

## **15.1 INTRODUCTION**

### **15.1.1 CONTEXT**

As the third-largest business district in the country, Lower Manhattan, including the former WTC complex, has long experienced the types and intensity of urban activities that result in the relatively high ambient noise levels characteristic of New York City's urban core. There were 107 million square feet of commercial office space, including approximately 14 million square feet at the former WTC complex, present in Lower Manhattan prior to September 11. As a result, the Project Site experienced high ambient noise levels associated with the daily life of a busy central business district. Within the immediate area of the Project Site and Lower Manhattan, typical activities included: heavy automobile and truck traffic volumes, buses, subways, emergency vehicle sirens, and noise generating construction equipment and, on occasion, outdoor events with large gatherings and concerts. Monitoring data collected in 2003 indicate that noise levels remain high, though somewhat lower than they were on September 10, 2001.

Shortly after the September 11 attacks, rescue and recovery efforts (emergency and construction vehicles) resulted in temporary increases in noise levels. Today, with traffic volumes approximately 15 to 25 percent lower than those of pre-September 11, ambient noise levels have also decreased, although these reductions may not be discernible to the average person. In general, noise levels are lower than pre-September 11 levels, because of reductions in office workers, visitors and activities (such as outdoor concerts or events) that previously catered to both the daytime and resident population.

Land uses in Lower Manhattan have become more diversified, beginning prior to the attacks on September 11, particularly in the Greenwich south corridor and north of WTC Site study areas. As this trend continued, the construction of residences and the conversion of office space to residential uses resulted in increases in noise associated with residential activity.

The Proposed Action would continue the reconstruction of Lower Manhattan, adding traffic and activity to the streets at and around the Project Site. The Memorial, in particular, would add a heightened level of activity throughout the day but also bring with it more noise. As Lower Manhattan starts to recapture its urban vitality, traffic and related activity would also reintroduce noise to the area. The Proposed Action would also bring to the Project Site uses that are sensitive to noise, including the Memorial, September 11 Place, Wedge of Light Plaza, Liberty Park North and South, and Heroes Park.

## **15.1.2 CONCLUSIONS**

### ***PRE-SEPTEMBER 11 SCENARIO***

Under the Pre-September 11 Scenario, the maximum noise level increases related to mobile sources associated with the Proposed Action in both 2009 and 2015 would be 1 decibel (dBA) or less. Because an increase of 3 dBA in noise levels (the threshold for significant noise impacts) is barely perceptible, the Proposed Action would not have significant noise impacts from mobile sources in either year. Potential stationary sources of noise would include heating, ventilation, and air conditioning (HVAC) systems, mechanical equipments, and wind turbines on top of Freedom Tower. The mechanical equipment and systems would utilize noise reduction devices to comply with applicable noise regulations and standards, as set forth in New York City Noise Code, subchapter 6, Section 24-243, Ambient Noise Quality Zone Criteria and Standards. Noise associated with the wind turbines, air tempering equipment, and ventilation shafts would be insignificant and would be masked by the background noise from street traffic and other noises typical for an urban environment. The Proposed Action would therefore not result in any significant noise impacts from stationary sources in either 2009 or 2015.

Future noise levels attributable to the operation (mobile and stationary sources) of the Proposed Action at the Memorial site would be 74 dBA in 2009 and 69 dBA in 2015, exceeding the U.S. Department of Housing and Urban Development (HUD) Site Acceptability Standards of 65 dBA, as current noise levels do. Based on HUD policy, 5-10 dBA attenuation would normally be required for the proposed Memorial site. It is anticipated that, through noise features and careful design measures, noise levels at the Memorial would be able to meet or approach the HUD Site Acceptability Criteria by the time the Proposed Action is completed and operational.

A noise analysis was conducted for a bus garage at the Project Site using Federal Transit Administration (FTA) methodology for assessing noise impacts of transit facilities. Future noise levels associated with garage operations would be substantially below the thresholds used by the FTA for transit facilities.

### ***CURRENT CONDITIONS SCENARIO***

Under the Current Conditions Scenario, the maximum noise level increases associated with the Proposed Action in both 2009 and 2015 would be 2 dBA or less. Potential stationary sources, such as mechanical equipment and systems, would utilize noise reduction devices to comply with applicable noise regulations and standards. Noise associated with potential stationary sources would be insignificant and would be masked by the background noise from street traffic and other noises, which are typical for an urban environment.

## **15.2 METHODOLOGY**

### **15.2.1 NOISE FUNDAMENTALS**

Noise, or unwanted sound, has numerous sources including airplanes, factories, railroads, power generation plants, and highway vehicles. Noise may have adverse effects on the human population in a variety of ways, depending on how loud and how frequent the source of noise is. The following provides an overview of the ways that noise is measured and predicted in environmental impact analysis. A discussion is provided below of “decibel” (“dB”) as the unit of measurement of sound levels, the use of a weighting method to account for the way that sound

levels are perceived by people and a logarithmic ('L') method to project and combine noise levels from different sources and over different time periods.

*SOUND LEVEL CHARACTERISTICS*

Sound pressure is the parameter that is normally measured in noise assessments. People's hearing mechanisms respond to "acoustic" pressures that represent the range from the threshold of hearing to the threshold of pain. 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 (denoted dB). When the SPL = 0 dB, the acoustic 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 mechanisms 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 measured using this weighting are noted as dBA. The letter "A" indicates that the sound has been filtered to reduce the strength of very low and very high frequency sounds, much as the human ear does. A listing of common noise sources with their associated typical dBA values is shown in Table 15-1.

**Table 15-1**  
**Examples of Common Sounds**  
**(A-Weighted Sound Level in Decibels [dBA])**

<b>A-weighted</b>	<b>Overall Level</b>	<b>Noise Environment</b>
120	Uncomfortably loud (32 times as loud as 70 dBA)	Military jet airplane takeoff at 50 feet.
100	Very loud (8 times as loud as 70 dBA)	Jet flyover at 1000 feet. Locomotive pass-by at 100 feet.
80	Loud (2 times as loud as 70 dBA)	Propeller plane flyover at 1000 feet. Diesel truck 40 mph at 50 feet.
70	Moderately loud	Freeway at 50 feet from pavement edge at 10 a.m. Vacuum cleaner (indoor).
60	Relatively quiet (1/2 as loud as 70 dBA)	Air conditioning unit at 100 feet. Dishwasher at 10 feet (indoor).
50	Quiet (1/4 as loud as 70 dBA)	Large transformers. Small private office (indoor).
40	Very quiet (1/8 as loud as 70 dBA)	Birds' calls. Lowest limit of urban ambient sound.
10	Extremely quiet	Just audible. (1/64 as loud as 70 dBA)
0		Threshold of hearing.

**Source:** Federal Agency Review of Selected Airport Noise Analysis Issues, 1992. Modified by The Louis Berger Group, Inc., 2003.

Table 15-1 indicates that most individuals in New York City are exposed to fairly high noise levels from many sources as they go about their daily activities. The degree of disturbance from unwanted sound depends essentially on three factors:

- The amount and nature of the intruding noise;
- The relationship between background noise and the intruding noise; and

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- The type of activity occurring where the noise is heard.

In considering the first of these factors (i.e., amount and nature of the intruding noise), 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. With regard to the second factor (the relationship between background noise and the intruding noise), 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 third factor (the type of activity occurring where the noise is heard) is related to the interference of noise with the activities of individuals. 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.

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. The average ability of an individual to perceive changes in noise levels is well documented (see Table 15-2). These guidelines permit direct estimation of an individual's probable perception of changes in noise levels. As a general rule, an increase or decrease of 10 dBA in noise level is perceived by an observer to be a doubling or halving of the sound, respectively.

**Table 15-2**  
**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.
<b>Source:</b> Bolt Beranek and Neuman, Inc., <i>Fundamentals and Abatement of Highway Traffic Noise</i> , Report No. PB-222-703. Prepared for Federal Highway Administration, June 1973.	

### *NOISE DESCRIPTORS ( $L_{eq}$ , $L_{10}$ , AND $L_{dn}$ )*

Because the sound pressure level unit of dBA describes a noise level at just one moment, and very few noises are constant, other ways of describing noise over more extended periods have been developed. A descriptor called the "equivalent sound level" ( $L_{eq}$ ) can be computed to characterize fluctuating noise heard over a specific period as if it had been a steady, unchanging sound. Types of descriptors include the following:

$L_{eq}$ : this 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 as  $L_{eq(24)}$ ), conveys the same sound energy as the actual time-varying sound.

$L_1$ ,  $L_{10}$ ,  $L_{50}$ ,  $L_{90}$ , and  $L_x$ : These are statistical sound level descriptors that are sometimes used to indicate noise levels that are exceeded 1, 10, 50, 90, and x percent of the time, respectively.

$L_{dn}$ : This is the day-night average sound level or cumulative noise exposure over a 24-hour period, with events between 10 pm and 7 am increased by 10 dBA to account for greater nighttime sensitivity to noise. The  $L_{dn}$ , which represents 24-hour levels with a 10 dBA penalty for nighttime hours, is useful for evaluating residential land uses, especially those with sleeping accommodations.

The relationship between  $L_{eq}$  and levels of exceedance is relevant because  $L_{eq}$  is defined in energy rather than straight numerical terms and is not simply related to the levels of exceedance. If the noise fluctuates very little, the  $L_{eq}$  approximates  $L_{50}$  or the median level. If the noise fluctuates broadly, the  $L_{eq}$  will be approximately equal to the  $L_{10}$  value. If extreme fluctuations are present, the  $L_{eq}$  will exceed  $L_{90}$  or the background level by 10 or more decibels. Thus, the relationship between  $L_{eq}$  and the levels of exceedance depends on the character of the noise. In community noise measurements, it has been observed that the  $L_{eq}$  is generally between  $L_{10}$  and  $L_{50}$ . The relationship between  $L_{eq}$  and exceedance levels has been used in this analysis to characterize the noise sources and to determine the nature and extent of their impact at all receptor locations.

