FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR THE CROTON WATER TREATMENT PLANT
METHODOLOGIES

4.10. NOISE

4.10.1. Introduction

Noise can be generated by both stationary (i.e., fixed location) sources, such as mechanical equipment and construction equipment, and mobile (i.e., moving) sources, such as cars, airplanes, trucks, buses and construction-related vehicles. Both types of noise sources have been considered in this analysis. The potential impact of noise depends on the sound pressure levels and frequency content of the source sound emissions, the spatial relationship between the source of the noise and the sensitive receptors (i.e., people in their homes, schools, etc.), the time of day the noise source is in operation, and the existing noise levels at the sensitive receptors. The methodologies selected to measure and analyze the noise related to this proposed project considered all of these factors.

Noise levels are measured in logarithmic units called decibels (dB). An overall measurement of sound results in a single decibel value that describes the noise environment, taking all frequencies into account. The human ear, however, does not sense all frequencies in the same manner; it is more sensitive to middle and high frequency noise than it is to low frequency noise. Therefore, noise measurements are often adjusted or weighted to account for human perception and sensitivities. The “A”-weighted scale, expressed in units called dBA, is the most common weighting network used in environmental noise assessments because it closely approximates the human sensory response.

Under normal conditions, a change in noise level of three decibels is required for the average person to perceive a difference in noise levels. A decrease of 10 decibels appears to the listener to be a halving of noise levels, while an increase of 10 decibels appears to be a doubling of the noise. Typically, public reaction to noise levels is a function of location (urban, suburban, rural), time of day, fluctuation of noise levels, duration, and the individual judgment of the listener. A list of common noise sources and their associated sound levels is presented in Table 4.10-1.

TABLE 4.10-1. NOISE LEVELS OF COMMON SOURCES

Sound Source	Sound Pressure Level (SPL) dBA
Air Raid Siren at 50 Feet	120
Maximum Levels at Rock Concerts (Rear Seats)	110
On Platform by Passing Subway Train	100
On Platform by Passing Heavy Truck or Bus	90
On Sidewalk by Typical Highway	80
On Sidewalk by Passing Automobiles with Mufflers	70
Typical Urban Area	60-70
Typical Suburban Area	50-60
Quiet Suburban Area at Night	40-50
Typical Rural Area at Night	30-40
Isolated Broadcast Studio	20

TABLE 4.10-1. NOISE LEVELS OF COMMON SOURCES

Sound Source	Sound Pressure Level (SPL) dBA
Audiometric (Hearing Testing) Booth	10
Threshold of Hearing	0

Notes: A change in 3 dBA is a just noticeable change in SPL. A change in 10 dBA is perceived as a doubling or halving in SPL.
Source: *CEQR Technical Manual*, Table 3R-1

4.10.1.1. Noise Descriptors

In order to describe fluctuating noise over a specific period, statistical noise descriptors were used. The most commonly used noise descriptors are the L_{10} and L_{eq}. L_{10} is the sound pressure level (SPL) exceeded 10 percent of the measurement time period. L_{eq} is the equivalent steady-state noise level, which, in a stated period of time, contains the same acoustic energy as the time-varying sound level during the time period; it accounts for both the duration and the magnitude of a noise. L_{eq} is the recommended noise descriptor used for stationary source noise analysis. However, for the purposes of developing noise attenuation measures for mechanical equipment, the maximum instantaneous octave band SPL noise descriptor is used to evaluate the high, low and mid-range frequency tones emitted from the mechanical equipment. The octave band SPLs are unweighted sound measurements that are usually provided by the equipment manufacturer at octave band center frequencies (i.e.: 31.5, 63, 125, 250, 500, 1000, 2000, 4000, and 8000 hertz [Hz]) and expressed as a decibel. For the mobile source noise analysis, L_{eq} and L_{10} are used to measure ambient noise levels and to make noise impact determinations. The L_{10} value is typically 3 dBA higher than the L_{eq} near roadways.

4.10.1.2. Applicable Noise Standards and Criteria

Noise levels associated with the construction and operation of the proposed project for the project sites within New York City are subject to City Environmental Quality Review (CEQR) Standards and Criteria and to the New York City Noise Code. For those project sites located outside of NYC, specific local standards were researched and are presented in the chapters of this report that discuss the potential impacts from construction and future operations. For each location in Westchester County, both local and CEQR standards were referenced. The more stringent of the standards was applied in each case to project activities.

