CHAPTER 13: NOISE AND VIBRATION

13.1. INTRODUCTION

This chapter describes potential noise and vibration impacts in the study area from the construction and operation of the proposed Emergency Ventilation Plant for the 8th Avenue and 7th Avenue Subways (Proposed Action). Existing ambient noise levels were measured at nine receptor locations, and vibration levels were measured at seven receptor locations within the study area. Construction noise levels were predicted for various stages and phases of construction, and ground-borne vibration levels from construction activities were predicted and evaluated for potential annoyance and damage to nearby buildings. The technical approach, methodology, and impact criteria were taken from the Federal Transit Administration's *Transit Noise and Vibration Impact Assessment Manual* (FTA, 2006).

13.2. SUMMARY FINDINGS

Ambient noise levels were measured at nine locations, (as shown in Figure 13-1) selected based on existing and anticipated future land-use conditions. Generally, the sites were chosen based on proximity to the three alternative sites for the proposed emergency ventilation plant, proximity to sensitive land-uses nearby, and potential increase in future noise levels. In brief, existing measured L_{eq} noise levels at the receptor locations ranged from 67 to 76 A-weighted decibels (dBA). Predicted construction noise levels vary widely at each receptor location due to different stages and phases of work, but are expected on occasion to exceed FTA's criteria of 80 dBA L_{eq} (8-hr) for residences, due primarily to the installation of secant piles. As such, potentially significant adverse impacts from construction noise would occur under the three alternatives. These adverse impacts would be minimized by mitigation measures identified in the CEPP and would be included in the construction contracts.

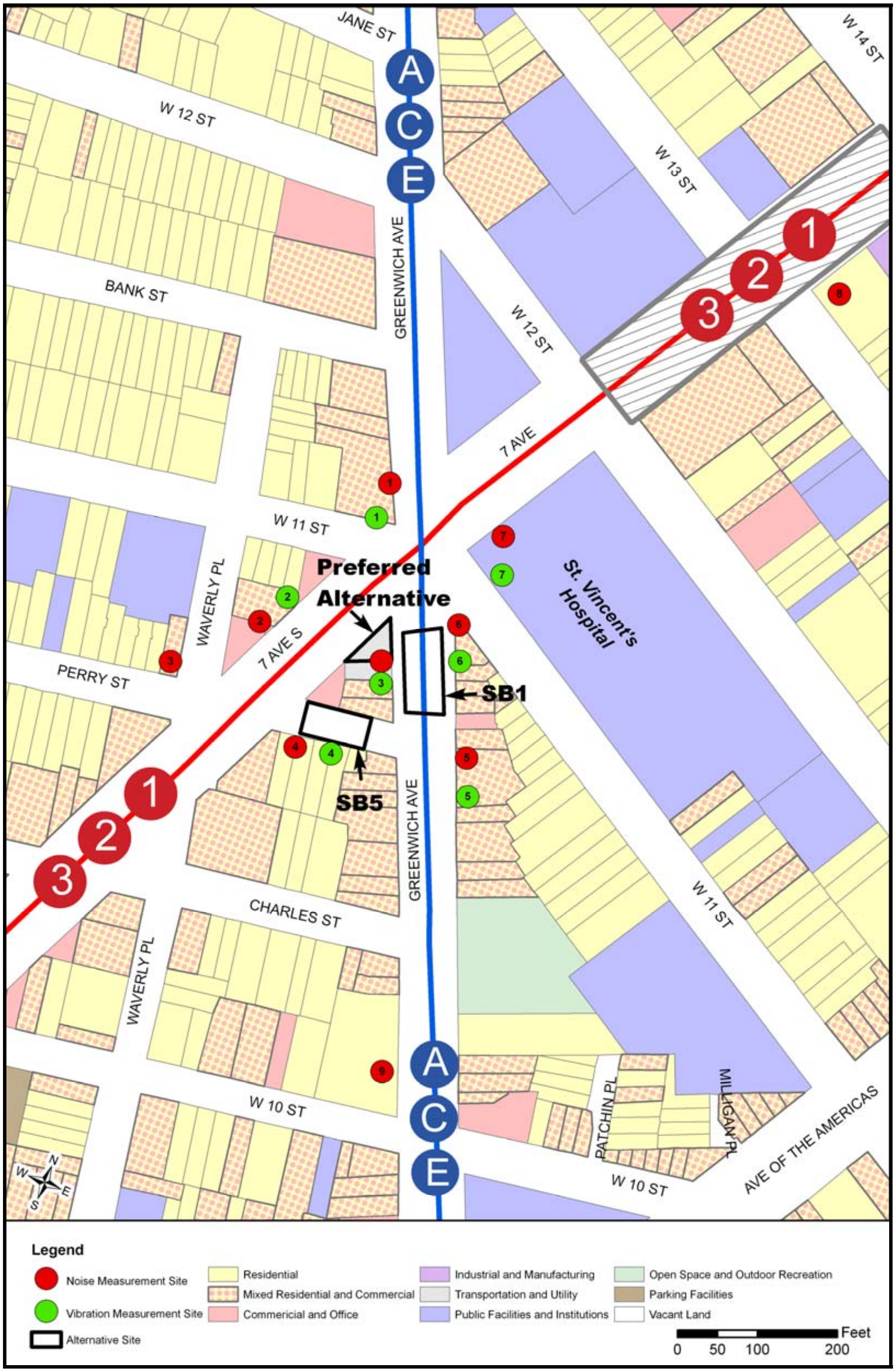
Vibration measurements were taken at seven receptor sites as shown in Figure 13-1. The major sources of vibration in the study area are subways, automobiles, trucks, and buses and existing measured ground-borne vibration velocity levels at the receptor locations ranged from 72 to 89 decibels (VdB). Predicted construction vibration levels vary widely at each receptor location, but are expected on occasion to exceed FTA's annoyance criteria of 72 VdB for residences, and 75 VdB for commercial buildings, due primarily to the use of pile drivers and hoe rams. (The FEIS noise and vibration analysis assumed a "worst-case" scenario, and MTA NYCT has committed not to use impact pile drivers during construction). Under certain circumstances, there is also the possibility that vibration levels could exceed FTA's damage criterion of 102 VdB; thus, mitigation measures to reduce construction vibration are warranted and would be included in the construction contracts.

13.3. CONCLUSIONS

13.3.1. CONSTRUCTION NOISE IMPACTS

Noise levels associated with the different stages of project construction activities were quantified for the Preferred Alternative and Alternatives SB1 and SB5 by using the FHWA RCNM (Federal Highway Administration's *Roadway Construction Noise Model*). The impact assessment considered the extent and duration of noise impact at each potentially affected noise receptor location during each stage and phase of construction. FTA's construction noise criteria are used for the impact analysis of the proposed ventilation plant. Predicted construction noise levels vary widely at each receptor location due to different stages and phases of work, but are expected on occasion to exceed FTA's criteria of 80 dBA L_{eq} (8-hr) for residences, due primarily to the installation of secant piles.

