Railroad Safety Trail **NSR**

Noise Study Report

Railroad Safety Trail
City of San Luis Obispo, San Luis Obispo County, California
05-SLO-California Blvd

Federal Project ATP-5016(057)

February 2016

Caltrans
CALIFORNIA DEPARTMENT OF TRANSPORTATION

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STATE OF CALIFORNIA
Department of Transportation
City of San Luis Obispo

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Chapter 1.0 Introduction

1.1 PURPOSE OF THE NOISE STUDY REPORT

The purpose of a Noise Study Report (NSR) is to evaluate noise impacts and abatement under the requirements of Title 23, Part 772 of the Code of Federal Regulations (23 CFR 772) "Procedures for Abatement of Highway Traffic Noise." 23 CFR 772 provides procedures for preparing operational and construction noise studies and evaluating noise abatement considered for Federal and Federal-aid highway projects. According to 23 CFR 772.3, all highway projects that are developed in conformance with this regulation are deemed to be in conformance with Federal Highway Administration (FHWA) noise standards. Compliance with 23 CFR 772 provides compliance with the noise impact assessment requirements of the National Environmental Policy Act (NEPA).

The Caltrans Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects (Protocol) (Caltrans 2011) provides Caltrans policy for implementing 23 CFR 772 in California. The Protocol outlines the requirements for preparing a NSR.

As required by the Local Assistance Procedures Manual, a Preliminary Environmental Study (PES) form was completed for the City of San Luis Obispo Railroad Safety Trail Project (Project). As indicated on the PES form, the proposed project is not a Type I or Type II project as defined in 23 CFR 772.5, as it would not increase the number of lanes or substantially change the vertical or horizontal alignment, or involve noise abatement on an existing highway. As a Type III project, noise analysis is not required under 23 CFR 772.

However, residences and other land uses are located adjacent to the project site and construction noise impacts may occur. This NSR was prepared to identify potential construction noise impacts under NEPA and the California Environmental Quality Act (CEQA), including compliance with local noise standards (City of San Luis Obispo Noise Control Ordinance).

1.2 PROJECT PURPOSE AND NEED

The Project area (California Boulevard corridor) is heavily travelled by pedestrians and bicyclists accessing California Polytechnic State University, San Luis Obispo (Cal Poly). Due to safety concerns, a safe and direct pedestrian/bicycle route between Cal Poly and the San Luis Obispo Amtrak station is needed. In 2001, the City of San Luis Obispo adopted a preferred alignment for the Railroad Safety Trail Project, which would span 1.4 miles within the City limits and primarily located within the Union Pacific Railroad (UPRR) right of way. This Class I bicycle trail and multi-use pathway is proposed to serve bicyclists, pedestrians, and roller-bladers. The Trail would also promote alternative forms of transportation and provide new recreational opportunities consistent with the goals set forth in the City's Bicycle Transportation Plan.

Chapter 2.0 Project Description

2.1 PROJECT COMPONENTS

Trail Alignment. The proposed Project is comprised of a 1,700-foot-long segment of the Railroad Safety Trail. The Project is a Class I multi-use bike path extending from the existing bike lane on California Boulevard at Taft Street along California Boulevard and the UPRR tracks to Pepper Street. The Trail would serve both pedestrians and two-way directional traffic for bicyclists. The proposed Trail segment consists of a 12-foot-wide wide multi-use path with two foot-wide paved shoulders. The Trail would consist of a structural section of asphalt concrete laid over an aggregate base.

The proposed Trail alignment begins on the west side of California Boulevard at Taft Street and continues south and parallel to the existing UPRR right of way. The Trail would cross over U.S. 101 on the existing California Boulevard overcrossing structure, then turn southwest between the California Highway Patrol property and the UPRR right of way and continue along the UPRR right-of-way to the western terminus (cul-de-sac) of Phillips Lane. The Trail alignment then continues west and crosses the UPRR tracks via a new bridge structure, where the Trail alignment meets to Pepper Street. The final portion of the Trail alignment continues south along the eastern shoulder of Pepper Street.

Drainage. The Project would result in the loss of a storm water detention basin located between the California Highway Patrol property and the UPRR tracks. To replace the function of the basin, a v-ditch would be constructed, and maintained for approximately 500 linear feet. The storm water collected in the basin currently drains to a headwall and pipe inlet near the U.S. 101 right-of- way. To maintain the existing drainage pattern, the storm water collected in the proposed v-ditch would flow to an open pipe inlet and an 18-inch diameter pipe that would connect the drainage inlet to the headwall and drain at the same location. Existing storm drain pipes that outfall from the California Highway Patrol property would be maintained and would outfall into the proposed v-ditch instead of the existing basin.

Right-of-Way. The City would need to obtain a permanent easement or right-of-way take from UPRR, Department of General Services (regarding the California Highway Patrol property) and two private properties near the Phillips Lane cul-de-sac. Temporary construction easements would be needed from UPRR and one private property.

Traffic. With the new Trail located on the existing California Boulevard/U.S. 101 overcrossing (Bridge No. 49C-0079) there is the potential need for a traffic management plan, due to the potential effect on U.S. 101 ramp operations. California Boulevard would need to be re-striped to accommodate the reduction of available space for traffic on the U.S. 101 overcrossing, which would reduce the number of northbound travel lanes from two to one.

Overcrossing Modifications and Retaining Walls. The existing California Boulevard/U.S. 101 overcrossing would need to be modified to include a raised curb and picket railing to separate the Trail from vehicle traffic. The existing sidewalk barrier (west side) would remain unmodified. Due to slopes just east of the UPRR tracks, a number of retaining walls/approach structures would be required to minimize earthwork within the UPRR right-of-way.

Bridge. The Trail would cross the UPRR tracks and connect to Pepper Street using a single-span prefabricated steel truss bridge, which would be approximately 97 feet in length. A reinforced concrete abutment would support each end of the truss bridge and provide the transitions (landings) between the retaining walls/approach structures and the bridge. The bridge abutments would be supported by 84-inch diameter cast-in-drilled-hole reinforced concrete piles.

