Noise Study Report

Washington Boulevard/Andora Bridge Improvement Project

City of Roseville, California

District 3-03-PLA-25501

CML 5182 (074)

July 2017

Caltrans

Summary

The City of Roseville (City) is proposing to improve a 0.85-mile section of Washington Boulevard as part of the proposed Washington Boulevard/Andora Bridge Improvement Project (proposed project) (Figure 1). The proposed project involves widening a two-lane section of Washington Boulevard between Sawtell Road and Pleasant Grove Boulevard to four lanes and replacing the existing 100-year-old Union Pacific Railroad (UPRR) bridge (referred to in this document as the Andora Underpass) on Washington Boulevard. The addition of two new lanes to Washington Boulevard would provide a continuous four-lane thoroughfare between Sawtell Road and Pleasant Grove Boulevard and improve traffic circulation and pedestrian traffic through the area. The proposed project is subject to state and federal environmental review requirements because the use of federal funds from the Federal Highway Administration (FHWA) is proposed. The California Department of Transportation (Caltrans) is the federal lead agency under FHWA assignment of National Environmental Policy Act (NEPA) responsibilities pursuant to 23 U.S. Code (USC) 327 and the City is the lead agency under the California Environmental Quality Act (CEQA).

The purpose of the proposed project is to improve existing and future traffic; enhance access and safety for motorists, pedestrians, and cyclists; and meet railroad clearance requirements. The proposed project would also provide better connectivity between the existing two-lane, 0.85-mile segment of Washington Boulevard and the existing four-lane segments of Washington Boulevard and provide an evacuation route in case of an emergency. The improvements would also offer a better and more continuous route for pedestrians and bicyclists, who are currently forced to detour off Washington Boulevard onto Derek Place.

The proposed project is in the city of Roseville, Placer County, along Washington Boulevard between Sawtell Road and Pleasant Grove Boulevard (Figure 2). Residential land uses are located throughout the project area. The southern end of the project area is surrounded by commercial development to the east and residential area to the west, and the Diamond Oaks and Kaseberg-Kingswood neighborhoods are adjacent to the central and northern portions of the project area. City general open space and preserve open space lands occupy the area immediately west of the Andora Underpass. Residential development is present on both sides of Washington Boulevard between the Andora Underpass and Pleasant Grove Boulevard. At the southern end of the project area, the UPRR line runs along the east side of Washington Boulevard, crosses over the road just south of the South Branch of Pleasant Grove Creek, and continues along the west side of the road toward Pleasant Grove Boulevard.

To prepare this the noise study report (NSR), short-term and long-term noise measurements were taken in the vicinity of the project site; locations were selected to be representative of the land use categories and activities within the project area. Short-term measurements were used to validate/calibrate the traffic noise modeling used in the study, and were also used (when appropriate) as noise modeling receivers for the analysis of worst-hour traffic noise levels under existing and future conditions. Long-term measurement sites were selected to capture the diurnal traffic noise level patterns in the project area. Additional modeling receivers were added to be representative of actual noise sensitive uses in the project area. Existing year (2015) and design year (or cumulative, year 2035) No-Build and design year Build (“no project” and “plus project”) worst-hour noise levels were modeled using the FHWA Traffic Noise Model (TNM), version 2.5, and are presented in Appendix B (Table B-1). Worst-hour traffic noise levels at the modeled receivers in the existing condition are predicted to be in the range of 43 to 68 dBA L_{eq}. Noise levels at the modeled receivers in the design year are predicted to be in the range of 44 to 68 dBA L_{eq} for No-Build conditions and 45 to 69 dBA L_{eq} for Build conditions. Noise levels at many of the receivers were predicted to increase under both Build and No-Build conditions as compared to existing conditions. Noise levels increased at modeled receivers for the future No-Build condition, relative to existing conditions, by up to 2 dB. Noise levels increased at modeled receivers for the future Build condition, relative to existing conditions, by up to 3 dB. Noise levels at modeled receivers for the future Build condition, relative to future No-Build conditions, also increased by up to 3 dB.

The modeling results indicate that traffic noise levels at multiple residential receptors in the project vicinity are expected to approach or exceed the NAC for residential land uses of 67 dBA L_{eq}. Specifically, six modeled receivers, which are representative of a total of eight residential receptors, had noise levels in the range of 67 to 68 dBA L_{eq}. Seven of these residential receptors are located on the east side of Washington Boulevard between Pleasant Grove Boulevard and Diamond Oaks Road, and one of these residential receptors is located on the north side of Kaseberg Drive, west of Washington Boulevard. No receivers are predicted to be exposed to a 12-dB increase under future Build conditions, relative to existing conditions. However, because the predicted noise level in the design-year approaches or exceeds 67 dBA L_{eq} for these 8 residential receptors, traffic noise impacts are predicted at these residences, and noise abatement must be considered in these two areas.

Pursuant to Caltrans and FHWA regulations and guidance, noise abatement is considered for land uses where traffic noise impacts are predicted. For receivers that are predicted to be exposed to traffic noise levels that approach or exceed the noise abatement criteria (NAC), noise abatement in the form of barriers was considered. Two barriers (Noise Barrier 1 and Noise Barrier 2) were analyzed along the project alignment, and reasonable allowances for the barriers were calculated. Those calculations are presented in Tables 7-1 and 7-2 in Chapter 7 of this report.

During construction of the proposed project, noise from construction activities would intermittently dominate the noise environment in the immediate area of construction. Construction equipment that is anticipated to be used for the project is expected to generate maximum noise levels ranging from 76 to 85 dBA at a distance of 50 feet. Noise produced by construction equipment would diminish at a rate of about 6 dBA per doubling of distance. As construction would not occur during the nighttime hours of 9:00 p.m. to 6:00 a.m., and as no piece of equipment proposed for project construction would generate noise levels of 86 dBA or greater at a distance of 50 feet, no adverse noise impacts from construction are anticipated. Construction noise would be short-term and intermittent, and the construction would be conducted in accordance with Caltrans Standard Specifications Section 14.8-02.

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List of Abbreviated Terms

ANSI	American National Standard Institute
BMPs	best management practices
CAD	computer-aided design
Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CIP	Capital Improvement Program
City	City of Roseville
CNEL	Community Noise Equivalent Level
CY	cubic yards
dB	decibel
dBA	A-weighted decibels
FHWA	Federal Highway Administration
HOT	high-occupancy toll
HOV	high-occupancy vehicle
Hz	Hertz
kHz	kilohertz
L_{dn}	Day-Night Level
L_{eq}	Equivalent Sound Level
L_{eq}(h)	hourly equivalent sound level
L_{max}	Maximum Sound Level
LOS	level of service
L_{xx}	Percentile-Exceeded Sound Level

mPa	micro-Pascal
mph	miles per hour
NAC	noise abatement criteria
NADR	Noise Abatement Decision Report
NEPA	National Environmental Policy Act
NSR	noise study report
PG&E	Pacific Gas and Electric
proposed project	Washington Boulevard/Andora Bridge Improvement Project
Protocol	Caltrans Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects
RTP	Regional Transportation Program
SLM	sound level meter
SPL	sound pressure level
SWPPP	Storm Water Pollution Prevention Plan
TeNS	Technical Noise Supplement
TNM 2.5	Traffic Noise Model Version 2.5
UPRR	Union Pacific Railroad
USC	United States Code

Chapter 1 Introduction

The City is proposing to improve a 0.85-mile section of Washington Boulevard as part of the proposed project (Figure 1). The proposed project involves widening a two-lane section of Washington Boulevard between Sawtell Road and Pleasant Grove Boulevard to four lanes and replacing the existing 100-year-old Andora Underpass on Washington Boulevard. The addition of two new lanes to Washington Boulevard would provide a continuous four-lane thoroughfare between Sawtell Road and Pleasant Grove Boulevard and improve traffic circulation and pedestrian traffic through the area. The proposed project is subject to state and federal environmental review requirements because the use of federal funds from FHWA is proposed. Caltrans is the federal lead agency under FHWA assignment of NEPA responsibilities pursuant to 23 U.S. Code (USC) 327 and the City is the lead agency under CEQA.

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 FHWA noise standards. Compliance with 23 CFR 772 provides compliance with the noise impact assessment requirements of NEPA.

The Caltrans *Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects* (Protocol) (California Department of Transportation 2011) provides Caltrans policy for implementing 23 CFR 772 in California. The Protocol outlines the requirements for preparing NSRs. Noise impacts associated with the project under CEQA will be evaluated separately in the project's CEQA document.

1.2 Project Purpose and Need

1.2.1 Purpose

The purpose of the proposed project is to improve existing and future traffic; enhance access and safety for motorists, pedestrians, and cyclists; and meet railroad clearance requirements. The proposed project would also provide better connectivity between the existing two-lane, 0.85-mile segment of Washington Boulevard and the existing four-lane segments of Washington Boulevard and provide an evacuation route in case of an emergency. The improvements would also offer a better and more continuous route for pedestrians and bicyclists, who are currently forced to detour off Washington Boulevard onto Derek Place.

1.2.2 Need

The project is needed because recurring morning and evening peak-period demand exceeds the current design capacity of Washington Boulevard, creating traffic operation and improving safety for motorists, pedestrians, and cyclists. These issues result in moderate delays and wasted fuel, which are expected to be exacerbated by anticipated increases in traffic from future population and employment growth.

The proposed project's objectives are as follows:

- Implement the adopted Capital Improvement Program (CIP) for the segment of Washington Boulevard between Sawtell Road and Pleasant Grove Boulevard.
- Improve vehicular traffic flow along Washington Boulevard between Sawtell Road and Pleasant Grove Boulevard by widening the road and the Andora Underpass.
- Enhance access and safety along this segment of Washington Boulevard for motorists, pedestrians, and cyclists by widening the boulevard.
- Provide a better and more continuous route for pedestrians and bicyclists on Washington Boulevard than the existing detour onto the more isolated Derek Place.
- Provide a consistent four-lane roadway along this length of Washington Boulevard by connecting the existing four-lane segments on either side of Sawtell Road and Pleasant Grove Boulevard.
- Improve traffic safety by alleviating the Andora Underpass' existing substandard vertical clearance.

