4.10 NOISE

4.10.1 Introduction

This section includes a description of acoustic fundamentals, existing ambient noise conditions, and an analysis of potential noise impacts associated with implementation of the proposed project.

No comments related to noise and/or vibration were received in response to the Notice of Preparation.

4.10.2 Environmental Setting

BACKGROUND ON ENVIRONMENTAL NOISE AND VIBRATION

Fundamentals of Environmental Sound and Noise

Acoustics is the scientific study that evaluates perception and properties of sound waves. Sound that is loud, disagreeable, unexpected, or unwanted is generally defined as noise. Common sources of environmental noise and associated noise levels are presented in Table 4.10-1.

Table 4.10-1 Typical Noise Levels

Common Outdoor Activities	Noise Level (dB)	Common Indoor Activities
	110	Rock band
Jet flyover at 1,000 feet	100	
Gas lawnmower at 3 feet	90	
Diesel truck moving at 50 mph at 50 feet	80	Food blender at 3 feet, Garbage disposal at 3 feet
Noisy urban area, Gas lawnmower at 100 feet	70	Vacuum cleaner at 10 feet, Normal speech at 3 feet
Commercial area, Heavy traffic at 300 feet	60	
Quiet urban daytime	50	Large business office, Dishwasher in next room
Quiet urban nighttime	40	Theater, Large conference room (background)
Quiet suburban nighttime	30	Library, Bedroom at night, Concert hall (background)
Quiet rural nighttime	20	Broadcast/Recording Studio
Threshold of Human Hearing	0	Threshold of Human Hearing

Notes: dB=decibels; mph=miles per hour

Source: California Department of Transportation (Caltrans) 2013a:2-20

Sound Properties

Sound levels are measured using the decibel scale, developed to relate to the range of human hearing. A decibel is logarithmic; it does not follow normal algebraic methods and cannot be directly summed. For example, a 65-decibel (dB) source of sound, such as a truck, when joined by another 65 dB source results in a sound amplitude of 68 dB, not 130 dB (i.e., doubling the source strength increases the sound pressure by 3 dB). A sound level increase of 10 dB corresponds to 10 times the acoustical energy, and an increase of 20 dB equates to a 100-fold increase in acoustical energy.

The human ear is not equally sensitive to loudness at all frequencies in the audible spectrum. To better relate overall sound levels and loudness to human perception, frequency-dependent weighting networks were developed, identified as A through E. There is a strong correlation between the way humans perceive sound and A-weighted sound levels. For this reason, the A-weighted sound levels are used to predict community response to noise from the environment, including noise from transportation and stationary sources, and are expressed as A-weighted decibels. All sound levels discussed in this section are A-weighted decibels unless otherwise noted.

Noise can be generated by a number of sources, including mobile sources such as automobiles, trucks, and airplanes and stationary sources such as activity at construction sites, machinery, and commercial and industrial operations. As sounds travels through the atmosphere from the source to the receiver, noise levels attenuate (i.e., decrease) depending on ground absorption characteristics, atmospheric conditions, and the presence of physical barriers. Noise generated from mobile sources generally attenuate at a rate of 4.5 dB per doubling of distance from the source. Noise from stationary sources generally attenuates at a rate of 6 to 7.5 dB per doubling of distance from the source.

Atmospheric conditions such as wind speed, wind direction, turbulence, temperature gradients, and humidity also alter the propagation of noise and affect levels at a receiver. Furthermore, the presence of a barrier (e.g., topographic feature, intervening building, and dense vegetation) between the source and the receptor can provide substantial attenuation of noise levels at the receiver. Both natural (e.g., berms, hills, and dense vegetation) and human-made features (e.g., buildings and walls) may function as noise barriers.

All buildings provide some exterior-to-interior noise reduction. The manner in which older homes in California were constructed generally provides a reduction of exterior-to-interior noise levels of about 20 to 25 dB with closed windows. The exterior-to-interior reduction of newer residential units is generally 30 dB or more. It should be noted the neighborhoods adjacent to the proposed project contain predominantly newer residential development, including both single family homes and multi-family apartments.

Common Noise Descriptors

The intensity of environmental noise fluctuates over time, and several different descriptors of time-averaged noise levels are used. The selection of a proper noise descriptor for a specific source depends on the spatial and temporal distribution, duration, and fluctuation of both the noise source and the environment. The noise descriptors most often used to characterize environmental noise are defined below (Caltrans 2013a:2-48).

- Equivalent Noise Level (L_{eq}): The average noise level during a specified time period; that is, the equivalent steady-state noise level in a stated period of time that would contain the same acoustic energy as the time-varying noise level during the same period (i.e., average noise level).
- Maximum Noise Level (L_{max}): The highest instantaneous noise level during a specified time period.
- Minimum Noise Level (L_{min}): The lowest instantaneous noise level during a specified time period.
- Day-Night Noise Level (L_{dn}): The 24-hour L_{eq} with a 10-dB penalty applied during the noise-sensitive hours from 10 p.m. to 7 a.m., which are typically reserved for sleeping.
- Community Noise Equivalent Level (CNEL): Similar to the L_{dn} described above with an additional 5-dB penalty applied during the noise-sensitive hours from 7 p.m. to 10 p.m., which are typically reserved for evening relaxation activities.
- Single Event Noise Levels (SEL): Sounds that occur in an irregular or non-repetitive manner, which makes them difficult to anticipate; these are usually measured by L_{max} noise levels.

Community noise is commonly described in terms of the ambient noise level, which is defined as the all-encompassing noise level associated with a given noise environment. The L_{eq}, or average noise level over a given period of time, is the foundation of composite noise descriptors such as L_{dn} and CNEL, which effectively indicate community response to ambient noise levels.

