

A. INTRODUCTION

This chapter assesses the potential for noise and vibration impacts from operation of the Portal Bridge Capacity Enhancement Project. The proposed build alternatives have potential to affect noise and vibration levels adjacent to the right-of-way in two possible ways. First, the project would change the track alignment slightly, potentially increasing noise and vibration levels at nearby locations. Second, the proposed operational improvements would lead to a potential increase in the maximum allowable speed along this section of the Northeast Corridor, which could lead to higher noise and vibration levels. Potential impacts during construction are discussed in Chapter 6, “Construction Impacts.” This chapter includes a discussion of the fundamentals of airborne noise, vibration and ground-borne noise impacts, along with the applicable standards, analysis methodologies, and impact criteria for each. Where potential impacts are identified, the feasibility and effectiveness of various mitigation measures are examined.

Airborne noise is what most people think of when they hear the word “noise.” It is noise that travels through the air—such as the sound of traffic on a nearby roadway, or children on a playground. Ground-borne noise is the rumbling sound caused by vibration (or oscillatory motion). With ground-borne noise, buildings and other structures act like speakers for low-amplitude noise. This chapter assesses the build alternative’s potential to create both types of noise, as well as vibrations.

An analysis of the effects of the project alternatives on noise was conducted following the methodology set forth in FTA’s guidance manual, *Transit Noise and Vibration Impact Assessment* (May 2006). This FTA guidance document sets forth methodologies for analyzing noise and vibration from commuter and inter-city rail operations and as such is the standard U.S. Department of Transportation (USDOT) methodology for assessing potential impacts of new and expanded rail transit systems. The analysis conducted and conclusions reached are described in this chapter.

B. NOISE FUNDAMENTALS, STANDARDS, AND IMPACT CRITERIA

AIRBORNE NOISE FUNDAMENTALS

Quantitative information on the effects of airborne noise on people is well documented. If sufficiently loud, noise may adversely affect people in several ways. For example, 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. These scales and methods consider such factors as loudness, duration, time of occurrence, and changes in noise level with time. However, all the stated effects of noise on people are subjective.

Sound pressure levels are measured in units called “decibels” (dB). The particular character of the noise that we hear (a whistle compared with a French horn, for example) is determined by the rate, or “frequency,” at which the air pressure fluctuates, or “oscillates.” Frequency defines

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the oscillation of sound pressure in terms of cycles per second. One cycle per second is known as 1 Hertz (Hz). People can hear over a relatively limited range of sound frequencies, generally between 20 Hz and 20,000 Hz, and the human ear does not perceive all frequencies equally well. High frequencies (the whistle, for example) are more easily discerned and therefore more intrusive than many of the lower frequencies (the lower notes on the French horn, for example).

“A”-Weighted Sound Level (dBA)

To bring a uniform noise measurement that simulates people’s perception of loudness and annoyance, the decibel measurement is weighted to account for those frequencies most audible to the human ear. This is known as the A-weighted sound level, or “dBA,” and it is the most often used descriptor of noise levels where community noise is the issue. As shown in Table 5.5-1, the threshold of human hearing is defined as 0 dBA; very quiet conditions (as in a library, for example) are approximately 40 dBA; levels between 50 dBA and 70 dBA define the range of acceptable daily activity; levels above 70 dBA would be considered noisy, and then loud, intrusive, and deafening as the scale approaches 130 dBA. For most people to perceive an increase in noise, it must be at least 3 dBA. At 5 dBA, the change will be readily noticeable (Bolt, Beranek and Newman, 1973). An increase of 10 dBA is generally perceived as a doubling of loudness.

**Table 5.5-1
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
Busy city street, loud shout	80
Busy traffic intersection	70
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
Background noise in an office	50
Suburban areas with medium density transportation	40
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.
Source: Cowan, James P. Handbook of Environmental Acoustics. Van Nostrand Reinhold, New York, 1994. Egan, M. David, Architectural Acoustics. McGraw-Hill Book Company, 1988.

It is also important to understand that combinations of different sources are not additive in an arithmetic manner, because of the dBA scale's logarithmic nature. For example, two noise sources—a vacuum cleaner operating at approximately 72 dBA and a telephone ringing at approximately 58 dBA—do not combine to create a noise level of 130 dBA, the equivalent of a jet airplane or air raid siren (see Table 5.5-1). In fact, the noise produced by the telephone ringing may be masked by the noise of the vacuum cleaner and not be heard. The logarithmic combination of these two noise sources would yield a noise level of 72.2 dBA.