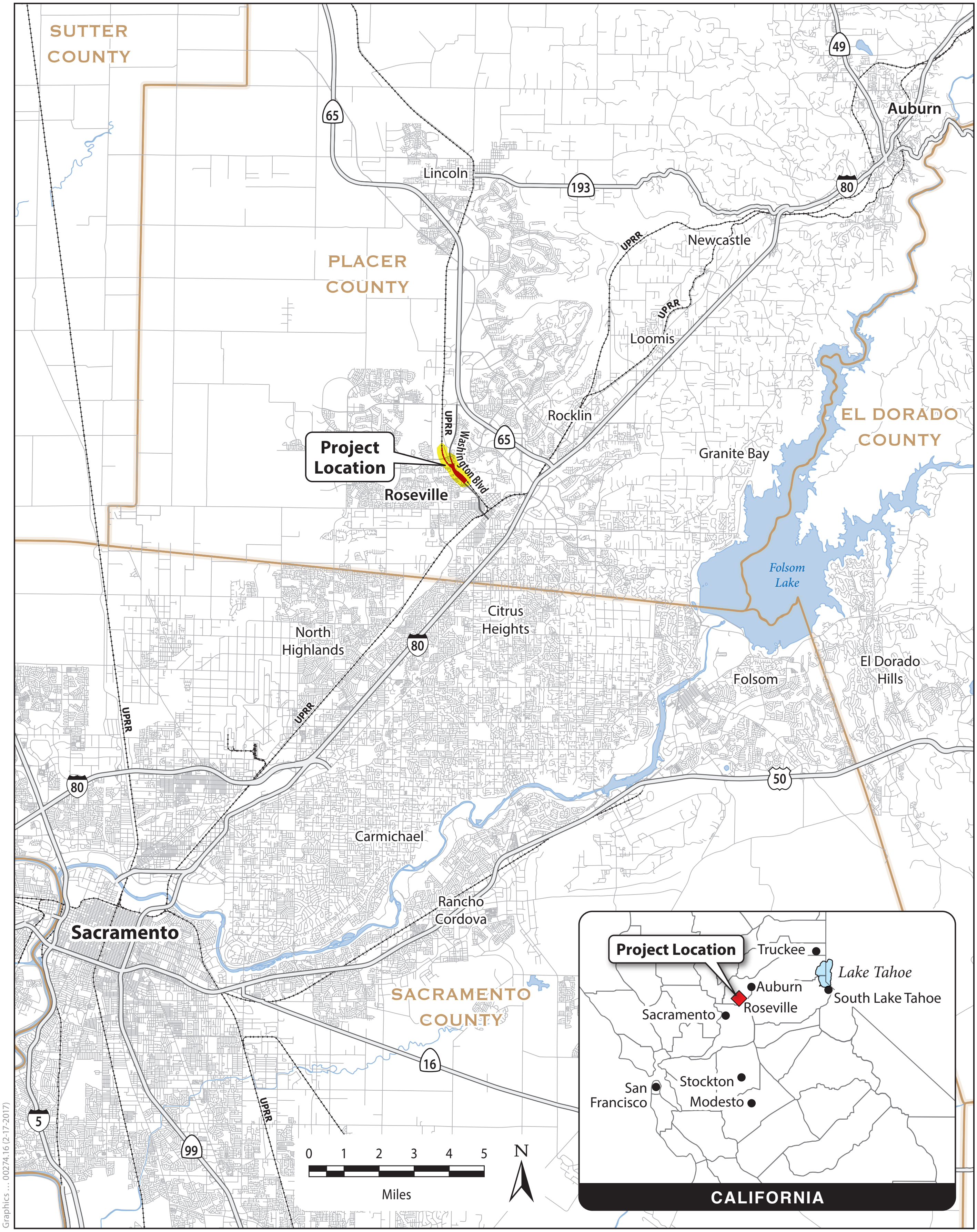

Figure 1
Regional Location

Chapter 2 Project Description

This chapter describes the proposed project, including a discussion of the project alternatives being considered.

2.1 Background

Washington Boulevard generally runs north-south and begins in downtown Roseville, at its junction with Oak Street, and ends at State Route (SR) 65. The boulevard provides an important local connection between downtown Roseville and North Central Roseville, Northwest Roseville, and North Industrial through its connections with other major local thoroughfares, including Foothills Boulevard, Pleasant Grove Boulevard, Roseville Parkway, Industrial Boulevard, and Blue Oaks Boulevard. Washington Boulevard provides a vital economic link from residential areas to shopping and employment centers in downtown Roseville.

Washington Boulevard was constructed as a two-lane road as part of the State Highway System approximately 100 years ago. The City decided to widen Washington Boulevard to improve the level of service (LOS) and other traffic performance measures and to accommodate increasing traffic volumes. The City elected to delay improvements to the 0.85-mile segment of Washington Boulevard associated with the proposed project because of the extensive coordination necessary with UPRR and the costs associated with widening the Andora Underpass.

The City's Transportation System 2035 CIP identifies improvements to Washington Boulevard, including the widening of Washington Boulevard between Sawtell Road and Pleasant Grove Boulevard, to improve traffic circulation and pedestrian traffic through the area. Approximately 18,000 vehicles per day presently travel through this segment, and the road improvements would enhance accessibility for motorists, pedestrians, and cyclists along Washington Boulevard and nearby intersections. To enable roadway widening at the narrow Andora Underpass, the existing structure must be removed and replaced. The Andora Underpass would need to remain open and accessible to rail traffic during project construction because approximately 25 trains travel over it each day.

In summer and fall 2016, the City and the project team met with residents and local businesses about the proposed project. More than a total of 45 community members attended two meetings with the project team to discuss the project, ask questions, and provide feedback on the project and proposed construction approach.

2.2 Project Limits and Surrounding Land Uses

The proposed project is in the city of Roseville, Placer County, along an approximately 0.85-mile segment of Washington Boulevard between Sawtell Road and Pleasant Grove Boulevard (Figure 2). At the southern end of the project area, the UPRR line runs along the east side of Washington Boulevard, crosses over the road just south of the South Branch of Pleasant Grove Creek, and continues along the west side of the road toward Pleasant Grove Boulevard. The southern end of the project area is surrounded by commercial development to the east and residential area to the west. The Diamond Oaks and Kaseberg-Kingswood neighborhoods are adjacent to the central and northern portions of the project area. City general open space and preserve open space lands occupy the area immediately west of the Andora Underpass. Residential development is present on both sides of Washington Boulevard between the Andora Underpass and Pleasant Grove Boulevard. An existing Class 1 (i.e., off-street) bike path along the east side of Washington Boulevard connects Diamond Oaks Road to Derek Place. Figure 3 shows an overview of the proposed project (including project components) and existing conditions described above.

2.3 Project Alternatives

The proposed design and construction of the project are described below. The project is depicted on Figure 1. Two Build Alternatives (Alternative 1 and Alternative 2) and a No Project Alternative are being considered for this project. The assessment of alternatives is based on design year (2035) conditions.

After extensive engineering and traffic analysis efforts, and review and screening of design concepts, two Build Alternatives that would meet the project’s purpose and need and objectives surfaced for consideration and analysis. Alternatives 1 and 2 would involve the same project components described above. The primary differences between the Build Alternatives are the construction access and traffic diversion options and the associated staging and duration of construction. Alternative 1 would involve complete road closure and rerouting of traffic for a period of 5 months and an estimated construction duration of 13 months; Alternative 2 would leave one lane open during construction and would require an estimated 20 months of construction.

2.3.1 Traffic Conditions and Geometric Design Parameters

The posted speed limit along Washington Boulevard is 45 miles per hour (mph). However, vehicles were observed traveling between 35 and 45 mph during the noise field survey.

