A. NOISE

This section describes existing noise conditions in the vicinity of the site, criteria for determining the significance of noise impacts, and estimates the likely noise that would result from construction activities, vehicular traffic, aircraft, and other noise sources. Where appropriate, mitigation measures are recommended to reduce project-related noise impacts to a less-than-significant level.

1. Setting

This setting section begins with an introduction to several key concepts and terms that are used in evaluating noise. It then explains the various agencies that regulate the noise environment in the project vicinity and summarizes key standards that are applied to the proposed project. This setting section concludes with a description of current noise conditions that are experienced in the project site vicinity.

a. Characteristics of Sound. Noise is generally defined as unwanted sound. Noise consists of any sound that may produce physiological or psychological damage and/or interfere with communication, work, rest, recreation, and sleep.

To the human ear, sound has two significant characteristics: *pitch* and *loudness*. Pitch is the number of complete vibrations or cycles per second of a wave that results in the range of tone from high to low. Loudness is the strength of a sound that describes a noisy or quiet environment, and it is measured by the amplitude of the sound wave. Loudness is determined by the intensity of the sound waves combined with the reception characteristics of the human ear. Sound intensity refers to how hard the sound wave strikes an object, which in turn produces the sound's effect. This characteristic of sound can be precisely measured with instruments. The analysis of a project defines the noise environment of the project area in terms of sound intensity and its effects on adjacent sensitive land uses.

(1) Measurement of Sound. Sound is characterized by various parameters that describe the rate of oscillation (frequency) of sound waves, the distance between successive troughs or crests in the wave, the speed that it travels, and the pressure level or energy content of a given sound. The sound pressure level has become the most common descriptor used to characterize the loudness (or amplitude) of an ambient sound, and the decibel (dB) scale is used to quantify sound intensity. A decibel (dB) is a unit of measurement which indicates the relative intensity of a sound. The 0 point on the dB scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Changes of 3 dB or less are only perceptible in laboratory environments. Audible increases in noise levels generally refer to a change of 3 dB or more, as this level has been found to be barely perceptible to the human ear in outdoor environments.

Because sound can vary in intensity by over one million times within the range of human hearing, a logarithmic loudness scale[1] is used to keep sound intensity numbers at a convenient and manageable level. Thus, a 10 dBA increase in the level of a continuous noise represents a perceived doubling of loudness, while a 20 dBA increase is 100 times more intense, and a 30 dBA increase is 1,000 times

[1] Unlike linear units such as inches or pounds, decibels are measured on a logarithmic scale, representing points on a sharply rising curve. The logarithmic decibel scale allows an extremely wide range of acoustic energy to be characterized in a manageable notation.

more intense. As noise spreads from a source, it loses energy so that the farther away the noise receiver is from the noise source, the lower the perceived noise level. Noise levels diminish or attenuate as distance from the source increases based on an inverse square rule, depending on how the noise source is physically configured. Noise level from a single-point source, such as a single piece of construction equipment at ground level, attenuates at a rate of 6 dB for each doubling of distance (between the single-point source of noise and the noise-sensitive receptor of concern). Heavily traveled roads with few gaps in traffic behave as continuous line sources and attenuate roughly at a rate of 3 dB per doubling of distance.

Since the human ear is not equally sensitive to all pitches (sound frequencies) within the entire spectrum, a special frequency-dependent rating scale has been devised to relate noise to human sensitivity in a process called "A-weighting," expressed as "dBA." The dBA or A-weighted decibel refers to a scale of noise measurement that approximates the range of sensitivity of the human ear to sounds of different frequencies. Table 1 contains a list of typical acoustical terms and definitions. Table 2 shows some representative noise sources and their corresponding noise levels in dBA.

There are many ways to rate noise for various time periods, but an appropriate rating of ambient noise affecting humans also accounts for the annoying effects of sound. Equivalent continuous sound level (L_{eq}) is the total sound energy of time varying noise over a sample period. However, the predominant rating scales for human communities in the State of California are the L_{eq}, the community noise equivalent level (CNEL), and the day-night average level (L_{dn}) based on A-weighted decibels (dBA). CNEL is the time varying noise over a 24-hour period, with a 5 dBA weighting factor applied to the hourly L_{eq} for noises occurring from 7:00 p.m. to 10:00 p.m. (defined as relaxation hours) and 10 dBA weighting factor applied to noise occurring from 10:00 p.m. to 7:00 a.m. (defined as sleeping hours). L_{dn} is similar to the CNEL scale, but without the adjustment for events occurring during the evening relaxation hours. CNEL and L_{dn} are within one dBA of each other and are normally exchangeable. The noise adjustments are added to the noise events occurring during the more sensitive hours. Typical A-weighted sound levels from various sources are described in Table 2.

Other noise rating scales of importance when assessing the annoyance factor include the maximum noise level (L_{max}), which is the highest exponential time averaged sound level that occurs during a stated time period. The noise environments discussed in this analysis are specified in terms of maximum levels denoted by L_{max} for short-term noise impacts. L_{max} reflects peak operating conditions, and addresses the annoying aspects of intermittent noise.