For purposes of the Proposed Action, the maximum 1-hour equivalent sound level ( $L_{eq(h)}$ ) was selected as the noise descriptor to be used in noise impact evaluation.  $L_{eq(h)}$  is the noise descriptor recommended for use in the *CEQR Technical Manual* for noise impact evaluation, and is used to provide an indication of the highest expected sound levels.  $L_{10(h)}$  is the noise descriptor used in the *CEQR Technical Manual* for purposes of building attenuation. In addition, 8-hour  $L_{eq}$  and 30-day  $L_{dn}$  levels are utilized as the noise descriptor for impact evaluation based on HUD and FTA guidelines. Details of the noise impact criteria are described below in section 15.2.2, "Guidelines and Regulations."

## 15.2.2 GUIDELINES AND REGULATIONS

The noise analysis for the Proposed Action incorporates the *CEQR Technical Manual* noise guidelines, the HUD noise standards for the assessment of noise impacts on the Memorial and FTA's guidelines for assessing noise impacts associated with the bus garage. In addition, guidelines developed by the New York State Department of Environmental Conservation (NYSDEC) were considered, as appropriate. Noise criteria and guidelines are summarized below.

### *CEQR TECHNICAL MANUAL GUIDELINES*

The *CEQR Technical Manual* contains noise exposure guidelines for use in city environmental impact reviews. For cases where the proposed action itself is a sensitive receptor (such as new residential or office developments), the CEQR guideline values are based on maintaining an interior noise level for the worst-case hour  $L_{eq}$  less than or equal to 45 dBA. The guidelines identify the exterior noise levels that would typically result in such interior noise levels. The guidelines also recommend a set of attenuation values to achieve acceptable interior noise levels for residential and commercial office properties. For example, where exterior noise levels are

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between 75 and 80 dBA, a 30 dBA noise attenuation through windows and building insulation is recommended. Since the Proposed Action would not include any residential development, the recommended attenuation values are only relevant for commercial office buildings, museum, performing arts center, and interior space of the Memorial. It is expected that the offices, museum, and performing arts center at the Project Site would be designed to meet the recommended attenuations by incorporating state-of-the-art technologies.

To analyze the impacts of the Proposed Action on *other* land uses, the *CEQR Technical Manual* provides the following criteria for impact significance:

- An increase of  $L_{eq(1)}$  noise levels by 5 dBA or more in the future with the Proposed Action over noise levels in the future without the Proposed Action, if the noise levels in the future without the Proposed Action are less than 60 dBA  $L_{eq(1)}$  and the analysis period is not a nighttime period.
- An increase in  $L_{eq(1)}$  noise levels of 4 dBA or more in the future with the Proposed Action (measured at receptors determined to be sensitive under the future without the Proposed Action scenario) over noise levels in the future without the Proposed Action, if the noise levels in the future without the Proposed Action are 61 dBA  $L_{eq(1)}$  and the analysis period is not a nighttime period.
- An increase in  $L_{eq(1)}$  noise levels of 3 dBA or more in the future with the Proposed Action (measured at receptors determined to be sensitive under the future without the Proposed Action) over noise levels in the future without the Proposed Action, if the noise levels in the future without the Proposed Action are greater than 62 dBA  $L_{eq(1)}$  and the analysis period is not a nighttime period.
- An increase in  $L_{eq(1)}$  noise levels of 3 dBA or more in the future with the Proposed Action (measured at receptors determined to be sensitive under the future without the Proposed Action scenario) over noise levels in the future without the Proposed Action, if the analysis period is a nighttime period, that is, between 10 p.m. and 7 a.m.

The Project Site and study area already experience high ambient noise levels typical to an urban environment. All measured noise levels currently exceed 65 dBA (see section 15.3). Consequently, the Project Site would continue to experience high noise levels in future, even without the Proposed Action (see details in section 15.3). Therefore, the relevant threshold for identifying significant noise impact is an increase of 3 dBA resulting from the Proposed Action. A 3 dBA increase threshold is a very stringent criterion in consideration of the fact that this amount of increase in noise levels is barely perceptible by the human ear (see Table 15-2).

### *HUD CRITERIA*

HUD is required to “be aware of the problem of noise and to take positive steps to protect residential and other sensitive land uses from high noise levels,” as explained in a HUD publication (1985). HUD first issued formal requirements related specifically to noise in 1971 (HUD Circular 1390.2). The requirements contained standards for exterior noise levels along with policies approving HUD-supported or assisted housing projects in high noise areas.

The focus of HUD’s noise policy is on avoiding noise impacts on sensitive receptors associated with a HUD action, such as funding of a new residential development. In terms of the Proposed Action, only the Memorial would qualify as a noise sensitive receptor that would be created by

the Proposed Action and funded by HUD. As the Memorial would be operational in 2009 and 2015, it was included in both the 2009 and 2015 noise analysis of construction conditions.

In general, HUD requirements establish three noise zones: an “acceptable zone” where all projects can be approved, a “normally unacceptable zone” where mitigation measures are required and where each project is individually evaluated; and an “unacceptable zone” in which projects are not, as a rule, approved. The HUD Site Acceptability Standards are presented in Table 15-3.

**Table 15-3  
HUD Noise Standards**

<b>Standard</b>	<b>Day-Night Average Sound Level DNL in dBA</b>	<b>Special Approvals and Requirements</b>
Acceptable	Not exceeding 65 dBA	None
Normally Acceptable	Above 65 dBA but not exceeding 75 dBA	Special Approvals Environmental Review Attenuation <sup>1</sup>
Unacceptable	Above 75 dBA	Special Approvals Environmental Review Attenuation <sup>2</sup>
<b>Notes:</b>		
1 5 dBA additional attenuation required for sites above 65 dBA but not exceeding 70 dBA and 10 dBA additional attenuation required for sites above 70 dBA but not exceeding 75 dBA.		
2 Attenuation measures to be submitted to HUD for approval on a case-by-case basis.		
<b>Source:</b> 24 CFR Part 51.104, pp 289; modified by The Louis Berger Group, Inc., 2001.		

Compared to the city’s CEQR noise guidelines, HUD criteria are based on  $L_{dn}$ , which is averaged over a 24-hour day-and-night period, with 10 dBA added to nighttime levels to account for nighttime sensitivities for residential developments. HUD recommends that outdoor day-night sound levels not exceed 65 dBA in residential areas. HUD’s rules also contain an exception to the 65 dB goal to permit consideration of other program objectives unrelated to noise, and to provide administrative flexibility (24 CFR 51.105). These exceptions apply where the project is located in an urban area and would not encourage incompatible development; where quieter sites meeting program goals are generally not available; and where the proposal meets other HUD program goals, conforms to local goals and maintains the character of the neighborhood. Noise level attenuation of 5 dBA is recommended for sites with  $L_{dn}$  above 65 dBA, but not exceeding 70 dBA. Noise level reduction of 10 dBA is recommended for sites with  $L_{dn}$  above 70 dBA but not exceeding 75 dBA.  $L_{dn}$  above 75 dBA would not be considered by HUD as acceptable for new residential development.

It is a HUD goal that the interior auditory environment not exceed a day-night average sound level of 45 dBA and that attenuation measures be employed where feasible, especially for noise sensitive interior spaces. HUD’s environmental criteria describe noise attenuation techniques in 24 CFR 51.103-51.104.

The focus of HUD’s noise policy is on avoiding noise impacts on sensitive receptors associated with a HUD action, such as funding of a new residential development. In terms of the Proposed Action, only the Memorial would qualify as a noise sensitive receptor that would be created by the Proposed Action. However, as the Memorial is not considered a residential use with noise

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sensitive activities during nighttime, application of HUD's 10 dBA nighttime penalty would result in a highly conservative standard.

### ***NYSDEC Guidelines***

The document entitled *Assessing and Mitigating Noise Impacts* by NYSDEC also provides noise exposure guidelines. The NYSDEC guidelines recommend the following criteria to define a significant noise impact for construction noise associated with both mobile and stationary construction equipment:

- Increases ranging from 0-3 dB are considered not to have an appreciable effect on receptors;
- Increases from 3-6 dBA may have the potential for adverse noise impacts, but only in cases where the most sensitive of receptors are present;
- Sound level increases of more than 6 dBA may require a closer analysis of impact potential depending on the existing sound pressure level (SPL) and the character of surrounding land use and receptors;
- An increase of 10 dBA deserves consideration of avoidance and mitigation measures in most cases

The NYSDEC guidelines also indicate that “the goal in an industrial/commercial area, where ambient Sound Pressure Levels (SPLs) are already at a high level, should be not to exceed the ambient SPL.” Based on acoustical principles, the SPL of two sounds of the same SPLs added together is equal to the single sound SPL plus 3 dBA. In other words, two identical SPLs added together will not double the SPL; but instead would only add 3 dBA in SPL. Therefore, an increase of 3 dBA or more resulting from the Proposed Action over future noise levels without the Proposed Action is considered to be the threshold for noise impact determination. Since the proposed Action is within a central business district, which already experiences high ambient noise levels (65 dBA or greater), the 3 dBA increase threshold is applicable to the Proposed Action.

