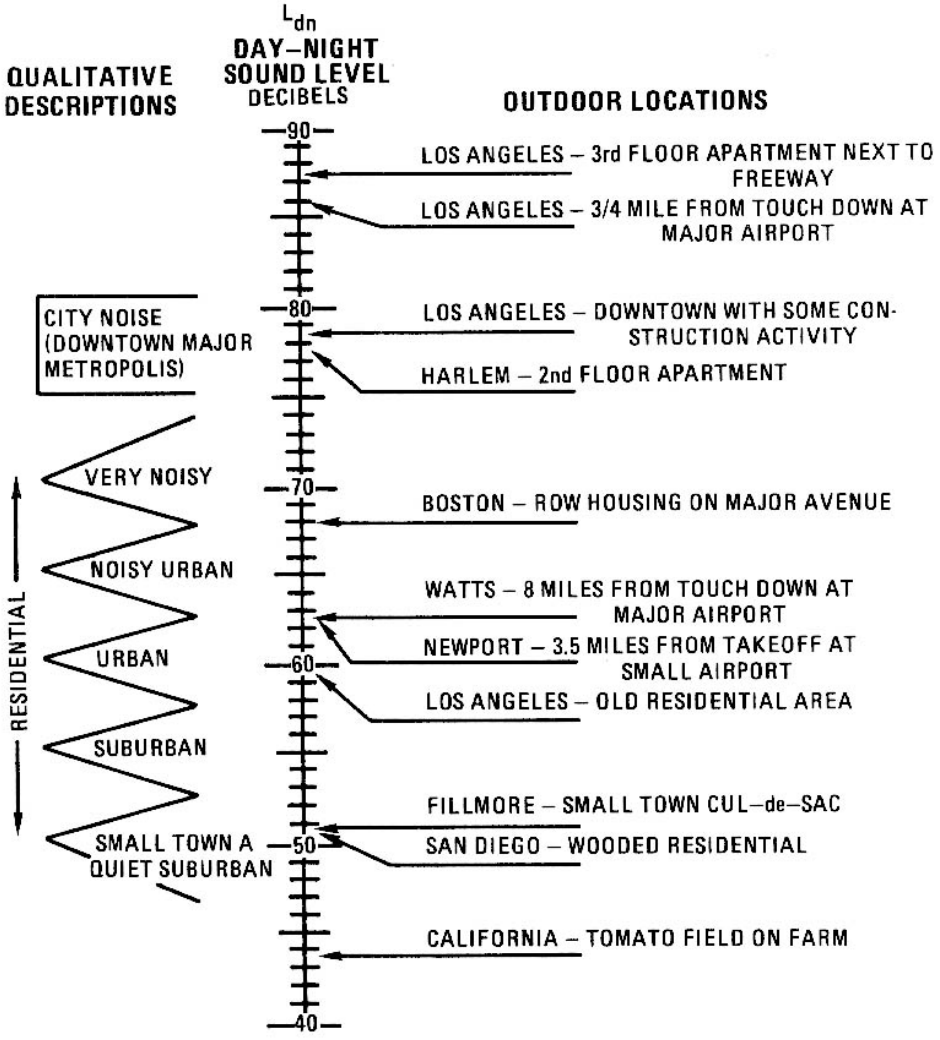
Therefore, significant vibration and ground-borne noise impacts are not expected along the proposed alignment in the 2010 Future With the Proposed Action.

