APPENDIX C

Noise and Vibration Assessment

REGNART CREEK TRAIL PROJECT NOISE AND VIBRATION ASSESSMENT

Cupertino, California

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INTRODUCTION

The City of Cupertino proposes to construct an approximately 0.8-mile shared-use facility along Regnart Creek, between Pacifica Drive and East Estates Drive. The trail would provide a bicycle and pedestrian pathway between the Cupertino Civic Center to the west and Creekside Park to the east, with intermediate connections to Wilson Park and local neighborhoods. The proposed project would extend a trail with shoulders of varying width along the existing Santa Clara Valley Water District maintenance road and would include the construction of one bridge at Wilson Park, as well as the demolition of the existing creek access ramp and construction of a replacement ramp near the park. The proposed bridge would be free-span. It is likely that the abutments would be outside the channel, and no work is expected in the bed or banks of the creek. The project would also construct wood privacy fences along residential property lines, pedestrian signal heads at road crossings, and signage at primary and secondary trailheads.

This report evaluates the project's potential to result in significant noise and vibration impacts with respect to applicable California Environmental Quality Act (CEQA) guidelines. The report is divided into two sections: 1) the Setting Section provides a brief description of the fundamentals of environmental noise, summarizes applicable regulatory criteria, and discusses the results of the ambient noise monitoring survey completed to document existing noise conditions; and 2) the Impacts and Mitigation Measures Section describes the significance criteria used to evaluate project impacts, provides a discussion of each project impact, and presents measures, where necessary, to mitigate the impacts of the project on sensitive receptors in the vicinity.

SETTING

Fundamentals of Environmental Noise

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound could be caused by its *pitch* or its *loudness*. *Pitch* is the height or depth of a tone or sound, depending on the relative rapidity (frequency) of the vibrations by which it is produced. Higher pitched signals sound louder to humans than sounds with a lower pitch. *Loudness* is intensity of sound waves combined with the reception characteristics of the ear. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

In addition to the concepts of pitch and loudness, there are several noise measurement scales which are used to describe noise in a particular location. A *decibel (dB)* is a unit of measurement which indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense, 30 decibels is 1,000 times more intense, etc. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10 decibel increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities. Technical terms are defined in Table 1.

There are several methods of characterizing sound. The most common in California is the *A-weighted sound level (dBA)*. This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are shown in Table 2. 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-equivalent sound/noise descriptor* is called L_{eq}. The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

The scientific instrument used to measure noise is the sound level meter. Sound level meters can accurately measure environmental noise levels to within about plus or minus 1 dBA. Various computer models are used to predict environmental noise levels from sources, such as roadways and airports. The accuracy of the predicted models depends upon the distance the receptor is from the noise source. Close to the noise source, the models are accurate to within about plus or minus 1 to 2 dBA.

Since the sensitivity to noise increases during the evening and at night -- because excessive noise interferes with the ability to sleep -- 24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The *Community Noise Equivalent Level* (*CNEL*) is a measure of the cumulative noise exposure in a community, with a 5 dB penalty added to evening (7:00 pm - 10:00 pm) and a 10 dB addition to nocturnal (10:00 pm - 7:00 am) noise levels. The *Day/Night Average Sound Level* (L_{dn} or *DNL*) is essentially the same as CNEL, with the exception that the evening time period is dropped and all occurrences during this three-hour period are grouped into the daytime period.

Effects of Noise

Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noises of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. Interior residential standards for multi-family dwellings are set by the State of California at 45 dBA DNL. Typically, the highest steady traffic noise level during the daytime is about equal to the DNL and nighttime levels are 10 dBA lower. The standard is designed for sleep and speech protection and most jurisdictions apply the same criterion for all residential uses. Typical structural attenuation is 12-17 dBA with open windows. With closed windows in good condition, the noise attenuation factor is around 20 dBA for an older structure and 25 dBA for a newer dwelling. Sleep and speech interference is therefore possible when exterior noise levels are about 57-62 dBA DNL with open windows and 65-70 dBA DNL if the windows are closed. Levels of 55-60 dBA are common along collector streets and secondary arterials, while 65-70 dBA is a typical value for a primary/major arterial. Levels of 75-80 dBA are normal noise levels at the first row of development outside a freeway right-of-way. In order to achieve an acceptable interior noise environment, bedrooms facing secondary roadways need to be able to have their windows closed; those facing major roadways and freeways typically need special glass windows.

Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that the causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The DNL as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to be disagreement about the relative annoyance of these different sources. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 50 dBA DNL. At a DNL of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the DNL increases to 70 dBA, the percentage of the population highly annoyed increases to about 25-30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a DNL of 60-70 dBA. Between a DNL of 70-80 dBA, each decibel increase increases by about 3 percent the percentage of the population highly annoyed. People appear to respond more adversely to aircraft noise. When the DNL is 60 dBA, approximately 30-35 percent of the population is believed to be highly annoyed. Each decibel increase to 70 dBA adds about 3 percentage points to the number of people highly annoyed. Above 70 dBA, each decibel increase results in about a 4 percent increase in the percentage of the population highly annoyed.

Fundamentals of Groundborne Vibration

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several different methods are typically used to quantify vibration amplitude. One method is the Peak Particle Velocity (PPV). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. In this report, a PPV descriptor with units of mm/sec or in/sec is used to evaluate construction generated vibration for building damage and human complaints. Table 3 displays the reactions of people and the effects on buildings that continuous or frequent intermittent vibration levels produce. The guidelines in Table 3 represent syntheses of vibration criteria for human response and potential damage to buildings resulting from construction vibration.

Construction activities can cause vibration that varies in intensity depending on several factors. The use of pile driving and vibratory compaction equipment typically generates the highest construction related groundborne vibration levels. Because of the impulsive nature of such activities, the use of the PPV descriptor has been routinely used to measure and assess groundborne vibration and almost exclusively to assess the potential of vibration to cause damage and the degree of annoyance for humans.

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. Human perception to vibration varies with the individual and is a function of 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.

Structural damage can be classified as cosmetic only, such as paint flaking or minimal extension of cracks in building surfaces; minor, including limited surface cracking; or major, that may threaten the structural integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher. The damage criteria presented in Table 3 include several categories for ancient, fragile, and historic structures, the types of structures most at risk to damage. Most buildings are included within the categories ranging from "Historic and some old buildings" to "Modern industrial/commercial buildings". Construction-induced vibration that can be detrimental to the building is very rare and has only been observed in instances where the structure is at a high state of disrepair and the construction activity occurs immediately adjacent to the structure.

The annoyance levels shown in Table 3 should be interpreted with care since vibration may be found to be annoying at lower levels than those shown, depending on the level of activity 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.

TABLE 1 Definition of Acoustical Terms Used in this Report

Term	Definition
Decibel, dB	A unit describing, the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20 micro Pascals.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micro Pascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e. g., 20 micro Pascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and Ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using 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.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the measurement period.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Day/Night Noise Level, L_{dn} or DNL	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 pm and 7:00 am.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 pm to 10:00 pm and after addition of 10 decibels to sound levels measured in the night between 10:00 pm and 7:00 am.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

Source: Handbook of Acoustical Measurements and Noise Control, Harris, 1998.

TABLE 2 Typical Noise Levels in the Environment

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	110 dBA	Rock band
Jet fly-over at 1,000 feet		
	100 dBA	
Gas lawn mower at 3 feet		
	90 dBA	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	80 dBA	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawn mower, 100 feet	70 dBA	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	60 dBA	
		Large business office
Quiet urban daytime	50 dBA	Dishwasher in next room
Quiet urban nighttime	40 dBA	Theater, large conference room
Quiet suburban nighttime		
	30 dBA	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	20 dBA	
		Broadcast/recording studio
	10 dBA	
	0 dBA	

Source: Technical Noise Supplement (TeNS), California Department of Transportation, September 2013.