Effects of Noise on Humans

Excessive and chronic (long-term) exposure to elevated noise levels can result in auditory and non-auditory effects on humans. Auditory effects of noise on people are those related to temporary or permanent hearing loss caused by loud noises. Non-auditory effects of exposure to elevated noise levels are those related to behavior and physiology. The non-auditory behavioral effects of noise on humans are primarily subjective effects such as annoyance, nuisance, and dissatisfaction, which lead to interference with activities such as communications, sleep, and learning. The non-auditory physiological health effects of noise on humans have been the subject of considerable research into possible correlations between exposure to elevated noise levels and health problems, such as hypertension and cardiovascular disease. The mass of research implies that noise-related health issues are predominantly the result of behavioral stressors and not a direct noise-induced response. The extent to which noise contributes to non-auditory health effects remains a subject of considerable research, with no definitive conclusions.

With respect to how humans perceive and react to changes in noise levels, a 1-dB increase is imperceptible, a 3-dB increase is barely perceptible, a 6-dB increase is clearly noticeable, and a 10-dB increase is subjectively perceived as approximately twice as loud (Egan 2007: 21). These subjective reactions to changes in noise levels were developed on the basis of test subjects' reactions to changes in the levels of steady-state pure tones or broad-band noise and to changes in levels of a given noise source. It is probably most applicable to noise levels in the range of 50 to 70 dB, because this is the usual range of voice and interior noise levels. For these reasons, a noise level increase of 3 dB or more is a typical threshold of significance for degradation of the existing noise environment.

Negative effects of noise exposure include physical damage to the human auditory system, interference with daily activities, sleep disturbance, and disease. Exposure to noise may result in physical damage to the auditory system, which may lead to gradual or traumatic hearing loss. Gradual hearing loss is caused by sustained exposure to moderately high noise levels over a period of time; traumatic hearing loss is caused by sudden exposure to extremely high noise levels over a short period. Gradual and traumatic hearing loss both may be permanent. In addition, noise may interfere with or interrupt sleep, relaxation, recreation, and communication. Although most interference may be classified as annoying, the inability to hear a warning signal (for example) may be considered dangerous. Noise may also be a contributor to diseases associated with stress, such as hypertension, anxiety, and heart disease. The degree to which noise contributes to such diseases depends on the frequency, bandwidth, and level of the noise and the exposure time (Caltrans 2013a:2-59, 2-61).

Fundamentals of Vibration

Vibration is the periodic oscillation of a medium or object with respect to a given reference point. Sources of ground vibration include natural phenomena (e.g., earthquakes, volcanic eruptions, sea waves, and landslides) and those introduced by human activity (e.g., explosions, machinery, traffic, trains, and construction equipment). Vibration sources may be continuous, (e.g., operating factory machinery) or transient in nature (e.g., explosions). Vibration levels can be depicted in terms of amplitude and frequency, relative to displacement, velocity, or acceleration.

Vibration amplitudes are commonly expressed in peak particle velocity (PPV) or root mean square (RMS) vibration velocity. Peak particle velocity is defined as the maximum instantaneous positive or negative peak of a vibration signal. Peak particle velocity is typically used in the monitoring of transient and impact vibration and has been found to correlate well with the stresses experienced by buildings (Federal Transit Administration [FTA] 2006:7-3; Caltrans 2013b:6). PPV and RMS vibration velocity are normally described in inches per second (in/sec).

Although PPV is appropriate for evaluating the potential for building damage, it is not always suitable for evaluating human response. It takes some time for the human body to respond to vibration signals. In a sense, the human body responds to average vibration amplitude. The RMS of a signal is the average of the squared amplitude of the signal, typically calculated over a 1-second period. As with

airborne sound, the RMS velocity is often expressed in decibel notation as vibration decibels (VdB), which serves to compress the range of numbers required to describe vibration (FTA 2006:7-3). This is based on a reference value of 1 micro (μ) in/sec.

The typical background vibration-velocity level in residential areas is approximately 50 VdB. Ground vibration is normally perceptible to humans at approximately 65 VdB. For most people, a vibration-velocity level of 75 VdB is the approximate dividing line between barely perceptible and distinctly perceptible levels (FTA 2006). Table 4.10-2 describes the general human response to different levels of ground vibration-velocity levels.

Table 4.10-2 Human Response to Different Levels of Ground Noise and Vibration

Vibration-Velocity Level	Human Reaction
65 VdB	Approximate threshold of perception.
75 VdB	Approximate dividing line between barely perceptible and distinctly perceptible. Many people find that transportation-related vibration at this level is unacceptable.
85 VdB	Vibration acceptable only if there are an infrequent number of events per day.

Notes: VdB = vibration decibels referenced to 1 μ inch/second and based on the root mean square (RMS) velocity amplitude.

Source: FTA 2006:7-8

NOISE SOURCES

The existing ambient noise environment in the project vicinity is defined primarily by vehicular traffic on Interstate 80 (I-80), major arterials and local roadways, and to a lesser extent by occasional aircraft over-flights and trains in the vicinity. Major arterials within the project area include Riverside Avenue, Rocky Ridge Drive, Sunrise Avenue, Cirby Way, and South Cirby Way. The project site is located approximately eight miles northeast of McClellan Airport and approximately 15 or more miles east of Sacramento International Airport; aircraft flyovers are infrequent. The Union Pacific Railroad and the Roseville rail yards are located approximately one mile or more to the west of the proposed project. Although railroad activity and aircraft over-flights are audible at the project site, distance from source to receptor and, in the case of railroad noise, shielding by intervening buildings, diminishes the perceived level of noise from these sources at the project site.

Most of the project area could be considered “quiet urban” with an expected background daytime ambient noise level of approximately 50 dB and nighttime ambient levels of approximately of 40 dB (Table 4.10-1). Locations along the trail alignment located more distant from roadways, such as the Sierra Gardens area and areas east of Rocky Ridge, may experience quieter ambient noise levels. Areas along the proposed trail alignment located closer to I-80, major arterials, and/or commercial areas, such as near Sunrise Avenue, are likely to experience higher background sound levels ranging from 60 dB to 70 dB, depending on daily activities.