TABLE 4.10-2. CEQR NOISE EXPOSURE GUIDELINES FOR USE IN NEW YORK CITY ENVIRONMENTAL IMPACT REVIEWS

Receptor Type	Time Period (1)	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
1. Outdoor area requiring serenity and quiet(2)		$L_{10} \leq 55$ dBA	---$L_{dn} \leq 60$ dBA---		---60 dB(A) $< L_{dn} < 65$ dBA---		---(1)$65 < L_{dn} \leq 70$ dBA, (II) $70 \leq L_{dn}$---		---$L_{dn} \leq 75$ dBA---
2. Hospital, nursing home		$L_{10} \leq 55$ dBA		$55 < L_{10} \leq 65$dBA		$65 < L_{10} \leq 80$dBA		$L_{10} > 80$ dBA	
3. Residence, residential hotel or motel	7am – 10pm	$L_{10} \leq 65$dBA		$65 < L_{10} \leq 70$ dBA		$70 < L_{10} \leq 80$ dBA		$L_{10} > 80$dBA	
	10pm – 7am	$L_{10} \leq 55$dBA		$55 < L_{10} \leq 70$ dBA		$70 < L_{10} \leq 80$ dBA		$L_{10} > 80$ dBA	
4. School, museum, library, court, house of worship, transient hotel or motel, public meeting room auditorium out-patient public health facility		Same as Residential Day (7am – 10pm)		Same as Residential Day (7am – 10pm)		Same as Residential Day (7am – 10pm)		Same as Residential Day (7am – 10pm)	
5. Commercial or Office		Same as Residential Day (7am – 10pm)		Same as Residential Day (7am – 10pm)		Same as Residential Day (7am – 10pm)		Same as Residential Day (7am – 10pm)	
6. Industrial, public areas only (4)	Note 4	Note 4		Note 4		Note 4		Note 4	

Source: New York City Department of Environmental Protection (adopted by NYCDEP for use in CEQR-2001 – Table 3R-3).(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 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. One may use the FAA-approved Ldn contours supplied by the Port Authority, or the noise contours may be computed from the federally approved INM Computer Model using flight data supplied by the Port Authority of New York and New Jersey.
4. External noise exposure standards for industrial areas of sound produced by industrial operations other than operating motor vehicles or other transportation facilities are spelled out in the New York City Zoning Resolution, Section 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).

4.10.1.2.1. New York City Environmental Quality Review (CEQR) Standards and Criteria

The NYCDEP has established four categories of acceptability based on receptor type and land use. The categories include "generally acceptable," "marginally acceptable," "marginally unacceptable," and "clearly unacceptable." These category definitions are shown in Tables 4.10-2 and 4.10-3. For most sensitive receptors, acceptable daytime noise levels (L_{10}) are less than or equal to 65 dBA and nighttime noise levels are less than or equal to 55 dBA. In addition, under CEQR, a project-generated increase of 3 dBA to 5 dBA (sliding scale) at a noise-sensitive location that is not temporary in nature is considered a significant adverse impact. During daytime hours, 65 dBA L_{eq1} is the absolute ambient noise level for an hour that, if increased by 3 dBA, is anticipated to result in a significant impact on sensitive receptors. If the ambient noise level is less than or equal to 60 dBA L_{eq1} then a 5 dBA increase is used to define a significant impact (at 61 dBA L_{eq}, a 4 dBA increase is tolerated). During nighttime hours (10PM to 7AM) a 3-dBA increase defines a significant impact regardless of the baseline ambient noise level.

TABLE 4.10-3. CEQR REQUIRED ATTENUATION VALUES TO ACHIEVE ACCEPTABLE INTERIOR NOISE LEVELS

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

Source: CEQR Technical Manual, Table 3R-4.

4.10.1.2.2. New York City Noise Code

The noise code establishes ambient noise quality zone (ANQZ) criteria and standards based on existing land use zoning designations. These criteria would apply to stationary source noise emissions during operation of the facility; construction activities are exempted from the ANQZ criteria. Table 4.10-4 summarizes these criteria.

