

## **4.8 NOISE**

This section describes the potential effects of the Revised Project in relation to noise and vibration. Included in this section is background information on noise and vibration, a brief summary of the regulatory framework that pertains to the Revised Project, an evaluation of the significance of Project impacts including noise and land use compatibility, long-term noise level increases resulting from Project-generated traffic, temporary noise, and vibration impacts during construction, and cumulative impacts.

### **4.8.1 NOISE AND VIBRATION TERMINOLOGY**

#### **4.8.1.1 NOISE**

Noise is unwanted sound. Several noise measurement scales are used to describe noise in a specific location. A decibel (dB) is a unit of measurement that indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound pressure that the healthy, unimpaired human ear can detect under controlled conditions. Sound levels in decibels are calculated on a logarithmic basis using the ratio of the assumed or measured sound pressure divided by a standardized, reference pressure (for sound, the reference pressure is 20  $\mu$ Pascals). Each 10 dB increase in sound level is perceived as an approximate doubling of loudness over a fairly wide range of amplitudes.

There are several methods of characterizing sound. The A-scale is a filter system that closely approximates the way the human ear perceives sound at different frequencies. Noise levels using A-weighted measurements are denoted with the abbreviation of “dB(A)” or “dBA.” The A-weighting filter system is very commonly used in the measurement and reporting of community noise, as well as in nearly all regulations and ordinances. All sound levels in this report are A-weighted, unless noted otherwise.

Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This energy-average or energy-equivalent sound/noise descriptor is abbreviated as  $L_{eq}$ . An hour is the most common time period over which energy-average sound is measured, but it can be measured over any duration (and the duration should be specified when the  $L_{eq}$  level is reported). Alternately, varying sound levels can be described by their statistical distribution over some fraction of a given observation period. These statistical sound levels are typically abbreviated as “ $L_n$ .” For example, the  $L_{50}$  noise level represents the noise level that is exceeded  $n=50$  percent of the time. That is, half of the time the noise level exceeds this level and half of the time the noise level is less than this level. For practical implementation, this level is representative of the noise that is exceeded 30 minutes in an hour. Similarly, the  $L_2$ ,  $L_8$ , and  $L_{25}$  values represent the noise levels that are exceeded  $n=2$ , 8, and 25 percent of the time or, equivalently, 1, 5, and 15 minutes in any given hour. These “ $n$ ” values are typically used to

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demonstrate compliance for stationary noise sources with a city's noise ordinance, as discussed below. Other values typically noted during a noise survey are the  $L_{\min}$  and  $L_{\max}$ . These values represent the minimum and maximum root-mean-square noise levels obtained over the measurement period.

Sensitivity to noise is subjective and varies from person to person, with the particular setting, and with the time-of-day. Sensitivity to noise typically increases during the evening and nighttime hours, when excessive noise can interfere with at-home activities and the ability to sleep. To account for these day/evening/night differences in sensitivity, 24-hour descriptors have been developed that incorporate artificial noise penalties that are added to quiet-time noise events. The Day/Night Average Sound Level, abbreviated as " $L_d$ ," is a measure of the cumulative noise exposure in a community, with a 10 dB addition applied to nocturnal (10:00 p.m. to 7:00 a.m.) noise levels. A similar 24-hour metric is the Community Noise Equivalent Level, or "CNEL," which extends the sensitivity adjustment by also applying a 3 dB addition to noise levels in the evening hours (7:00 p.m. to 10:00 p.m.). For typical community noise environments, the  $L_{dn}$  and CNEL levels are nearly always within 1 dB of each other and, therefore, are commonly used interchangeably (as will be the case in this document).

Additional technical terms are defined in Table 4.8-1. To provide a frame of reference to common experiences, representative outdoor and indoor noise levels are shown in Table 4.8-2.

### 4.8.1.2 GROUNDBORNE VIBRATION

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several methods are typically used to quantify the amplitude of vibration including Peak Particle Velocity (PPV) and Root Mean Square (RMS) velocity. PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. RMS velocity is defined as the square root of the arithmetic mean (average) of the squares of the original velocity values. PPV and RMS vibration velocity amplitudes are used to evaluate human response to vibration. Table 4.8-3 displays human annoyance and the effects on buildings resulting from continuous vibration.

As discussed previously for noise, annoyance to vibration is also subjective and dependent on situational conditions such as the receptor's physical orientation, the frequency content of the vibrational energy, and the impulsiveness of the vibration (described, in part, by the crest factor). Vibrations may be found to be annoying at much lower levels than those shown in the table, depending on the level of activity and/or the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying.

Low-level vibrations frequently cause irritating, secondary vibration, such as a slight rattling of windows, doors, or stacked dishes. The rattling sound can give rise to exaggerated vibration complaints, even though there is very little risk of actual structural damage. In high noise environments, which are more prevalent where groundborne vibration approaches perceptible levels, this rattling phenomenon may also be produced by loud airborne environmental noise which causes induced vibration in exterior doors and windows.

**TABLE 4.8-1 DEFINITIONS OF ACOUSTICAL TERMS**

Term	Definitions
Decibel, dB	A unit of level that denotes the ratio between two quantities proportional to power; the number of decibels is 10 times the logarithm (to the base 10) of this ratio. For decibels describing sound pressures, the reference pressure is 20 $\mu$ Pascals.
Frequency, Hz	Of a function periodic in time, the number of times that the quantity repeats itself in one second (i.e., number of cycles per second).
A-Weighted Sound Level, dBA	The sound level obtained by use of the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. All sound levels in this report are A-weighted, unless noted otherwise.
Statistical Sound Level or n-exceedance Sound Level, $L_n$ (e.g., $L_{01}$ , $L_{10}$ , $L_{50}$ , $L_{90}$ )	The fast-response, A-weighted noise levels equaled or exceeded by a fluctuating sound level for n-percent of a stated time period. For example, 1 percent, 10 percent, 50 percent, and 90 percent of the stated period. The $L_{10}$ level is commonly called the 'intrusive sound level' and is near the maximum level in that time period, while the $L_{90}$ is commonly called the 'residual sound level' and is near the minimum level in that period.
Equivalent Continuous Noise Level, $L_{eq}$	The level of a steady sound that, in a stated time period and at a stated location, has the same A-weighted sound energy as the time-varying sound.
Community Noise Equivalent Level*, CNEL	The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of five decibels to sound levels occurring in the evening from 7:00 p.m. to 10:00 p.m. and after the addition of 10 decibels to sound levels occurring in the nighttime between 10:00 p.m. and the following 7:00 a.m.
Day/Night Noise Level*, $L_{dn}$	The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of 10 decibels to sound levels occurring in the nighttime between 10:00 p.m. and 7:00 a.m.
$L_{max}$ , $L_{min}$	The maximum and minimum A-weighted sound levels measured on a sound level meter, during a designated time interval, using fast-response time averaging. The $L_{max}$ is equal to the $L_0$ and the $L_{min}$ is equal to the $L_{100}$ .
Ambient Noise Level	The all-encompassing noise associated with a given environment at a specified time. It is usually a composite of sounds from many sources and from many directions, both near and far, with no particular sound source being dominant.
Intrusive	The noise that intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, time of occurrence, and tonal or informational content, as well as the increment above the ambient noise level.

\* Note:  $L_{dn}$  and CNEL values rarely differ by more than 1 dB. As a matter of practice, CNEL values are considered to be equivalent to and interchangeable with  $L_{dn}$  values and are treated as such in this assessment.

Source: Harris, Cyril, 1998. Handbook of Acoustical Measurements and Noise Control. Acoustical Society of America, 3rd Edition.

Construction activities can cause vibration that varies in intensity depending on several factors. Pile driving and vibratory compaction equipment typically generate the highest construction-related groundborne vibration levels. Because of the impulsive nature of such activities, the use of the peak particle velocity (PPV) descriptor has been routinely used to measure and assess groundborne vibration and, almost exclusively, to assess the potential of vibration to induce structural damage and/or annoyance reactions from humans.