Effects of Distance on Noise

Noise varies with distance. For example, highway traffic 50 feet away from a receptor (such as a person listening to the noise) typically produces sound levels of approximately 70 dBA. The same highway noise measures 66 dBA at a distance of 100 feet, assuming soft ground conditions. This decrease is known as “drop-off.” The outdoor drop-off rate for line sources, such as traffic, is a decrease of approximately 4.5 dBA (for soft ground) for every doubling of distance between the noise source and receptor (for hard ground the outdoor drop-off rate is 3 dBA for line sources). Assuming soft ground, for point sources, such as amplified rock music, the outdoor drop-off rate is a decrease of approximately 7.5 dBA for every doubling of distance between the noise source and receptor (for hard ground the outdoor drop-off rate is 6 dBA for point sources).

Noise Descriptors Used in Impact Assessment

The sound-pressure level unit of dBA describes a noise level at just one moment but since very few noises are constant, other ways of describing noise over more extended periods have been developed. One way of describing fluctuating sound is to describe the fluctuating noise heard over a specific period as if it were a steady, unchanging sound (i.e., as if it were averaged over that time period). 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 as $L_{eq(24)}$), conveys the same sound energy as the actual time-varying sound.

A descriptor for cumulative 24-hour exposure is the day-night sound level, abbreviated as L_{dn} . This is a 24-hour measure that accounts for the moment-to-moment fluctuations in A-weighted noise levels due to all sound sources during 24 hours, combined. Mathematically, the L_{dn} noise level is the energy average of all $L_{eq(1)}$ noise levels over a 24-hour period, where nighttime noise levels (10 PM to 7 AM) are increased by 10 dBA before averaging.

Following FTA guidance, either the maximum $L_{eq(1)}$ sound level or the L_{dn} sound level is used for impact assessment, depending on land use category as described below.

VIBRATION FUNDAMENTALS

Fixed railway operations have the potential to produce high vibration levels, since railway vehicles contact a rigid steel rail with steel wheels. Train wheels rolling on the steel rails create vibration energy that is transmitted into the track support system. The amount of vibrational energy is strongly dependent on such factors as how smooth the wheels and rails are and the vehicle suspension system. The vibration of the track structure “excites” the adjacent ground, creating vibration waves that propagate through the various soil and rock strata to the foundations of nearby buildings. As the vibration propagates from the foundation through the

remaining building structure, certain resonant, or natural, frequencies of various components of the building may be excited.

The effects of ground-borne vibration may include discernable movement of building floors, rattling of windows, and shaking of items on shelves or hanging on walls. In extreme cases, the vibration can cause damage to buildings. The vibration of floors and walls may cause perceptible vibration, rattling of such items as windows or dishes on shelves. The movement of building surfaces and objects within the building can also result in a low-frequency rumble noise. The rumble is the noise radiated from the motion of the room surfaces, even when the motion itself cannot be felt. This is called ground-borne noise.

Vibrations consist of rapidly fluctuating motions in which there is no “net” movement. When an object vibrates, any point on the object is displaced from its initial “static” position equally in both directions so that the average of all its motion is zero. Any object can vibrate differently in three mutually independent directions: vertical, horizontal, and lateral. It is common to describe vibration levels in terms of velocity, which represents the instantaneous speed at a point on the object that is displaced. In a sense, the human body responds to an average vibration amplitude, which is usually expressed in terms of the root mean square (rms) amplitude.

All vibration levels in this document are referenced to 1×10^{-6} inches per second. “VdB” (referenced to 1×10^{-6} inches per second) is used for vibration decibels to reduce the potential for confusion with noise decibels.

EFFECT OF PROPAGATION PATH

Vibrations are transmitted from the source to the ground, and propagate through the ground to the receptor. Soil conditions have a strong influence on the levels of ground-borne vibration. Stiff soils, such as some clay and rock, can transmit vibrations over substantial distances. Sandy soils, wetlands, and groundwater tend to absorb movement and thus reduce vibration transmission. Because subsurface conditions vary widely, measurement of actual vibration conditions, or transfer mobility, at the site can be the most practical way to address the variability of propagation conditions.

