# Noise Study Report

Albion River Bridge Project

Mendocino County, California

01-MEN-1-42.4/43.3

EA: 01-40110/EFIS:0100000154

**March 2024**

For individuals with sensory disabilities, this document is available in Braille, large print, on audiocassette, or computer disk. To obtain a copy in one of these alternate formats, please call or write to Caltrans, Attn: Rachelle Estrada, 1656 Union Street, Eureka, CA 95501; (707) 449-6587 (Voice) or use the California Relay Service (800) 735-2929 (TTY to Voice), (800) 735-2922 (Voice to TTY) or 711.

# Noise Study Report

Albion River Bridge Project

Mendocino County, California

01-MEN-1-42.4/43.3

EA: 01-40110/EFIS:0100000154

March 2024

Prepared By: Ryan Pommerenck Date: 03/28/2024

Ryan Pommerenck, Noise Specialist
Office of Environmental Engineering
Caltrans District 3/North Region

Approved By: Christopher Dennis Date: 03/28/2024

Christopher Dennis, Branch Chief
Office of Environmental Engineering
Caltrans District 3/North Region

# Summary

The California Department of Transportation (Caltrans), in cooperation with the Federal Highway Administration (FHWA), is proposing the Albion River Bridge Project (Project). The project includes the replacement of the Albion River Bridge (No. 10-0136), which is located in Mendocino County on State Route (SR) 1 approximately 15 miles south of Fort Bragg. The total length of the Project is approximately one mile, between postmile (PM) 43.3 and PM 44.2.

Within the limits of the Project, SR 1 is an undivided conventional highway with two 11- to 12-foot-wide travel lanes and 0- to 4-foot-wide shoulders. The existing Albion River Bridge (bridge) was constructed in 1944 during World War II and is 969 feet long with a total width of 28.5 feet. The bridge was listed on the National Register of Historic Places and the California Register of Historic Resources in 2017. The bridge sits approximately 155 feet above the Albion River, spanning a relatively narrow canyon with steep slopes reaching approximately 140 to 150 feet above the valley floor. The Albion River outlets to the Pacific Ocean approximately 170 feet downstream of the bridge and is tidally influenced. Beneath the bridge is the privately-held Albion River Campground and Marina (Albion Campground) and Albion Flat Beach (Albion Beach). The topography on top of the headlands includes gently rolling hills and the highway travels through cuts on each end of the bridge. The cuts provide shielding for some of the residences along the highway.

There are three replacement alternatives. Alternative 1 would replace the Albion River Bridge with a new bridge to the west of the existing bridge, Alternative 2 would replace the Albion River Bridge with a new bridge to the east of the existing bridge, Alternative 3 would replace the Albion River Bridge with a new bridge on the same alignment as the existing bridge using half width construction.

This noise study follows the California Department of Transportation (Caltrans) Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects (Protocol) (Caltrans 2020). The purpose of this noise report is to discuss the current noise environment, potential traffic noise impacts under worst-case traffic conditions due to the proposed project and short-term construction noise. This Noise Study Report summarizes the evaluation of noise impacts under the requirements of Title 23, Part 772 of the Code of Federal Regulations "Procedures for Abatement of Highway Traffic Noise." According to 23 CFR 772, all highway projects that are developed in conformance with this regulation are deemed to be in conformance with FHWA noise standards.

Alternative 1 and Alternative 2 are considered Type I projects because the proposed alignments would result in a substantial horizontal alteration. Alternative 3 does not result in substantial horizontal alterations and is considered a Type III project. Under 23 CFR 772, a substantial horizontal alignment is defined as a project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition. 23 CFR 772 requires an evaluation of potential noise impacts for Type I projects, this noise study was prepared to address potential noise impacts from Alternative 1 and Alternative 2.

The dominant source of noise in the project area is highway noise. Existing noise levels in the project area range between 46 and 60 decibels for a 1-hour A-weighted equivalent sound level (dBA $L_{eq}$(h)). Under the build Alternatives in the design year, noise levels are predicted to be between 48 and 62 dBA $L_{eq}$(h). The maximum increase in noise between existing condition and the design-year build condition is predicted to be 6 dB. The predicted noise levels for this project are below the noise abatement criteria and do not substantially exceed the existing noise levels at receptors identified in the project area. Noise abatement is not considered for this project.

Caltrans is the California Environmental Quality Act (CEQA) lead agency on this project. Accordingly, the CEQA significance of noise impacts is based on Caltrans standards. Normally, Caltrans does not consider traffic noise to be significant under CEQA unless the project is predicted to result in a substantial increase in noise. Caltrans has not established a single numerical threshold to determine whether an increase is considered substantial. This report presents the technical information needed to evaluate noise impacts under CEQA; however, the significance of noise impacts under CEQA are addressed in the environmental document.

During construction there would be a temporary increase in noise at receptors near the Project area. Construction noise would be intermittent, short-term, and monitored and controlled in accordance with Caltrans Standard Specifications and minimization measures included in Chapter 8.

# Table of Contents

# List of Figures

# List of Tables

# List of Abbreviated Terms

| | |
|---|---|
| CEQA | California Environmental Quality Act |
| CFR | Code of Federal Regulations |
| CNEL | Community Noise Equivalent Level |
| dB | Decibels |
| FHWA | Federal Highway Administration |
| Hz | Hertz |
| kHz | Kilohertz |
| $L_{dn}$ | Day-Night Level |
| $L_{eq}$ | Equivalent Sound Level |
| $L_{eq(h)}$ | Equivalent Sound Level over one hour |
| $L_{max}$ | Maximum Sound Level |
| LOS | Level of Service |
| $L_{xx}$ | Percentile-Exceeded Sound Level |
| mPa | micro-Pascals |
| mph | miles per hour |
| NAC | noise abatement criteria |
| NADR | Noise Abatement Decision Report |
| NEPA | National Environmental Policy Act |
| NSR | Noise Study Report |
| Protocol | Caltrans Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects |
| SPL | sound pressure level |
| TeNS | Caltrans' Technical Noise Supplement |
| TNM 2.5 | FHWA Traffic Noise Model Version 2.5 |

# **Chapter 1.** Introduction

## 1.1. Purpose of the Noise Study Report

The purpose of this 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 2020) provides Caltrans policy for implementing 23 CFR 772 in California. The Protocol outlines the requirements for preparing noise study reports (NSR). Noise impacts associated with this project under the California Environmental Quality Act (CEQA) are evaluated separately in the project’s environmental document.

## 1.2. Project Purpose and Need

The project is needed to address functional, safety and structural deficiencies of the bridge. The bridge is in a poor and deteriorating condition and is not an appropriate design for the harsh environment in which it is located. The purpose of this project is to provide a bridge across the Albion River that meets modern seismic safety standards, provides safe and reliable multimodal access, and minimizes ongoing maintenance costs.

# **Chapter 2.** Project Description

## 2.1. No-Build

The No-Build (No-Action) Alternative, the proposed project would not occur and the existing bridge would remain in its current configuration. The existing bridge would continue to deteriorate, becoming increasingly susceptible to significant damage and/or failure due to the marine environment, a seismic event, heavy cyclical loads, and/or a tsunami. Given the condition of the existing bridge, extensive recurring maintenance projects and structural improvement projects would be necessary to maintain current level of service.

## 2.2. Project Build Alternatives

The Build Alternatives consist of options that would improve safety features (e.g., vehicle barriers and roadway alignment), provide a separated pedestrian walkway on the west side of the new structure, and widened shoulder widths for multimodal use. Under the Build Alternatives, a new bridge would be constructed on an alignment either to the west of the existing bridge (West Alignment), to the east of the existing bridge (East Alignment), or generally within but slightly west of the existing bridge (On-Alignment) as follows:

- Alternative 1: West Alignment
    - Design Option 1A: Four Span Segmental Box Girder Bridge
    - Design Option 1B: Spandrel Arch with Box Girder Approaches
- Alternative 2: East Alignment
    - Design Option 2A: Three Span Segmental Box Girder Bridge
    - Design Option 2B: Spandrel Arch with Box Girder Approaches
- Alternative 3: On-Alignment (Half-Width)
    - Design Option 3A: Four Span Box Girder Bridge

A replacement bridge would have two 12-foot-wide travel lanes and 6-foot-wide shoulders, steel barrier rails, and a separated 6-foot-wide pedestrian walkway on the west side with a barrier railing. Construction elements would include tree and vegetation removal, cut and fill, temporary and permanent shoring (e.g., cofferdams and retaining walls), use of temporary trestles, construction of a new bridge, demolition of the existing bridge, construction of roadway approaches connecting SR 1 to the new structure, re-establishment of roadside drainage and cross-culverts, utility relocation, and improvements to SR 1 and local connector roads and intersections within the project area. The new bridge pier foundations would be constructed using Cast-In-Drill-Hole (CIDH) piles, Cast-In-Steel Shell (CISS) piles, or steel micropiles. During construction, soil nail walls and/or anchored soldier pile walls would be used to shore excavations at the south and north embankments and cofferdams would be used to shore excavations at piers in or near the water.