### ***FTA Noise Guidelines***

FTA noise guidelines were included in the analysis of noise impacts associated with the bus garage south of Liberty Street, which may involve FTA funding assistance. The FTA guidance manual *Transit Noise and Vibration Assessment* (1995) describes a recommended noise screening and assessment methodology, based on various transportation-related and acoustic professional sources, for assessment of ambient and transit-related noise. As part of the methodology, an initial screening is conducted (*general noise assessment*) to determine the need for a more detailed noise impact assessment. The initial screening comprises an evaluation of distance between source and receptor distance. The FTA noise analysis begins with the identification of existing receptors in the study area based on existing land use. Should this result in the identification of potentially sensitive receptors, a more detailed investigation is recommended to assess potential noise impacts (*detailed noise assessment*). Land use categories for the FTA noise impact criteria are presented in Table 15-4. Qualification of a receptor as sensitive under the FTA standards depends on the distance of the receptor from the proposed facility, and on the type of facility.



**Table 15-4**  
**Land Use Categories and Metrics For FTA Transit Noise Impact Criteria**

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor $L_{eq}(H)^*$	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use.
2	Outdoor $L_{dn}$	Residences and buildings where people normally sleep. This category includes homes, hospitals and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor $L_{eq}(H)^*$	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries and churches where it is important to avoid interference with such activities as speech, meditation and concentration on reading material. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios and concert halls fall into this category. Places for meditation or study associated with cemeteries, monuments, museums. Certain historical sites, parks and recreational facilities are also included.
<b>Note:</b> * $L_{eq}$ for the noisiest hour of transit-related activity during hours of noise sensitivity. <b>Source:</b> Federal Transit Administration, <i>Transit Noise and Vibration Assessment</i> , April 1995.		

### 15.3 CURRENT CONDITIONS SCENARIO

Potential noise impacts from mobile and stationary sources were evaluated under the Current Conditions Scenario to provide a perspective relative to current conditions. However, as described in section 15.4, impact significance was determined based on noise level increases of 3 dBA or more under the Pre-September 11 Scenario.

#### 15.3.1 EXISTING CONDITIONS 2003

Transportation and land use data, traffic projections, engineering design plans, and construction schedules were used as the basis for noise and vibration analyses. Continuous 24-hour noise measurements and short-term 20-minute  $L_{eq}$  levels were conducted during the fall of 2003 at a total of 24 measurement sites. The locations of the measurement sites are presented in Figure 15-1. The 24 sites were selected based on a number of factors including:

1. proximity to the Project Site;
2. present and future land uses (as presented in Chapter 3, "Land Use and Public Policy"; and,
3. potential traffic changes based on pre- and post-September 11 traffic data (as presented in Chapter 13A, "Traffic and Parking").

Most of the 24 monitoring sites are located mid-block where noise levels are typically lower than at intersections. Because existing noise levels tend to be lower at mid-block, a small increase in noise level is more likely to generate an impact to receptors at these locations.

The measurements were conducted during weekdays in the fall of 2003. Continuous 24-hour noise measurements were conducted at five sites, including Sites 8, 11, 14, 21, and 22 (primarily at receptor sites adjacent to existing residential uses). Of the remaining 19 receptor sites, 17 sites were measured during weekdays to account for traffic noise. Multiple short-term (20-minute)

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measurements were conducted during weekday a.m. or p.m. peak, midday, and late night hours in order to collect variation in noise levels over different periods of a day. The remaining two short-term measurement sites, including Site 23 and 24, were at the location of the proposed Memorial. At these two sites, short-term 20-minute measurements were conducted during weekends instead of weekdays in order to collect ambient noise levels and avoid the effects of on-site construction noise.

The results of the measurements taken at the 24 receptor locations are presented in Table 15-5, with additional details provided in Appendix H. As shown in the table and appendix, the measured peak noise levels ranged between 66 and 85 dBA. The estimated  $L_{dn}$  ranged between 65 and 80 dBA. These levels represent a relatively noisy urban environment with streets experiencing high levels of vehicular activity, including cars, buses, trucks, and pedestrian traffic. Details of each measurement site and results are described in Appendix H.

### **15.3.2 FUTURE WITHOUT THE PROPOSED ACTION 2009—CURRENT CONDITIONS SCENARIO**

Under the future without the Proposed Action, the Proposed Action would not be constructed or operational in 2009. None of the proposed development would take place and the WTC Site would be left in its present condition after completion of the permanent WTC PATH Terminal and interim improvements. The Adjacent Sites would be developed independently.

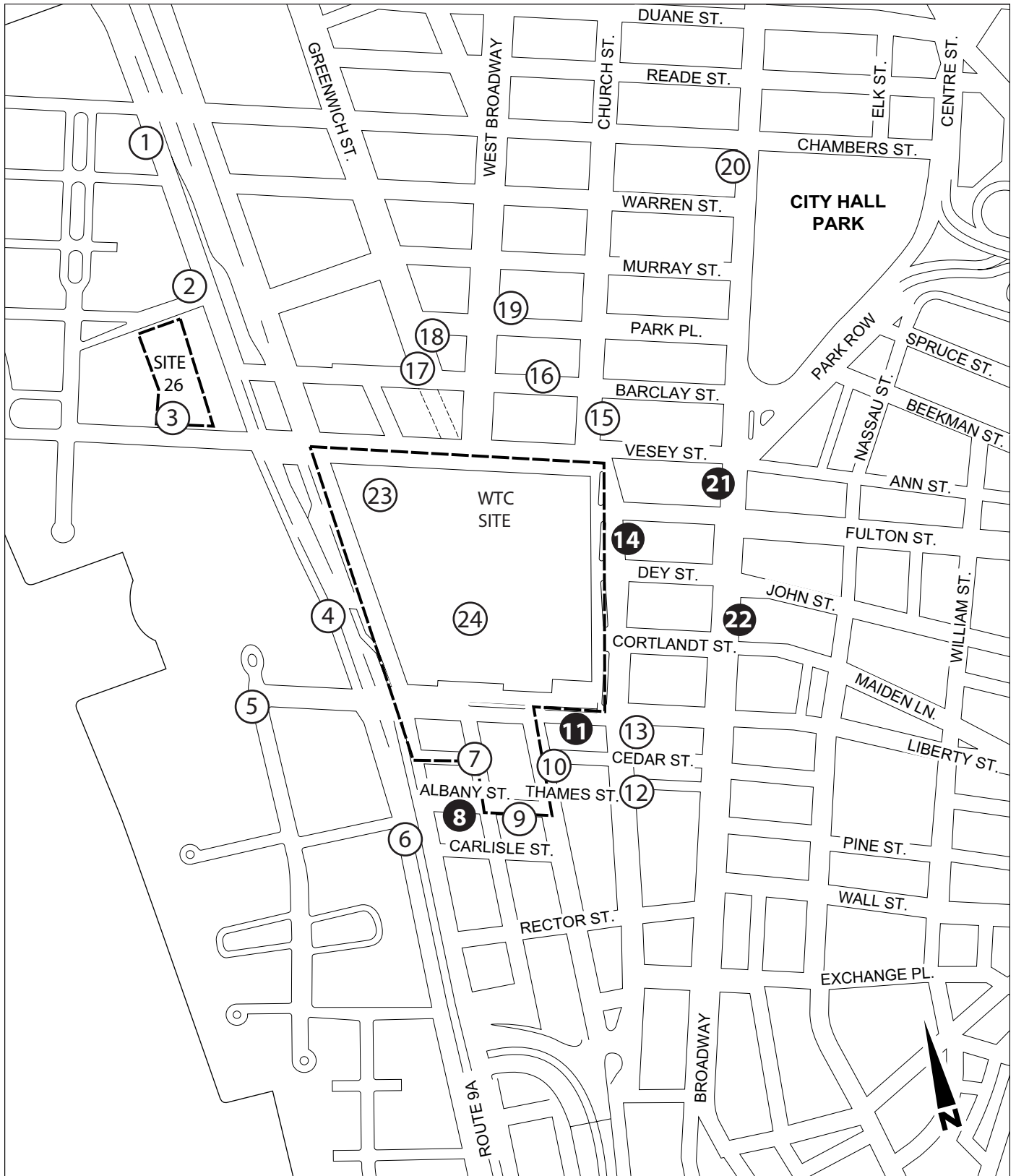
The traffic conditions and resultant noise level changes over 2003 Existing Conditions are presented in Appendix H. Under the future without the Proposed Action, changes in noise levels would range from a decrease by 2 dBA over 2003 existing conditions, to an increase by 8 dBA. The projected changes in noise levels are attributable to the changes in traffic conditions. Noise levels in 2009 without the Proposed Action are presented in Table 15-6, together with the results for 2009 with the Proposed Action.

### **15.3.3 PROBABLE IMPACTS OF THE PROPOSED ACTION 2009—CURRENT CONDITIONS SCENARIO**

Noise levels projected for the 2009 future with the Proposed Action were compared against the future without the Proposed Action to identify any incremental change in noise levels attributable to the Proposed Action. The results of the noise analysis for mobile sources and stationary sources are described below.

#### *MOBILE SOURCES*

The traffic conditions and resultant noise level changes for the Proposed Action are presented in Appendix H. Noise levels for the future with the Proposed Action and the future without the Proposed Action and differences between these conditions are presented in Table 15-6. Noise levels in 2009 associated with the future with the Proposed Action would remain unchanged from the future without the Proposed Action at 22 of 24 sites evaluated. Noise levels at two sites (Sites 11 and 17, as shown in Table 15-6) would increase 1 dBA over that of the future without the Proposed Action, based on the noise generated by mobile sources. For the future with the Proposed Action in 2009, the maximum noise level resulting from mobile sources would increase by 1 dBA over the future without the Proposed Action.