HUMAN RESPONSE TO VIBRATION LEVELS

Although the perceptibility threshold for ground-borne vibration is about 65 VdB, the typical threshold of human annoyance is 72 VdB. As a comparison, buses and trucks rarely create vibration that exceeds 72 VdB unless there are significant bumps in the road, and these vehicles are operating at moderate speeds. Vibration levels for typical human and structural responses and sources are shown in Table 5.5-2. Background vibration is usually well below the threshold of human perception, and is of concern only when the vibration affects very sensitive manufacturing or research equipment. Electron microscopes, high-resolution lithography equipment, recording studios, and laser and optical benches are typical of equipment that is highly sensitive to vibration.

**Table 5.5-2
Typical Levels of Ground-borne Vibration**

Human/Structural Response	Velocity Level (VdB)	Typical Sources (at 50 feet)
Threshold, minor cosmetic damage fragile buildings	100	Blasting from construction projects Bulldozers and other heavy tracked construction equipment
Difficulty with vibration-sensitive tasks, such as reading a video screen	90	Locomotive powered freight train
Residential annoyance, infrequent events	80	Rapid Transit Rail, upper range Commuter Rail, typical range
Residential annoyance, frequent events	70	Bus or Truck over bump Rapid Transit Rail, typical range
Limit for vibration-sensitive equipment. Approximate threshold for human perception of vibration	60	Bus or truck, typical
	50	Typical background vibration

Source: U.S. Dept of Transportation, FTA, *Transit Noise and Vibration Impact Assessment*, May 2006.

NOISE STANDARDS AND CRITERIA

AIRBORNE NOISE STANDARDS AND CRITERIA

The FTA guidance manual defines noise criteria based on the specific type of land use that would be affected, with explicit operational noise impact criteria for three land use categories. These impact criteria are based on either peak 1-hour L_{eq} or 24-hour L_{dn} values. Table 5.5-3 describes the land use categories defined in the FTA report, and provides noise metrics used for determining operational noise impacts. As described in Table 5.5-3, categories 1 and 3—which include land uses that are noise-sensitive, but where people do not sleep—require examination using the 1-hour L_{eq} descriptor for the noisiest peak hour. Category 2, which includes residences, hospitals, and other locations where nighttime sensitivity to noise is very important, requires examination using the 24-hour L_{dn} descriptor.

**Table 5.5-3
FTA’s Land Use Category and Metrics for 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 the intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls.
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. Places for study or meditation associated with cemeteries, monuments, museums, campgrounds and recreational facilities can also be considered to be in this category. Certain historical sites and parks are also included.

Note: * L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity.
Source: *Transit Noise and Vibration Impact Assessment*, FTA, May 2006.

Figure 5.5-1 shows FTA's noise impact criteria for transit projects. The FTA impact criteria are keyed to the noise level generated by the project (called "project noise exposure") in locations of varying existing noise levels. Two types of impacts—moderate and severe—are defined for each land use category, depending on existing noise levels. Thus, where existing noise levels are 40 dBA, for land use categories 1 and 2, the respective L_{eq} and L_{dn} noise exposure from the project would create moderate impacts if they were above approximately 50 dBA, and would create severe impacts if they were above approximately 55 dBA. For category 3, a project noise exposure level above approximately 55 dBA would be considered a moderate impact, and above approximately 60 dBA would be considered a severe impact. The difference between "severe impact" and "moderate impact" is that a severe impact occurs when a change in noise level occurs that a significant percentage of people would find annoying, while a moderate impact occurs when a change in noise level occurs that is noticeable to most people but not necessarily sufficient to result in strong adverse reactions from the community.