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**TABLE 4.8-2 TYPICAL SOUND LEVELS**

Common Outdoor Activities	Noise Level, dBA Perception	Common Indoor Activities
Jet Engine (within 25 feet)	-140- damaging	None
Civil Defense Siren (within 25 feet)	-130- threshold of pain	None
Accelerating noisy motorcycle (within 10 feet)	-120- threshold of feeling	Hard rock band (close to stage)
Power Saw (at 3 feet)	-110- extremely loud	Other concert (close to stage)
Subway; Jet Fly-over (at 100 feet)	-100- very loud	
Gas Lawnmower (at 3 feet)	-95- very loud	Crying Baby (within 3 feet)
Tractor (at 25 feet)	-90- very loud	
Some Construction Equipment (at 50 feet)	-85- loud	Food Blender (at 1 foot)
Diesel Truck going 50 mph (at 50 feet)	-80- loud	Garbage Disposal (at 1 foot)
Noisy Urban Area during Daytime	-75- moderately loud	Busy restaurant
Gas Lawnmower (at 100 feet)	-70- moderately loud	Vacuum Cleaner (at 10 feet)
Commercial Area	-65- moderate	Normal Speech (at 3 feet)
Heavy Traffic (at 300 feet)	-60- moderate	Sewing machine
Air Conditioner	-55- moderate	Large Business Office
Quiet Urban Area during Daytime	-50- quiet	Dishwasher in Next Room
Quiet Urban Area	-45- quiet	Refrigerator
Quiet Urban Area during Nighttime	-40- faint	Theater, Large Conference Room (background)
Quiet Suburban Area during Nighttime	-35- faint	Average residence (without audio or video systems)
Quiet Suburban Area during Nighttime	-30- very faint	Library
Quiet Rural Area	-25- very faint	Bedroom at Night, Concert Hall (background)
Rustling Leaves	-20- very quiet	Broadcast/Recording Studio
Very Quiet Remote Area	-15- extremely quiet	Anechoic chamber or sound testing laboratory
Threshold of Human Hearing	-0-	Threshold of Human Hearing

Sources: California Department of Transportation, Noise, Air Quality, and Hazardous Waste Management Office, *Technical Noise Supplement*, November 2009. PlaceWorks reference files.

**TABLE 4.8-3 REACTION OF PEOPLE AND DAMAGE TO BUILDINGS FOR CONTINUOUS VIBRATION LEVELS**

Velocity Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.006 to 0.019	Threshold of perception: Possibility of intrusion	Vibration unlikely to cause damage of any type
0.08	Vibrations readily perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
0.10	Level at which continuous vibrations begin to annoy people	Virtually no risk of “architectural” damage to normal buildings
0.20	Vibrations annoying to people in buildings	Threshold at which there is a risk of “architectural” damage to normal dwellings such as plastered walls or ceilings.
0.4 to 0.6	Vibrations considered unpleasant by people subjected to continuous vibrations	Vibration at this level would cause “architectural” damage and possibly minor structural damage.

Source: Transportation Related Earth-borne Vibrations. Caltrans, Technical Advisory, TAV-02-01-R9601, February 2002.

The two primary concerns with construction-induced vibration – the potential to damage a structure and the potential to interfere with the enjoyment of life – are evaluated against different vibration limits. Studies have shown that the threshold of perception for average persons is in the range of 0.008 to 0.012 inches/sec (0.2 to 0.3 mm/sec) in PPV. Human perception to vibration varies with the individual and is a function of the physical setting and the type of vibration. Persons exposed to elevated ambient vibration levels, such as people in an urban environment, may tolerate a higher vibration level.

One of the problems with developing suitable criteria for groundborne vibration is the limited research into human response to vibration and, more importantly, human annoyance inside buildings. The U.S. Department of Transportation, Federal Transit Administration has developed rational vibration limits that can be used to evaluate human annoyance to groundborne vibration. These criteria are primarily based on experience with rapid transit and commuter rail systems.

Structural damage can be classified as cosmetic only, such as minor cracking of building elements, or damage that may threaten the integrity of a building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher and there is no general consensus as to what amount of vibration may pose a threat for structural damage to a building. Construction-induced vibration that can be detrimental to the building is very rare and has only been observed in instances where the structure is in a high state of disrepair and the construction activity occurs immediately adjacent to the structure.

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### 4.8.2 ENVIRONMENTAL SETTING

#### 4.8.2.1 REGULATORY FRAMEWORK

Federal, State, and local regulatory criteria have been developed to minimize noise and vibration exposure at sensitive land uses. This section describes the regulatory framework related to noise and vibration in and around the Project site.

##### State Regulations

Housing in the State of California is subject to the environmental noise limits set forth in the 2007 California Building Code (Chapter 12, Appendix Section 1207.11.2). Also, the California Code of Regulations (CCR) Title 24 “Sound Transmission Control” requires an acoustical analysis for any new residential building located in an area where the annual Day-Night Noise level ( $L_{dn}$ ) exceeds 60 decibels [dBA] (technical terms are defined in Section 4.8.1, above). The report resulting from this analysis is required to show the topographical relationship of noise sources and dwelling sites, and to state the predicted noise exposure levels at the exterior of the proposed dwelling structures; considering present and future conditions as the basis for the predictions. The report is to identify noise attenuation measures to be applied and to provide an analysis demonstrating that the proposed buildings could be designed to limit intruding noise.<sup>1</sup> Title 24 also establishes that the maximum interior noise level at any habitable room due to exterior noise should be no more than 45 dBA  $L_{dn}$ /CNEL. Title 24 further requires that the building be oriented, shielded, and designed to have sufficient sound insulation so as to meet such maximum level attributable to exterior sources in any habitable room with all exterior doors and windows in the closed position.

##### Local Regulations

###### *City of Lafayette General Plan Noise Element*

The Noise Element of the City’s General Plan sets forth several policies and programs to assess and control environmental noise. These policies and programs establish indoor and outdoor noise standards for residential uses. To evaluate the compatibility between land uses and future noise in Lafayette, the Noise Element includes land use and noise compatibility guidelines, presented in Table 4.8-4 below. For ambient noise of up to 55 dBA  $L_{dn}$ , the development of residential projects are considered “normally acceptable,” and for ambient noise levels ranging from 55 dBA  $L_{dn}$  to 75 dBA  $L_{dn}$ , development of multi-family residential projects are considered “conditionally acceptable.” Outdoor sports, recreation, neighborhood parks, and play grounds are normally acceptable up to 65 dBA  $L_{dn}$  and conditionally acceptable from 65 dBA to 80 dBA  $L_{dn}$ .

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<sup>1</sup> As summarized in: Wilson Ihrig & Associates (WIA), June 16, 2011, CCR Title 24 Noise Study, The Terraces of Lafayette Multifamily Project, Lafayette, California.

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**TABLE 4.8-4 CITY OF LAFAYETTE NOISE AND LAND USE COMPATIBILITY STANDARDS**

Land Use Category	Exterior Noise Exposure (Ldn dB)					
	55	60	65	70	75	80
Residential, Hotels, and Motels	Normally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable
	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable
	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable
Outdoor Sports and Recreation, Neighborhood Parks and Playgrounds	Normally Acceptable	Normally Acceptable	Normally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable
	Normally Acceptable	Normally Acceptable	Normally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable
Schools, Libraries, Museums, Hospitals, Personal Care, Meeting Halls, Churches	Normally Acceptable	Normally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable
	Normally Acceptable	Normally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable
	Normally Acceptable	Normally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable
Office Buildings, Business Commercial and Professional	Normally Acceptable	Normally Acceptable	Normally Acceptable	Normally Acceptable	Conditionally Acceptable	Unacceptable
	Normally Acceptable	Normally Acceptable	Normally Acceptable	Normally Acceptable	Conditionally Acceptable	Unacceptable
	Normally Acceptable	Normally Acceptable	Normally Acceptable	Normally Acceptable	Conditionally Acceptable	Unacceptable
Auditoriums, Concert Halls, Amphitheaters	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable	Unacceptable
	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable	Unacceptable
	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable	Unacceptable
	<p><b>NORMALLY ACCEPTABLE</b>                      Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal, conventional construction, without any special insulation requirements.</p>					
	<p><b>CONDITIONALLY ACCEPTABLE</b>                      Specified land use may be permitted only after a detailed analysis of the noise reduction requirements and needed noise insulation features included in the design.</p>					
	<p><b>UNACCEPTABLE</b>                      New construction or development should generally not be undertaken because mitigation is usually not feasible to comply with noise element policies.</p>					

Source: City of Lafayette General Plan, Noise Element.

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Under “conditionally acceptable” conditions, the specified land use may be permitted only after a detailed analysis of the noise reduction requirements and needed noise insulation features included in the design.

Policy N-1.3 of the Noise Element, dealing with Noise and Land Use Compatibility Standards, was enacted to ensure that all new noise-sensitive development proposals be reviewed with respect to (the above matrix). Noise exposure shall be determined through actual on-site noise measurements.