SENSITIVE LAND USES

Noise-sensitive land uses generally include those uses where noise exposure could result in health-related risks to individuals, as well as places where quiet is an essential element of their intended purpose. Residential dwellings are of primary concern because of the potential for increased and prolonged exposure of individuals to both interior and exterior noise levels. Parks, schools, historic sites, cemeteries, and recreation areas are also generally considered sensitive to increases in exterior noise levels. Places of worship, and other similar places where low interior noise levels are of great importance are also considered noise-sensitive. Noise-sensitive land uses are also considered to be vibration-sensitive. Specifically, commercial and industrial buildings where ground vibration (including

vibration levels that may be well below those associated with human annoyance) could interfere with operations within the building would be most sensitive to ground vibration (e.g., hospitals, laboratories).

The project site is located within a natural creek corridor and is surrounded by a variety of developed urban land uses, including single-family and multi-family residential dwellings, retail and commercial businesses, medical offices, a senior assisted-living facility, parks, and schools. Residential back yards are adjacent to the project site along much of the alignment. As mentioned in the project description, the proposed trail would be aligned through, or adjacent to the Cherry Glen, Cirby Side, Cresthaven, Hillcrest, Maidu, Meadow Oaks, Sierra Gardens, and South Cirby neighborhoods.

The proposed paved trail and bridges would be located between 10 and over 200 feet from nearby residences and as close as two feet from existing commercial development and medical offices located at 720 and 729 Sunrise Avenue. The proposed construction staging areas for the project would include all proposed trail areas, driveways of some commercial and multi-family land uses, and vacant or undisturbed lots. The boundaries of the staging areas may be as close as 5 feet from existing structures.

4.10.3 Regulatory Setting

FEDERAL

Federal Noise Control Act of 1972

The basic motivating legislation for noise control in the United States was the Federal Noise Control Act (1972), which addressed the issue of noise as a threat to human health and welfare, particularly in urban areas. In response to the Noise Control Act, the U.S. Environmental Protection Agency (EPA) published Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety (EPA 1974). In summary, EPA findings were that sleep, speech, and other types of essential activity interference could be avoided in residential areas if the L_{dn} did not exceed 55 dB outdoors and 45 dB indoors. The EPA intent was not that these findings necessarily be considered as mandatory standards, criteria, or regulatory goals, but as advisory exposure levels below which there is no reason to suspect that the general population would be at risk from any of the identified health or welfare effects of noise. The EPA Levels report also identified 5 dB as an adequate margin of safety before an increase in noise level would produce a significant increase in the severity of community reaction (i.e., increased complaint frequency, annoyance percentages) provided that the existing baseline noise exposure did not exceed 55 dB L_{dn}.

LOCAL

City of Roseville General Plan

The Noise Element in the City of Roseville General Plan outlines policies and implementation measures to achieve the City of Roseville's (City) goals of protecting Roseville residents from the harmful and annoying effects of exposure to excessive noise and establishes separate acceptable noise level criteria for land uses affected by either fixed noise sources or transportation-related noise sources.

The following goals, policies and implementation programs of the Noise Element would apply to the proposed project:

GOAL 1: Protect City residents from the harmful and annoying effects of exposure to excessive noise.

- **Policy 10:** Regulate construction-related noise to reduce impacts on adjacent uses consistent with the City's Noise Ordinance.

City of Roseville Municipal Code

The City of Roseville has a Noise Ordinance (Chapter 9.24 of the City Code) that is designed to prohibit unnecessary, excessive, and annoying sound levels from all sources. Key provisions of the ordinance that may be applicable to the proposed project include:

- Section 9.24.030 provides exemptions for certain activities, including but not limited to: sound sources typically associated with residential uses (e.g., children at play, air conditioning and similar equipment, but not including barking dogs); property maintenance activities between the hours of 8:00 a.m. and 9:00 p.m.; and private construction between the hours of 7:00 a.m. and 7:00 p.m. Monday-Friday, and between 8:00 a.m. and 8:00 p.m. on Saturdays and Sundays, provided that all construction equipment is fitted with factory installed muffling devices and maintained in good working order (City of Roseville 2014).
- Section 9.24.100 establishes specific sound level standards by which exposure of sensitive receptors to noise is regulated for area-wide sources, including fixed sources, non-transportation sources, and amplified music. Hourly sound levels are limited to 50 dB L_{eq} in the daytime (7:00 a.m. to 10:00 p.m.) and 45 dB L_{eq} at nighttime (10:00 p.m. to 7:00 a.m.). Maximum sound levels are limited to 70 dB L_{max} in the daytime (7:00 a.m. to 10:00 p.m.) and 65 dB L_{max} at nighttime (10:00 p.m. to 7:00 a.m.).
- Section 9.24.140 exempts City operations and activities from the provisions of Chapter 9.24.

4.10.4 Impacts

THRESHOLDS OF SIGNIFICANCE

Based on Appendix G of the CEQA Guidelines, the proposed project was determined to result in a significant noise impact if it would result in any of the following:

- 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;
- exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels;
- a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project;
- a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project;
- 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; or
- for a project within the vicinity of a private airstrip, expose people residing or working in the project area to excessive noise levels.

ISSUES OR POTENTIAL IMPACTS NOT DISCUSSED FURTHER

The proposed project is not located within an airport land use planning area and is not within the vicinity of a private airstrip. Thus, potential impacts associated with exposure to aircraft noise are not discussed further.