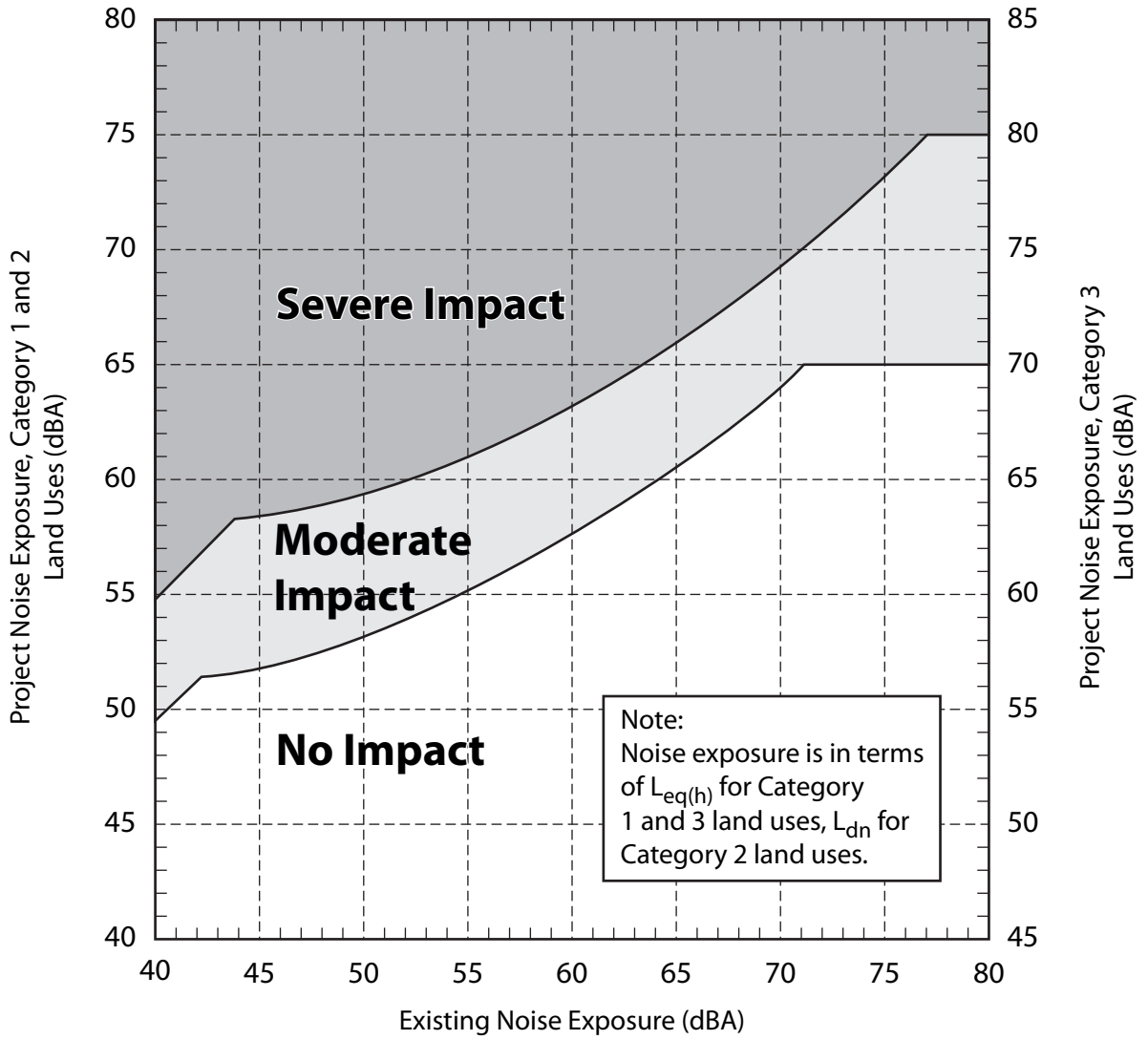
VIBRATION STANDARDS AND CRITERIA

With the construction of new rail rapid transit systems in the past 20 years, considerable experience has been gained about how communities would react to various levels of building vibration. This experience, combined with the available national and international standards, represents a good foundation for predicting annoyance from ground-borne noise and vibration in residential areas. Table 5.5-2 summarizes typical human or structural responses to various levels of vibration.

The FTA criteria for environmental impact from ground-borne vibration and noise are based on the maximum levels for a single event. The impact criteria as defined in the FTA guidance manual are shown in Table 5.5-4. The criteria for acceptable ground-borne vibration are expressed in terms of rms velocity levels in decibels and the criteria for acceptable ground-borne noise are expressed in terms of A-weighted sound level. As shown in the table, the FTA methodology provides three different impact criteria—one for "infrequent" events, when there are fewer than 30 vibration events per day, one for "occasional" events, when there are between 30 and 70 vibration events per day, and one for "frequent" events, when there are more than 70 vibration events per day. It should be noted that these impacts would occur only if a project would cause ground-borne noise or vibration levels that are higher than existing vibration levels. Thus, if the vibration level for a building in Category 1 is already 70 VdB (5 VdB above the 65 VdB threshold listed in Table 5.5-4) but the proposed project would not increase that level, then the proposed project would not be considered to have an impact.