2.2 CONSTRUCTION

A staged construction concept would be implemented. Temporary lane closures along California Boulevard on the overcrossing, as well as Pepper Street near Phillips Lane would be required. Temporary traffic control devices would be used to limit public access to the bulb (end) of the Phillips Lane cul-de-sac during the bridge and retaining wall construction.

Construction staging areas have yet to be identified; however, the California Highway Patrol parking lot may be considered for a construction staging area.

Chapter 3.0 Fundamentals of Traffic Noise

The following is a brief discussion of fundamental traffic noise concepts. For a detailed discussion, refer to Caltrans' Technical Noise Supplement (TeNS) (Caltrans 2013), a technical supplement to the Protocol that is available on the Caltrans website (http://www.dot.ca.gov/hq/env/noise/pub/TeNS_Sept_2013B.pdf).

3.1 SOUND, NOISE, AND ACOUSTICS

Sound can be described as the mechanical energy of a vibrating object transmitted by pressure waves through a liquid or gaseous medium (e.g., air) to a hearing organ, such as a human ear. Noise is defined as loud, unexpected, or annoying sound. In the science of acoustics, the fundamental model consists of a sound (or noise) source, a receiver, and the propagation path between the two. The loudness of the noise source and obstructions or atmospheric factors affecting the propagation path to the receiver determines the sound level and characteristics of the noise perceived by the receiver. The field of acoustics deals primarily with the propagation and control of sound.

3.2 FREQUENCY

Continuous sound can be described by frequency (pitch) and amplitude (loudness). A low-frequency sound is perceived as low in pitch. Frequency is expressed in terms of cycles per second, or Hertz (Hz) (e.g., a frequency of 250 cycles per second is referred to as 250 Hz). High frequencies are sometimes more conveniently expressed in kilohertz (kHz), or thousands of Hertz. The audible frequency range for humans is generally between 20 Hz and 20,000 Hz.

3.3 SOUND PRESSURE LEVELS AND DECIBELS

The amplitude of pressure waves generated by a sound source determines the loudness of that source. Sound pressure amplitude is measured in micro-Pascals (mPa). One mPa is approximately one hundred billionth (0.00000000001) of normal atmospheric pressure. Sound pressure amplitudes for different kinds of noise environments can range from less than 100 to 100,000,000 mPa. Because of this huge range of values, sound is rarely expressed in terms of mPa. Instead, a logarithmic scale is used to describe sound pressure level (SPL) in terms of decibels (dB). The threshold of hearing for young people is about 0 dB, which corresponds to 20 mPa.

3.4 ADDITION OF DECIBELS

Because decibels are logarithmic units, SPL cannot be added or subtracted through ordinary arithmetic. Under the decibel scale, a doubling of sound energy corresponds to a 3-dB increase. In other words, when two identical sources are each producing sound of the same loudness, the resulting sound level at a given distance would be 3 dB higher than one source under the same conditions. For example, if one automobile produces an SPL of 70 dB when it passes an observer, two cars passing simultaneously would not produce 140 dB, rather they would combine to produce 73 dB. Under the decibel scale, three sources of equal loudness together produce a sound level approximately 5 dB louder than one source.

3.5 A-WEIGHTED DECIBELS

The decibel scale alone does not adequately characterize how humans perceive noise. The dominant frequencies of a sound may have a substantial effect on the human response to that sound. Although the intensity (energy per unit area) of a sound is a purely physical quantity, the loudness or human response is determined by the characteristics of the human ear.

Human hearing is limited in the range of audible frequencies as well as in the way it perceives the SPL in that range. In general, people are most sensitive to the frequency range of 1,000–8,000 Hz, and perceive sounds within that range better than sounds of the same amplitude in higher or lower frequencies. To approximate the response of the human ear, sound levels of individual frequency bands are weighted, depending on the human sensitivity to those frequencies. Then, an "A-weighted" sound level (expressed in units of dBA) can be computed based on this information.

The A-weighting method approximates the frequency response of the average young ear when listening to most ordinary sounds. When people make judgments of the relative loudness or annoyance of a sound, their judgments correlate well with the A-scale sound levels of those sounds. Other weighting methods have been devised to address high noise levels or other special problems (e.g., B-, C-, and D-scales), but these scales are rarely used in conjunction with highway traffic noise. Noise levels for traffic noise reports are typically reported in terms of A-weighted decibels or dBA. Table 1 describes typical A-weighted noise levels for various noise sources.

Table 1. Typical A-Weighted Noise Levels

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	— 110 —	Rock band
Jet fly-over at 1000 feet		
	— 100 —	
Gas lawn mower at 3 feet		
	— 90 —	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	— 80 —	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawn mower, 100 feet	**— 70 —**	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	**— 60 —**	
		Large business office
Quiet urban daytime	**— 50 —**	Dishwasher next room
Quiet urban nighttime	**— 40 —**	Theater, large conference room (background)
Quiet suburban nighttime		
	— 30 —	Library
Quiet rural nighttime		Bedroom at night, concert
	— 20 —	
		Broadcast/recording studio
	— 10 —	
Lowest threshold of human hearing	**— 0 —**	Lowest threshold of human hearing

Source: Caltrans 2013.

3.6 HUMAN RESPONSE TO CHANGES IN NOISE LEVELS

As discussed above, doubling sound energy results in a 3 dB increase in sound. However, given a sound level change measured with precise instrumentation, the subjective human perception of a doubling of loudness will usually be different than what is measured.

Under controlled conditions in an acoustical laboratory, the trained, healthy human ear is able to discern 1 dB changes in sound levels, when exposed to steady, single-frequency ("pure-tone") signals in the mid-frequency (1,000 Hz–8,000 Hz) range. In typical noisy environments, changes in noise of 1 to 2 dB are generally not perceptible. However, it is widely accepted that people are able to begin to detect sound level increases of 3 dB in typical noisy environments. Further, a 5 dB increase is generally perceived as a distinctly noticeable increase, and a 10 dB increase is generally perceived as a doubling of loudness. Therefore, a doubling of sound energy (e.g., doubling the volume of traffic on a highway) that would result in a 3 dB increase in sound, would generally be perceived as barely detectable.