TABLE 4.10-4. NEW YORK CITY NOISE CODE ANQZ CRITERIA

Ambient Noise Quality Zone	Daytime Maximum L_{eq} (7 AM-10 PM)	Nighttime Maximum L_{eq} (10 PM-7 AM)
(N1) Low-Density Residential (R1-R3) Land Use	60 dBA	50 dBA
(N2) High-Density Residential (R4-R10) Land Use	65 dBA	55 dBA
(N3) Commercial and Manufacturing (C1-C8, M1-M3) Land Use	70 dBA	70 dBA

Separate standards have been designed specifically for construction noise. These standards require that:

- Construction equipment and motor vehicles meet specified noise emission standards as specified in the New York City Noise Code and USEPA Noise Emission Standards for Construction Equipment.

- Construction activities are limited to weekdays between 7 AM and 6 PM. If extra hours are needed a variance must be obtained. Unnecessary noise should not be created during the handling and transportation of construction materials.

CEQR defines a noise-sensitive receptor as an area where human activity may be adversely affected by the following:

- When noise levels exceed predefined thresholds of acceptability, or
- When noise levels increase by an amount exceeding predefined *CEQR Technical Manual* thresholds.

4.10.2. Baseline Conditions

4.10.2.1. Existing Conditions

4.10.2.1.1. Mobile Source Noise

Included as part of the traffic and transportation analyses, major thoroughfares in the vicinity of each project site were identified. Major thoroughfares are those major roads (such as expressways, parkways, and major regional routes) that already experience large volumes of traffic and that are anticipated to provide the primary vehicular access to the project site. The proposed transportation routes are the local roadways that connect the major thoroughfares described above to each site. It is the proposed project transportation routes that shall be considered in the noise analysis.

Noise-sensitive receptor locations for monitoring and analysis were selected based on the existing land uses adjacent to the roadways anticipated to experience an increase in traffic volume as a result of the proposed project. Land uses considered sensitive to noise included residences, schools and parks (daytime only), churches, and hospitals. Route segments that did not contain sensitive receptors along them were not considered for further noise analysis.

The passenger car equivalence (PCE) concept as outlined in the *CEQR Technical Manual* was used to compare the existing baseline traffic with the future traffic anticipated as a result of the proposed project at sites both in New York City and in Westchester. Based on this comparative analysis, a listing of route segments whose PCE value doubled or more as a result of the proposed construction was compiled and recommended for more detailed analyses. All other route segments were screened out because the incremental change in noise level would be less than three dBA. Vehicle classification information compiled during the traffic study for the proposed action was converted to PCEs using the standards established in the *CEQR Technical*

Manual and as shown in Table 4.10-5. For example, the introduction of one medium size truck is the equivalent of introducing thirteen passenger cars.

TABLE 4.10-5. PASSENGER CAR EQUIVALENCE VALUES

Vehicle Type	PCE
Each Automobile or Light truck	1 PCE
Each Medium Truck	13 PCE
Each Bus	18 PCE
Each Heavy Truck	47 PCE

Following a determination that a particular route segment required a detailed analysis to determine if an impact would occur (on the basis of the PCE concept described above), existing mobile source noise levels were determined for that location. Field measurements were conducted during those hours that required a detailed analysis. A one-hour measurement was taken at a representative receptor location for each noise study route segment that required a detailed analysis. To be conservative, the receptor closest to the roadway along each noise study route segment was selected as the representative receptor location. Noise measurements were taken in front of the selected representative location at each noise study route segment in accordance with the noise monitoring protocols outlined in the *CEQR Technical Manual* and other applicable local regulations. Traffic data were collected simultaneously with the noise measurements. Traffic volume, vehicle classification, roadway geometry, and data collection time and duration were recorded.

A Bruel and Kjaer Type 2260 (B&K) noise analyzer was used to measure existing sound levels. The B&K analyzer is a microprocessor-based state-of-the-art instrument that can monitor in accordance with all noise exposure criteria currently in use. The analyzer was tripod-mounted and was equipped with a windscreen to eliminate noise associated with wind blowing across the microphone. The noise analyzer was calibrated with an acoustical calibrator before and after each measurement. Weather conditions were noted to ensure a true reading. Recommended meteorological conditions (as specified by the manufacturer) were:

- Wind speed under 12 mph
- Relative humidity under 90 percent
- Temperature above 14°F and below 122°F
- No precipitation

Each of the route segments requiring further analysis were modeled using the Federal Highway Administration (FHWA) approved Traffic Noise Model Version 2.1 (TNM). TNM uses traffic volumes, speed, and roadway alignment and geometry to predict the noise levels for designated monitoring locations. Route segments requiring detailed analysis using TNM were field measured as described above using the noise analyzer in order to verify that a good correlation existed between field-measured and the model-predicted existing noise levels. Noise measurements collected at the monitoring locations were compared with modeled results in order to verify that the two values were within 3 dBA of each other.