The limits are specified for the three land use categories defined below:

- **Vibration Category 1: High Sensitivity**—Buildings where low ambient vibration is essential for the operations within the building, which may be well below levels associated with human annoyance. Typical land uses are vibration-sensitive research and manufacturing, hospitals, and university research operations.
- **Vibration Category 2: Residential**—This category covers all residential land uses and any buildings where people sleep, such as hotels and hospitals. No differentiation is made between different types of residential areas. This is primarily because ground-borne vibration and noise are experienced indoors and building occupants have practically no means to reduce their exposure. Even in a noisy urban area, the bedrooms often will be quiet in buildings that have effective noise insulation and tightly closed windows. Hence, an occupant of a bedroom in a noisy urban area is likely to be just as sensitive to ground-borne noise and vibration as someone in a quiet suburban area.



Source: Transit Noise and Vibration Impact Assessment, FTA-VA-90-1003-06, May 2006

Table 5.5-4

**Ground-Borne Vibration (GBV) and Ground-Borne Noise (GBN) Impact Criteria
for General Assessment**

Land Use Category	GBV Impact Levels (VdB re 1 micro-inch/sec)			GBN Impact Levels (dB re 20 micro Pascals)		
	Frequent Events ¹	Occasional Events ²	Infrequent Events ³	Frequent Events ¹	Occasional Events ²	Infrequent Events ³
Category 1: Buildings where vibration would interfere with interior operations	65 VdB ⁴	65 VdB ⁴	65 VdB ⁴	N/A ⁴	N/A ⁴	N/A ⁴
Category 2: Residences and buildings where people normally sleep	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA
Notes:						
1 "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.						
2 "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.						
3 "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail systems.						
4 This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.						
5 Vibration-sensitive equipment is not sensitive to ground-borne noise.						

- **Vibration Category 3: Institutional**—This category includes schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference.

There are some buildings, such as concert halls, TV and recording studios, auditoriums, and theaters that can be very sensitive to vibration and ground-borne noise, but do not fit into any of these three categories. Special vibration level thresholds are defined for these land uses. In addition, FTA has established vibration criteria for fragile buildings (94 VdB, 0.2 in/sec) and very fragile buildings (90 VdB, 0.12 in/sec). The operational activities associated with the project would not reach these levels and therefore, these criteria are only evaluated in the construction impacts assessment (see Chapter 6, "Construction Impacts").

C. REGULATORY CONTEXT AND METHODOLOGY

AIRBORNE NOISE ANALYSIS METHODOLOGY

The analysis of airborne noise was performed using procedures set forth in the FTA guidance manual, *Transit Noise and Vibration Impact Assessment* (May 2006). Following the methodologies set forth in this document, airborne noise impacts should be analyzed using a three-step process that consists of a screening procedure, a general noise assessment, and a detailed noise analysis. The screening procedure is performed first to determine whether any noise-sensitive receptors are within distances where impacts are likely to occur. If the screening reveals that there are noise-sensitive receptors in locations where impacts are likely to occur, then a general noise assessment is performed to determine locations where noise impacts could occur. If this general assessment indicates that a potential for noise impact does exist, then a detailed noise analysis may be necessary. FTA's detailed analysis methodology is used to predict

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impacts and evaluate the effectiveness of mitigation with greater precision than can be achieved with the general noise assessment. The methodology and results of the FTA noise analysis screening procedure are presented below.

STEP 1: NOISE SCREENING

The FTA methodology begins with a noise screening to determine whether any noise-sensitive receptors are within a distance where an impact is likely to occur. According to the FTA screening methodology, potential impacts may occur if noise receptors are within 750 feet of the centerline of a commuter rail mainline¹ if the pathway between the track and the receptor is unobstructed, or 375 feet from the track centerline if the pathway is obstructed (since obstructions block some noise and therefore reduce the distance the noise will travel).

Based on a review of current aerial photography and land-use maps, it was found that a noise-sensitive receptor, Hudson County Park at Laurel Hill (Laurel Hill Park), is located within the screening distances of the proposed project.

STEP 2: GENERAL NOISE ASSESSMENT

Since there may be sensitive receptors within the screening distance, a general noise assessment analysis was conducted to examine the effect of increased train speed and change in alignment on noise levels using the procedures contained in the FTA guidance manual. According to FTA's guidance document, the potential for noise impacts at sensitive land use locations would occur if the project-generated noise levels, or "noise exposure," exceed the levels shown in Figure 5.5-1.