Program N-1.2.2 includes criteria to evaluate noise impacts from new developments to sensitive uses. Substantial increase would result if a project would:

- Cause the Ldn in existing residential areas to increase by 3 dB or more; or
- Cause the Ldn in existing residential areas to increase by 2 dB or more if the Ldn would exceed 70 dB; or
- Cause the Ldn resulting exclusively from project-generated traffic to exceed an Ldn of 60 dBA at any existing residence.

For residential developments, the outdoor standard of 60 dBA  $L_{dn}$  applies for recreational areas such as pool and playground areas. For small decks and balcony areas, the standard is 65 dBA  $L_{dn}$ . The basic indoor noise standard for residential uses is 45 dBA  $L_{dn}$ , which is consistent with the State’s Title 24 requirements and which is promulgated in the Noise Element via Program N-1.4.3.

While the State Title 24 mandates an acoustical analysis for any new residential building located in an area where the annual Day-Night Noise level ( $L_{dn}$ ) exceeds 60 decibels, the City’s Noise Element (in Program N-1.4.2) uses an even stricter threshold of 55 dBA  $L_{dn}$ . Program N-1.4.2 states: “This study shall describe how the Revised Project will comply with the Noise and Land Use Compatibility Standards. The study shall also satisfy the requirements set forth in Title 24, part 2 of the California Government Code, Noise Insulation Standards, for multi-family attached dwellings, hotels, motels, etc., regulated by Title 24.”

The City’s Noise Element requirements for interior noise are contained in Policy N-1.4: “Residential and Noise Sensitive Land Use Standards: Require a standard of 40 - 45  $L_{dn}$  (depending on location) for indoor noise level for all new residential development including hotels and motels, and a standard of 55  $L_{dn}$  for outdoor noise, except near the freeway. These limits shall be reduced by 5 dB for senior housing and residential care facilities.” However, no indication is given in the Element as to which locations require mitigation of interior noise to 40  $L_{dn}$ . As such, this document uses a 45 dBA  $L_{dn}$  criteria for interior noise, which is consistent with the requirements of the California Code of Regulations Title 24.

### *Lafayette Municipal Code*

#### Community Noise

The Lafayette Municipal Code (Chapter 5-2) contains the City’s Noise Ordinance. The Noise Ordinance is designed to control unnecessary, excessive, and annoying sounds from sources on private property by setting



limits that cannot be exceeded at adjacent properties. The Noise Ordinance specifies noise levels that cannot be exceeded at adjacent properties during specified periods of time, as presented in Table 4.8-5.

**TABLE 4.8-5 CITY OF LAFAYETTE NOISE ORDINANCE STANDARDS**

Receiving Land Use Category	Noise Level Limit Standard—dBA	
	10 p.m. to 7 a.m.	7 a.m. to 10 p.m.
Single-family residential	45	50
Multi-family residential, schools, libraries, public spaces	50	55
Commercial	60	55

Source: Lafayette Municipal Code, Table 5-205.

The allowed noise level standards shown on Table 4.8-5 shall not be exceeded:

- For a cumulative period of more than thirty minutes in any hour; or
- The noise standard plus five dB(A) for a cumulative period of more than 15 minutes in any hour; or
- The noise standard plus ten dB(A) for a cumulative period of more than 5 minutes in any hour; or
- The noise standard plus fifteen dB(A) for a cumulative period of more than 1 minute in any hour; or
- The noise standard plus twenty dB(A) for any period of time.

### Construction Noise

The City of Lafayette limits the hours of permitted construction to the hours of 8:00 a.m. to 8:00 p.m. Monday through Saturday, and between 10:00 a.m. to 6:00 p.m. on Sundays and legal holidays, provided that such construction activities do not exceed 80 dBA at the nearest affected property or individual equipment items do not exceed 83 dBA at 50 feet (Section 5-208[d]). For construction equipment that does not create a noise disturbance, as defined by the stationary noise limits, construction activities can operate between 7:00 a.m. and 10:00 p.m. (Section 5-207[e]).<sup>2</sup>

## **4.8.2.2 EXISTING CONDITIONS**

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An ambient noise survey and acoustical evaluation was completed by Wilson Ihrig Associates Inc. (WIA) in June of 2011. Ambient noise monitoring was conducted by WIA at three locations to determine the existing noise levels in the Project site. Long-term noise level measurements were taken continuously from May 19 to May 25, 2011 (i.e., seven full days, inclusively) and provided typical hourly ( $L_{eq-1hr}$ ), and daily levels ( $L_{dn}$ ). Short-term noise level measurements were also taken at five locations by WIA during this same survey period to evaluate the noise frequency spectrum. The noise monitoring locations taken at the Project site by

<sup>2</sup> City of Lafayette, 2011. City of Lafayette Municipal Code.

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WIA are presented in Figure 4.8-1, and the results of the noise level measurements taken at the Project site are summarized in Table 4.8-6; the methodology and detailed results of the noise measurements are included in Appendix I of the Certified EIR.

**TABLE 4.8-6 ON-SITE EXISTING NOISE LEVELS SUMMARY**

Measurement Location <sup>a</sup>	Noise Levels (dBA)		Measurement Type
	L <sub>DN</sub>	L <sub>eq</sub>	
LT-A	68	–	Long-term (7-day average)
LT-M	66	–	Long-term (7-day average)
LT-N	73	–	Long-term (7-day average)
ST-A	–	65	Short-term (approximately 15 minutes)
ST-B	–	61	Short-term (approximately 15 minutes)
ST-K	–	63	Short-term (approximately 15 minutes)
ST-M	–	63	Short-term (approximately 15 minutes)
ST-N	–	62	Short-term (approximately 15 minutes)

a. On-Site noise monitoring locations included in Figure 4.8-1.

Source: Noise monitoring was conducted May 19, 2011 by Wilson, Ihrig & Associates.

The long-term noise levels in the Project site taken at location LT-A, which is representative of the south exposure for proposed structures on the southern portion of the site, measured 68 dBA L<sub>dn</sub>. The long-term noise measurements taken at location LT-M, which is representative of the south exposure of proposed structures on the eastern portion of the site, measured 67 dBA L<sub>dn</sub>. The long-term noise measurements taken at location LT-N, which is representative of the east exposure of proposed structures on the northern portion of the site, measured 73 dBA L<sub>dn</sub>. These measurements indicate that the major sources of noise in the Project site are vehicular traffic on Pleasant Hill Road on the east side of the site, and traffic on State Highway 24 on the south and west sides of the site. The Project site is also affected by BART train pass-bys and background traffic noise on Deer Hill Road and Interstate 680, located about one mile to the east.

To evaluate the existing conditions at the homes in the vicinity of the Project site, noise level measurements were taken by PlaceWorks on December 6, 2011. Table 4.8-7 summarizes the results of the noise level measurements taken at nearby homes in the vicinity of the Project site. These noise level measurements were taken at off-site locations (shown in Figure 4.8-2) to evaluate the existing noise conditions at the residential areas nearest to the Project site and to assess potential impacts from the Revised Project to off-site uses. The noise measurement detailed results are presented in Appendix I of the certified EIR.



Source: USGS; PlaceWorks, 2014.

FIGURE 4.8-1  
On-Site Noise Level Measurement Locations



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TABLE 4.8-7 OFF-SITE EXISTING NOISE LEVELS SUMMARY

Measurement Location <sup>a</sup>	Noise Levels (dBA)		Measurement Type
	L <sub>DN</sub>	L <sub>eq</sub>	
ST-1	–	54	Short-term (approximately 15-minutes)
ST-2	–	66	Short-term (approximately 15-minutes)
ST-3	–	67	Short-term (approximately 15-minutes)

a. Off-Site noise monitoring locations included in Figure 4.8-2.  
 Source: Noise monitoring was conducted on December 06, 2011 by PlaceWorks.

## Vibration

There are no major stationary sources of groundborne vibration in the vicinity of the Project site. BART trains operate on a rail line approximately 150 feet south of the Project site boundary (and approximately 240 feet south of the nearest residential structure in the revised Project). To evaluate groundborne impacts to the Project site, the Federal Transit Administration’s (FTA) general vibration assessment methodology was utilized. The procedure provides screening distances from the rail line to the property line, where further analysis would be required to evaluate vibration impacts. For FTA Category 1 land uses (i.e. residences and buildings where people normally sleep), the critical distance from the right-of-way is 200 feet.<sup>3</sup> Although the property line is 150 feet from the rail line, the proposed residential structures are no closer than 240 feet, so the actual land uses that would potentially be subject to groundborne vibration are beyond the screening distance. The distance of the site to the tracks is outside the screening distance that would require further evaluation, therefore, vibration from BART train pass-bys is not significant, and no further evaluation to analyze vibration impacts would be required for this source of vibration.