Noise impacts can be described in three categories. The first is audible impacts that refer to increases in noise levels noticeable to humans. Audible increases in noise levels generally refer to a change of 3.0 dBA or greater, since, as described earlier, this level has been found to be barely perceptible in exterior environments. The second category, potentially audible, refers to a change in the noise level between 1.0 and 3.0 dBA. This range of noise levels has been found to be noticeable only in laboratory environments. The last category is changes in noise level of less than 1.0 dBA that are inaudible to the human ear. Only audible changes in existing ambient or background noise levels are considered potentially significant.

Table 1: Definitions of Acoustical Terms

Term	Definitions
Decibel, dB	A unit of level that denotes the ratio between two quantities proportional to power; the number of decibels is 10 times the logarithm (to the base 10) of this ratio.
Frequency, Hz	Of a function periodic in time, the number of times that the quantity repeats itself in one second (i.e., number of cycles per second).
A-Weighted Sound Level, dBA	The sound level obtained by use of A-weighting. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. All sound levels in this report are A-weighted, unless reported otherwise.
L_{01}, L_{10}, L_{50}, L_{90}	The fast A-weighted noise levels equaled or exceeded by a fluctuating sound level for 1 percent, 10 percent, 50 percent, and 90 percent of a stated time period.
Equivalent Continuous Noise Level, L_{eq}	The level of a steady sound that, in a stated time period and at a stated location, has the same A-weighted sound energy as the time varying sound.
Community Noise Equivalent Level, CNEL	The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of five decibels to sound levels occurring in the evening from 7:00 p.m. to 10:00 p.m. and after the addition of 10 decibels to sound levels occurring in the night between 10:00 p.m. and 7:00 a.m.
Day/Night Noise Level, L_{dn}	The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of 10 decibels to sound levels occurring in the night between 10:00 p.m. and 7:00 a.m.
L_{max}, L_{min}	The maximum and minimum A-weighted sound levels measured on a sound level meter, during a designated time interval, using fast time averaging.
Ambient Noise Level	The all encompassing noise associated with a given environment at a specified time, usually a composite of sound from many sources at many directions, near and far; no particular sound is dominant.
Intrusive	The noise that intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

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

Table 2: Typical A-Weighted Sound Levels

Noise Source	A-Weighted Sound Level in Decibels	Noise Environments
Near Jet Engine	140	Deafening
Civil Defense Siren	130	Threshold of pain
Hard Rock Band	120	Threshold of feeling
Accelerating Motorcycle at a Few Feet Away	110	Very loud
Pile Driver; Noisy Urban Street/Heavy City Traffic	100	Very loud
Ambulance Siren; Food Blender	95	Very loud
Garbage Disposal	90	Very loud
Freight Cars; Living Room Music	85	Loud
Pneumatic Drill; Vacuum Cleaner	80	Loud
Busy Restaurant	75	Moderately loud
Near Freeway Auto Traffic	70	Moderately loud
Average Office	60	Moderate
Suburban Street	55	Moderate
Light Traffic; Soft Radio Music in Apartment	50	Quiet
Large Transformer	45	Quiet
Average Residence Without Stereo Playing	40	Faint
Soft Whisper	30	Faint
Rustling Leaves	20	Very faint
Human Breathing	10	Very faint

Source: Compiled by LSA Associates, Inc., 2009.

(2) Physiological Effects of Noise. According to the U.S. Department of Housing and Urban Development's 1985 Noise Guidebook, permanent physical damage to human hearing begins at prolonged exposure to noise levels higher than 85 to 90 dBA. Exposure to high noise levels affects our entire system, with prolonged noise exposure in excess of 75 dBA increasing body tensions, and thereby affecting blood pressure, functions of the ear, and the nervous system. In comparison, extended periods of noise exposure above 90 dBA would result in permanent cell damage. When the noise level reaches 120 dBA, a tickling sensation occurs in the human ear even with short-term exposure. This level of noise is called the threshold of feeling. For avoiding adverse effects on human physical and mental health in the workplace or in communities, the U.S. Department of Labor, Occupation Health and Safety Administration (OSHA) requires the protection of workers from hearing loss when the noise exposure equals or exceeds an 8-hour time-weighted average of 85 dBA.[1]

Unwanted community effects of noise occur at levels much lower than those that cause hearing loss and other health effects. Annoyance to noise occurs when it interferes with sleeping, conversation, noise-sensitive work, including learning or listening to radio, television, or music. According to the World Health Organization (WHO) noise studies, during daytime hours, few people are seriously annoyed by activities with noise levels below 55 dBA, or moderately annoyed with noise levels below 50 dBA.[2]

2. Regulatory Setting

A project would have a significant noise effect if it would substantially increase the ambient noise levels in the vicinity, exceed noise abatement criteria, or conflict with adopted plans and goals of the community in which it is located. The applicable noise standards governing the project site are the State's noise criteria (as outlined in the *Traffic Noise Analysis Protocol*), El Dorado County's Noise Element of the General Plan,[3] and applicable sections of the El Dorado County Code.[4]

a. Caltrans Traffic Noise Analysis Protocol for New Highway Construction and Reconstruction Projects

The California Department of Transportation (Caltrans) outlines their requirements for noise impact analysis transportation projects in the *Traffic Noise Analysis Protocol* (Protocol).[5] The Protocol specifies the policies, procedures, and practices to be used by agencies that sponsor new construction or reconstruction of State or federal-aid highway projects. Traffic noise impacts result from one or more of the following occurrences: (1) an increase of 12 A-weighted decibels (dBA) or more over existing noise levels, or (2) predicted noise levels approach or exceed the Noise Abatement Criteria (NAC). A sound level is considered to approach an NAC level when the sound level is within 1 dB of the NAC (e.g., 66 dBA is considered to approach the NAC of 67 dBA, but 65 dBA is not). Table 3 summarizes the State's adopted NAC corresponding to various land use activity categories.