### Alternative 1: West Alignment

The West Alignment Alternative would include either a 4-span box girder replacement bridge (Design Option 1A) or a 12-span box girder replacement bridge with an open-spandrel arch (Design Option 1B) to the west of the existing bridge. The bridge superstructure would involve concrete spans from the north abutment to the south abutment, for a total bridge length of approximately 1,020 feet for Design Option 1A and approximately 1,069 feet for Design Option 1B. Demolition of the existing bridge and removal of a portion of the existing roadway approaches would occur once the new bridge is constructed and traffic is diverted. A west alignment bridge would take approximately three years to construct.

### Alternative 2: East Alignment

The East Alignment Alternative would include either a 3-span box girder replacement bridge with two piers (Design Option 2A) or an 11-span box girder replacement bridge with a spandrel arch (Design Option 2B) to the east of the existing bridge. The bridge superstructure would involve concrete spans from the north abutment to the south abutment, for a total bridge length of approximately 1,020 feet for Design Option 2A and approximately 1,143 feet for Design Option 2B. Demolition of the existing bridge and removal of a portion of the existing roadway approaches would occur once the new bridge is constructed and traffic is diverted. An east alignment bridge would take approximately three years to construct.

Alternative 3: On-Alignment (Half-Width)

The On-Alignment Alternative would include a 4-span box girder replacement bridge (Design Option 3A) generally on the same alignment as (and slightly west of) the existing bridge. The bridge superstructure would involve concrete spans from the north abutment to the south abutment, for a total bridge length of 943 feet. Demolition of the existing bridge and removal of the existing roadway approaches would occur after the western half of the new bridge substructure and superstructure (southbound lane) are constructed, and before the eastern half of the substructure and superstructure are constructed. An on-alignment bridge would take approximately five years to construct.

Other Construction Elements

All build alternatives would require several construction access roads and staging areas. Access roads would be constructed to the north abutment by constructing a temporary roadway and/or trestle off Albion River North Side Road, to the east side of the south abutment by constructing a temporary roadway and/or trestle off of Albion River South Side Road and to the west side of the south abutment from one of the potential stating areas south of the Albion River and west of SR 1, and to the Albion Campground from SR 1 along or adjacent to Albion River North Side Road. Equipment and materials would likely be located on staging areas in the Albion Campground, and north and south of the Albion River. Access roads and staging areas would require tree and vegetation removal, grading, and temporary surfacing (e.g., base rock or asphalt). All build alternatives would require right-of-way acquisitions and utility easements from private parcels. All build alternatives would also require temporary construction easements (TCEs) within private parcels.

It is anticipated that general public access to the Albion Beach from the Albion Campground would be restricted during construction for the safety of construction workers and the public, and access to the Albion Campground would be limited to the campground office, parking lot, restrooms, picnic area, and the dock and marina.

# **Chapter 3.** Fundamentals of Traffic Noise

The following is a brief discussion of fundamental traffic noise concepts. For a detailed discussion, please refer to Caltrans' Technical Noise Supplement (TeNS) (Caltrans 2013), a technical supplement to the Protocol that is available on Caltrans Web site (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 receptor, and the propagation path between the two. The loudness of the noise source and obstructions or atmospheric factors affecting the propagation path to the receptor determine the sound level and characteristics of the noise perceived by the receptor. The field of acoustics deals primarily with the propagation and control of sound.

## 3.1. 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.

## 3.2. 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.

## 3.3. 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 5 dB louder than one source.

## 3.4. A-Weighted Decibels

The decibel scale alone does not adequately characterize how humans perceive noise. The dominant frequencies of a sound have a substantial effect on the human response to that sound. Although the intensity (energy per unit area) of the 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 network 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 networks 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 3-1 describes typical A-weighted noise levels for various noise sources.

**Table 3-1. 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 hall (background) |
| | — 20 — | |
| | | Broadcast/recording studio |
| | — 10 — | |
| Lowest threshold of human hearing | — 0 — | Lowest threshold of human hearing |

*Source:* Caltrans 2013.

## 3.5. 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 midfrequency (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.

## 3.6. 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. In effect, $L_{eq}$ is the steady-state sound level containing the same acoustical energy as the time-varying sound that actually occurs during the same 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.

## 3.7. 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.

### 3.7.1. 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.

### 3.7.2. Ground Absorption

The propagation path of noise from a highway to a receptor 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 receptor, 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 receptor, 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.

### 3.7.3. 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.

### 3.7.4. Shielding by Natural or Human-Made Features

A large object or barrier in the path between a noise source and a receptor can substantially attenuate noise levels at the receptor. 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 receptor specifically to reduce noise. A barrier that breaks the line of sight between a source and a receptor will typically result in at least 5 dB of noise reduction. Taller barriers provide increased noise reduction. Vegetation between the highway and receptor is rarely effective in reducing noise because it does not create a solid barrier.

# **Chapter 4.** Federal Regulations and State Policies

This report focuses on the requirements of 23 CFR 772, as discussed below.

## 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 substantially 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). This includes the addition of a through-traffic lane that functions as a high-occupancy vehicle (HOV) lane, high-occupancy toll (HOT) 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 is determined to be a Type I project under this definition, the entire project area as defined in the environmental document is 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 772.11, 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 below.

Table 4-1 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.

### 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.

**Table 4-1.** Activity Categories and Noise Abatement Criteria (23 CFR 772)

| Activity Category | Activity $L_{eq}[h]$[1] | Evaluation Location | 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, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings. |
| D | 52 | Interior | Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and 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 that are not permitted. |

[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 permitted for this activity category.

## 4.2. State Regulations and Policies

### 4.2.1. California Environmental Quality Act (CEQA)

Noise analysis under the California Environmental Quality Act (CEQA) may be required regardless of whether or not the project is a Type I project. The CEQA noise analysis 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

The significance of noise impacts under CEQA are addressed in the environmental document rather than the NSR. Even though the NSR (or noise technical memorandum) does not specifically evaluate the significance of noise impacts under CEQA, it must contain the technical information that is needed to make that determination in the environmental document.

### 4.2.2. Section 216 of the California Streets and Highways Code

Section 216 of the California Streets and Highways Code 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.

# **Chapter 5.** Study Methods and Procedures

## 5.1. Methods for Identifying Land Uses and Selecting Noise Measurement and Modeling Receiver Locations

A field investigation was conducted to identify land uses that could be subject to traffic and construction noise impacts from the proposed project. Existing land uses in the project area were categorized by land use type and Activity Category (see Table 4-1), and the extent of frequent human use. The geometry of the project relative to nearby existing and planned land uses was also identified. Noise receptors in the project area were identified using parcel mapping aerial images and field investigations. Activity Category B, C, F and G are within the Project area.

As stated in the Protocol, noise abatement is only considered where frequent human use occurs and where a lowered noise level would be of benefit. Although all land uses are evaluated in this analysis, the focus is on locations of frequent human use that would benefit from a lowered noise level. Accordingly, this impact analysis focuses on locations with defined outdoor activity areas, such as residential backyards and common use areas at hotels and park areas.

A single long-term measurement site was selected to capture the diurnal traffic noise level pattern in the project area. Seven short-term measurement locations were selected to serve as representative modeling locations. Access to private property was limited on this project. Noise measurements were taken within Caltrans or County right-of-way and at several private residence that granted access. Additional other non-measurement locations were selected as modeling locations.

## 5.2. Field Measurement Procedures

A field noise study was conducted in accordance with recommended procedures in TeNS. The following is a summary of the procedures used to collect short-term and long-term sound level data.

### 5.2.1. Short-Term Measurements

Short-term noise measurements were conducted on September 28, 2016, April 3, 2023 and April 4, 2023 using Larson Davis Model 831 Precision Type 1 sound level meters (serial number 1087 and 1109). The calibration of the meter was checked before and after the measurement using a Larson Davis Model CAL150B calibrator (serial number 2178). Measurements intervals were between 20 and 30 minutes at each site. A total of seven short-term noise measurements were conducted at Activity Category B, C and G land uses. Short-term measurement locations are identified in Figure 5-1.

During the short-term measurements, field staff attended each meter. Two or more consecutive measurements were taken at each monitoring location. Dominant noise sources observed during each minute period were identified and logged. Using this approach, those minutes when traffic noise was observed to be a dominant contributor to noise levels at a given measurement location could be distinguished from periods where other non-traffic noise sources (such as aircraft and lawn equipment) contributed significantly to existing noise levels.

Traffic on SR 1 was classified and counted during short-term noise measurements. Vehicles were classified as automobiles, medium-duty trucks, or heavy-duty trucks. An automobile was defined as a vehicle with two axles and four tires that are designed primarily to carry passengers. Small vans and light trucks were included in this category. Medium-duty trucks included all cargo vehicles with two axles and six tires. Heavy-duty trucks included all vehicles with three or more axles. The posted speed on SR 1 ranges between 50 and 55 mph. There is a 30 mph speed advisory on the north side of the bridge for southbound traffic and a 35 mph speed advisory on the south side of the bridge for northbound traffic.

### 5.2.2. Long -Term Measurements

Long-term monitoring was conducted at one location (LT-1) using a Larson Davis Model 820 Type 1 sound level meter (serial number 1376). The purpose of these measurements was to identify variations in sound levels throughout the day. The long-term sound level data was collected over a 22-hour period, beginning Tuesday, September 27, 2016, and ending Wednesday, September 28, 2016.

Long-term monitoring location LT-1 was located at the residence at 33890 Albion River South Side Road on the south side of SR 1, approximately 120 feet from the SR 1 edge-of-pavement. This is the same location where ST-6 measurements were taken (refer to Figure 5-1).