### 4.8.3 CHANGES IN THE REVISED PROJECT RELATED TO NOISE

Consistent with the Terraces of Lafayette Project, the Revised Project would continue to be composed primarily of residential uses; the Revised Project, however, would contain single-family, rather than multifamily uses, and would add new recreational/open space uses to the site. All the potential noise-related impacts resulting from these changes in the Revised Project are discussed in the Impacts Discussion section, below.

The change from multi- to single-family uses would result in relatively minor changes related to noise. Since the new project would include fewer units, noise generation from activities and traffic associated with the project is anticipated to be less than from the Terraces of Lafayette Project. Conversely, the change from

<sup>3</sup> Federal Transit Administration, 2006. Transit Noise and Vibration Impact Assessment, FTA-VA-90-1003-06, Chapter 9, Table 9-2.



Source: USGS; PlaceWorks, 2014.

FIGURE 4.8-2  
Off-Site Noise Level Measurement Locations

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larger multi-family structures to smaller, single-family structures would serve to decrease shielding effects, meaning that noise levels in the interior portions of the site could potentially be higher.

The inclusion of recreational/open space uses would also result in changes related to noise. The proposed dog park, play areas, and sports field would serve to generate somewhat higher levels of noise than might be anticipated from a purely residential project. These potential noise increases could be attributable to both increased traffic and to the sounds resulting from use of these facilities.

### 4.8.4 STANDARDS OF SIGNIFICANCE

The Revised Project would result in a significant noise or vibration impact if it would:

1. 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.
2. Expose persons to or generate of excessive groundborne vibration or groundborne noise levels.
3. Result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the Project.
4. Result in substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the Project.

An Initial Study was prepared for the Revised Project (see Appendix A of this Draft Supplemental EIR). Based on the analysis contained in the Initial Study, it was determined the Revised Project would result in a less-than-significant impact for the following significance criteria. These criteria are, therefore, not discussed in this chapter:

- For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, expose people residing or working in the project area to excessive noise levels.
- For a project within the vicinity of a private airstrip, expose people residing or working in the project area to excessive noise levels.

### 4.8.5 IMPACT DISCUSSION

This section analyzes potential project-specific and cumulative impacts to noise.

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<b>NOI-1</b>	<b>The Revised Project would result in the exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.</b>
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As discussed above, the City of Lafayette set noise standards for exterior and interior noise for new residential developments. Wilson Ihrig & Associates (WIA) prepared an acoustical study to evaluate the noise impacts to the Revised Project and to propose architectural design features needed to meet the City's interior noise standards. In the WIA study, future noise was estimated assuming a standardized annual traffic volume increase over the next 10 years. This corresponded to an effective increase over the coming decade of 1 dB above the existing conditions for traffic-related noise. Based on the results of the WIA noise measurements taken at the Project site and on the adjustments to account for future traffic growth, the Revised Project would be exposed to future exterior noise levels between 67 and 74 dBA  $L_{dn}$  at some of the building facades. Although the project plans have been modified to include single- rather than multi-family residential uses, these uses would be located at similar distances from the most substantial existing sources of noise, most notably Highway 24, and the previous modeling results for maximum exterior noise reception therefore remain valid. These results, in concert with the recommended architectural design features, would be considered "conditionally acceptable" in terms of the City's Land Use/Noise Compatibility standards presented in Table 4.8-4.

## Exterior Noise Requirements

The Noise Element, Program N-1.4.2, requires that an acoustical study be conducted for all new residential projects with a future  $L_{dn}$  noise exposure of 55  $L_{dn}$  or greater. Similarly, the State of California Title 24 requires such an acoustical study if projected noise exposures are above 60  $L_{dn}$ .

As an extension of the Noise and Land Use Compatibility Standards, acceptable outdoor environments are defined as: "The standard for maximum outdoor noise levels in residential areas is an  $L_{dn}$  of 60 dB(A). This standard is applied where outdoor use is a major consideration, such as backyards in single-family housing developments and recreation areas in multifamily developments. This standard should not be applied to outdoor areas such as small decks and balconies typically associated with multifamily residential developments which can have a higher standard of 65  $L_{dn}$ ."

The WIA study found that existing and future exterior noise at the Project site would be above the 65  $L_{dn}$  value across most of the site under existing topographical conditions. With the original Terraces of Lafayette project in place, the study found that the noise exposure levels in all open areas behind the proposed structures would be less than 60  $L_{dn}$  due to the barrier effect of the edges of the graded terraces and the buildings. The WIA analyses concluded that given the high degree of shielding from structures, sound walls or fences would not be necessary to mitigate noise in outdoor areas.<sup>4</sup> However, given that the Revised Project no longer includes larger, multi-family structures and now places recreational areas between proposed structures and the primary sources of noise (most notably Highway 24), those shielding effects would be diminished or eliminated. The proposed development buildings would still provide some degree of shielding from State Highway 24 traffic sources and Pleasant Hill Road sources, but given the new site configuration, such shielding could not be assumed to adequately reduce outdoor ambient noise to levels

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<sup>4</sup> Wilson Ihrig & Associates, 2011. CCR Title 24 Noise Study, The Terraces of Lafayette Multifamily Project, Lafayette, California.

## NOISE

consistent with the General Plan. Given the relatively dense spacing between most of the proposed housing units, sufficient shielding from traffic noise may be present for certain open areas on the interior portions of the Project site such that outdoor exposures in areas between buildings will still be less than 60  $L_{dn}$ .<sup>5</sup> However, some yard or courtyard areas for individual homes may be exposed to noise in excess of that which would be permissible for such areas. Additionally, park and recreation areas associated with the proposed Project may be exposed to noise levels in excess of that which would be “Normally Acceptable.” Therefore, certain outdoor and recreation areas of the Revised Project would not comply with the land use compatibility standards of the Noise Element for outdoor and recreation areas, resulting in a *significant* impact.

### Interior Noise Requirements

The Lafayette Land Use Compatibility Standard and Title 24 requirements establish a maximum interior noise level of 45  $L_{dn}$  for all new residential development.

According to the WIA study, future exterior noise levels would reach 70 to 74 dBA  $L_{dn}$  at some building facades. With a commonly applied noise reduction factor of 15 dB for open windows in a typical bedroom/living room space, the WIA report concluded that interior noise levels would exceed the standard if residents had open exterior windows. For this situation, the California Building Code mandates an alternative method of supplying fresh air (such as mechanical ventilation) to allow the occupant the option of controlling noise by closing the windows (and still having a source of fresh air). The WIA report presented several options for alternative fresh air supplies, including ducted air through HVAC systems; use of passive, ducted air inlets; and/or the use of “Z-duct” air intake devices (please refer to the WIA report in Appendix I of the Certified EIR for additional details).

For standard residential construction with closed windows, a typical noise reduction factor of 20 to 25 decibels can be assumed.<sup>6</sup> With a 74  $L_{dn}$  exterior noise environment and a 25 dB reduction, the interior levels without additional attenuation would be above 45  $L_{dn}$  (i.e. 74 exterior – 25 reduction = 49 interior dBA). Therefore, standard construction materials and methods would not provide sufficient exterior-to-interior noise attenuation to meet the 45 dBA  $L_{dn}$  noise threshold for interior rooms. Without additional noise attenuation features, homes that face State Route 24 or Pleasant Hill Road and have exterior noise levels above 70  $L_{dn}$  would experience projected interior levels that exceed the 45 dBA  $L_{dn}$  noise standard and would result in a significant impact prior to mitigation. Implementation of special noise control treatments, including sound-rated windows and doors, plus a suitable form of ventilation (as discussed above), would be required to reduce interior noise levels to below the 45 dBA  $L_{dn}$  threshold. The impact would therefore be *significant*.

**Significance before Mitigation:** Significant.

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<sup>5</sup> Wilson Ihrig & Associates, 2011, CCR Title 24 Noise Study, The Terraces of Lafayette Multifamily Project, Lafayette, California.

<sup>6</sup> NPC Library: Protective Noise Levels, <http://www.nonoise.org/library/levels/levels.htm>, accessed on February 7, 2012.



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**NOI-2      The Revised Project would not result in the exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels.**

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## **Groundborne Vibration or Noise from Existing Facilities**

Consistent with common CEQA practice, the assessment of potential vibration effects in this Draft EIR uses the Federal Transit Administrations (FTA's) Noise and Vibration Guidance Manual and its well-proven methodologies. The FTA's Transit Noise and Vibration Impact Assessment, which is used nationwide for Federal Highway Administration and State transit projects, is organized so that the manual's user moves through successive steps of analysis – from a screening procedure, to a general assessment, to a detailed analysis (for both noise or vibration). The basis for the increasing depth of evaluation is that if no impacts are indicated at any given step, then subsequent steps are not necessary to be performed. The prudence of this approach and the conservatism built into the evaluation methodologies have been verified over many years and several versions/updates of this document. On-site measurements are therefore not the only way to demonstrate the ground vibration potential from BART trains, and conclusions regarding vibration impacts were able to be made without performing on-site measurements.