FIGURE 13-1: NOISE AND VIBRATION STUDY AREA



The Preferred Alternative would have the fewest number of potential construction noise impacts, with these impacts expected to occur during the years 2010 and 2011. Alternative SB1 would have the greatest number of potential construction noise impacts, with these impacts expected to occur during in the years 2010, 2011, 2012, and 2013. Alternative SB5 would result in a moderate number of potential construction noise impacts, with these impacts expected to occur during the years 2010 and 2012. Potentially significant adverse impacts from construction noise would occur under the three alternatives. These adverse impacts would be minimized by mitigation measures identified in the CEPP and would be included in the construction contracts.

13.3.2. CONSTRUCTION VIBRATION IMPACTS

As shown in Table 13-10 through 13-12, with the exception of pile drivers, vibration levels for the types of equipment likely to be used during constructions are estimated to be below the vibration damage threshold criterion for buildings, but would likely cause vibration levels exceeding FTA's annoyance criteria. Since the FEIS analyzed a "worst-case" scenario, it can be concluded, based on MTA NYCT's commitment not to use impact pile drivers, that vibration levels under all three alternatives would be below the threshold criteria for building damage.

13.3.3. CONSTRUCTION-RELATED TRAFFIC NOISE IMPACTS

Two analysis sites (N-8 and N-9) were selected and monitored in order to evaluate the potential effect of construction-related truck noise. These two locations are situated away from the on-site construction activity. Based on the analysis, there would be no construction-related traffic noise impacts at the two potentially affected noise monitoring sites (N-8 and N-9 are adjacent to residential and institutional uses) since they are located far from the construction activity.

13.3.4. OPERATIONAL NOISE IMPACTS

Noise from the mechanical ventilation of the subway tunnels will result primarily from the operation of the fans used for tunnel supply air and exhaust through the louvers. Exterior noise levels from the proposed ventilation plant would be consistent with New York CEQR noise criteria, which limit ventilation noise levels to 65 dBA during the daytime and less than a 3-dBA increase over the nighttime existing L_{eq} noise level. This will be accomplished by establishing appropriate noise-related specifications for the ventilation system, including ventilation duct work, airflow velocities, louvered openings in the ventilation plant exterior walls, fan type, fan size, pressure drop and silencer characteristics.

13.3.5. CONSTRUCTION ENVIRONMENTAL PROTECTION PLAN (CEPP)

MTA NYCT is committed to developing and implementing an extensive mitigation program to reduce and alleviate the project's potential noise and vibration impacts. In order to minimize potential construction noise and vibration impacts, MTA NYCT proposes to incorporate mitigation measures in its Construction Environmental Protection Program (CEPP) and related plans and construction specifications by incorporating noise reduction features. These mitigation measures, by way of the CEPP, would be implemented within the construction of the emergency ventilation plant to proactively reduce potentially adverse effects associated with noise and vibration. Contractors will be required to implement mitigation measures to achieve the levels specified in the performance standards identified in Tables 13-1 and 13-5 for noise and in Table 13-2 for vibration.

NOISE CONTROL METHODS

Notwithstanding the specific noise levels specified herein, MTA NYCT will utilize the noise control measures listed below to minimize to the greatest extent feasible the noise levels in neighborhoods near the construction site:

- Utilize OSHA-compliant quieter-type, manually adjustable backup alarms set to their low level.
- Utilize shields, impervious fences or other physical barriers to inhibit transmission of noise.
- Utilize sound attenuating housings or enclosures around noise producing equipment.
- Utilize effective intake and exhaust mufflers on internal combustion engines and compressors.
- Line or cover hoppers, storage bins and chutes with sound absorbing material.
- Avoid the use of pneumatic or gasoline driven saws.
- Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.
- Route construction equipment and other vehicles carrying spoils, concrete or other materials over streets and routes that would cause the least disturbance to residents in the vicinity of the activity.
- Position stationary equipment to minimize noise impact on the community.
- Avoid the use of impact pile driving methods wherever practicable. Where piles must be driven, vibratory, sonic, or other types of pile drivers that produce slightly lower vibration levels would be used.
- Develop and implement a noise-monitoring program in order to quantify noise levels at nearby sensitive receptors during construction.

VIBRATION CONTROL METHODS

Notwithstanding the specific vibration levels specified herein, MTA NYCT will utilize vibration control measures listed below to minimize to the greatest extent feasible the vibration levels in all neighborhoods near the construction site:

- Use vibratory pile drivers or auguring for setting piles in lieu of impact pile drivers.
- Specify realistic vibration limits in contract documents, such as those listed in Table 13-2.
- Develop and implement a vibration-monitoring program in order to quantify vibration levels at nearby sensitive receptors during construction.
- Inform people living and working in the vicinity about construction method, possible effects, quality control measures, and precautions to be used; and the channels of communication available to them.
- Route truck traffic and heavy equipment to avoid impacts to sensitive receptors.
- Properly secure street decking over cut-and-cover excavations.
- Schedule work to limit nighttime work in residential areas.
- Minimize the duration of any high vibration activities.

In addition to the mitigation measures described above, NYCT would consult with appropriate agencies, such as the NYCDOB, and refer to applicable guidance set forth by the New York State Office of Parks, Recreation and Historic Preservation (OPRHP) and the New York City Landmarks Preservation Commission (LPC) to protect historic resources from increased vibration levels associated with construction activities. The CEPP would be developed pursuant to consultation with the OPRHP and would be implemented before commencement of any excavation or construction. The CEPP would include an overall plan of protection and avoidance of structural and architectural damage for all the potentially affected historic resources.

13.4. STUDY AREA

The study area for the analysis of noise and vibration was based on where potential impacts could occur during construction and operation of MTA NYCT's emergency ventilation plant. The study area includes construction truck routes and construction areas surrounding the alternative sites for the proposed emergency ventilation plant as well as the emergency ventilation plant itself (Figure 13-1). Noise-sensitive receptors are located within the study area, including residential apartments, with the lower floors typically occupied by commercial establishments, and a hospital (St. Vincent's Hospital).

13.5. NOISE AND VIBRATION CHARACTERISTICS

Environmental noise and vibration in built-up urban areas is generated by numerous sources including airplanes, factories, railroads, power generation plants, construction equipment, and highway vehicles. Noise and vibration may have adverse effects on humans in a variety of ways, depending on how loud and how often the noise is heard, and the potential for vibration to annoy people or damage buildings.

The following section provides an overview of the ways that noise and vibration are measured and predicted in environmental impact analyses. The "decibel" as the unit of measurement of sound and vibration levels is defined. The use of A-weighting to account for the way that sound levels are perceived by the human ear, and a logarithmic addition procedure to combine noise levels from different sources and over different time periods, are described.