## 5.3. Traffic Noise Levels Prediction Methods

Traffic noise levels were predicted using the FHWA Traffic Noise Model Version 2.5 (TNM 2.5). TNM 2.5 is a computer model based on two FHWA reports: FHWA-PD-96-009 and FHWA-PD-96-010 (FHWA 1998a, 1998b). Key inputs to the traffic noise model were the locations of roadways, traffic mix and speed, shielding features (e.g., topography and buildings), ground type, and receptors. Three-dimensional representations of these inputs were developed using CAD drawings, aerials, and topographic contours provided by the project engineer.

Traffic noise was evaluated under existing conditions, design-year no-project conditions, and design-year conditions with the build alternatives. Loudest-hour traffic volumes, vehicle classification percentages, and traffic speeds under existing and design-year (2051) conditions were provided by the Caltrans Office of Travel Forecasting & Modeling (Caltrans 2023) for input into the traffic noise model. Table A-1 in Appendix A summarize the traffic volumes and assumptions used for modeling existing and design-year conditions with and without the project alternative.

To validate the accuracy of the model calculations, TNM 2.5 was used to compare measured traffic noise levels to modeled noise levels at field measurement locations. For each receptor, traffic volumes counted during the short-term measurement periods were normalized to 1-hour volumes. These normalized volumes were assigned to the corresponding project area roadways to simulate the noise source strength at the roadways during the actual measurement period. Modeled and measured sound levels were compared to determine the accuracy of the model and if additional adjustment of the model was necessary. Modeled results that vary from measurements by more than 3 dB are adjusted. Model results were 3 dB or less; therefore, no adjustments were required.

## 5.4. Methods for Identifying Traffic Noise Impacts and Consideration of Abatement

Traffic noise impacts are considered to occur at receptor locations where predicted design-year noise levels are 12 dB or more greater than existing noise levels, or where predicted design-year noise levels approach or exceed the NAC for the applicable activity category. Where traffic noise impacts are identified, noise abatement must be considered for reasonableness and feasibility as required by 23 CFR 772 and the Protocol.

Traffic noise levels are not predicted to increase by 12 dB or more than existing noise levels and will not approach or exceed the NAC; therefore, traffic noise abatement was not considered on this project.

Figure 5-1. Noise Monitoring Positions

# **Chapter 6.** Existing Noise Environment

## 6.1. Existing Land Uses

A field investigation was conducted to identify land uses that could be subject to traffic and construction noise impacts from the proposed project. The following land uses were identified in the project area:

- Activity Category B - Residential
- Activity Category C - Campground
- Activity Category E - Hotel/Motel
- Activity Category F - Commercial and Agricultural
- Activity Category G - Undeveloped Land Use

Activity categories F and G are not sensitive to highway traffic noise. Although all developed land uses are evaluated in this analysis, noise abatement is only considered for areas of frequent human use that would benefit from a lowered noise level. Accordingly, this impact analysis focuses on locations with defined outdoor activity areas, such as residential backyards and common use areas at campgrounds and hotels.

## 6.2. Noise Measurement Results

The existing noise environment in the project area is characterized below based on short- and long-term noise monitoring that was conducted.

### 6.2.1. Short-Term Monitoring

Table 6-1 summarizes the results of the short-term noise monitoring conducted in the project area.

### Table 6-1. Summary of Short-Term Measurements

| Position | Address | NAC | Land Uses | Date | Start Time | Duration (minutes) | Measured $L_{eq}$ | Autos |  | Medium Trucks |  | Heavy Trucks |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  | NB | SB | NB | SB | NB | SB |
| ST-1 | 3081 N Highway 1 | B | Residential | 4/04/2023 | 11:01 | 30 | 49.1 | 45 | 47 | 5 | 3 | 0 | 0 |
|  |  |  |  |  | 11:31 | 30 | 49.4 | 57 | 48 | 6 | 4 | 1 | 0 |
| ST-2 | 3700 Albion Little River Rd | B | Residential | 9/28/2016 | 14:54 | 20 | 52.3 | 32 | 37 | 1 | 0 | 2 | 2 |
|  |  |  |  |  | 15:14 | 20 | 52.4 | 30 | 40 | 2 | 3 | 3 | 2 |
| ST-3 | 3740 Albion Little River Rd | G | Undeveloped | 4/04/2023 | 9:09 | 30 | 49.0 | 48 | 51 | 3 | 3 | 0 | 2 |
|  |  |  |  |  | 9:39 | 30 | 48.4 | 52 | 41 | 3 | 4 | 0 | 1 |
| ST-4 | Albion River Campground | C | Campground | 4/04/2023 | 14:03 | 30 | 53.2 | 73 | 18 | 6 | 1 | 0 | 0 |
|  |  |  |  |  | 14:30 | 30 | 51.4 | 82 | 19 | 0 | 0 | 0 | 1 |
| ST-5 | Albion River Campground | C | Campground | 4/04/2023 | 12:54 | 30 | 46.2 | 80 | 47 | 4 | 3 | 0 | 0 |
|  |  |  |  |  | 13:24 | 30 | 45.2 | 78 | 51 | 3 | 3 | 0 | 0 |
| ST-6 | 33890 Albion River South Side Rd | B | Residential | 9/28/2016 | 13:03 | 20 | 54.1 | 59 | 48 | 0 | 3 | 1 | 1 |
|  |  |  |  |  | 13:20 | 20 | 55.3 | 61 | 51 | 1 | 1 | 0 | 1 |
| ST-7 | 33870 Albion River South Side Rd | G | Undeveloped | 4/03/2023 | 13:12 | 30 | 51.6 | 51 | 54 | 2 | 1 | 1 | 0 |
|  |  |  |  |  | 13:42 | 30 | 53.4 | 65 | 65 | 3 | 1 | 0 | 0 |

*Note:* Refer to Figure 5-1 for measurement locations.

### 6.2.2. Long-Term Monitoring

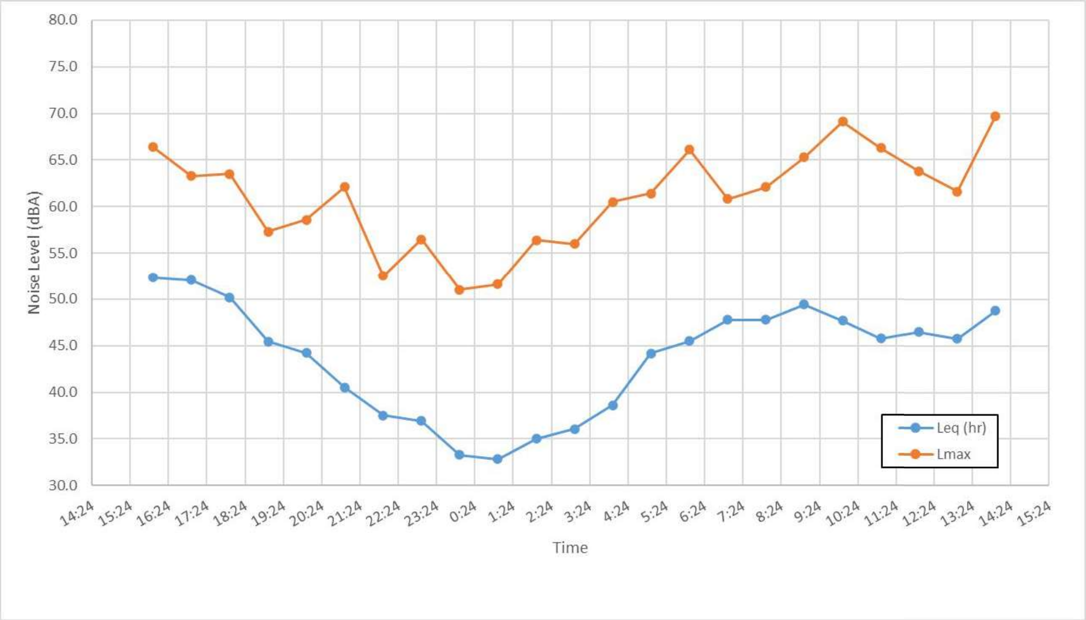
The long-term sound level data was collected over a 22-hour period, beginning Tuesday, September 27, 2016, and ending Wednesday, September 28, 2016. Long-term monitoring location LT-1 was located at the residence at 33890 Albion River South Side Road on the south side of SR 1, approximately 120 feet from the SR 1 edge-of-pavement. The average loudest-hour sound level measured was 52.3 dBA $L_{eq}$(h) during 4:00 p.m. Table 6-2 and Figure 6-1 summarize the results of the long-term monitoring.

**Table 6-2. Summary of Long-Term Monitoring at Location LT-1**

| Hour Beginning | Average (dBA Leq[h]) | Difference from Loudest Hour (dB) |
|---|---|---|
| **16:00** | **52.3** | 0.0 |
| 17:00 | 52.1 | -0.3 |
| 18:00 | 50.2 | -2.2 |
| 19:00 | 45.5 | -6.9 |
| 20:00 | 44.2 | -8.1 |
| 21:00 | 40.5 | -11.8 |
| 22:00 | 37.5 | -14.8 |
| 23:00 | 36.9 | -15.4 |
| 0:00 | 33.3 | -19.1 |
| 1:00 | 32.8 | -19.5 |
| 2:00 | 35.0 | -17.3 |
| 3:00 | 36.0 | -16.3 |
| 4:00 | 38.6 | -13.7 |
| 5:00 | 44.2 | -8.2 |
| 6:00 | 45.5 | -6.8 |
| 7:00 | 47.8 | -4.6 |
| 8:00 | 47.8 | -4.6 |
| 9:00 | 49.4 | -2.9 |
| 10:00 | 47.7 | -4.7 |
| 11:00 | 45.8 | -6.6 |
| 12:00 | 46.5 | -5.9 |
| 13:00 | 45.8 | -6.6 |
| 14:00 | 48.8 | -3.6 |

*Note:* Worst noise hour noise level is bolded.