- Project Site
- ⊕ Measurement Sites
- ⊕ 24 Hours Measurement Sites

**Table 15-5  
2003 Noise Measurement Results**

Site ID	Site Name & Address	Land Use	Date	Peak Noise Level $L_{eq}$ in dBA	24-hour $L_{dn}$ (dBA)
1	PS 89 Playground on West St	Public Facilities & Institutions	12/10/03 & 12/16/03	72	77
2	NW Corner of Murray St & West St	Open Space & Outdoor Recreation	12/10/03 & 12/16/03	73	78
3	Embassy Suites & Regal Cinemas on Vesey St	Hotel	12/10/03 & 12/16/03	68	71
4	World Financial Center/Dow Jones, side of West St (Vesey St & Liberty St)	Bikeway	12/9/03-12/10/03	67	72
5	Gateway Plaza (corner of Liberty St & South End Av)	Residential	12/9/03-12/10/03	66	67
6	SW corner of Albany St & West Street (parking lot)	Residential	12/9/03-12/10/03	73	77
7	Cedar St & Washington St (Fence on Cedar St)	Proposed Park/Church Residential	12/9/03-12/10/03	66	65
8	Marriott Hotel-85 West Street, side of Albany Street	Residential	12/9/2003	74	75
9	4 Albany St	Residential	12/9/03-12/10/03	69	69
10	120 Cedar St (on Greenwich St)	Institutional	12/9/03-12/10/03	69	70
11	114 Liberty St	Residential	12/9/2003	71	71
12	95 Trinity Building	Institutional	12/9/03-12/10/03	76	78
13	SE corner of Liberty St & Trinity Pl (at Park corner)	Public open space	12/9/03-12/10/03	76	75
14	Hilton Millennium Hotel-Dey Street	Hotel	8/13/03-8/14/03	72	74
15	St. Peter's Church on Church St	Public Facilities & Institutions	12/10/03 & 12/16/03	75	75
16	100 Church Street-Barclay St Entrance	Commercial & Office	12/10/03 & 12/16/03	72	71
17	Barclay St & Washington Street Intersection	Commercial & Office	12/10/03-12/17/03	73	70
18	Park Pl & Greenwich St (corner of BMCC)	Commercial & Office	12/10/03-12/17/03	73	69
19	NE corner of Park Pl & West Broadway	Residential	12/10/03-12/17/03	71	73
20	Tower 270-Broadway & Chambers	Residential	12/10/03-12/17/03	75	76
21	St. Paul's Chapel NW corner of Broadway & Fulton St	Church	8/12/03-8/13/03	85	80
22	180 Broadway	Residential	8/12/03-8/13/03	76	79
23	WTC Bath tub	Proposed Memorial	12/13/2003	67	72
24	WTC Bath tub	Proposed Memorial	12/13/2003	67	73

**Note:** Sites 8, 11, 14, 21, and 22 were measured for continuous 24-hours.  
**Source:** The Louis Berger Group, Inc. 2003

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**Table 15-6  
Noise Levels with and Without the Proposed Action in 2009—Current Conditions Scenario**

Site ID	Site Name & Address	Land Use	Future Without the Proposed Action	Future With the Proposed Action	
			L <sub>eq</sub> (dBA)	L <sub>eq</sub> (dBA)	Changes in L <sub>eq</sub> (dBA)
1	PS 89 Playground on West St	Public Facilities & Institutions	73	73	0
2	NW Corner of Murray St & West St	Open Space & Outdoor Recreation	72	72	0
3	Embassy Suites & Regal Cinemas on Vesey St	Hotel	67	67	0
4	World Financial Center/Dow Jones, side of West St (Vesey St & Liberty St)	Bikeway	68	68	0
5	Gateway Plaza (corner of Liberty St & South End Av)	Residential	69	69	0
6	SW corner of Albany St & West Street (parking lot)	Residential	75	75	0
7	Cedar St & Washington St (Fence on Cedar St)	Proposed Park/Church Residential	66	66	0
8	Marriott Hotel-85 West Street, side of Albany Street	Residential	74	74	0
9	4 Albany St	Residential	69	69	0
10	120 Cedar St (on Greenwich St)	Institutional	69	69	0
11	114 Liberty St	Residential	79	80	+1
12	95 Trinity Building	Institutional	77	77	0
13	SE corner of Liberty St & Trinity Pl (at Park corner)	Public open space	78	78	0
14	Hilton Millennium Hotel-Dey Street	Hotel	74	74	0
15	St. Peter's Church on Church St	Public Facilities & Institutions	77	77	0
16	100 Church Street-Barclay St Entrance	Commercial & Office	74	74	0
17	Barclay St & Washington Street Intersection	Commercial & Office	76	77	+1
18	Park Pl & Greenwich St (corner of BMCC)	Commercial & Office	73	73	0
19	NE corner of Park Pl & West Broadway	Residential	71	71	0
20	Tower 270-Broadway & Chambers	Residential	74	74	0
21	St. Paul's Chapel NW corner of Broadway & Fulton St	Church	84	84	0
22	180 Broadway	Residential	74	74	0
23	WTC Bathtub	Proposed Memorial	68	68	0
24	WTC Bathtub	Proposed Memorial	68	68	0

**Note:**  
1. The "With the Proposed Action" noise levels and their changes were calculated based on reasonable worst-case conditions, under which Route 9A was assumed to be constructed at-grade. Although the detailed modeling results were not available for the Route 9A Tunnel Alternative, it is estimated that noise levels at Sites 4, 23, and 24 would be approximately 6 dBA less than those presented in this table.

**Source:** The Louis Berger Group, Inc. 2003

Because they are part of the Proposed Action and represent new sensitive receptors themselves, a separate evaluation was conducted for the proposed Memorial, parks and open spaces, museum, and performing arts center at the Project Site. As mentioned earlier, the Project Site experienced high noise levels, prior to September 11, 2001, which are considered to be typical for an urban environment. This condition continued into 2003, when noise levels measured at all receptor locations during peak hours exceeded 65 dBA (see section 15.2). Because the area at and adjacent to the Project Site would continue to be part of one of the largest central business districts in the United States, high noise levels attributable to mobile sources would be expected with or without the Proposed Action in the future.

Noise levels at outdoor below-grade areas of the proposed Memorial in 2009 could be up to 68 dBA (see Table 15-6) and would not change from those anticipated without the Proposed Action. The noise levels at-grade at Heroes Park (Site 4), Wedge of Light Plaza (Site 14), museum (Site 23), and part of the Memorial (Site 23 and 24) would range between high 60s and mid-70s in 2009. Noise levels would be similar to those under pre-September 11 conditions, when they already exceeded the CEQR guideline levels, and would be similar to noise levels at public spaces such as City Hall Park, Bowling Green Park, and Battery Park.

### *STATIONARY SOURCES*

For the future with the Proposed Action, the potential stationary noise sources would be the HVAC systems of the buildings at the Project Site, mechanical equipment, substations, and wind turbines on top of Freedom Tower. Mechanical equipment and systems of the new buildings would incorporate noise reduction technology devices to comply with all applicable noise regulations and standards. For example, HVAC systems would be designed to be fully enclosed and would not generate detectable noise.

Freedom Tower would include multiple wind turbines installed on top of the building to generate electricity. Wind turbines typically consist of an enclosure called a nacelle, which contains the gearbox and generator, and three blades that rotate around a hub protruding from the enclosure. Wind turbines typically include two potential sources of noise: the turbine blades passing through the air as the hub rotates, and the gearbox and generator in the nacelle. Noise from the blades would be minimized by careful attention to the design and manufacture of the blades. The noise from the gearbox and generator is contained within the nacelle by sound insulation and isolation materials. The sound power level from a single wind turbine is usually between 90 and 100 dBA. This creates a sound pressure level of 50-60 dBA at a distance of approximately 120 feet from the turbine, that is, about the same level as conversational speech. At a distance of 1,500 feet, the equivalent sound pressure level generated by wind turbines would be 25-35 dBA when the wind is blowing from the turbine towards the receptor. Ten such wind turbines, all at a distance of approximately 1,500 feet, would create a noise level of 35-45 dBA under the same conditions.<sup>1</sup> With the wind blowing in the opposite direction the noise level would be approximately 10 dBA. Considering the elevation of the turbines above 1,000 feet and the substantial background noise at receptor locations, noise generated by the wind turbines would not be discernible at receptor locations. Noise associated with air tempering equipment and ventilation shafts would be insignificant and be masked by the background noise from street traffic and other noises, which are typical for an urban environment.

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<sup>1</sup> "Noise from wind turbines." The British Wind Energy Association. United Kingdom. 2000. [www.bew.com/ref/noise.html](http://www.bew.com/ref/noise.html)

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Because they are part of the Proposed Action and represent new sensitive receptors themselves, a separate stationary source noise impact evaluation was conducted for the proposed Memorial, parks and open spaces, museum, and performing arts center at the Project Site. As mentioned in Chapter 21, “Construction Impacts,” peak construction activities, such as below-grade and at-grade construction at the Project Site would be completed by 2008. After completion of the Memorial and parks in 2009, however, some construction activities including construction of the upper floors of Towers 2, 3, 4, and 5 would still be ongoing at the Project Site. Construction activities on the Project Site would thus increase the noise level at the Memorial and the parks in 2009. Construction noise would only occur during daytime hours between 7am and 6pm, Monday through Saturday (see “Construction Impacts,” section 21.3.2). Based on information of construction plans and site layouts, peak-hour construction noise levels were calculated. These are presented in Appendix J. Peak-hour construction noise levels could reach 77 and 79 dBA, respectively, at the Memorial and parks. Therefore, peak construction noise levels could temporarily increase by approximately 10 dBA over the projected ambient noise levels at the Memorial and parks. Construction noise would not occur on a continuous basis and would shift around the site. Construction of Towers 2, 3, 4, and 5 in 2009 would be advancing substantially above street level, thereby resulting in dispersion of construction noise and natural attenuation of noise by distance. As the lower floors of the towers are completed they would become gradually enclosed with construction of the exterior walls thereby further attenuating noise exposure.