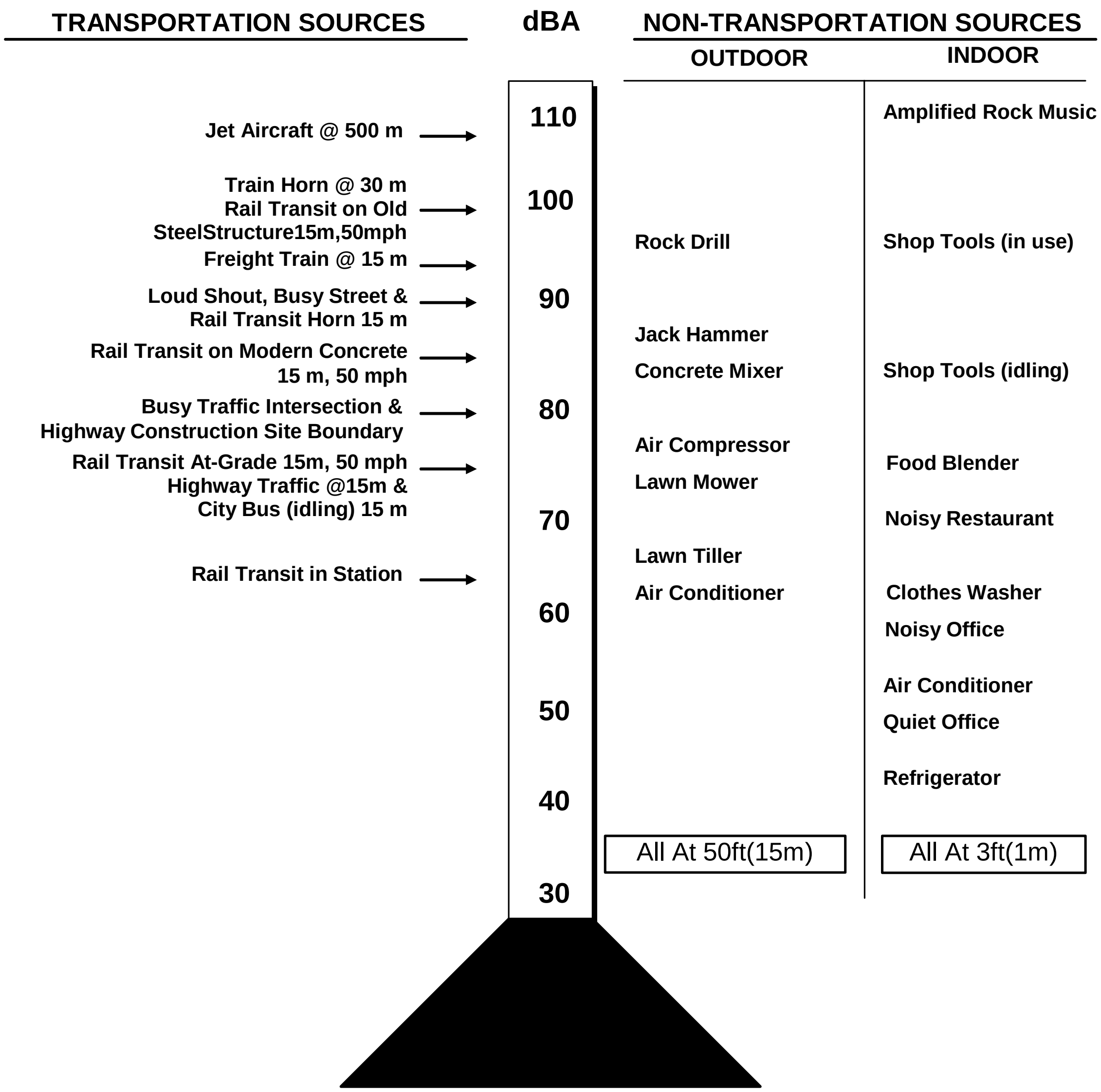
13.5.1. SOUND LEVEL CHARACTERISTICS

Sound pressure is the parameter that is normally measured in noise assessments. People's hearing respond to sound pressures that represent the range from the threshold of hearing to the threshold of pain. For convenience, this vast range is represented as a logarithmic scale. A basic measure of sound is the sound pressure level (SPL), which is expressed in decibels (abbreviated as dB). When the SPL = 0 dB, the sound pressure is the same as the threshold of hearing. Therefore, 0 dB corresponds to the threshold of hearing, or the SPL at which people with healthy hearing can just begin to hear a sound.

Sound is often measured and described in terms of its overall energy, taking all frequencies into account. However, the human hearing process is not the same at all frequencies. Therefore, noise measurements are often adjusted or weighted, as a function of frequency to account for human perception and sensitivities. The A-weighted adjustment method is the most commonly used. Sound levels using this weighting are noted as dBA. Some common sources with their dBA values are shown in Figure 13-2.

It is important to note that individuals have different sensitivities to noise, relating to loudness, noise patterns, etc. For example, noises occurring during sleeping hours are usually considered to be more of a nuisance than the same noises in the daytime. Individuals tend to judge the annoyance of an unwanted noise in terms of its relationship to noise from other sources. For instance, the blowing of a car horn at night when background noise levels are typically about 45 dBA would generally be more objectionable than the blowing of a car horn in the afternoon when background noises are likely to be 60 dBA or higher. The interference of noise is related to the type of activity occurring where the noise is heard. In a 60-dBA environment, work activities requiring high levels of concentration may be interrupted by loud noises, while activities requiring manual effort may not be interrupted by noise to the same degree.

FIGURE 13-2: COMMON INDOOR AND OUTDOOR NOISE LEVELS



Sources: FTA Report DOT-T-95-16. "Transit Noise and Vibration Impact Assessment: Final Report", May 2006

Sound is described by a logarithmic scale and sound levels cannot be simply added. In fact, a doubling of the noise source produces only a 3-dBA increase in the sound pressure (noise) level. For example, two sounds of 50 dBA added together would be equal to 53 dBA, not 100 dBA. In other words, a doubling of sound sources would only increase the total sound level by 3 dBA. Studies have shown that a 3-dBA increase is barely perceptible to the human ear, whereas a change of 5 dBA is readily perceptible. As a general rule, an increase or decrease of 10 dBA in noise level is perceived by a listener to be a doubling or halving of the sound, respectively.

One way of describing fluctuating sound is to describe the noise heard over a specific period as if it had been a steady, unchanging sound level. For this condition, a descriptor called the L_{eq}, or "level equivalent", sound level is used. L_{eq} is the constant sound level that, in a given situation and period, conveys the same acoustical energy as the actual time-varying sound.

13.5.2. VIBRATION CHARACTERISTICS

Although ground-borne vibration is sometimes noticeable outdoors, it is almost exclusively an indoor problem. Vibrations of floors and walls of the building may cause perceptible vibrations or rattling of windows or dishes, or even a rumbling noise heard by people inside. The rumbling noise is termed "ground-borne noise" as opposed to the "air-borne noise" from the outdoor noise sources heard outside the house or inside with windows open. Vibration effects can range from simply causing annoyance to people inside buildings, to minor (cosmetic) damage to walls and ceiling, to major structural damage, although the latter is an extremely rare occurrence.

In order to determine the level at which ground-borne vibration interferes with human activity it is important to determine what scale to use. For some fields of interest, the range of vibration intensities is extremely wide and, as in the case of noise, a decibel scale is used. However, vibration decibels are based on a different scale than noise decibels. In other fields, vibration levels are usually restricted to narrow and direct measurement units (called engineering units). The frequency range of interest may be very small or very large. Further, the desired parameter for assessment purposes could be displacement, velocity, or acceleration caused by vibration.