3.7 NOISE DESCRIPTORS

Noise in our daily environment fluctuates over time. Some fluctuations are minor, but some are substantial. Some noise levels occur in regular patterns, but others are random. Some noise levels fluctuate rapidly, but others slowly. Some noise levels vary widely, but others are relatively constant. Various noise descriptors have been developed to describe time-varying noise levels. The following are the noise descriptors most commonly used in traffic noise analysis.

Equivalent Sound Level (L_{eq}): L_{eq} represents an average of the sound energy occurring over a specified period. The 1-hour A-weighted equivalent sound level (L_{eq}[h]) is the energy average of A-weighted sound levels occurring during a one-hour period, and is the basis for noise abatement criteria (NAC) used by Caltrans and FHWA.

Percentile-Exceeded Sound Level (L_{xx}): L_{xx} represents the sound level exceeded for a given percentage of a specified period (e.g., L_{10} is the sound level exceeded 10% of the time, and L_{90} is the sound level exceeded 90% of the time).

Maximum Sound Level (L_{max}): L_{max} is the highest instantaneous sound level measured during a specified period.

Day-Night Level (L_{dn}): L_{dn} is the energy average of A-weighted sound levels occurring over a 24-hour period, with a 10 dB penalty applied to A-weighted sound levels occurring during nighttime hours between 10 p.m. and 7 a.m.

Community Noise Equivalent Level (CNEL): Similar to L_{dn}, CNEL is the energy average of the A-weighted sound levels occurring over a 24-hour period, with a 10 dB penalty applied to A-weighted sound levels occurring during the nighttime hours between 10 p.m. and 7 a.m., and a 5 dB penalty applied to the A-weighted sound levels occurring during evening hours between 7 p.m. and 10 p.m.

3.8 SOUND PROPAGATION

When sound propagates over a distance, it changes in level and frequency content. The manner in which noise reduces with distance depends on the following factors.

3.8.1 Geometric Spreading

Sound from a localized source (i.e., a point source) propagates uniformly outward in a spherical pattern. The sound level attenuates (or decreases) at a rate of 6 decibels for each doubling of distance from a point source. Highways consist of several localized noise sources on a defined path, and hence can be treated as a line source, which approximates the effect of several point sources. Noise from a line source propagates outward in a cylindrical pattern, often referred to as cylindrical spreading. Sound levels attenuate at a rate of 3 decibels for each doubling of distance from a line source.

3.8.2 Ground Absorption

The propagation path of noise from a highway to a receiver is usually very close to the ground. Noise attenuation from ground absorption and reflective-wave canceling adds to the attenuation associated with geometric spreading. Traditionally, the excess attenuation has also been expressed in terms of attenuation per doubling of distance. This approximation is usually sufficiently accurate for distances of less than 200 feet. For acoustically hard sites (i.e., sites with a reflective surface between the source and the receiver, such as a parking lot or body of water,), no excess ground attenuation is assumed. For acoustically absorptive or soft sites (i.e., those sites with an absorptive ground surface between the source and the receiver, such as soft dirt, grass, or scattered bushes and trees), an excess ground-attenuation value of 1.5 decibels per doubling of distance is normally assumed. When added to the cylindrical spreading, the excess ground attenuation results in an overall drop-off rate of 4.5 decibels per doubling of distance.

3.8.3 Atmospheric Effects

Receptors located downwind from a source can be exposed to increased noise levels relative to calm conditions, whereas locations upwind can have lowered noise levels. Sound levels can be increased at large distances (e.g., more than 500 feet) from the highway due to atmospheric temperature inversion (i.e., increasing temperature with elevation). Other factors such as air temperature, humidity, and turbulence can also have significant effects.

3.8.4 Shielding by Natural or Human-Made Features

A large object or barrier in the path between a noise source and a receiver can substantially attenuate noise levels at the receiver. The amount of attenuation provided by shielding depends on the size of the object and the frequency content of the noise source. Natural terrain features (e.g., hills and dense woods) and human-made features (e.g., buildings and walls) can substantially reduce noise levels. Walls are often constructed between a source and a receiver specifically to reduce noise. A barrier that breaks the line of sight between a source and a receiver will typically result in at least 5 dB of noise reduction. Taller barriers provide increased noise reduction. Vegetation between the highway and receiver is rarely effective in reducing noise because it does not create a solid barrier.

Chapter 4.0 Regulatory Requirements and Standards

4.1 FEDERAL REGULATIONS

4.1.1 23 CFR 772

23 CFR 772 provides procedures for preparing operational and construction noise studies and evaluating noise abatement considered for federal and Federal-aid highway projects. Under 23 CFR 772.7, projects are categorized as Type I, Type II, or Type III projects.

FHWA defines a Type I project as a proposed federal or federal-aid highway project for the construction of a highway on a new location or the physical alteration of an existing highway which significantly changes either the horizontal or vertical alignment of the highway. The following projects are also considered to be Type I projects:

- The addition of a through-traffic lane(s), including the addition of a through-traffic lane that functions as a high-occupancy vehicle lane, high-occupancy toll lane, bus lane, or truck climbing lane.
- The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane.
- The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange.
- Restriping existing pavement for the purpose of adding a through traffic lane or an auxiliary lane.
- The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot, or toll plaza.

If a project includes components listed above, the entire project as defined in the environmental document is assessed as required for a Type I project.

A Type II project is a noise barrier retrofit project that involves no changes to highway capacity or alignment. A Type III project is a project that does not meet the classifications of a Type I or Type II project. Type III projects do not require a noise analysis under 23 CFR 772.

Under 23 CFR 772.11, noise abatement must be considered for Type I projects if the project is predicted to result in a traffic noise impact. In such cases, 23 CFR 772 requires that the project sponsor "consider" noise abatement before adoption of the final NEPA document. This process involves identification of noise abatement measures that are reasonable, feasible, and likely to be incorporated into the project, and of noise impacts for which no apparent solution is available.