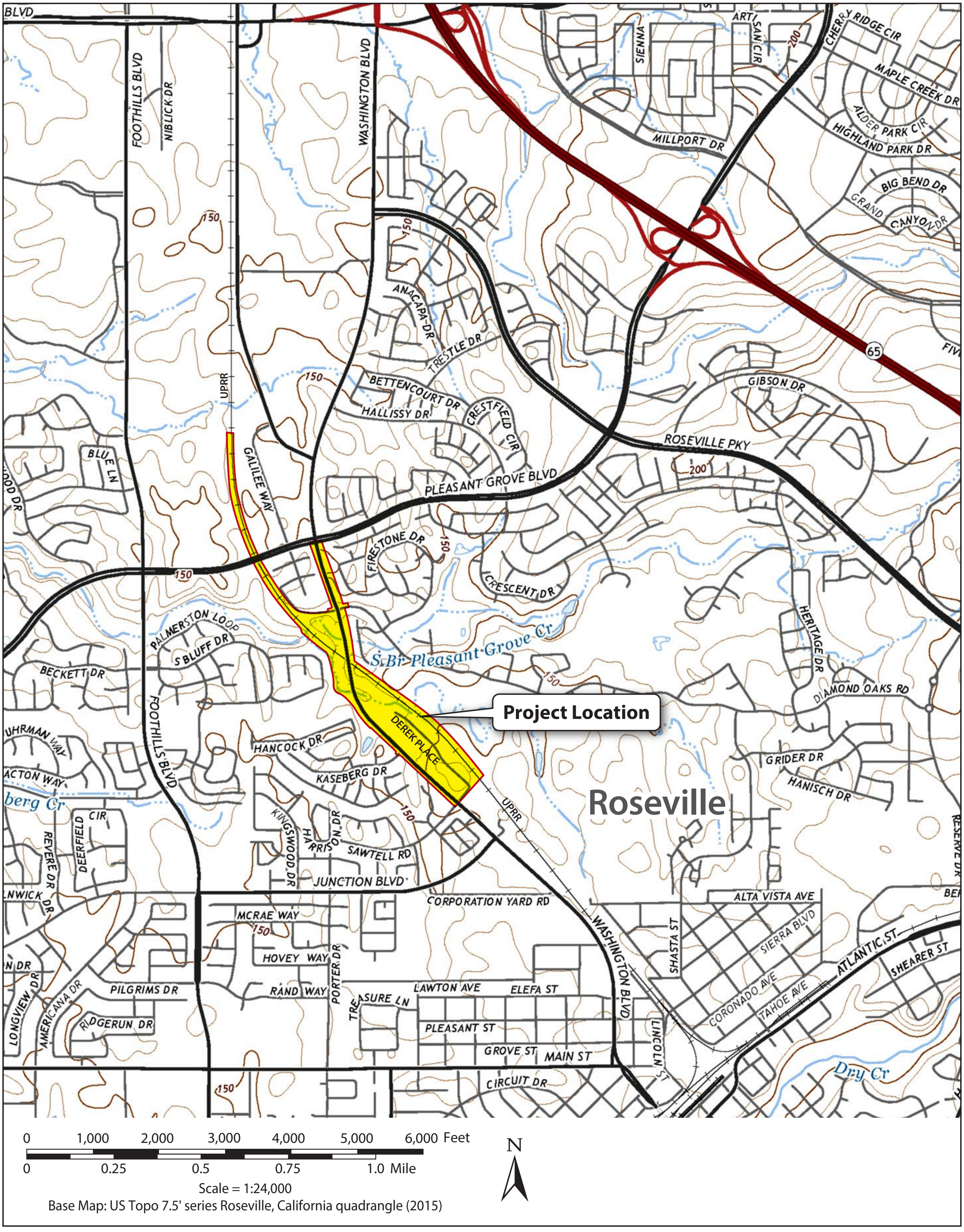

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Figure 2
Project Location

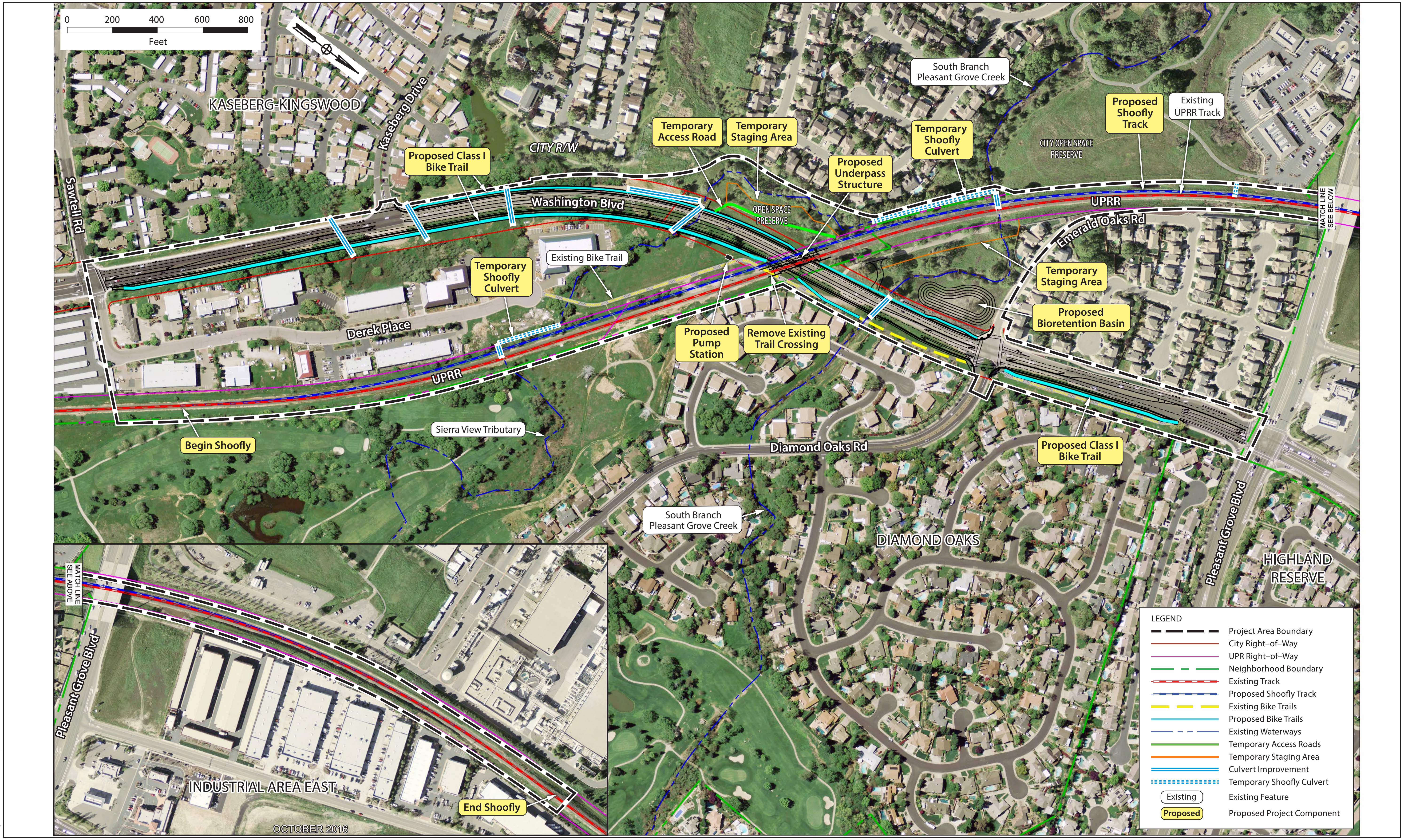

Figure 3
Project Components

2.3.2 Alternative 1 (Proposed Project)

Alternative 1 (the proposed project) would include the following elements:

- Widening approximately 0.85 mile of Washington Boulevard from two to four lanes with a raised median separating northbound and southbound traffic.
- Widening the Andora Underpass to a two-span bridge with columns located in the roadway median island to accommodate the additional two lanes.
- Adding 8-foot-wide Class 2 (i.e., on-street with appropriate signing and striping) bike lanes along both sides of Washington Boulevard.
- Expanding the existing Class 1 bike path on the east side of Washington Boulevard from Diamond Oaks Road to Derek Place with a 10- to 12-foot-wide path parallel to Washington Boulevard and connecting it to Sawtell Road.
- Removing the existing bicycle/pedestrian crossing under UPRR and providing a new connection between the existing Derek Place trail to the new Class 1 bike path along Washington Boulevard (described above).
- Adding a new 8- to 12-foot-wide multiuse path on the west side of Washington Boulevard between Emerald Oaks Road and Kaseberg Drive. Portions of the proposed multiuse path may be deferred until additional construction funding is available.
- Providing traffic signal modifications. The existing traffic signal at Diamond Oaks Road would be modified to conform to the new four-lane roadway.
- Conducting floodplain, water quality, and drainage improvements.
- Relocating existing utilities, including sewer, water, telecommunications, and natural gas.
- Temporally restriping Foothills Boulevard at Junction Boulevard to provide two left-turn lanes from southbound Foothills Boulevard to eastbound Junction Boulevard.

The proposed project would not alter the existing bus turnout adjacent to southbound Washington Boulevard and south of Pleasant Grove Boulevard. Each of the major proposed project components is described in greater detail below. Figure 3 provides an overview of these components.

Washington Boulevard Widening

The proposed project would consist of widening Washington Boulevard to allow two through lanes in each direction with a raised median separating the northbound and southbound traffic. Concrete curbs would define the new edge of roadway and separate the vehicular traffic from the pedestrians.

Andora Underpass and Bridge Widening

The existing Andora Underpass has substandard vertical clearance. To provide standard vertical clearance, the profile grade of Washington Boulevard would be lowered approximately 3 feet. The lowering of the roadway would also require removal and replacement of two drainage culvert crossings.

Widening the Andora Underpass would involve broadening the existing bridge structure to a two-span bridge with columns located in the roadway median island. The existing 100-year-old roadway crosses beneath the UPRR tracks at a 45-degree angle. Because UPRR now limits bridge skews to a maximum of 30 degrees, the proposed bridge median columns would be slightly skewed by approximately 15 degrees. The existing Andora Underpass can accommodate two railroad tracks, although only one track currently exists at this location. Therefore, the project would be designed to accommodate two UPRR tracks; accommodate widening the structure for a future second track. The project would construct only a single track bridge structure.

The Andora Underpass would have concrete abutments and wingwalls. The concrete would have some relief to mimic the appearance of an old style Works Progress Administration bridge. There is also the potential for incorporating architectural enhancements, color, and features into the concrete facade to provide additional visual interest and character for the structure. The superstructure would consist of painted steel girders with painted steel hand railings extending above the track level. The bottom of the structure (soffit) would show the individual steel girders and not be smooth like a normal concrete highway bridge.

No second track is proposed as part of this project; however, the ability to easily add a second track to the structure without needing to widen the concrete abutments is a project requirement. According to UPRR, there are no reasonably foreseeable plans to install a second track.

Railroad Shoofly

During the 6-month construction period, railroad traffic would be maintained except for short time periods allowed by UPRR. During removal of the existing Andora Underpass, the railroad would be detoured to a temporary track, known as a shoofly. An estimated 25 trains would use the track per day. During the transition from the old track to the shoofly and then back again, the rail line would be shut down to train traffic for about 4 hours. No trains would be diverted around the project site to other rail lines.

The shoofly would be within UPRR- and City-owned rights of way (as shown in Figure 3). The shoofly would be approximately 6,200 feet long (1.2 miles), would extend up to 0.75 mile north and 0.5 mile south of the Andora Underpass, and could shift up to 65 feet westerly. Temporary fill would be placed within the portion of the Sierra View Tributary (an estimated 600 feet) that runs along the tracks to accommodate the temporary shoofly alignment.

The temporary railroad shoofly would be constructed using soil excavated from the project site for the roadway widening and reconstruction of the existing roadway structural section. No imported fill is expected to be needed. Approximately 13,500 cubic yards (CY) of fill would be placed east of Washington Boulevard and 22,500 CY would be placed west of Washington Boulevard to create the shoofly.

The temporary shoofly fill would be removed and disposed at permitted soil disposal sites. Railroad slopes would be restored using the appropriate seed mix and in accordance with the project Storm Water Pollution Prevention Plan (SWPPP) and any permit conditions.

Bike Trail Improvements

Eight-foot-wide Class 2 bike lanes would also be included along both sides of the roadway. The existing Class 1 bike path on the east side of Washington Boulevard from Diamond Oaks Road to Derek Place would be replaced with a 10-foot-wide Class 1 bike trail parallel to Washington Boulevard to connect to Sawtell Drive. The existing pedestrian underpass approximately 100 feet east of Washington Boulevard would be abandoned. A new 10-foot-wide multiuse path on the west side of Washington Boulevard between Emerald Oaks Road and Kaseberg Drive is also proposed; however, the construction of this path may be deferred until additional construction funding is available.

Floodplain, Water Quality, and Drainage Improvements

The lowering of Washington Boulevard under the Andora Underpass requires a variety of drainage and floodplain improvements because the low point of Washington Boulevard would be below the 100-year flood elevation. These improvements include the following (shown in Figure 3):

- Regrading ditches and adding a drainage pump station to drain the Andora Underpass.
- Constructing a bioretention basin to treat existing stormwater and comply with current stormwater quality requirements (Water Quality Order No. 2013-0001-DWQ). The new bioretention basin would be used to treat stormwater runoff that originates from the northern portion of the project and an area tributary to the intersection of Washington Boulevard and Pleasant Grove Boulevard. The bioretention basin (shown in Figure 3) would be constructed on the City-owned parcel bordered by Emerald Oaks Road, the South Branch of Pleasant Grove Creek, and Washington Boulevard. This parcel currently supports an open

annual grassland. The basin would be created by excavation, construction of a berm along the east side of the South Branch of Pleasant Grove Creek, and placement of imported drain rock and sand-compost mix to support runoff retention, water quality treatment and specialized planting.

- Replacing and extending corrugated metal pipes (CMPs) in four crossings of unnamed tributaries of Sierra View Tributary to support widening of Washington Boulevard.
- Replacing and extending two box culvert replacements (Sierra View Tributary and South Branch of Pleasant Grove Creek).

Traffic Signal Improvements

No new traffic signals are proposed as part of the project; however, the existing traffic signal at Diamond Oaks Road would be modified to conform to the new four-lane roadway and the traffic signal at Pleasant Grove Boulevard would have signal re-timing only.