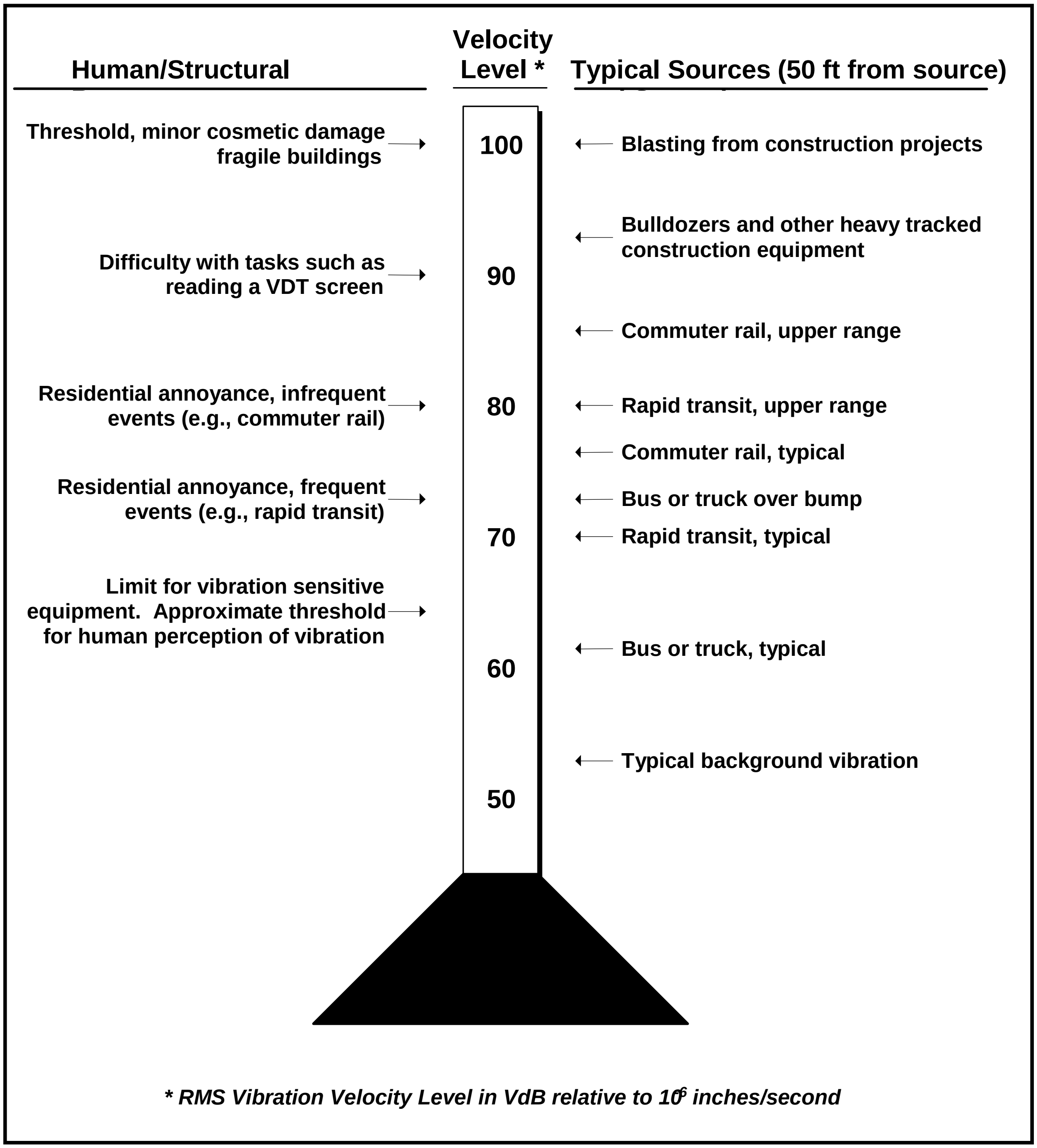
In order to accommodate a wide range of data needs, a spectral analysis of vibration velocity and acceleration levels is needed to assess human perception. Velocity is the preferred unit for assessing potential damage to buildings because it is a measure of the energy carried by vibration. Because of the general preference to use velocity as a measure of both annoyance and building damage, vibration criteria and predicted vibration levels are presented in terms of overall vibration velocity levels in decibels (VdB). Figure 13-3 illustrates common sources of vibration and the human or structural response to these velocity levels. The perceptibility threshold is about 65 VdB. Damage to buildings may occur at levels above 100 VdB, although damage to old, fragile, or historic buildings may occur at levels above 95 VdB.

13.6. REGULATORY FRAMEWORK

13.6.1. INTRODUCTION

The noise analysis of MTA NYCT's emergency ventilation plant construction and operation was conducted according to FTA noise and vibration guidelines contained in *Transit Noise and Vibration Impact Assessment*, May 2006, which specifically relates to transit projects.

FIGURE 13-3: COMMON VIBRATION SOURCES AND LEVELS



Source: Transit Noise and Vibration Impact Assessment, FTA, DOT-T-95-16, May 2006

13.6.2. FTA NOISE GUIDELINES

FTA's guidance manual describes a recommended noise assessment methodology, based on various transportation-related and construction noise sources. Receptors are noise-sensitive locations where human activity may be adversely affected when noise levels exceed predefined thresholds of acceptability for residential, commercial, or industrial land-uses.

In the case of construction noise criteria, FTA guidelines identify a screening distance of 1,500 feet between construction noise sources and noise-sensitive receptors. Within this distance, detailed noise assessment is recommended. The noise criteria and the descriptors used to evaluate project noise from construction and operations are dependent on the type of land-use in the vicinity of the proposed project.

Table 13-1 presents FTA's construction noise criteria for both the *general noise assessment* and the *detailed noise assessment* conducted in accordance with FTA methodologies. Whereas work activities are expected to only occur during the daytime, noise impact would occur if noise levels at the nearest noise-sensitive receptor exceed FTA's-recommended daytime values during construction as shown in Table 13-1.

TABLE 13-1: FTA IMPACT CRITERIA FOR CONSTRUCTION

Land-use	8-hour L_{eq} (dBA)	
	Day	Night
Residential	80	70
Commercial	85	85
Industrial	90	90

Source: *Federal Transit Administration, Transit Noise and Vibration Assessment, May 2006.*

13.6.3. FTA VIBRATION GUIDELINES

FTA's *Transit Noise and Vibration Impact Assessment* guidelines include a set of threshold criteria for ground-borne vibration and ground-borne noise during transit operations. Vibration levels for typical human and structural responses are shown in Table 13-2. The threshold criteria are based on past experiences with human sensitivity and community responses to ground-borne vibration. In terms of vibration during construction, FTA defines a set of damage threshold criteria in VdB, which is often used in measuring the magnitude of vibration. FTA's criteria for environmental impact from ground-borne vibration from transit operations are based on the maximum levels for a single event. The criteria are specified for three land-use categories that include, in descending order of sensitivity, buildings where low vibration is essential, residences, and commercial/institutional buildings.

TABLE 13-2: FTA GROUND-BORNE VIBRATION IMPACT CRITERIA[1]

Land-use Category	Vibration Velocity Impact Levels	
	Frequent Events[2]	**Infrequent Events[3]**
Category 1: Buildings where low ambient vibration is essential for interior operations	65 VdB[4]	65 VdB[4]
Category 2: Residences and Buildings where people normally sleep	72 VdB	80 VdB
Category 3: Institutional land-uses with primarily daytime use	75 VdB	83 VdB

Source: FTA report FTA-VA-90-1003-06, May 2006

Notes:
1. Vibration Levels Expressed in VdB are 1 micro inch/sec.
2. "Frequent Events" is defined as more than 70 vibrations per day.
3. "Infrequent Events" is defined as fewer than 70 vibration events per day.
4. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscope.