6. 2025 Future Without the Proposed Action

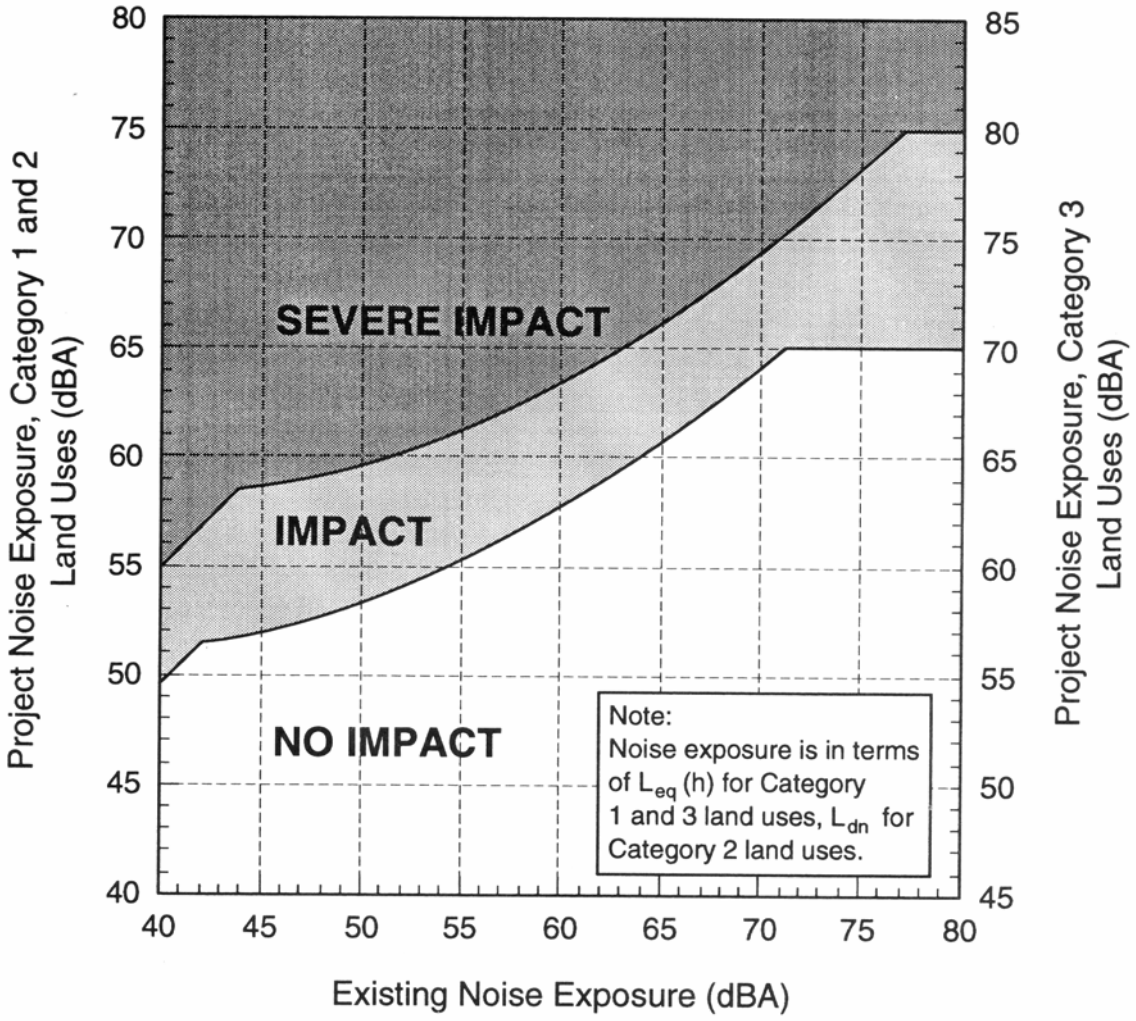
The vibration and ground-borne noise environment in the 2025 Future Without the Proposed Action is expected to be similar to that of the Existing Condition and the year 2010 Future Without the Proposed Action.