Traffic noise impacts, as defined in 23 CFR 772.5, occur when the predicted noise level in the design-year approaches or exceeds the NAC specified in 23 CFR 772, or a predicted noise level substantially exceeds the existing noise level (a "substantial" noise increase). 23 CFR 772 does not specifically define the terms "substantial increase" or "approach"; these criteria are defined in the Protocol, as described in Section 4.1.2.

Note that the NAC address long-term traffic noise, and not short-term construction noise. 23 CFR 772.19 states that land uses affected by noise from construction of Type I and II projects must be identified, measures to minimize or eliminate adverse construction noise impacts must be identified, and these measures must be incorporated into the project's plans and specifications.

Table 2 summarizes NAC corresponding to various land use activity categories. Activity categories and related traffic noise impacts are determined based on the actual or permitted land use in a given area.

Table 2. Activity Categories and Noise Abatement Criteria

Activity Category	NAC, Hourly A-Weighted Noise Level (dBA L_{eq}[h])[1]	Description of Activities
A	57 Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose
B[2]	67 Exterior	Residential
C[2]	67 Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or non-profit institutional structures, radio studios, recording studios, recreational areas, Section 4(f) sites, schools, television studios, trails and trail crossings
D	52 Interior	Auditoriums, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or non-profit institutional structures, radio studios, recording studios, schools, television studios
E	72 Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A–D or F.
F		Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G		Undeveloped lands without specific land use designations or zoning.

[1] The L_{eq}(h) activity criteria values are for impact determination only and are not design standards for noise abatement measures. All values are A-weighted decibels (dBA).

[2] Includes undeveloped lands zoned or permitted for this activity category.

4.1.2 Traffic Noise Analysis Protocol for New Highway Construction and Reconstruction Projects

The Protocol specifies the policies, procedures, and practices to be used by agencies that sponsor new construction or reconstruction of federal or Federal-aid highway projects. The Protocol defines a noise increase as substantial when the predicted noise levels with project implementation exceed existing noise levels by 12 dBA or more. The Protocol also states that a sound level is considered to approach an NAC level when the sound level is within 1 dB of the NAC identified in 23 CFR 772 (e.g., 66 dBA is considered to approach the NAC of 67 dBA, but 65 dBA is not).

The Technical Noise Supplement to the Protocol provides detailed technical guidance for the evaluation of highway traffic noise. This includes field measurement methods, noise modeling methods, and report preparation guidance.

4.2 STATE REGULATIONS AND POLICIES

4.2.1 California Environmental Quality Act

Noise analysis under CEQA is completely independent of the 23 CFR 772 analysis done for NEPA. Under CEQA, the baseline noise level is compared to the build noise level. The assessment entails looking at the setting of the noise impact and then how large or perceptible any noise increase would be in the given area. Key considerations include the uniqueness of the setting, the sensitive nature of the noise receptors, the magnitude of the noise increase, the number of residences affected, and the absolute noise level. Other considerations addressed in a CEQA noise impact analysis may include compliance with policies and standards provided in general plan noise elements and local noise ordinances.

The significance of noise impacts under CEQA are addressed in the environmental document rather than the NSR. Even though the NSR does not specifically evaluate the significance of noise impacts under CEQA, this NSR contains technical information needed to make that determination in the environmental document.

4.2.2 Section 216 of the California Streets and Highways Code

This Section relates to the noise effects of a proposed freeway project on public and private elementary and secondary schools. Under this code, a noise impact occurs if, as a result of a proposed freeway project, noise levels exceed 52 dBA L_{eq}(h) in the interior of public or private elementary or secondary classrooms, libraries, multipurpose rooms, or spaces. This requirement does not replace the "approach or exceed" NAC criterion for FHWA Activity Category E for classroom interiors, but it is a requirement that must be addressed in addition to the requirements of 23 CFR 772.

If a project results in a noise impact under this code, noise abatement must be provided to reduce classroom noise to a level that is at or below 52 dBA L_{eq}(h). If the noise levels generated from freeway and roadway sources exceed 52 dBA L_{eq}(h) prior to the construction of the proposed freeway project, then noise abatement must be provided to reduce the noise to the level that existed prior to construction of the project.

4.3 CITY OF SAN LUIS OBISPO

4.3.1 General Plan

The City's General Plan Noise Element includes standards for the acceptability of noise sensitive uses to be constructed near transportation noise sources (refer to Table 3). In addition, the Noise Element includes maximum noise exposure levels for proposed new transportation noise sources, including:

- Outdoor activity area standard of 60 dBA L_{dn} (or CNEL) for residences, hotels, motels hospitals, nursing homes, theaters, auditoriums, music halls, churches, meeting halls, office buildings and mortuaries.
- Indoor standard of 45 dBA L_{dn} (or CNEL) for residences, hotels, motels hospitals and nursing homes.
- Indoor standard of 35 dBA L_{eq}(h) for theaters, auditoriums and music halls.
- Indoor standard of 45 dBA L_{eq}(h) for churches, meeting halls, office buildings and mortuaries.

Table 3. Acceptability of New Noise-Sensitive Uses Exposed to Transportation Noise Sources

Land Use Category	Community Noise Exposure Ldn or CNEL, dBA						
		55	60	65	70	75	80
Residences, Theaters, Auditoriums, Music Halls	Acceptable	Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable	Unacceptable	Unacceptable
Motels, Hotels	Acceptable	Acceptable	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable	Unacceptable
Schools, Libraries, Churches, Hospitals, Nursing Homes, Meeting Halls, Churches, Mortuaries	Acceptable	Acceptable	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable	Unacceptable
Playgrounds	Acceptable	Acceptable	Acceptable	Acceptable	Conditionally Acceptable	Unacceptable	Unacceptable
Office Buildings	Acceptable	Acceptable	Conditionally Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable	Unacceptable
Neighborhood Parks	Acceptable	Acceptable	Acceptable	Conditionally Acceptable	Conditionally Acceptable	Unacceptable	Unacceptable

(light grey)	Acceptable: development may be permitted without specific noise studies or mitigation.
(dark grey)	Conditionally Acceptable: development may be permitted if designed to meet noise exposure standards; a specific noise study is usually required.
(black)	Unacceptable: development with acceptable noise exposure is generally not possible.