Figure 6-1. Long-Term Monitoring at Location LT-1



## 6.3. Noise Model Validation

TNM 2.5 was used to compare measured traffic noise levels to modeled noise levels at field measurement locations. Table 6-3 compares measured and modeled noise levels at each measurement location (see Figure 5-1). The predicted sound levels are within 3 dB or less of the measured sound levels and are, therefore, considered to be in reasonable agreement with the measured sound levels. Therefore, no further adjustment of the model was necessary.

**Table 6-3. Comparison of Average Measured to Predicted Sound Levels in the TNM Model**

| Measurement Position | Average Measured Sound Level (dBA) | Predicted Sound Level (dBA) | Measured minus Predicted (dB) | Validation Factor (dB) |
|---|---|---|---|---|
| ST-1 | 49 | 51 | -2 | 0 |
| ST-2 | 53 | 55 | -2 | 0 |
| ST-3 | 49 | 48 | 1 | 0 |
| ST-4 | 52 | 49 | 3 | 0 |
| ST-5 | 46 | 44 | 2 | 0 |
| ST-6 | 55 | 56 | -1 | 0 |
| ST-7 | 53 | 54 | -1 | 0 |

# Chapter 7. Future Noise Environment, Impacts, and Considered Abatement

## 7.1. Future Noise Environment and Impacts

Table B-1 in Appendix B summarizes the traffic noise modeling results for existing conditions, design-year no build condition, and design year build condition for Alternative 1 and Alterative 2. Alternative 3 would not substantially change the location or operation of the roadway; therefore, noise levels in the design year are expected to be equivalent to the design year no build condition. Predicted design-year traffic noise levels with the project are compared to existing conditions and to design-year no-project conditions. The comparison to existing conditions is included in the analysis to identify traffic noise impacts as defined under 23 CFR 772. The comparison to no-project conditions indicates the direct effect of the project.

As stated in the TeNS, modeling results are rounded to the nearest decibel before comparisons are made. In some cases, this can result in relative changes that may not appear intuitive. An example would be a comparison between calculated sound levels of 64.4 and 64.5 dBA. The difference between these two values is 0.1 dB. However, after rounding, the difference is reported as 1 dB.

Noise levels discussed in this section are based on model results, using loudest-hour traffic conditions for the Existing, No Build, and Build scenarios. Seven short-term noise measurement locations (ST-1 through ST-7) were identified along the project corridor. There are fifty-five modeled receiver locations, the modeled receiver locations include the short-term locations. Receiver locations are shown in Figures 7-1 through 7-3.

Modeling results in Table B-1 indicate the following:

**Activity Category B (Residential)**

Alternative 1A

The traffic noise modeling results in Table B-1 indicates traffic noise levels at residential uses will be in the range of 49 to 59 dBA $L_{eq}$(h) in the design-year. The results also indicate that the increase in noise between existing conditions and the design-year is predicted to be 0 to 3 dB. Because the predicted noise levels in the design-year are not predicted to approach or exceed the noise abatement criterion (67 dBA $L_{eq}$[h]) or result in a substantial increase in noise, no traffic noise impacts are predicted at these locations.

Alternative 1B

The traffic noise modeling results in Table B-1 indicates traffic noise levels at residential uses will be in the range of 49 to 59 dBA $L_{eq}$(h) in the design-year. The results also indicate that the increase in noise between existing conditions and the design-year is predicted to be 0 to 3 dB. Because the predicted noise levels in the design-year are not predicted to approach or exceed the noise abatement criterion (67 dBA $L_{eq}$[h]) or result in a substantial increase in noise, no traffic noise impacts are predicted at these locations.

Alternative 2A

The traffic noise modeling results in Table B-1 indicates traffic noise levels at residential uses will be in the range of 51 to 62 dBA $L_{eq}$(h) in the design-year. The results also indicate that the increase in noise between existing conditions and the design-year is predicted to be 1 to 6 dB. Because the predicted noise levels in the design-year are not predicted to approach or exceed the noise abatement criterion (67 dBA $L_{eq}$[h]) or result in a substantial increase in noise, no traffic noise impacts are predicted at these locations.

Alternative 2B

The traffic noise modeling results in Table B-1 indicates traffic noise levels at residential uses will be in the range of 50 to 60 dBA $L_{eq}$(h) in the design-year. The results also indicate that the increase in noise between existing conditions and the design-year is predicted to be 0 to 4 dB. Because the predicted noise levels in the design-year are not predicted to approach or exceed the noise abatement criterion (67 dBA $L_{eq}$[h]) or result in a substantial increase in noise, no traffic noise impacts are predicted at these locations.

### Activity Category C (Campground)

Alternative 1A

The traffic noise modeling results in Table B-1 indicates traffic noise levels at campground uses will be in the range of 48 to 54 dBA $L_{eq}$(h) in the design-year. The results also indicate that the increase in noise between existing conditions and the design-year is predicted to be 0 to 2 dB. Because the predicted noise levels in the design-year are not predicted to approach or exceed the noise abatement criterion (67 dBA $L_{eq}$[h]) or result in a substantial increase in noise, no traffic noise impacts are predicted at these locations.

Alternative 1B

The traffic noise modeling results in Table B-1 indicates traffic noise levels at campground uses will be in the range of 48 to 54 dBA $L_{eq}$(h) in the design-year. The results also indicate that the increase in noise between existing conditions and the design-year is predicted to be 0 to 2 dB. Because the predicted noise levels in the design-year are not predicted to approach or exceed the noise abatement criterion (67 dBA $L_{eq}$[h]) or result in a substantial increase in noise, no traffic noise impacts are predicted at these locations.

Alternative 2A

The traffic noise modeling results in Table B-1 indicates traffic noise levels at campground uses will be in the range of 50 to 54 dBA $L_{eq}$(h) in the design-year. The results also indicate that the increase in noise between existing conditions and the design-year is predicted to be 2 to 4 dB. Because the predicted noise levels in the design-year are not predicted to approach or exceed the noise abatement criterion (67 dBA $L_{eq}$[h]) or result in a substantial increase in noise, no traffic noise impacts are predicted at these locations.

Alternative 2B

The traffic noise modeling results in Table B-1 indicates traffic noise levels at campground uses will be in the range of 50 to 56 dBA $L_{eq}$(h) in the design-year. The results also indicate that the increase in noise between existing conditions and the design-year is predicted to be 0 to 4 dB. Because the predicted noise levels in the design-year are not predicted to approach or exceed the noise abatement criterion (67 dBA $L_{eq}$[h]) or result in a substantial increase in noise, no traffic noise impacts are predicted at these locations.

**Activity Category E (Hotel/Motel)**

Alternative 1A

The traffic noise modeling results in Table B-1 indicates traffic noise levels at campground uses will be in the range of 51 to 58 dBA $L_{eq}$(h) in the design-year. The results also indicate that the increase in noise between existing conditions and the design-year is predicted to be 2 dB. Because the predicted noise levels in the design-year are not predicted to approach or exceed the noise abatement criterion (72 dBA $L_{eq}$[h]) or result in a substantial increase in noise, no traffic noise impacts are predicted at these locations.

Alternative 1B

The traffic noise modeling results in Table B-1 indicates traffic noise levels at campground uses will be in the range of 51 to 58 dBA $L_{eq}$(h) in the design-year. The results also indicate that the increase in noise between existing conditions and the design-year is predicted to be 2 dB. Because the predicted noise levels in the design-year are not predicted to approach or exceed the noise abatement criterion (72 dBA $L_{eq}$[h]) or result in a substantial increase in noise, no traffic noise impacts are predicted at these locations.

Alternative 2A

The traffic noise modeling results in Table B-1 indicates traffic noise levels at campground uses will be in the range of 51 to 57 dBA $L_{eq}$(h) in the design-year. The results also indicate that the increase in noise between existing conditions and the design-year is predicted to be 1 to 3 dB. Because the predicted noise levels in the design-year are not predicted to approach or exceed the noise abatement criterion (72 dBA $L_{eq}$[h]) or result in a substantial increase in noise, no traffic noise impacts are predicted at these locations.

Alternative 2B

The traffic noise modeling results in Table B-1 indicates traffic noise levels at campground uses will be in the range of 51 to 58 dBA $L_{eq}$(h) in the design-year. The results also indicate that the increase in noise between existing conditions and the design-year is predicted to be 2 dB. Because the predicted noise levels in the design-year are not predicted to approach or exceed the noise abatement criterion (72 dBA $L_{eq}$[h]) or result in a substantial increase in noise, no traffic noise impacts are predicted at these locations.