7. 2025 Future With the Proposed Action With Traffic Mitigation

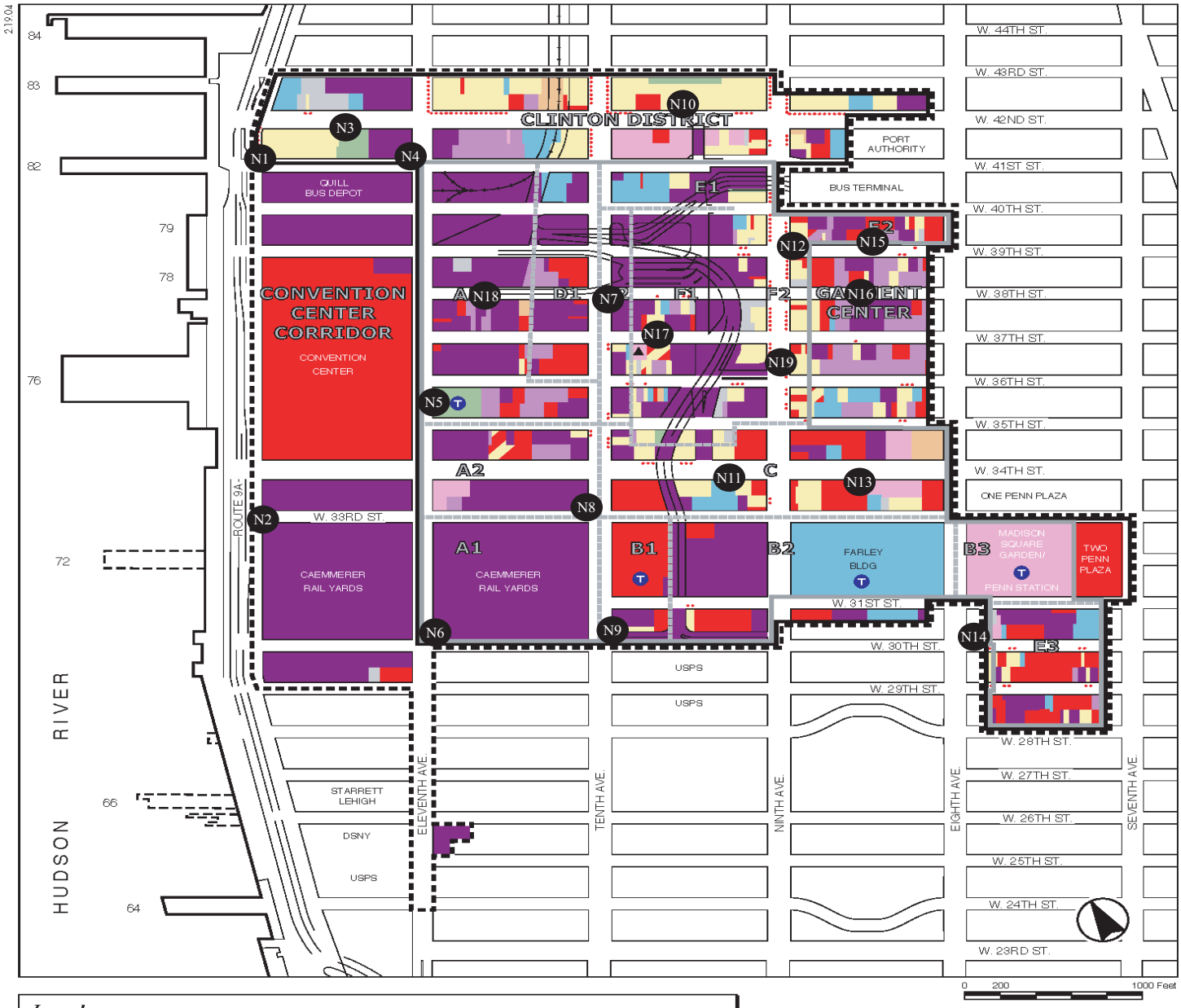
Projected residential, office, and retail space development is expected to occur within the Hudson Yards area between 2010 and 2025. However, material increase in capacity is planned for the No. 7 Subway Extension. Consequently, the vibration and ground-borne noise environment is expected to be the same as that in the 2010 Future With the Proposed Action. No vibration and ground-borne impacts are expected in the year 2025 as a result of the Proposed Action. ❖