Utility Relocations

The lowering of the roadway would necessitate relocation of City-owned sewer and water lines, underground telecommunication lines, and potential adjustments to underground Pacific Gas and Electric (PG&E) gas lines.

2.3.3 Construction Method

Construction of the proposed project would consist of the activities described below.

Equipment and Material Staging Areas

Potential equipment and material staging areas have been identified for the purpose of this analysis and are shown in Figure 3. The contractor would use City-owned areas outside the roadway for staging. Parcels on the south side would be used for shoofly construction. The bioretention basin area would be used for staging activities on the north side of the tracks. During the road closure period, staging would also occur in the roadway between Diamond Oaks and the UPRR tracks. The staging areas would be used for fueling and maintaining equipment, as well as designated materials disposal and storage.

Construction Access and Traffic Control

Construction would temporarily affect traffic on Washington Boulevard and auxiliary streets. As part of the proposed project, Washington Boulevard would be closed to vehicular traffic for up to 6 months. Vehicles would be rerouted on city streets. To accommodate the increased vehicular traffic on the detour route, the Foothills Boulevard/Junction Boulevard intersection would be temporarily restriped to add a second left-turn lane from southbound Foothills Boulevard to eastbound Junction Boulevard. Existing traffic signals would be temporarily modified to provide an adequate LOS during the construction period.

Railroad Shoofly Installation

To support the temporary shoofly, temporary culverts would be installed in approximately 500 feet of an unnamed tributary to the South Branch of Pleasant Grove Creek and 300 feet of a section of the Sierra View Tributary (shown in Figure 3). In addition, a temporary culvert would be inserted into the South Branch of Pleasant Grove Creek concrete box culvert (under the UPRR) to act as a temporary extension. The existing concrete box culvert pedestrian undercrossing would be temporarily extended to maintain drainage and pedestrian access under the shoofly. The shoofly fill material will be placed over the culverts after they are installed.

Once the remaining earthwork was placed and compacted, imported material that is similar to roadway aggregate base would be placed along the length of the shoofly. Imported railroad rock ballast would be placed along with new track and ties starting approximately 500 feet from the beginning of the shoofly and 2,050 feet from the end. Approximately 500 feet of existing track and ties at the south end of the shoofly and 2,050 feet at the north end of the shoofly would be shifted to the shoofly alignment by UPRR employees. Once the shoofly is opened to train traffic, the existing underpass would be removed.

Washington Boulevard would be open to traffic during the initial phases of shoofly construction and remain open until all shoofly earthwork was completed outside the limits of the existing roadway. Washington Boulevard would then be closed to all vehicular traffic to complete the shoofly earthwork.

After the new Andora Underpass is completed, UPRR would shift the trains back to the existing track alignment and the shoofly, including rails and ties, would be removed. The earthen material occupying Washington Boulevard would be removed to allow the remaining part of the structure footings and abutment to be installed. The final step in the clean-up phase would involve removing the temporary culverts and shoofly earthwork, restoring the existing ditches, hydroseeding slopes for controlling erosion, removing the temporary extension of the pedestrian undercrossing, and filling the existing pedestrian undercrossing with sand.

Earthwork

Grading

Grading would be allowed only as necessary to construct the proposed project within a designated work area. All grading activities would be evaluated for consistency with the City's Flood Damage Prevention Ordinance (City of Roseville Municipal Code Chapter 9.80). Waste soils or other solid debris from project construction would be kept out of wetlands and drainages by implementing construction best management practices (BMPs) specified in the SWPPP.

Material Excavation, On-Site Use, and Imported Borrow

Construction of the proposed project would require the excavation of approximately 62,000 CY of soil from the site, including 850 CY of concrete associated with the Andora Underpass concrete abutments. An estimated 29,000 CY of this material will be used to construct the temporary shoofly which will then be removed and disposed of at an approved site.

Stream Dewatering

Dewatering may be necessary in Sierra View Tributary, South Branch of Pleasant Grove Creek, and associated tributaries that contain water during the construction period. Most of the streams receive irrigation runoff during the summer construction period and natural rainfall flows during winter months. The construction contractor may choose one of the following dewatering methods, depending on the amount of water present in the stream during installation of the new permanent and temporary culverts:

- Contractor constructs a temporary dam in the stream and places a temporary culvert to allow the water to flow past the work zone. Pumping would not be used. The temporary culvert would be removed after the new culvert is in place and prior to backfilling.
- Contractor places a pump and pumps water into a detention basin that is constructed with permeable rock per standard BMP methods. The pump would be on the upstream side and the discharge on the downstream side. A pump allows the contractor to locate the discharge pipe and discharge point at a location of his choosing and therefore can keep the discharge pipe out of the work zone.

Construction Equipment and Schedule

Construction of the entire project is expected to require less than 2 years. Table 2-1 lists the equipment likely to be used for construction. It is possible that not all equipment types listed in this table would be used for project construction, and it is possible that additional construction equipment may be used. However, this list includes some of the loudest equipment and provides for a reasonable assessment of project-related construction noise for the purposes of this analysis.

Table 2-1. Construction Equipment

Equipment	Construction Purpose
Paver	Paving roadways
Backhoe/Tractor	Soil manipulation and drainage work
Bulldozer/Loader	Earthwork construction, cleaning and grubbing, tree removal
Dump Truck	Fill material delivery/surplus removal
Excavator	Soil and rock manipulation
Grader	Ground leveling
Haul Trucks	Earthwork construction; large tree removal; material delivery
Concrete pump systems	Concrete delivery to various locations along the bridge
Roller (static and vibratory)	Earthwork and compacting
Scraper	Earthwork construction; clearing and grubbing
Truck with Seed Sprayer	Erosion control and landscaping
Water Truck	Earthwork construction; clearing and grubbing

2.4 Alternative 2 (One Lane Closure during Construction)

Alternative 2 is designed to satisfy the project objectives identified in Section 1.2, *Purpose and Need*, while avoiding or minimizing environmental impacts associated with the project. The alignment and associated project components for Alternative 2 are the same as described for Alternative 1and involve the same improvements to Washington Boulevard; however, it differs in its construction approach, including traffic diversion and schedule. The main difference from the proposed project is that Alternative 2 would leave one lane open during construction and would require an estimated 20 to 24 months to construct because a temporary railroad bridge is required over Washington Boulevard to maintain train traffic.

Under Alternative 2, Washington Boulevard vehicular traffic would be allowed to pass through the project site under the control of one-way flagging operations during some of the construction phases. However, the travelling public would still be significantly delayed during construction under Alternative 2 because it would not be possible to maintain two lanes of traffic flow during most of the construction period; therefore, more than half of the normal traffic would use an alternative route.

2.5 No Project Alternative

The No Project Alternative would not involve any improvements to Washington Boulevard. The existing roadway and Andora Underpass would remain in their current state.

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), which is a technical supplement to the Protocol (California Department of Transportation 2013).

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.

3.2 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 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 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 to 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
	— 20 —	
		Broadcast/recording studio
	— 10 —	
Lowest threshold of human hearing	— 0 —	Lowest threshold of human hearing

Source: California Department of Transportation 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 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.

3.7 Noise Descriptors

Noise in our daily environment fluctuates over time. Some fluctuations are minor, but others 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 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 10:00 p.m. and 7:00 a.m., and a 5-dB penalty applied to the A-weighted sound levels occurring during evening hours between 7:00 p.m. and 10:00 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 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.

3.8.3 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 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 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). 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 as 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 TeNS 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.
B2	67	Exterior	Residential
C2	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.

Activity Category	Activity $L_{eq}(h)$[1]	Evaluation Location	Description of Activities
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

Noise analysis under 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

This chapter describes the study methods and procedures to support preparation of this NSR.

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. Land uses in the project area were categorized by land use type, activity category (as defined in Table 4-1), and the extent of frequent human use. As directed by the Protocol, although all developed land uses were considered in this analysis, the focus was on outdoor locations with frequent human use that would benefit from a lowered noise level. Accordingly, this impact analysis focused on locations with defined outdoor activity areas (specifically, residential backyards). The geometry of the project area relative to nearby existing land uses was also identified.

Short-term measurement locations were selected to be representative of the land use categories and activities within the project area. In addition, long-term measurement sites were selected to capture the diurnal traffic noise level patterns in the project area. The short-term measurements were used to validate/calibrate the traffic noise modeling used in the study and were used as noise modeling receivers (where applicable) for the analysis of worst noise hour under existing and future conditions. Additional modeling receivers were added to be representative of actual noise sensitive uses in the project area.

5.2 Field Measurement Procedures

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

5.2.1 Short-Term Measurements

Existing noise levels were measured on Tuesday, September 27, 2016. The noise measurement locations are shown in Figure 4. All short-term measurements were conducted in accordance with the TeNS (California Department of Transportation 2013).

The land uses within the project area are mostly single-family residential, with a few multi-family residential and some commercial/light industrial land uses located in the southern portion of the project area. Short-term measurements were taken at five sites: ST-1, ST-2, ST-3, ST-4 and ST-5. All measurements were taken relatively close to Washington Boulevard. Measurement site ST-1 was on the east side of Washington Boulevard between Pleasant Grove Boulevard and Diamond Oaks Road/Emerald Oak Road; the measurement was taken on public property adjacent to the residential backyard fence of 123 Silverado Circle (on the Washington Boulevard side of the fence). ST-2 was on the west side of Washington Boulevard between Pleasant Grove Boulevard and Diamond Oaks Road/Emerald Oak Road; the measurement was taken between 465 Elmwood Court and 464 Elmwood Court, with an intervening block wall located between the noise meters and Washington Boulevard. ST-3 was on the east side of Washington Boulevard between Diamond Oaks Road and the Andora Underpass; the measurement was taken in the vacant lot next to 120 Glenwood Circle, also with an intervening block wall located between the noise meters and Washington Boulevard. This was the same wall that separated the adjacent homes from Washington Boulevard. ST-4 and ST-5 were both on the west side of Washington Boulevard, south of the Andora Underpass. ST-4 was taken in the residential backyard of 1228 Hawthorne Loop. ST-5 was taken on public property approximately 30 feet east of 35 Hancock Drive. The purpose of these measurements was to validate the traffic noise model for Washington Boulevard. Because access could not be obtained to private residential yards, ST-1, ST-3, and ST-5 did not directly represent areas of frequent human use. However, these sites were selected as the closest accessible locations to the adjacent residential receptors. At each location, two simultaneous 15-minute measurements were obtained. The results of the short-term noise monitoring are provided in Table 6-1 in Chapter 6 of this report.

One Larson Davis Model 831 sound level meter (SLM) and one Larson Davis Model LxT meter were used to conduct two simultaneous short-term noise measurements at each measurement location. The Larson Davis 831 SLM is classified as Type 1 (precision-grade) instrument, as defined in American National Standard Institute (ANSI) specification S1.4 and International Electrotechnical Commission publications 804 and 651. The Larson Davis Model LxT Meter is also classified as a Type 1 meter. The meters were set to the “slow” time-response mode and the A-weighting filter network.