For each route segment, field observations were conducted to verify that vehicular traffic was the dominant noise source. Varying traffic volumes, therefore, dictated noisiest and quietest periods at each receptor, i.e. traffic peak times correspond with the noisiest periods, and lowest traffic-volume periods correspond to quietest periods.

4.10.2.1.2. Stationary Source Noise

Stationary sources of noise include construction activities at the project site and operations at the proposed plant. Potential noise sources included construction equipment and machinery associated with industrial and manufacturing operations, and heating, ventilating, and air-conditioning systems. A monitoring program was conducted to identify and determine the existing ambient conditions at the various sites. Baseline monitoring was performed for 24 hours at the property boundaries closest to the nearest noise-sensitive receptors identified at the three water treatment plant sites (Eastview, Mosholu, and the Harlem River). The remaining off-site facilities (NCA Shaft Nos. 9, 14, and 18, Gate House No. 1, and the Jerome Park Reservoir) were monitored in a similar fashion. Monitoring durations corresponded to future construction hours and times of operations of the local receptors at each site.

Following baseline measurements, 20-minute measurements were taken at sensitive receptors proximate to the water treatment plant site and off-site facilities. Measurements were taken during the quietest and noisiest time periods as determined by the baseline monitoring.

Noise from adjacent stationary sources was included as part of the ambient background noise levels, but monitoring locations were chosen to minimize the contribution from adjacent roadways.

4.10.2.2. Future Without the Project

4.10.2.2.1. Mobile Source Noise

Future baseline noise levels for the Future Without the Project year were predicted using TNM for those mobile source receptors that required further analyses. The following years were used for operations analysis at the three sites; the Eastview Site was 2010, and the Mosholu and Harlem River Sites were 2011. The years used for peak construction analysis corresponded with the peak construction-related traffic year. The years used for this analysis were 2006 for the Eastview Site, 2007 for the Mosholu Site, and 2009 for the Harlem River Site. With the exception of the Jerome Park Reservoir, the peak construction year at the off-site facilities would be 2013. Jerome Park Reservoir peak construction year would be 2010.

For those route segments that were analyzed in greater detail, future noise levels were predicted at each of the mobile source sensitive receptor sites using TNM. The total traffic volume and vehicle mix for route segments being analyzed for the Future Without the Project year was predicted by adding a growth factor plus the incremental change from soft sites (if applicable) to the existing traffic data collected during the traffic count program. The growth factor was established by entering traffic data for the future condition into TNM in order to predict a future baseline noise level. The incremental change between the TNM-calculated existing condition and the TNM-calculated Future Without the Project then was established. This incremental change then was added to the measured existing condition noise value already established during existing conditions analysis in order to predict a Future Without the Project value. The predicted and TNM-calculated Future Without the Project values were compared to each other to establish that a good correlation existed between TNM and actual measurements.

4.10.2.2.2. Stationary Source Noise

Future conditions without the project were predicted based upon the anticipated changes in land use. Changes in land use include those new projects that may be completed that affect the land use of areas in proximity to the water treatment plant site. If new projects were anticipated, the estimated future noise levels at any receptor site due to proposed changes were either added to or subtracted from the existing measurements using the following formula:

Future Noise Levels (FNL) = $10 \text{ Log } (10^{\text{Existing noise level/10}} + 10^{\text{Noise level of changes/10}})$

4.10.3. Potential Impacts

4.10.3.1. Potential Project Impacts

Potential noise impacts from future operations at each of the proposed project sites were analyzed. Additional noise contributions from off-site facilities following construction activities were not anticipated.

4.10.3.1.1. Mobile Source Noise

Future mobile source noise levels associated with the proposed project were predicted using the same methodology as for the Future Without the Project analysis, except that project-induced traffic noise for the build year was added to the noise level established for Future Without the Project. The resultant levels were compared to CEQR thresholds in addition to relevant local, county, and state standards, if applicable.