TABLE 3 Reaction of People and Damage to Buildings from Continuous or Frequent Intermittent Vibration Levels

Velocity Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.01	Barely perceptible	No effect
0.04	Distinctly perceptible	Vibration unlikely to cause damage of any type to any structure
0.08	Distinctly perceptible to strongly perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
0.1	Strongly perceptible	Threshold at which there is a risk of damage to fragile buildings with no risk of damage to most buildings
0.25	Strongly perceptible to severe	Threshold at which there is a risk of damage to historic and some old buildings.
0.3	Strongly perceptible to severe	Threshold at which there is a risk of damage to older residential structures
0.5	Severe - Vibrations considered unpleasant	Threshold at which there is a risk of damage to new residential and modern commercial/industrial structures

Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, September 2013.

Regulatory Background

The State of California and the City of Cupertino have established regulatory criteria that are applicable in this assessment. The State CEQA Guidelines, Appendix G, are used to assess the potential significance of impacts pursuant to local General Plan policies, Municipal Code standards, or the applicable standards of other agencies. A summary of the applicable regulatory criteria is provided below.

State CEQA Guidelines. CEQA contains guidelines to evaluate the significance of effects of environmental noise attributable to a proposed project. Under CEQA, noise impacts would be considered significant if the project would result in:

(a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local General Plan or Noise Ordinance, or applicable standards of other agencies;

(b) Generation of excessive groundborne vibration or groundborne noise levels; or

(c) For a project located within the vicinity of a private airstrip or 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, if the project would expose people residing or working in the project area to excessive noise levels.

CEQA does not define what noise level increase would be considered substantial. Typically, an increase in the CNEL noise level resulting from the project at noise sensitive land uses of 3 dBA or

greater would be considered a significant impact when projected noise levels would exceed those considered acceptable for the affected land use. An increase of 5 dBA CNEL or greater would be considered a significant impact when projected noise levels would remain within those considered acceptable for the affected land use.

City of Cupertino General Plan. The Health and Safety Chapter in the City of Cupertino General Plan Community Vision 2015-2040 sets forth policies related to noise control in the City. The following policies are applicable to the proposed project:

> **Policy 6-60: Noise Control Techniques.** Require analysis and implementation of techniques to control the effects of noise from industrial equipment and processes for projects near homes.
>
> **Policy 6-61: Hours of Construction.** Restrict non-emergency building construction work near homes during evening, early morning, and weekends by enforcing the noise regulations in the Municipal Code.
>
> **Policy 6-62: Construction and Maintenance Activities.** Regulate construction and maintenance activities. Establish and enforce reasonable periods of the day, for weekdays, weekends and holidays for construction activities. Require construction contractors to use only construction equipment incorporating the best available noise control technology.
>
> **Policy 6-63: Sound Wall Requirements.** Exercise discretion in requiring sound walls to be sure that all other measures of noise control have been explored and that the sound wall blends with the neighborhood. Sound walls should be landscaped.

City of Cupertino Municipal Code. The City's Municipal Code contains a Zoning Ordinance that limits noise levels at adjacent properties. The following sections establish applicable limits:

> **10.48.040 Daytime and Nighttime Maximum Noise Levels.** Individual noise sources, or the combination of a group of noise sources located on the same property, shall not produce a noise level exceeding those specified on property zoned as follows, unless specifically provided in another section of this chapter:

Land Use at Point of Origin	Maximum Noise Level at Complaint Site of Receiving Property	
	Nighttime	Daytime
Residential	50 dBA	60 dBA
Nonresidential	55 dBA	65 dBA

> **10.48.050 Brief Daytime Incidents.**
>
> A. During the daytime period only, brief noise incidents exceeding limits in other sections of this chapter are allowed; providing, that the sum of the noise duration in minutes plus the excess noise level does not exceed twenty in a two-hour period. For example, the following combinations would be allowable:

Noise Increment Above Normal Standard	Noise Duration in 2-Hour Period
5 dBA	15 minutes
10 dBA	10 minutes
15 dBA	5 minutes
19 dBA	1 minute

B. For multifamily dwelling interior noise, Section 10.48.054, the sum of excess noise level and duration in minutes of a brief daytime incident shall not exceed ten in any two-hour period, measured at the receiving location.
C. Section 10.48.050A does not apply to Section 10.48.055 (Motor Vehicle Idling).

10.48.051 Landscape Maintenance Activities. The use of motorized equipment for landscape maintenance activities shall be limited to the hours of 8:00 a.m. to 8:00 p.m. on weekdays, and 9:00 a.m. to 6:00 p.m. on weekends and holidays, with the exception of landscape maintenance activities for public schools, public and private golf courses, and public facilities, which are allowed to begin at 7:00 a.m. The use of motorized equipment for landscape maintenance activities during these hours is exempted from the limits of Section 10.48.040; provided, that reasonable efforts are made by the user to minimize the disturbances to nearby residents by, for example, installation of appropriate mufflers or noise baffles, running equipment only the minimal period necessary, and locating equipment so as to generate minimum noise levels on adjoining properties.

10.48.053 Grading, Construction and Demolition.

A. Grading, construction and demolition activities shall be allowed to exceed the noise limits of Section 10.48.040 during daytime hours; provided, that the equipment utilized has high-quality noise muffler and abatement devices installed and in good condition, and the activity meets one of the following two criteria:
    1. No individual device produces a noise level more than eighty-seven dBA at a distance of twenty-five feet (7.5 meters); or
    2. The noise level on any nearby property does not exceed eighty dBA.
B. Notwithstanding Section 10.48.053A, it is a violation of this chapter to engage in any grading, street construction, demolition or underground utility work within seven hundred fifty feet of a residential area on Saturdays, Sundays and holidays, and during the nighttime period, except as provided in Section 10.48.030.
C. Construction, other than street construction, is prohibited on holidays, except as provided in Sections 10.48.029 and 10.48.030.
D. Construction, other than street construction, is prohibited during nighttime periods unless it meets the nighttime standards of Section 10.48.040.
E. The use of helicopters as a part of a construction and/or demolition activity shall be restricted to between the hours of nine a.m. and six thirty p.m. Monday through Friday only, and prohibited on the weekends and holidays. The notice shall be given at least twenty-four hours in advance of said usage. In cases of emergency, the twenty-four hour period may be waived.

10.48.060 Noise Disturbances. No person shall unreasonably make, continue, or cause to be made or continued, any noise disturbance as defined in Section 10.48.010. "Noise disturbance" means any sound which:

1. Endangers or injures the safety or health of humans or animals; or
2. Annoys or disturbs a reasonable person of normal sensitivities; or
3. Endangers or damages personal or real property.

Existing Noise Environment

The proposed trail would run along Regnart Creek between Torre Avenue and East Estates Drive in the City of Cupertino. This trail would be adjacent to single-family residences. Other surrounding land uses would include Wilson Park, Civic Center buildings, and Library Field.

A noise monitoring survey was performed at the site beginning on Wednesday, January 2, 2019 and concluding on Friday, January 4, 2019. The monitoring survey included two long-term (LT-1 and LT-2) and two short-term (ST-1 and ST-2) noise measurements, as shown in Figure 1.

The noise environment in the project vicinity is dominated by traffic noise along the local roadways that either run parallel to the proposed trail or cross the trail, such as Pacifica Drive and South Blaney Avenue. Local neighborhood activities also contribute to the noise environment in the area.