Source: City of San Luis Obispo General Plan Noise Element, 1996

The Noise Element also includes maximum noise exposure levels for proposed new noise-sensitive uses due to existing stationary noise sources, including:

- Daytime (7 a.m. to 10 p.m.) standard of 50 dBA L_{eq}(h).
- Nighttime (10 p.m. to 7 a.m.) standard of 45 dBA L_{eq}(h).

These City standards do not apply to the proposed project as it consists of a bicycle/pedestrian trail and not a roadway or railroad line. Therefore, operational noise would be limited to user's voices, and bicycle tire and chain noise, which is typical of surrounding residential and commercial land uses and would not cause exceedances of noise exposure levels.

4.3.2 Noise Control Ordinance

Section 9.12 of the City's Municipal Code provides standards for noise generation to control excessive and annoying noise and vibration in the City. The proposed project would be subject to this ordinance. Section 9.12.050.6 provides noise restrictions associated with operation of construction equipment, which are summarized in Table 4.

Table 4. City Construction Noise Restrictions (dBA L_{eq})

Time Period	Single-family Residential	Multi-family Residential	Mixed Residential & Commercial	Business Properties
Mobile Equipment (less than 10 days)				
Daily from 7 a.m. to 7 p.m., except Sundays and legal holidays	75 dBA	80 dBA	85 dBA	85 dBA
Daily from 7 p.m. to 7 a.m., and all day on Sundays and legal holidays	60 dBA	65 dBA	70 dBA	85 dBA
Stationary Equipment (10 days or more)				
Daily from 7 a.m. to 7 p.m., except Sundays and legal holidays	60 dBA	65 dBA	70 dBA	75 dBA
Daily from 7 p.m. to 7 a.m., and all day on Sundays and legal holidays	50 dBA	55 dBA	60 dBA	75 dBA

Source: City of San Luis Obispo Municipal Code

Chapter 5.0 Study Methods and Procedures

The proposed bicycle/pedestrian multi-use trail would not generate any vehicle trips or modify local traffic patterns, such that no long-term noise increases would occur. Therefore, this NSR focuses on short-term construction noise and utilizes the Roadway Construction Noise Model (RCNM) developed by FHWA (2006).

5.1 SELECTION OF RECEIVERS AND MEASUREMENT SITES

Land uses adjacent to the construction impact area were selected as receivers, including residential and commercial land uses. Receivers assessed include the following:

1. Multi-family residential east of Hathway Avenue (near STA 10+00 to 13+00).
2. Single-family residential east of Hathway Avenue (near STA 13+00 to 14+00).
3. Office buildings south of California Boulevard (near STA 19+00 to 23+00).
4. Multi-family residential east of Johnson Avenue (near STA 19+00 to 24+00).
5. Single-family residential west of Pepper Street (near STA 25+00 to 27+00).

Measurement sites were selected to characterize the noise environment of these and nearby receivers.

5.2 FIELD MEASUREMENT

Short-term, daytime noise levels were measured at four locations:

M1. California Highway Patrol parking lot near California Boulevard, representing receiver 3.

M2. Sidewalk near 785 Pepper Street, representing receiver 5.

M3. Sidewalk at 640 Johnson Avenue, representing receiver 4.

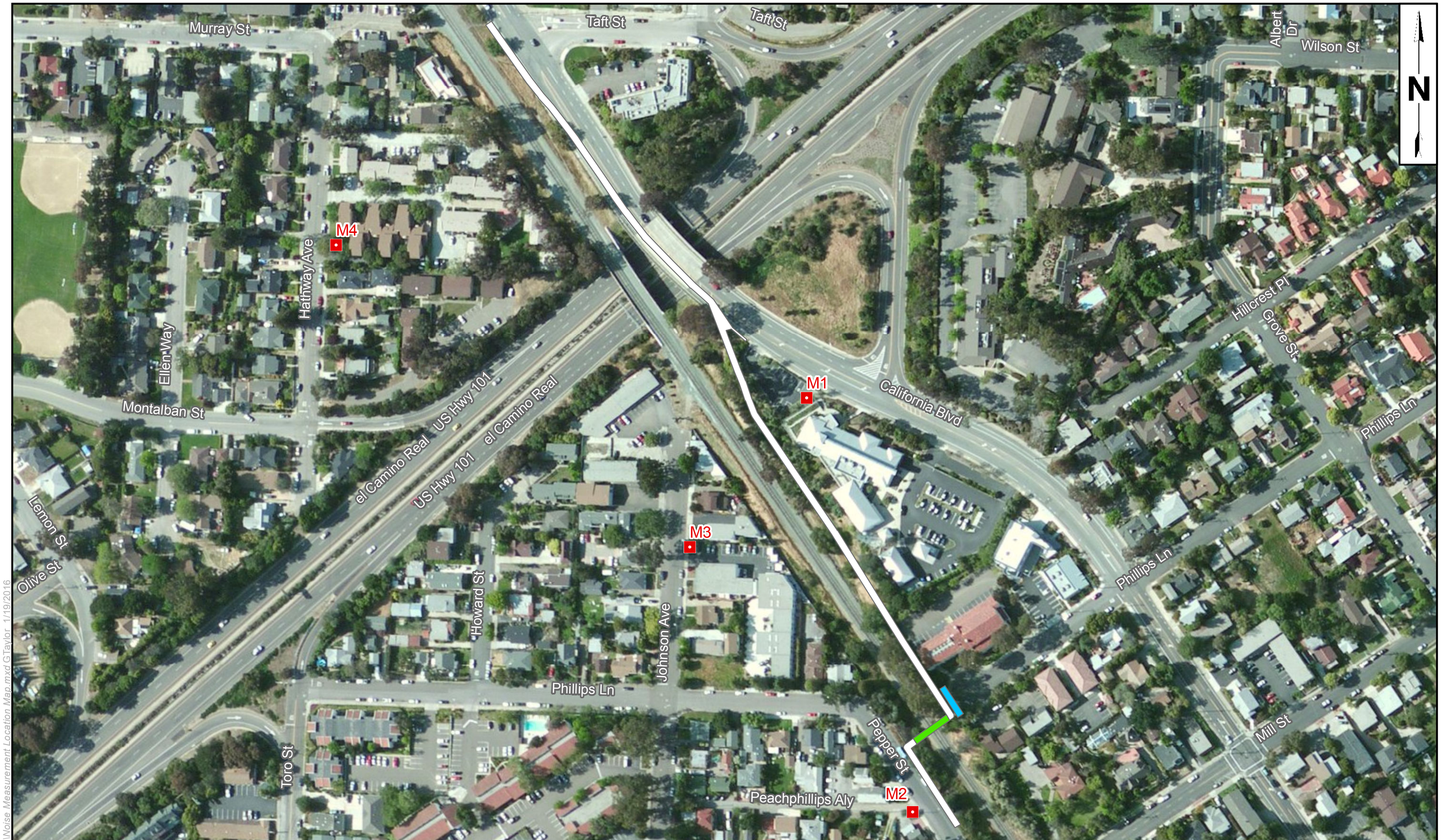
M4. Sidewalk near 528 Hathway Avenue, representing receivers 1 and 2.