Construction noise reduction measures would be implemented through Environmental Performance Commitments and Best Management Practices to limit potential construction-related noise impacts, to the extent practicable. A range of mitigation measures that may be employed is included in Chapter 22, “Mitigation,” and in Appendix J for specific noise-generating construction activities. In addition, the Memorial design would utilize noise reduction features and technology to the extent practicable; especially at parts of the Memorial considered to be important for “serenity and quiet”. Further attenuation of noise levels may be achieved through careful design and planning, such as site layouts and landscaping. Applicability of new technologies and noise reduction features (such as sound masking) would also be investigated and incorporated into the design of the proposed Memorial.

Buildings associated with the proposed hotel, performing arts center, museums, and St. Nicholas Church within or adjacent to the Project Site would include noise mitigation measures to achieve interior noise levels specified by applicable standards and criteria. A noise level attenuation of 30-40 dBA would be recommended for these sensitive receptor sites. These attenuation goals would be achieved by utilizing modern technologies during the final design of future development at the Project Site.

It should be noted that the noise levels resulting from the latter stages of construction at the Project Site would be considerably below those at the peak of construction in 2006. Furthermore, construction activities would reduce over time and would not result in a permanent elevation of noise levels at the Project Site, including the Memorial site.

### *HUD-BASED NOISE ANALYSIS*

A noise analysis was conducted for the proposed Memorial based on HUD Noise Assessment Guidelines and policy. The proposed Memorial would be located primarily at-grade and adjacent to the former WTC tower footprints. Based on information in section 15.3.1, street traffic and pedestrians form the predominant noise sources at the Project Site. The noise levels measured in 2003 at the proposed Memorial site were 67 dBA and exceeded HUD Site Acceptability

Standards of 65 dBA. These sites would be considered “normally unacceptable” under existing conditions during peak noise hours.

It is anticipated that traffic and pedestrians would continue to be the predominant noise sources at the proposed Memorial in the future. Based on the HUD noise methodology, noise levels attributed to operation and construction of the Proposed Action were calculated. As presented in Table 15-7, the future noise levels ( $L_{dn}$ ) attributed to the operation (mobile and stationary sources) of the Proposed Action at the Memorial would be 68 dBA in 2009. The proposed Memorial is expected to be completed and operational in 2009. Due to the construction of Towers 2, 3, 4, and 5 at the Project Site, noise levels at the Project Site would increase in 2009. Construction noise levels at the proposed Memorial were calculated based on the preliminary construction plans and schedules. Noise levels ( $L_{dn}$ ) at the proposed Memorial could reach 73 dBA in 2009 during the peak construction month. Overall  $L_{dn}$  levels including mobile and stationary source emissions would be 74 dBA and would exceed HUD Site Acceptability Standards of 65 dBA and be considered to be “normally unacceptable.” Based on HUD Policy, a 10 dB attenuation would be required for the proposed Memorial during the construction in 2009.

**Table 15-7  
2009 Overall Noise Level  $L_{dn}$  at Sensitive Receptors  
HUD Noise Analysis —Current Conditions Scenario**

Site	Site Name & Address	Land Use	HUD Acceptability Standards	Mobile Source Noise Levels $L_{dn}$ in dBA	Stationary Source (Construction) Noise Levels $L_{dn}$ in dBA	Overall Noise Levels $L_{dn}$ in dBA
23	WTC Bathtub	Proposed Memorial	65	68	71	72
24	WTC Bathtub	Proposed Memorial	65	68	73	74

**15.3.4 FUTURE WITHOUT THE PROPOSED ACTION 2015—CURRENT CONDITONS SCENARIO**

Under the future without the Proposed Action, the Proposed Action would not be constructed or operational in 2015. None of the proposed developments would take place and the WTC Site would have been left in approximately its present condition after completion of the permanent WTC PATH Terminal and interim improvements. The Adjacent Sites would be developed independently under this scenario.

The traffic conditions and resultant noise level changes over 2003 existing conditions are presented in Appendix H. Noise levels in the future without the Proposed Action would range from a decrease in noise levels by 1 dBA to an increase by 9 dBA compared to 2003 existing conditions. The changes in noise levels would be attributed to the changes in traffic conditions. Noise levels in 2015 without the Proposed Action are presented in Table 15-8 together with the results for 2015 with the Proposed Action.



### **15.3.5 PROBABLE IMPACTS OF THE PROPOSED ACTION 2015—CURRENT CONDITIONS SCENARIO**

Noise levels in 2015 in the future with the Proposed Action were compared against those of the future without the Proposed Action to identify any incremental changes in noise levels attributable to the operation of the Proposed Action. The results of the noise analysis are presented below.

#### *MOBILE SOURCES*

Traffic conditions and resultant noise level changes are presented in Appendix H. The 2015 noise levels in future without the Proposed Action and in the future with the Proposed Action and their relative changes are presented in Table 15-8. Noise levels in the future with the Proposed Action would decrease or remain unchanged compared to those in the future without the Proposed Action at 16 of the 24 sites evaluated. Noise levels in the future with the Proposed Action would increase between 1 and 2 dBA compared to those in the future without the Proposed Action at 8 of the 24 sites evaluated. The maximum noise level increases in 2015 over the future without the Proposed Action would be 2 dBA.

#### *STATIONARY SOURCES*

Mechanical equipment and building systems in 2015 would utilize noise reduction devices to comply with applicable noise regulations and standards. Noise associated with the wind turbines, air tempering equipment, and ventilation shafts would be insignificant and be masked by the background noise from street traffic and other noises, which are typical for urban environments, as discussed previously for the 2009 conditions with the Proposed Action.

#### *HUD-BASED NOISE ANALYSIS*

It is anticipated that traffic and pedestrians would remain to be the predominant noise sources at the proposed Memorial in the future. As presented in Table 15-9, the future noise levels attributable to the operation (mobile and stationary sources) of the Proposed Action at the Memorial site would be 68 dBA in 2015 and would exceed HUD Site Acceptability Standards of 65 dBA, as they currently do. Because construction of the Proposed Action would have been completed by 2015, there would be no construction noise associated with the Proposed Action. Based on HUD Policy, 5 dBA attenuation would normally be required for the proposed Memorial site, as it is considered to be in the “normally unacceptable” category due to elevated operational noise in 2015.

### **15.4 PRE-SEPTEMBER 11 SCENARIO**

For the Pre-September 11 Scenario, potential noise impacts from mobile and stationary sources were evaluated. Noise impacts that could potentially occur as the result of the Proposed Action, include any of the following:

noise impacts as a result of vehicular traffic increase at and near the Project Site;

- noise generated from stationary equipment at the Project Site, including construction equipment in 2009.

**Table 15-8**  
**Noise Levels with and Without the Proposed Action In 2015**  
**Current Conditions Scenario**

Site ID	Site Name & Address	Land Use	Future Without the Proposed Action	Future With the Proposed Action	
			L <sub>eq</sub> (dBA)	L <sub>eq</sub> (dBA)	Changes in L <sub>eq</sub> (dBA)
1	PS 89 Playground on West St	Public Facilities & Institutions	73	74	+1
2	NW Corner of Murray St & West St	Open Space & Outdoor Recreation	73	75	+2
3	Embassy Suites & Regal Cinemas on Vesey St	Hotel	68	70	+2
4	World Financial Center/Dow Jones, side of West St (Vesey St & Liberty St)	Bikeway	68	68	0
5	Gateway Plaza (corner of Liberty St & South End Av)	Residential	70	70	0
6	SW corner of Albany St & West Street (parking lot)	Residential	75	75	0
7	Cedar St & Washington St (Fence on Cedar St)	Proposed Park/Church Residential	66	66	0
8	Marriott Hotel-85 West Street, side of Albany Street	Residential	74	74	0
9	4 Albany St	Residential	69	69	0
10	120 Cedar St (on Greenwich St)	Institutional	69	68	-1
11	114 Liberty St	Residential	80	82	+2
12	95 Trinity Building	Institutional	77	77	0
13	SE corner of Liberty St & Trinity Pl (at Park corner)	Public open space	79	80	+1
14	Millennium Hotel-Dey Street	Hotel	74	75	+1
15	St. Peter's Church on Church St	Public Facilities & Institutions	78	78	0
16	100 Church Street-Barclay St Entrance	Commercial & Office	74	74	0
17	Barclay St & Washington Street Intersection	Commercial & Office	75	77	+2
18	Park Pl & Greenwich St (corner of BMCC)	Commercial & Office	73	73	0
19	NE corner of Park Pl & West Broadway	Residential	71	73	+2
20	Tower 270-Broadway & Chambers	Residential	75	75	0
21	St. Paul's Chapel NW corner of Broadway & Fulton St	Church	85	85	0
22	180 Broadway	Residential	76	75	-1
23	WTC Bath tub	Proposed Memorial	68	68	0
24	WTC Bath tub	Proposed Memorial	68	68	0

**Notes:**

- The "With the Proposed Action" noise levels and their changes were calculated based on reasonable worst-case conditions, under which Route 9A was assumed to be constructed at-grade. Although the detailed modeling results were not available for the Route 9A Tunnel Alternative, it is estimated that noise levels at Sites 4, 23, and 24 would be approximately 6 dBA less than those presented in this table.

