Chapter 11: Noise

A. INTRODUCTION

The noise analysis for the proposed project consists of two parts—a screening analysis to determine whether traffic generated by the proposed project would have the potential to result in significant noise impacts, and an analysis to determine the level of building attenuation necessary to ensure that the proposed project's interior noise levels satisfy applicable interior noise criteria. This chapter does not include an analysis of potential stationary source noise impacts from the proposed project's mechanical equipment, because such mechanical equipment would be designed to meet all applicable noise regulations and, therefore, would not result in adverse noise impacts.

The analysis presented below concludes that changes in noise levels with the proposed project would be barely perceptible and insignificant, and would be below the City Environmental Quality Review (CEQR) threshold for a significant adverse impact. In terms of noise attenuation, to maintain an interior noise level of 50 dBA $L_{10(1)}$ or less, the proposed project would need 23 dBA of window/wall attenuation along Navy Street and 26 dBA of window/wall attenuation along Nassau Street. The proposed buildings' façades would be designed to provide a composite Outdoor-Indoor Transmission Class (OITC) rating greater than or equal to these attenuation requirements.

B. NOISE FUNDAMENTALS

Noise pollution in an urban area comes from many sources. Some sources are activities essential to the health, safety, and welfare of a city's inhabitants, such as noise from emergency vehicle sirens, garbage collection operations, and construction and maintenance equipment. Other sources, such as traffic, are essential to the viability of a city as a place to live and do business. Although these and other noise-producing activities are necessary to a city, the noise they produce is undesirable. Urban noise detracts from the quality of the living environment, and there is increasing evidence that excessive noise represents a threat to public health.

Quantitative information on the effects of airborne noise on people is well-documented. If sufficiently loud, noise may interfere with human activities such as sleep, speech communication, and tasks requiring concentration or coordination. It may also cause annoyance, hearing damage, and other physiological problems. Several noise scales and rating methods are used to quantify the effects of noise on people, taking into consideration such factors as loudness, duration, time of occurrence, and changes in noise level with time. However, it must be noted that all the stated effects of noise on people vary greatly with each individual.

"A"-WEIGHTED SOUND LEVEL (dBA)

Noise is typically measured in units called decibels (dB), which are 10 times the logarithm of the ratio of the sound pressure squared to a standard reference presence squared. Because loudness is important in the assessment of the effects of noise on people, the dependence of loudness on frequency must be taken into account in the noise scale used in environmental assessments. One of the simplified scales that accounts for the dependence of perceived loudness on frequency is the use of a weighting network, known as "A"-weighting, in the measurement system to simulate the response of the human ear. For most noise assessments, the A-weighted sound pressure level in units of dBA is used in view of its widespread recognition and its close correlation with perception. In the current study, all measured noise levels are reported in dBA. Common noise levels in dBA are shown in **Table 11-1**.

ABILITY TO PERCEIVE CHANGES IN NOISE LEVELS

The average ability of an individual to perceive changes in noise levels is well-documented (see **Table 11-2**). Generally, changes in noise levels of less than 3 dBA are barely perceptible to most listeners, whereas changes in noise levels of 10 dBA are normally perceived as doubling (or halving) of noise loudness. These guidelines permit direct estimation of an individual's probable perception of changes in noise levels.

Table 11-1
Common Noise Levels

Sound Source	(dBA)
Military jet, air raid siren	130
Amplified rock music	110
Jet takeoff at 500 meters	100
Freight train at 30 meters	95
Train horn at 30 meters	90
Heavy truck at 15 meters	80–90
Busy city street, loud shout	80
Busy traffic intersection	70–80
Highway traffic at 15 meters, train	70
Predominantly industrial area	60
Light car traffic at 15 meters, city or commercial areas, or residential areas close to industry	50–60
Background noise in an office	50
Suburban areas with medium-density transportation	40–50
Public library	40
Soft whisper at 5 meters	30
Threshold of hearing	0

Note: A 10 dBA increase in level appears to double the loudness, and a 10 dBA decrease halves the apparent loudness.
Sources: Cowan, James P. *Handbook of Environmental Acoustics,* Van Nostrand Reinhold, New York, 1994. Egan, M. David, Architectural Acoustics. McGraw-Hill Book Company, 1988.