13.6.4. FTA VIBRATION CRITERIA FOR BUILDING DAMAGE

FTA guidelines for assessing vibration damage criteria are presented in FTA's Manual for various structural categories. For the building category that includes reinforced concrete, steel, or timber, the threshold for minor cosmetic damage is a peak particle velocity (PPV) of 0.5 inches per second. This is consistent with procedures promulgated by the New York City Department of Buildings. A peak particle velocity of 0.5 inches per second corresponds to a vibration velocity level of 102 VdB when a crest factor (Peak/RMS) of 4 is assumed.

13.6.5. NEW YORK CITY DEPARTMENT OF BUILDINGS (NYCDOB) POLICY

NYCDOB has developed a set of policy and procedures (PPN # 10/88) in order to avoid potential damage to historical structures resulting from adjacent construction, and for any existing structure designated by the Commissioner. The procedures require a monitoring program to reduce the likelihood of construction damages to adjacent historical structures and to detect at an early stage the beginnings of damage so that construction procedures can be changed. PPN # 10/88 includes a PPV threshold of 0.5 inches per second for potential vibration damage.

13.7. EXISTING CONDITIONS

13.7.1. AMBIENT NOISE MEASUREMENTS

Ambient noise levels were measured in September 2007 at a total of nine locations, as shown in Figure 13-1, using instrumentation that meets or exceeds accuracy requirements described in ANSI Standard S1.4. These sites were selected for noise measurements based on existing and anticipated future land-use conditions. Generally, the sites were chosen on the basis of proximity to the three alternative sites for the proposed emergency ventilation plant (i.e., Seventh Avenue, Perry Street, and Greenwich Avenue), proximity to sensitive land-uses nearby, and potential increase in future noise levels. All of the monitoring locations were selected due to their close proximity to an existing residential building and the proposed ventilation plant construction area. The nine sites are primarily located at mid-block locations, rather than intersections, in order to better reflect residential, institutional, and other representative receptors in the project area.

The microphone for the noise measurements was placed at a position typical of residential noise exposure, e.g., at the setback near the front facade of dwellings. As a rule, the position was along an intersecting street to minimize the influence of sound reflected from buildings, preferably where the cross street traffic was much less significant that of the evaluated right-of-way.

Short-term measurements were performed using manually attended instrumentation for periods nominally 15 minutes in length, during which both objective sound level statistics and subjective observations of noise sources were recorded. Measurements were performed on weekdays - excluding Monday mornings and Friday afternoons and evenings to avoid possible weekend-traffic influences. The measurements were performed in the peak-traffic periods, nominally between 10 AM and 2 PM.

The results of the noise measurements taken at the nine receptor locations are provided in Table 13-3. The L_{eq} (1-hour) noise levels ranged from a low level of 67 dBA to a high level of 76 dBA.

13.7.2. GROUND-BORNE VIBRATION MEASUREMENTS

Vibration measurements were taken at seven receptor sites as shown in Figure 13-1. The major sources of vibration in the study area are subways, automobiles, trucks, and buses. The resulting measured vibration levels can be seen in Table 13-4. Subway trains traveling under Seventh Avenue and Greenwich Avenue and their contribution to the existing background vibration level are reflected in the field measurements. Vibration measurements in the vicinity of the three alternative sites measured between 72 and 89 VdB; which exceeds FTA vibration criteria for all land-use categories except at the St. Vincent's Hospital (see Table 13-4).

13.8. ENVIRONMENTAL CONSEQUENCES

13.8.1. NOISE FROM CONSTRUCTION ACTIVITIES

Noise levels from the different phases of construction activities were quantified for the Preferred Alternative and Alternatives SB1 and SB5 by using the FHWA RCNM (Federal Highway Administration's *Roadway Construction Noise Model*). The construction equipment noise emission levels used as input to this model are the same as those specified in the New York City Department of Environmental Protection (NYCDEP) construction noise regulations. The equipment noise emissions and acoustical usage factors in the RCNM model can be seen in Table 13-5.

The modeling procedures use an equation that accounts for the noise level of each piece of construction equipment, the amount of time the equipment is in use (usage factor), and the distance between the equipment and the receptor. The combination of noise from several pieces of equipment operating during the same time period is obtained from addition of the L_{eq} values for each piece of equipment.

The results of the construction-phase noise analysis for the Preferred Alternative and Alternatives SB1 and SB5 are summarized below and are also presented in Tables 13-6 through 13-8. The impact assessment considered the duration of noise impact at each noise monitoring location during each stage of construction (see Chapter 4: Construction Methods and Activities, Section 4.4.2). Noise monitoring sites N-8 and N-9 are not affected by construction noise since they are located too far away. These two sites were monitored in order to investigate the potential traffic noise impact from construction-related trucks passing through these two areas.

TABLE 13-3: EXISTING NOISE MEASUREMENT RESULTS

Receptor Number	Measurement Site Address	Land-use	Measured L_{eq} (1-hr) (dBA)	FTA Criteria* (dBA)
N-1	Two Boots To Go West Pizza @ 201 West 11th Street (6-story building - upper levels residential)	Commercial & Residential	73	80
N-2	Rear of apartment building facing Seventh Avenue @ 227 Waverly Place (6-story building)	Residential	71	80
N-3	Doma & Gallery @ 17 Perry Street (4-story building - upper levels residential)	Commercial & Residential	69	80
N-4	Apartment Building @ 4 Perry Street (4-story building)	Residential	67	80
N-5	The Original Sandwich Shoppe of NY @ 58A Greenwich Avenue (4-story building - upper levels residential)	Commercial & Residential	70	80
N-6	West Village Florist @ 70 Greenwich Avenue (4 story building - upper levels residential)	Commercial & Residential	71	80
N-7	St. Vincent's Hospital Reiss Pavilion @ 153 West 11th Street (10 story building)	Institutional	71	80
N-8	Apartment Building @ 175 West 13th Street	Residential	76	80
N-9	Apartment Building @ 33 Greenwich Avenue	Residential	73	80

* FTA criteria for construction noise based on 8-hour L_{eq} for various land use.

TABLE 13-4: EXISTING VIBRATION MEASUREMENT RESULTS

Receptor Number	Measurement Site Address	Land-use	Measured PPV (inches/sec)	Measured Level (VdB)	FTA Criteria* (VdB)
V-1	Two Boots To Go West Pizza @ 201 West 11th Street (6-story building - upper levels residential)	Commercial & Residential	0.008	78	72
V-2	Rear of apartment building facing Seventh Avenue @ 227 Waverly Place (6-story building)	Residential	0.015	84	72
V-3	Doma & Gallery @ 17 Perry Street (4-story building - upper levels residential)	Commercial & Residential	0.030	89	72
V-4	Apartment Building @ 4 Perry Street (4-story building)	Residential	0.0075	78	72
V-5	The Original Sandwich Shoppe of NY @ 58A Greenwich Avenue (4-story building - upper levels residential)	Commercial & Residential	0.0155	84	72
V-6	West Village Florist @ 70 Greenwich Avenue (4 story building - upper levels residential)	Commercial & Residential	0.004	84	72
V-7	St. Vincent's Hospital Reiss Pavilion @ 153 West 11th Street (10 story building)	Institutional	0.0155	72	75

* FTA criteria for construction noise based on 8-hour L_{eq} for various land use.