IMPACT ANALYSIS

Impact 4.10-1	Short-term construction-related noise.
Applicable Policies and Regulations	Caltrans Standard Specifications City of Roseville General Plan 2035, Noise Element City of Roseville Municipal Code, Chapter 9.24 (Noise)
Significance with Policies and Regulations	Proposed Project: Potentially significant Alignment Option 1A: Potentially significant Alignment Option 1C: Potentially significant Alignment Option 5A: Potentially significant
Mitigation Measures	Mitigation Measures 4.10-1 (Proposed Project, Option 1A, Option 1C, Option 5A)
Significance after Mitigation	Significant and unavoidable (Proposed Project, Option 1A, Option 1C, Option 5A)

Proposed Trail Alignment

During construction of the project, noise from construction activities may intermittently dominate the noise environment in the immediate area of construction. Caltrans Standard Specifications state that noise levels generated during construction shall comply with applicable local, state, and federal regulations, and that all equipment shall be fitted with adequate mufflers according to manufacturer specifications. Additionally, the City's noise ordinance exempts private construction noise from its standards during certain hours and exempts city operations and activities, including construction, altogether (see subsection 4.10.3).

Construction noise associated with the proposed project would be temporary and intermittent, and noise levels would vary depending on the type of construction activity. Construction activity would include site preparation (e.g., excavation, grading, and vegetation clearing), material delivery, worker commute vehicle travel to and from the site, trenching and asphalt paving, bridge construction, retaining wall construction and other related activities. Noise levels associated with anticipated project construction equipment are shown below in Table 4.10-3.

Table 4.10-3 Representative Ground Vibration and Noise Levels for Construction Equipment

Equipment	dBA L_{max} at 50 feet[1]
Backhoe	78
Chain Saw	85
Concrete Mixing Truck	79
Crane	81
Dozer	82
Drill Rig	84
Excavator	81
Grader	85
Jack Hammer	89
Loader	79
Off-Highway Trucks	76
Paver	77
Pump	81
Vibratory Roller	80

Notes: dBA L_{max}= maximum noise level

1. All equipment reference noise levels obtained from FHWA 2006 except the chainsaw which was obtained from Berger 2010.

Source: FHWA 2006, Berger 2010

Construction noise can be characterized based on the type of activity and associated equipment needed and, in this analysis, is evaluated by considering noise levels associated with site preparation (clearing/grubbing/grading), trail construction, bridge construction, and retaining wall construction. Based on anticipated equipment needed for each activity, a likely combination of simultaneous equipment use was modeled for each construction activity. Further, it is anticipated that bridge construction could occur at the same time as retaining wall construction. This represents the likely loudest construction noise scenario that could occur over the entire length of the proposed trail alignment. Modeled noise levels for each activity are shown below in Table 4.10-4.

Table 4.10-4 Noise Levels from Construction Activity

Construction Activity	Construction Noise (dBA) at 50 feet (L_{eq}/L_{max})	Construction Noise (dBA) at 100 feet (L_{eq}/L_{max})	Construction Noise (dBA) at 300 feet (L_{eq}/L_{max})
Site Preparation (Clearing/Grubbing/Grading)	84.6/90.2	78.6/84.1	69.0/74.6
Trail Construction	83.3/89.2	77.3/83.2	67.7/73.7
Bridge Construction (Darling Way)	86.0/90.5	80.0/84.5	70.5/74.9
Prefabricated Bridge Construction	82.8/87.7	76.8/81.6	67.3/72.1
Retaining Wall	82.0/86.2	76.0/80.2	66.4/70.6
Bridge and Retaining Wall simultaneously	87.5/91.9	81.4/85.9	71.9/76.3

Source: Modeled by Ascent Environmental. Inc, 2018

As shown in Table 4.10-4, the typical construction noise for each activity type would range from approximately 82 dBA L_{eq}/86 dBA L_{max} to 86 dBA L_{eq}/ 91 dBA L_{max} and the loudest construction noise levels could be approximately 88 dBA L_{eq}/ 92 dBA L_{max} at 50 feet. Further, as shown in Table 4.10-4, noise levels would decrease with increasing distance from the construction site.

The location and distance of residences and other sensitive receptors in relationship to the project site would vary considerably. In some cases, the rear property lines of residences would be several hundred feet or more from the proposed trail. In other cases, they could be within 50 feet or less. Backyards of residential homes would likely be areas most affected by construction activities. Noise from trail construction activities would also occur as close as 10 feet to commercial land uses directly north of the trail alignment between Sunrise Avenue and Oakridge Drive.

The majority of construction activities would be on the lower end of the expected ranges of noise levels, because the expected construction activities for the paved trail (the main project component) would not require extensive combined use of heavy (i.e., the noisiest) equipment in close proximity to each other. Further, construction activity along the 4.25-mile trail alignment would be temporary at any one location. Construction of the trail would occur in separate phases along each segment of the trail over a period of several years, such that construction would not take place along all segments of the 4.25-mile length of the proposed project simultaneously. While the majority of trail construction would be intermittent and transient, construction locations that include bridges and retaining walls would be more site specific and prolonged. Nevertheless, the highest construction noise at these locations is expected to be generated during the bridge construction phase, which includes the use of a jackhammer, resulting in 86 dBA L_{eq}/ 90.5 dBA L_{max} at 50 feet. If bridge construction were to combine with the retaining wall construction, noise levels would be up to 87.5 dBA L_{eq}/91.9 dBA L_{max}. Although City activities including construction are exempt from the regulations of the Noise Ordinance, construction activities for City projects typically occur within the daytime and early evening timeframes established by the Noise Ordinance for private construction (7:00 a.m. – 7:00 p.m. Monday-Friday and 8:00 a.m. – 8:00 p.m. Saturday and Sunday). Construction times may be adjusted when determined necessary by the City to reduce traffic

congestion or minimize construction noise impacts on sensitive receptors (including residential at various locations and the office buildings west of Sunrise Avenue).