Table 11-2
Average Ability to Perceive Changes in Noise Levels

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

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

NOISE DESCRIPTORS USED IN IMPACT ASSESSMENT

Because the sound pressure level unit of dBA describes a noise level at just one moment, and because very few noises are constant, other ways of describing noise over more extended periods have been developed. One way is to describe the fluctuating noise heard over a specific period as if it had been a steady, unchanging sound. For this condition, a descriptor called the "equivalent sound level," L_{eq}, can be computed. L_{eq} is the constant sound level that, in a given situation and period (e.g., 1 hour, denoted by $L_{eq(1)}$, or 24 hours, denoted by $L_{eq(24)}$), conveys the same sound energy as the actual time-varying sound. Statistical sound level descriptors, such as L_1, L_{10}, L_{50}, L_{90}, and L_x, are sometimes used to indicate noise levels that are exceeded 1, 10, 50, 90, and x percent of the time, respectively. Discrete event peak levels are given as L_{01} levels.

For purposes of the proposed project, the maximum 1-hour equivalent sound level ($L_{eq(1)}$) has been selected as the noise descriptor to be used in this noise impact evaluation. $L_{eq(1)}$ is the noise descriptor recommended for use in the *CEQR Technical Manual* for vehicular traffic and construction noise impact evaluation, and is used to provide an indication of highest expected sound levels. The 1-hour L_{10} is the noise descriptor used in the *CEQR Technical Manual* noise exposure guidelines for City environmental impact review classification.

C. NOISE STANDARDS AND CRITERIA

Noise levels associated with the construction and operation of the proposed project would be subject to the emission source limitations of the New York City Noise Control Code and are compared to noise criteria established for the CEQR process. Other standards and guidelines promulgated by federal agencies are also useful in measuring impacts.

NEW YORK CITY NOISE CONTROL CODE

The New York City Noise Control Code, amended in December 2005, contains prohibitions regarding unreasonable noise, requirements for noise due to construction activities, circulation devices, and specific noise standards, with some specific noise sources being prohibited from being "plainly audible" within a receiving property.

NEW YORK CEQR NOISE CRITERIA

The *CEQR Technical Manual* contains noise exposure guidelines for use in City environmental impact review and required attenuation values to achieve acceptable interior noise levels. These values are shown in **Tables 11-3** and **11-4**. Noise exposure is classified into four categories: "acceptable," "marginally acceptable," "marginally unacceptable," and "clearly unacceptable." The *CEQR Technical Manual* criteria are based on maintaining an interior noise level for the worst-case hour $L_{10(1)}$ less than or equal to 45 dBA (for commercial uses it would be the worst-case hour $L_{10(1)}$ less than or equal to 50 dBA).

Table 11-3
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]		$L_{10} \le 55$ dBA	---------- $Ldn \le 60$ dBA ----------	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Hospital, nursing home		$L_{10} \le 55$ dBA		$55 < L_{10} \le 65$ dBA	---------- $60 < Ldn \le 65$ dBA ----------	$65 < L_{10} \le 80$ dBA	(i) $65 < Ldn \le 70$ dBA, (II) $70 \le Ldn$	$L_{10} > 80$ dBA	---------- $Ldn \le 75$ dBA ----------
Residence, residential hotel, or motel	7 AM to 10 PM	$L_{10} \le 65$ dBA		$65 < L_{10} \le 70$ dBA		$70 < L_{10} \le 80$ dBA		$L_{10} > 80$ dBA	
	10 PM to 7 AM	$L_{10} \le 55$ dBA		$55 < L_{10} \le 70$ dBA		$70 < L_{10} \le 80$ dBA		$L_{10} > 80$ dBA	
School, museum, library, court, house of worship, transient hotel or motel, public meeting room, auditorium, outpatient public health facility		Same as Residential Day (7 AM-11 PM)		Same as Residential Day (7 AM-11 PM)		Same as Residential Day (7 AM-11 PM)		Same as Residential Day (7 AM-11 PM)	
Commercial or office		Same as Residential Day (7 AM-11 PM)		Same as Residential Day (7 AM-11 PM)		Same as Residential Day (7 AM-11 PM)		Same as Residential Day (7 AM-11 PM)	
Industrial, public areas only[4]	Note 4	Note 4		Note 4		Note 4		Note 4	

Notes:
(i) In addition, any new activity shall not increase the ambient noise level by 3 dBA or more; (ii) *CEQR Technical Manual* noise criteria for train noise are similar to the above aircraft noise standards: the noise category for train noise is found by taking the L_{dn} value for such train noise to be an L_{dn}^{y} (L_{dn} contour) value.