4.10.3.1.2. Stationary Source Noise

Noise levels due to the operation of the proposed water treatment plant were estimated. Mechanical equipment anticipated to be major sources of noise at the proposed plant was identified. The manufacturer's noise specifications for the equipment were obtained and a plan of the proposed plant's layout was used to develop an accurate representation of where the various pieces of equipment would be situated. Projected noise levels at noise-sensitive receptors then were calculated using a logarithmic noise equation that accounts for barrier and distance attenuation. The equation is presented below. These calculated noise levels were compared to applicable noise ordinances and criteria.

$L_{eq} = E.L. - 20\log(D_1/D_2) - A_e$, where:

L_{eq} = average noise level at a noise sensitive receptor due to a single equipment unit throughout the day

E.L. = equipment noise level at a reference distance of D_2

D_1 = distance from the receptor to the unit of equipment

D_2 = distance at which equipment noise level data is known (reference distance)

A_e = attenuation factors. Attenuation factors considered in this analysis were attenuation due to physical barriers ($A_{barrier}$), usually from the interior and exterior walls of the water treatment plant.

Once the average noise level for each individual unit of equipment was computed, the contribution of all the equipment on site was summed to provide a total noise level at each noise sensitive receptor.

Noise emissions from the emergency generator that would be located at each facility were not considered in the above analysis. Emergency generators are requisite to maintaining and restoring public utilities during an emergency situation, and are usually limited in operational duration. Their use during an emergency, therefore, is generally exempt from most noise regulations. However, the testing of this equipment, although infrequent, is not exempt. The noise levels of the equipment during testing were estimated using point source extrapolation. Each water treatment plant site would have two 1500 KW diesel generators, with both anticipated to operate simultaneously during testing. Acoustical absorptive material and silencers are included in the design of the enclosure and openings.

4.10.3.2. Potential Construction Impacts

Noise impacts during the construction phase include contributions from construction equipment and construction-related vehicles. Noise impacts at sensitive receptor locations were evaluated for the appropriate peak construction year and based upon the type and quantity of construction equipment utilized, as well as distance from the construction site to the sensitive receptor. Each of the three water treatment plant site alternatives, as well as each of the off-site facilities, was analyzed for potential impacts from mobile and stationary construction noise.

4.10.3.2.1. Construction-Related Mobile Source Noise

Construction-related noise levels for vehicles approaching and leaving the site was determined utilizing the methodology employed for determining mobile source noise impacts during facility operation. Future noise levels were modeled to identify potential construction impacts using TNM. The modeling with TNM was conducted using the same methodology as that used for the Future With the Project impact analyses during plant operations.

The peak construction-related years for noise from mobile sources were those periods with the highest volume of project-generated truck traffic. Peak years are anticipated to be 2006 for the Eastview Site, 2007 for the Mosholu Site, and 2009 for the Harlem River Site.

With the exception of the Jerome Park Reservoir, construction activities at the off-site facilities are anticipated to run from 2011 until 2015. Because construction activities are anticipated to run at a steady state for the duration of this work, the midpoint year of 2013 was selected as the peak construction year for the purpose of this analysis. The peak construction year for Jerome Park Reservoir would be 2010.

Construction activities for each of the sites were anticipated to be limited to weekdays between 7:00 AM - 6:00 PM. This analysis determined the highest predicted overall noise levels that would occur during construction of the proposed project. Because of the potential increased perception of noise impacts when background noise is low, an additional screening level analysis was performed to account for off-peak hours during the weekday. This analysis preliminarily identified the greatest incremental change in noise levels that would occur during construction. The existing traffic volumes were lower during these off-peak hours than the peak hours studied, thus resulting in lower baseline noise levels. For lower baseline sound levels, the same traffic volume increase would cause a greater incremental noise level increase**.** This method compares the predicted incremental construction traffic to the existing traffic values using PCEs.