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[1] Occupational Safety & Health Administration. Regulations, Standards 29 CFR, Occupational Noise Exposure 1910.95.

[2] World Health Organization, Guidelines for Community Noise, Geneva, 1999. Available on the internet at: http://www.who.int/docstore/peh/noise/guidelines2.html.

[3] El Dorado County. 2004. *El Dorado County General Plan, Public Health, Safety, and Noise Element*. July 19.

[4] El Dorado County, 2009. *El Dorado, California, County Code*. December 10.

[5] Caltrans, 2006. *Traffic Noise Analysis Protocol*, August.

Table 3: Activity Categories and Noise Abatement Criteria

Activity Category	Noise Abatement Criteria, A-weighted Noise Level, Average Decibels Over One Hour	Description of Activities
A	57 Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose
B	67 Exterior	Picnic areas, recreation areas, playgrounds, active sport areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals
C	72 Exterior	Developed lands, properties, or activities not included in Categories A or B above
D	--	Undeveloped lands
E	52 Interior	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums

Source: Caltrans, 2006. *Traffic Noise Analysis Protocol.*

The Caltrans' Technical Noise Supplement (TeNS) and 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.

In identifying noise impacts, primary consideration is given to exterior areas of frequent human use. In situations where there are no exterior activities, or where the exterior activities are far from the roadway or physically shielded in a manner that prevents an impact on exterior activities, the interior criterion is used as the basis for consideration of noise abatement.

b. Section 216 of the California Street 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 nonfreeway 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.

c. The County of El Dorado Noise Standards

The County of El Dorado addresses noise in the Noise Element of the General Plan and the County's Ordinances. The Noise Element includes maximum allowable noise exposure standards for new transportation noise sources. These standards are shown in Table 4. According to the Noise Element, noise created by new transportation noise sources shall be mitigated so as not to exceed the levels specified in Table 4 at existing noise-sensitive land uses.

The County further establishes significance criteria for noise impacts as being an increase of more than 5 dBA L_{dn} caused by new transportation noise sources where existing or project noise levels are less than 60 dBA L_{dn}; or an increase of more than 3 dBA L_{dn} where existing or project noise levels range between 60 dBA and 65 dBA L_{dn}; or an increase of more than 1.5 dBA L_{dn} caused by new transportation noise sources where existing or project noise levels are greater than 65 dBA L_{dn} at the outdoor activity areas of residential uses.

The County has also established noise standards for activities associated with actual construction of a project and restricts major noise producing activities to the hours of 7:00 a.m. to 7:00 p.m., Monday through Friday, and to the hours of 8:00 a.m. to 5:00 p.m. on weekends and federal holidays. In community regions and adopted plan areas, maximum noise levels from construction activities during these hours shall not exceed 75 dBA L_{max} at residential land uses, and shall not exceed 90 dBA L_{max} at commercial, public facility, or industrial land uses.

The County Ordinance establishes that it is unlawful for any person to willfully make, emit, or transmit or cause to be made, emitted, or transmitted any loud and raucous noise upon or from any public highway or public thoroughfare, or from any public or private property to such an extent that it unreasonably interferes with the peace and quiet of another's private property.

Table 4: Maximum Allowable Noise Exposure for Transportation Noise Sources

Land Use	Outdoor Activity Areas [1] L_{dn}/CNEL, dB	Interior Spaces L_{dn}/CNEL, dB	Interior Spaces L_{eq}, dB [2]
Residential	60 [3]	45	--
Transient Lodging	60 [3]	45	--
Hospitals, Nursing Homes	60 [3]	45	--
Theaters, Auditoriums, Music Halls	--	--	35
Churches, Meeting Halls, Schools	60 [3]	--	40
Office Buildings	--	--	45
Libraries, Museums	--	--	45
Playgrounds, Neighborhood Parks	70	--	--

Notes:

[1] In Communities and Rural Centers, where the location of outdoor activity areas is not clearly defined, the exterior noise level standard shall be applied to the property line of the receiving land use. For residential uses with front yards facing the identified noise source, an exterior noise level criterion of 65 dB Ldn shall be applied at the building facade, in addition to a 60 dB Ldn criterion at the outdoor activity area. In Rural Regions, an exterior noise level criterion of 60 dB Ldn shall be applied at a 100 foot radius from the residence unless it is within Platted Lands where the underlying land use designation is consistent with Community Region densities in which case the 65 dB Ldn may apply. The 100-foot radius applies to properties which are five acres and larger; the balance will fall under the property line requirement.

[2] As determined for a typical worst-case hour during periods of use.

[3] Where it is not possible to reduce noise in outdoor activity areas to 60 dB Ldn/CNEL or less using a practical application of the best-available noise reduction measures, an exterior noise level of up to 65 dB Ldn/CNEL may be allowed provided that available exterior noise level reduction measures have been implemented and interior noise levels are in compliance with this table.

Source: El Dorado County. 2004. *El Dorado County General Plan, Public Health, Safety, and Noise Element*. July 19.