The Revised Project site would not be expected to experience substantially different vibration levels from either freeway traffic flows or BART movements as have been experienced for years at the many existing residential structures on or near Circle Creek Drive, Loveland Drive, Linda Vista Lane, Mount Diablo Court, Old Tunnel Road, or Viela Court. These structures are at similar distances from the vibration sources as are the Project's first-row buildings. Since there are no known, undue vibration issues with these existing structures from either BART or traffic sources, and since the BART line was subject to a CEQA evaluation process for vibration impacts prior to its construction, the sensibility of using the FTA screening methodology in this situation is seen as being appropriate.<sup>7</sup>

The FTA manual, on page 7-1 for Basic Ground-borne Vibration Concepts states: "In contrast to airborne noise, ground-borne vibration is not a common environmental problem. It is unusual for vibration from sources such as buses and trucks to be perceptible, even in locations close to major roads." Given the screening distance of 200 feet for residential land uses, it is safe to infer that 200 feet or more from a major road is beyond the range of being "close" to the roadway.

Groundborne vibration propagation varies greatly with differing geologies. This issue is addressed in the FTA manual (see pages 7-8, 7-11 [Table 7-2], and 9-4). To account for these variations, the FTA

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<sup>7</sup> The FTA Noise and Vibration Manual is one of the most-used and most-referenced impact guidance documents for transportation impact assessments, not only in California but throughout the US. It was last updated in 2006 by the national acoustical consulting firm of Harris Miller Miller & Hanson, Inc. (HMMH) and is consistent with impact assessment methodologies used for transportation-related projects that are under the purview of the Federal Highway Administration and Caltrans. In regard to its being up to date, the manual states: "...with the construction of new rail rapid transit system in the past 30 years, considerable experience has been gained as to how people react to various levels of building vibration. This experience, combined with the available national and international standards [as of 2006], represents a good foundation for predicting annoyance from ground-borne noise and vibration in residential area as well as interference with vibration-sensitive activities." (FTA Manual, page 8-1, 2006).

## NOISE

methodology—including the screening process used for this project’s assessment—utilizes a conservative “safety factor” of 5 decibels in vibration level. For both rapid transit or light rail vehicles and rubber-tired vehicles, this equates to an approximate 1.5x safety factor for distance (FTA Figure 10-1). The FTA manual states on page 9-4: “Because of the 5-decibel safety factor, even with efficient propagation, the screening distances will identify most of the potentially impacted areas... When there is evidence of efficient propagation, such as previous complaints about existing transit facilities or a history of problems with construction vibration, the distances in [Table 9-2] should be increased by a factor of 1.5.” While anecdotal experience may indicate that groundborne vibration impacts at distances beyond 200 feet are possible for other projects at other locations, there are no known groundborne vibration issues from the BART line and freeway at the numerous existing residential areas adjacent to the Revised Project site. As such, the sensibility of using the FTA screening methodology in this situation is seen as being appropriate.

Therefore, as previously noted, the Project site would not be exposed to excessive groundborne noise or vibration from either the BART line or other potential sources and the long-term impact would be *less than significant*.

### Groundborne Vibration or Noise from Project Construction

During construction of the Revised Project, operation of heavy construction equipment has the potential to generate high ground vibration levels which have the potential to cause structural damage and/or annoyance to nearby sensitive receptors. Vibration levels generated by construction activities would vary depending on distance from the source, soil conditions, construction methods, and the equipment used. This analysis evaluates the potential for architectural damage or annoyance due to vibration caused by construction equipment.

The nearest existing structures to the Revised Project include a ranch with outdoor classes and a summer camp for children directly north of the Project site across Deer Hill Road. The threshold at which there is a risk of “architectural” damage (visible cracks) to normal dwellings, such as plastered walls or ceilings, is 0.2 inches per second peak particle velocity (PPV). Heavy construction equipment such as bulldozers, backhoe/hoe rams, and jackhammers generally generate vibration levels of less than 0.1 in/sec PPV<sup>8</sup> at a reference distance of 25 feet. These closest vibration-sensitive receptors are 195 feet and 240 feet, respectively, from the closest potential construction activities (near the site boundary). At these distances, the potential construction-related vibration would be well below the FTA’s 0.2 PPV inches/second criteria for vibration-induced architectural damage at the surrounding structures. For other existing structures that are more distant from the Project site (than the above ranch/camp property), such as the single-family residential land uses east of Pleasant Hill Road, the day care center along Stanley Boulevard, and several schools in the area, the groundborne vibration from Project sources would be significantly reduced by the relatively long propagation pathways and would result in construction-related vibration that would be

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<sup>8</sup> Federal Transit Administration, 2006, Transit Noise and Vibration Impact Assessment, FTA-VA-90-1003-06. Vibration levels measured at 25 feet.

considerably below the FTA's 0.2 PPV inches/second criteria for vibration-induced architectural damage. The vibration damage evaluation results are summarized in Table 4.8-8.

Based on this analysis, architectural damage from vibration impacts would be *less than significant* and no mitigation measures are required.

In addition to architectural damage, the Project construction activities have the potential to create vibration-related annoyance responses at nearby sensitive receptors. Peak vibration levels occur when construction equipment operates directly adjacent to the property line. Although the maximum vibration could be perceptible in certain instances, peak vibration events occur infrequently. In addition, construction activities occur during daytime on weekdays, which is the time of day when sensitivity is lowest and many residents are not in their homes. Therefore, construction vibration impacts are based on the average vibration levels that would be experienced by sensitive receptors the majority of the time. Note that commercial and industrial land uses are not considered to be noise- or vibration-sensitive land uses. Table 4.8-9 shows vibration levels from construction equipment operating at the Project site at the pertinent vibration-sensitive residential land uses. Additionally, Table 4.8-10 shows for reference the levels of vibration from various pieces of construction equipment.

Average vibration levels for large off-road construction equipment would not exceed 60 VdB at the nearest off-site land uses and would not exceed the FTA criterion for vibration annoyance of 75 VdB. Therefore, impacts from vibration annoyance are *less than significant* and no mitigation measures are required.

**Significance before Mitigation:** Less than significant.

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**NOI-3            The Revised Project would not result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.**

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The proposed Project would be developed with residential, recreational, and open space uses and there would be no major stationary sources of noise from the Project.

Landscaping, maintenance, HVAC systems, and human activity are all intermittent sources of low-level noise that typically occur with residential and recreational land uses. The frequency, intensity, and duration of these activities tend to vary over time depending on any number of factors, and development under the Revised Project is anticipated to result in their continued occurrence. Development of the Revised Project would include an increase in the number of dwelling units and residents in the area; it can therefore be assumed that there would be some marginal amount of noise resulting from basic human activity and building systems such as HVAC. Overall, such activities and systems associated with new residential uses are not typically considered to be a source of excessive noise that would result in a significant impact to ambient noise levels in an already urbanized area subject to existing traffic noise.

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**TABLE 4.8-8 CONSTRUCTION-RELATED VIBRATION ARCHITECTURAL DAMAGE POTENTIAL**

Nearest Structure	Distance	Projected Construction Vibration, PPV (in/sec) <sup>a</sup>	Vibration Damage Threshold, PPV (in/sec) <sup>b</sup>	Exceeds Threshold?
House near west corner	240 feet	<0.01	0.20	No
Ranch plus house	195 feet	<0.01	0.20	No

a. Vibration levels from the listed off-road construction equipment are equivalent to vibration levels generated by a large bulldozer based at a distance of 25 feet.

b. Per methodology from FTA Chapter 12, with the threshold based on engineered concrete and masonry buildings, per Table 12-3.

Source: PlaceWorks, 2014.

**TABLE 4.8-9 CONSTRUCTION-RELATED VIBRATION ANNOYANCE POTENTIAL**

Nearest Structure	Distance	Projected Construction Vibration-(VdB) <sup>a</sup>	Vibration Annoyance Threshold-(VdB) <sup>b</sup>	Exceeds Threshold?
House near west corner	240 feet	58	75	No
Ranch plus house	195 feet	60	75	No

a. Vibration levels from the listed off-road construction equipment are equivalent to vibration levels generated by a large bulldozer based at a distance of 25 feet.

b. Per methodology from FTA Chapter 8, with the threshold based on Category 2 Receptors (residential uses) and 'occasional events' from the vibration source.