The general noise assessment methodology consists of determining the project noise exposure at 50 feet from the centerline of track along portions of the rail line where the maximum train speed would increase, and comparing the calculated levels with the criteria based on land use categories. The FTA noise screening methodology determined that there was only one noise sensitive land use, Laurel Hill Park, within the screening distance. Laurel Hill Park would be an FTA land use Category 3, which uses the 1-hour L_{eq} noise metric. Existing noise levels at Laurel Hill Park were estimated to be 70 dBA $L_{eq(1)}$ (according to the procedure set forth in the FTA guidance manual for a noise sensitive land use located 50 to 100 feet from an Interstate Highway, in this case Interstate I-95, which is the same as the New Jersey Turnpike in the study area).

The calculations to predict the noise levels from the increased train speed and change in the alignment along the rail line branch take into account: the type of trains and type of locomotives, number of trains and number of locomotives on each train, the speed of the trains, characteristics of the track, and the time of day.

VIBRATION ANALYSIS METHODOLOGY

The vibration analysis for the project alternatives was performed using the procedures described in the FTA guidance manual, *Transit Noise and Vibration Impact Assessment* (May 2006). To examine potential impacts during operation, the FTA guidance document (similar to the approach

¹ FTA's guidance manual uses the term "Commuter Rail Mainline" as a description of the potential noise source. Although the Northeast Corridor is both a commuter rail line as well as an inter-city rail line, the term "Commuter Rail Mainline" will be used in this chapter to maintain consistency with the guidance.

for assessing noise) lays out a three-step approach for the analysis of vibration and ground-borne noise: a screening procedure, a general assessment methodology, and a detailed analysis methodology. The screening procedure is used to determine whether any noise-sensitive receptors are within distances where impacts are likely to occur; the general assessment methodology is used to determine locations or rail segments where there is the potential for impacts; and the detailed analysis methodology is used to predict impacts and evaluate the effectiveness of mitigation with greater precision than can be achieved with the general assessment.

Based upon existing land uses of the project’s study area, the vibration analysis only requires a screening analysis for two reasons: (1) the lack of vibration sensitive receptors in the project study area, and (2) the vibration sensitive receptors that are located in the project study area are located at large distances from the centerline of the commuter rail tracks under each alternative. The methodology and results of the FTA vibration analysis screening procedure are presented below.

The first step in the FTA vibration analysis is to determine if there is the potential for a vibration impact based on the type of project. Since the Portal Bridge project is of the steel-wheel/steel-rail type, a vibration screening analysis was performed. Table 5.5-5 shows screening distances based upon the type of project and the category of land use involved.

**Table 5.5-5
Screening Distances for Vibration Assessment**

Type of Project	Critical Distance for Land Use Categories* Distance from Right-of-Way or Property Line (feet)		
	Category 1	Category 2	Category 3
Conventional Commuter Railroad	600	200	120
Rail Rapid Transit	600	200	120
Light Rail Transit	450	150	100
Intermediate Capacity Transit	200	100	50
Bus Project (if not previously screened out)	100	50	N/A
Note: * The land-use categories are defined in Chapter 8 of the FTA Manual. Some vibration-sensitive land uses are not included in these categories. Examples are: concert halls and TV studios which, for the screening procedure, should be evaluated as Category 1; and theaters and auditoriums which should be evaluated as Category 2.			
Source: Transit Noise and Vibration Impact Assessment, FTA, May 2006, pages 9-4.			

No vibration sensitive land uses are located within their appropriate screening distances. Therefore, no further vibration analysis was performed, as specified in FTA’s guidance manual.

D. NO ACTION ALTERNATIVE

Section B of Chapter 3, “Project Alternatives,” describes several regional transportation projects that are expected to be completed by 2030. In the No Action Alternative, changes to the current rail service operations along the corridor could alter noise levels at land uses adjacent to the right-of-way. While these changes would be small (e.g., adding additional cars to an existing scheduled train) they could result in small increases that may result in adverse effects at more sensitive locations. The analysis of the No Action Alternative must also consider changes in the study area that could affect noise levels or noise sensitive receptors. For the most part the dominant noise source in area is the rail line, while some sites (such as the Hudson County Park at Laurel Hill) are also affected by noise from the New Jersey Turnpike. The most important change under the No Action Alternative would be the potential expansion of the Hudson County

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Park at Laurel Hill. Therefore, the analysis focuses on the expanded park for the assessment of noise under the No Action Alternative.