TABLE 13-5: CONSTRUCTION NOISE EMISSION LEVELS AND USAGE FACTORS

revised: 7/26/05		Acoustical	Spec 721.560	Actual Measured
	Impact	Use Factor	Lmax @ 50ft	Lmax @ 50ft
Equipment Description	**Device ?**	**(%)**	**(dBA, slow)**	**(dBA, slow)**
				(samples averaged)
All Other Equipment > 5 HP	No	50	85	-- N/A --
Auger Drill Rig	No	20	85	84
Backhoe	No	40	80	78
Bar Bender	No	20	80	-- N/A --
Blasting	Yes	-- N/A --	94	-- N/A --
Boring Jack Power Unit	No	50	80	83
Chain Saw	No	20	85	84
Clam Shovel (dropping)	Yes	20	93	87
Compactor (ground)	No	20	80	83
Compressor (air)	No	40	80	78
Concrete Batch Plant	No	15	83	-- N/A --
Concrete Mixer Truck	No	40	85	79
Concrete Pump Truck	No	20	82	81
Concrete Saw	No	20	90	90
Crane	No	16	85	81
Dozer	No	40	85	82
Drill Rig Truck	No	20	84	79
Drum Mixer	No	50	80	80
Dump Truck	No	40	84	76
Excavator	No	40	85	81
Flat Bed Truck	No	40	84	74
Front End Loader	No	40	80	79
Generator	No	50	82	81
Generator (<25KVA, VMS signs)	No	50	70	73
Gradall	No	40	85	83
Grader	No	40	85	-- N/A --
Grapple (on backhoe)	No	40	85	87
Horizontal Boring Hydr. Jack	No	25	80	82
Hydra Break Ram	Yes	10	90	-- N/A --
Impact Pile Driver	Yes	20	95	101
Jackhammer	Yes	20	85	89
Man Lift	No	20	85	75
Mounted Impact Hammer (hoe ram)	Yes	20	90	90
Pavement Scarafier	No	20	85	90
Paver	No	50	85	77
Pickup Truck	No	40	55	75
Pneumatic Tools	No	50	85	85
Pumps	No	50	77	81
Refrigerator Unit	No	100	82	73
Rivit Buster/chipping gun	Yes	20	85	79
Rock Drill	No	20	85	81
Roller	No	20	85	80
Sand Blasting (Single Nozzle)	No	20	85	96
Scraper	No	40	85	84
Shears (on backhoe)	No	40	85	96
Slurry Plant	No	100	78	78
Slurry Trenching Machine	No	50	82	80
Soil Mix Drill Rig	No	50	80	-- N/A --
Tractor	No	40	84	-- N/A --
Vacuum Excavator (Vac-truck)	No	40	85	85
Vacuum Street Sweeper	No	10	80	82
Ventilation Fan	No	100	85	79
Vibrating Hopper	No	50	85	87
Vibratory Concrete Mixer	No	20	80	80
Vibratory Pile Driver	No	20	95	101
Warning Horn	No	5	85	83
Welder / Torch	No	40	73	74

Source: Roadway Construction Noise Model (RCNM), FHWA 2006

TABLE 13-6: THE PREFERRED ALTERNATIVE: CONSTRUCTION NOISE AT RECEPTOR LOCATIONS

Receptor Number	Receptor Description	Distance from the Site (ft)	Existing Noise Level (L_{eq} dBA)	Range of Predicted Noise Levels for all Phases and Stages (L_{eq} dBA)	FTA Criteria* (L_{eq} dBA)	Potential Impact (Yes/No)
N-1	Two Boots To Go West Pizza @ 201 West 11th Street	189	73	66 to 83	80	Yes
N-2	Rear of apartment bldg facing Seventh Avenue @ 227 Waverly Place	147	71	68 to 86	80	Yes
N-3	Doma & Gallery @ 17 Perry Street	253	69	63 to 81	80	Yes
N-4	Apartment building @ 4 Perry Street	158	67	68 to 85	80	Yes
N-5	The Original Sandwich Shoppe of NY @ 58A Greenwich Avenue	232	70	64 to 82	80	Yes
N-6	West Village Florist @ 70 Greenwich Avenue	105	71	71 to 89	80	Yes
N-7	St. Vincent's Hospital Reiss Pavilion @ 153 W.11th Street	211	71	65 to 82	80	Yes

* FTA criteria for construction noise based on 8-hour L_{eq} for various land use.

TABLE 13-7: ALTERNATIVE SB1: CONSTRUCTION NOISE AT RECEPTOR LOCATIONS

Receptor Number	Receptor Description	Distance from the Site (ft)	Existing Noise Level (L_{eq} dBA)	Range of Predicted Noise Levels for all Phases and Stages (L_{eq} dBA)	FTA Criteria* (L_{eq} dBA)	Potential Impact (Yes/No)
N-1	Two Boots To Go West Pizza @ 201 West 11th Street	214	73	65 to 82	80	Yes
N-2	Rear of apartment bldg facing Seventh Avenue @ 227 Waverly Place	206	71	65 to 83	80	Yes
N-3	Doma & Gallery @ 17 Perry Street	41	69	79 to 97	80	Yes
N-4	Apartment building @ 4 Perry Street	140	67	69 to 86	80	Yes
N-5	The Original Sandwich Shoppe of NY @ 58A Greenwich Avenue	144	70	68 to 86	80	Yes
N-6	West Village Florist @ 70 Greenwich Avenue	58	71	76 to 94	80	Yes
N-7	St. Vincent's Hospital Reiss Pavilion @ 153 W.11th Street	173	71	67 to 84	80	Yes

* FTA criteria for construction noise based on 8-hour L_{eq} for various land use.

TABLE 13-8: ALTERNATIVE SB5: CONSTRUCTION NOISE AT RECEPTOR LOCATIONS

Receptor Number	Receptor Description	Distance from the Site (ft)	Existing Noise Level (L_{eq} dBA)	Range of Predicted Noise Levels for all Phases and Stages (L_{eq} dBA)	FTA Criteria* (L_{eq} dBA)	Potential Impact (Yes/No)
N-1	Two Boots To Go West Pizza @ 201 West 11th Street	316	73	62 to 79	80	No
N-2	Rear of apartment bldg facing Seventh Avenue @ 227 Waverly Place	147	71	68 to 86	80	Yes
N-3	Doma & Gallery @ 17 Perry Street	211	69	65 to 82	80	Yes
N-4	Apartment building @ 4 Perry Street	53	67	77 to 94	80	Yes
N-5	The Original Sandwich Shoppe of NY @ 58A Greenwich Avenue	168	70	67 to 84	80	Yes
N-6	West Village Florist @ 70 Greenwich Avenue	211	71	65 to 82	80	Yes
N-7	St. Vincent's Hospital Reiss Pavilion @ 153 W.11th Street	305	71	62 to 79	80	No

* FTA criteria for construction noise based on 8-hour L_{eq} for various land use.

THE PREFERRED ALTERNATIVE

- Construction activities during Stage 1 would result in a noise impact at receptors located within approximately 105 feet from the construction site.
- Construction activities during Stages 2 and 3 would result in a noise impact at all of the receptor sites within approximately 250 feet from the construction site.
- Construction activities during Stage 4 would not result in a noise impact during any of the construction phases at any of the receptor locations.