During short-term measurements, a noise analyst attended the noise meters at all times. For all measurements, data from the 15-minute measurement was automatically logged in the meter and subsequently downloaded after the completion of the field visit. Dominant noise sources observed and other relevant measurement conditions were also identified and logged manually on the field data sheets. In all cases, traffic noise was the dominant contributor to the measured noise levels. The calibration of the meters was checked before and after the measurements using a Larson Davis Model CAL200 calibrator.

Temperature, wind speed, and humidity were recorded manually during the short-term monitoring sessions using a Kestrel 3000 portable weather station. Weather conditions were well

Figure 4
Noise Measurement Locations

suited for noise measurements, free from precipitation and high winds, with low to moderate humidity.

The relevant traffic data during each short-term measurement was captured by manually tallying vehicle traffic along Washington Boulevard.

Traffic volumes during each measurement were counted and classified. Vehicles were classified as automobiles, medium-duty trucks, heavy-duty trucks, buses, or motorcycles. Washington Boulevard has a posted speed limit of 45 mph. However, the speeds recorded during the field noise study ranged from 35 to 45 mph. For the purposes of noise model validation, the following vehicle speeds were used for the traffic noise model (TNM) calibration runs based on field observations during each of the short-term measurements.

Measurement Site	Modeled Speeds
ST-1	45
ST-2	45
ST-3	45
ST-4	39
ST-5	40

5.2.2 Long-Term Measurements

Long-term monitoring was conducted at three locations (LT-1, LT-2 and LT-3) on September 27 through October 1, 2016, using three Piccolo SLM-P3 Integrating SLMs manufactured by SoftdB. The Piccolo SLM-P3 is a Type 2 instrument, as defined in ANSI specification S1.4-1984 and International Electrotechnical Commission publications 804 and 651. The long-term measurement locations are identified in Figure 4. The purpose of these measurements was to identify diurnal noise, traffic noise patterns throughout a typical day/night cycle. The results of long-term monitoring are provided in Chapter 6 of this report.

5.3 Traffic Noise Level Prediction Methods

Traffic noise levels were predicted using FHWA Traffic Noise Model Version 2.5 (TNM 2.5). The TNM 2.5 computer model is based on two FHWA reports: FHWA-PD-96-009 and FHWA-PD-96-010 (Federal Highway Administration 1998a, 1998b). Key geometric inputs for the traffic noise model were the locations of roadways, shielding features (e.g., topography and buildings), noise barriers, and receivers. Three-dimensional representations of these inputs were developed using computer-aided design (CAD) drawings, profiles, and topographic contours provided by the Project design team. MicroStation software was the primary tool used to digitize the geometric inputs, based on the CAD files provided by the project engineer, for input into TNM 2.5.

5.3.1 Validation of the Traffic Noise Model

To validate/calibrate the accuracy of the model, TNM 2.5 was used to compare measured traffic noise levels with modeled noise levels at the short-term measurement locations. For each receiver, traffic volumes counted during the short-term measurement periods were normalized to 1-hour volumes. These normalized volumes were assigned to Washington Boulevard to simulate the strength of the noise source during the actual measurement period. Modeled and measured sound levels were then compared to determine the accuracy of the model and whether additional calibration was necessary. The results of validation/calibration modeling are described in Chapter 6 of this report.

5.3.2 Traffic Noise Modeling

Traffic noise was modeled under existing conditions, design-year No-Build conditions, and design-year Build conditions. Appendix A summarizes the traffic volumes and assumptions used for each case. The source of traffic volumes used in the modeling was the *Transportation Study for the Washington/Andora Widening Project* (Fehr & Peers 2017). Vehicle Mix assumptions were provided by the Project Engineer (Horton pers. comm). Modeled receiver locations are shown in Figure 5.

The peak-hour data presented in the transportation study indicated that overall traffic volumes throughout the project area were relatively similar during the AM and the PM peak hours. However, the PM peak hour had volumes that were consistently slightly higher than the AM peak hour. Therefore, all modeling of existing and design-year (i.e., future) traffic noise was based on PM peak hour traffic volumes (Fehr & Peers 2017). A copy of the *Final Transportation Study for the Washington/Andora Widening Project* is included in Appendix E.

Traffic speeds for all existing and design-year traffic noise modeling were based on posted speeds.

5.4 Methods for Identifying Traffic Noise Impacts and the Consideration of Abatement

Traffic noise impacts occur at receptor locations where predicted design-year noise levels under Build conditions are at least 12 dB greater than existing noise levels or where predicted design-year noise levels under Build conditions 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.

According to the Protocol, abatement measures are considered acoustically feasible if a minimum noise reduction of 5 dB is predicted for at least one impacted receptor with implementation of the abatement measures. Any receptor that is predicted to receive 5 dB or more of noise reduction from an abatement measure is identified as a *benefited* receptor. In addition, barriers should be designed to intercept the line of sight from the exhaust stack of a truck to the first tier of receptors, as stated in Caltrans' *Highway Design Manual*, Chapter 1100 (California Department of Transportation 2014). Other factors that affect feasibility include topography, access requirements for driveways and ramps, the presence of local cross streets, utility conflicts, other noise sources in the area, and safety considerations.

The overall reasonableness of noise abatement is determined by three factors.

- The noise reduction design goal.
- The cost of noise abatement.
- The viewpoints of benefited receptors (including property owners and residents of the benefited receptors).

As stated in the Protocol, Caltrans' acoustical design goal is that a barrier must be predicted to provide at least 7 dB of noise reduction at one or more benefited receptors. This design goal applies to any receptor and is not limited to impacted receptors.

The Protocol defines the procedure for assessing reasonableness of noise barriers from a cost perspective. Based on 2017 construction costs an allowance of $92,000 is provided for each benefited receptor. The total allowance for each barrier is calculated by multiplying the number of benefited receptors by $92,000. If the estimated construction cost of a barrier is less than the total calculated allowance for the barrier, the barrier is considered reasonable from a cost perspective. The viewpoints of benefits receptors are determined by a survey that is typically conducted after completion of the noise study report. The process for conducting the survey is described in detail in the Protocol.

This NSR identifies potential traffic noise impacts should they exist, and analyzes and assesses whether noise abatement is feasible (providing at least 5 dB of noise reduction at one or more affected receptors), whether the design goal has been met (providing at least 7 dB of noise reduction at one or more benefited receptors), and whether noise barriers intercept the line of sight from the exhaust stack of a heavy truck to the first row of receptors. This NSR also calculates the reasonable cost allowance based on the number of benefited receptors. However, this NSR does not report the actual costs of construction and does not make any conclusions on the overall reasonableness of noise abatement. The analysis of construction costs and the subsequent determination of overall abatement reasonableness are provided in a separate Noise

Abatement Decision Report (NADR). Any discussions of reasonableness throughout the remainder of this NSR are limited solely to whether abatement meets the design goal of 7 dB insertion loss.

Chapter 6 Existing Noise Environment

6.1 Existing Land Uses

Land uses surrounding the project site include predominantly residential land uses, as well as some areas of open space, with commercial/light industrial land uses located in the southern portion of the project area on the east side of Washington Boulevard. The general topography of the project area is relatively flat, yet is characterized by mild slopes.

Many receptors (e.g., residential land uses) are located within the immediate vicinity of the project site, including residences along Washington Boulevard as well as the side streets perpendicular to this main thoroughfare. Sensitive receptors located near the project area are almost exclusively Activity Category B (residential) land uses.

Although all developed land uses are addressed under the Protocol, 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 associated with residential backyards exposed to traffic noise from Washington Boulevard. Most of Washington Boulevard is already developed with solid sound-attenuating walls (e.g., concrete block walls), and the noise reduction that results from these walls is included in the modeling results.

6.2 Noise Measurement Results

The existing noise environment in the project area is characterized below. The characterizations are based on the short- and long-term noise monitoring conducted for the proposed project.

6.2.1 Short-Term Monitoring

Table 6-1 summarizes the results of short-term noise monitoring conducted in the project area. It lists the receiver name; general location or address (when available); land use category; measurement start time, date, and duration; and the measured L_{eq}. Table 6-1 also identifies the normalized (1-hour) traffic volumes based on the traffic videos obtained at the time of each measurement, and the corresponding traffic speeds; these are the traffic data used in the model validation/calibration runs. Field photos and noise measurement field sheets are included in Appendix C to this NSR.

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Table 6-1. Summary of Short-Term Measurements

Receiver	Address/Location and Approximate GPS Coordinates	Land Use/ Activity Category	Start Date/ Time	Meter	Duration (minutes)	Leq (dBA)	Roadway and Direction	Autos (Speed)	Medium Trucks (Speed)	Heavy Trucks (Speed)	Buses (Speed)	Motorcycles (Speed)
ST-1	Across fence from 123 Silverado Circle, Roseville, CA 95678 GPS: 38°46'21.13"N, 121°18'10.53"W	Public Right-of-Way/G [a]	09-27-2016/ 12:40 p.m.	LD LxT/ LD 831	15	68.3 /NA [b]	Washington Boulevard NB	179 (45 mph)	1 (45 mph)	1 (45 mph)	—	2 (45 mph)
							Washington Boulevard SB	163 (45 mph)	6 (45 mph)	1 (45 mph)	—	—
ST-2	Between 465 Elmwood Court and 464 Elmwood Court, Roseville, CA 95678 GPS: 38°46'18.49"N, 121°18'11.67"W	Residential/B	09-27-2016/ 11:48 a.m.	LD LxT/ LD 831	15	56.4 /56.7	Washington Boulevard NB	154 (45 mph)	1 (45 mph)	4 (45 mph)	1 (45 mph)	1 (45 mph)
							Washington Boulevard SB	144 (45 mph)	—	1 (45 mph)	—	33 (45 mph)
ST-3	Vacant Lot adjacent to 120 Glenwood Circle, Roseville, CA 95678 GPS: 38°46'11.37"N, 121°18'6.53"W	Undeveloped Land/G [a]	09-27-2016/ 02:45 p.m.	LD LxT/ LD 831	15	54.8 /55.2	Washington Boulevard NB	215 (45 mph)	—	—	—	—
							Washington Boulevard SB	227 (45 mph)	2 (45 mph)	—	2 (45 mph)	—
ST-4	1228 Hawthorne Loop, Roseville, CA 95678 GPS: 38°46'5.26"N, 121°18'10.51"W	Residential/B	09-27-2016/ 10:55 a.m.	LD LxT/ LD 831	15	49.9 /50.1	Washington Boulevard NB	113 (39 mph)	1 (39 mph)	1 (39 mph)	—	4 (39 mph)
							Washington Boulevard SB	119 (39 mph)	2 (39 mph)	2 (39 mph)	—	1 (39 mph)
ST-5	30 feet east of 35 Hancock Drive, Roseville, CA 95678 and Washington Boulevard GPS: 38°45'58.96"N, 121°18'5.18"W	Open Space/G [a]	09-27-2016/ 03:35 p.m.	LD LxT/ LD 831	15	59.8 /59.9	Washington Boulevard NB	250 (40 mph)	1 (40 mph)	—	2 (40 mph)	—
							Washington Boulevard SB	199 (40 mph)	—	—	—	4 (40 mph)

GPS = global positioning system
NB = northbound
SB = southbound
a Because access could not be obtained to private residential yards, ST-1, ST-3, and ST-5 did not directly represent areas of frequent human use. However, these sites were selected as the closest accessible locations to the adjacent residential receptors. These short-term measurement locations were used for calibration of the traffic noise model at adjacent residential receivers only. Existing and design-year noise levels at ST-1, ST-3 and ST-5 are reported in Appendix B but are not used to assess traffic noise impacts.
b During ST-1, the LD-831 meter did not capture 15 minutes of data.

