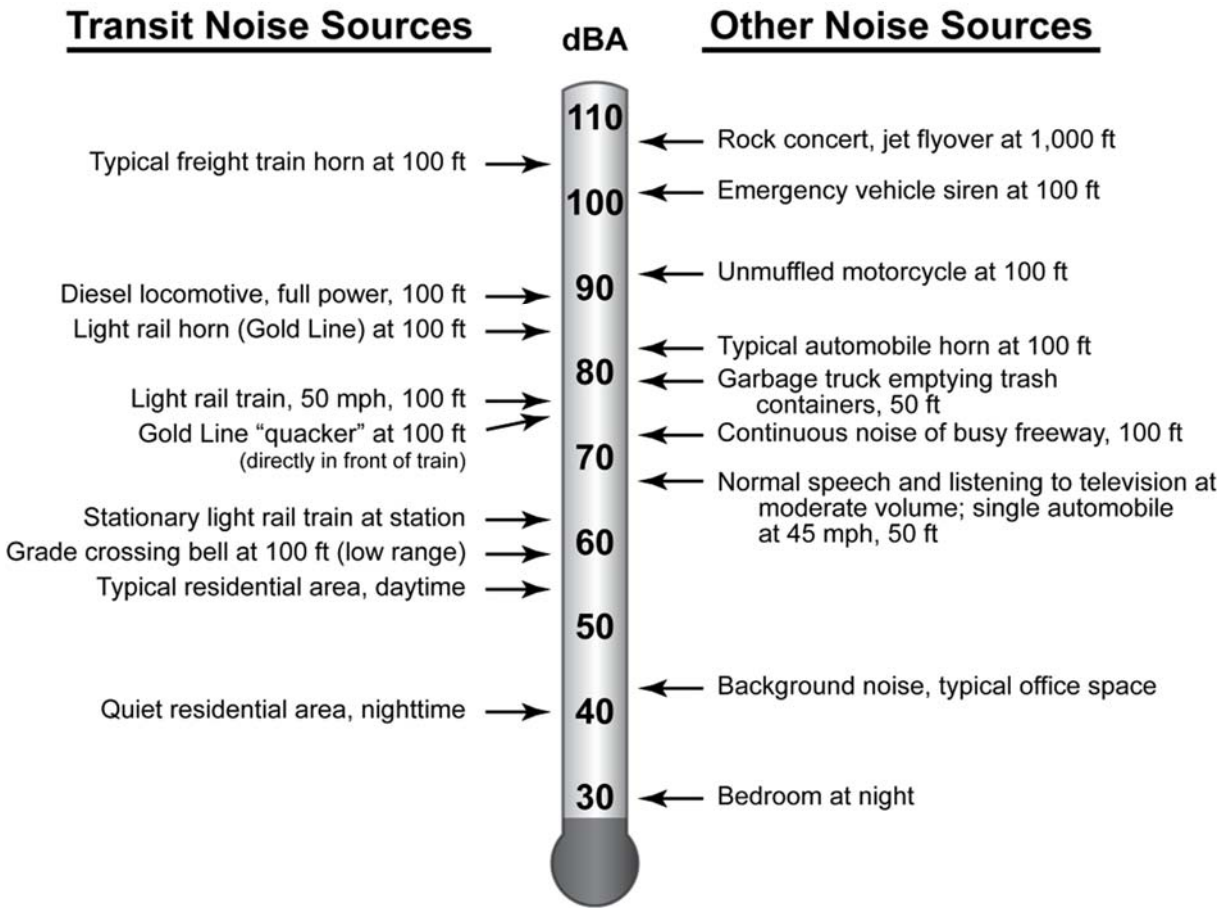
3.7 NOISE AND VIBRATION

This section provides an overview of noise and vibration and evaluates the construction and operational impacts associated with the Proposed Project. The following discussion provides background information pertinent to the impact analysis. Additional detailed information can be found in the Noise and Vibration Technical Report included as Appendix E.

Noise Information

Sound is characterized by both its amplitude and frequency (or pitch). The human ear does not hear all frequencies equally. In particular, the ear deemphasizes low and very high frequencies. To better approximate the sensitivity of human hearing, the A-weighted decibel scale has been developed. A-weighted decibels are abbreviated as "dBA." On this scale, the human range of hearing extends from approximately 3 dBA to around 140 dBA. As a point of reference, Figure 3.7.1 includes examples of A-weighted sound levels from common outdoor and indoor sounds.

Figure 3.7.1 Typical Outdoor and Indoor Noise Levels



Source: FTA, 2006.

Using the decibel scale, sound levels from two or more sources cannot be directly added together to determine the overall sound level. Rather, the combination of two sounds at the same level yields an increase of 3 dB. The smallest recognizable change in sound level is approximately 1 dB. A 3-dB increase in the A-Weighted sound level is generally considered perceptible, whereas a 5-dB increase is readily perceptible. A 10-dB increase is judged by most people as an approximate doubling of the perceived loudness.

Following are brief definitions of the measures of environmental noise used to assess potential impacts:

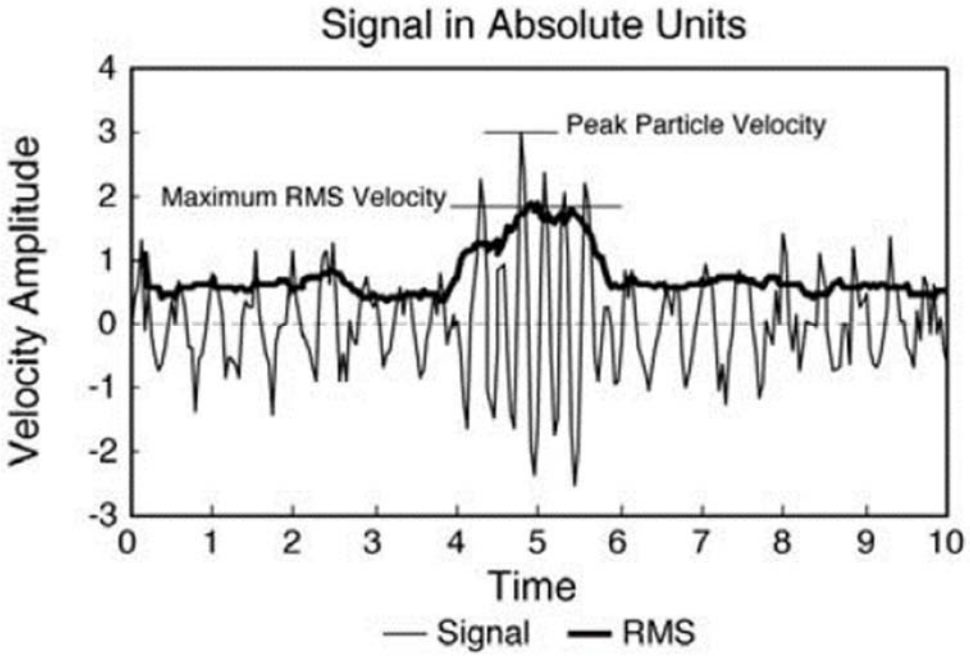
- **Maximum Sound Level (L_{max}):** L_{max} is the maximum sound level that occurs during an event such as a train passing. For this analysis, L_{max} is defined as the maximum sound level using the slow setting on a standard sound level meter, which is equivalent to the maximum one-second root mean square (RMS) average sound level.
- **Equivalent Sound Level (L_{eq}):** Environment sound fluctuates constantly. The equivalent sound level (L_{eq}) is the most common means of characterizing community noise. L_{eq} represents a constant sound that, over a specified period of time, has the same sound energy as the time-varying sound. L_{eq} is typically used to evaluate noise effects at institutional land uses, such as schools, churches, and libraries.
- **Day-Night Sound Level (L_{dn}):** L_{dn} is basically a 24-hour L_{eq} with an adjustment to reflect the greater sensitivity of most people to nighttime noise. The adjustment is a 10-dB penalty for all sound that occurs between the hours of 10:00 p.m. to 7:00 a.m. L_{dn} is the most common measure of total community noise over a 24-hour period and is typically used to evaluate noise effects at residences.
- **Exceedance Level (L_{xx}):** This is the sound level exceeded for a given percentage of the measurement period. For example, the L_{99} is the sound level exceeded 99 percent of the measurement period. For a one-hour period, L_{99} is the sound level exceeded for all except 36 seconds of the hour. L_1 represents typical maximum sound levels, L_{33} is approximately equal to L_{eq} when free-flowing traffic is the dominant noise source, L_{50} is the median sound level, and L_{99} is close to the minimum sound level.
- **Community Noise Equivalent Level (CNEL):** CNEL is an average sound level during a 24-hour period. CNEL is a noise measurement scale, which accounts for noise source, distance, single event duration, single event occurrence, frequency, and time of day. Human reaction to sound between 7:00 p.m. and 10:00 p.m. is as if the sound were actually 5 dBA higher than if it occurred from 7:00 a.m. to 7:00 p.m. From 10:00 p.m. to 7:00 a.m., humans perceive sound as if it were 10 dBA higher due to the lower background level. Hence, the CNEL is obtained by adding an additional 5 dBA to sound levels in the evening from 7:00 p.m. to 10:00 p.m. and 10 dBA to sound levels in the night from 10:00 p.m. to 7:00 a.m. Because CNEL accounts for human sensitivity to sound, the CNEL 24-hour figure is always a higher number than the actual 24-hour average.

- **Sound Exposure Level (SEL):** SEL is a measure of the acoustic energy of an event such as a train passing. In essence, the acoustic energy of the event is compressed into a one-second period. SEL increases as the sound level of the event increases and as the duration of the event increases. It is often used as an intermediate value in calculating overall metrics such as L_{eq} and L_{dn}.

Vibration Basics

Vibration is an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. Humans can perceive vibration transmitted through the ground or through the air depending on the signal frequency. When evaluating human response, groundborne vibration is usually expressed in terms of decibels using the RMS vibration velocity. Some limits are also presented in terms of the peak particle velocity (PPV). RMS is defined as the average of the squared amplitude of the vibration signal. To avoid confusion with sound decibels, the abbreviation VdB is used for vibration decibels. All vibration decibels in this report use a decibel reference of 1 micro-inch/second (µin/sec.). PPV is the maximum instantaneous positive or negative peak of an oscillating vibration signal, in this report using velocity in inches/second (in/sec). The RMS amplitude is always positive, and always less than the PPV. Figure 3.7.2 shows a sample vibration signal, where the bold line is the RMS velocity and the lighter-weight line is the raw signal.

Figure 3.7.2 Comparing PPV and RMS Values of a Sample Vibration Signal



Source: FTA, 2006.

The potential adverse effects of rail transit groundborne vibration are as follows:

- **Perceptible Building Vibration:** This is when building occupants feel the vibration of the floor or other building surfaces. Experience has shown that the threshold of human perception is around 65 VdB and that vibration that exceeds 75 to 80 VdB may be intrusive and annoying to building occupants.
- **Rattle:** The building vibration can cause rattling of items on shelves and hanging on walls, and various different rattle and buzzing noises from windows and doors.
- **Reradiated Noise:** The vibration of room surfaces radiates sound waves that may be audible to humans. This is referred to as groundborne noise. When audible groundborne noise occurs, it sounds like a low-frequency rumble. For a surface rail system such as the proposed project, the groundborne noise is usually masked by the normal airborne noise radiated from the transit vehicle and the rails.
- **Damage to Building Structures:** Although it is conceivable that vibration from a light rail system could cause damage to fragile buildings, the vibration from rail transit systems is usually one to two orders of magnitude below the most restrictive thresholds for preventing building damage. Hence the vibration impact criteria focus on human annoyance, which occurs at much lower amplitudes than does building damage.

Most noise terms have a vibration equivalent by replacing the noise level with a vibration level. Following are three vibration terms used for quantifying vibration energy:

- **Equivalent Vibration Level (L_{eq}):** The L_{eq} represents a constant vibration that, over a specified period of time, has the same sound energy as the time-varying vibration.
- **Peak Particle Velocity (PPV):** The maximum, instantaneous positive or negative peak of an oscillating vibration signal.
- **Exceedance Level (L_{xx}):** This is the vibration level exceeded for a given percentage of the measurement period. For example, the L_{99} is the vibration level exceeded 99 percent of the measurement period. For a one-hour period, L_{99} is the vibration level exceeded for all except 36 seconds of the hour. L_1 represents typical maximum vibration levels, L_{50} is the median vibration level, and L_{99} is close to the minimum vibration level.
- **Maximum Vibration Level (L_{max}):** L_{max} is the maximum vibration level that occurs during an event such as a train passing.

3.7.1. REGULATORY FRAMEWORK

In compliance with CEQA, the operational and construction noise and vibration impact assessment was performed in accordance with Federal Transit Administration (FTA) guidance and State and local regulations.

3.7.1.1. Federal

The FTA has published guidance in the Transit Noise and Vibration Impact Assessment document for assessing transit noise and vibration, including those generated on rail yards.[1] The guidance manual provides prediction procedures and impact criteria for determining potential impacts in environmental documents. Regarding noise, the potential for impacts is dependent on the type of land use. Table 3.7.1 lists the three FTA land-use categories and the applicable noise metric for each category. For Category 2 land uses (residential areas where people sleep), noise exposure is characterized using L_{dn}. In calculating L_{dn}, noise generated during nighttime hours is more heavily weighted than daytime noise to reflect residents' greater sensitivity to noise during those hours. For Category 1 and Category 3 land uses (primarily daytime uses), noise exposure is characterized using the peak hour L_{eq}, which is a time-averaged sound level over the loudest hour of transit-related activity.