### Activity Category F and G (Commercial, Agricultural, and Undeveloped Land Use)

The traffic noise modeling results in Table B-1 indicates traffic noise levels at commercial, agricultural and undeveloped uses are predicted to be in the range of 48 to 62 dBA $L_{eq}$(h) in the design-year. The results also indicate that the increase in noise between existing conditions and the design-year is 0 to 4 dB. Because there is no noise abatement criterion for Category F or G uses in this area and because the project would not result in a substantial increase in noise, no traffic noise impacts are predicted to occur in this area and noise abatement does not need to be considered in this area.

## 7.2. Preliminary Noise Abatement Analysis

Traffic noise modeling results in Table B-1 indicates loudest traffic noise levels will remain below the noise abatement criterion and would not result in a substantial increase in noise at any land uses with in the project area. Therefore, traffic noise impacts are not predicted for these areas. Accordingly, noise abatement does not need to be considered.

Figure 7-1. Noise Modeling Receiver Locations Alternative 1A and 1B

Figure 7-2. Noise Modeling Receiver Locations Alternative 2A

Figure 7-3. Noise Modeling Receiver Locations Alternative 2B

# **Chapter 8.** Construction Noise

Noise generated by construction activities would be a function of the noise levels generated by individual pieces of construction equipment, the type and amount of equipment operating at any given time, the timing and duration of construction activities, and the proximity of nearby receptors. Construction noise would primarily result from the operation of heavy construction equipment and arrival and departure of heavy-duty trucks. Construction noise levels will vary on a day-to-day basis during each phase of construction depending on the specific task being completed.

## 8.1. Regulatory Criteria

Noise associated with construction is controlled by Caltrans Standard Specification Section 14-8.02, "Noise Control," which states the following:

- Control and monitor noise resulting from work activities
- Do not exceed 86 dBA Lmax at 50 feet from the job site activities from 9 p.m. to 6 a.m.

## 8.2. Construction Phasing and Noise Levels

During construction, noise from construction activities may intermittently dominate the noise environment in the immediate area of construction. Project construction is anticipated to include clearing and grubbing, earthwork, paving, bridge construction (excluding pile driving) and pile driving.

FHWA's Roadway Construction Noise Model (RCNM) was used to calculate the maximum and average noise levels anticipated during each phase of construction. Table 8-1 shows the typical loudest equipment expected for each type of work for each of these phases.

## Table 8-1. Construction Equipment by Phase

| Construction Phase | Equipment | Maximum Noise Level ($L_{max}$, dBA at 50 feet) | Hourly Average Noise Level ($L_{eq[h]}$, dBA at 50 feet) |
|---|---|---|---|
| Clearing and Grubbing | Dozer | 82 | 78 |
| | Excavator | 81 | 77 |
| | Grader | 85 | 81 |
| | Heavy Truck | 77 | 73 |
| | Backhoe | 78 | 74 |
| Earthwork | Dozer | 82 | 78 |
| | Excavator | 81 | 77 |
| | Grader | 85 | 81 |
| | Heavy Truck | 77 | 73 |
| | Roller | 80 | 73 |
| | Scraper | 84 | 80 |
| | Backhoe | 78 | 74 |
| | Hoe Ram | 90 | 80 |
| Paving | Concrete Saw | 90 | 83 |
| | Heavy Truck | 77 | 73 |
| | Pavement Scarafier | 85 | 78 |
| | Paver | 77 | 74 |
| | Roller | 80 | 73 |
| | Tractor | 84 | 80 |
| Bridge Construction (excluding pile driving) | Bore/Drill Rig | 84 | 77 |
| | Crane | 81 | 73 |
| | Concrete Saw | 90 | 83 |
| | Excavator | 81 | 77 |
| | Heavy Truck | 77 | 73 |
| | Air Compressor | 78 | 74 |
| | Rough Terrain Forklift | 84 | 79 |
| | Backhoe | 78 | 74 |
| Pile Driving | Impact Pile Driver | 101 | 94 |
| | Vibratory Pile Driver | 101 | 94 |

Source: FHWA's RCNM

Table 8-2 summarizes noise levels produced by the loudest construction equipment anticipated for each phase. RCNM includes representative sound levels for the most common types of construction equipment and the approximate usage factors of such equipment that were developed based on an extensive database of information gathered during the construction of the Central Artery/Tunnel Project in Boston, Massachusetts (CA/T Project or "Big Dig"). The usage factors represent the percentage of time that the equipment would be operating at full power. Equipment anticipated during each phase of construction were input into RCNM to calculate noise levels at distances of 50 feet, 100 feet and 500 feet from the construction activity. Noise generated by construction equipment drops off at a rate of 6 dB per doubling of distance.

**Table 8-1. Construction Equipment Noise**

| Construction Phase | Maximum Noise Level ($L_{max}$, dBA) | | | Hourly Average Noise Level ($L_{eq[h]}$, dBA) | | |
|---|---|---|---|---|---|---|
| | 50 feet | 100 feet | 500 feet | 50 feet | 100 feet | 500 feet |
| Clearing and Grubbing | 85 | 79 | 65 | 87 | 81 | 67 |
| Earthwork | 90 | 84 | 70 | 89 | 83 | 69 |
| Paving | 90 | 84 | 70 | 86 | 80 | 66 |
| Bridge Construction (excluding pile driving) | 90 | 84 | 70 | 88 | 82 | 68 |
| Pile Driving | 101 | 95 | 81 | 99 | 93 | 79 |

Source: FHWA's RCNM

The loudest noise generating construction activity on this project would be pile driving. Pile driving would be required during construction of the new bridge abutments, piers and temporary work structures. Pile driving typically occurs during daytime hours over short durations with breaks in between each pile. Typical pile driving can generate noise levels ranging between 95 and 101 dBA $L_{max}$ at 50 feet.

For Alternative 1A, the abutments on the north and south sides of the bridge may be supported by either driven steel piles or cast-in-drilled hole (CIDH) piles. If driven piles are selected for the abutments, pile driving may occur within 125 feet of residential areas on the north side of the bridge and within 275 feet of residential areas on the south side of the bridge. At these distances, maximum outdoor noise levels during pile driving would be approximately 93 and 86 dBA $L_{max}$ respectively. If the CIDH piles are selected for the abutments, the nearest pile driving may occur within 200 feet of residential areas on the north side of the bridge and 430 feet of residential areas on the south side of the bridge during construction of pier 2 and pier 4. At these distances, maximum outdoor noise levels during pile driving would be approximately 89 and 82 dBA $L_{max}$ respectively.

For Alternative 1B, abutment piles are expected to be CIDH with no pile driving. Pile driving may be required at pier 2, pier 11, and pier 12. Pile driving may occur within 175 feet of residential areas on the north side of the bridge and within 300 feet of residential areas on the south side of the bridge during construction of pier 2 and pier 12. At these distances, maximum outdoor noise levels during pile driving would be approximately 90 and 85 dBA $L_{max}$ respectively.

For Alternative 2A, abutment piles are expected to be CIDH with no pile driving. Pile driving may be required at pier 2 and pier 3. Pile driving may occur within 400 feet of residential areas on the north side of the bridge and within 270 feet of residential areas on the south side of the bridge. At these distances, maximum outdoor noise levels during pile driving would be approximately 83 and 86 dBA $L_{max}$ respectively.

For Alternative 2B, abutment piles are expected to be CIDH with no pile driving. Pile driving may be required at pier 2, pier 3, pier 10 and pier 11. Pile driving may occur within 145 feet of residential areas on the north side of the bridge and within 115 feet of residential areas on the south side of the bridge during construction of pier 2 and pier 11. At these distances, maximum outdoor noise levels during pile driving would be approximately 92 and 94 dBA $L_{max}$ respectively.

For Alternative 3, abutment piles are expected to be CIDH with no pile driving. Pile driving may be required at pier 2, pier 3, and pier 4. Pile driving may occur within 300 feet of residential areas on the north side of the bridge and within 380 feet of residential areas on the south side of the bridge during construction of pier 2 and pier 4. At these distances, maximum outdoor noise levels during pile driving would be approximately 85 and 83 dBA $L_{max}$ respectively.

The beach area and picnic areas near the bridge would be exposed to high noise levels during pile driving for the new bridge foundation and temporary work structures. These areas may also be exposed to elevated noise levels during other construction phases. Public access to the beach and outdoor use areas near the bridge would be restricted during construction this would prevent exposing the public to substantial construction noise during use of the Albion River Campground. Table 8-3 shows noise generated by impact pile driving operations at various distances from the pile driving operation. Acoustic shielding would be provided during the pile driving operation which would reduce noise levels shown in Table 8-3.

**Table 8-3. Noise from Impact Pile Driving Operation**

| **Distance from Pile Driving (feet)** | **Maximum Noise Level ($L_{max}$, dBA)** | **Hourly Average Noise Level ($L_{eq[h]}$, dBA)** |
|---|---|---|
| 50 | 101 | 99 |
| 75 | 98 | 96 |
| 150 | 92 | 90 |
| 200 | 89 | 87 |
| 400 | 83 | 81 |
| 800 | 77 | 70 |

The residential areas and hotel within the project limits are located on bluffs above the Albion River. Depending on construction activity location and selected alternative, some of these locations could be partially shielded by topography when work is occurring below the bridge. The estimated construction noise levels present in this section do not account for potential shielding and represent a worst-case assessment of potential noise impacts.

## 8.3. Construction Noise Minimization Measures

To reduce the potential for noise impacts resulting from Project construction, the following measures shall be implemented during Project construction.