ALTERNATIVE SB1

- Construction activities during Stage 1 would result in a noise impact at receptors located within approximately 60 feet from the construction site.
- Construction activities during Stage 2 would result in a noise impact at receptors located within approximately 60 feet from the construction site.
- Construction activities during Stage 3 would result in a noise impact at receptors located within approximately 41 feet from the construction site.
- Construction activities during Stage 4 would result in a noise impact at receptors located within approximately 60 feet from the construction site.

ALTERNATIVE SB5

- Construction activities during Stage 1 would result in a noise impact at receptors located within approximately 53 feet from the construction site.
- Construction activities during Stage 2 would result in a noise impact at receptors located within approximately 53 feet from the construction site.
- Construction activities during Stage 3 would result in a noise impact at receptors located within approximately 53 feet from the construction site.
- Construction activities during Stage 4 would result in noise impact at receptors located within approximately 53 feet from the construction site.

Detailed results of potential construction noise impacts for each alternative during the different stages of construction are provided in Tables 13-6 through 13-8 and in Appendix C. The Preferred Alternative would have the least number of construction noise impact events—a total of 231 events in the year 2010 and 64 events in the year 2011. Alternative SB1 would result in the following number of construction noise impact events—a total of 739 events in the year 2010, 220 events in the year 2011, 149 events in the year 2012, and 269 events in the year 2013 (multiple noise impact events can occur over the course of a day). Alternative SB5 would result in the following number of construction noise impact events—a total of 323 events in the year 2010, and 680 events (multiple noise impact events can occur over the course of a day) in the year 2012.

13.8.2. VIBRATION FROM CONSTRUCTION ACTIVITIES

SOURCE VIBRATION LEVELS FOR CONSTRUCTION EQUIPMENT

Listed in Table 13-9 are vibration source levels recommended by FTA for analysis of heavy construction equipment. These levels are average source levels under a wide variety of construction activities. This information is used for predicting vibration levels at various receptor distances from the operation of construction equipment.

TABLE 13-9: SOURCE LEVELS FOR CONSTRUCTION EQUIPMENT VIBRATION

Equipment	PPV* at 25 ft (in/sec)	Approximate L_v at 25 ft ** (VdB re 10^{-6} in/sec)
Pile Driver (impact, upper range)	1.518	112
Pile Driver (impact, typical)	0.644	104
Pile Driver (sonic, upper range)	0.734	105
Pile Driver (sonic, typical)	0.170	93
Clam shovel drop (slurry wall)	0.202	94
Large bulldozer	0.089	87
Caisson drilling	0.089	87
Loaded trucks	0.076	86
Jackhammer	0.035	79
Small bulldozer	0.003	58

Source: Guidance Manual for Transit Noise and Vibration Impact Assessment, May 2006

* Peak Particle Velocity
** RMS (Root Mean Square) Velocity in decibels (VdB)

Tables 13-10 through 13-12 show vibration levels predicted at each receptor for the Preferred Alternative and Alternatives SB1 and SB5 generated by different types of construction equipment at various distances from the construction sites. The vibration impact threshold for minor damage to structures is a peak particle velocity of 0.5 in/sec (or 102 VdB) and the thresholds for annoyance are taken from FTA's guidelines for frequent vibration events.

Without accounting for MTA NYTC's commitment to not use impact pile driving equipment during construction, the vibration evaluation took into account the use of such equipment to represent a "worst-case" condition. The results of this "worst-case" condition indicate the following:

- Construction of the Preferred Alternative is predicted not to result in damage to structures but would cause potential annoyance at all the receptors V-1 through V-7 as shown in Table 13-10.
- Construction of Alternative SB1 may result in cosmetic damage to structures near V-3 at 17 Perry Street during pile driving and hoe ram operations ("worst-case" conditions), and may cause annoyance at all of the receptors V-1 through V-7 as shown in Table 13-11.
- Construction of Alternative SB5 may result in cosmetic damage to structures near V-4 at 4 Perry Street during pile driving and hoe ram operations ("worst-case" conditions), and may cause annoyance at all the receptors V-1 through V-7 as shown in Table 13-12.

TABLE 13-10: THE PREFERRED ALTERNATIVE: CONSTRUCTION VIBRATION AT RECEPTOR LOCATIONS

Receptor Number	Receptor Description	Distance from the Site (ft)	Existing Vibration Level (VdB)	Range of Predicted Vibration Levels for all Phases and Stages (VdB)	FTA Criteria* Struct/Annoy (VdB)	Potential Impact Struct/Annoy (Yes/No)
V-1	Two Boots To Go West Pizza @ 201 West 11th Street	189	78	86	102 / 72	No / Yes
V-2	Rear of apartment bldg facing Seventh Avenue @ 227 Waverly Place	147	84	63 to 89	102 / 72	No / Yes
V-3	Doma & Gallery @ 17 Perry Street	253	89	82	102 / 72	No / Yes
V-4	Apartment building @ 4 Perry Street	158	78	62 to 88	102 / 72	No / Yes
V-5	The Original Sandwich Shoppe of NY @ 58A Greenwich Avenue	232	84	83	102 / 72	No / Yes
V-6	West Village Florist @ 70 Greenwich Avenue	105	84	67 to 93	102 / 72	No / Yes
V-7	St. Vincent's Hospital Reiss Pavilion @ 153 W.11th Street	211	72	84	102 / 75	No / Yes

* FTA criteria for construction noise based on 8-hour L_{eq} for various land use.

TABLE 13-11: ALTERNATIVE SB1: CONSTRUCTION VIBRATION AT RECEPTOR LOCATIONS

Receptor Number	Receptor Description	Distance from the Site (ft)	Existing Vibration Level (VdB)	Range of Predicted Vibration Levels for all Phases and Stages (VdB)	FTA Criteria* Struct/Annoy (VdB)	Potential Impact Struct/Annoy (Yes/No)
V-1	Two Boots To Go West Pizza @ 201 West 11th Street	214	78	84	102 / 72	No / Yes
V-2	Rear of apartment bldg facing Seventh Avenue @ 227 Waverly Place	206	84	85	102 / 72	No / Yes
V-3	Doma & Gallery @ 17 Perry Street	41	89	80 to 106	102 / 72	Yes / Yes
V-4	Apartment building @ 4 Perry Street	140	78	64 to 90	102 / 72	No / Yes
V-5	The Original Sandwich Shoppe of NY @ 58A Greenwich Avenue	144	84	63 to 89	102 / 72	No / Yes
V-6	West Village Florist @ 70 Greenwich Avenue	58	84	75 to 101	102 / 72	No / Yes
V-7	St. Vincent's Hospital Reiss Pavilion @ 153 W.11th Street	173	72	87	102 / 75	No / Yes

* FTA criteria for construction noise based on 8-hour L_{eq} for various land use.