**Source:** The Louis Berger Group, Inc. 2003

**Table 15-9  
2015 Overall Noise Level  $L_{dn}$  at the Sensitive Receptors—HUD Noise Analysis**

<b>Site</b>	<b>Site Name &amp; Address</b>	<b>Land Use</b>	<b>HUD Acceptability Standards</b>	<b>Mobile Source Noise Levels <math>L_{dn}</math> in dBA</b>	<b>Exceeded HUD 65 dBA Standards</b>
23	WTC Bathtub	Proposed Memorial	65	68	Yes
24	WTC Bathtub	Proposed Memorial	65	68	Yes
<b>Source:</b> The Louis Berger Group, Inc. 2003					

Impact significance was determined based on noise level increases of 3 dBA or more under the Pre-September 11 Scenario.

**15.4.1 BASELINE CONDITIONS**

As discussed in Chapter 2, “Methodology,” analyses under the Pre-September 11 Scenario reflect a reasonable depiction of conditions that would have been expected in the study area absent the events of September 11. Current traffic conditions represent a substantial decrease over traffic conditions prior to September 11, 2001 and thus do not reflect the noise conditions prior to September 11, 2001.

Pre-September 11 conditions were developed based on a comparison of traffic volume data between pre-September 11 and 2003 current conditions. Noise levels measured in 2003 were adjusted based on the difference in traffic volumes between 2003 and pre-September 11 to approximate the noise levels likely present prior to September 11, 2001. Table 15-10 represents the pre-September 11 noise levels as adjusted based on pre-September 11 traffic conditions.

**15.4.2 FUTURE WITHOUT THE PROPOSED ACTION 2009—  
PRE-SEPTEMBER 11 SCENARIO**

Without the Proposed Action, the WTC Site would remain in its pre-September 11 conditions in 2009. The Adjacent Sites would also remain in their respective pre-September 11 conditions—namely, 130 Liberty Street would still be operational, and Site 26 would be a parking lot that would be developed in the future years.

The traffic conditions and resultant noise level changes over pre-September 11 conditions are presented in Appendix H. Under the future without the Proposed Action, changes in noise levels would range from a decrease in 2009 by 1 dBA over pre-September 11 conditions, to an increase by 3 dBA. The changes in noise levels would be attributable to the changes in traffic conditions.

**15.4.3 PROBABLE IMPACTS OF THE PROPOSED ACTION 2009—  
PRE-SEPTEMBER 11 SCENARIO**

To characterize the 2009 noise environment with the Proposed Action, noise levels were compared against those of the future without the Proposed Action to identify any incremental changes in noise levels attributable to the operation of the Proposed Action. The results of the noise analysis are presented below.

**Table 15-10**  
**Pre-September 11 Noise Levels in dBA**

Site ID	Site Name & Address	Land Use	2003		Pre-September 11	
			L <sub>eq</sub>	L <sub>dn</sub>	L <sub>eq</sub>	L <sub>dn</sub>
1	PS 89 Playground on West St	Public Facilities & Institutions	72	77	72	77
2	NW Corner of Murray St & West St	Open Space & Outdoor Recreation	73	78	73	78
3	Embassy Suites & Regal Cinemas on Vesey St	Hotel	68	71	71	74
4	World Financial Center/Dow Jones, side of West St (Vesey St & Liberty St)	Bikeway	67	72	67	72
5	Gateway Plaza (corner of Liberty St & South End Av)	Residential	66	67	66	67
6	SW corner of Albany St & West Street (parking lot)	Residential	73	77	75	79
7	Cedar St & Washington St (Fence on Cedar St)	Proposed Park/Church Residential	66	65	67	66
8	Marriott Hotel-85 West Street, side of Albany Street	Residential	74	75	74	75
9	4 Albany St	Residential	69	69	69	69
10	120 Cedar St (on Greenwich St)	Institutional	69	70	69	70
11	114 Liberty St	Residential	71	71	79	79
12	95 Trinity Building	Institutional	76	78	78	80
13	SE corner of Liberty St & Trinity Pl (at Park corner)	Public open space	76	75	78	77
14	Hilton Millennium Hotel-Dey Street	Hotel	72	74	75	77
15	St. Peter's Church on Church St	Public Facilities & Institutions	75	75	77	77
16	100 Church Street-Barclay St Entrance	Commercial & Office	72	71	74	73
17	Barclay St & Washington Street Intersection	Commercial & Office	73	70	77	74
18	Park Pl & Greenwich St (corner of BMCC)	Commercial & Office	73	69	73	69
19	NE corner of Park Pl & West Broadway	Residential	71	73	76	78
20	Tower 270-Broadway & Chambers	Residential	75	76	75	76
21	St. Paul's Chapel NW corner of Broadway & Fulton St	Church	85	80	85	80
22	180 Broadway	Residential	76	79	76	79
23	WTC Bathtub	Proposed Memorial	67	72	67	72
24	WTC Bathtub	Proposed Memorial	67	73	67	73

**Source:** The Louis Berger Group, Inc. 2003

### *MOBILE SOURCES*

The 2009 noise levels of the future without the Proposed Action and the future with the Proposed Action and their relative changes are presented in Table 15-11. In general, it is not expected that the 2009 traffic volumes under the Proposed Action on and adjacent to the Project Site would return to pre-September 11 levels. The 2009 traffic conditions and resultant noise level changes for the Proposed Action are presented in Appendix H. The noise level would not increase over 2009 future without the Proposed Action. In fact, 2009 noise levels with the Proposed Action would decrease relative to noise levels of 2009 without the Proposed Action at most sites evaluated. In sum, there would not be any significant noise impacts from mobile sources associated with the Proposed Action.

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**Table 15-11  
2009 Future Noise Levels Resulting from Mobile Sources (L<sub>eq</sub> In dBA)  
Pre-September 11 Scenario**

Site ID	Site Name & Address	Land Use	Future Without the Proposed Action	Future With the Proposed Action	
			L <sub>eq</sub>	L <sub>eq</sub>	Changes in L <sub>eq</sub>
1	PS 89 Playground on West St	Public Facilities & Institutions	73	73	0
2	NW Corner of Murray St & West St	Open Space & Outdoor Recreation	74	72	-2
3	Embassy Suites & Regal Cinemas on Vesey St	Hotel	69	67	-2
4	World Financial Center/Dow Jones, side of West St (Vesey St & Liberty St)	Bikeway	68	67	-1
5	Gateway Plaza (corner of Liberty St & South End Av)	Residential	69	68	-1
6	SW corner of Albany St & West Street (parking lot)	Residential	74	74	0
7	Cedar St & Washington St (Fence on Cedar St)	Proposed Park/Church Residential	66	66	0
8	Marriott Hotel-85 West Street, side of Albany Street	Residential	74	74	0
9	4 Albany St	Residential	69	69	0
10	120 Cedar St (on Greenwich St)	Institutional	69	67	-2
11	114 Liberty St	Residential	80	79	-1
12	95 Trinity Building	Institutional	78	77	-1
13	SE corner of Liberty St & Trinity Pl (at Park corner)	Public open space	79	78	-1
14	Hilton Millennium Hotel-Dey Street	Hotel	76	76	0
15	St. Peter's Church on Church St	Public Facilities & Institutions	78	78	0
16	100 Church Street-Barclay St Entrance	Commercial & Office	74	74	0
17	Barclay St & Washington Street Intersection	Commercial & Office	77	77	0
18	Park Pl & Greenwich St (corner of BMCC)	Commercial & Office	73	73	0
19	NE corner of Park Pl & West Broadway	Residential	71	70	-1
20	Tower 270-Broadway & Chambers	Residential	75	74	-1
21	St. Paul's Chapel NW corner of Broadway & Fulton St	Church	85	83	-2
22	180 Broadway	Residential	76	74	-2
23	WTC Bathtub	Proposed Memorial	68	68	0
24	WTC Bathtub	Proposed Memorial	68	68	0

**Notes:**

- The "With the Proposed Action" noise levels and their changes were calculated based on the worst-case conditions, under which Route 9A was assumed to be constructed at-grade. Although the detailed modeling results were not available for the Route 9A Tunnel Alternative, it is estimated that noise levels at Sites 4, 23, and 24 would be approximately 6 dBA less than those presented in this table.

**Source:** The Louis Berger Group, Inc., 2003.

Because they are part of the Proposed Action and represent new sensitive receptors themselves, a separate evaluation was conducted for the proposed Memorial, parks and open spaces, museum, and performing arts center. As mentioned earlier, the Project Site experienced high noise levels, prior to September 11, 2001, which are considered to be typical for an urban environment. All measured noise levels during peak hours exceeded 65 dBA (see section 15.2). Because the area at and adjacent to the Project Site would continue to be part of one of the largest central business districts in the United States, high noise levels would be expected with or without the Proposed Action in the future.

Noise levels at outdoor below-grade areas of the proposed Memorial in 2009 would be approximately 68 dBA (see Table 15-9) and not change from those Without the Proposed Action. The noise levels at-grade at Heroes Park, Wedge of Light Plaza, museum, and outdoor part of the Memorial would range between high 60s and mid-70s in 2009.

Noise levels would be similar to those under Pre-September 11 Conditions, when they already exceeded the CEQR guideline levels, and would be similar to noise levels at public spaces such as City Hall Park, Bowling Green Park, and Battery Park. While reduction of external noise levels to below CEQR and HUD recommended levels in the future is not considered practicable, the Memorial design may be able to utilize noise reduction features and technology (such as sound masking) to counteract the effects of background noise and for its interior spaces would incorporate noise attenuation construction measures.