Long-term noise measurement LT-1 was made from a tree located along the western segment of the existing access road, approximately 170 feet east of the Cupertino Library. Hourly average noise levels at this location typically ranged from 48 to 55 dBA L_{eq} during the day and from 42 to 50 dBA L_{eq} at night. The community noise equivalent level on Thursday, January 3, 2019 was 54 dBA CNEL.

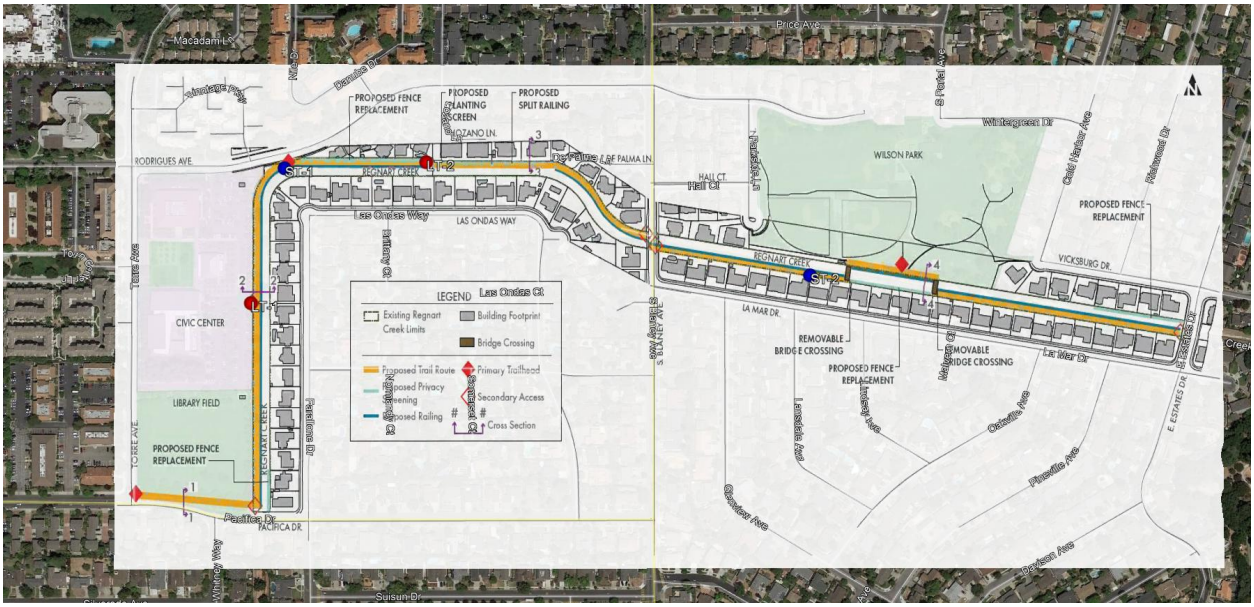
Long-term noise measurement LT-2 was made from a tree located along the northern segment of the existing access road, approximately 475 feet from the Rodrigues Avenue access gate to the west. Hourly average noise levels at this location typically ranged from 44 to 57 dBA L_{eq} during the day and from 40 to 48 dBA L_{eq} at night. The community noise equivalent level on Thursday, January 3, 2019 was 52 dBA CNEL.

Short-term noise measurements were made over 10-minute periods, concurrent with the long-term noise data, on Friday, January 4, 2019, between 1:00 p.m. and 1:30 p.m. in order to complete the noise survey. The short-term measurement results for ST-1 and ST-2 are summarized in Table 4.

Noise measurement ST-1 was made between LT-1 and LT-2 along Rodrigues Avenue, approximately 40 feet from the centerline of the roadway. Traffic noise along the roadway was the dominant noise source and resulted in noise levels ranging from 62 to 65 dBA. An airplane flyover also contributed to the noise measurement, with noise levels of 51 dBA. The 10-minute average noise level measured at ST-1 was 57 dBA $L_{eq(10\text{-}min)}$. ST-2 was made along the existing access road just south of Wilson Park baseball fields. Typical ambient noise dominated this measurement, with other noise sources including three airplane flyovers with noise levels ranging from 55 to 56 dBA, two sirens with noise levels ranging from 50 to 55 dBA, and a noisy truck along Blaney Avenue

generating noise levels of 56 dBA at ST-2. The 10-minute average noise level measured at ST-2 was 47 dBA $L_{eq(10\text{-}min)}$.

FIGURE 1 Noise Measurement Locations



Source: Google Earth, 2018.