Table 5.5-6 shows the results of the FTA general noise assessment for the No Action Alternative. As Laurel Hill Park is an FTA Category 3 land use, the predicted noise levels were calculated for the worst case peak hour. The general noise assessment concludes that the potential for moderate impacts would occur at noise sensitive locations approximately 322 feet from the centerline of the track, and the potential for severe impacts would occur at noise sensitive locations approximately 174 feet from the centerline of the track. Laurel Hill Park is outside the boundary of the FTA moderate and severe impact areas. Therefore, there is no impact at Laurel Hill Park in the No Action Alternative.

Table 5.5-6
No Action Alternative – General Noise Assessment Results

Land Use	Descriptor	Existing Predicted Noise Level (L _{eq(1)})	Moderate Impact (Distance From Track Centerline)	Severe Impact (Distance From Track Centerline)	Potential Impacts?
Laurel Hill Park (Category 3)	L _{eq(1)}	70 dBA	322 Feet	174 Feet	No Impact

Note: For full definition of land use categories, see Table 5.5-3.

As discussed in Chapter 5.1, “Land Use and Social Conditions,” it is possible that a waterfront walkway will be constructed on the recently purchased 14.9-acre parcel as part of an expansion of Laurel Hill Park. The planned expansion of Laurel Hill Park is located east of the Hackensack River, north of the Northeast Corridor rail line, south of the New Jersey Turnpike, and southwest of the current Laurel Hill Park. The southern edge of the expansion of Laurel Hill Park is less than 100 feet from the track centerline. In the No Action Alternative, the portion of new parcel that is within 322 feet north of the Northeast Corridor would be in the FTA moderate impact boundary, and the portion of the new parcel that is within 174 feet north of the Northeast Corridor would be in the severe impact boundary.

E. PROBABLE IMPACTS OF THE BUILD ALTERNATIVES

As discussed in Chapter 3, “Project Alternatives,” four feasible build alternatives (Alternatives FE, FS, DE, and DS) have been identified and Alternative DS is the preferred alternative. All the build alternatives would result in comparable noise levels since rail traffic would be similar. Table 5.5-7 shows the results of the FTA general noise assessment for the build alternatives. As Laurel Hill Park is an FTA Category 3 land use, the predicted noise levels were calculated for the worst case peak hour. The general noise assessment concludes that the potential for moderate impacts would occur at noise sensitive locations approximately 419 feet from the centerline of the track, and the potential for severe impacts would occur at noise sensitive locations approximately 226 feet from the centerline of the track. Over the Hackensack River, the tracks would be divided between the north bridge and south bridge in the proposed design. With respect to the northern bridge, the general assessment concludes that the potential for moderate impacts would occur at noise sensitive locations approximately 400 feet from the centerline of the track, and the potential for severe impacts would occur at noise sensitive locations approximately 216 feet from the centerline of the track. With respect to the southern bridge, the general noise assessment concludes that the potential for moderate impacts would occur at noise sensitive locations approximately 77 feet from the centerline of the track, and there is no potential for severe impacts at noise sensitive locations at any distance from the centerline of the

track. Since Laurel Hill Park is outside the boundary of the FTA moderate and severe impact areas, no adverse noise impacts would result in the park from the build alternatives.

With all build alternatives, a portion of the planned expansion of Laurel Hill Park parcel that is within 419 feet north of the Northeast Corridor would be subject to moderate noise impacts. The portion of the parcel that is within 226 feet north of the Northeast Corridor would be subject to severe noise impacts. Due to the proximity of the Laurel Hill Park expansion to the existing rail corridor, the No Action Alternative would also result in moderate and severe noise impacts on this resource. Therefore, the impacts that would occur at the Laurel Hill Park would be similar under any of the project alternatives, including the No Action Alternative.

**Table 5.5-7
Build Alternatives – General Noise Assessment Results**

Land Use	Descriptor	Existing Predicted Noise Level (L _{eq(1)})	Moderate Impact (Distance From Track Centerline)	Severe Impact (Distance From Track Centerline)	Potential Impacts?
Laurel Hill park (Category 3)	L _{eq(1)}	70 dBA	419 Feet	226 Feet	No Impact
Note: For full definition of land use categories, see Table 5.5-3.					

Under the build alternative, no vibration sensitive land uses are located within their appropriate screening distances. Therefore, no further vibration analysis was performed. *