Table 3.7.1. FTA Land Use Categories and Noise Metrics

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	L_{eq}(h) /a/	A tract of land where quiet is an essential element of 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	L_{dn} /b/	Residences and buildings in which people sleep. This category includes homes, hospitals, and hotels, where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	L_{eq}(h) /a/	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 meditation or study 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.

/a/ L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity.
/b/ L_{dn} is a measure that counts for full 24 hours of noise, with penalties for noise at night, which is defined as 10:00 p.m. to 7:00 a.m.
Source: FTA, 2006.

Regarding vibration, the potential for impacts is also dependent on the type of land use. Category 1 land uses include buildings where vibration would interfere with interior operations. Category 2 land uses include residences and buildings where people normally sleep. Category 3 land uses include institutions with primarily daytime use. In addition, the FTA has stated that some buildings, such as concert halls, recording studios and theaters, can be very sensitive to vibration and usually warrant special attention during the environmental evaluation.

[1] FTA, *Transit Noise and Vibration Impact Assessment*, 2006.

3.7.1.2. State

There are no State noise or vibration standards relevant to the Proposed Project.

3.7.1.3. Local

City of Los Angeles

The City regulates noise in the LAMC. Chapter XI (Noise Regulation) prohibits unnecessary, excessive, and annoying noise from all sources subject to its police power, although this does not apply to train operations. LAMC Chapter IV - Section 41.40 restricts construction activities before 7:00 a.m. and after 9:00 p.m. on weekdays. Construction activities are also prohibited before 8:00 a.m. and after 6:00 p.m. on Saturdays and holidays and are prohibited during all hours on Sundays. These time restrictions do not apply if a written application is submitted to the Executive Director of the Board of Police Commissioners and a variance is approved. A variance from the City may be obtained for nighttime activities, and construction activities occurring in accordance with variances are defined as consistent with Section 41.40.

3.7.2. EXISTING SETTING

Noise and vibration sensitive receivers were identified using the FTA Guidance Manual's definitions of noise- and vibration-sensitive land uses. The sensitive receivers were identified within a screening area of 350 feet (one slightly farther at 410 feet due to direct line of site and lower noise limits - Willow Studios) from the Project Site and grouped based on similar acoustic environments. As shown in Figures 3.7-3 and 3.7-4, noise-sensitive receivers include OSF and associated outdoor recreational areas, a school, and a film studio. OSF is located at 300 South Santa Fe Avenue, SCI-Arc is located at 960 East 3rd Street, and Willows Studios is located at 1335 Willow Street. OSF includes two multi-family residence buildings divided into different receivers grouped by similar noise environments, where many of the dwelling units are facing the Project Site. The school building is SCI-Arc, one long building across the street from OSF, which is also divided into multiple receivers grouped by similar noise environments. The other receiver is Willow Studios (film studios). Commercial and industrial uses, including food processing facilities, are not considered sensitive to noise per the FTA Guidance Manual.

Ambient noise in the project area was established by noise measurements. Noise measurements were taken at the locations shown in Figures 3.7.3 and 3.7.4. The purpose of the noise measurements was to document the existing noise environment and to develop baseline data for assessing the potential noise impacts resulting from the Proposed Project. Data were collected in November 2016 and September 2017 to characterize existing noise levels. The data collection included long-term (LT) measurements over 24-hour periods and short-term (ST) measurements over 10 to 120 minutes. The established existing noise levels for each sensitive receiver are shown in Table 3.7.2.

Figure 3.7.3 Sensitive Receivers and Noise Monitoring Locations (OSF and SCI-Arc)

Source: Terry A. Hayes Associates Inc., 2017; ATS Consulting, 2017.

Figure 3.7.4 Sensitive Receivers and Noise Monitoring Locations (Willow Studios)

Source: Terry A. Hayes Associates Inc., 2017; ATS Consulting, 2017.

Table 3.7.2. Summary of Existing Noise at Sensitive Receivers

Sensitive Receiver		Applicable Measurement Site	Loudest Hour L_{eq} (dBA)	L_{dn} (dBA)	CNEL (dBA)
ID	Location				
R-1	OSF (North Building – North End)	LT-2	62	68	69
R-2	OSF (North Building – Center)	LT-2	62	68	69
R-3	OSF (North Building – South End)	LT-2	62	68	69
R-4	OSF (North Building – South End, Shielded)	LT-2	62	68	69
R-5	OSF (South Building – North End)	LT-1	61	65	66
R-6	OSF (South Building – Center)	LT-1	61	65	66
R-7	OSF (South Building – South End)	LT-1	61	65	66
R-A	OSF, BBQ	ST-2	62	NA	NA
R-B	OSF, Pool/Spa	ST-1	59	NA	NA
R-C	SCI-Arc (North End)	ST-3	70	NA	NA
R-D	SCI-Arc (Center)	ST-3	70	NA	NA
R-E	SCI-Arc (South End)	ST-3	70	NA	NA
R-F	Willow Studios	ST-4	76	NA	NA

Source: ATS Consulting, 2018; AECOM, 2016.

Existing sources of noise include train operations, Rail Yard activities, aircraft overflights, and vehicle traffic. The 24-hour L_{dn} and CNEL metrics are not applicable to the analysis of the institutional and recreational receivers and are noted as NA in Table 3.7.2. Additional details about the measurements can be found in the Noise and Vibration Technical Report in Appendix E.[2]

3.7.3. THRESHOLDS OF SIGNIFICANCE

In accordance with Appendix G of the CEQA Guidelines, the Proposed Project would have a significant impact related to noise and vibration if it would:

- Expose persons to or generate noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;
- Expose persons to or generate excessive groundborne vibration or groundborne noise levels;
- Result in a substantial permanent increase in ambient noise levels in the Project vicinity above levels existing without the Project;
- Result in a substantial temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the Project;
- Expose persons residing or working in an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or a public use airport, to excessive noise levels; and/or

[2]ATS Consulting, *Division 20 Portal Widening/Turnback Facility Noise and Vibration Technical Report*, 2018.

- Expose persons residing or working within the vicinity of a private airstrip to excessive noise levels.

3.7.3.1. Noise

Construction

The FTA guidance manual includes reasonable criteria for assessing construction noise impacts. Per the general assessment guidance in Chapter 12 of the FTA guidance manual, a potential impact could occur from construction noise if the noise level exceeds the following (which are expressed in one-hour Leq):

- Residential: Day 90 dBA; Night 80 dBA
- Commercial: Day 100 dBA; Night 100 dBA
- Industrial: Day 100 dBA; Night 100 dBA

The FTA has not established criteria for institutional land uses. Institutional land uses are assessed in the following analysis as residences.