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6.2.2 Long-Term Monitoring

Long-term monitoring was conducted at three locations (LT-1, LT-2, and LT-3) between September 27 through October 1, 2016. The purpose of the long-term noise measurement was to determine changes in noise levels within the project area throughout a typical day. The hourly noise monitoring data from the 3 full days recorded for the three long-term measurements are provided in tabular and graphical formats in Table 6-2 and Figures 5, 6, and 7. The long-term monitoring locations are shown in Figure 4. The highly-variable noise levels observed at LT-2 are due to the proximity of the UPRR.

Table 6-2. Long-Term Monitoring at Site LT-1

Beginning Hour	Wednesday September 28, 2016 Hourly dBA (Leq[h])	Wednesday September 28, 2016 Difference from Loudest Hour (dBA)	Thursday September 29, 2016 Hourly dBA (Leq[h])	Thursday September 29, 2016 Difference from Loudest Hour (dBA)	Friday September 30, 2016 Hourly dBA (Leq[h])	Friday September 30, 2016 Difference from Loudest Hour (dBA)
0:00	64.9	-10.8	69.0	-6.3	65.8	-10.2
1:00	63.5	-12.2	63.7	-11.6	64.0	-12.0
2:00	62.1	-13.6	62.5	-12.8	61.9	-14.1
3:00	61.6	-14.1	62.2	-13.1	62.2	-13.8
4:00	65.8	-9.9	64.7	-10.6	64.7	-11.3
5:00	69.1	-6.6	69.5	-5.8	69.1	-6.9
6:00	72.8	-2.9	72.8	-2.5	72.5	-3.5
7:00	75.1	-0.6	75.1	-0.2	75.4	-0.6
8:00	74.8	-0.9	74.6	-0.7	**76.0**	**0.0**
9:00	73.3	-2.4	73.8	-1.5	74.5	-1.5
10:00	73.2	-2.5	72.9	-2.4	73.7	-2.3
11:00	73.4	-2.3	73.7	-1.6	74.0	-2.0
12:00	73.8	-1.9	74.0	-1.3	74.4	-1.6
13:00	73.6	-2.1	73.6	-1.7	74.2	-1.8
14:00	74.2	-1.5	75.0	-0.3	75.0	-1.0
15:00	74.6	-1.1	74.9	-0.4	75.4	-0.6
16:00	75.2	-0.5	**75.3**	**0.0**	73.2	-2.8
17:00	**75.7**	**0.0**	72.3	-3.0	75.1	-0.9
18:00	74.1	-1.6	70.0	-5.3	75.1	-0.9
19:00	72.3	-3.4	72.7	-2.6	72.8	-3.2
20:00	71.8	-3.9	72.0	-3.3	72.7	-3.3
21:00	70.2	-5.5	71.1	-4.2	71.6	-4.4
22:00	68.7	-7.0	69.1	-6.2	71.9	-4.1
23:00	66.8	-8.9	68.1	-7.2	70.3	-5.7
Maximum	**75.7**		**75.3**		**76.0**	
Minimum	**61.6**		**62.2**		**61.9**	

Note:
Worst noise hour on each day is bolded.

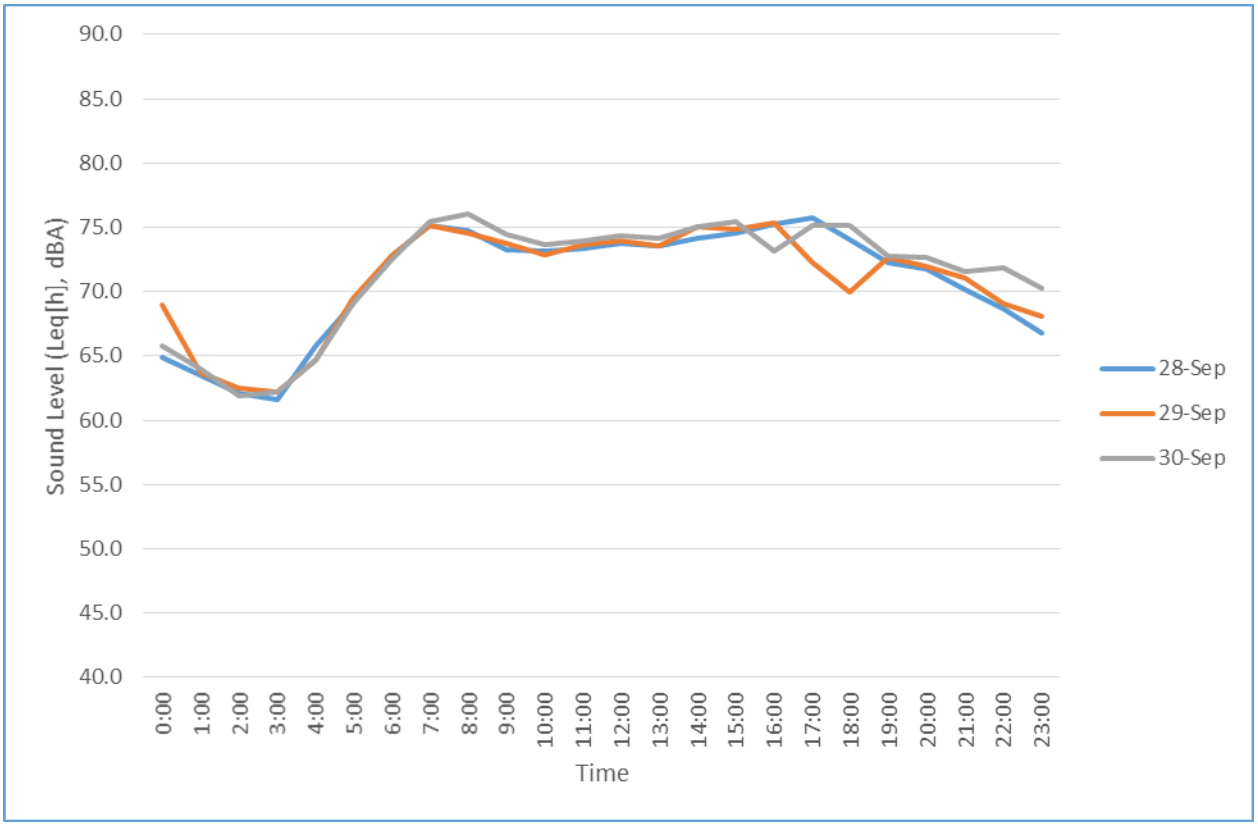

Figure 5. Long-Term Monitoring at Site LT-1

Table 6-3. Long-Term Monitoring at Site LT-2

Beginning Hour	Wednesday September 28, 2016		Thursday September 29, 2016		Friday September 30, 2016	
	Hourly dBA (L_{eq}[h])	Difference from Loudest Hour (dBA)	Hourly dBA (L_{eq}[h])	Difference from Loudest Hour (dBA)	Hourly dBA (L_{eq}[h])	Difference from Loudest Hour (dBA)
0:40	74.3	-2.1	45.4	-32.5	67.8	-10.4
1:40	43.7	-32.7	45.1	-32.8	59.1	-19.1
2:40	43.8	-32.6	69.9	-8.0	69	-9.2
3:40	48.2	-28.2	71.6	-6.3	45.2	-33.0
4:40	50.9	-25.5	71.7	-6.2	73.9	-4.3
5:40	54.5	-21.9	73	-4.9	51.2	-27.0
6:40	69	-7.4	54.6	-23.3	53.9	-24.3
7:40	68.7	-7.7	55.6	-22.3	63.4	-14.8
8:40	72.8	-3.6	74.8	-3.1	70.8	-7.4
9:40	51.8	-24.6	52.3	-25.6	75.2	-3.0
10:40	52.4	-24.0	53.1	-24.8	73.9	-4.3
11:40	70.5	-5.9	**77.9**	**0.0**	54.9	-23.3
12:40	72.8	-3.6	76.1	-1.8	**78.2**	**0.0**
13:40	72.4	-4.0	71.9	-6.0	56	-22.2
14:40	75.7	-0.7	54.9	-23.0	55.3	-22.9
15:40	76.3	-0.1	75.2	-2.7	73.6	-4.6
16:40	**76.4**	**0.0**	73.5	-4.4	54.4	-23.8
17:40	55.1	-21.3	47.7	-30.2	69.1	-9.1
18:40	51.8	-24.6	52.3	-25.6	52.7	-25.5
19:40	51.3	-25.1	51.7	-26.2	68.2	-10.0
20:40	75.7	-0.7	50.6	-27.3	72.7	-5.5
21:40	65.6	-10.8	48.9	-29.0	53.2	-25.0
22:40	71.4	-5.0	69.6	-8.3	49.3	-28.9
23:40	68.1	-8.3	46.2	-31.7	48.1	-30.1
Maximum	**76.4**		**77.9**		**78.2**	
Minimum	**43.7**		**45.1**		**45.2**	

Notes:
Worst noise hour on each day is bolded.
The highly-variable noise levels observed at LT-2 are due to the close proximity of the UPRR.