Source: PlaceWorks, 2014.

**TABLE 4.8-10 GROUNDBORNE VIBRATION LEVELS FOR CONSTRUCTION EQUIPMENT**

Equipment	Approximate Velocity Level at 25 Feet (VdB)	Approximate RMS <sup>a</sup> Velocity at 25 Feet (inch/sec)
Large Bulldozer	87	0.089
Caisson Drilling	87	0.089
Jackhammer	79	0.035
Small Bulldozer	58	0.003
Loaded Trucks	86	0.076
FTA Criteria – Human Annoyance (Daytime)	78 to 90 <sup>b</sup>	—
FTA Criteria – Structural Damage	—	0.2 to 0.5 <sup>c</sup>

a. RMS velocity calculated from vibration level (VdB) using the reference of 1 micro-inch/second.

b. Depending on affected land use. For residential 78 VdB, for offices 84 VdB, workshops 90 VdB.

c. Depending on affected building structure, for timber and masonry buildings 0.2 in/sec, for reinforced-concrete, steel, or timber 0.5 in/sec.

Source: Federal Transit Administration, Transit Noise, and Vibration Impact Assessment, 2006.

Minor stationary-related noise from the operation of air conditioning units, and noise from the parking lots would tend to be masked by traffic noise on Deer Hill Road, Pleasant Hill Road, and Highway 24. Further, the Project would be required to comply with the noise ordinance standards presented in Table 4.8-4. Consequently, the proposed Project's long-term, stationary related noise impacts to off-site uses would be *less than significant*, and no mitigation is required.

As discussed further below, activities associated with use of the proposed dog park and soccer field would not result in substantial permanent increases to ambient noise levels. Even when anticipated noise increases from these activities are added to anticipated noise increases from traffic, the impacts are expected to remain below the minimum 2.0 dBA threshold, especially since noise from recreational activities would be intermittent and variable.

Potential long-term noise increases could also be caused by Project-related traffic. A noise analysis was performed to identify the magnitude of potential traffic noise impacts on roadways around the Project site.

As previously discussed, substantial increase would result if Project-related traffic would:

- Cause the  $L_{dn}$  in existing residential areas to increase by 3 dB or more; or
- Cause the  $L_{dn}$  in existing residential areas to increase by 2 dB or more if the  $L_{dn}$  would exceed 70 dBA; or
- Cause the  $L_{dn}$  resulting exclusively from Project-generated traffic to exceed an  $L_{dn}$  of 60 dBA at any existing residence.

To evaluate the potential noise level increases from Project-related traffic, the forecasts included in the Traffic Impact Study prepared for this EIR by TJKM were utilized. Although the project has undergone revisions to include single-family rather than multi-family residential uses, this would not result in increased traffic generation as a result of the project, and the decrease in the number of units would reduce traffic generation by the residential portion of the project. The traffic study indicates that the largest existing traffic flows in the area around the Project site are presently on Pleasant Hill Road between State Highway 24 and Stanley Road/ Deer Hill Road. This also holds true for future, Project-related traffic increases, since the largest portion of Project traffic would utilize Pleasant Hill Road. As discussed in Section 4.9, Transportation and Traffic, the proposed Project would generate 82 trips during the AM peak hour, and 175 trips during the PM peak hour. Both of these trip generation rates are lower than the originally evaluated project. The portion of Project trips that would use Pleasant Hill Road (between State Highway 24 and Stanley Road/Deer Hill Road) were calculated based on the TJKM intersection distribution analysis. Traffic estimates (see Appendix L) show that the increase in traffic along the highest traffic flow segment, Pleasant Hill Road, would be less than 5 percent. This incremental increase in traffic flow equates to an associated noise level increase of less than 0.2 dB, which is well below the most restrictive criterion of a 2 dB increase. Therefore, the direct long-term traffic noise impacts of the revised Project to off-site uses would be *less than significant*.

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Additionally, even when overall future increases to traffic in the area are considered, the Revised Project would not contribute to a substantial permanent increase in ambient noise levels. Deer Hill Road and Pleasant Valley Road are the two roadways that would experience the most significant increase in traffic as a result on the project. Future peak hour traffic volumes along these roadways are anticipated to increase by 27 percent and 17 percent respectively.<sup>9</sup> These increases in traffic volumes would be anticipated to result in maximum increases to ambient noise levels of 1.0 dBA and 0.7 dBA, respectively. These increases would be well under the 2.0 dBA increase that is minimum to result in a significant impact. Therefore, development of the Revised Project would have a *less-than-significant impact* with respect to increases to traffic noise.

### Dog Park Use

The dog park use has the potential to result in the addition of noise from dogs at play, most notably barking and other animal sounds. Such noise would not be constant, would be restricted to hours of park operation, and would vary by the number of dogs using the park and the individual character of the dogs.

Based on the usage of the dog park estimated for the traffic analysis, the maximum number of dogs in the park at any given time would range between 20 and 34. Use of dog parks and other recreational facilities is often dependent upon the schedules of those who live and work in a particular area. Since many residents work during the day on weekdays, it is unlikely that the park would be used to capacity during weekdays from the late morning through late afternoon. Instead, use of the park would be highest in the early morning and evening hours, before and after residents' work hours. Use would also be expected to be high on weekends; however, this higher use would be more evenly spread throughout the morning, afternoon, and evening hours, meaning that full-capacity use would be less likely at any given time. Although the highest use would most likely occur in the evening hours and on weekends, variability between the schedules of individuals would mean that dog park use by those individuals would not occur all at once, and full-capacity use outside of peak times, such as weekday early evenings, would be rare.

The dog park would likely be at full capacity only on rare occasions, and, even on those rare occasions, it would be unusual for all of the dogs in the park to be barking simultaneously. Dogs bark for a variety of reasons, and the propensity for loud or frequent barking varies between individual dogs; some dogs rarely, if ever bark, even while at play, whereas other dogs may bark nearly constantly. It is therefore reasonable to expect that any group of dogs using the park at a particular time would exhibit a range of barking volume and frequency, as determined by the demeanor of the dogs and the degree to which owners exercise control over their dog's barking. With the rare exception of unusual events which prompt excitement and barking by all dogs present, it is thus unlikely that all dogs would simultaneously engage in barking.

The addition of dog barking to this already noisy environment would not cause significant increases to the ambient noise level, because noise levels increase logarithmically with the addition of noise sources, and the

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<sup>9</sup> Maximum peak-hour traffic volumes along Pleasant Valley Road are projected to increase from 2,716 under existing conditions to 3,175 under cumulative conditions with the Revised Project. Maximum peak-hour traffic volumes along Deer Hill Road are projected to increase from 1,095 under existing conditions to 1,390 under cumulative conditions with the Revised Project.

contribution of each individual new source decreases as more sources are added. Using a set of simplified assumptions, it is possible to consider how many dogs would be necessary to result in a particular increase to ambient noise levels. With noise sources of equal loudness, a 3 dBA increase in instantaneous noise levels occurs with approximately a doubling of the number of sources, and a 5 dBA increase occurs with approximately a tripling of the number of noise sources. During the late afternoon and early evening, both car traffic and dog park use would be at their highest. Assuming barking dogs and passing cars are roughly equivalent in terms of noise level, the number of simultaneously barking dogs would need to meet or exceed the number of passing cars to result in an instantaneous increase of 3 dBA or greater. Since this is not anticipated to occur frequently, and since such occurrences would generally be limited to peak hours, it is unlikely that such brief events would result in overall increases to ambient noise levels of 3 dBA or greater.

Additionally, the nearest sensitive residential receptors would be located at a distance of approximately 120 feet or more to the west of the edge of the proposed dog park play area. This distance would provide for an effective buffer zone and a notable amount of sound attenuation due to spreading loss effects. Noise levels decrease at a rate of approximately 6 dBA per doubling of distance. Therefore, a sound as perceived at 120 feet from its source, would be about 12 dBA less loud than it would be at approximately 30 feet from the source. Given these spreading effects, significant attenuation of noise from the proposed dog park would occur over the distance between the edge of the dog park and the nearest sensitive receptor. Additionally, given that the proposed dog park is separated from the proposed residences by Deer Hill Road, traffic along this roadway, as well as Highway 24, would likely serve to mask much of the noise associated with use of the dog park. There is one existing residence that would not be separated from the dog park by a roadway; however, this residence would be approximately 175 feet from the active use areas of the dog park, and noise would therefore be further attenuated, in addition to masking effects from noise along Highway 24.