- When feasible, noise-generating construction activities shall be restricted to between 7:00 a.m. and 7:00 p.m. Monday through Saturday, with no construction occurring on Sunday or Federal holidays. If work is necessary outside of these hours, notifications shall be made to interested parties in advance and additional noise controls shall be implemented where practical and feasible.

- All internal combustion engine driven equipment shall be equipped with manufacturer recommended intake and exhaust mufflers that are in good condition and appropriate for the equipment.

- Unnecessary idling of internal combustion engines within 100 feet of residences shall be strictly prohibited.

- "Quiet" air compressors and other "quiet" equipment shall be utilized where such technology exists.

- Provide acoustic shielding around pile driving hammer.

# Chapter 9. References

Caltrans. 2013. Technical Noise Supplement. September. Sacramento, CA: Environmental Program, Noise, Air Quality, and Hazardous Waste Management Office. Sacramento, CA. Available: (http://www.dot.ca.gov/hq/env/noise/pub/TeNS_Sept_2013B.pdf).

———. 2020. Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects. May. Sacramento, CA. Available: (https://dot.ca.gov/-/media/dot-media/programs/environmental-analysis/documents/env/traffic-noise-protocol-april-2020-a11y.pdf).

Caltrans. 2023. California Department of Transportation, Office of Travel Forecasting & Modeling. Traffic Data and Designation Request Memo

Caltrans. 2020. Transportation and Construction Vibration Guidance Manual. September. Sacramento, CA: Environmental Program, Noise, Air Quality, and Hazardous Waste Management Office. Sacramento, CA. Available: (https://dot.ca.gov/-/media/dot-media/programs/environmental-analysis/documents/env/tcvgm-apr2020-a11y.pdf)

Federal Highway Administration. 2011. Highway Traffic Noise: Analysis and Abatement Guidance. December. Washington D.C. FHWA-HEP-10-025. Available: (http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/revguidance.pdf)

———. 1998a. FHWA Traffic Noise Model, Version 1.0 User's Guide. January. FHWA-PD-96-009. Washington D.C.

———. 1998b. FHWA Traffic Noise Model, Version 1.0. February. FHWA-PD-96-010. Washington D.C.

———. 2006. Roadway Construction Noise Model. February, 15, 2006. Available: (http://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/).

Federal Transit Administration. 2006. *Transit Noise and Vibration Impact Assessment.* (DOT-T-95-16.) Office of Planning, Washington, DC. Prepared by Harris Miller Miller & Hanson, Inc. Burlington, MA.

# **Appendix A** Traffic Data

**Table A-1. Traffic Data for Existing Conditions**

| Scenario | Existing | 2051 No-Build | 2051 Build |
|---|---|---|---|
| Peak Hour Auto | 458 | 572 | 572 |
| Peak Hour Heavy Truck | 22 | 28 | 28 |

# **Appendix B** Predicted Future Noise Levels

## Table B-1. Predicted Future Noise

| Receptor I.D. | Land Use | Number of Dwelling Units | Address | Existing Noise Level $L_{eq}$(h), dBA | SR-1 Future Worst Hour Noise Levels - $L_{eq}$(h), dBA | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Design Year Noise Level without Project Leq(h), dBA | Alternative 1A | | | Alternative 1B | | | Alternative 2A | | | Alternative 2B | | | Activity Category (NAC) | Impact Type |
| | | | | | | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | | |
| R-1 | Hotel/Motel | 1 | 3790 N Highway 1 | 49 | 50 | 51 | 1 | 1 | 51 | 1 | 1 | 51 | 1 | 1 | 51 | 1 | 1 | E (72) | None |
| R-2 | Hotel/Motel | | 3790 N Highway 1 | 53 | 54 | 55 | 1 | 1 | 55 | 1 | 1 | 56 | 1 | 2 | 55 | 1 | 1 | E (72) | None |
| R-3 | Hotel/Motel | | 3801 N Highway 1 | 56 | 57 | 58 | 1 | 1 | 58 | 1 | 1 | 57 | 1 | 0 | 58 | 1 | 1 | E (72) | None |
| R-4 (ST-1) | Residential | 1 | | 56 | 57 | 58 | 1 | 1 | 58 | 1 | 1 | 57 | 1 | 0 | 57 | 1 | 0 | B (67) | None |
| R-5 | Undeveloped | None | | 57 | 58 | 59 | 1 | 1 | 59 | 1 | 1 | 59 | 1 | 1 | 58 | 1 | 0 | G | None |
| R-6 | Undeveloped | None | | 59 | 60 | 61 | 1 | 1 | 61 | 1 | 1 | 60 | 1 | 0 | 59 | 1 | -1 | G | None |
| R-7 | Undeveloped | None | 3781 N Highway 1 | 57 | 58 | 58 | 1 | 0 | 58 | 1 | 0 | 58 | 1 | 0 | 58 | 1 | 0 | G | None |
| R-8 | Residential | 1 | 3775 N Highway 1 | 55 | 56 | 57 | 1 | 1 | 57 | 1 | 1 | 57 | 1 | 1 | 56 | 1 | 0 | B (67) | None |
| R-9 | Residential | 1 | 3751 N Highway 1 | 56 | 57 | 58 | 1 | 1 | 58 | 1 | 1 | 58 | 1 | 1 | 57 | 1 | 0 | B (67) | None |
| R-10 | Residential | 1 | 3725 N Highway 1 | 57 | 58 | 58 | 1 | 0 | 58 | 1 | 0 | 59 | 1 | 1 | 58 | 1 | 0 | B (67) | None |
| R-11 | Residential | 1 | 3700 Albion Little River Rd | 58 | 59 | 59 | 1 | 0 | 59 | 1 | 0 | 61 | 1 | 2 | 60 | 1 | 1 | B (67) | None |

| Receptor I.D. | Land Use | Number of Dwelling Units | Address | Existing Noise Level $L_{eq}$(h), dBA | SR-1 Future Worst Hour Noise Levels - $L_{eq}$(h), dBA | | | | | | | | | | | | | Activity Category (NAC) | Impact Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Design Year Noise Level without Project Leq(h), dBA | Alternative 1A | | | Alternative 1B | | | Alternative 2A | | | Alternative 2B | | | | |
| | | | | | | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | | |
| R-12 (ST-2) | Residential | 1 | 3720 Albion Little River Rd | 56 | 57 | 57 | 1 | 0 | 57 | 1 | 0 | 59 | 1 | 2 | 58 | 1 | 1 | B (67) | None |
| R-13 | Residential | 1 | 3740 Albion Little River Rd | 53 | 54 | 55 | 1 | 1 | 55 | 1 | 1 | 56 | 1 | 2 | 55 | 1 | 1 | B (67) | None |
| R-14 (ST-3) | Undeveloped | None | 3721 Albion Little River Rd | 51 | 52 | 53 | 1 | 1 | 53 | 1 | 1 | 55 | 1 | 3 | 54 | 1 | 2 | G | None |
| R-15 | Residential | 1 | 3751 Albion Little River Rd | 55 | 56 | 57 | 1 | 1 | 57 | 1 | 1 | 61 | 1 | 5 | 59 | 1 | 3 | B (67) | None |
| R-16 | Residential | 1 | 3887 Albion Little River Rd | 52 | 53 | 55 | 1 | 2 | 55 | 1 | 2 | 57 | 1 | 4 | 56 | 1 | 3 | B (67) | None |
| R-17 | Residential | 2 | Albion River North Side Rd | 51 | 52 | 54 | 1 | 2 | 54 | 1 | 2 | 56 | 1 | 4 | 54 | 1 | 2 | B (67) | None |
| R-18 | Campground | 1 | Albion River North Side Rd | 52 | 53 | 54 | 1 | 1 | 54 | 1 | 1 | 54 | 1 | 1 | 56 | 1 | 3 | C (67) | None |
| R-19 | Campground | | Albion River North Side Rd | 53 | 54 | 52 | 1 | -2 | 52 | 1 | -2 | 52 | 1 | -2 | 53 | 1 | -1 | C (67) | None |
| R-20 (ST-4) | Campground | | Albion River North Side Rd | 52 | 53 | 52 | 1 | -1 | 52 | 1 | -1 | 50 | 1 | -3 | 56 | 1 | 3 | C (67) | None |
| R-21 (ST-5) | Campground | | 3500 N Highway 1 | 46 | 47 | 48 | 1 | 1 | 48 | 1 | 1 | 50 | 1 | 3 | 50 | 1 | 3 | C (67) | None |
| R-22 | Undeveloped | None | 33920 Albion River South Side Rd | 49 | 50 | 50 | 1 | 0 | 50 | 1 | 0 | 51 | 1 | 1 | 51 | 1 | 1 | G | None |
| R-23 | Undeveloped | None | 33950 Albion River South Side Rd | 52 | 53 | 52 | 1 | -1 | 52 | 1 | -1 | 56 | 1 | 3 | 56 | 1 | 3 | G | None |
| R-24 | Residential | 1 | 33880 Albion River South Side Rd | 48 | 49 | 49 | 1 | 0 | 49 | 1 | 0 | 52 | 1 | 3 | 52 | 1 | 3 | B (67) | None |
| R-25 | Residential | 1 | 33890 Albion River South Side Rd | 56 | 57 | 54 | 1 | -3 | 54 | 1 | -3 | 59 | 1 | 2 | 58 | 1 | 1 | B (67) | None |