### *STATIONARY SOURCES*

For the Proposed Action, the mechanical equipment and systems would utilize sufficient applicable noise reduction devices to comply with applicable noise regulations and standards. The noise from stationary sources other than construction would be insignificant and would be masked by the background noise from street traffic and other noises, which are typical for urban environment.

For the future with the Proposed Action, the potential stationary noise sources would be the HVAC systems of the buildings at the Project Site, mechanical equipment, substations, and wind turbines on top of Freedom Tower. Mechanical equipment and systems of the new buildings would incorporate noise reduction technology devices to comply with all applicable noise regulations and standards. For example, HVAC systems would be designed to be fully enclosed and would not generate detectable noise.

Freedom Tower would include multiple wind turbines installed on the top of the building to generate electricity. Wind turbines typically consist of an enclosure called a nacelle, which contains the gearbox and generator, and three blades that rotate around a horizontal hub protruding from the enclosure. Wind turbines typically include two potential sources of noise: the turbine blades passing through the air as the hub rotates, and the gearbox and generator in the nacelle. Noise from the blades is minimized by careful attention to the design and manufacture of the blades. The noise from the gearbox and generator is contained within the nacelle by sound insulation and isolation materials.

The sound power level from a single wind turbine is usually between 90 and 100 dBA. This creates a sound pressure level of 50-60 dBA at a distance of approximately 120 feet from the turbine, that is, about the same level as conversational speech. At a distance of 1,500 feet, the equivalent sound pressure level generated by wind turbines would be 25-35 dBA when the wind is blowing from the turbine towards the receptor. Ten such wind turbines, all at a distance of

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approximately 1,500 feet, would create a noise level of 35-45 dBA under the same conditions.<sup>1</sup> With the wind blowing in the opposite direction the noise level would be about 10 dBA. Considering the elevation of the turbines above 1,000 feet and the substantial background noise at receptor locations, noise generated by the wind turbines would not be discernible at receptor locations.

Noise associated with air tempering equipment and ventilation shafts would be insignificant and be masked by the background noise from street traffic and other noises, which are typical for an urban environment.

### ***Construction Noise in 2009***

Because they are part of the Proposed Action and represent new sensitive receptors themselves, a separate stationary source noise impact evaluation was conducted for the proposed Memorial, parks and open spaces, museum, and performing arts center. These elements of the Proposed Action would experience elevated noise levels in 2009. As mentioned in the Chapter 21, “Construction Impacts,” peak construction activities, such as below-grade and at-grade construction at the Project Site would be completed by 2008. After completion of the Memorial and parks in 2009, however, some construction activities including construction of upper floors of Towers 2, 3, 4, and 5 would still be ongoing at the Project Site. Construction activities on the Project Site would increase the noise level at the Memorial and the parks in 2009.

Construction noise would generally only occur during daytime hours between 7 AM and 6 PM. Peak-hour construction noise levels were calculated based on information of construction plans and site layouts, and are presented in Table 15-12. Peak-hour construction noise levels in 2009 would equal to or exceed construction noise threshold criteria at Sites 4 through 15, 23, and 24. Peak-hour construction noise levels would reach 77 and 79 dBA, respectively, at the Memorial and parks. Peak construction noise levels would exceed CEPO-CEQR recommended guidelines for sensitive receptors and would be approximately 10 dBA greater than the ambient noise levels at the Memorial and parks. Since a 10 dBA increase in noise level generally results in doubling of loudness (see section 15.1.1), the noisiest construction activities, when they occur, would substantially increase the perceived noise at the Memorial and parks.

Construction noise would not occur on a continuous basis and would shift around the site, reflecting areas of construction activity at any given time of day and phase of construction of the various structures on-site. Construction of Towers 2, 3, and 4 in 2009 would be advancing substantially above street level, thereby resulting in dispersion of construction noise and natural attenuation of noise by distance. As the lower floors of the towers are completed they would become gradually enclosed with construction of the exterior walls thereby further attenuating noise exposure.

Construction noise reduction measures would be implemented through Environmental Performance Commitments and Best Management Practices to limit potential construction-related noise impacts, to the extent practicable. A range of mitigation measures that may be employed is included in Chapter 22, “Mitigation” and in Appendix J for specific noise-generating construction activities.

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<sup>1</sup> “Noise from wind turbines.” The British Wind Energy Association. United Kingdom. 2000. [www.bwea.com/ref/noise.html](http://www.bwea.com/ref/noise.html)

**Table 15-12**  
**2009 Future Construction Noise Levels ( $L_{eq}$  in dBA)**

Site ID	Site Name & Address	Land Use	Criteria Threshold (dBA)	2009 Peak-Hour Construction $L_{eq}$ (dBA)	Impact?
1	PS 89 Playground on West St	Public Facilities & Institutions	72	66	No
2	NW Corner of Murray St & West St	Open Space & Outdoor Recreation	73	65	No
3	Embassy Suites & Regal Cinemas on Vesey St	Hotel	68	66	No
4	World Financial Center/Dow Jones, side of West St (Vesey St & Liberty St)	Bikeway	67	76	Yes
5	Gateway Plaza (corner of Liberty St & South End Av)	Residential	66	69	Yes
6	SW corner of Albany St & West Street (parking lot)	Residential	73	73	Yes
7	Cedar St & Washington St (Fence on Cedar St)	Proposed Park/Church Residential	66	78	Yes
8	Marriott Hotel-85 West Street, side of Albany Street	Residential	74	78	Yes
9	4 Albany St	Residential	69	85	Yes
10	120 Cedar St (on Greenwich St)	Institutional	69	83	Yes
11	114 Liberty St	Residential	71	89	Yes
12	95 Trinity Building	Institutional	76	76	Yes
13	SE corner of Liberty St & Trinity Pl (at Park corner)	Public open space	76	86	Yes
14	Hilton Millennium Hotel-Dey Street	Hotel	72	83	Yes
15	St. Peter's Church on Church St	Public Facilities & Institutions	75	76	Yes
16	100 Church Street-Barclay St Entrance	Commercial & Office	72	70	No
17	Barclay St & Washington Street Intersection	Commercial & Office	73	67	No
18	Park Pl & Greenwich St (corner of BMCC)	Commercial & Office	73	68	No
19	NE corner of Park Pl & West Broadway	Residential	71	68	No
20	Tower 270-Broadway & Chambers	Residential	75	64	No
21	St. Paul's Chapel NW corner of Broadway & Fulton St	Church	85	72	No
22	180 Broadway	Residential	76	74	No
23	WTC Bathtub	Proposed Memorial	67	77	Yes
24	WTC Bathtub	Proposed Memorial	67	79	Yes

**Source:** The Louis Berger Group, Inc. 2003



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In addition, the Memorial design would utilize to the extent practicable noise reduction features and technology to the extent practicable, especially at parts of the Memorial considered to be important for “serenity and quiet”. Attenuation of noise levels may be achieved through careful design and planning, such as site layouts and landscaping. Applicability of new technologies and noise reduction features, would also be investigated and incorporated into the design of the proposed Memorial.

Buildings associated with the proposed hotel, performing arts center, museums, and St. Nicholas Church within or adjacent to the Project Site would include noise mitigation measures to achieve interior noise levels specified by applicable Standards and criteria. A noise level attenuation of 30-40 dBA would be recommended for these sensitive receptor sites. These attenuation goals will be achieved by utilizing modern technologies during the final design of future development at the Project Site.

### HUD-BASED NOISE ANALYSIS

A noise analysis was conducted for the proposed Memorial based on HUD Noise Assessment Guidelines and policy. The proposed Memorial would be located at and adjacent to the former WTC tower footprints, covering an area from approximately 30 feet below-grade up to street level. Based on information in section 15.3.1, street traffic and pedestrians form the predominant noise sources at the Project Site. The noise levels measured in 2003 at the proposed Memorial site were 67 dBA and exceeded HUD Site Acceptability Standards of 65 dBA. These sites would be considered “normally unacceptable” under existing conditions during peak noise hours.

It is anticipated that traffic and pedestrians would continue to be the predominant noise sources at the proposed Memorial in the future. Based on the HUD noise methodology, noise levels attributed to operation and construction of the Proposed Action were calculated. As presented in Table 15-13, the future noise levels ( $L_{dn}$ ) attributed to the operation (mobile and stationary sources) of the Proposed Action at the Memorial would be 68 dBA in 2009. The proposed Memorial is expected to be completed and operational in 2009. Due to the construction of Towers 2, 3, 4, and 5 at the Project Site, noise levels at the Project Site would increase in 2009. Construction noise levels at the proposed Memorial were calculated based on the preliminary construction plans and schedules. Noise levels ( $L_{dn}$ ) at the proposed Memorial could reach 73 dBA in 2009 during the peak construction month. Overall  $L_{dn}$  levels including mobile and stationary source emissions would be 74 dBA and would exceed HUD Site Acceptability Standards of 65 dBA and be considered to be “normally unacceptable”. Based on HUD Policy, a 10 dB attenuation would be required for the proposed Memorial during the construction in 2009.

**Table 15-13**  
**2009 Overall Noise Level  $L_{dn}$  at Sensitive Receptors**  
**HUD Noise Analysis—Pre-September 11 Scenario**

Site	Site Name & Address	Land Use	HUD Acceptability Standards	Mobile Source Noise Levels $L_{dn}$ in dBA	Stationary Source (Construction) Noise Levels $L_{dn}$ in dBA	Overall Noise Levels $L_{dn}$ in dBA
23	WTC Bathtub	Proposed Memorial	65	67	71	72
24	WTC Bathtub	Proposed Memorial	65	67	73	74

**Source:** The Louis Berger Group, Inc. 2003

Based on the HUD *Noise Guide Book*, noise attenuation alternatives include:

Relocate noise sensitive uses out of the high noise area;

Prevent the noise from reaching noise sensitive users through noise barriers; and

- Provide noise attenuation for at least interiors of the buildings located in high noise areas.