3. Existing Setting

a. Existing Facility

US 50 is the primary transportation corridor extending through El Dorado County from west to east and serves all of the county's major population centers, including El Dorado Hills, Cameron Park, Placerville, and South Lake Tahoe. US 50 is also the major commute route to employment locations in the greater Sacramento area and the major shipping route for goods movement by truck. The existing facility is a divided freeway, constructed in 1965, and widened in 2002. In the immediate project vicinity, US 50 is a four-lane freeway with an eastbound truck-climbing lane on Bass Lake grade. Just west of the project area there are high occupancy vehicle (HOV) lanes from the county line to El Dorado Hills Boulevard. High occupancy vehicle lanes are restricted to carpools (i.e., vehicles with two or more people), vanpools, and buses during morning and evening peak hours.

Existing US 50 lane widths within the project limits are two 12-foot lanes eastbound with a 5-foot inside shoulder and an 8-foot outside shoulder through the Silva Valley Parkway undercrossing, after which the Bass Lake truck climbing lane begins with three 12-foot lanes and 10-foot shoulders. The existing westbound US 50 is two 12-foot lanes with a 5-foot inside shoulder and a 10-foot outside shoulder. There is an eastbound truck-climbing lane on Bass Lake Grade east of the proposed interchange location to provide for slow trucks on the 7 percent mainline grade. This truck climbing lane terminates at the top of the grade just before the Bass Lake Road interchange.

A two-lane, roughly north-south road passes under US 50 at the White Rock Road undercrossing. This road is called Silva Valley Parkway north of US 50 and White Rock Road south of US 50. The existing Silva Valley Parkway consists of two 12-foot lanes with 6-foot shoulders.

b. Existing Land Uses

A field investigation was conducted to identify land uses that could be subject to traffic and construction noise impacts from the proposed project. As stated in the Protocol, noise abatement is only considered for areas of frequent human use that would benefit from a lowered noise level. Although all developed land uses are evaluated in this analysis, the focus is on locations of frequent human use that would benefit from a lowered noise level. Accordingly, this impact analysis focuses on locations with defined outdoor activity areas, such as residential backyards and exterior common use areas of church and day care land uses in the project vicinity.

The surrounding area is characterized by rolling grasslands with scattered oaks. Carson Creek flows north-south just east of the proposed interchange location. Land uses on the north side of US 50 include residential development, Oak Meadows Elementary School and a church. Land uses on the south side of US 50 include a Pacific Gas and Electric Company substation, the El Dorado Hills Town Center commercial development, office development, and agricultural grazing land. Two roads connect development north and south of US 50: El Dorado Hills Boulevard to the west of the project and White Rock Road/Silva Valley Parkway in the project vicinity.

The proposed interchange will be located east of the El Dorado Hills Boulevard interchange. On the north side of US 50, the topography varies from fairly steep to more gradual in an east-west direction. Carson Creek passes through a triple 10-foot-wide box culvert under US 50 and flows south into Deer Creek and ultimately to the Cosumnes River. On the south side of US 50, the topography slopes gradually from east to west until reaching Carson Creek, where the slope drops off into the stream channel and then rises again on the west.

c. Noise Measurement Results

Short-term noise measurement locations were selected to represent the primary noise sensitive land uses within the project area. Table 5 contains the results of these measurements. The noise monitoring locations are shown in Figure 1; the noise monitoring physical locations and the primary noise sources at each site are further described in Table 6. Table 7 shows the meteorological conditions at the monitoring locations during the short-term noise monitoring. The sound level measurement documentation sheets, traffic counts, and documented meteorological data are provided in Appendix E.

Table 5. Short-Term Ambient Noise Monitoring Results

Monitor No.	Date	Start Time	Duration	dBA L_{eq}
M-1	4/13/2010	12:05	15 minutes	73.3
M-2	4/13/2010	12:45	15 minutes	63.8
M-3	4/13/2010	1:20	15 minutes	62.5

Source: LSA Associates, Inc., 2010.
dBA = A-weighted decibel L_{eq} = Equivalent Sound Level

Table 6. Physical Locations of Noise Level Measurements

Monitor No.	Corresponding Modeled Receptor No.	Location	Noise Sources
M-1	R4-R7, R13-R14	3959 Park Drive – next to Kindercare day-care center	Traffic on US 50
M-2	R2-R3, R8-R12	1250 Joerger Cutoff Road – in front of house used as law office, near adjacent cemetery property	Traffic on US 50
M-3	R1	1441 Tong Road – by play area next to Capital Korean Presbyterian Church	Traffic on US 50

Source: LSA Associates, Inc., 2010.
Note: Refer to Figure 1 for noise measurement locations.

Table 7. Meteorological Conditions During Noise Monitoring

Date	Maximum Wind Speed (mph)	Average Wind Speed (mph)	Temperature (F)	Relative Humidity (%)
4/13/2010	3.2	2.2	59.4	55
4/13/2010	5.4	2.7	61.8	47
4/13/2010	4.5	24	63.1	51

Source: LSA Associates, Inc., 2010.
mph = miles per hour F = degrees Fahrenheit

Figure 1: Noise monitoring, modeled receptors, and modeled sound barrier locations map

d. Existing Traffic Noise Model Results

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

TNM 2.5 is sensitive to the volume of trucks on the roadway because trucks contribute disproportionally to the traffic noise. Truck percentages were obtained from the most recent available data on Caltrans website, the 2008 Annual Average Daily Truck Traffic on the California State Highway System.[1] Based on this report, the annual average daily traffic on this segment of US 50 includes 93.6 percent automobiles, 2.7 percent medium trucks (two-axle with six wheels but not including dually pick-up trucks), and 3.7 percent heavy trucks (three- or more axle vehicles).