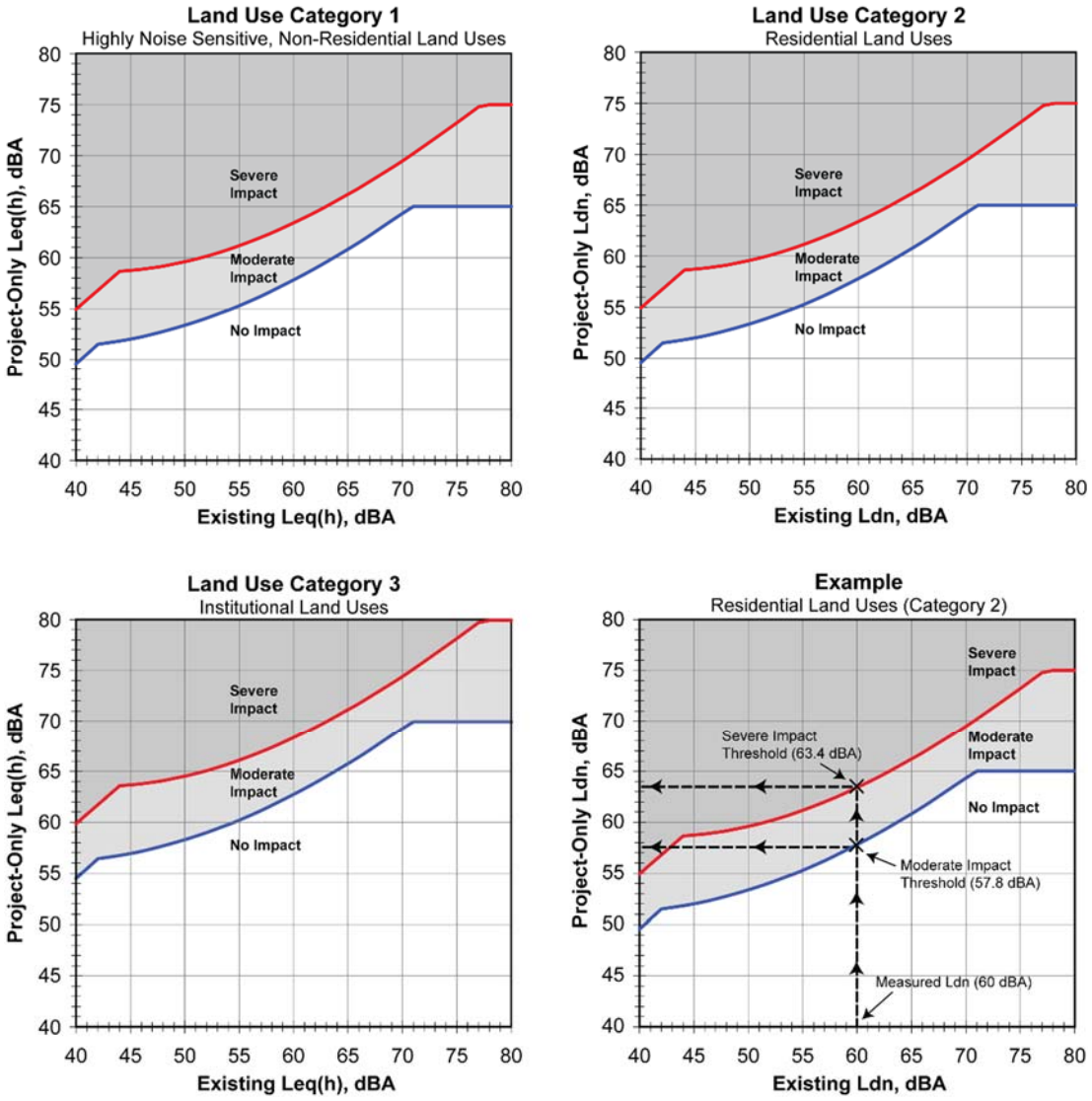
The FTA guidance also includes detailed assessment criteria using the eight-hour L_{eq} and the 30-day average L_{dn}. The detailed analysis requires very specific information including the specific equipment in use at any given time, horsepower, and precise duration of activities. The analysis is based on the equipment that is likely to be used during the loudest periods of construction, along with their measured noise levels at a distance of 50 feet. This level of detail was not available during the Draft EIR phase of the planning process, so the impact determination for construction noise is based on the FTA general assessment guidelines set forth above.

Operations

The FTA noise impact threshold is a sliding scale based on existing noise exposure and noise-sensitivity of the affected land uses. The basic concept of the FTA noise impact criteria is that more Project-related noise is allowed in areas where existing noise is higher. However, in areas where existing noise exposure is higher, the allowable increase above the existing noise exposure decreases. For example, in an area with an existing noise level of 55 dBA, the allowable increase in noise level is 3 dB, resulting in a maximum allowable future noise level of 58 dBA. For an area with an existing noise level of 60 dBA, the allowable increase in noise level is only 2 dB, resulting in a maximum allowable future noise level of 62 dBA.

FTA noise impact criteria are shown in Figure 3.7.5. The sample graph located in the bottom right corner may help clarify the concept of a sliding scale for noise impact. Assume that the existing noise has been measured at 60 dBA L_{dn}. This is the total noise from all existing noise sources over a 24-hour period: traffic, aircraft, lawnmowers, children playing, birds chirping, etc. Starting at 60 dBA on the horizontal axis, follow the vertical line up to where it intersects the moderate and severe impact curves. Then refer to the left axis to see the impact thresholds.

Figure 3.7.5 Noise-Sensitive Receivers



Source: FTA, 2006.

An existing noise of 60 dBA L_{dn} gives thresholds of 57.8 dBA L_{dn} for moderate impact and 63.4 dBA L_{dn} for severe impact. Only severe impacts are considered to be significant within the context of CEQA. Note that the values are measured in tenths of a decibel to avoid confusion from rounding off; in reality, one cannot perceive a tenth of a decibel change in sound level.

3.7.3.2. Vibration

Construction

The primary concern regarding construction vibration is potential damage to structures. Table 3.7.3 shows FTA guidance for construction vibration limits for various building categories. It is important to note that the vibration limits are the levels at which there is a risk for damage for each building category, not the level at which damage would occur.

Table 3.7.3. FTA Construction Vibration Damage Risk Criteria

Building Category	Peak Particle Velocity (inches/second)	Approximate L_v (VdB)
I. Reinforced concrete, steel or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Nonengineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90

Source: FTA, 2006.

Operations

The potential adverse effects of rail transit groundborne vibration include perceptible building vibration, rattle noises, reradiated noise (groundborne noise), and cosmetic or structural damage to buildings. The vibration caused by modern rapid transit rail operations is well below what is considered necessary to damage buildings. Therefore, the criteria for building vibration caused by transit operations are only concerned with potential annoyance of building occupants.