Despite the exemption of public construction activities under the City's noise ordinance, project construction would temporarily increase ambient noise levels in the project's vicinity. The impact of construction noise at residences, businesses, and structures would depend on the existing outdoor noise levels, the distance from the noise source to the receptor, the type of construction, window treatments, and the presence or absence of insulation. As discussed above, background noise levels along the proposed trail alignment vary depending on distance from major transportation noise sources and intervening structures (such as fences and buildings) and topography. The proposed project could result in sudden increases of outdoor noise levels during construction, depending on the proximity of construction activities to existing receptors and the existing ambient noise levels. In some cases, existing receptors are as close as 10 feet from the proposed construction activity (i.e., commercial land uses north of the trail alignment between Sunrise Avenue and Oakridge Drive). Therefore, it is likely that construction noise could result in an increase in 10 dBA or more, which represents noise levels shown to be subjectively perceived as twice as loud as existing noise levels (Egan 2007:21). Thus, noise from project construction would be noticeable, although temporary, and construction of the proposed project would result in substantial temporary increases in noise levels in the project vicinity.

Conclusion

Implementation of the proposed project would create temporary substantial construction noise in close proximity to residences and commercial land uses that would be perceptible and potentially disturb residents and business operations. Construction during the typical daytime and early evening hours may lessen impacts to residents, but daytime construction could result in disturbances to normal business operations. Despite the exemption of public construction activities under the City's noise ordinance, the proximity of project construction to nearby residences and businesses would result in substantial temporary increases in noise levels at those locations. Thus, noise impacts from construction of the proposed project would be **potentially significant**.

Alignment Option 1A

Construction activities for Option 1A would be the same type and general magnitude of activities that would occur under the Proposed Trail Alignment. The location of construction activities under Option 1A would vary slightly based on differences in the alignment of the northernmost section of the trail south of Darling Way and east of Riverside Avenue. The multi-use trail would shift to the south side of Cirby Creek and would be closer to existing commercial land uses and further away from residential land uses located north of Cirby Creek. Additionally, the total number of bridges under Option 1A would be less than the number of bridges constructed under the Proposed Trail Alignment, which would result in less noise overall from bridge construction activities. Furthermore, Bridge #3 would be located further away from existing residential land uses located north of Cirby Creek than Bridges #2 and #4 under the Proposed Trail Alignment. For all other sections of the trail, both the trail alignment and bridge locations would be the same as the Proposed Trail Alignment. While there would be some differences in the locations of the trail and changes in proximity to sensitive receptors would occur, the magnitude, frequency, and duration of construction activities and associated noise would be similar to those identified in Table 4.10-4 and would not be substantially different under Option 1A compared to the Proposed Trail Alignment. This impact would be **potentially significant**.

Alignment Option 1C

Construction activities for Option 1C would be the same type and general magnitude of activities that would occur under the Proposed Trail Alignment. The location of construction activities under Option 1C would vary somewhat based on differences in the alignment of the northernmost section of trail near Darling Way and east of Riverside Avenue. The location of the multi-use trail under Option 1C would shift to the east side of Dry Creek and would be within 50 feet or less of existing residential land uses. Option 1C would not require the widening of the Darling Way bridge; therefore, the total number of bridges requiring construction under Option 1C in the areas near Darling Way and east of Riverside

Avenue would be less than the number of bridges constructed under the Proposed Trail Alignment, which would result in less noise overall from bridge construction activities; however, a series of retaining walls would be constructed under Option 1C along the trail alignment both north and south of Darling Way and north of Bridge #2. For all other sections of the trail, both the trail alignment and bridge locations would be the same as the Proposed Trail Alignment. The construction of retaining walls would result in construction activity occurring closer to residences under Option 1C than under the Proposed Trail Alignment. Apart from the construction of retaining walls, some other differences in the locations of the trail and changes in proximity to sensitive receptors would also occur. Thus, although the magnitude, frequency, and duration of construction activities under Option 1C would be similar compared to the Proposed Trail Alignment, the activities may occur closer to residences under Option 1C compared to the Proposed Trail Alignment. This impact would be **potentially significant**.

Alignment Option 5A

Construction activities for Option 5A would be the same type and general magnitude of activities that would occur under the Proposed Trail Alignment. The location of construction activities under Option 5A would vary from the Proposed Trail Alignment because of differences in the alignment of the trail near Sunrise Avenue along Linda Creek. The location of the multi-use trail under Option 5A would shift to the south side of Linda Creek, which would result in trail paving and construction activities located further away from existing residential land uses on the north side of Linda Creek. The alignment under Option 5A would be closer to existing commercial uses and some existing residential uses south of Linda Creek based on a trail spur that would connect to an existing path at Meadow Gate Drive. A series of retaining walls would be constructed under Option 5A along the trail alignment on both sides of Sunrise Avenue, compared to only on the north side of Linda Creek under the Proposed Trail Alignment. Option 5A would also require the construction of Bridge #14 over Linda Creek east of Sunrise Avenue, rather than Bridge #13 west of Sunrise Avenue. Thus, although the magnitude, frequency, and duration of construction activities under Option 5A would be similar to those identified in Table 4.10-4, the activities may occur closer to residences under Option 5A compared to the Proposed Trail Alignment. This impact would be **potentially significant**.

Mitigation Measures

Mitigation Measure 4.10-1: Employ Noise-Reducing Construction Practices

This mitigation will apply to the Proposed Trail Alignment and Alignment Options 1A, 1C, and 5A.