Table Notes:
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 nursing homes.
3 One may use FAA-approved L_{dn} 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 sounds produced by industrial operations other than operating motor vehicles or other transportation facilities are spelled out 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).

Source: New York City Department of Environmental Protection (adopted policy 1983).

Table 11-4
Required Attenuation Values to Achieve Acceptable Interior Noise Levels

	Marginally Unacceptable				Clearly Unacceptable
Noise Level With Proposed Project	$70 < L_{10} \le 73$	$73 < L_{10} \le 76$	$76 < L_{10} \le 78$	$78 < L_{10} \le 80$	$80 < L_{10}$
Attenuation[1]	(I) 28 dB(A)	(II) 31 dB(A)	(III) 33 dB(A)	(IV) 35 dB(A)	$36 + (L_{10} - 80)^2$ dB(A)

Notes:
1 The above composite window-wall attenuation values are for residential dwellings. Commercial and office spaces/meeting rooms would be 5 dB(A) less in each category. All the above categories require a closed window situation and hence an alternate means of ventilation.
2 Required attenuation values increase by 1 dB(A) increments for L_{10} values greater than 80 dBA.

Source: New York City Department of Environmental Protection.

D. IMPACT DEFINITION

As recommended in the *CEQR Technical Manual*, this study uses the following criteria to define a significant adverse noise impact:

- An increase of 5 dBA, or more, for conditions in future with the proposed project (With Action) $L_{eq(1)}$ noise levels at sensitive receptors (including residences, play areas, parks, schools, libraries, and houses of worship) over those calculated for conditions in the future without the proposed project (No Action), if the No Action levels are less than 60 dBA $L_{eq(1)}$ and the analysis period is not a nighttime period.
- An increase of 4 dBA, or more, in With Action $L_{eq(1)}$ noise levels at sensitive receptors over those calculated for the No Action condition, if the No Action levels are 61 dBA $L_{eq(1)}$ and the analysis period is not a nighttime period.
- An increase of 3 dBA, or more, in With Action $L_{eq(1)}$ noise levels at sensitive receptors over those calculated for the No Action condition, if the No Action levels are greater than 62 dBA $L_{eq(1)}$ and the analysis period is not a nighttime period.
- An increase of 3 dBA, or more, in With Action $L_{eq(1)}$ noise levels at sensitive receptors over those calculated for the No Action condition, if the analysis period is a nighttime period (defined by the *CEQR Technical Manual* criteria as being between 10 PM and 7 AM).

E. NOISE PREDICTION METHODOLOGY

The dominant operational noise sources in the study area are vehicular traffic on adjacent and nearby streets and roadways as determined through field observations made during the project noise monitoring, which is described below. Noise from other sources, such as nearby industrial or commercial uses, are limited and do not contribute significantly to local ambient noise levels. To screen area roadways for the potential to have a significant project noise impact, a proportional modeling technique was used to determine approximate increases in noise levels.

The proportional modeling technique assumes that traffic on the immediately adjacent street or roadway is the dominant noise source. Using this technique, the prediction of future noise levels, where traffic is the dominant noise source, is based on a calculation using measured existing noise levels and predicted changes in traffic volumes to determine No Action and With Action levels. Using this methodology, vehicular traffic volumes were converted into Passenger Car Equivalent (PCE) values, for which one medium-duty truck (having a gross weight between 9,900 and 26,400 pounds) is assumed to generate the noise equivalent of 13 cars; one heavy-duty truck (having a gross weight of more than 26,400 pounds) is assumed to generate the noise equivalent of 47 cars; and one bus (vehicles designed to carry more than nine passengers) is assumed to generate the noise equivalent of 18 cars. Future noise levels are calculated using the following equation:

$$F\ NL - E\ NL = 10 * \log_{10} (F\ PCE / E\ PCE)$$

where:

F NL = Future Noise Level

E NL = Existing Noise Level

F PCE = Future PCEs

E PCE = Existing PCEs

With this methodology—assuming traffic is the dominant noise source at a particular location—if the existing traffic volume on a street is 100 PCE and if the future traffic volume were increased by 50 PCE to a total of 150 PCE, the noise level would increase by 1.8 dBA. Similarly, if the future traffic volume were increased by 100 PCE, or doubled to a total of 200 PCE, the noise level would increase by 3.0 dBA.