The first alternative was not considered practicable since it is essential to have a Memorial at the Project Site despite the fact that the Project Site is located in a high noise area typical of a central business district. The second and third alternatives will be considered through careful design and planning. Application of new technologies and noise reduction features would also be considered, where feasible and appropriate, for the proposed Memorial in order to meet the HUD Site Acceptability Standards.

Construction noises, different from operation noises, are mostly temporary in nature and only occur in daytime hours between 7 AM and 6 PM. For the Proposed Action, construction noise reduction measures would be implemented through application of the *Sustainable Design Guidelines* (see current draft in Appendix A) and the Environmental Performance Commitments (EPCs). Both provide measures for the Proposed Action that are designed to avoid, minimize and mitigate potential impacts. A range of mitigation measures that may be employed are evaluated in Chapter 21, “Construction Impacts,” for specific noise-generating construction activities.

#### **15.4.4 FUTURE WITHOUT THE PROPOSED ACTION 2015— PRE-SEPTEMBER 11 SCENARIO**

For the future without the Proposed Action in 2015, the WTC Site would remain in its pre-September 11 conditions. The Adjacent Sites would be further developed independently under this scenario.

The traffic conditions and resultant noise level changes over pre-September 11 conditions are presented in Appendix H. In the future without the Proposed Action, changes in noise levels would range from a decrease by 1 dBA over pre-September 11 conditions, to an increase by 5 dBA. The changes in noise levels would be attributable to the changes in traffic conditions compared to September 10, 2001.

#### **15.4.5 PROBABLE IMPACTS OF THE PROPOSED ACTION 2015— PRE-SEPTEMBER 11 SCENARIO**

Noise levels in the future with the Proposed Action were compared against noise levels in the future without the Proposed Action to identify any incremental changes in noise levels attributable to the operation of the WTC and Memorial. The results of the noise analysis are presented below:

##### *MOBILE SOURCES*

The traffic conditions and resultant noise level changes for the 2015 future with the Proposed Action are presented in Appendix H. The 2015 noise levels in the future without the Proposed Action and the future with Proposed Action and their relative changes are presented in Table 15-14. The maximum noise level increases in 2015 in the future with the Proposed Action would be 1 dBA. Specifically, noise levels at most of the sites would not change compared to those of

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**Table 15-14  
2015 Future Noise Levels (L<sub>eq</sub> in dBA)—Pre-September 11 Scenario**

Site ID	Site Name & Address	Land Use	Future Without the Proposed Action	Future With the Proposed Action	
			L <sub>eq</sub>	L <sub>eq</sub>	Changes in L <sub>eq</sub>
1	PS 89 Playground on West St	Public Facilities & Institutions	73	74	1
2	NW Corner of Murray St & West St	Open Space & Outdoor Recreation	74	74	0
3	Embassy Suites & Regal Cinemas on Vesey St	Hotel	69	69	0
4	World Financial Center/Dow Jones, side of West St (Vesey St & Liberty St)	Bikeway	69	69	0
5	Gateway Plaza (corner of Liberty St & South End Av)	Residential	70	69	-1
6	SW corner of Albany St & West Street (parking lot)	Residential	75	75	0
7	Cedar St & Washington St (Fence on Cedar St)	Proposed Park/Church Residential	66	66	0
8	Marriott Hotel-85 West Street, side of Albany Street	Residential	74	74	0
9	4 Albany St	Residential	69	69	0
10	120 Cedar St (on Greenwich St)	Institutional	69	69	0
11	114 Liberty St	Residential	81	82	1
12	95 Trinity Building	Institutional	79	78	-1
13	SE corner of Liberty St & Trinity Pl (at Park corner)	Public open space	80	80	0
14	Hilton Millennium Hotel-Dey Street	Hotel	75	75	0
15	St. Peter's Church on Church St	Public Facilities & Institutions	78	78	0
16	100 Church Street-Barclay St Entrance	Commercial & Office	74	73	-1
17	Barclay St & Washington Street Intersection	Commercial & Office	77	78	1
18	Park Pl & Greenwich St (corner of BMCC)	Commercial & Office	73	73	0
19	NE corner of Park Pl & West Broadway	Residential	71	72	1
20	Tower 270-Broadway & Chambers	Residential	75	75	0
21	St. Paul's Chapel NW corner of Broadway & Fulton St	Church	86	85	-1
22	180 Broadway	Residential	77	75	-2
23	WTC Bathtub	Proposed Memorial	69	69	0
24	WTC Bathtub	Proposed Memorial	69	69	0

**Notes:**

- The "With the Proposed Action" noise levels and their changes were calculated based on the reasonable worst-case conditions, under which Route 9A was assumed to be constructed at-grade. Although the detailed modeling results were not available for the Route 9A Tunnel Alternative, it is estimated that noise levels at Sites 4, 23, and 24 would be approximately 6 dBA less than those presented in this table.

**Source:** The Louis Berger Group, Inc. 2003

future without the Proposed Action. Noise levels at 5 of the 24 sites evaluated would decrease compared to those of future without the Proposed Action. Therefore, there would be no significant noise impacts from mobile sources in 2015 for the Proposed Action.

*STATIONARY SOURCES*

Similar to the 2009 future with the Proposed Action, mechanical equipment and building systems in 2015 would utilize noise reduction devices to comply with applicable noise regulations and standards. The noise from stationary sources would be insignificant and be masked by the background noise from street traffic and other noises, which are typical for urban environment. Therefore, no significant noise impacts from stationary sources would be expected in 2015 for the Proposed Action.

*HUD-BASED NOISE ANALYSIS*

It is anticipated that traffic and pedestrians would remain to be the predominant noise sources at the proposed Memorial in the future. As presented in Table 15-15, the future noise levels attributable to the operation (mobile and stationary sources) of the Proposed Action at the Memorial site would be 69 dBA in 2015 and would exceed HUD Site Acceptability Standards of 65 dBA, as they currently do. Because construction of the Proposed Action would have been completed by 2015, there would be no construction noise associated with the Proposed Action.

**Table 15-15  
2015 Overall Noise Level  $L_{dn}$  at the Sensitive Receptors—HUD Noise Analysis**

Site	Site Name & Address	Land Use	HUD Acceptability Standards	Mobile Source Noise Levels $L_{dn}$ in dBA	Exceeded HUD 65 dBA Standards
23	WTC Bathtub	Proposed Memorial	65	69	Yes
24	WTC Bathtub	Proposed Memorial	65	69	Yes

**Source:** The Louis Berger Group, Inc. 2003

Based on HUD Policy, 5 dBA attenuation would normally be required for the proposed Memorial site, as it is considered to be in the “normally unacceptable” category due to elevated operational noise in 2015. Attenuation features and technology would be incorporated in the design of the Memorial, to the greatest extent possible, especially at parts of the Memorial considered to be important for “serenity and quiet”. In particular, attenuation of noise levels would be achieved through careful design and planning, such as site layouts and landscaping. New technologies and noise reduction features would also be investigated. Although details of the Memorial design are not available, it is anticipated that the proposed Memorial through these and similar measures would meet the HUD Site Acceptability Criteria in 2015, when the Proposed Action is expected to be completed and operational.

**15.5 FTA NOISE ANALYSIS FOR THE PROPOSED UNDERGROUND GARAGE**

A noise analysis of bus garage operations was conducted based on FTA guidelines for transit facilities, in order to provide relevant information in the event that construction of the bus garage were funded by FTA. The proposed bus garage would be located on the Project Site, either under

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the ground below grade between Liberty and Albany Streets at the Southern Site or at Site 26, west of Route 9A between Vesey Street and Park Place. For either alternative, the proposed garage entrances and exits would be placed at the same locations. Noise from subsurface garage operations would be shielded by the at-grade surface and structures above. The only potential noise increases would be attributable to vehicles, including buses and trucks, entering and exiting the garage.

Future bus garage traffic was already included in the overall traffic projections and noise analyses for the future with the Proposed Action in 2009 and 2015, based on CEQR criteria. Based on the results of CEQR noise analyses in sections 15.3 and 15.4, there would not be any noise impacts associated with the Proposed Action in 2009 or 2015. Consequently, there would not be any potential noise impacts associated with the operation of the future bus garage. In addition, noise levels attributed to vehicles entering and exiting the garage were also calculated and potential impacts evaluated based on FTA guidelines and criteria. The results are presented in Table 15-16. The closest sensitive receptor to the proposed garage entrance would be the reconstructed St. Nicholas Church, which is immediately south of Liberty Street between Route 9A and Washington Street. St. Nicholas Church would be a Category 3 land use under FTA guidelines (see Table 15-4). Projected future noise levels at the church attributable to garage operations would be 63 dBA in 2009 and 67 dBA in 2015. Noise levels would not exceed the FTA impact threshold criterion of 70 dBA in either 2009 or 2015.

**Table 15-16  
Potential Noise Impacts from the Proposed Garage—FTA Detailed Analysis**

Scenario	Site	Garage Traffic	Noise Attributed to Garage Operations $L_{eq}$ dBA	Existing 2003 $L_{eq}$ dBA	FTA Impact/Severe Impact Threshold	Impact	Severe Impact
2009	St. Nicholas Church	84	63	70	70/74	No	No
2015	St. Nicholas Church	195	67	70	70/74	No	No

**Source:** The Louis Berger Group, Inc. 2003

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