Feasible measures that can be used to limit construction noise include the following:

- Locate stationary noise generating construction equipment as far as feasible from noise-sensitive uses.
- Do not idle inactive construction equipment for prolonged periods (i.e., more than 5 minutes).
- Prohibit unmuffled engine exhaust systems. All construction equipment powered by gasoline or diesel engines shall have factory-installed sound control devices, or sound control devices that are at least as effective as those originally provided by the manufacturer, and all equipment shall be operated and maintained in good working order to minimize noise generation pursuant to Section 9.24.030 of the Noise Ordinance.
- The contractor shall provide advance written notification to owners and renters of buildings located within 50 feet of construction activities. The notice shall explain when construction is expected. The notice shall include contact information for the project manager.
- When construction occurs outside of the typical daytime and early evening hours (7:00 a.m. – 7:00 p.m. Monday-Friday and 8:00 a.m. – 8:00 p.m. Saturday and Sunday) or within 50 feet of noise sensitive commercial or office buildings, the use of noise-generating construction equipment will be avoided to the extent feasible. When not feasible, construction contractors will specify proposed noise-reducing construction practices or alternative schedules that will be employed to reduce construction noise. Measures specified by the contractors will be reviewed and approved by the

City prior to construction activities. In these situations, feasible noise reduction measures include the following:

- Alternative construction schedule to minimize disturbance to normal office operations; and/or
- Use temporary noise-reducing barriers positioned between noise-generating equipment (including hand operated jack hammers) and the sensitive receptor building. Such barriers may include commercially manufactured noise-insulating blankets/quilts or as equal materials with similar noise reduction performance as approved by the resident engineer. When temporary barrier units are joined together, the mating surfaces shall be flush with each other with no gaps.

Significance after Mitigation

Implementation of this mitigation measure would reduce impacts associated with construction activities; however, even with a reduction in construction noise through the above mitigation measure, disturbances could occur and project construction would still result in substantial temporary or periodic increases in ambient noise levels in the project vicinity above existing levels, and this impact would remain **significant and unavoidable**.

Impact 4.10-2	Long-term increases in use-related noise.
Applicable Policies and Regulations	City of Roseville General Plan 2035, Noise Element City of Roseville Municipal Code, Chapter 9.24 (Noise)
Significance with Policies and Regulations	Proposed Project: Less than significant Alignment Option 1A: Less than significant Alignment Option 1C: Less than significant Alignment Option 5A: Less than significant
Mitigation Measures	None required (Proposed Project, Option 1A, Option 1C, Option 5A)
Significance after Mitigation	Less than significant (Proposed Project, Option 1A, Option 1C, Option 5A)

Proposed Trail Alignment

The proposed project would introduce new pedestrian and bicycle activities on a new paved multi-use trail. These are non-motorized activities that would not result in a substantial increase in noise levels above ambient noise conditions. The sound of people talking while using the trail could be audible at nearby residential uses or other sensitive receptors; however, such activities would be consistent with the level of noise typically experienced in residential neighborhoods where children may be playing or where neighbors may converse with one another.

Events such as fun runs may occur along the trail. Per City practices, these events occur during daytime hours and further meet the noise generation standards of section 9.24.130 of the Noise Ordinance.

No motorized vehicles would be permitted to use the trail with the exception of occasional City or other public agency vehicles or equipment for maintenance or inspection purposes. Any noise generated by City vehicles or maintenance equipment would be temporary in nature and is considered exempt under Chapter 9.24 of the Roseville Municipal Code.

The Proposed Trail Alignment is located in existing creek corridors in an urbanized area and passes beneath several existing roadways. Some of these roadways are major arterials, including I-80 where existing ambient sound levels associated with roadway noise are likely to be higher than along other portions of the alignment, such as adjacent to residential areas. However, any exposure of trail users to existing roadway noise while traveling underneath such roadways would be temporary in nature and thus would not result in adverse effects.

Conclusion

Long-term uses associated with the proposed project would be predominantly non-motorized activities and would not expose persons to or generate use-related noise levels in excess of adopted standards. This impact would be **less than significant**.

Alignment Option 1A

Use of Option 1A would result in activities and noise characteristics similar to those described under the Proposed Trail Alignment above. Therefore, use-related impacts under Option 1A would be **less than significant**.

Alignment Option 1C

Use of Option 1C would result in activities and noise characteristics similar to those described under the Proposed Trail Alignment above. Therefore, use-related impacts under Option 1C would be **less than significant**.

Alignment Option 5A

Use of Option 5A would result in activities and noise characteristics similar to those described under the Proposed Trail Alignment above. Therefore, use-related impacts under Option 5A would be **less than significant**.

Mitigation Measures

None required.

Impact 4.10-3	Exposure to construction-related groundborne vibrations.
Applicable Policies and Regulations	City of Roseville Municipal Code, Chapter 9.24 (Noise)
Significance with Policies and Regulations	Proposed Project: Potentially significant Alignment Option 1A: Potentially significant Alignment Option 1C: Potentially significant Alignment Option 5A: Potentially significant
Mitigation Measures	Mitigation Measure 4.10-3 (Proposed Project, Option 1A, Option 1C, Option 5A)
Significance after Mitigation	Less than significant (Proposed Project, Option 1A, Option 1C) Significant and unavoidable (Option 5A)

Proposed Trail Alignment

Construction activities generate varying degrees of temporary ground vibration, depending on the specific construction equipment used and activities involved. Ground vibration generated by construction equipment spreads through the ground and diminishes in magnitude with increases in distance. Construction-related ground vibration is normally associated with impact equipment such as pile drivers, jackhammers, and the operation of some heavy-duty construction equipment, such as dozers and trucks. The effects of ground vibration may be imperceptible at the lowest levels, result in low rumbling sounds and detectable vibrations at moderate levels, and high levels of vibration can cause sleep disturbance in places where people normally sleep or annoyance in buildings that are primarily used for daytime functions and sleeping.

The project would not include the development of any new permanent stationary sources of ground vibration or permanent transportation infrastructure that would also result in ground vibration from passing heavy duty vehicles and; therefore, this analysis focusses on construction-induced vibration. Depending on the specific construction equipment used and activities involved, such activities may result in varying degrees of temporary ground vibration and noise during construction.