ANALYSIS PROCEDURE

To determine potential noise impacts from the project-generated traffic noise source, the following procedure was used:

- Determine sensitive receptors within the adjacent study area where the maximum project noise levels would be likely to occur;
- Perform field noise measurements to determine the existing ambient noise levels at the selected receptors;
- Calculate noise levels in the future with the proposed project using the proportional technique previously described; and
- Determine total noise levels due to the project-generated traffic in the future with the proposed project.

F. EXISTING CONDITIONS

SITE DESCRIPTION

The project site is located at the northeast corner of Navy Street and Nassau Street and is bounded by Navy Street to the west, Nassau Street to the south, and the Brooklyn Navy Yard industrial park to the north and east. The project area is heavily trafficked, and is occupied by industrial uses along with a variety of residential and other noise-sensitive uses.

SELECTION OF NOISE RECEPTOR LOCATIONS

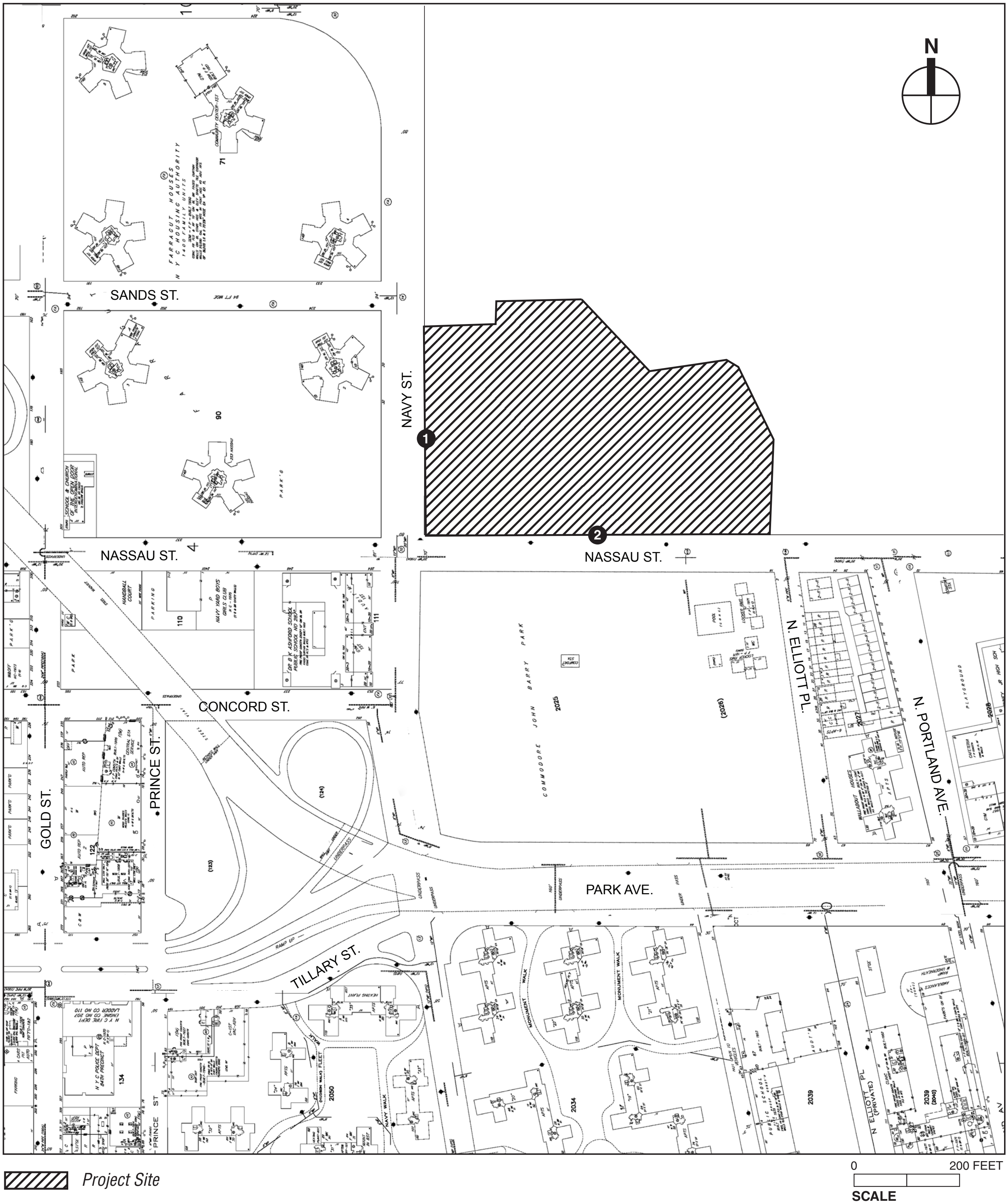
Two receptor locations immediately adjacent to the project site were selected. **Table 11-5** lists the locations of each noise receptor site. **Figure 11-1** shows the receptor site locations. Receptor Site 1 is on the east side of Navy Street (across the street from the Farragut Houses) and Receptor Site 2 is on the north side of Nassau Street (across the street from Commodore Barry Park). These receptor sites are representative of other locations in the immediate area, and are generally the locations where the maximum potential for project impacts would be expected based on project-generated traffic increases.

