Noise Study Report

McHenry Avenue Widening Project

County of Stanislaus

District 10-STA

STPL-5938(233)

May 2017

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Summary

The County of Stanislaus proposes to widen the existing two-lane McHenry Avenue to a total of five lanes (two north bound lanes, two south bound lanes, and one continuous left turn/median lane) from the intersection of Ladd/Patterson Road to 0.25 mile south of the intersection with East River Road. This project will not include widening or structural improvements to the McHenry Avenue Bridge over the Stanislaus River (Bridge No. 38C-0032). As part of the widening of McHenry Avenue, the McHenry Avenue Bridge over Dry Slough (Bridge No. 38C-0002) will be removed and replaced with a culvert topped with earthen fill from a disposal/borrow site located approximately 6 miles south west of the project area or with fill taken from other parts of the project area. The project will also include a drainage basin for stormwater runoff, as well as striping for four lanes and a center turn lane throughout the entirety of the project from the intersection of Ladd/Patterson Road and McHenry Avenue, to the intersection of East River Road and McHenry Avenue. The project is located in Stanislaus County, California. Caltrans is the lead agency under the California Environmental Quality Act (CEQA) and is the lead agency under the National Environmental Policy Act (NEPA). The purpose of the proposed project is to reduce congestion, improve traffic operations, and enhance safety. The roadway is experiencing operational problems caused by high peak period traffic volumes. Vehicle hours of delay, average speeds, travel times and other traffic performance measures will continue to degrade as growth increases in the surrounding area. This project is included in the Fiscal Years 2014/15 Federal Transportation Improvement Program (FTIP) and is funded through Caltrans Local Assistance.

Existing Environment

A field investigation was conducted to identify land uses that could be subject to traffic and construction noise impacts from the proposed Project. These sensitive receivers fall into exterior Noise Abatement Criteria (NAC) Activity Category B. The associated NAC Activity Category for each identified land use is listed in Table B-1 of Appendix B.

The proposed northbound and southbound McHenry lanes are located within unincorporated Stanislaus County. The terrain within the proposed project area is generally flat. Land uses within the project area consist of single-family residences, agricultural uses, and vacant undeveloped land. The dominant noise source for sensitive land uses within the proposed project area is traffic traveling on McHenry Avenue.

An assessment of the proposed project area was performed to identify land uses that would be subject to traffic and construction noise impacts from the proposed project.

Field visits, aerial and Microstation mapping provided by the project Engineer, street views in Google Maps and field photographs of the project area were used to identify noise-sensitive land uses. Single-family sensitive receivers were identified in those areas where outdoor frequent human use would occur. These land uses fall into the NAC Activity Category B. The FHWA and Caltrans NAC for Activity Category B is 67 dBA L_{eq}(h).

Short-term noise monitoring was conducted at three (3) locations in October 2016. Measurements were taken for duration of 15-minutes. Meteorological conditions (temperature, wind speed and direction, relative humidity) were logged for each measurement session on field data forms, provided in Appendix C. Manual vehicle classification counts were collected in October 2016 for adjacent roadways at each measurement location for subsequent use in calibrating the noise prediction model. Noise measurements were conducted using Larson-Davis Models 824 Type 1 sound level meters. Noise measurement locations are shown in Figure 4.

Existing noise levels in the proposed project area range from 50 to 70 dBA L_{eq}(h), as shown in Table B-1, Appendix B. Noise levels approached to within 1 dBA, or exceeded their respective NAC Activity Category criteria, at one existing sensitive receiver location.

Future Traffic Noise Impacts

Under No-Build conditions the proposed improvements to McHenry Avenue would not be constructed. The traffic noise modeling results for the design year No-Build Alternative range from 51 to 72 dBA L_{eq}(h), as shown in Table B-1 of Appendix B. No-Build noise levels at one of the evaluated receivers exceeded its NAC Activity Category standard.

The design year traffic noise modeling results for the Build Alternative range from 52 to 74 dBA L_{eq}(h), as shown in Table B-1 of Appendix B. Noise levels from Existing to No-Build conditions are expected to increase by 1.5 to 1.6 dB. The increase in noise levels is due to the slight increases in traffic volumes from Existing to No-Build conditions. Noise levels for the design year under the Build Alternative are expected to increase by 1 to 4 dB compared to design year No-Build noise levels. Build noise levels exceeded the NAC Activity criteria at one existing residence. Therefore, a noise abatement evaluation was required.

Sound wall heights were evaluated in 2 foot increments ranging in height from 6 feet to 16 feet. Results of the noise abatement evaluation are presented in Tables B-1 in Appendix B for the Build Alternative.

Evaluated Sound Wall Locations

Sound Wall SW-W1

Receiver NR-23:

SW-W1 was evaluated on the edge of the shoulder along northbound McHenry Avenue to shield receiver NB-23. SW-W1 was found to be feasible at a minimum height of 8 feet where SW-W1 was raised in 2 foot increments from 6 feet to 16 feet in height. In order to meet the Caltrans acoustical design goal of a 7 dB reduction, a 14 foot sound wall must be erected. A 12 foot sound wall is able to provide a 6.7 dB reduction and break the line of sight of an 11.5 foot truck stack.

Construction Noise Impacts

No adverse noise impacts from construction are anticipated because construction would be conducted in accordance with the Caltrans' Standard Specifications 14-8.02 "Noise Control" and SSP 14-8.02. Construction noise would be short-term, intermittent and overshadowed by traffic noise within the project area.