Caisson drilling, the drilling of shafts for piers, would be required for bridge pier column installation for all proposed bridges. No pile driving would occur at any of the proposed bridges. In addition, other heavy-duty equipment (i.e., small dozers) would be used for construction activities and at bridge construction sites. Therefore, it is assumed that caisson drilling would occur as close as 88 feet from a sensitive receptor – between the easternmost pile of the proposed widening on Darling Way Bridge and a single-family home at the southwest corner of Darling Way and Hernandez Lane. Construction and drilling of other proposed bridges would occur no closer than 100 feet from existing structures.

Construction of the trail would result in activities with less intense vibration than drilling. Typical equipment could include small dozers and, in some instances, jack hammers for site preparation, and loaded trucks for materials delivery. Trail construction activity would mostly be located at least 15 feet away or more from nearby structures, but could in some instances occur within 15 feet of existing noise-sensitive receptors.

Staging areas (including construction access routes) would accommodate movement of loaded trucks carrying materials and equipment to and from the proposed trail alignment. Loaded truck activity could result in groundborne vibrations similar to drilling anywhere within the staging areas. Staging areas would be located at various locations along the alignment including near private driveways and in vacant lots. Some of these areas border neighboring residences and can be as close as 5 feet from an existing residential structure (such as the staging area on Oakridge Drive). Staging areas/construction access routes near/along private driveways at 720 Sunrise Avenue and 729 Sunrise Avenue could be located as close as 20 feet from noise-sensitive receptors such as medical offices and clinics.

Ground vibration and noise levels associated with various types of construction equipment and activities are summarized in Table 4.10-5.

Table 4.10-5 Representative Ground Vibration and Noise Levels for Construction Equipment

Equipment	PPV at 25 feet (in/sec)[1]	Approximate L_v (VdB) at 25 feet
Impact Pile Driver	1.518	112
Blasting	1.13	109
Sonic Pile Driver	0.734	104
Large Dozer	0.089	87
Caisson Drilling	0.089	87
Loaded Trucks	0.076	86
Rock Breaker	0.059	83
Jackhammer	0.035	79
Small Dozer	0.003	58

PPV = peak particle velocity; L_V = the root mean square velocity expressed in vibration decibels (VdB), assuming a crest factor of 4

Source: FTA 2006:p.12-6,12-8

Recommended standards from the FTA are used to determine if the project's construction activities would result in significant exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels. This impact would be significant if it would result in vibration levels that exceed FTA's recommended standard of 0.2 in/sec PPV with respect to the prevention of structural damage for non-engineered timber and masonry buildings or FTA's maximum acceptable level of 80 VdB with respect to human response for residential uses [i.e., annoyance] at nearby existing vibration-sensitive land uses. Table 4.10-6 shows the distances between equipment operation and receptors within which FTA thresholds would be exceeded. The selected equipment types represent what would most likely be used for construction of this project.

Table 4.10-6 Distance Standards between Vibratory Construction Equipment and Receptors

Equipment	Structural Damage Standard Minimum Distance to Reach 0.2 in/sec PPV (feet)	Human Disturbance Standard Minimum Distance to Reach 80 L_v (VdB) (feet)
Caisson Drilling/Large Dozer	15	43
Loaded Trucks	13	40
Jackhammer	8	23
Small Dozer	2	5

Note: Locating equipment operations within the distances above from a receptor would increase the structural damage standards above 0.2 in/sec PPV and the human disturbance threshold of 80 VdB at that receptor.

PPV = peak particle velocity; L_V = the root mean square velocity expressed in vibration decibels (VdB), assuming a crest factor of 4

Source: FTA 2006:p.12-6,12-8

FTA's vibratory structural damage and human disturbance standards would be exceeded if the minimum setback distances for the types of equipment listed in Table 4.10-6 cannot be maintained during construction. As described above, drilling would occur no closer than 88 feet away from an existing residence. Thus, drilling activities would occur within the distances described above that would not result in an exceedance of FTA's recommended threshold for human disturbance (i.e., 80 VdB) and/or structural damage (i.e., 0.2 in/sec PPV) and is not discussed further.

Structural Effects

According to Table 4.10-6, structural damage could occur when large construction equipment is operated within the following minimum setbacks from existing structures: large dozers and drilling 15 feet, loaded trucks 13 feet, Jackhammer 8 feet, and small dozer 2 feet. A review of the proposed trail alignment (Exhibits 3-5 through 3-12) indicates that construction activity within staging areas, along access routes, and along the trail alignment could exceed these set back requirements. For example, within the Oakridge Drive Staging Area, loaded trucks could operate within slightly greater than 5 feet of an existing adjacent residence and construction access routes located west of Sundown Way and east and west of Sunrise Avenue could result in loaded trucks operating within 20 feet of existing structures. Furthermore, trail construction could require use of jackhammers and small dozers within 5 feet of office buildings on the north side of Linda Creek at Sunrise Avenue. Thus, trail construction, and use of staging areas and access routes could, depending on the type of building materials and construction techniques, result in exceedances of FTA's structural damage thresholds when the minimum setback distances shown in Table 4.10-6 cannot be met.

Human Disturbance

According to Table 4.10-6, human disturbance could occur when large construction equipment is operated within the following minimum setbacks from existing occupied structures: large dozers and drilling 43 feet, loaded trucks 40 feet, Jackhammer 23 feet, and small dozer 5 feet. A review of the proposed trail alignment (Exhibits 3-5 through 3-12) indicates that at certain locations construction activity within staging areas, along access routes, and along the trail alignment could exceed these set back requirements. For example, within the Oakridge Drive Staging Area loaded trucks could operate within slightly greater than 5 feet of an existing adjacent residence and construction access routes located west of Sundown Way and east and west of Sunrise Avenue could result in loaded trucks operating within 20 feet of existing structures. Furthermore, jackhammers and small dozers may operate within 5 feet of office buildings. Thus, trail construction, and use of staging areas and access routes could, depending on the type of building materials and construction techniques, result in exceedances of FTA's human disturbance thresholds when the minimum setback distances shown in Table 4.10-6 cannot be met.