| Receptor I.D. | Land Use | Number of Dwelling Units | Address | Existing Noise Level $L_{eq}$(h), dBA | SR-1 Future Worst Hour Noise Levels - $L_{eq}$(h), dBA | | | | | | | | | | | | | Activity Category (NAC) | Impact Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Alternative 1A | | | Alternative 1B | | | Alternative 2A | | | Alternative 2B | | | | |
| | | | | | Design Year Noise Level without Project Leq(h), dBA | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | | |
| R-26 (ST-6) | Residential | 1 | 33891 Albion River South Side Rd | 58 | 59 | 56 | 1 | -3 | 56 | 1 | -3 | 62 | 1 | 3 | 60 | 1 | 1 | B (67) | None |
| R-27 | Residential | 1 | 33879 East Ln | 55 | 56 | 56 | 1 | 0 | 56 | 1 | 0 | 58 | 1 | 2 | 57 | 1 | 1 | B (67) | None |
| R-28 | Residential | 1 | 33875 East Ln | 53 | 54 | 53 | 1 | -1 | 53 | 1 | -1 | 56 | 1 | 2 | 55 | 1 | 1 | B (67) | None |
| R-29 | Residential | 1 | 33861 East Ln | 52 | 53 | 53 | 1 | 0 | 53 | 1 | 0 | 56 | 1 | 3 | 55 | 1 | 2 | B (67) | None |
| R-30 | Residential | 1 | 33851 East Ln | 51 | 52 | 52 | 1 | 0 | 52 | 1 | 0 | 55 | 1 | 3 | 54 | 1 | 2 | B (67) | None |
| R-31 | Residential | 1 | 33831 East Ln | 51 | 52 | 52 | 1 | 0 | 52 | 1 | 0 | 54 | 1 | 2 | 53 | 1 | 1 | B (67) | None |
| R-32 | Residential | 1 | 33795 East Ln | 50 | 51 | 51 | 1 | 0 | 51 | 1 | 0 | 54 | 1 | 3 | 53 | 1 | 2 | B (67) | None |
| R-33 | Residential | 1 | 3400 N Highway 1 | 49 | 50 | 50 | 1 | 0 | 50 | 1 | 0 | 52 | 1 | 2 | 52 | 1 | 2 | B (67) | None |
| R-34 | Undeveloped | None | 33870 Albion River South Side Rd | 54 | 55 | 55 | 1 | 0 | 55 | 1 | 0 | 55 | 1 | 0 | 55 | 1 | 0 | G | None |
| R-35 (ST-7) | Undeveloped | None | 33861 Albion River South Side Rd | 58 | 59 | 59 | 1 | 0 | 59 | 1 | 0 | 60 | 1 | 1 | 59 | 1 | 0 | G | None |
| R-36 | Residential | 1 | 33880 Albion St | 54 | 55 | 55 | 1 | 0 | 55 | 1 | 0 | 56 | 1 | 1 | 55 | 1 | 0 | B (67) | None |
| R-37 | Residential | 1 | 33870 Albion St | 53 | 54 | 54 | 1 | 0 | 54 | 1 | 0 | 55 | 1 | 1 | 55 | 1 | 1 | B (67) | None |
| R-38 | Residential | 1 | 33860 Albion St | 52 | 53 | 53 | 1 | 0 | 53 | 1 | 0 | 55 | 1 | 2 | 54 | 1 | 1 | B (67) | None |
| R-39 | Residential | 1 | 33850 East Ln | 51 | 52 | 52 | 1 | 0 | 52 | 1 | 0 | 54 | 1 | 2 | 53 | 1 | 1 | B (67) | None |
| R-40 | Residential | 1 | 33840 Albion St | 50 | 51 | 52 | 1 | 1 | 52 | 1 | 1 | 53 | 1 | 2 | 53 | 1 | 2 | B (67) | None |
| R-41 | Residential | 1 | 33830 Albion St | 50 | 51 | 51 | 1 | 0 | 51 | 1 | 0 | 53 | 1 | 2 | 52 | 1 | 1 | B (67) | None |
| R-42 | Residential | 1 | 33820 Albion St | 49 | 50 | 50 | 1 | 0 | 50 | 1 | 0 | 52 | 1 | 2 | 52 | 1 | 2 | B (67) | None |
| R-43 | Residential | 1 | 3300 N Highway 1 | 49 | 50 | 50 | 1 | 0 | 50 | 1 | 0 | 52 | 1 | 2 | 51 | 1 | 1 | B (67) | None |

| Receptor I.D. | Land Use | Number of Dwelling Units | Address | Existing Noise Level $L_{eq}$(h), dBA | SR-1 Future Worst Hour Noise Levels - $L_{eq}$(h), dBA | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Design Year Noise Level without Project Leq(h), dBA | Alternative 1A | | | Alternative 1B | | | Alternative 2A | | | Alternative 2B | | | Activity Category (NAC) | Impact Type |
| | | | | | | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project $L_{eq}$(h), dBA | Design Year Noise Level without Project minus Existing Conditions $L_{eq}$(h), dBA | Design Year Noise Level with Project Minus No Project Conditions $L_{eq}$(h), dBA | | |
| R-44 | Residential | 1 | 3300 N Highway 1 | 50 | 51 | 50 | 1 | -1 | 50 | 1 | -1 | 51 | 1 | 0 | 50 | 1 | -1 | B (67) | None |
| R-45 | Residential | 1 | 34900 Albion Ridge Rd | 58 | 59 | 59 | 1 | 0 | 59 | 1 | 0 | 59 | 1 | 0 | 58 | 1 | -1 | B (67) | None |
| R-46 | Commercial | 1 | 34011 Albion Ridge Rd | 57 | 58 | 58 | 1 | 0 | 58 | 1 | 0 | 57 | 1 | -1 | 57 | 1 | -1 | F | None |
| R-47 | Commercial | None | 3187 Spring Grove Rd | 54 | 55 | 54 | 1 | -1 | 54 | 1 | -1 | 55 | 1 | 0 | 54 | 1 | -1 | F | None |
| R-48 | Undeveloped | None | 3269 Spring Grove Rd | 48 | 49 | 49 | 1 | 0 | 49 | 1 | 0 | 49 | 1 | 0 | 49 | 1 | 0 | G | None |
| R-49 | Undeveloped | None | | 56 | 57 | 57 | 1 | 0 | 57 | 1 | 0 | 57 | 1 | 0 | 57 | 1 | 0 | G | None |
| R-50 | Undeveloped | None | | 58 | 59 | 59 | 1 | 0 | 59 | 1 | 0 | 59 | 1 | 0 | 58 | 1 | -1 | G | None |
| R-51 | Undeveloped | None | 3000 N Shoreline | 60 | 61 | 61 | 1 | 0 | 61 | 1 | 0 | 62 | 1 | 1 | 60 | 1 | -1 | G | None |
| R-52 | Commercial | 1 | 2981 Spring Grove Rd | 48 | 49 | 49 | 1 | 0 | 49 | 1 | 0 | 49 | 1 | 0 | 48 | 1 | -1 | F | None |
| R-53 | Residential | None | | 60 | 61 | 61 | 1 | 0 | 61 | 1 | 0 | 61 | 1 | 0 | 61 | 1 | 0 | G | None |
| R-54 | Undeveloped | None | 2960 Spring Grove Rd | 60 | 61 | 60 | 1 | -1 | 60 | 1 | -1 | 61 | 1 | 0 | 60 | 1 | -1 | G | None |
| R-55 | Residential | 1 | 3790 N Highway 1 | 54 | 55 | 55 | 1 | 0 | 55 | 1 | 0 | 55 | 1 | 0 | 55 | 1 | 0 | B (67) | None |

Note: All NAC are exterior unless note.

# **Appendix C** Construction Vibration Assessment

## C.1. Construction Vibration

Vibrations travel through the ground from the point at which energy is imparted (e.g., pile strike). Vibrations are spread out and reflected between different soil layers and attenuates as it travels due to the spreading and damping properties of the soil or rock through which the vibration travels. Consequently, the process of vibration propagation is often complex and difficult to predict for any given site. Generally, vibrations will spread through the ground and diminish in strength as the distance from the vibration source increases.

Construction vibration has the potential to cause architectural or structural damage to buildings in the project area during operation of heavy equipment or impact equipment. Ground vibration and ground-borne noise can also be a source of annoyance to residences near the vibration-generating activities. Vehicle traffic, including heavy trucks traveling on a highway, rarely generates vibration amplitudes high enough to cause structural or cosmetic damage.

Construction activities result in varying degrees and types of ground vibration, depending on the type of equipment, construction methods, the intensity and duration of the specific construction activity, and underlying soil types. Operation of construction equipment can generate sustained (continuous or frequent intermittent) ground vibrations or single isolated vibration events (transient ground vibrations). Equipment or activities typical of continuous or frequent intermittent vibration include excavation equipment, tracked vehicles, traffic on a highway, vibratory and impact pile drivers, pile extraction equipment, and vibratory compaction equipment. Equipment or activities typical of single-impact (transient) or low-rate repeated impact vibration include, blasting, drop balls, and crack-and-seat equipment.

## C.2. Regulatory Criteria

The Caltrans Transportation and Construction Vibration Guidance Manual includes procedures to assess the potential for construction-related vibration impacts. Table C-1 summarizes the guidelines for potential damage to structures. The manual also identifies vibration levels that could cause disturbance to humans. Table C-2 summarizes the guidelines for potential annoyance to nearby residences.