## **Sports Field Use**

The Revised Project would include a new sports field and community park, with children's play area toward the northern end of the Project site. These new uses are anticipated to generate a modest increase in noise that would not result in substantial temporary or periodic increases to ambient noise levels.

The nearest existing sensitive receptors, existing residential uses, and proposed residential uses would, respectively, be approximately 250 feet, 500 feet, and 150 feet from the center of the proposed soccer field. At these distances, the projected noise increases resulting from an ongoing soccer game would be 0.2 dBA, 1.6 dBA, and 1.1 dBA, respectively. These increases were based on anticipated noise levels from use of the playing fields added to measured ambient noise levels; a spreadsheet showing these calculations is included in Appendix K. These levels are below the minimum 2.0 dBA threshold for potential impacts, and given that use of the fields would not be constant, the overall increases would be even lower. Therefore, the impact from use of the new sports field is anticipated to be *less than significant*.

**Significance before Mitigation:** Less than significant.

## NOISE

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**NOI-4            The Revised Project would not result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.**

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Short-term construction activities would periodically increase ambient noise levels in the Project vicinity and would subside once construction of the proposed Project is completed. Construction activities associated with the proposed Project are estimated to take up to 40 months to complete. The noisiest phase, grading and site preparation, would occur over a six-month period.

### Construction Vehicles

The transport of workers and equipment to the construction site would incrementally increase noise levels along site access roadways. Even though there would be a relatively high single-event noise exposure potential with passing trucks (a maximum noise level of 86 dBA at 50 feet),<sup>10</sup> the expected number of workers and trucks is minimal relative to the existing traffic flows on streets adjacent to the Project site. The truck trips would be spread throughout the workday and would primarily occur during non-peak traffic periods. The primary construction traffic access roadway is expected to be Pleasant Hill Road. Estimated traffic flows on Pleasant Hill Road between State Highway 24 and Deer Hill Road are 25,000 vehicles per day.<sup>11</sup> From Applicant projections for construction activities, haul/vendor trucks would consist of a peak of approximately 12 trips per day (in and out of the Project site). Vehicle trips for workers would include a peak of approximately 50 daily trips. These levels of haul truck and worker vehicle traffic flows (theoretical maximum of 62 trips) would be negligible compared to the volumes of traffic currently generated on this roadway segment (25,000 existing trips); even if all construction vehicles were to use Deer Hill Road, this volume would still remain negligible compared to existing traffic volumes for the roadway (1,095 existing trips). Therefore, these impacts are *less than significant* at noise receptors along the construction routes.

### Construction Equipment

Noise generated during construction is based on the type of equipment used, the location of the equipment relative to sensitive receptors, and the timing and duration of the noise-generating activities. Noise levels are the average noise levels for each construction phase. Each stage involves the use of different kinds of construction equipment and, therefore, has its own distinct noise characteristics.

Noise levels from construction activities are usually dominated by the loudest piece of construction equipment. Noise levels from Project-related construction activities were calculated assuming the use of all

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<sup>10</sup> California Department of Transportation, 2009, Technical Noise Supplement. Prepared by ICF International.

<sup>11</sup> The average daily volume of any given roadway segment is estimated as five times the AM peak, added to five times the PM peak volume. The AM and PM peak volumes on Pleasant Hill Road are both approximately 2,500 ±10 cars. Thus, (5 x 2,500)+(5 x 2,500) = 25,000.



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applicable construction equipment at the same time at average distances (center of construction site to nearest property line of nearest noise-sensitive receptor off-site) and are shown in Table 4.8-11.

**TABLE 4.8-11 AVERAGE CONSTRUCTION NOISE LEVELS**

Noise-Sensitive Land Use		Ground Clearing and Demolition	Site Preparation	Foundation Construction	Building Construction	Finishing and Cleanup
Adjacent Residential (across Deer Hill Road and Pleasant Hill Road)	Average – 500 feet <sup>a</sup>	76	80	73	74	80
	When near property line – 240 feet	70	74	67	68	74

Notes: Noise levels based on noise level of All Applicable Equipment in Use as indicated in Bolt et al. does not include attenuation as a result of intervening topography or structures. Additionally, since revised project would feature fewer units and smaller structures, these estimated construction noise levels are likely conservative.

a. Average distance is defined as the approximate distance from the receiving property line to the center of construction activities.

Source: Bolt, Beranek and Newman, Inc., 1971. Noise from Construction Equipment and Operations, Building Equipment and Home Appliances. Prepared for the United States Environmental Protection Agency, Washington, DC.

Additionally, the construction noise levels shown in this table reflect the original analysis and are therefore conservative, because the project has been revised to include fewer units and would now be composed of single-family homes rather than multi-story multi-family structures. Noise impacts from construction would therefore be further reduced. Table 4.8-12 provides noise levels from various pieces of construction equipment, for reference.

Average noise levels at the closest residential land uses to the north and northwest could be in the range of 67 to 74 dBA  $L_{eq}$  for periods during the highest levels of construction activity. While these average noise levels would be higher than the ambient noise environment at noise-sensitive land uses, construction activities would fluctuate throughout the workday as equipment would not be in use at the same time at one location, nor for an extended period of time on any given workday. Furthermore, construction activities would comply with the Municipal Code. As presented in Section 4.8.2.1, Regulatory Framework, above, the City of Lafayette limits the hours of permitted construction activities, as well as the noise emissions of construction equipment. Enforcement of the noise standards is under the purview of the City Code Enforcement Officer. Overall, construction activities would generally be restricted to the least noise-sensitive portions of the day, and maximum noise levels would be infrequent throughout the workday for the approximately 40-month duration. Implementation of mitigation measures would ensure that noise levels from construction activities would not impact nearby sensitive receptors. With the implementation of the Mitigation Measure NOI-2 (see below), construction noise would remain *less than significant*.

**Significance Without Mitigation:** Less than significant.

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**TABLE 4.8-12 EQUIPMENT NOISE EMISSION LEVELS FOR COMMON CONSTRUCTION EQUIPMENT**

Construction Equipment	Typical Noise Level (dBA) At 50 Feet	Construction Equipment	Typical Noise Level (dBA) At 50 Feet
Air Compressor	81	Paver	89
Backhoe	80	Pneumatic Tool	85
Ballast Equalizer	82	Pump	76
Ballast Tamper	83	Rail Saw	90
Compactor	82	Rock Drill	98
Concrete Mixer	85	Roller	74
Concrete Pump	71	Saw	76
Concrete Vibrator	76	Scarifier	83
Crane, Derrick	88	Scraper	89
Crane, Mobile	83	Shovel	82
Dozer	85	Spike Driver	77
Generator	81	Tie Cutter	84
Grader	85	Tie Handler	80
Impact Wrench	85	Tie Inserter	85
Jack Hammer	88	Truck	88
Loader	85		

Source: Federal Transit Administration, Transit Noise, and Vibration Impact Assessment, 2006.

### 4.8.6 CUMULATIVE IMPACTS

**NOISE-5 Implementation of the Revised Project, in combination with past, present, and reasonably foreseeable projects, would not result in significant cumulative impacts with respect to noise.**

The above analysis of the Revised Project addresses cumulative impacts in regard to noise, as well as groundborne noise and vibration received or generated by activities and traffic associated with the Revised Project. Although multiple simultaneous nearby noise sources may, in combination, result in higher overall noise levels, this effect is captured and accounted for by the ambient noise level metrics that form the basis of the standards of significance for noise analysis. Any measurement of sound or ambient noise, whether for the purpose of evaluating land use compatibility, establishing compliance with noise standards, or determining point-source violations of a noise ordinance, necessarily will incorporate noise from all other nearby, perceptible sources. Ambient noise level measurements included noise from building operations and

equipment, such as HVAC; vehicles and traffic; BART trains; human activity; and animals and natural sounds, such as rustling leaves.

Cumulative noise impacts may occur when traffic associated with a development, in combination with reasonably foreseeable projects, causes noise levels to substantially increase at an existing sensitive receptor. As noted above, noise levels on Pleasant Hill Road and Deer Hill Road associated with the Revised Project and cumulative traffic growth would not result in a significant impact.

The Revised Project would not generate substantial noise due to the operation of stationary noise sources and new stationary noise sources would generally be sufficiently distant from existing sensitive receptors to prevent cumulative impacts. As discussed above, minute increases to ambient noise from new recreational uses are not anticipated to result in significant increases to noise levels, even when combined with existing ambient noise levels and increases to traffic. Increases in stationary source noise associated with the revised Project would therefore comply with the Municipal Code limits and would not substantially increase existing ambient noise levels.