Table 11-5
Noise Receptor Locations

Receptor	Location
1	Navy Street between Nassau Street and Sands Street
2	Nassau Street between Navy Street and N. Elliott Place

NOISE MONITORING

At each receptor location, 20-minute noise measurements were made for weekday three time periods—AM (8:00 to 9:00 AM), midday (MD) (Noon to 1:00 PM), and PM (5:00 to 6:00 PM) to determine existing noise levels. Measurements were taken on September 14, 2010.



Project Site

1 Noise Receptor Location

3.4.11

Noise Receptor Locations
Figure 11-1

EQUIPMENT USED DURING NOISE MONITORING

Measurements were performed using a Brüel & Kjær Sound Level Meter (SLM) Type 2260 (S/N 2375602), a Brüel & Kjær ½-inch microphone Type 4189 (S/N 2375182), and a Brüel & Kjær Sound Level Calibrator Type 4231 (S/N 2688762). The Brüel & Kjær SLM is a Type 1 instrument according to ANSI Standard S1.4-1983 (R2006). The SLM has a laboratory calibration date of July 30, 2010 which is valid through July of 2011. The microphone was mounted at a height of five feet above the ground surface on a tripod and at least three feet away from any large sound-reflecting surface to avoid major interference with sound propagation. The SLM was calibrated before and after readings with a Brüel & Kjær Type 4231 Sound Level Calibrator using the appropriate adaptor. Measurements at each location were made in dBA. The data were digitally recorded by the sound level meter and displayed at the end of the measurement period in units of dBA. Measured quantities included L_{eq}, L_1, L_{10}, L_{50}, and L_{90}. A windscreen was used during all sound measurements except for calibration. All measurement procedures were based on the guidelines outlined in ANSI Standard S1.13-2005.

RESULTS OF BASELINE MEASUREMENTS

Table 11-6 summarizes the results of the baseline measurements for the weekday AM, MD, and PM analysis hours (see **Appendix C, Exhibit 1**). In general, noise levels are moderate to relatively high and reflect the level of vehicular activity on the adjacent streets. In terms of CEQR noise exposure guidelines, during the hour with the highest measured noise levels, based on the measured L_{10} values, existing noise levels at two receptors are in the "marginally unacceptable" category.

Table 11-6
Measured Existing Noise Levels (in dBA)

Receptor	Location	Time	$L_{eq(1)}$	L_1	L_{10}	L_{50}	L_{90}
1	Navy Street between Nassau Street and Sands Street	AM	68.7	79.2	71.3	64.8	60.6
		MD	65.6	75.2	68.7	61.8	56.2
		PM	70.7	80.6	71.4	65.5	60.3
2	Nassau Street between Navy Street and N. Elliott Place	AM	70.6	79.4	73.5	68.5	62.1
		MD	69.6	79.2	72.5	66.0	58.0
		PM	71.5	82.1	73.9	68.1	59.9

Notes: Field measurements were performed by AKRF, Inc. on September 14, 2010.