FIGURE 2 Daily Trend in Noise Levels at LT-1, Wednesday, January 2, 2019

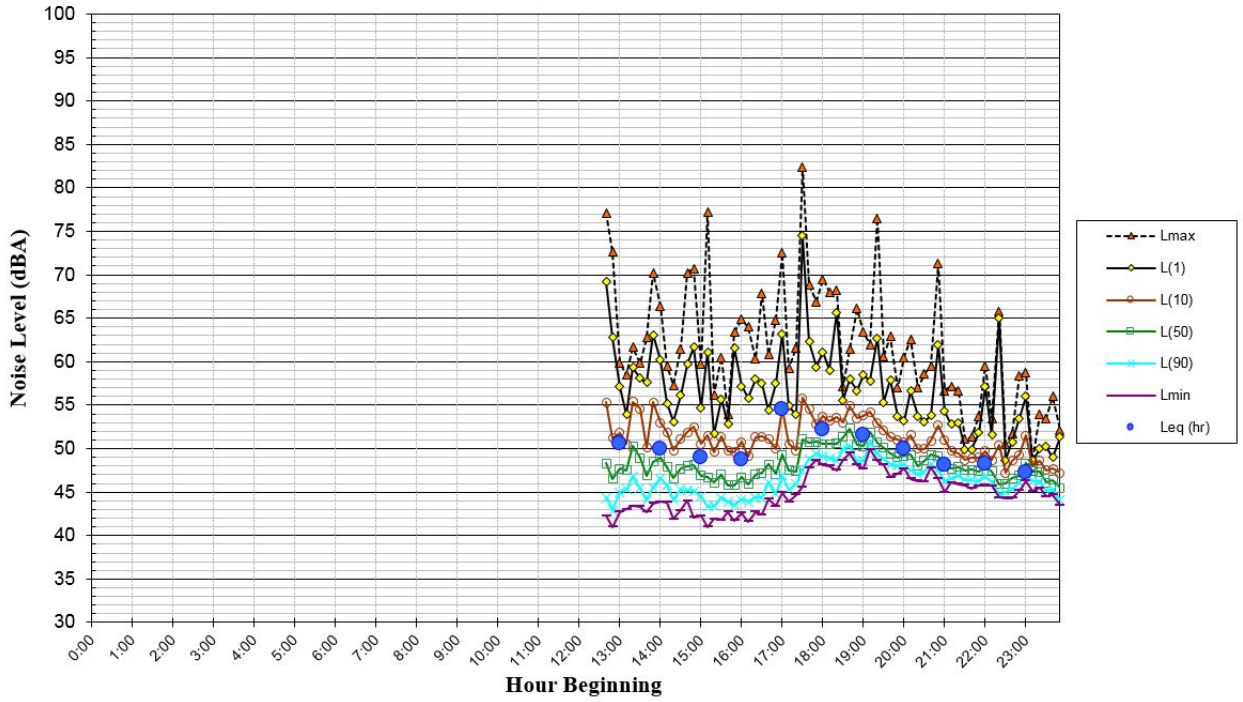


FIGURE 3 Daily Trend in Noise Levels at LT-1, Thursday, January 3, 2019

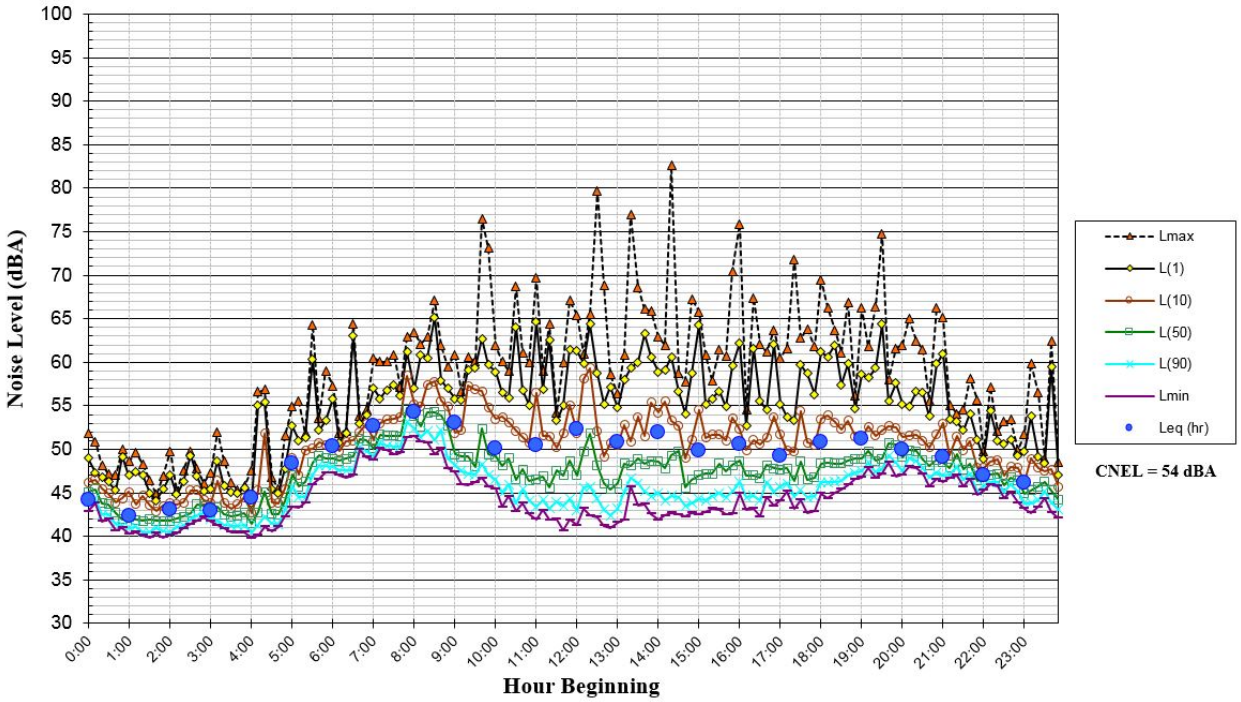


FIGURE 4 Daily Trend in Noise Levels at LT-1, Friday, January 4, 2019

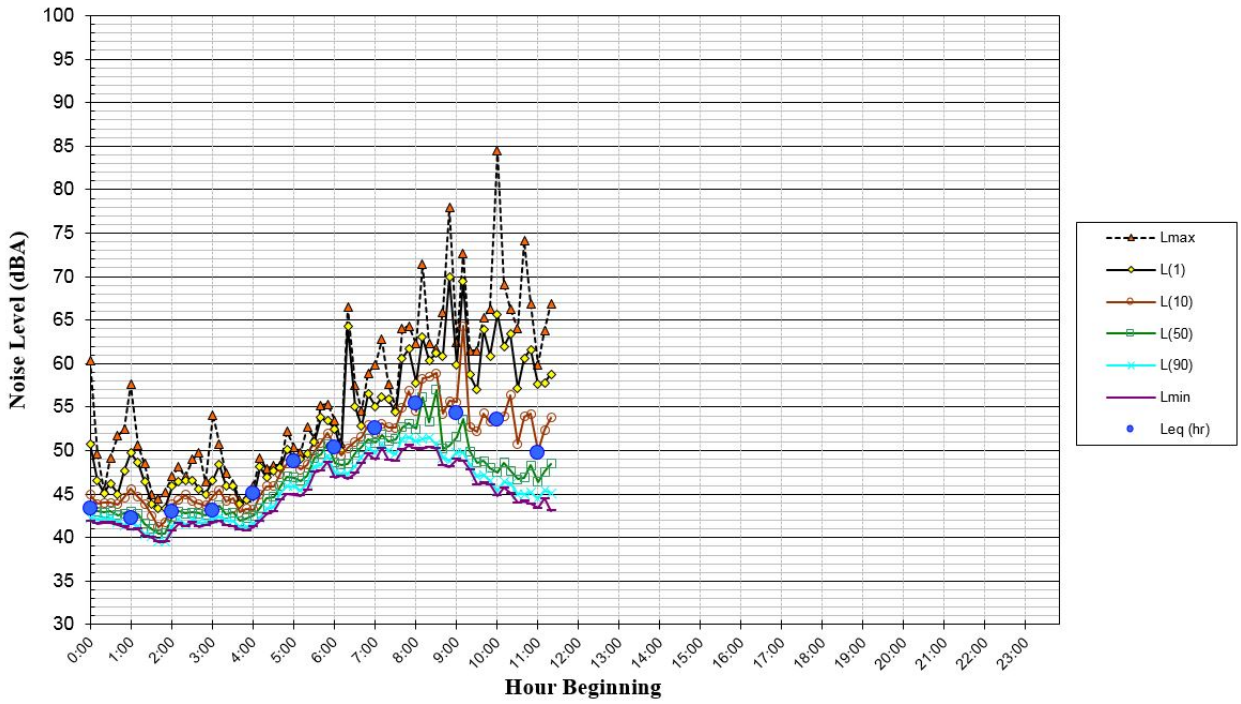


FIGURE 5 Daily Trend in Noise Levels at LT-2, Wednesday, January 2, 2019

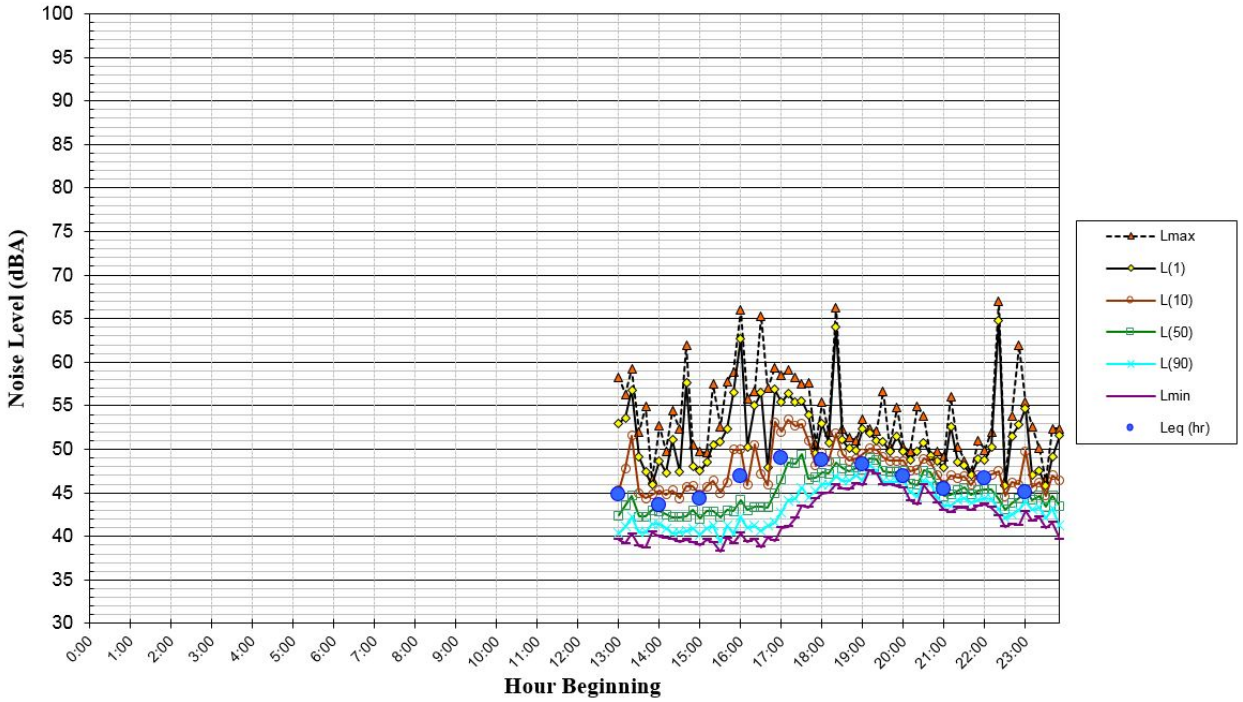


FIGURE 6 Daily Trend in Noise Levels at LT-2, Thursday, January 3, 2019

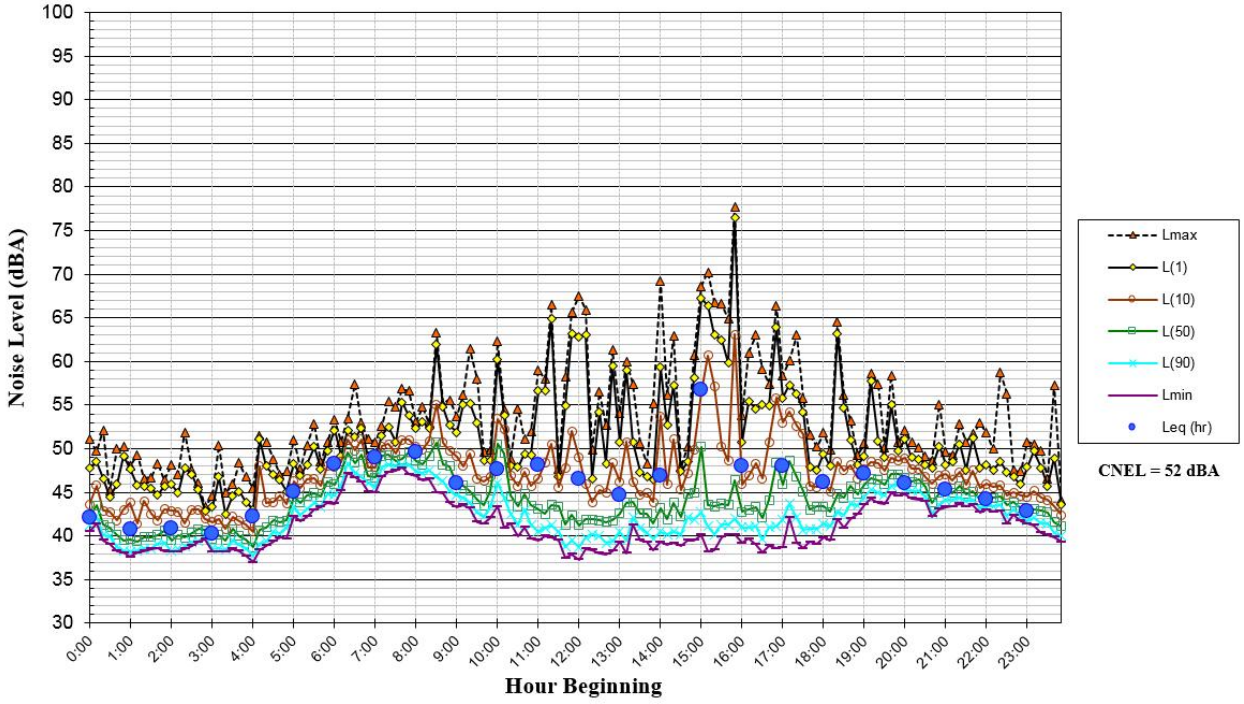


FIGURE 7 Daily Trend in Noise Levels at LT-2, Friday, January 4, 2019

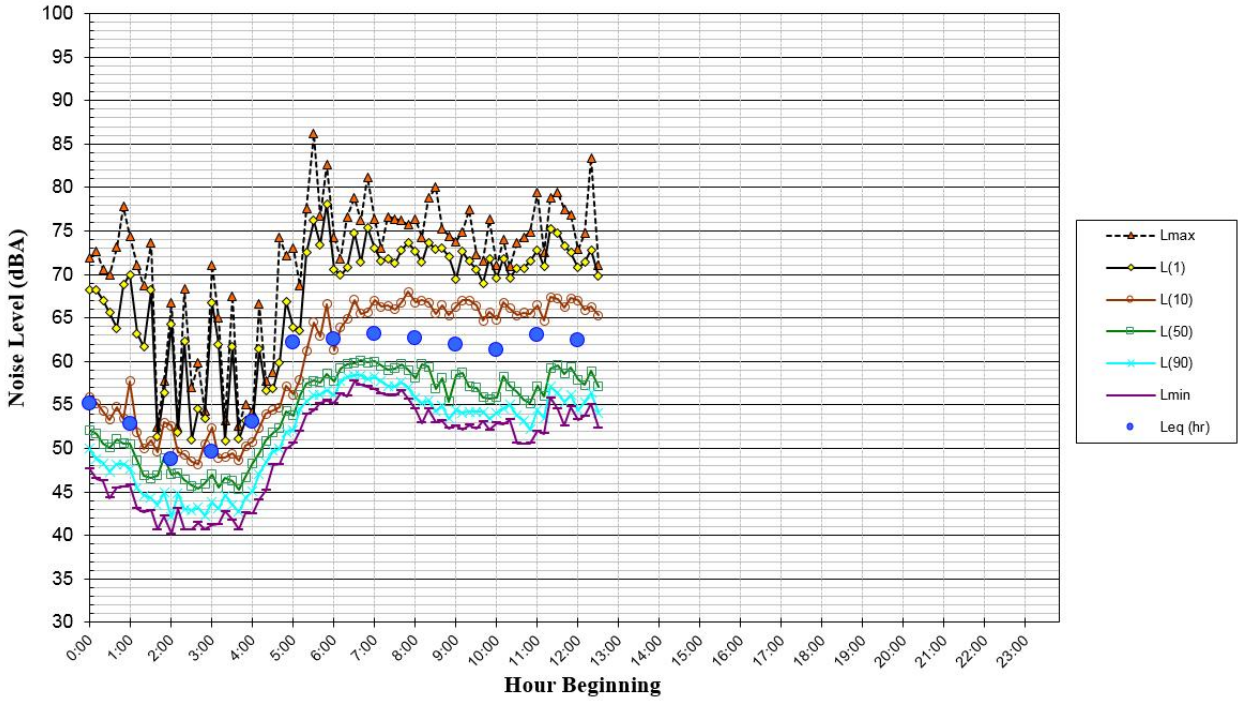


TABLE 4 Summary of Short-Term Noise Measurement Data

Noise Measurement Location	Date, Time	L_{max}	$L_{(1)}$	$L_{(10)}$	$L_{(50)}$	$L_{(90)}$	$L_{eq(10)}$
ST-1: On access road near the Rodrigues Avenue gate.	1/2/2019, 13:00-13:10	67	66	62	53	45	57
ST-2: On access road just south of Wilson Park baseball fields.	1/2/2019, 13:20-13:30	57	56	51	44	42	47

NOISE IMPACTS AND MITIGATION MEASURES

Significance Criteria

The following criteria were used to evaluate the significance of environmental noise resulting from the project:

- A significant noise impact would be identified if the project would generate a substantial temporary or permanent noise level increase over ambient noise levels at existing noise-sensitive receptors surrounding the project site and that would exceed applicable noise standards presented in the General Plan or Municipal Code at existing noise-sensitive receptors surrounding the project site.