The FTA vibration impact criteria are based on the maximum indoor vibration level as a train passes. There are no impact criteria for outdoor spaces such as parks because outdoor groundborne vibration does not provoke the same adverse human reaction as indoor vibration. Table 3.7.4 shows the applicable groundborne vibration and noise criteria. These criteria assume frequent train events (more than 70 per day). The Category 1 criteria are applied to buildings where vibration would interfere with interior operations. The Category 2 criteria are applied to residential land uses (homes, hotels, etc.), where there is nighttime use; this category is similar to the Category 2 land uses defined for noise. The Category 3 criteria are applied to institutional land uses (schools, libraries, churches, etc.), where use is primarily during the daytime; this category is similar to the Category 3 land uses defined for noise analysis.

Table 3.7.4. FTA Groundborne Noise and Vibration Impact Criteria for General Assessment

Location	Groundborne Vibration Impact Levels (VdB)	Groundborne Noise Impact Levels (dBA)
Category 1 - Buildings where vibration would interfere with interior operations	65	N/A
Category 2 - Residences	72	35
Category 3 - Institutional uses	75	40

Source: FTA, 2006.

Some buildings, such as concert halls, recording studios and theaters, can be very sensitive to vibration. Given the sensitivity of these buildings, they usually warrant special attention during the environmental evaluation of a transit project. Table 3.7.5 shows the FTA criteria for acceptable levels of groundborne vibration and groundborne noise for various categories of special buildings. Historic structures that do not fall into the FTA land use categories are not included in the assessment for vibration impact from rapid transit rail operations. The

vibration impact thresholds are based on annoyance, and the primary concern for historic structures is the risk of damage.

Table 3.7.5. Groundborne Noise and Vibration Impact Criteria for Special Buildings

Special Building Types	Groundborne Vibration Impact Levels (VdB re 1 micro-inch/second)	Groundborne Noise Impact Levels (dBA re 20 micro Pascals)
Concert Halls	65	25
TV Studios	65	25
Recording Studios	65	25
Auditoriums	72	30
Theaters	72	35

Source: FTA, 2006.

The recommended limit in the FTA guidance for buildings extremely susceptible to damage is 90 VdB, which is 18 decibels higher than the limit for Category 2 (residential) land uses. Vibration from rapid transit rail operations will be well below the limit for buildings extremely susceptible to damage.

3.7.4. IMPACT ANALYSIS AND MITIGATION MEASURES

The ensuing discussions address the potential significance of noise and vibration impacts associated with construction and operation of the Proposed Project in accordance with the Appendix G Environmental Checklist criteria and the specific limits and standards identified above.

Impact 3.7.1 Would the Proposed Project expose persons to or generate noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?

Impact Analysis

Significant Impact (Construction); Less-than-Significant Impact with Mitigation (Operations). The following analysis addresses the potential for impacts during construction and operational activities.

Construction

Equipment noise levels were obtained from the FHWA Roadway Construction Noise Model (RCNM). Construction noise levels depend on the number of pieces and type of equipment, their general condition, the amount of time each piece operates per day, the presence or absence of noise-attenuating features such as walls, and the location of the construction activities relative to the sensitive receivers. The majority of these variables are left to the discretion of the construction contractor selected as the project approaches the construction phase. The equipment that is likely to be used during the noisiest periods of construction,

along with their measured noise levels at a distance of 50 feet, are shown in Table 3.7.6. Reference levels and usage factors for these pieces of equipment are collected from the RCNM.

Table 3.7.6. Construction Noise by Equipment Piece at 50 Feet

Equipment Description	Source Usage Factor (% time under full load)	L_{max} Level @ 50 feet (dBA)
Backhoe	40	78
Compactor (ground)	20	83
Concrete Saw	20	90
Dozer	40	82
Drum Mixer	50	80
Dump Truck	40	76
Excavator	40	81
Front End Loader	40	79
Grader	40	85
Grapple (on backhoe)	40	87
Hydra Break Ram	10	90
Jackhammer	20	89
Mounted Impact Hammer (hoe ram)	20	90
Pavement Scarafier	20	90
Paver	50	77
Roller	20	80
Scraper	40	84
Shears (on backhoe)	40	96
Welder / Torch	40	74

Source: FHWA, 2008.

The analysis considered multiple phases of construction activities, including demolition of the existing yard buildings (south of 1st Street and east of OSF); demolition of the concrete parking lot (south of 1st Street and east of and adjacent to OSF); construction of an asphalt access road; construction of storage tracks; modifications to the Bridge; and construction of yard tracks. Equipment assumptions and predicted noise levels associated with each phase are provided in the Noise and Vibration Technical Report included as Appendix E. Table 3.7.7 summarizes the highest L_{eq} for noise-sensitive land uses. Daytime noise levels would exceed the 90 dBA L_{eq} FTA criteria at OSF during all analyzed phases of construction activity and during building demolition at the north end of SCI-Arc.

Table 3.7.7. Maximum Predicted Construction Noise Levels

Receiver ID	Receiver Name	Distance between Noise Source and Receiver (ft)	Noise L_{eq} (dBA) /a/	Construction Activities Associated with Exceedances /b/
R-1	OSF (North Building – North End)	12	105.9	*Demolition of building abutting OSF* Pavement demolition in lot adjacent to OSF
R-2	OSF (North Building – Center)	12	105.9	*Demolition of building abutting OSF* Pavement demolition in lot adjacent to OSF Storage track construction
R-3	OSF (North Building – South End)	12	105.9	*Demolition of building abutting OSF* Pavement demolition in lot adjacent to OSF Storage track construction
R-4	OSF (North Building – South End, Shielded)	12	90.9	*Demolition of building abutting OSF*
R-5	OSF (South Building – North End)	24	96.8	Demolition of building abutting OSF *Pavement demolition in lot adjacent to OSF*
R-6	OSF (South Building – Center)	246	74.7	None
R-7	OSF (South Building – South End)	488	68.8	None
R-A	OSF, BBQ	5	104.9	Demolition of building abutting OSF Pavement demolition in lot adjacent to OSF *Storage track construction*
R-B	OSF, Pool/Spa	24	99.9	*Demolition of building abutting OSF* Pavement demolition in lot adjacent to OSF
R-C	SCI-Arc (North End)	143	74.4	None
R-D	SCI-Arc (Center)	293	68.2	None
R-E	SCI-Arc (South End)	730	60.3	None
R-F	Willow Studios	415	66.6	None

/a/ The listed L_{eq} value represents the construction activity with the highest noise level. L_{eq} values are compared to the FTA general assessment criterion of 90 dBA L_{eq}. Exceedances are underlined.

/b/ Italicized construction activities are associated with the highest L_{eq} listed in the adjacent column. Other activities listed also indicate exceedances.

Source: ATS Consulting, 2018.