TABLE 13-12: ALTERNATIVE SB5: CONSTRUCTION VIBRATION AT RECEPTOR LOCATIONS

Receptor Number	Receptor Description	Distance from the Site (ft)	Existing Vibration Level (VdB)	Range of Predicted Vibration Levels for all Phases and Stages (VdB)	FTA Criteria* Struct/Annoy (VdB)	Potential Impact Struct/Annoy (Yes/No)
V-1	Two Boots To Go West Pizza @ 201 West 11th Street	316	78	79	102 / 72	No / Yes
V-2	Rear of apartment bldg facing Seventh Avenue @ 227 Waverly Place	147	84	63 to 89	102 / 72	No / Yes
V-3	Doma & Gallery @ 17 Perry Street	211	89	84	102 / 72	No / Yes
V-4	Apartment building @ 4 Perry Street	53	78	76 to 102	102 / 72	Yes / Yes
V-5	The Original Sandwich Shoppe of NY @ 58A Greenwich Avenue	168	84	61 to 87	102 / 72	No / Yes
V-6	West Village Florist @ 70 Greenwich Avenue	211	84	84	102 / 72	No / Yes
V-7	St. Vincent's Hospital Reiss Pavilion @ 153 W.11th Street	305	72	79	102 / 75	No / Yes

* FTA criteria for construction noise based on 8-hour L_{eq} for various land use.

MOBILE SOURCES

Future Seventh Avenue traffic, some of which would normally travel south on Greenwich Avenue, would be diverted through Perry Street towards Greenwich Avenue during construction of the ventilation plant. This would cause an eightfold increase in truck volumes through Perry Street resulting in an approximately 9 dBA increase in traffic noise level at receptor sites N-3 and N-4 (residences on that stretch of Perry Street). For most of the construction phases under the Preferred Alternative, such increase in traffic noise would result in noise impact at the residential sites on Perry Street between Waverly Place and Greenwich Avenue. However, under Alternatives SB1 and SB5, construction noise at the Perry Street receptors between Waverly Place and Greenwich Avenue would reach high levels, and to a large extent, would mask construction traffic-related noise levels at the residential receptors on Perry Street.

Existing noise levels were monitored at receptor location N-8, which is located on Seventh Avenue between West 13th and West 14th Streets, and at receptor location N-9, which is located on Greenwich Avenue between Charles Street and West 10th Street, in order to determine if construction-related traffic would result in noise impacts at these representative receptors. Since Seventh Avenue and Greenwich Avenue are already carrying large volumes of traffic, construction-related traffic passing by these two locations would not significantly add to the existing total traffic volume, and therefore, would not cause perceptible changes to existing noise levels.

During operation in years 2013 or 2014, the emergency ventilation plant would not generate additional vehicular traffic. Therefore, there would be no substantial difference between the No Action/construction phase alternatives and the Build conditions. As a result, the only potential mobile source associated with operation of the ventilation plant would be the existing subway station and subway trains. As stated in FTA's assessment guidelines, subway noise is generally not a problem for surrounding sensitive receptors because the ground acts as a barrier to noise transmission. The subway lines and stations are underground and fully covered, with the exception of ventilation gratings and shafts in the sidewalk. As a result, the noise from underground fixed-rail operations propagates through these openings to reach the surface. Siting of the ventilation plant would not result in any change in existing train operations, so operational noise impacts are not anticipated.

STATIONARY SOURCES

Noise from the mechanical ventilation of the subway tunnels will result primarily from the operation of the fans used for tunnel supply air and exhaust through the portals. Exterior noise levels from the proposed emergency ventilation plant would be consistent with CEQR noise criteria, which limit ventilation noise levels to 65 dBA during the daytime and less than a 3-dBA increase over the nighttime L_{eq} noise level. This will be accomplished by establishing appropriate noise-related specifications for the ventilation system, including ventilation duct work, airflow velocities, louvered openings in the ventilation plant exterior walls, fan type, fan size, pressure drop and silencer characteristics. In general, fan noise would be controlled using a combination of in-duct splitter attenuators that can achieve between 20 to 30 dBA reductions in noise, sound absorptive plenums (large rooms enclosed by acoustic materials that can achieve between 10 and 15 dBA reductions), and acoustic louvers. Operation of the emergency ventilation plant would not have adverse noise and vibration impacts. The emergency ventilation plant would be structurally designed to accommodate HVAC and mechanical equipment within the plants to minimize noise impacts to adjacent uses and public areas. Silencers and/or enclosures would be used to minimize these impacts to achieve compliance with the New York City Noise Code.

13.9. SUMMARY OF SIGNIFICANT ADVERSE IMPACTS AND MITIGATION MEASURES

13.9.1. SIGNIFICANT ADVERSE IMPACTS

During construction, there may be significant noise impacts at the nearby receptors within approximately 250 feet, 50 feet and 53 feet, respectively, from the emergency ventilation plant construction site under the Preferred Alternative and Alternatives SB1 and SB5, depending on the construction stage and activities.

Significant adverse noise impacts may result at spoils removal locations during certain construction periods because of the proximity of construction to certain sensitive receptors. The types and extent of the noise impacts would be comparable in all construction phases. However, activities creating such impacts would not occur during the late night and early morning hours (e.g., 10 PM to 7 AM).

Significant adverse impacts from vibration would not occur during construction activities, since MTA NYCT has committed to avoid the use of impact pile drivers and hoe rams.

During operations, no significant adverse impacts for noise or vibration are expected to result, so no mitigation is needed other than to ensure compliance with the New York City Noise Code through appropriate design and specification of the emergency ventilation plant and machinery.

13.9.2. MITIGATION MEASURES

NOISE CONTROL METHODS

MTA NYCT is committed to developing and implementing an extensive mitigation program to reduce and alleviate the project's noise impacts during construction. Contractors would be required to implement noise mitigation measures to achieve the levels specified in the performance standards identified in Tables 13-1 and 13-5.

Notwithstanding the specific noise levels specified herein, MTA NYCT would utilize the noise control measures listed below to minimize, to the greatest extent feasible and practicable, the noise levels in neighborhoods near the construction site:

- Utilize OSHA-compliant quieter-type manually adjustable backup alarms set to their low level.
- Utilize shields, impervious fences or other physical barriers to inhibit transmission of noise.
- Utilize sound retardant housings or enclosures around noise producing equipment.
- Utilize effective intake and exhaust mufflers on internal combustion engines and compressors.
- Line or cover hoppers, storage bins and chutes with sound absorbing material.
- Avoid the use of pneumatic or gasoline driven saws.
- Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.
- Route construction equipment and other vehicles carrying spoil, concrete or other materials over streets and routes that will cause the least disturbance to residents in the vicinity of the activity.
- Position stationary equipment to minimize noise impact on the community.
- Develop and implement a noise monitoring program in order to quantify noise levels at nearby sensitive receptors during construction.

VIBRATION CONTROL METHODS

Notwithstanding the specific vibration levels specified herein, MTA NYCT would utilize vibration control measures listed below to minimize to the greatest extent feasible the vibration levels in all neighborhoods near the construction site:

- Use vibratory pile drivers or auguring for setting piles in lieu of impact pile drivers.
- Specify realistic vibration limits in contract documents, such as those listed in Table 13-2.
- Develop and implement a vibration monitoring program in order to quantify vibration levels at nearby sensitive receptors during construction.
- Inform people living and working in the vicinity about construction method, possible effects, quality control measures, and precautions to be used; and the channels of communication available to them.
- Route truck traffic and heavy equipment to avoid impacts to sensitive receptors.
- Properly secure street decking over cut-and-cover excavations.
- Schedule work to limit nighttime work in residential areas.
- Minimize the duration of any high vibration activities.