In summary, the Revised Project would not contribute a “cumulatively considerable” increase in ambient noise levels of 2 dBA  $L_{dn}$  or more. Thus, permanent increases in ambient noise levels resulting from the Revised Project, in combination with expected growth in the general area, would result in a *less-than-significant* impact.

**Significance before Mitigation:** Less than significant.

## 4.8.7 SUMMARY OF SIGNIFICANT IMPACTS AND MITIGATION MEASURES

Modifications to the Certified EIR mitigation measure are identified in ~~strikeout text~~ to indicate deletions and underlined text to signify additions.

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**NOI-1**      **Because standard construction methods are not expected to provide enough insulation to achieve City and State 45 dBA  $L_{dn}$  interior noise standards, a significant impact would occur without additional noise protection measures. Mitigation Measure NOI-1 is required to meet the City’s interior noise standard.**

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**Mitigation Measure NOI-1:** WIA utilized building elevations and floor plans prepared by the architect for the Terraces of Lafayette Project to determine the exterior-to-interior noise reductions necessary to meet interior noise standards. Prior to the issuance of building permits, the Project applicant shall submit a final acoustical report for the Revised Project to the City of Lafayette for review and approval. The final acoustical report shall be prepared to the satisfaction of the Planning and

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Building Director, or his/her designee, and shall demonstrate that all homes meet the City's interior noise standards.

The final acoustical report shall describe and quantify the noise sources impacting the residential buildings, the amount of outdoor to indoor noise reduction provided in the architectural plans, and any upgrades required to meet the interior noise standard of 45 dBA CNEL/ $L_{dn}$  for residential habitable rooms. The required noise reduction may be accomplished by providing construction elements such as but not limited to: (1) weatherstripped solid core exterior doors; (2) upgraded dual glazed windows and wall assemblies; (3) mechanical ventilation/air conditioning; and (4) exterior wall/roof assemblies free of cut outs or openings. The measures described in the final acoustical report shall be incorporated into the final construction plans and shall be the responsibility of and constructed by the project applicant.

The exterior glazing, entry doors, exterior wall, and supplemental ventilation design features shall be designed to achieve a 45 dBA  $L_{dn}$  interior noise standard. These features are summarized below and additional details are provided in the WIA report that is included in Appendix I.

- ~~Two classes of exterior glazing are indicated for windows, sliding glass doors, and entry doors:
  - ~~Class I elements shall have a minimum OITC 24/STC 28 rating~~
  - ~~Class II elements shall have a minimum OITC 21/STC 25 rating~~~~

~~(Note: The different classes are based on the location of proposed buildings on the Project site, per Figures 12 and 13 of the WIA report. Also note that the recommended OITC/STC ratings are for full window assemblies (glass and frame), rather than just for the glass itself.)~~

- ~~If hard floor surfaces (such as hardwood or ceramic tile) are used, then the minimum recommended glazing rating (above) shall be increased by two OITC/STC points for windows serving those rooms.~~
- ~~Entrance doors, together with their perimeter seals, shall have STC ratings not less than 26. Such tested doors shall operate normally with commercially available seals. Solid-core wood-slab doors 1-3/8 inches (35 mm) thick minimum or 18-gage insulated steel-slab doors with compression seals all around, including the threshold, may be considered adequate without other substantiating information.~~
- ~~Acceptable acoustical caulking, applied per the manufacturer's directions, shall be used to properly seal windows, doorways, electrical outlets (in exterior walls), and the indicated intersections of interior gypsum wall board (GWB) installations throughout the affected buildings.~~
- ~~Potential architectural element suppliers shall verify the acoustical performance ratings by providing laboratory test data for the specific assembly type submitted for the Project.~~

- ~~Exterior wall assemblies shall have a minimum OITC 38 (comparable to STC 50) rating. This can be achieved with 'typical' assembly designs for this type of multi-family development, which were assumed to consist of 7/8-inch stucco over plywood shear sheathing, 4- to 6-inch deep studs, fiberglass batt insulation in the stud cavity, and at least one layer of 5/8-inch gypsum board on the interior face of the wall.~~
- ~~Supplemental ventilation shall be provided in the architectural design so as to allow for closed windows as well as the adequate supply of fresh air per applicable building codes.~~

**Significance after Mitigation:** Less than significant. Through the selection of appropriate architectural elements and with proper construction and installation techniques, interior impacts resulting from exterior noise levels would be reduced to a less-than-significant level.

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**NOI-2**      **Because outdoor recreation areas would not be positioned or adequately shielded to achieve City 60 dBA L<sub>dn</sub> exterior noise standards established by the City, a significant impact would occur without additional noise protection measures.**

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**Mitigation Measure NOI-2:** WIA utilized original grading and site plans prepared by the proposed Project's architect to determine the exterior noise levels; such a report has not been prepared for the Revised Project. Potential mitigation measures are not feasible, and the impact is therefore significant and unavoidable. Potential means of protecting outdoor recreation areas from excessive noise levels include relocating such recreation areas, or constructing soundwalls or berms; however, given site constraints discussed below, neither of these options would be feasible for all impacted locations.

Project recreation areas include a sports field, a children's play area, a dog park, a landscaped pedestrian path, shared/private pathways and courtyards, and other landscaped areas that may be used for incidental recreational uses. Recreational areas that would be most subject to excessive noise include the landscaped areas and pedestrian path that run along the periphery of the Project site, portions of recreation areas closest to adjacent roadways, and a limited number of private backyards or courtyards closest to and/or facing adjacent roadways, especially Highway 24. Since peripheral landscaped areas and paths are intended, in part, to act as visual and acoustic screening for the Revised Project, relocating these areas to the interior of the developed areas would defeat this purpose. Relocation of the other uses, such as the sports field, dog park, and the children's play area, to interior portions of the Project site would increase noise and other impacts to the residences, by putting them in closer proximity to the noise generated by activity associated with these areas. Relocating private yards or courtyards away from individual residences, or removing them entirely would defeat the purpose of including such amenities. Finally, construction of berms and soundwalls is regarded as infeasible due to the aesthetic and circulation impacts of such features. Soundwalls are generally regarded as unsightly, and due to project topography, the required height of berms and soundwalls would render them exceptionally disruptive to the planning and visual character of the site.

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Despite the potential for certain public/private recreation areas to receive noise in excess of local standards, a significant portion of outdoor recreation areas would experience “normally acceptable” noise levels, and none of the outdoor recreation areas are anticipated to receive noise at levels that would be regarded as “unacceptable” for these uses. Moreover, including these amenities in the Revised Project would enhance quality of life for Revised Project and Lafayette residents. Nevertheless, given these considerations, no feasible mitigation measures are available, and the impact would be significant and unavoidable.

**Significance after Mitigation:** Significant and unavoidable.

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**NOI-3:** While the magnitude of the average noise levels would be higher than the ambient noise environment at noise-sensitive land uses during the construction phase, construction activities and the associated noise emissions would fluctuate both daily and throughout the entire construction schedule. By use of the following methods and procedures, construction noise will be reduced to the extent reasonably feasible.

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**Mitigation Measures NOI-32:** The construction contractor shall adhere to the following measures during construction activities:

- Use of construction equipment shall be restricted to the hours of 8:00 a.m. to 6:00 p.m. Monday through Friday.
- Material deliveries and haul-off truck trips shall be restricted to the hours of ~~8~~7:00 a.m. to ~~6~~4:00 p.m. Monday through Friday. Further, all such construction trips shall avoid, to the extent reasonably feasible, peak traffic periods along Pleasant Hill Road and Deer Hill Road (i.e. morning rush hour, mid-afternoon school pick-up time, and afternoon rush hour).
- Prior to the start of and for the duration of construction, the contractor shall properly maintain and tune all construction equipment in accordance with the manufacturer’s recommendations to minimize noise emissions.
- Prior to use of any construction equipment, the contractor shall fit all equipment with properly operating mufflers, air intake silencers, and engine shrouds no less effective than as originally equipped by the manufacturer.
- During construction, the construction contractor shall place stationary construction equipment and material delivery (loading/unloading) areas so as to maintain the greatest distance from the nearest residences.
- The construction contractor shall post a sign at the work site that is clearly visible to the public, providing a contact name and telephone number for lodging a noise complaint.

These measures shall be listed on the grading plan and monitored by the City during construction.

**Significance after Mitigation:** Less than significant. Through the selection of appropriate construction equipment and operating techniques, coupled with adherence to the City of Lafayette time-of-day restrictions, construction noise levels would be reduced to a less-than-significant level.

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