Similarly, nighttime noise levels would exceed the limits at OSF. The FTA has identified a 100-dBA threshold for commercial and industrial land uses. This noise level would be exceeded for land uses located within approximately 20 feet of heavy-duty equipment. The nearest commercial/industrial facilities to proposed construction activities are located approximately 40 feet to the north across Commercial Street. Construction noise levels for commercial and industrial uses would be less than the FTA criteria. However, without mitigation, the Proposed Project would result in a significant impact at OSF related to construction noise.

Operations

The noise assessment methodology follows the Detailed Noise Assessment guidelines outlined in the FTA guidance. The noise prediction models use standard formulas to characterize noise from rapid transit rail vehicles. The existing Division 20 Rail Yard includes numerous sources of noise. Some of these noise sources would change as a result of the Proposed Project. As such, noise predictions for the Proposed Project include all future noise sources and predicted noise levels are compared to existing conditions. The noise sources include all the Proposed Project elements: turnback tracks, yard tracks, and storage tracks, and associated wheel squeal, use of horns, TPSS unit, and light maintenance.

They also include other noise sources in the area: public address system, mechanical equipment (e.g., heating, ventilation, and air conditioning system), washing platform, traffic on Santa Fe Avenue, aircraft flyovers, and non-Metro passenger rail (Metrolink and Amtrak). Detailed methodology is provided in the Noise and Vibration Technical Report included as Appendix E.

The nearest sensitive receiver to the Division 20 Rail Yard is OSF. The City approved OSF in 2007 and required that the building shell construction (i.e., exterior wall assembly, windows, doors, and roof assembly) be designed with a minimum Sound Transmission Class (STC) rating of 35 or as required to meet the interior noise level of 45 dBA.[3] To be conservative, a 30 dB STC was applied to this analysis. Predicted sound levels are shown for both exterior and interior for OSF.

Table 3.7.8 presents the predicted noise levels at sensitive receivers. The noise predictions are based on the closest part of each building or portion of building that is closest to the tracks. The analysis determined that, without mitigation, the Proposed Project would result in significant exterior noise levels at residential OSF locations near tracks with curvature and special trackwork. This includes the northern two sections of the north building (IDs R-1 and R-2) and the north section of the south building (ID R-5). However, the analysis demonstrates that interior OSF noise impacts would not be significant. Assuming a building noise reduction of 30 dB with windows and doors closed, the predicted interior noise levels would be less than the 45 dBA CNEL design guidelines. Additional analysis showed that, without mitigation, there would be no significant impacts for the outdoor apartment balconies facing the rail yard. No significant impacts are predicted for the OSF outdoor common use barbeque area (ID R-A), OSF pool/spa area (ID R-B), SCI-Arc (IDs R-C, R-D, and R-E), and Willow Studios (ID R-F).

The portal widening requires a new ventilation shaft building to be installed on the parcel currently occupied by LAPD Viertel's Central Division Police Garage. The building would house three fans that would only operate in the event of an emergency, such as a fire. The ventilation shaft would be located approximately 1,000 feet from residences to the east, 1,500 feet from OSF, and not near a hospital, school, or other similar land sensitive land use.

[3]City of Los Angeles, *One Santa Fe Mixed-Use Project Final EAF/Initial Study/Mitigated Negative Declaration,* October 2017.

Table 3.7.8. Summary of Predicted Noise Impacts

ID	Near Track Dist. (ft)	Sensitive Receiver	Metric Applied	Noise Level (dBA) /a/			
				Existing	Predicted Outdoor/Indoor	Allowable Increase	
						Moderate	Severe
R-1	120	OSF (North Building – North End)	L_{dn}/CNEL	68	72/42	1.2	3.1
R-2	85	OSF (North Building – Center)	L_{dn}/CNEL	68	72/42	1.2	3.1
R-3	80	OSF (North Building – South End)	L_{dn}/CNEL	68	67/37	1.2	3.1
R-4	105	OSF (North Building – South End, Shielded)	L_{dn}/CNEL	68	66/36	1.2	3.1
R-5	50	OSF (South Building – North End)	L_{dn}/CNEL	65	69/39	1.4	3.6
R-6	50	OSF (South Building – Center)	L_{dn}/CNEL	65	69/39	1.4	3.6
R-7	65	OSF (South Building – South End)	L_{dn}/CNEL	65	69/39	1.4	3.6
R-A	85	OSF, BBQ	L_{eq}	60	69	4.6	9.0
R-B	60	OSF, Pool/Spa	L_{eq}	59	64	4.9	9.4
R-C	215	SCI-Arc (North End)	L_{eq}	70	70	2.8	6.0
R-D	260	SCI-Arc (Center)	L_{eq}	70	70	2.8	6.0
R-E	260	SCI-Arc (South End)	L_{eq}	70	70	2.8	6.0
R-F	410	Willow Studios	L_{eq}	76	71	0.3	2.1

/a/ Note: Underlined values indicate an exceedance of the FTA severe limits.

Source: ATS Consulting, 2018.

Emergency operation of the fans due to fire is unlikely to occur and the potential for noise exposure is low. Furthermore, emergency noise would be short-term and intermittent by nature and is not considered a source of nuisance noise.

Metro's acquisition of the 100-120 North Santa Fe Avenue property would provide a new location for existing MOW functions that would be displaced by the new storage tracks. The existing building would be renovated and repurposed for use by Metro and no major demolition or construction activities are planned at this location. In addition, the facility would primarily be used as training and office space for MOW employees. Minimal exterior space would be used for storage and staging, and the building would not be a substantial source of noise.

Mitigation Measures

NV-1 The Contractor shall submit a Noise Control and Monitoring Plan to Metro that is prepared, stamped, and administered by the Contractor's Acoustical Engineer. This plan shall state that:

- Equipment shall include enclosed engines, acoustically attenuating shields, and/or high-performance mufflers;
- Equipment and staging areas shall be located away from noise-sensitive receivers;
- Equipment shall not idle when not in use;

- Temporary noise barriers and/or noise control curtains shall be installed;
- Construction-related truck traffic shall be routed away from local residential streets and/or sensitive receivers;
- Impact pile driving shall be prohibited.
- The use of impact devices such as jackhammers and hoe rams shall be minimized, using concrete crushers and pavement saws instead;
- The Noise Control and Monitoring Plan shall include a site drawing, an inventory of equipment, calculations of the one-hour L_{eq} noise levels at sensitive receptors (i.e., OSF), and compliance with FTA noise criteria. An updated Noise Control and Monitoring Plan shall be completed and submitted within ten days of the start of each quarterly period, or whenever there is a major change in work schedule, construction methods, or equipment operations.

NV-2 Metro shall install low-impact frogs at locations with special trackwork. This applies to the OSF-adjacent storage yard and yard tracks within a 200-foot radius of the northern portion of the northern OSF building. This also applies to existing yard tracks leading to the Maintenance Facility, as well as new yard tracks within a 200-foot radius of the northern portion of the southern OSF building.