    - Hourly average noise levels during construction that would exceed 60 dBA L_{eq} at residential land uses or exceed 70 dBA L_{eq} at public buildings and exceed the

ambient noise environment by at least 5 dBA L_{eq} for a period of more than one year would constitute a significant temporary noise increase in the project vicinity.

- A significant permanent noise level increase would occur if project operations would result in: a) a noise level increase of 5 dBA CNEL or greater, with a future noise level of less than 60 dBA CNEL, or b) a noise level increase of 3 dBA CNEL or greater, with a future noise level of 60 dBA CNEL or greater.

- A significant noise impact would be identified if the project would expose persons to or generate noise levels that would exceed applicable noise standards presented in the General Plan or Municipal Code.

- A significant impact would be identified if the construction of the project would generate excessive vibration levels surrounding receptors. Groundborne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in cosmetic damage to normal buildings.

- A significant noise impact would be identified if the project would expose people residing or working in the project area to excessive noise levels.

Impact 1a: **Temporary Construction Noise.** Existing noise-sensitive land uses would be exposed to a temporary increase in ambient noise levels due to project construction activities. The incorporation of construction best management practices as project conditions of approval would result in a **less-than-significant** temporary noise impact.

Noise impacts resulting from construction depend upon the noise generated by various pieces of construction equipment, the timing and duration of noise-generating activities, and the distance between construction noise sources and noise-sensitive areas. Construction noise impacts primarily result when construction activities occur during noise-sensitive times of the day (e.g., early morning, evening, or nighttime hours), the construction occurs in areas immediately adjoining noise-sensitive land uses, or when construction lasts over extended periods of time.

Section 10.48.053 of the City's Municipal Code exempts construction noise from the noise limits defined in Section 10.48.040 if activities occur on weekdays during daytime hours, provided that the equipment utilized has high-quality noise muffler and abatement devices installed and are in good condition. The construction activities also need to meet the following two criteria: 1) no individual device shall produce noise levels exceeding 87 dBA at a distance of 25 feet; and 2) the noise level measured at any nearby property shall not exceed 80 dBA. Construction activities are prohibited on weekends, holidays, or during nighttime hours at sites within 750 feet of a residential land use.

The noise level threshold for speech interference indoors is 45 dBA. Assuming a 15 dBA exterior-to-interior reduction for standard residential construction and a 25 dBA exterior-to-interior reduction for standard commercial/public building construction, this would correlate to an exterior threshold of 60 dBA L_{eq} at residential land uses and 70 dBA L_{eq} at public buildings. Additionally, temporary construction would be annoying to surrounding land uses if the ambient noise

environment increased by at least 5 dBA L_{eq} for an extended period of time. Therefore, the temporary construction noise impact would be considered significant if project construction activities exceeded 60 dBA L_{eq} at nearby residences or exceeded 70 dBA L_{eq} at nearby public buildings and exceeded the ambient noise environment by 5 dBA L_{eq} or more for a period longer than one year.

The existing residential receptors located along the proposed trail between Pacifica Drive and Rodrigues Avenue would be exposed to ambient noise from the Civic Center buildings and local traffic. Ambient noise levels at these residences and the public buildings would range from 48 to 57 dBA L_{eq} during daytime hours, as measured at LT-1 and ST-1. The residences located between Rodrigues Avenue and East Estates Drive would be exposed to ambient noise levels from Wilson Park and surrounding traffic noise. The ambient noise levels measured at LT-2, ST-1, and ST-2 represent the existing conditions at these residences, which range from 44 to 57 dBA L_{eq} during daytime hours.

Construction activities generate considerable amounts of noise, especially during earth-moving activities and during the construction of the building's foundation when heavy equipment is used. The typical range of maximum instantaneous noise levels would be 78 to 90 dBA L_{max} at a distance of 50 feet, as shown in Table 5. Typical hourly average construction-generated noise levels for recreational land uses are about 71 to 89 dBA L_{eq} measured at a distance of 50 feet from the center of the site during busy construction periods (e.g., earth moving equipment, impact tools, etc.), as shown in Table 6.

Construction activities for the proposed project, in addition to the walking path construction, would include demolition of the existing creek access ramp just south of Wilson Park and construction of a replacement ramp and a single bridge. The bridge would connect the park to the walking path along the southern bank of the creek. A detailed list of equipment expected to be used for the proposed project construction and phasing information was provided. Table 7 summarizes these data and provides the estimated hourly average noise levels expected at the nearest noise-sensitive land uses, public buildings, and parks located along the proposed trail. The equipment expected for each phase of construction were assumed to be operating simultaneously for the construction noise level calculations, which represents a credible worst-case scenario at nearby receptors. Construction noise levels were estimated from the center of the trail to nearest property line of the receptor. However, no one receptor would be exposed to construction over the entire duration of the project due to the length of the project corridor and the fact that construction activities would advance along the corridor as construction proceeds. This would further reduce the cumulative amount of time that individual receptors would be exposed to elevated construction noise levels.

The backyards of each of the residences along the trail have a solid wooden fence that is expected to remain or be reconstructed under project conditions. This fence, which is about 5 to 6 feet tall, would provide up to 5 dBA of noise reduction from the construction activity. However, for receptors in second-story rooms of the residences, the fence would not provide acoustical shielding. Additionally, the backyard receptors may still have direct line-of-sight to some pieces of noisy equipment that are taller than the fence. Conservatively, the estimated noise levels summarized in Table 7 do not assume reductions due to intervening buildings or the existing fence.

TABLE 5 Construction Equipment, 50-foot Noise Emission Limits

Equipment Category	L_{max} Level (dBA)[1,2]	Impact/Continuous
Arc Welder	73	Continuous
Auger Drill Rig	85	Continuous
Backhoe	80	Continuous
Bar Bender	80	Continuous
Boring Jack Power Unit	80	Continuous
Chain Saw	85	Continuous
Compressor[3]	70	Continuous
Compressor (other)	80	Continuous
Concrete Mixer	85	Continuous
Concrete Pump	82	Continuous
Concrete Saw	90	Continuous
Concrete Vibrator	80	Continuous
Crane	85	Continuous
Dozer	85	Continuous
Excavator	85	Continuous
Front End Loader	80	Continuous
Generator	82	Continuous
Generator (25 KVA or less)	70	Continuous
Gradall	85	Continuous
Grader	85	Continuous
Grinder Saw	85	Continuous
Horizontal Boring Hydro Jack	80	Continuous
Hydra Break Ram	90	Impact
Impact Pile Driver	105	Impact
Insitu Soil Sampling Rig	84	Continuous
Jackhammer	85	Impact
Mounted Impact Hammer (hoe ram)	90	Impact
Paver	85	Continuous
Pneumatic Tools	85	Continuous
Pumps	77	Continuous
Rock Drill	85	Continuous
Scraper	85	Continuous
Slurry Trenching Machine	82	Continuous
Soil Mix Drill Rig	80	Continuous
Street Sweeper	80	Continuous
Tractor	84	Continuous
Truck (dump, delivery)	84	Continuous
Vacuum Excavator Truck (vac-truck)	85	Continuous
Vibratory Compactor	80	Continuous
Vibratory Pile Driver	95	Continuous
All other equipment with engines larger than 5 HP	85	Continuous

Notes: [1] Measured at 50 feet from the construction equipment, with a "slow" (1 sec.) time constant.