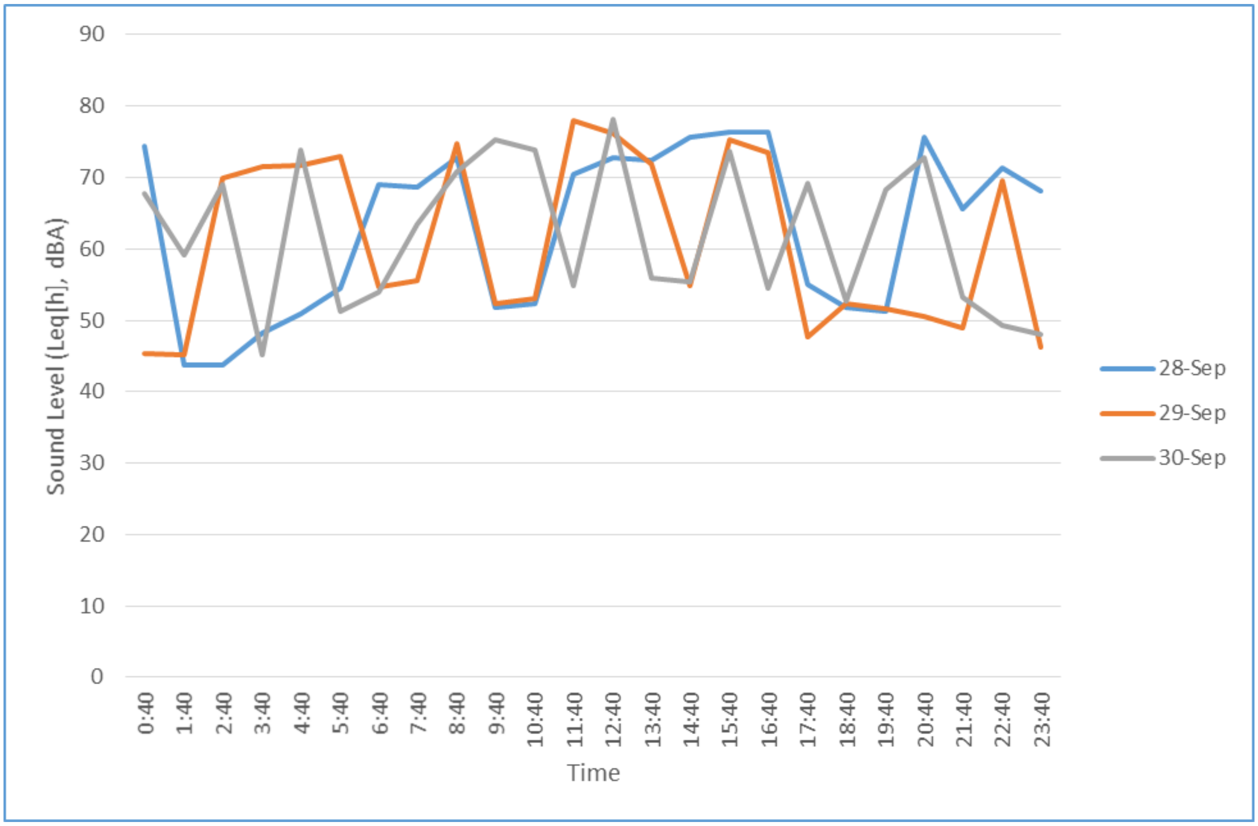

Figure 6. Long-Term Monitoring at Site LT-2

Table 6-4. Long-Term Monitoring at Site LT-3

Beginning Hour	Wednesday September 28, 2016		Thursday September 29, 2016		Friday September 30, 2016	
	Hourly dBA (L_{eq}[h])	Difference from Loudest Hour (dBA)	Hourly dBA (L_{eq}[h])	Difference from Loudest Hour (dBA)	Hourly dBA (L_{eq}[h])	Difference from Loudest Hour (dBA)
0:00	65.1	-10.9	66.2	-9.8	66.5	-10.9
1:00	63.5	-12.5	65	-11.0	65.2	-12.2
2:00	61.9	-14.1	63.4	-12.6	61.7	-15.7
3:00	61	-15.0	64.1	-11.9	63.1	-14.3
4:00	66.7	-9.3	66.8	-9.2	65.6	-11.8
5:00	70.1	-5.9	70.5	-5.5	70.3	-7.1
6:00	73.3	-2.7	73.5	-2.5	73	-4.4
7:00	75	-1.0	75.5	-0.5	75.5	-1.9
8:00	74.8	-1.2	74.6	-1.4	76.2	-1.2
9:00	73.8	-2.2	74.2	-1.8	74.8	-2.6
10:00	73.5	-2.5	73.9	-2.1	74.2	-3.2
11:00	73.7	-2.3	74	-2.0	74.5	-2.9
12:00	73.8	-2.2	74	-2.0	74.6	-2.8
13:00	73.4	-2.6	74	-2.0	74.2	-3.2
14:00	74	-2.0	74.8	-1.2	74.9	-2.5
15:00	74.1	-1.9	75	-1.0	75.4	-2.0
16:00	74.3	-1.7	74.7	-1.3	**77.4**	**0.0**
17:00	**76**	**0.0**	75.2	-0.8	75.7	-1.7
18:00	74	-2.0	71.6	-4.4	74.7	-2.7
19:00	72.7	-3.3	**76**	**0.0**	73.1	-4.3
20:00	72.1	-3.9	72.8	-3.2	72.3	-5.1
21:00	71.2	-4.8	72.9	-3.1	72.5	-4.9
22:00	69.3	-6.7	69.9	-6.1	75.6	-1.8
23:00	67.4	-8.6	68.7	-7.3	70.2	-7.2
Maximum	**76.0**		**76.0**		**77.4**	
Minimum	**61.0**		**63.4**		**61.7**	

Note:
Worst noise hour on each day is bolded.

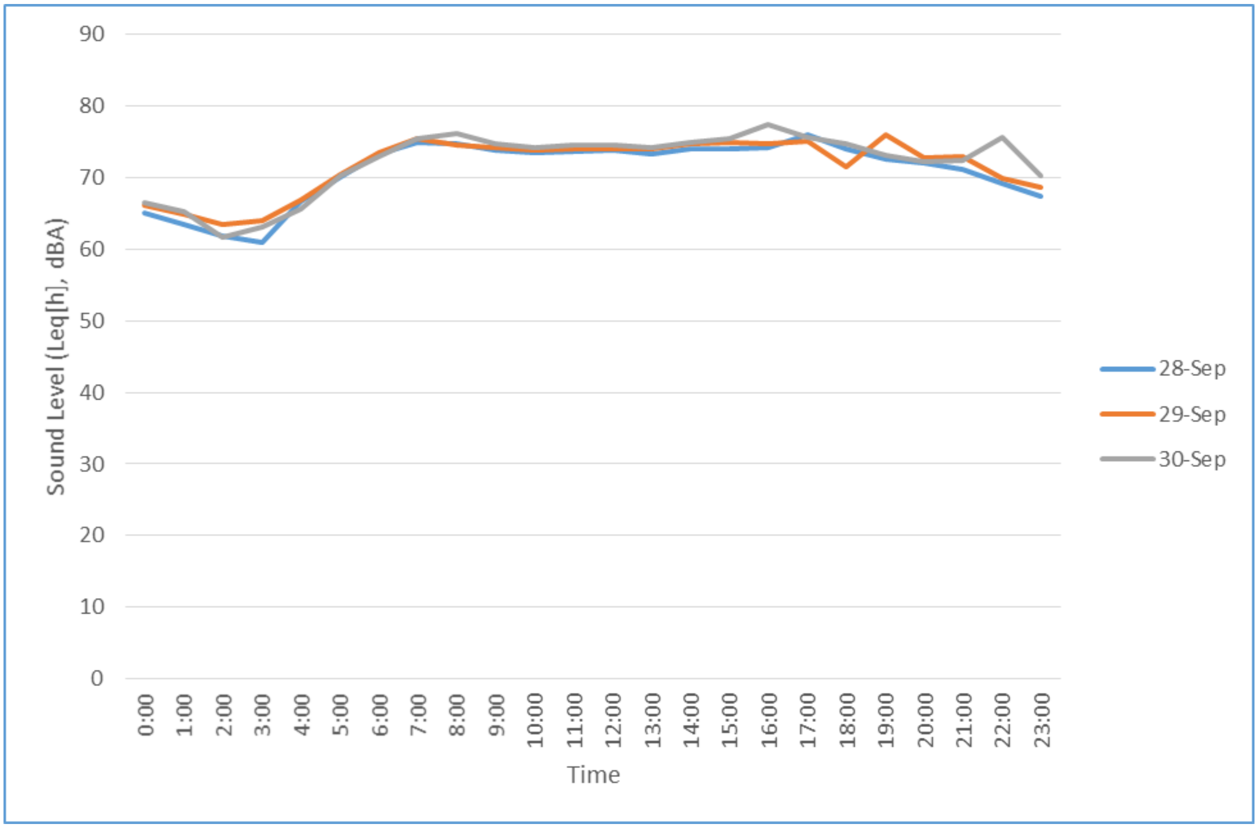

Figure 7. Long-Term Monitoring at Site LT-3

6.2.3 Traffic Noise Model Calibration

TNM 2.5 was used to compare measured traffic noise levels with modeled noise levels at field measurement locations using the traffic count data collected at the time of the noise measurements. Table 6-3 compares measured and modeled noise levels at each measurement location. Good agreement (within 0 to 3 dB) was achieved between the measured and modeled results. As such, modeling results do not need to be adjusted with calibration factors. Modeled existing worst-hour traffic noise levels at all modeling receivers are listed in Appendix B (Table B-1).

Table 6-5. Comparison of Measured and Modeled Sound Levels in the TNM 2.5 Model

Modeled Receiver Number – Measurement Site	Measured Sound Level (dBA)	Predicted Sound Level (dBA)	Measured minus Predicted (dB)	K-Factor Used	K-Factor Applied to Additional Modeled Receiver(s)
ST-1a	68.3	65.8	+2.5	0.0	—
ST-1b	NA		NA [b]	0.0	—
ST-2a	56.4	55.7	+0.7	0.0	—
ST-2b	56.7		+1.0	0.0	—
ST-3a	54.8	56.4	-1.6	0.0	—
ST-3b	55.2		1.2	0.0	—
ST-4a	49.9	52.3	-2.4	0.0	—
ST-4b	50.1		-2.2	0.0	—
ST-5a	59.8	61.6	-1.8	0.0	—
ST-5b	59.9		-1.7	0.0	—

b During ST-1, the LD-831 meter did not capture 15 minutes of data.

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 and design-year conditions with (Build) and without (No Project) the project, noting that the project alternatives both have the same proposed future alignment and traffic volumes. Predicted design-year traffic noise levels under the Build conditions are compared to existing conditions and to design-year conditions under the No Project Alternative. The comparison to existing conditions is included in the analysis to identify traffic noise impacts as defined under 23 CFR 772. The comparison to the 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 would reported as 1 dB.

The traffic noise modeling results in Table B-1 indicate that worst-hour traffic noise levels at the modeled receivers in the existing (No-Build) condition are predicted to be in the range of 43 to 68 dBA L_{eq}. Modeled noise levels in the design year are predicted to be in the range of 44 to 68 dBA L_{eq} for No-Build conditions and 45 to 69 dBA L_{eq} for Build conditions.