G. THE FUTURE WITHOUT THE PROPOSED PROJECT

Using the methodology previously described, future noise levels without the proposed project were calculated for the two receptors for the 2014 analysis year (see **Appendix C, Exhibit 2**). These No Action values are shown in **Table 11-7**.

Table 11-7
No Action Noise Levels (in dBA)

Receptor	Location	Time	Existing $L_{eq(1)}$	No Action $L_{eq(1)}$	$L_{eq(1)}$ Change	No Action $L_{10(1)}$
1	Navy Street between Nassau Street and Sands Street	AM	68.7	68.8	0.1	71.4
		MD	65.6	65.7	0.1	68.8
		PM	70.7	70.8	0.1	71.5
2	Nassau Street between Navy Street and N. Elliott Place	AM	70.6	70.8	0.2	73.7
		MD	69.6	69.9	0.3	72.8
		PM	71.5	71.7	0.2	74.1

In 2014, the increase in $L_{eq(1)}$ noise levels would be less than 1 dBA for all analysis periods at the two receptor sites. Changes of this magnitude would be barely perceptible and insignificant, and would be below the CEQR threshold for a significant adverse impact. In terms of CEQR Noise Exposure Guidelines, noise levels at the two receptor sites would remain in the "marginally unacceptable" category.

H. PROBABLE IMPACTS OF THE PROPOSED PROJECT

Using the methodology previously described, noise levels in the future with the proposed project were calculated for the 2014 year (see **Appendix C, Exhibit 2**). These future values are shown in **Table 11-8**. In 2014, the increase in $L_{eq(1)}$ noise levels would be less than 1 dBA for all analysis periods at the two receptor sites. Changes of this magnitude would be barely perceptible and insignificant, and would be below the CEQR threshold for a significant adverse impact. In terms of CEQR Noise Exposure Guidelines, noise levels at the two receptors would remain in the "marginally unacceptable" category.

Table 11-8
Future Noise Levels With the Proposed Project (in dBA)

Receptor	Location	Time	No Action $L_{eq(1)}$	With Action $L_{eq(1)}$	$L_{eq(1)}$ Change	With Action $L_{10(1)}$
1	Navy Street between Nassau Street and Sands Street	AM	68.8	69.1	0.3	71.7
		MD	65.7	66.4	0.7	69.5
		PM	70.8	71.0	0.2	71.7
2	Nassau Street between Navy Street and N. Elliott Place	AM	70.8	71.0	0.2	73.9
		MD	69.9	70.3	0.4	73.2
		PM	71.7	71.9	0.2	74.3

I. NOISE ATTENUATION MEASURES

As shown in **Table 11-4**, the *CEQR Technical Manual* has set noise attenuation quantities for buildings based on exterior $L_{10(1)}$ noise levels to maintain interior noise levels of 50 dBA or lower for commercial and office uses. The results of the building attenuation analysis are shown in **Table 11-9** (see **Appendix C, Exhibit 3**).

Table 11-9
Building Attenuation Analysis

Receptor	Location	Maximum With Action $L_{10(1)}$	CEQR Window/Wall Attenuation Requirement for Residential Uses	CEQR Window/Wall Attenuation Requirement for Commercial and Office Uses
1	Navy Street between Nassau Street and Sands Street	71.7	28 dBA	23 dBA
2	Nassau Street between Navy Street and N. Elliott Place	74.3	31 dBA	26 dBA

Based on the CEQR attenuation requirements and the proposed project's uses (i.e., commercial and office space), to maintain an interior noise level of 50 dBA $L_{10(1)}$ or less, the proposed project would need 23 dBA of window/wall attenuation along Navy Street and 26 dBA of window/wall attenuation along Nassau Street. The proposed buildings' façades, including these elements, would be designed to provide a composite OITC rating greater than or equal to the attenuation requirements listed in **Table 11-9**. These attenuation requirements would be specified in the lease or other legally binding agreement between the Brooklyn Navy Yard Development Corporation (BNYDC) and the developer to be designated by BNYDC pursuant to a Request for Proposals.

In addition, the proposed buildings' mechanical systems (i.e., heating, ventilation, air conditioning and refrigeration systems) would be designed to meet all applicable noise regulations (i.e., Subchapter 5, §24-227 of the New York City Noise Control Code, the New York City Department of Buildings Code and Section 926 of the New York City Mechanical Code) and to avoid producing levels that would result in any significant increase in ambient noise levels. ✷