[2] Noise limits apply to total noise emitted from equipment and associated components operating at full power while engaged in its intended operation.

[3]Portable Air Compressor rated at 75 cfm or greater and that operates at greater than 50 psi.

TABLE 6 Typical Ranges of Construction Noise Levels at 50 Feet, L_{eq} (dBA)

	Domestic Housing		Office Building, Hotel, Hospital, School, Public Works		Industrial Parking Garage, Religious Amusement & Recreations, Store, Service Station		Public Works Roads & Highways, Sewers, and Trenches	
	I	II	I	II	I	II	I	II
Ground Clearing	83	83	84	84	84	83	84	84
Excavation	88	75	89	79	89	71	88	78
Foundations	81	81	78	78	77	77	88	88
Erection	81	65	87	75	84	72	79	78
Finishing	88	72	89	75	89	74	84	84

I - All pertinent equipment present at site.
II - Minimum required equipment present at site.

Source: U.S.E.P.A., Legal Compilation on Noise, Vol. 1, p. 2-104, 1973.

TABLE 7 Estimated Construction Noise Levels at Nearby Land Uses

Phase	Time Duration	Construction Equipment (Quantity)	Calculated Hourly Average L_{eq} from Center of Trail to Nearest Land Use Property Line, dBA			
			Pacifica Dr. to Rodrigues Ave.		Rodrigues Ave. to E. Estates Dr.	
			Res. (35ft)	Public Bldgs. (25ft)	Res. (25ft)	Wilson Park (65ft)
Demolition	1/1/2020-3/27/2020	Concrete/Industrial Saw (2) Excavator (2) Rubber-Tired Dozer (2) Tractor/Loader/Backhoe (2)	92	95	95	87
Site Preparation	1/1/2020-3/27/2020	Grader (3) Scraper (3) Tractor/Loader/Backhoe (3)	92	95	95	87
Grading/ Excavation	1/1/2020-3/27/2020	Excavator (3) Grader (3) Rubber-Tired Dozer (3) Tractor/Loader/Backhoe (3)	93-97[a]	96-100[a]	96-100[a]	88-92[a]
Trenching	3/27/2020-6/22/2020	Tractor/Loader/Backhoe (2) Excavator (2)	88	91	91	82
Structure	6/22/2020-10/29/2020	Crane (1) Tractor/Loader/Backhoe (1)	84	87	87	78
Paving	6/22/2020-10/29/2020	Cement and Mortar Mixer (3) Paver (3) Paving Equipment (3) Roller (3) Tractor/Loader/Backhoe (3)	93-94[b]	96-97[b]	96-97[b]	88-89[b]

[a] The range of levels for the grading/excavation phase reflects the grading/excavation equipment only and the overlapping period with the demolition and site preparation phases.
[b] The range of levels for the paving phase reflects the paving equipment only and the overlapping period with the structure phase.

As shown in Table 7, noise from the construction of the proposed project would potentially exceed the 87 dBA threshold for a single piece of equipment at a distance of 25 feet and hourly average noise levels estimated during worst-case scenario conditions (i.e., all pertinent equipment present at the site) would potentially exceed the 80 dBA L_{eq} threshold at nearby properties. Further, noise levels would at times exceed 60 dBA L_{eq} at residential land uses during typical construction phases and would at times exceed 70 dBA L_{eq} at public buildings. Further, ambient levels at the surrounding uses would potentially be exceeded by 5 dBA L_{eq} or more at various times throughout construction.

The proposed project is expected to take a total of 10 months to complete, which would be less than the one-year threshold, which defines a temporary increase in noise. As stated previously, no individual receptor would be exposed to construction over the entire duration of the project due to the length of the project corridor and the fact that construction activities would advance along the corridor as construction proceeds. This would further reduce the cumulative amount of time that individual receptors would be exposed to elevated construction noise levels.

Reasonable regulation of the hours of construction, as well as regulation of the arrival and operation of heavy equipment and the delivery of construction material, are necessary to protect the health and safety of persons, promote the general welfare of the community, and maintain the quality of life.

Construction activities will be conducted in accordance with the provisions of the City's Municipal Code, which limits temporary construction work to daytime hours, Monday through Friday. Construction is prohibited on weekends and all holidays. Further, the City requires that all equipment have a high-quality noise muffler and abatement devices installed and are in good condition. Additionally, the construction crew shall adhere to the following construction best management practices to reduce construction noise levels emanating from the site and minimize disruption and annoyance at existing noise-sensitive receptors in the project vicinity.

Construction Best Management Practices

Develop and implement a construction noise control plan, including, but not limited to, the following available controls:

- Equip all internal combustion engine-driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment.

- Unnecessary idling of internal combustion engines should be strictly prohibited.

- Locate stationary noise-generating equipment, such as air compressors or portable power generators, as far as possible from sensitive receptors as feasible. If they must be located near receptors, adequate muffling (with enclosures where feasible and appropriate) shall be used to reduce noise levels at the adjacent sensitive receptors. Any enclosure openings or venting shall face away from sensitive receptors.

- Utilize "quiet" air compressors and other stationary noise sources where technology exists.

- Construction staging areas shall be established at locations that will create the greatest distance between the construction-related noise sources and noise-sensitive receptors nearest the project site during all project construction.

- Locate material stockpiles, as well as maintenance/equipment staging and parking areas, as far as feasible from residential receptors.

- Control noise from construction workers' radios to a point where they are not audible at existing residences bordering the project site.

- The contractor shall prepare a detailed construction schedule for major noise-generating construction activities. The construction plan shall identify a procedure for coordination with adjacent residential land uses so that construction activities can be scheduled to minimize noise disturbance.

- Designate a "disturbance coordinator" who would be responsible for responding to any complaints about construction noise. The disturbance coordinator will determine the cause of the noise complaint (e.g., bad muffler, etc.) and will require that reasonable measures be implemented to correct the problem. Conspicuously post a telephone number for the disturbance coordinator at the construction site and include in it the notice sent to neighbors regarding the construction schedule.

The implementation of the reasonable and feasible controls outlined above would reduce construction noise levels emanating from the site in order to minimize disruption and annoyance. With the implementation of these controls and recognizing that noise generated by construction activities would occur over a temporary period, the increase in ambient noise levels due to project construction would be less-than-significant.

Mitigation Measure 1a: No further mitigation required.

Impact 1b: Noise Levels in Excess of Standards. The proposed project is not expected to generate noise in excess of standards established in the City's General Plan and Municipal Code at the nearby sensitive receptors. **This is a less-than-significant impact.**

Daily Operational Noise

When the source of noise originates from nonresidential land uses, Section 10.48.040 of the City's Municipal Code limits noise levels received on any nearby land use to 65 dBA L_{eq} during daytime hours (7:00 a.m. to 10:00 p.m.) and to 55 dBA L_{eq} at night (10:00 p.m. to 7:00 a.m.). Additionally, Section 10.48.050 provides further noise limitations during daytime hours for sources that occur for brief periods of time. For a 5-minute noise duration occurring within a 2-hour period, the noise limits mentioned above would increase by 15 dBA (80 dBA during daytime hours and 70 dBA during nighttime hours). For a 1-minute noise duration occurring within a 2-hour period, the noise limits mentioned above would increase by 19 dBA (84 dBA during daytime hours and 74 dBA during nighttime hours).

Activities expected along the proposed trail would include bicycling, walking, and jogging. Noise levels generated by activity on the trail would be minimal. Typical noise levels generated by people talking or laughing would range from 50 to 55 dBA at 20 feet. The loudest noise sources would include warning whistles or bells from bicycles or a person shouting, which would typically range from 65 to 70 dBA at 20 feet. Typical hourly average noise levels for trails is less than 45 dBA L_{eq} at 20 feet.