Noise levels at many of the modeled receivers are predicted to increase under both Build and No-Build conditions as compared to existing conditions. Noise levels are predicted to increase by up to 2 dB for the future No-Build condition, relative to existing conditions. Noise levels are predicted to increase by up to 3 dB for the future Build condition, relative to existing conditions,. Noise levels at modeled receivers for the future Build condition, relative to future No-Build conditions, also increased by up to 3 dB.

The results in Table B-1 indicate that traffic noise levels at multiple residential receivers in the project vicinity are expected to approach or exceed the NAC for residential land uses of 67 dBA L_{eq}. Specifically, six modeled receivers, which are representative of a total of eight residential receptors, had noise levels in the range of 67 to 68 dBA L_{eq} under the Build condition. Seven of these residential receptors are located on the east side of Washington Boulevard between Pleasant Grove Boulevard and Diamond Oaks Road, and one of these residential receptors is located on the north side of Kaseberg Drive, west of Washington Boulevard. No receivers were predicted to have a 12-dB increase under future Build conditions, relative to existing conditions. However, because the predicted noise level in the design-year approaches or exceeds 67 dBA L_{eq} for these eight residential receptors, traffic noise impacts are predicted at these residences, and noise abatement must be considered in these two areas.

7.2 Preliminary Noise Abatement Analysis

Noise abatement is considered where noise impacts are predicted in areas of frequent human use that would benefit from a lowered noise level. According to 23 CFR 772(13)(c) and 772(15)(c), federal funding may be used for the following abatement measures:

- Construction of noise barriers, including acquisition of property rights, either within or outside the highway right-of-way.
- Traffic management measures including, but not limited to, traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations.
- Alteration of horizontal and vertical alignments.
- Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise.
- Noise insulation of Activity Category D land use facilities listed in Table 4-1. Post-installation maintenance and operational costs for noise insulation are not eligible for Federal-aid funding.

Noise barriers are the only form of noise abatement considered for this project. Each noise barrier evaluated has been evaluated for feasibility based on achievable noise reduction. For each noise barrier found to be acoustically feasible, reasonable cost allowances were calculated by multiplying the number of benefited receptors by $92,000 (The base cost allowance for any 2017 reasonable/feasible analysis is $92,000).

Table B-1 in Appendix B summarizes results at receiver locations for the northern barrier (Barrier NB-1) and Table B-2 summarizes results at the receiver location for the barrier located close to the middle of the project alignment (Barrier NB-2).

For any noise barrier to be considered reasonable from a cost perspective the estimated cost of the noise barrier should be equal to or less than the total cost allowance calculated for the barrier. The cost calculations of the noise barrier must include all items appropriate and necessary for construction of the barrier, such as traffic control, drainage modification, retaining walls, landscaping for graffiti abatement, and right-of-way costs. Construction cost estimates are not provided in this NSR, but are presented in the NADR. The NADR is a design responsibility and is prepared to compile information from the NSR, other relevant environmental studies, and design considerations into a single, comprehensive document before public review of the project. The NADR is prepared by the project engineer after completion of the NSR and prior to publication of the draft environmental document. The NADR includes noise abatement construction cost estimates that have been prepared and signed by the project engineer based on site-specific conditions. Construction cost estimates are compared to reasonableness allowances in the NADR to identify which wall configurations are reasonable from a cost perspective.

The design of noise barriers presented in this report is preliminary and has been conducted at a level appropriate for environmental review and not for final design of the project. Preliminary information on the physical location, length, and height of noise barriers is provided in this report. If pertinent parameters change substantially during the final project design, preliminary noise barrier designs may be modified or eliminated from the final project. A final decision on the construction of the noise abatement will be made upon completion of the project design.

Traffic noise impacts are predicted at five receivers located on the eastern side of Washington Boulevard between Pleasant Grove Boulevard and Diamond Oaks Road, and noise abatement must be considered. Receivers M16, M18, M19, M20, and M21 represent a total of seven residences in this area. A detailed modeling analysis was conducted for a barrier located at the western edge of the property lines for these seven residences; the modeled wall is located at the top of the slope located to the east of Washington Boulevard in this area. The barrier evaluated is identified as Barrier NB-1 in Figure 8. Barrier heights in the range of 6 to 16 feet were evaluated in 2-foot increments. Table C-1 in Appendix C summarizes the results of the barrier analysis for each receiver in this area. Table 7-1 summarizes the calculated noise reductions and reasonable allowances for each barrier height. Based on the analysis, barrier heights of 6 to 16 feet were found to be feasible and to meet the design goal of 7 dB insertion loss.

Table 7-1. Summary of Reasonableness Allowances—Barrier NB-1

Barrier I.D. and location	NB-1, eastern side of Washington Blvd between Pleasant Grove Blvd and Diamond Oaks Rd.
Predicted Sound Level without Barrier	
Design Receiver	M18
Design Year Noise Level, dBA L_{eq}(h)	68 dBA
Design Year Noise Level Minus Existing Noise Level	2 dB

Design Year with Barrier	6-Foot Barrier[1]	8-Foot Barrier	10-Foot Barrier	12-Foot Barrier	14-Foot Barrier	16-Foot Barrier
Barrier Noise Reduction, dB	7	10	12	14	15	16
Number of Benefited Receptors	4	4	7	7	7	7
Reasonable Allowance Per Benefited Receptor	$92,000	$92,000	$92,000	$92,000	$92,000	$92,000
Total Reasonable Allowance	$368,000	$368,000	$644,000	$644,000	$644,000	$644,000

[1] Minimum height need to achieve 7 dB noise reduction design goal.

An additional traffic noise impact is predicted at one residence on the western side of Washington Boulevard just north of the intersection of Kaseberg Drive and Washington Boulevard, and noise abatement must be considered here as well. Receiver M52 represents a single residence in this area. A detailed modeling analysis was conducted for a barrier located at along the existing fence line located between Washington Boulevard and the residential neighborhood along Kaseberg Drive. The barrier evaluated is identified as Barrier NB-2 in Figure 8. Barrier heights in the range of 6 to 16 feet were evaluated in 2-foot increments. Table C-1 in Appendix C summarizes the results of the barrier analysis for Receiver M52. Table 7-2 summarizes the calculated noise reductions and reasonable allowances for each barrier height. Based on the analysis, barrier heights of 10 to 16 feet were found to be feasible, and barrier heights of 12 to 16 feet were found to be feasible and to meet the design goal of 7 dB insertion loss.

Table 7-2. Summary of Reasonableness Allowances —Barrier NB-2

Barrier I.D. and location	NB-2, Western side of Washington Boulevard North of Kaseberg Drive along existing fence line.					
Predicted Sound Level without Barrier						
Design Receiver	M52					
Design Year Noise Level, dBA L_{eq}(h)	67 dBA					
Design Year Noise Level Minus Existing Noise Level	1 dB					
Design Year with Barrier	**6-Foot Barrier1**	**8-Foot Barrier**	**10-Foot Barrier**	**12-Foot Barrier[1]**	**14-Foot Barrier**	**16-Foot Barrier**
Barrier Noise Reduction, dB	0	2	5	7	9	11
Number of Benefited Receptors	0	0	1	1	1	1
Reasonable Allowance Per Benefited Receptor	$92,000	$92,000	$92,000	$92,000	$92,000	$92,000
Total Reasonable Allowance	$0	$0	$0	$92,000	$92,000	$$92,000

[1] Minimum height need to achieve 7 dB noise reduction design goal.

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Figure 8
Modeling Locations and Proposed Barriers
Sheet 1 of 3

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Figure 8
Modeling Locations and Proposed Barriers
Sheet 2 of 3

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Figure 8
Modeling Locations and Proposed Barriers
Sheet 3 of 3

Chapter 8 Construction Noise

During construction of the project, noise from construction activities may intermittently dominate the noise environment in the immediate area of construction. Noise associated with construction is controlled by Caltrans Standard Specification Section 14-8.02, “Noise Control,” which states the following.

- Do not exceed 86 dBA L_{max} at 50 feet from the job site activities from 9:00 p.m. to 6:00 a.m.
- Equip an internal combustion engine with the manufacturer-recommended muffler. Do not operate an internal combustion engine on the job site without the appropriate muffler.

Table 8-1 summarizes noise levels produced by construction equipment that is could to be used for the project. Note that construction activities associated with project components generally would occur Monday through Friday between 7:00 a.m. and 7:00 p.m. No nighttime construction is proposed. Therefore, project construction is not expected to occur between 9:00 p.m. and 6:00 a.m. Further, construction equipment is expected to generate noise levels ranging from 76 to 85 dBA at a distance of 50 feet, and noise produced by construction equipment would be reduced at a rate of about 6 dB per doubling of distance. Refer to Table 8-1 below for a list of equipment proposed for project construction, and the L_{max} noise levels at 50 feet for each equipment type.

Table 8-1. Construction Equipment Noise

Equipment	L_{max} at 50 feet (dBA, slow)
Backhoe/Tractor	78
Bulldozer/Loader	82
Compactor	83
Concrete Pump Truck	81
Concrete Mixer Truck	79
Dump Truck	76
Excavator	81
Forklift	79
Front-end Loader / Bobcat	79
Grader	85
Haul Trucks	76
Roller (static and vibratory)	80
Scraper	84
Water Truck	76

Source: Federal Highway Administration 2006.

No adverse noise impacts from construction are anticipated because construction would be conducted in accordance with Caltrans Standard Specifications Section 14.8-02 and would not occur during the nighttime hours of 9:00 p.m. to 6:00 a.m. Construction noise would be short-term and intermittent.

Chapter 9 References

9.1 References Cited

California Department of Transportation. 2011. *Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects.* May. Sacramento, CA. Available: http://www.dot.ca.gov/hq/env/noise/pub/ca_tnap_may2011.pdf.

———. 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.

———. 2014. *Highway Design Manual*. September. Available: http://www.dot.ca.gov/hq/oppd/hdm/pdf/english/HDM_Complete_22Sep2014.pdf.

Federal Highway Administration. 1998a. Traffic Noise Model, Version 1.0 User's Guide. January. FHWA-PD-96-009. Washington D.C. Available: http://www.fhwa.dot.gov/environment/noise/traffic_noise_model/old_versions/tnm_version_10/users_guide/tnm10usersguide.pdf.

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

———. 2004. Traffic Noise Model, Version 2.5. February. Washington D.C.

———. 2006. *Roadway Construction Noise Model, User's Guide*. February, 15, 2006. Available: http://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/.

———. 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.

Fehr & Peers. 2017. *Final Transportation Study for the Washington/Andora Widening Project*. January.

9.2 Personal Communications

Horton, Garry. 2016. Project Engineer. Mark Thomas & Co, Sacramento, CA. November 9, 2016–email message to ICF regarding truck mix/percentage on Washington Boulevard.

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Chapter 10 Preparer Qualifications

Elizabeth Scott. Noise Analyst. 5 years of experience. BA, Environmental Studies, University of Southern California, 2010. MA, Environmental Studies, University of Southern California, 2011.

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