Conclusion

Construction activities would typically be during daytime hours, so the potential for human disturbance at residences would not occur when inhabitants are most likely to be sleeping. However, ground borne vibrations and noise levels could disturb residents who are home during the day and people present at nearby noise-sensitive receptors that operate during weekday business hours. Therefore, the proposed project would potentially expose persons and structures to generation of excessive ground borne vibration or ground borne noise levels for temporary periods of time during project construction. This impact would be **potentially significant**.

Alignment Option 1A

Construction of Option 1A would result in activities and vibration characteristics similar to those described under the Proposed Trail Alignment above, except Under Alignment Option 1A, Bridge #3 would be located closer to commercial uses on Riverside Avenue and farther away from the residential uses in the Hillcrest neighborhood (compared to the Proposed Trail Alignment Bridges #2 and #4) as shown on Exhibit 3-13 in Chapter 3, "Project Description." Construction activity for Bridge #3 would occur no closer than 85 feet from the nearest structure, a commercial land use, outside of the project boundary and no closer than 180 feet from the nearest residence. However, Option 1A would still include the same staging areas and other trails areas as the Proposed Trail Alignment. Therefore, impacts under Option 1A would be **potentially significant**.

Alignment Option 1C

Construction of Option 1C would result in activities and vibration characteristics similar to those described under the Proposed Trail Alignment, above, and would include both Bridge #2 and #4 in the same locations as the Proposed Trail Alignment (see Exhibit 3-14 in Chapter 3, "Project Description"). Construction activity at Bridge #4 would occur no closer than 85 feet from the nearest structure, a commercial land use, outside of the project boundary and no closer than 120 feet from the nearest residence. However, Option 1C would still include the same staging areas and other trails areas as the Proposed Trail Alignment. Therefore, impacts under Option 1C would be **potentially significant**.

Alignment Option 5A

Construction of Option 5A would result in activities and vibration characteristics similar to those described under the Proposed Trail Alignment above, except that the trail alignment along Linda Creek near Sunrise Avenue would travel along the south side of the creek instead of the north side (see Exhibit 3-15 in Chapter 3, "Project Description"). This option would move trail construction activities approximately 90 feet further south from the dental clinic at 720 Sunrise Avenue, but closer to other commercial uses along Sundown Way west of Sunrise Avenue and commercial and residential uses east of Sunrise Avenue. Construction would be located further away from existing residential land uses on the north side of Linda Creek, but it would be closer to existing commercial uses and some existing residential uses south of Linda Creek. A series of retaining walls would be constructed under Option 5A along the trail alignment on both sides of Sunrise Avenue, compared to only on the north side of Linda Creek under the Proposed Trail Alignment. Option 5A would also require the construction of Bridge #14 over Linda Creek east of Sunrise Avenue, rather than Bridge #13 west of Sunrise Avenue. Thus, although the magnitude, frequency, and duration of construction activities under Option 5A would be similar compared to the Proposed Trail Alignment, the activities may occur closer to residences under Option 5A compared to the Proposed Trail Alignment. The construction footprint for Bridge #14 would be no closer than 35 to 45 feet from the nearest residential structure (near homes along Meadow Gate Drive). This may be within the 43 foot range for human disturbance for caisson drilling. Therefore, impacts under Option 5A would be **potentially significant**.

Mitigation Measures

Mitigation Measure 4.10-3: Reduce exposure to construction-generated ground vibration.

This mitigation will apply to the Proposed Trail Alignment and Alignment Options 1A, 1C, and 5A.

Construction documents shall specify construction practices that reduce the adverse effects of ground vibration associated with project construction activities. Measures specified by the design engineer will be reviewed and approved by the City prior to approval of the plans and specifications and may include, but are not limited to, the measures listed below.

- Implement Mitigation Measure 4.10-1.
- All construction equipment on construction sites shall be operated as far away from vibration- and noise-sensitive sites as reasonably feasible.
- Earthmoving, dozing, and ground-impacting operations shall be phased so as not to occur simultaneously in areas close to offsite sensitive receptors, to the extent feasible. The total vibration level produced could be significantly less when each vibration source is operated at separate times.
- As part of final design, project engineers shall identify areas on the project plans where work may be constrained due to proximity of structures. The designs shall specify requirements that during project construction on the trail alignment, no heavy vibratory equipment (i.e., the types of equipment listed in Table 4.10-5), shall be operated within 13 feet of off-site building structures unless otherwise approved in writing by the City Engineer. Non-vibratory equipment, such as hand tools, and handheld vibratory compactors and rollers may be used. Use of different material types including slurry cement and concrete paving approved by the Engineer, may be used to reduce or eliminate the need for vibratory equipment. Those portions of the project site located within 13 feet of an off-site building structure shall be identified on construction documents and demarcated with stakes, flags, rope and/or markings on the ground.
- For Option 5A, locate caisson drilling for Bridge 14 forty-three (43) feet or greater from existing occupied structures, if feasible.
- Staging areas shall be adjusted and temporary fencing shall be installed to ensure that loaded trucks shall not operate within 13 feet of existing structures.

Significance after Mitigation

Implementation of Mitigation Measure 4.10-3 would reduce project-generated on-site groundborne vibration and noise levels during construction activities below FTA recommendations for preventing structural damage to off-site buildings and limit annoyance of area residents and noise- and vibration-sensitive businesses. As a result, this impact would be reduced to a **less-than-significant** level. Under Alignment Option 5A, if the caisson drilling for Bridge #14 cannot feasibly be located greater than 43 feet from occupied structures, vibration human disturbance impacts would be **significant and unavoidable** for Alignment Option 5A.