**Table C-1. Guideline for Potential Damage from Continuous or Frequent Intermittent and Transient Vibration Levels to Structures**

| Structure Condition | Maximum Velocity Level, PPV (in/sec) | |
|---|---|---|
| | Transient Source | Continuous or Frequent Intermittent Source |
| Modern Industrial/ Commercial Structures | 2.0 | 0.5 |
| New Residential Structures | 1.0 | 0.5 |
| Older Residential Structures | 0.5 | 0.3 |
| Historic and some Old Structures | 0.5 | 0.25 |

Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, April 2020.

**Table C-2. Guideline for Potential Annoyance from Continuous or Frequent Intermittent and Transient Vibration Levels**

| Human Response | Maximum Velocity Level, PPV (in/sec) | |
|---|---|---|
| | Transient Source | Continuous or Frequent Intermittent Source |
| Barely perceptible | 0.04 | 0.01 |
| Distinctly perceptible | 0.25 | 0.04 |
| Strongly perceptible | 0.9 | 0.10 |
| Severe | 2.0 | 0.4 |

Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, April 2020.

## C.3. Construction Vibration Levels

Table C-3 presents typical vibration levels that could be expected from representative construction equipment at a reference distance of 25 feet. Vibration levels are highest close to the source, and then attenuate with increasing distance depending on soil conditions.

The PPV was estimated using reference vibration source amplitudes and the simplified Wiss propagation model described in Chapter 4 of the 2020 Caltrans Transportation and Construction Vibration Guidance Manual. The vibration amplitudes estimated using this method represent typical worst-case values. Actual values from equipment used by the contractor may result in vibration amplitudes that exceed or are lower than the estimated values.

For impact hammers, PPV is estimated using the following formula:

$$PPVpile\ driver = PPVref\,(25/D)^{n}\,(Eequip/Eref)^{0.5}\ (in/sec)$$

Where:

$PPV_{ref}$ *= reference pile driver at 25 feet.*

$n$ *= soil type calibration factor (assume* $n=1.1$*).*

$D$ *=distance from the pile driver to the receiver in feet.*

*Eequip = rated energy of impact pile driver in ft-lbs.*

*Eref = 36,000 ft-lb (rated energy of reference pile driver)*

For all other equipment, the equation becomes:

$$PPVequip = PPVref(25/D)^{n}\ (in/sec)$$

Where:

$PPV_{ref}$ *= Reference vibration at 25 feet.*

$n$ *= soil type calibration factor (assume* $n=1.1$*).*

$D$ *=distance from the pile driver to the receiver in feet.*

**Table C-3. Construction Vibration from Equipment**

| **Equipment** | **Vibration Level (in/sec PPV)** | | | | |
|---|---|---|---|---|---|
| | **25 feet** | **50 feet** | **75 feet** | **100 feet** | **200 feet** |
| Vibratory Roller | 0.210 | 0.098 | 0.063 | 0.046 | 0.021 |
| Large Bulldozer | 0.089 | 0.042 | 0.027 | 0.019 | 0.009 |
| Drilling | 0.089 | 0.042 | 0.027 | 0.019 | 0.009 |
| Hoe Ram | 0.244 | 0.114 | 0.073 | 0.053 | 0.025 |
| Loaded Truck | 0.076 | 0.035 | 0.023 | 0.017 | 0.008 |
| Impact Pile Driver (typical) | 0.650 | 0.303 | 0.194 | 0.141 | 0.066 |
| Impact Pile Driver (upper limit)[1] | 1.532 | 0.715 | 0.458 | 0.333 | 0.156 |
| Vibratory Pile Driver | 0.650 | 0.303 | 0.194 | 0.141 | 0.066 |

Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, April 2020.

[1] Upper limit impact pile driving assumes maximum driving energy of 200,000 ft-lbs

Table C-4 shows the distance to potential damage for structures. Impact pile driving that occurs within 130 feet of historic buildings, 110 feet of older residential buildings or 70 feet of new residential and commercial structures has the potential to cause damage. Vibratory pile driving that occurs within 60 feet of historic buildings, 50 feet of older residential buildings or 32 feet of new residential and commercial structures has the potential to cause damage. Hoe rams have the highest PPV for other construction equipment. Hoe rams operating within 25 feet of historic buildings, 21 feet of older residential buildings or 13 feet of new residential and commercial structures has the potential to cause damage.

**Table C-4. Distance to Potential Structure Damage**

| Structure Type | Distance to Threshold (feet) | | |
|---|---|---|---|
| | Impact Pile Driving (upper limit) | Vibratory Pile Driving | Other Equipment |
| Modern Industrial/ Commercial Structures | 70 | 32 | 13 |
| New Residential Structures | 70 | 32 | 13 |
| Older Residential Structures | 110 | 50 | 21 |
| Historic and some Old Structures | 130 | 60 | 25 |

Table C-5 shows the distance to potential annoyance to nearby residences. Vibration from impact pile would be considered severe within 85 feet of the pile driving operation and would be barely perceptible beyond 2,500 feet. Vibratory pile driving would be considered severe at distances less than 40 feet and would be barely perceptible beyond 1,115 feet. Vibrations from a hoe ram would be considered severe within 16 feet and would be barely perceptible beyond 455 feet.

**Table C-5. Distance to Potential Annoyance**

| Human Response | Distance to Threshold (feet) | | |
|---|---|---|---|
| | Impact Pile Driving (upper limit) | Vibratory Pile Driving | Other Equipment |
| Barely perceptible | 2,500 | 1,115 | 455 |
| Distinctly perceptible | 690 | 315 | 130 |
| Strongly perceptible | 300 | 140 | 55 |
| Severe | 85 | 40 | 16 |

If proposed construction activity occurs within the distances to structures shown in Table C-4, a preconstruction survey that documents the existing condition of the buildings and vibration monitoring during construction is recommended. The preconstruction survey should identify and document both structural and cosmetic damage on the interior and exterior of the building. The length and width of cracks should be measured, and if deemed necessary, monitored during construction. Areas that are typically inspected during a preconstruction survey include foundations, interior/exterior walls, hardscaping, and interior floors. The survey should include a photo log or video log, and if known, list the cause of the damage. Vibration monitors should be placed outside the buildings at the point closest to the vibration source. NSSP 14-8.03 Vibration Monitoring and 14-8.04 Crack Monitoring are recommended.

# **Appendix D** Supplemental Data

**Figure D-1. Short-Term Monitoring at Location LT-1, September 28/29, 2016**

Figure D-2. Short-Term Monitoring at Location ST-1, April 4, 2023

Figure D-3. Short-Term Monitoring at Location ST-2, September 28, 2016

**Figure D-4. Short-Term Monitoring at Location ST-3, April 4, 2023**

**Figure D-5. Short-Term Monitoring at Location ST-4, April 4, 2023**

**Figure D-6. Short-Term Monitoring at Location ST-5, April 4, 2023**

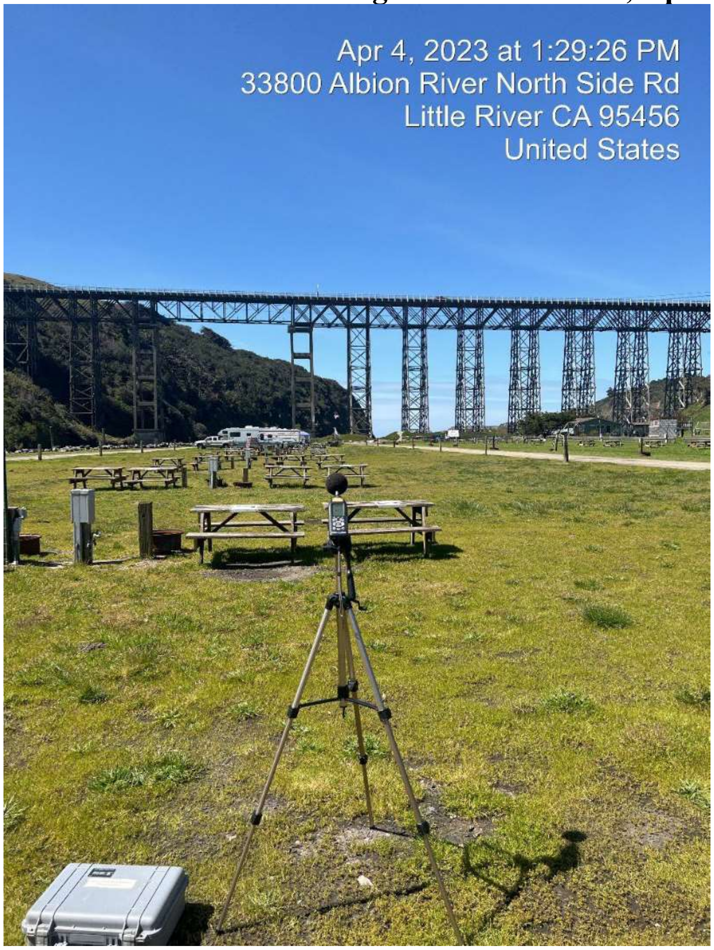


**Figure D-7. Short-Term Monitoring at Location ST-6, September 28, 2016**

Figure D-8. Short-Term Monitoring at Location ST-7, April 3, 2023