Because the constrained PM peak-hour traffic volumes for existing conditions were used in modeling the existing traffic noise levels, the modeled existing traffic noise levels were not adjusted for peak-hour noise levels using the long-term monitoring results or otherwise existing traffic noise levels would be overestimated. The vehicle percentage calculations for the existing conditions are provided in Appendix E.

The generalized land use data and location of particular sensitive receptors were the basis for the selection of the noise monitoring and analysis sites. A total of eleven (11) receptor locations were modeled, representing one church, one day care, and multiple commercial land uses in the project vicinity.

Short-term noise monitoring was conducted at three locations on Tuesday, April 13, 2010 between 11:00 a.m. and 2:00 p.m. when traffic was free flowing. All measurements were made using a Larson Davis Model 720 Type 2 sound level meter (Serial No. 0519). Measurements were taken over a 15-minute period at each site.

Traffic on US 50 and roadways adjacent to each monitoring location was classified and counted during each short-term (15-minute) noise measurement. Vehicles were classified as automobiles, medium-duty trucks, or heavy-duty trucks. An automobile was defined as a vehicle with two axles and four tires that are designed primarily to carry passengers. Small vans and light trucks were included in this category. Medium-duty trucks included all cargo vehicles with two axles and six tires. Heavy-duty trucks included all vehicles with three or more axles. The posted speeds on US 50 and adjacent roadways, as well as the observed average travel speeds during each short-term noise measurement, were documented.

A total of three separate calibration model runs were performed using the traffic numbers collected during the short-term noise monitoring. The results of these model runs were compared to the measured ambient noise levels to ensure the accuracy of the TNM 2.5 model outputs. Correction factors, known as K-factors, are calculated as measured sound levels minus the modeled sound levels.

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[1] Caltrans, 2009. *2008 Annual Average Daily Truck Traffic on the California State Highway System.* September. http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/

Table 8 shows the measured ambient noise level, the modeled existing noise levels using the concurrent traffic counts taken during the noise monitoring, and the resulting K-factor at each of the three monitoring locations. Based on the TeNS, K-factors within 2 dBA are considered to be in reasonable agreement with the measured sound levels and no calibration of the model is required. Therefore, only the K-factor for monitor location M3 was applied to the predicted traffic noise model results.

Table 8. Comparison of Measured to Predicted Sound Levels in the TNM Model

Monitor No.	Corresponding Modeled Receptor No.	Measured Sound Level L_{eq} (dBA)	Predicted Sound Level $L_{eq}(h)$ (dBA)	Measured minus Predicted (dBA)
M1	**R4-R7, R13-R14**	73.3	73.2	0.1
M2	**R2-R3, R8-R12**	63.8	63.3	0.5
M3	**R1**	62.5	65.6	-3.1

Source: LSA Associates, Inc. 2010.
dBA = A-weighted decibel L_{eq} = Equivalent Sound Level $L_{eq}(h)$ = Equivalent Sound Level per Hour

The existing traffic noise levels at all 11 modeled receptor locations are shown in Table 9. Of the 11 modeled receptor locations, none currently "approach or exceed" the NAC. As shown in Table 9, sensitive land uses (including church and day care properties) with outdoor active use areas were evaluated against the Activity Category B at 67 dBA L_{eq} NAC for exterior noise levels. The modeling input and output data for the existing conditions is provided in Appendix E.

Table 9. Existing Traffic Noise Levels

Rec I.D.	Location	Type of Land Use	No. of Units Repre-sented [1]	Noise Abatement Category	Existing Noise Level, dBA $L_{eq}(h)$
R1	Tong Road	Church	4	B(67)	65
R2	Joerger Cutoff Road	Commercial	1	C(72)	64
R3	Joerger Cutoff Road	Cemetery	2	B(67)	61
R4	Saratoga Way	Day Care	1	B(67)	61
R5	Saratoga Way	Day Care	1	B(67)	62
R6	Saratoga Way	Commercial	1	C(72)	62
R7	Mercedes Lane	Commercial	2	C(72)	63
R8	Mercedes Lane	Commercial	2	C(72)	53
R9	Mercedes Lane	Commercial	2	C(72)	49
R10	Mercedes Lane	Commercial	2	C(72)	51
R11	Mercedes Lane	Commercial	4	C(72)	65

Source: LSA Associates, Inc. 2010.
[1] Based on the number of 100-foot frontage units, as defined in the TeNS, since all receptors represent non-residential land uses.
dBA = A-weighted decibel $L_{eq}(h)$ = Hourly Equivalent Sound Level NAC = Noise Abatement Criteria

4. Project Impact Analysis

a. Traffic Noise Levels Prediction Methods

Traffic noise levels were predicted using TNM 2.5. Traffic noise was evaluated under existing conditions, design year no-project conditions, and design year conditions with the project alternatives. PM peak hour traffic volumes under existing and design-year (2030) conditions were obtained from the traffic operations study prepared for this project by Dowling Associates, Inc.[1] The PM peak-hour traffic volumes were used as they were higher overall than the AM peak-hour volumes.