The nearest residential property line would be approximately 6 feet from the center of the trail. While most of the adjacent residences have a 5- to 6-foot wooden fence along the edge of the property lines that would provide 5 dBA reduction, residences along Lozano Lane and De Palma Lane would have direct line-of-sight to the proposed trail. At a distance of 6 feet from the property line, talking or laughing would generate noise levels of 61 to 66 dBA assuming no attenuation from a property line fence. Whistles, bells, or shouting would generate unattenuated noise levels of 76 to 81 dBA at the nearest residential property line. The hourly average noise level at these residential backyards would be 56 dBA L_{eq}. For residences with 5- to 6-foot property line fence, hourly average noise levels at a distance of 6 feet would be 51 dBA L_{eq}.

Due to the nature of the activities on the trail, the length of time nearby residences would be exposed to potential noise from these activities would be short in duration, as the trail occupants would be moving along the trail. Typical talking or laughing would be below the daytime and nighttime thresholds for sources lasting less than 1 minute and 5 minutes during any two-hour period. Additionally, whistles, bells, and shouting would result in noise levels below the 1-minute and 5-minute thresholds during both daytime and nighttime hours. With hourly average noise levels of up to 56 dBA L_{eq}, operational noise from the proposed project would meet the daytime and nighttime thresholds at property lines of the residential uses. This would be a less-than-significant impact.

Maintenance and Landscaping Activities

Section 10.48.051 of the City's Municipal Code limits landscape maintenance activities to between 8:00 a.m. and 8:00 p.m. on weekdays and to between 9:00 a.m. and 6:00 p.m. on weekends and holidays. During these allowable hours, maintenance activities are exempt from the above noise limits, provided reasonable efforts are made to minimize noise disturbance.

It is assumed that all maintenance and landscaping activities would occur during the City's allowable hours. Under this assumption, this would be a less-than-significant impact.

Mitigation Measure 1b: None required.

Impact 1c: Permanent Noise Level Increase. The proposed project is not expected to cause a substantial permanent noise level increase at the existing residential land uses in the project vicinity. **This is a less-than-significant impact.**

A significant impact would occur if the permanent noise level increase due to project-generated traffic was 3 dBA CNEL or greater for future ambient noise levels exceeding 60 dBA CNEL or was 5 dBA CNEL or greater for future ambient noise levels at or below 60 dBA CNEL. Based on

the 2020 Noise Contours for the City of Cupertino provided in the City's General Plan, and the results of the ambient noise survey, the residences adjoining the proposed trail would be exposed to future noise levels below 60 dBA CNEL. Therefore, a significant impact would occur if the project increased levels by 5 dBA CNEL or more.

To determine the effect of the project-generated noise level increase, the hourly average noise levels due to project operations, which as stated in Impact 1b would be less than 45 dBA L_{eq}, is conservatively assumed to occur every hour within a 24-hour period although high activity along the trail is not expected to occur during nighttime hours. Under this assumption, the estimated community noise equivalent level would be below 52 dBA CNEL. With ambient noise levels ranging from 52 to 54 dBA CNEL, the proposed project would increase noise levels by up to 3 dBA CNEL (assuming activities 24 hours per day, as described above) and would not result in a permanent noise level increase of 5 dBA CNEL or more at the surrounding noise-sensitive receptors. This is a less-than-significant impact.

Mitigation Measure 1c: None required.

Impact 2: Excessive Groundborne Vibration due to Construction. Construction-related vibration levels resulting from activities at the project site would potentially exceed 0.3 in/sec PPV at the nearest noise-sensitive receptors. **This is a potentially significant impact.**

The construction of the project may generate vibration when heavy equipment or impact tools (e.g. jackhammers, hoe rams) are used. Construction activities would include grading, foundation work, paving, and new building framing and finishing. According to the list of construction equipment provided for this project, pile driving, which can cause excessive vibration, would not be required for the proposed project construction. Critical factors pertaining to the impact of construction vibration on sensitive receptors include the proximity of the existing structures to the project site, the soundness of the structures, and the methods of construction used.

For structural damage, the California Department of Transportation recommends a vibration limit of 0.5 in/sec PPV for buildings structurally sound and designed to modern engineering standards, 0.3 in/sec PPV for buildings that are found to be structurally sound but where structural damage is a major concern, and a conservative limit of 0.08 in/sec PPV for ancient buildings or buildings that are documented to be structurally weakened. No known ancient buildings or buildings that are documented to be structurally weakened adjoin the project area. Therefore, conservatively, groundborne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in a significant vibration impact.

Table 8 presents typical vibration levels that could be expected from construction equipment at a distance of 25 feet. Project construction activities, such as rolling stock equipment (tracked vehicles, compactors, etc.) and structural construction of walking bridges, may generate substantial vibration in the immediate vicinity. Jackhammers typically generate vibration levels of 0.035 in/sec PPV, and drilling typically generates vibration levels of 0.09 in/sec PPV at a distance of 25 feet. Vibration levels would vary depending on soil conditions, construction methods, and equipment used.

Noise-sensitive receptors are located along the walking trail on either side of the project corridor. Each of these residences adjoin the edge of the project site, and the nearest building façades could be as close as 5 to 30 feet from the nearest construction equipment. At 30 feet, vibration levels would be up to 0.17 in/sec PPV; however, for construction activities 5 feet from the nearest building façade, vibration levels would potentially be up to 1.23 in/sec PPV, which would potentially exceed the 0.3 in/sec PPV threshold. This is a potentially significant impact.

TABLE 8 Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft. (in/sec)	PPV at 20 ft. (in/sec)	Vibration Levels at Nearest Façades (in/sec PPV)	
				PPV at 5 ft. (in/sec)	PPV at 30 ft. (in/sec)
Clam shovel drop		0.202	0.258	1.186	0.165
Hydromill (slurry wall)	in soil	0.008	0.010	0.047	0.007
	in rock	0.017	0.022	0.100	0.014
Vibratory Roller		0.210	0.268	1.233	0.172
Hoe Ram		0.089	0.114	0.523	0.073
Large bulldozer		0.089	0.114	0.523	0.073
Caisson drilling		0.089	0.114	0.523	0.073
Loaded trucks		0.076	0.097	0.446	0.062
Jackhammer		0.035	0.045	0.206	0.029
Small bulldozer		0.003	0.004	0.018	0.002

Source: Transit Noise and Vibration Impact Assessment, United States Department of Transportation, Office of Planning and Environment, Federal Transit Administration, May 2006, as modified by Illingworth & Rodkin, Inc., January 2020.

Mitigation Measure 2:

The following measures shall be implemented where vibration levels due to construction activities would exceed 0.3 in/sec PPV at nearby sensitive uses:

- Comply with the construction noise ordinance to limit hours of exposure. The City's Municipal Code allows construction activities during daytime hours, Monday through Friday. Construction is prohibited on weekends and all holidays.

- Prohibit the use of heavy vibration-generating construction equipment within 20 feet of the structures located along the project corridor.

- The contractor shall alert heavy equipment operators to the close proximity of the adjacent structures so they can exercise extra care.

The implementation of these mitigation measures would reduce a potential impact to a less-than-significant level.

Impact 3: **Excessive Aircraft Noise.** The project site is located more than two miles from a public airport or public use airport and would not expose people residing or working in the project area to excessive noise levels. **This is a less-than-significant impact.**

The City of Cupertino has no commercial, military, or general aviation airports. Mineta San José International Airport, located approximately 5.4 miles northeast of the project site, is the closest airport to the project site. The project site lies outside the area of influence for this airport. Noise from aircraft would not substantially increase ambient noise levels at the project site and would have no impact on the proposed project.

Mitigation Measure 3: **None required.**