The location of each noise measurement is provided in Exhibit A. Measurements were conducted on January 15, 2016 using a Larson-Davis LXT Type 1 precision integrating sound level meter. The meter was calibrated using a Larson-Davis CAL200 Calibrator which generates a known sound level of 114.0 dBA. Measurements were conducted for 20 minutes on a weekday morning.

5.3 NOISE PREDICTION

The RCNM is FHWA's national model for the prediction of construction noise. The RCNM is based on the noise prediction calculations and the equipment database used in the Central Artery/Tunnel project in Boston, Massachusetts, which is the largest urban construction project ever conducted in the United States.

The RCNM allows the estimation of three key metrics of interest: Lmax, Leq, and L10 at receptor locations for a construction operation that can include up to 20 pieces of equipment. RCNM allows for user-defined construction equipment and user-defined noise limit criteria. The two main uses of the RCNM are to allow typical computer users to: 1) easily predict noise emissions from construction equipment, and 2) determine a construction work plan's compliance with noise criteria limits. A variety of construction work scenarios can be created quickly, allowing the user to determine the impact of changing construction equipment and adding/removing the effects of shielding due to noise mitigation devices such as barriers.



LEGEND:

- Noise Measurement Location
- Phillips Lane Connection
- Proposed Bridge
- Proposed Path Alignment

Source: ESRI Online Basemap, TIGER Centerlines, County of San Luis Obispo
Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Notes: This map was created for informational and display purposes only.

0 125 250
Feet

padre associates, inc.
ENGINEERS, GEOLOGISTS & ENVIRONMENTAL SCIENTISTS

PROJECT NAME:
RAILROAD SAFEY TRAIL
SAN LUIS OBISPO COUNTY, CA

PROJECT NUMBER: 1502-2211

DATE: January 2016

NOISE MEASUREMENT LOCATION MAP

FIGURE 1

Z:\Kristin\GIS Maps\Map Project\Railroad Safety Trail\Noise Measurement Location Map.mxd GTaylor 1/19/2016

Chapter 6.0 Existing Noise Environment

The noise environment of the project area is dominated by vehicle traffic on U.S. 101 (trail alignment crosses over U.S. 101), rail traffic on the UPRR tracks (within 30 feet of the trail alignment), and local traffic (including California Boulevard). Other noise sources include outdoor activities (baseball, basketball, skating) at Santa Rosa Park, and landscape maintenance activities at surrounding residential and commercial land uses.

Table 5 presents noise monitoring data collected on January 15, 2016 at four locations which represent current noise levels at nearby residential and commercial noise receivers. The location of each noise measurement site is provided in Exhibit A. Noise monitoring forms are included as Appendix A.

Table 5. Current (2016) Measured Noise Levels adjacent to the Trail Alignment (dBA L_{eq})

Measurement Location	Time	Distance to Primary Noise Source (feet)[1]	Distance to Trail Construction Area (feet)	dBA L_{eq}
M1: California Highway Patrol parking lot near California Boulevard	9:14-9:34 a.m.	340	50	61.5
M2: sidewalk near 785 Pepper Street	9:42-10:02 a.m.	1,000	50	54.9
M3: sidewalk at 640 Johnson Avenue	10:10-10:30 a.m.	380	180	54.6
M4: sidewalk near 528 Hathway Avenue[2]	10:40-11:00 a.m.	400	450	56.7

[1] U.S. 101 centerline

[2] Measured noise value may be higher than typical due to portable generator/pump operation across the street

Table 6 provides an estimate of existing noise levels at project receivers based on noise contours for roadways and railroad lines taken from the City's Noise Guidebook (1990 data). However, these highway noise contours represent higher than actual noise levels due to shielding by intervening topography (not included in the modeling), which is present at each project receiver. Existing (2016) noise levels may be higher than 1990 modeled values presented in Table 6 due to the likely increase in traffic and rail volumes. Based on data presented in Table 6, existing residential receivers are located in areas considered to be only conditionally acceptable due to exposure to transportation noise (refer to Table 3).

Table 6. Estimated Existing Noise Levels at Project Receivers from the City's Noise Guidebook (dBA L_{dn})

	U.S. 101 Noise (1990 data)		Railroad Noise (1990 data)	
Receiver	**Distance to U.S. 101 Center-line (feet)**	**dBA L_{dn}**	**Distance to Track Center-line (feet)**	**dBA L_{dn}**
Multi-family residential east of Hathway Avenue	250	65-70	70	60-65
Single-family residential east of Hathway Avenue	125	>70	65	60-65
Office buildings south of California Boulevard	375	65-70	65	60-65
Multi-family residential east of Johnson Avenue	300	65-70	60	60-65
Single-family residential west of Pepper Street	825	60-65	115	60

Chapter 7.0 Construction Noise

The proposed project is not a Type I or Type II project as defined in 23 CFR 772.5; therefore, this analysis is limited to construction noise.