The modeled future vehicle speeds on US 50 were assumed to remain the same as the existing posted speeds of 65 miles per hour (mph) for automobiles and medium trucks, and 55 mph for heavy trucks. The average vehicle speeds on freeway ramps were assumed to be 35 mph for both automobiles and trucks.

The modeled future (2030) traffic noise levels were compared to the existing noise level (for substantial increases in noise levels) and to the NAC to determine the potential noise impacts. Future traffic noise levels with the project were also compared to future noise levels that would occur without the project to determine if a significant increase, as defined by local noise impact standards, would occur. Feasible noise abatement measures were analyzed to reduce the projected noise impacts.

b. Future Noise Environment and Impacts

Table 10 summarizes the traffic noise modeling results for existing and design-year conditions with and without the project. Predicted design-year traffic noise levels with the project are compared to existing conditions and to design-year no-project conditions. The comparison to existing conditions is included in the analysis to determine whether a substantial noise increase would occur. The modeled future noise levels for each of the project build alternatives were also compared to the NAC to determine whether a traffic noise impact would occur. The comparison to no-project conditions indicates the direct effect of the project.

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

The predicted year 2030 traffic sound levels at the representative sensitive receptor locations along the project corridor were determined with existing terrain and barrier features modeled (including existing buildings, solid fences and walls) and using the future (2030) predicted peak-hour traffic volumes. The model input and output data for the predicted future (2030) no-project conditions (assuming existing roadway conditions but with year 2030 traffic volumes) are included in Appendix E. The model input and output data for the predicted future (2030) roadway conditions with the project are included in Appendix E.

If the predicted traffic noise level is 12 dBA or more higher than the corresponding existing modeled noise level at the sensitive receptor location analyzed, or if the peak-hour traffic noise level at a sensitive receptor location is predicted to "approach or exceed" the NAC, then noise abatement measures must be considered. As shown in Table 10, none of the modeled receptor locations would experience a substantial noise increase of 12 dBA or more. However, modeling results do indicate that of the 11 modeled receptor locations, predicted traffic noise levels for the future year 2030 with-project conditions would "approach or exceed" the NAC under the Activity Category B (67) for only one (1) of the modeled receptor locations, the church land use represented by modeled receptor

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[1] Dowling Associates, Inc., 2009. *Traffic Operations Study – US50 Silva Valley Parkway Interchange*. June.

location number **R1**. Therefore, traffic noise impacts are predicted to occur at Activity Category B land uses within the project area, and noise abatement must be considered.

Table 10. Predicted Traffic Noise Levels (dBA $L_{eq(h)}$)

Rec I.D.	Location	Type of Land Use	NAC	Existing Noise Level	Future (2030) No Project Noise Levels	Future Plus Project (2030) Noise Levels	Change from Existing Level	Change from No Project Level	Approach or Exceed NAC? Yes/No
R1	Joerger Cutoff Road	Church	B(67)	65	68	67	2	-1	YES
R2	Saratoga Way	Commercial	C(72)	64	67	67	3	0	No
R3	Saratoga Way	Cemetery	B(67)	61	63	64	3	1	No
R4	Saratoga Way	Day Care	B(67)	61	64	64	3	0	No
R5	Mercedes Lane	Day Care	B(67)	62	65	65	3	0	No
R6	Mercedes Lane	Commercial	C(72)	62	66	66	4	0	No
R7	Mercedes Lane	Commercial	C(72)	63	66	66	3	0	No
R8	Mercedes Lane	Commercial	C(72)	53	57	57	4	0	No
R9	Mercedes Lane	Commercial	C(72)	49	52	52	3	0	No
R10	Joerger Cutoff Road	Commercial	C(72)	51	53	53	2	0	No
R11	Saratoga Way	Commercial	C(72)	65	69	70	5	1	No

Source: LSA Associates, Inc. 2010.
dBA = A-weighted decibel $L_{eq(h)}$ = Hourly Equivalent Sound Level NAC = Noise Abatement Criteria

c. 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. Potential noise abatement measures identified in the Protocol include the following:

- Avoiding the impact by using design alternatives, such as altering the horizontal and vertical alignment of the project;
- Constructing noise barriers;
- Acquiring property to serve as a buffer zone;
- Using traffic management measures to regulate types of vehicles and speeds; and
- Acoustically insulating public-use or nonprofit institutional structures.

All of these abatement options have been considered. However, because of the configuration and location of the project, abatement in the form of noise barriers is the only abatement that is considered to be feasible. The following is a discussion of noise abatement considered for the modeled receptor locations where traffic noise impacts are predicted.

d. Noise Barrier Analysis

The church land use, represented by modeled receptor location number R1, was the only modeled receptor location that would experience traffic noise levels that approach or exceed the NAC for Activity Category B. A single sound barrier, identified as **SB1**, was analyzed to protect this modeled impacted sensitive receptor location that would be exposed to traffic noise levels approaching or exceeding 67 dBA L_{eq}. The sound barrier was analyzed at the following heights: 6, 8, 10, 12 ft. This modeled sound barrier, as shown in Figure 1, would be located on the edge of the west-bound shoulder of US 50 from approximately station marker 119+75 of the westbound off-ramp to station marker 108+25 of the westbound off-ramp. As portions of the sound barrier located along the proposed edge of shoulder would be located less than 13 feet of the edge of the travel lane, sound barrier heights greater than 12 feet were not considered feasible. The results of the traffic noise modeling with insertion of a sound barrier are shown in Table 11.