Significance After Mitigation

The Noise Control and Monitoring Plans would track and lessen potentially significant construction noise levels. High-performance mufflers are known to reduce engine noise by more than 5 dB and noise barriers typically reduce construction noise by more than 10 dB. However, heavy-duty equipment would operate adjacent to OSF at times and the analysis does not demonstrate that noise levels would be lower than the significance thresholds. Consequently, significant noise levels would be unavoidable at OSF, particularly if nighttime construction is required. Therefore, the Proposed Project would result in a significant and unavoidable impact related to construction noise.

The primary causes of the significant operational noise levels are wheel squeal and noise from wheels crossing over gaps in standard frogs for the yard tracks leading into the storage yard adjacent to the OSF, those passing under the bridge heading toward the Division 20 Rail Yard, and those leading to the Maintenance Facility. Mitigation Measure **NV-2** would reduce Proposed Project noise levels by 1.6 to 3.4 dB. This would eliminate all significant noise impacts shown in Table 3.7.8.

Impact 3.7.2 Would the Proposed Project expose persons to or generate excessive groundborne vibration or groundborne noise levels?

Impact Analysis

Significant Impact (Construction); Less-than-Significant Impact (Operations). The following analysis addresses the potential for impacts during construction and operational activities.

Construction

Vibration levels associated with construction activities were estimated using FTA guidance.[4] The same demolition and construction operations assumed when estimating the noise generated have been assumed when estimating the construction vibration. The equipment that is likely to be used during construction, along with reference vibration levels at a distance of 50 feet are listed in Table 3.7.9. The table also shows the minimum distance in feet that a piece of equipment must be from the nearest receiver to not have its operation time limited by FTA criteria. The breakdown of equipment assumed for each phase of construction, as well as vibration levels for individual pieces of equipment at each receiver are available in the Noise and Vibration Technical Report.[5]

Table 3.7.9. Construction Vibration by Equipment Piece at 50 feet

Equipment Description	Reference Level Source	Peak Particle Velocity at 50 ft (inches/second)	L_v at 50 ft (VdB)	Minimum Distance from Receiver w/ Unlimited Use Time (ft) /a/
Backhoe	FTA - Hoe Ram	0.031	78	80
Compactor (ground) /a/	Dowding - Heavy Vehicles	0.063	84	117
Dozer	FTA - Large Bulldozer	0.031	78	80
Drum Mixer	FTA - Loaded Trucks	0.027	77	74
Dump Truck	FTA - Loaded Trucks	0.027	77	74
Excavator	FTA - Hoe Ram	0.031	78	80
Front End Loader	FTA - Small Bulldozer	0.001	49	10
Grader	FTA - Large Bulldozer	0.031	78	80
Grapple (on backhoe)	FTA - Hoe Ram	0.031	78	80
Hydra Break Ram[a]	Dowding - Pavement Breaker	0.052	82	109
Jackhammer	FTA - Jackhammer	0.012	70	44
Mounted Impact Hammer (hoe ram)	FTA - Hoe Ram	0.031	78	80
Pavement Scarafier /a/	Dowding - Pavement Breaker	0.052	82	109
Paver	FTA - Large Bulldozer	0.031	78	80
Roller	FTA - Vibratory Roller	0.074	85	136
Scraper	FTA - Large Bulldozer	0.031	78	80
Shears (on backhoe)	FTA - Hoe Ram	0.031	78	80

/a/ Unlimited use distance determined as distance where the level falls below the 72 VdB annoyance L_v limit.
Source: ATS Consulting, 2018.

The Noise and Vibration Technical Report shows vibration levels for every phase of construction at each receiver. Table 3.7.10 shows only the theoretical worst-case maximum vibration level for the purposes of determining potential impacts. The highest vibration levels occur for construction activities occurring adjacent to OSF.

[4]FTA, *Transit Noise and Vibration Impact Assessment*, 2006.
[5]ATS Consulting, *Division 20 Portal Widening/Turnback Facility Noise and Vibration Technical Report*, 2018.

Table 3.7.10. Maximum Vibration Predictions

Receiver ID	Receiver Name	PPV (inches/sec)	L_V (VdB)
R-1	OSF (North Building – North End)	1.644	112.3
R-2	OSF (North Building – Center)	2.340	115.0
R-3	OSF (North Building – South End)	2.340	115.0
R-4	OSF (North Building – South End, Shielded)	1.644	112.3
R-5	OSF (South Building – North End)	0.156	91.8
R-6	OSF (South Building – Center)	0.006	62.5
R-7	OSF (South Building – South End)	0.002	54.5
R-A	OSF, BBQ	2.340	115.0
R-B	OSF, Pool/Spa	1.644	112.3
R-C	SCI-Arc (North End)	0.011	68.6
R-D	SCI-Arc (Center)	0.004	59.2
R-E	SCI-Arc (South End)	0.001	47.3
R-F	Willow Studios	0.003	57.4

Note: Underlined values indicate an exceedance of the 0.2 in/sec PPV damage limit or 72 VdB annoyance L_V limit.
Source: ATS Consulting, 2018.

These activities include the demolition of existing structures and facilities and the construction of storage tracks. These activities require the use of heavy-duty equipment that cannot be avoided based on applicable construction methods.

Vibration levels would vary greatly depending on the construction phase, equipment, and distance to the receiver. Vibration levels reduce quickly with distance and are typically only substantial within approximately 50 feet of the source. The majority of construction activities would occur more than 50 feet from OSF. However, in the following analysis, the maximum vibration PPV and L_V was predicted for every phase of construction at each receiver.

The results predict that the vibration levels would exceed the FTA standards when equipment operates very close to the receiver, as is the case near the OSF apartment complex during the building and concrete demolition operations. Therefore, without mitigation, the Proposed Project would result in a significant impact related to construction vibration.

Operations

Vibration levels associated with operational activities were estimated using FTA guidance.[6] Vibration-sensitive land uses along the corridor were identified using the same procedure as the noise analysis. The vibration levels at specific buildings were estimated by reading values from an FTA reference curve and applying adjustments to account for factors such as track support system, vehicle speed, type of building, and track and wheel condition. Prediction models were used to predict vibration levels from train operations at all sensitive receivers in the Project area. The predictions were compared to the applicable FTA impact thresholds to identify potential vibration impacts.

[6] FTA, *Transit Noise and Vibration Impact Assessment*, 2006.

The significance thresholds applicable to the Proposed Project are a maximum vibration level of 72 VdB for Category 2 (residential), 78 VdB for Category 3 (institutional) land uses, and 65 VdB for recording studios. The thresholds apply to the overall L_{max} vibration level and an impact would occur if this level exceeds those thresholds for receivers of the applicable type. Limits are also set by FTA for maximum groundborne noise: 35 dBA for Category 2, 40 dBA for Category 3, and 25 dBA for recording studios. Groundborne noise radiates off the structure and is caused directly by groundborne vibration.