7.1 METHODOLOGY

The FHWA Roadway Construction Noise Model was used to estimate construction noise at residential and commercial noise receivers for comparison to the NAC (Table 2) and City of San Luis Obispo construction noise restrictions (Table 4). Two construction scenarios were developed for noise modeling, including railroad bridge construction and trail construction. Equipment assumed to be operating on a peak day during bridge construction include a rotary drill rig and wheeled loader. Equipment assumed to be operating on a peak day during trail construction include a wheeled loader, motor grader and roller compactor. Model inputs and outputs are provided in Appendix B.

7.2 FEDERAL REQUIREMENTS (23 CFR 772)

The results of construction noise modeling are provided in Table 7. Construction of the proposed project would cause the NAC to be exceeded. The NAC are not applicable to short-term construction noise, and the proposed trail is not a Type I or Type II project. Therefore, the mandate of 23 CFR 772.19 to identify and mitigate adverse construction noise impacts is not applicable.

Table 7. Comparison of the NAC to the Roadway Construction Noise Model Results (dBA L_{eq})

Receiver	NAC	Modeling Scenario	Construction Peak Noise Levels	Approach or Exceed the NAC?
Multi-family residential east of Hathway Avenue	67	Trail construction	73.6	Yes
Single-family residential east of Hathway Avenue	67	Trail construction	73.6	Yes
Office buildings south of California Boulevard	72	Trail construction	77.8	Yes
Multi-family residential east of Johnson Avenue	67	Trail construction	73.6	Yes
Single-family residential west of Pepper Street	67	Pile drilling for bridge abutments	76.1	Yes

No adverse noise impacts from construction are anticipated because construction would be conducted in accordance with Caltrans Standard Specifications Section 14-8 (Noise & Vibration) and applicable local noise standards. Construction noise would be short-term, intermittent, and overshadowed by local traffic noise. Further, implementing the following measures would minimize the temporary noise impacts from construction:

- All equipment will have sound-control devices that are no less effective than those provided on the original equipment. No equipment will have an unmuffled exhaust.
- As directed by Caltrans, the contractor will implement appropriate additional noise mitigation measures, including changing the location of stationary construction equipment, turning off idling equipment, rescheduling construction activity, notifying adjacent residents in advance of construction work, and installing acoustic barriers around stationary construction noise sources.

7.3 CITY OF SAN LUIS OBISPO NOISE STANDARDS

The results of construction noise modeling as compared to construction noise restrictions of the City's Municipal Code are provided in Table 8. Noise generated by pile drilling (and other bridge construction activities) at the proposed bridge site would result in exceedances of the construction noise restrictions at residences along Pepper Street.

Table 8. Comparison of City Construction Noise Restrictions to the Roadway Construction Noise Model Results (dBA L_{eq})

Receiver	Applicable Restriction	Modeling Scenario	Construction Peak Noise Levels	Exceed Noise Restriction?
Multi-family residential east of Hathway Avenue	80[1]	Trail construction	73.6	No
Single-family residential east of Hathway Avenue	75[1]	Trail construction	73.6	No
Office buildings south of California Boulevard	85[1]	Trail construction	77.8	No
Multi-family residential east of Johnson Avenue	80[1]	Trail construction	73.6	No
Single-family residential west of Pepper Street	60	Pile drilling for bridge abutment	76.1	**Yes**

[1] The mobile noise restriction is used as construction equipment would not be at any one location for 10 days or more

As required by CEQA, construction noise minimization measures will be included in the environmental document, likely including the following measures:

- At least twenty (20) days prior to commencement of construction, the contractor shall provide written notice to all property owners, businesses, and residents within 300 feet of the trail alignment. The notice shall contain a description of the project, the construction schedule, including days and hours of construction, the name and phone number of the City's project environmental coordinator and contractor(s), site rules and conditions of approval pertaining to construction activities.

- Construction (including preparation for construction work, such as equipment transportation) shall only be permitted Monday through Saturday between the hours of 7:00 a.m. and 7:00 p.m. Construction shall not occur on legal holidays.
- All construction equipment, including trucks and stationary equipment, shall be professionally maintained and fitted with standard manufacturers' mufflers, silencing devices and engine covers.
- Temporary construction noise barriers (blanket type or non-reflective solid type, minimum 10 feet tall at road grade, rated at STC-25 or better) shall be installed and maintained between pile drilling work areas and affected residences on Pepper Street during bridge construction. Noise levels shall be monitored for compliance.

Chapter 8.0 References

California Department of Transportation. 2011. *Traffic Noise Analysis Protocol*.

California Department of Transportation. 2013. *Technical Supplement to the Traffic Noise Analysis Protocol*.

City of San Luis Obispo. 1996a. *General Plan Noise Element*.

City of San Luis Obispo. 1996b. Noise *Guidebook; Measurement & Mitigation Techniques*.

City of San Luis Obispo. undated. Municipal Code Section 9.12.

Federal Highway Administration. 2006. *Roadway Construction Noise Model.*

APPENDIX A

NOISE MEASUREMENT DATA SHEETS

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AMBIENT NOISE MEASUREMENT DATA SHEET

Project Name: Railroad Safety Trail
Project Number: 1502-2211

M Location: CHP office - M1
Date: 1/15/16

Operator: Ingamells
Day of Week: Friday

Conditions: Sky Cloudy, some sun
Wind ~1-3 mph

Noise Sources: Traffic on California Ave, and U.S. 101
Union Pacific Railroad tracks ~120' away, no rail traffic

Distance from Primary Source: 27 ft to curb, (see Google Earth)

Begin Time: 914
End Time: 934

Leq: 61.5
Lmax:

SEL:
Lmin:

Notes: Topographic attenuation of U.S. 101 traffic
traffic noise on California Blvd much more noticeable

Noise Meter: Larson-Davis LXT
Calibrator: CAL200 @ 114 dBA

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AMBIENT NOISE MEASUREMENT DATA SHEET

Project Name: Railroad Safety Trail
Project Number: 1502-2211
Location: (M2) - Pepper Street, near alley
Date: 1/15/16
Operator: Ingamells
Day of Week: Friday
Conditions: Sky Mostly cloudy **Wind** +/- calm