Table 11. Sound Barrier Modeling Results

Sound Barrier I.D.	Rec I.D.	Existing $L_{eq}(h)$	Future (2030) No Project $L_{eq}(h)$	Future (2030) Plus Project $L_{eq}(h)$	With 6 ft Barrier		With 8 ft Barrier		With 10 ft Barrier		With 12 ft Barrier	
					$L_{eq(h)}$	I. L.	$L_{eq(h)}$	I. L.	$L_{eq(h)}$	I. L.	$L_{eq(h)}$	I. L.
SB1	**R1**	65	68 [1]	67	67	0	67	0	65	2	64	3

Source: LSA Associates Inc., 2010.
I. L. = Insertion Loss, the decibel reduction with insertion of the modeled sound barrier
ft = feet $L_{eq(h)}$ = Equivalent Sound Level per Hour NAC = Noise Abatement Criteria

This noise barrier was then evaluated for feasibility based on achievable noise reduction. Section 3 of the Protocol states that a minimum noise reduction of 5 dBA must be achieved at the impacted receivers in order for the proposed noise abatement measure to be considered feasible. The feasibility criterion is not necessarily a noise abatement design goal. Greater noise reductions are encouraged if they can be reasonably achieved. Elements that may restrict feasibility include topography; access requirements for driveways, ramps, etc.; location of local streets in relation to the proposed project; other noise sources in the area; and safety considerations.

As shown in Table 11, none of the modeled sound barriers would result in at least a minimum reduction of 5 dBA at the impacted receptor location. The greatest insertion loss achieved by the modeled sound barrier was only 3 dBA. Therefore, none of the modeled sound barriers are considered feasible according to the State's noise impact analysis criteria as outlined in the TeNS and Protocol.

For purposes of the CEQA analysis required for this project, a comparison must also be made between the predicted project traffic noise levels and the future traffic noise levels that would be experienced without the project. As shown in Table 10, predicted traffic noise levels with the proposed project would actually be 1 dBA lower at the impacted sensitive receptor location represented by modeled receptor number R1, than would be experienced under the future (2030) conditions without the project. This is due to the fact that the proposed alignment of the off-ramp and the new overcrossing actually provides shielding from some of the mainline traffic noise. Therefore, predicted traffic noise levels with the project would result in a less-than-significant impact on noise sensitive land uses in the project vicinity compared to the predicted traffic noise levels that would be experienced without the project.

According to the County's Noise Element, noise created by new transportation noise sources shall be mitigated so as not to exceed the levels specified in Table 4 at existing noise-sensitive land uses. The County further establishes significance criteria for noise impacts as being an increase of more than 3 dBA L_{dn} where existing or project noise levels range between 60 dBA and 65 dBA L_{dn}; or an increase of more than 1.5 dBA L_{dn} caused by new transportation noise sources where existing or project noise levels are greater than 65 dBA L_{dn} at the outdoor activity areas of residential uses. The closest residential land uses are located over 700 feet from the closest portion of the proposed project alignment. Although the County's project level impact criteria are stated in terms of the weighted 24-hour day-night average levels (L_{dn}) (and not in terms of the modeled peak hour traffic noise levels (L_{eq}(h)) shown in Tables 9, 10, and 11), in suburban/rural areas, such as the project area, where nighttime noise levels drop significantly compared to daytime noise levels, the 24-hour weighted average L_{dn} is typically equivalent to or lower than the peak hour traffic noise levels. Assuming a conservative estimate that the L_{dn} would be equivalent to the L_{eq}(h), the project traffic noise levels would attenuate to well below 50 dBA L_{dn} at the nearest residential land uses.

The County's Noise Element also states that, for church land uses, where it is not possible to reduce noise in outdoor activity areas to 60 dB L_{dn} or less using a practical application of the best-available noise reduction measures, an exterior noise level of up to 65 dB L_{dn} may be allowed provided that available exterior noise level reduction measures have been implemented and interior noise levels are in compliance with this table. Future traffic noise levels without the project are predicted to range up to 68 dBA L_{eq}(h) at the church property on Tong Road. However, as shown in the preceding abatement analysis, implementation of noise abatement in the form of a noise barrier would not be feasible. In addition, project related traffic noise levels would not contribute to the increase in future traffic noise levels at the modeled receptor location **R1** representing the outdoor active use area of the church on Tong Road, but rather result in a 1 dBA decrease compared to traffic noise levels without the project. Therefore, project-related traffic noise levels would result in a less-than-significant impact on surrounding noise sensitive land uses based on the County's noise standards.

e. Construction Noise Impacts

Two types of short-term noise impacts would occur during construction of the project. The first type would be from construction crew commutes and the transport of construction equipment and materials to the project site and would incrementally raise noise levels on access roads leading to the site. The pieces of heavy equipment for grading and construction activities will be moved on site, will remain for the duration of each construction phase, and will not add to the daily traffic volume in the project vicinity. A high single event noise exposure potential at a maximum level of 87 dBA L_{max} from trucks passing at 50 feet (15 m) will exist. However, the projected construction traffic will be small when compared to existing traffic volumes on Silva Valley Parkway; and its associated long-term noise level change will not be perceptible. Therefore, short-term construction-related worker commutes and equipment transport noise impacts would be less than significant.