As shown in Table 3.7.11, no groundborne vibration or noise impacts are predicted using FTA methods/limits at any sensitive receivers. Therefore, the Proposed Project would result in a less-than-significant impact related to operational vibration.

Table 3.7.11. Summary of Predicted Vibration Levels

Receiver ID	Receiver Name	Near Track Dist. (ft)	Groundorne Vibration (VdB)	Groundborne Noise (dBA)	GBV Criteria (VdB)	GBN Criteria (dBA)	GBV Impact	GBN Impact
R-1	OSF (North Building – North End)	65	53	18	72	35	--	--
R-2	OSF (North Building – Center)	10	67	32	72	35	--	--
R-3	OSF (North Building – South End)	10	67	32	72	35	--	--
R-4	OSF (North Building – South End, Shielded)	60	48	13	72	35	--	--
R-5	OSF (South Building – North End)	40	60	25	72	35	--	--
R-6	OSF (South Building – Center)	40	60	25	72	35	--	--
R-7	OSF (South Building – South End)	40	60	25	72	35	--	--
R-A	OSF, BBQ	10	67	32	78	40	--	--
R-B	OSF, Pool/Spa	40	51	16	78	40	--	--
R-C	SCI-Arc (North End)	150	53	18	78	40	--	--
R-D	SCI-Arc (Center)	230	53	18	78	40	--	--
R-E	SCI-Arc (South End)	230	53	18	78	40	--	--
R-F	Willow Studios	410	53	18	65	25	--	--

Source: ATS Consulting, 2018.

Mitigation Measures

NV-3 The Contractor shall submit a Vibration Monitoring Plan to Metro that is prepared, stamped, and administered by the Contractor's Acoustical Engineer. This plan shall include:

- A survey of OSF building foundations with photographs of existing conditions limited to buildings within 25 feet of high-vibration-generating construction activities. Another survey shall be completed at the end of construction activities to

assess potential damage. Damaged structures shall be returned to the preconstruction state by the Contractor.

- A requirement to monitor vibration at any building where vibratory rollers or similar high-vibration-generating equipment would be operated within 25 feet of buildings and at any location where complaints about vibration are received from building occupants. Construction activities shall be stopped and alternative methods introduced if vibration levels exceed 0.2 inches per second at OSF. Examples of high-vibration construction activities include the use of vibratory compaction or hoe rams next to sensitive buildings. Alternative procedures include use of non-vibratory compaction in limited areas and a concrete saw in place of a hoe ram to break up pavement.
- Nighttime construction activities near OSF shall not include equipment operations within the minimum distances shown in Table 3.7.9.

Significance After Mitigation

Mitigation Measure **NV-3** includes a Vibration Monitoring Plan to track and lessen potentially significant vibration levels. The Proposed Project requires the demolition of structures and facilities within five feet of OSF. Heavy-duty equipment would be necessary to complete the demolition process and remove debris from the area adjacent to OSF. There is no applicable construction method for eliminating equipment vibration directly adjacent to OSF, and the analysis does not demonstrate that mitigated vibration levels would be lower than the significance thresholds. Therefore, the Proposed Project would result in a significant and unavoidable impact related to construction vibration.

Impact 3.7.3 Would the Proposed Project result in a substantial permanent increase in ambient noise levels in the Project vicinity above levels existing without the Project?

Impact Analysis

Significant Impact. Permanent increases in noise levels are assessed in detail within the analysis of Impact 3.7-1. The analysis determined that, without mitigation, the Proposed Project would result in significant exterior noise levels at residential OSF locations near tracks with curvature and special trackwork. This includes the northern two sections of the north building (IDs R-1 and R-2) and the north section of the south building (ID R-5). However, the analysis demonstrates that interior OSF noise levels would not be significant. Therefore, without mitigation, the Proposed Project would result in a significant impact related to permanent increases in noise.

Mitigation Measures

Mitigation to address permanent increases in noise levels was discussed in the analysis of Impact 3.7-1. Refer to Mitigation Measure **NV-2** for mitigation related to permanent operational noise.

Significance After Mitigation

The primary causes of the significant operational noise levels are wheel squeal and noise from wheels crossing over gaps in standard frogs for the yard tracks leading into the storage yard adjacent to the OSF, those passing under the bridge heading toward the Division 20 Rail Yard, and those leading to the Maintenance Facility. Mitigation Measure **NV-2** would reduce Proposed Project noise levels by 1.6 to 3.4 dB. This would eliminate all significant noise impacts shown in Table 3.7.8.

Impact 3.7.4 Would the Proposed Project result in a substantial temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the Project?

Impact Analysis

Significant Impact. Temporary and periodic increases in noise levels are assessed in detail within the analysis of Impact 3.7-1. Daytime noise levels would exceed the FTA criteria at OSF during all analyzed phases of construction activity and at the north end of SCI-Arc during building demolition. Similarly, nighttime noise levels would exceed the limits at OSF during construction activities. Therefore, without mitigation, the Proposed Project would result in a significant impact related to temporary and periodic increases in noise.

Mitigation Measures

Mitigation to address temporary and periodic increases in noise levels was discussed in the analysis of Impact 3.7.1. Refer to Mitigation Measure **NV-1** for mitigation related to construction noise.

Significance After Mitigation

The Noise Control and Monitoring Plans would track and lessen potentially significant construction noise levels. High-performance mufflers are known to reduce engine noise by more than 5 dB and noise barriers typically reduce construction noise by more than 10 dB. However, heavy-duty equipment would operate adjacent to OSF at times and the analysis does not demonstrate that noise levels would be less than the significance thresholds. Therefore, the Proposed Project would result in a significant and unavoidable impact temporary impact related to construction noise.

Impact 3.7.5 Would the Proposed Project expose persons residing or working in an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or a public use airport, to excessive noise levels?

Impact Analysis

No Impact. The Proposed Project is not located within an airport land use plan or within two miles of a public airport or public use airport. The nearest public airport is Hawthorne Municipal Airport, located approximately 10 miles southwest of the Project Site. Accordingly,

the Proposed Project would not expose people working or residing in the project area to excessive noise levels from a public airport or public use airport. Therefore, the Proposed Project would not result in an impact related to noise exposure from public airports.

Mitigation Measures

No impact would occur and mitigation measures are not required.

Impact 3.7.6 Would the Proposed Project expose persons residing or working within the vicinity of a private airstrip to excessive noise levels?

Impact Analysis

No Impact. The Proposed Project is not within the proximity of a private airstrip. Therefore, the Proposed Project would result in no impact related to excessive noise levels associated with private airstrips.

Mitigation Measures

No impact would occur and mitigation measures are not required.