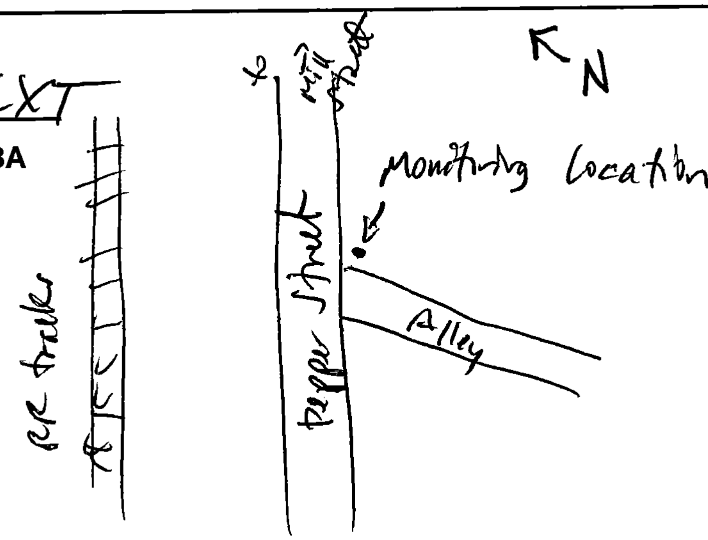
Noise Sources: Distant traffic on U.S. 101, light traffic on Pepper Street + Mill Street, Birds, distant landscaping equipment (blower?)

Distance from Primary Source: 9 ft to C/L Pepper Street

Begin Time: 942
End Time: 1002
Leq: 54.9
Lmax:
SEL:
Lmin:

Notes:

Noise Meter: Larson-Davis LXT
Calibrator: CAL200 @ 114 dBA



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AMBIENT NOISE MEASUREMENT DATA SHEET

M3

Project Name: Railroad Safety Trail **Project Number:** 1502-2211

Location: (M3) 640 Johnson Street, sidewalk **Date:** 1/15/16

Operator: Ingamells **Day of Week:** Friday

Conditions: Sky Partly Cloudy **Wind** ~ calm (0-2 mph)

Noise Sources: Distant traffic on U.S. 101, portable generator (pump) operating across street, few cars on Johnson Street no rail traffic on nearby tracks

Distance from Primary Source: 9 ft to C/L Johnson Street

Begin Time: 1010 **End Time:** 1030

Leq: 54.6 **Lmax:**

SEL: **Lmin:**

Notes: Pair red/blue macaws?

Noise Meter: Larson-Davis LXT

Calibrator: CAL200 @ 114 dBA

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AMBIENT NOISE MEASUREMENT DATA SHEET

Project Name: Railroad Safety Trail Project Number: 1502-2211

Location: (M4) - Hathway Ave, sidewalk between 520 + 528 Date: 1/15/16

Operator: Ingamells Day of Week: Friday

Conditions: Sky Scattered clouds Wind 1-3 mph

Noise Sources: Distant traffic on U.S. 101, light traffic on Hathway Ave

Distance from Primary Source: 9 ft to C/L Hathway Ave

Begin Time: 1040 End Time: 1100

Leq: 56.7 Lmax:

SEL: Lmin:

Notes:

Noise Meter: Larson-Davis LXT

Calibrator: CA200 @114dBA

APPENDIX B

ROADWAY CONSTRUCTION NOISE MODEL DATA

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 01/11/2016
Case Description: Trail Construction

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
East of Hathway Ave	Residential	70.0	65.0	60.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Front End Loader	No	40		79.1	150.0	0.0
Grader	No	40	85.0		150.0	0.0
Roller	No	20		80.0	100.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Front End Loader	69.6	65.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	75.5	71.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	74.0	67.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	75.5	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #2 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
South of California Blvd	Commercial	65.0	60.0	60.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Front End Loader	No	40		79.1	100.0	0.0
Grader	No	40	85.0		100.0	0.0
Roller	No	20		80.0	50.0	0.0

Results

Equipment	Calculated (dBA) Lmax	Calculated (dBA) Leq	Noise Limits (dBA) Day Lmax	Noise Limits (dBA) Day Leq	Noise Limits (dBA) Evening Lmax	Noise Limits (dBA) Evening Leq	Noise Limits (dBA) Night Lmax	Noise Limits (dBA) Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Noise Limit Exceedance (dBA) Day Leq	Noise Limit Exceedance (dBA) Evening Lmax	Noise Limit Exceedance (dBA) Evening Leq	Noise Limit Exceedance (dBA) Night Lmax	Noise Limit Exceedance (dBA) Night Leq
Front End Loader	73.1	69.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	79.0	75.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	80.0	77.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #3 ****

Description	Land Use	Baselines (dBA) Daytime	Baselines (dBA) Evening	Baselines (dBA) Night
West of Pepper St	Residential	65.0	60.0	60.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Front End Loader	No	40		79.1	115.0	0.0
Grader	No	40	85.0		115.0	0.0
Roller	No	20		80.0	65.0	0.0

Results

Equipment	Calculated (dBA) Lmax	Calculated (dBA) Leq	Noise Limits (dBA) Day Lmax	Noise Limits (dBA) Day Leq	Noise Limits (dBA) Evening Lmax	Noise Limits (dBA) Evening Leq	Noise Limits (dBA) Night Lmax	Noise Limits (dBA) Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Noise Limit Exceedance (dBA) Day Leq	Noise Limit Exceedance (dBA) Evening Lmax	Noise Limit Exceedance (dBA) Evening Leq	Noise Limit Exceedance (dBA) Night Lmax	Noise Limit Exceedance (dBA) Night Leq
Front End Loader	71.9	67.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	77.8	73.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	77.7	70.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	77.8	76.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/05/2016
Case Description: Pile Drilling for Bridge

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
West of Pepper St	Residential	65.0	60.0	60.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Auger Drill Rig	No	20		84.4	65.0	0.0
Front End Loader	No	40		79.1	100.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Auger Drill Rig	82.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	73.1	69.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	82.1	76.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A