The second type of short-term noise impact is related to noise generated during excavation, grading, and roadway construction. Construction is performed in discrete steps, each of which has its own mix of equipment and, consequently, its own noise characteristics. These various sequential phases would change the character of the noise generated and, therefore, the noise levels along the project alignment as construction progresses. Despite the variety in the type and size of construction equipment, similarities in the dominant noise sources and patterns of operation allow construction-related noise ranges to be categorized by work phase. Table 12 lists typical construction equipment noise levels (L_{max}) recommended for noise impact assessments, based on a distance of 50 feet between the equipment and a noise receptor.

Typical noise levels at 50 feet from an active construction area range up to 91 dBA L_{max} during the noisiest construction phases. The site preparation phase, which includes grading and paving, tends to generate the highest noise levels, because the noisiest construction equipment is earthmoving equipment. Earthmoving equipment includes excavating machinery such as backfillers, bulldozers, and front loaders. Earthmoving and compacting equipment includes compactors, scrapers, and graders. Typical operating cycles for these types of construction equipment may involve one or two minutes of full power operation followed by three or four minutes at lower power settings.

Table 12: Typical Construction Equipment Maximum Noise Levels, L_{max}

Type of Equipment	Range of Maximum Sound Levels (dBA at 50 feet)	Suggested Maximum Sound Levels for Analysis (dBA at 50 feet)
Pile Drivers	81 to 96	93
Rock Drills	83 to 99	96
Jackhammers	75 to 85	82
Pneumatic Tools	78 to 88	85
Pumps	68 to 80	77
Scrapers	83 to 91	87
Haul Trucks	83 to 94	88
Electric Saws	66 to 72	70
Portable Generators	71 to 87	80
Rollers	75 to 82	80
Dozers	85 to 90	88
Tractors	77 to 82	80
Front-End Loaders	86 to 90	88
Hydraulic Backhoe	81 to 90	86
Hydraulic Excavators	81 to 90	86
Graders	79 to 89	85
Air Compressors	76 to 89	85
Trucks	81 to 87	85

Source: Bolt, Beranek & Newman, 1987. *Noise Control for Buildings and Manufacturing Plants.*

Construction of the proposed project is expected to require the use of earthmovers, bulldozers, water trucks, and pickup trucks. Noise associated with the use of construction equipment is estimated between 79 and 89 dBA L_{max} at a distance of 50 feet from the active construction area for the grading phase. As seen in Table 12, the maximum noise level generated by each scraper is assumed to be approximately 87 dBA L_{max} at 50 feet from the scraper in operation. Each bulldozer would also generate approximately 85 dBA L_{max} at 50 feet. The maximum noise level generated by water trucks and pickup trucks is approximately 86 dBA L_{max} at 50 feet from these vehicles. Each doubling of the sound source with equal strength increases the noise level by 3 dBA. Each piece of construction equipment operates as an individual point source. The worst case composite noise level at the nearest noise-sensitive receptor during this phase of construction would be 91 dBA L_{max} (at a distance of 50 feet from an active construction area).

The closest sensitive receptor locations, which include the church land use on Tong Road and the day care use on Park Drive, are located approximately 160 feet from proposed project construction areas. Therefore, these receptor locations may be subject to short-term noise reaching 81 dBA L_{max} generated by construction activities along the project alignment.

Mitigation Measure NOISE-1: To reduce construction noise impacts to a less-than-significant level, the project sponsor shall ensure the contractor complies with the County's hours of construction, as outlined below, as well as the other following measures:

- Noise producing construction activities shall be limited to between the hours of 7:00 a.m. and 7:00 p.m. Monday through Friday, and between 8:00 a.m. and 5:00 p.m. on weekends and federal holidays. In addition, in community regions and adopted plan areas, maximum noise levels from construction activities during these hours shall not exceed 90 dBA L_{max} at commercial, public facility, or industrial land uses.

- The project contractors shall equip all construction equipment, fixed or mobile, with properly operating and maintained mufflers consistent with manufacturers' standards;
- The project contractor shall place all stationary construction equipment so that emitted noise is directed away from sensitive receptors nearest the project site; and
- The construction contractor shall locate equipment staging in areas that will create the greatest possible distance between construction-related noise sources and noise-sensitive receptors nearest the project site during all project construction.

Implementation of this multi-part mitigation measure would reduce project related construction noise impacts to a less-than-significant level. (LTS)

f. Groundborne Vibration Impacts

No permanent noise sources that would expose persons to excessive ground borne vibration or noise would be located within the project site. Therefore, implementation of the proposed project would not permanently expose persons within or around the project area to excessive ground borne vibration or noise.

Construction activities associated with implementation of the proposed project, including potential rock blasting activities, could temporarily expose persons in the vicinity of the project site to perceptible ground borne vibration or ground borne noise levels. The closest noise sensitive land uses to potential rock blasting areas is the church land use on Tong Road located approximately 600 feet from potential rock blasting areas. At this distance, groundborne vibration and noise would be barely perceptible. In addition, implementation of Mitigation Measure NOISE-1 would further reduce any potential impacts from construction-related groundborne vibration or noise to less-than-significant levels.