4.10.3.2.2. Construction-Related Stationary Source Noise

The future noise levels associated with on-site construction activities were assessed using a logarithmic noise equation designed to calculate noise levels generated by construction equipment and activities at construction sites. The equation uses equipment noise levels and "usage factors" to calculate average noise levels for each month of construction, using the following equation:

L_{eq} = E.L. + 10log(U.F.) - 20log(D/50) -10(G)log(D/50)- Ae, where:

L_{eq}	=	average noise level at a noise sensitive receptor due to a single equipment unit throughout the day
E.L.	=	equipment noise level at a reference distance (D_2)
G	=	a constant accounting for topography and ground effects
D_1	=	distance from the receiver to the unit of equipment
D_2	=	distance at which equipment noise level data is known (reference distance)
U.F.	=	a usage factor that accounts for the fraction of time that a piece equipment is in use throughout the day.
A_e	=	attenuation factors. Attenuation factors considered in this analysis were attenuation due to ground effects (A_{env}) and attenuation due to physical barriers ($A_{barrier}$).

Once the average noise level for the individual unit of equipment is computed, the contribution of all the equipment on site was summed to provide a total noise level at the noise-sensitive receptor.

A-weighted sound pressure level ranges for the different equipment used in the construction phases are summarized in Table 4.10-6.

Because of the size of the proposed water treatment plant construction sites, the exact location of the various equipment units at any time in the future would vary. A random number generator was utilized to approximate the variable location of construction equipment throughout the areas of the site and over the course of the construction schedule. This methodology placed construction equipment in a random fashion for each month throughout the proposed construction site. Noise levels then were calculated for each receptor for each month of construction.

The total noise level for construction (both stationary and mobile sources) was identified and compared to Future Without the Project conditions. Because construction activities at the remote facilities are anticipated to be steady state, noise levels experienced at sensitive receptors were calculated for a single representative month.

TABLE 4.10-6. SOUND PRESSURE LEVEL RANGES FOR CONSTRUCTION EQUIPMENT (Values are in dBA at 50 feet)

Equipment Type	Sound Pressure Level
Compacter	72-88
Front Loaders	72-97
Backhoes	72-93
Tractors	73-96
Scrapers, Graders	77-95
Pavers	82-92
Trucks	70-96
Cement Mixers	71-90
Cement Pumps	75-84
Cranes	76-95
Pumps	70-80
Generators	70-82
Compressors	68-86
Pneumatic Wrenches	82-88
Jackhammers, Drills	76-98
Pile Drivers (Peak Levels)	89-104
Vibrators	70-81
Saws	67-93
Tamper (at 1 meter)	94-100

Source: Harris, C., Handbook of Noise Control, 2nd Edition. New York: McGraw-Hill Book Company, 1979.

4.10.3.2.3. Vibration from Construction-Related Activities

Due to the magnitude of this project, it is possible that excavation activities may cause vibrations. Excessive vibration is defined as the generation of vibrations of such intensity, duration, frequency or character which annoy, disturb, or cause or tend to cause adverse psychological or physiological effects on persons, or damage or tend to damage personal or real property. Although tunnel boring machines have been used on a number of projects within the City of New York and vibration has seldom caused any impacts during these operations, any potential impacts on people or property due to vibration would be addressed for the proposed project. The impact of the vibrations would be reduced to levels permitted by applicable local regulations and codes.

Vibrations could occur due to rock blasting activities and from tunnel-boring machines (TBMs). The main factors in rock blasting that affect vibration levels are charge weight and distance from blast area to sensitive receptor. Whereas distance cannot be altered, the charge weight may effectively be controlled through the use of delays. Delays divide a charge into many smaller individual blasts, thereby reducing charge weight and consequently associated vibrations.

Vibrations from advancing TBMs may affect sensitive electronic equipment. The tunneling subcontractor would perform a study during the engineering phase of the project that would determine effects of TBMs on sensitive equipment and effective methods to mitigate vibration.

The tunneling subcontractor would develop a vibrations monitoring program during the engineering phase of the project. Prior to any boring activities, the location of the bore path would be reviewed to identify any businesses, hospitals, residences, or other facilities located in the vicinity of the planned boring.

Once excavation activities have commenced, facilities identified as sensitive receptors would be notified ahead of blasting activities. Monitoring would be conducted by a specialty contractor adjacent to the receptor during boring activities. All complaints received would be investigated thoroughly.

4.10.4. Mitigation

Mitigation measures were investigated for potential impacts caused by operation and construction noise. The feasibility of each mitigation measure was considered and identified. The effects of mitigation measures, such as portable or fixed-location noise barriers, were estimated. Specific mitigation measures are discussed in the “Mitigation” section for each site.