Typical Noise Levels in L_{DN}
Figure 22-1

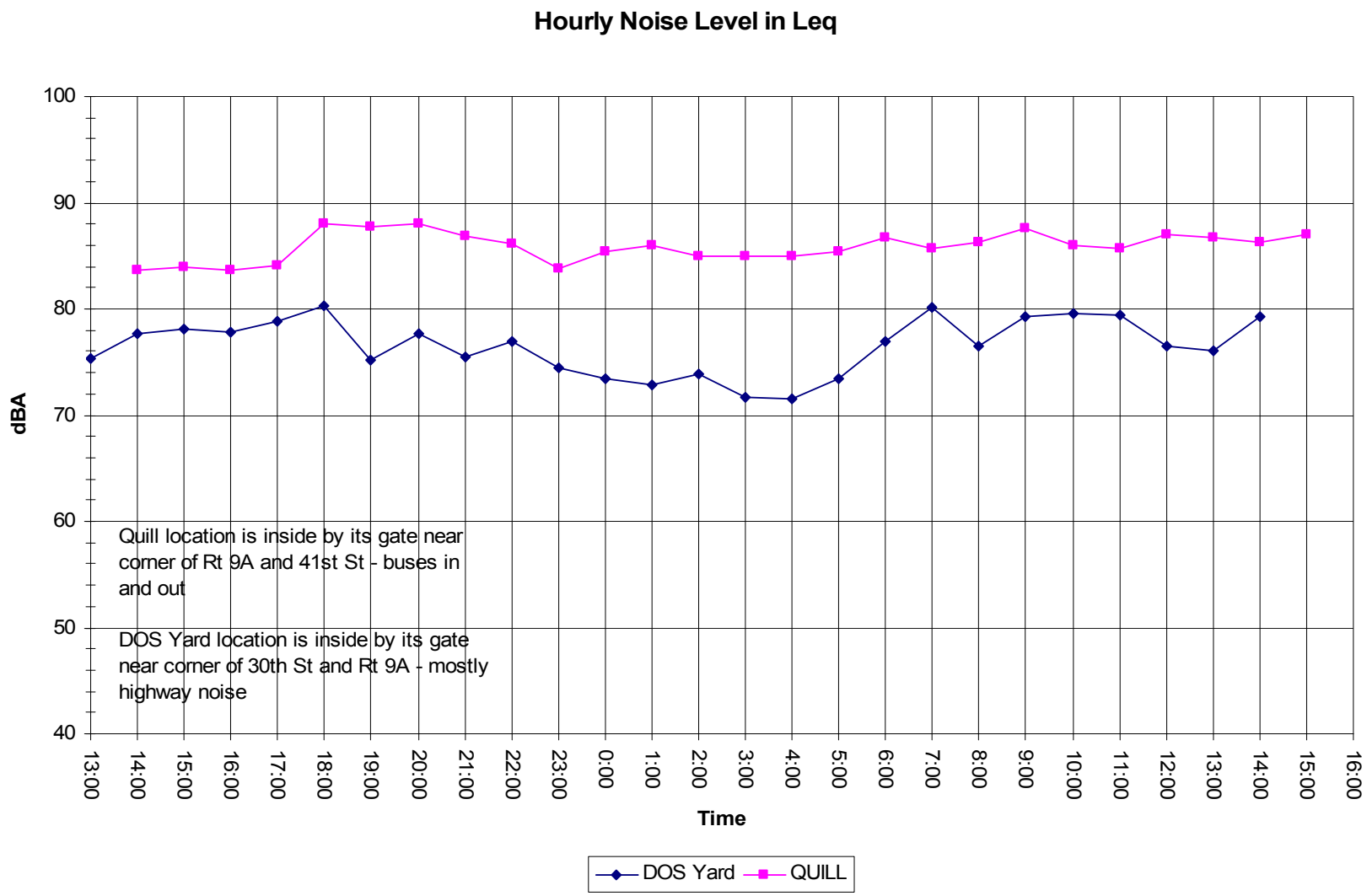


FTA Noise Impact Criteria for Transit Projects
Figure 22-2



Noise Monitoring and Analysis Sites

Figure 22-3



Continuous Noise Monitoring at Quill & DOS Yard
Figure 22-4

Legend

- Proposed Rezoning Area Boundary
- Project Area Boundary
- Proposed Special Hudson Yards District (SHYD) Boundary
- Proposed SHYD Subdistrict Boundary
- A2 Proposed SHYD Subareas
- Residential
- Ground Floor Retail
- Commercial
- Hotels
- Community Facilities/ Institutions
- Entertainment
- Open Space/Recreation
- Industrial/Manufacturing
- Transportation
- Vacant
- Under Construction
- Transportation Below
- V1 Vibration Sampling Site

Subdistrict Names

- A Large-Scale Plan
- B Farley Corridor
- C 34th Street Corridor
- D Tenth Avenue Corridor
- E Other Areas
- F Hell's Kitchen

Location of Vibration Sampling Sites

Figure 22-5