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List of Abbreviated Terms

CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CNEL	Community Noise Equivalent Level
dB	Decibels
dBA	A-weighted Decibels
FHWA	Federal Highway Administration
Hz	Hertz
kHz	Kilohertz
L_{dn}	Day-Night Level
L_{eq}	Equivalent Sound Level
L_{eq}(h)	Equivalent Sound Level over one hour
L_{max}	Maximum Sound Level
LOS	Level of Service
L_n	Percentile-Exceeded Sound Level
μPa	Mcro-Pascals
mph	Mles Per Hour
NAC	Noise Abatement Criteria
NADR	Noise Abatement Decision Report
NEPA	National Environmental Policy Act
NSR	Noise Study Report
Protocol	Caltrans Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects
SPL	Sound Pressure Level
TeNS	Caltrans' Technical Noise Supplement
TNM 2.5	FHWA Traffic Noise Model Version 2.5

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Chapter 1. Introduction

1.1. Purpose of the Noise Study Report

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

The California Department of Transportation (Caltrans) Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects (Protocol) (Caltrans 2011) provides Caltrans policy for implementing 23 CFR 772 in California. The Protocol outlines the requirements for preparing NSRs. Noise impacts associated with this project under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) has been evaluated in accordance with this Protocol.

Chapter 2. Project Description

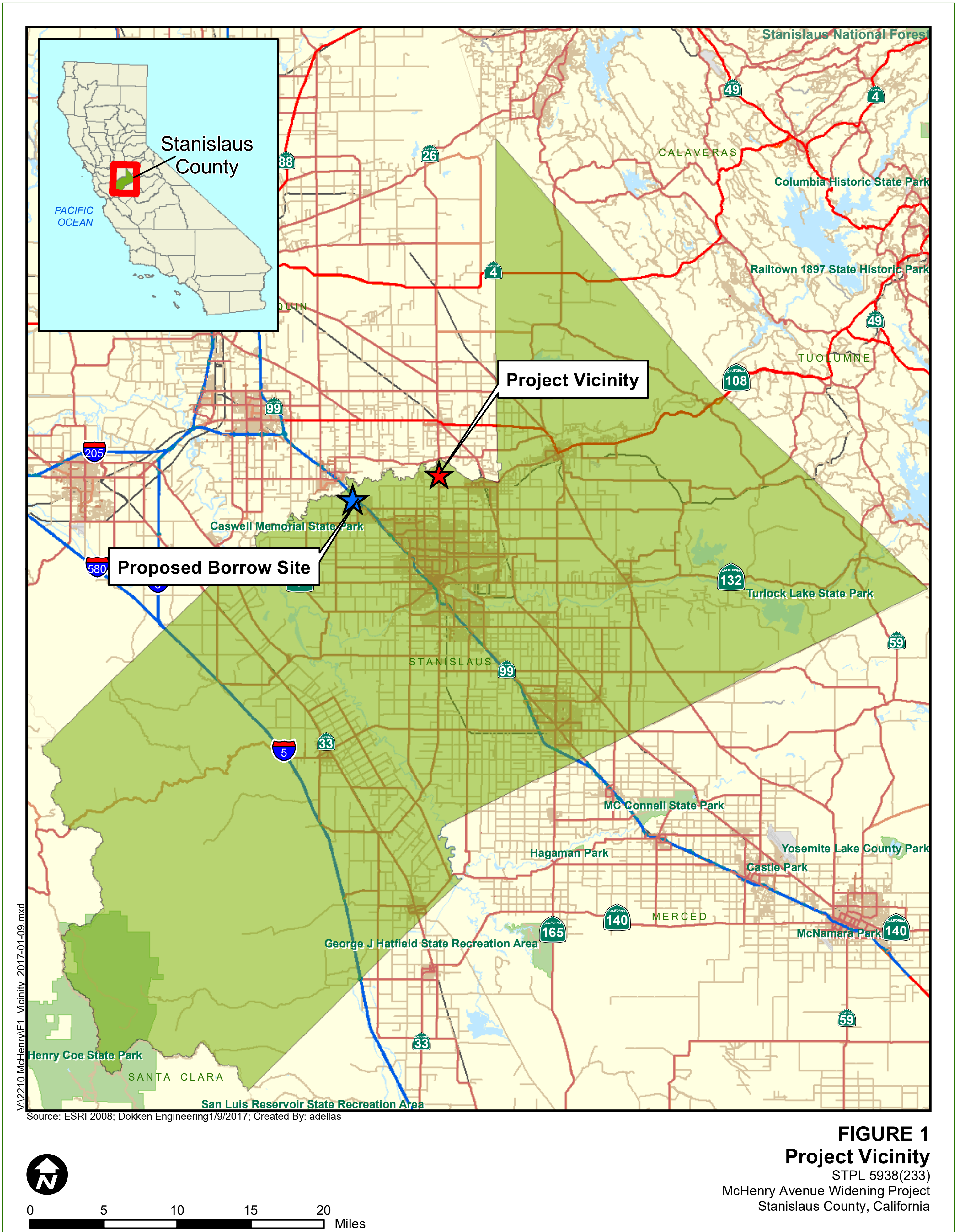
The County of Stanislaus proposes to widen the existing two-lane McHenry Avenue to a total of five lanes (two north bound lanes, two south bound lanes, and one continuous left turn/median lane) from the intersection of Ladd/Patterson Road to 0.25 mile south of the intersection with East River Road. This project will not include widening or structural improvements to the McHenry Avenue Bridge over the Stanislaus River (Bridge No. 38C-0032). As part of the widening of McHenry Avenue, the McHenry Avenue Bridge over Dry Slough (Bridge No. 38C-0002) will be removed and replaced with a culvert topped with earthen fill from a disposal/borrow site located approximately 6 miles south west of the project area or with fill taken from other parts of the project area. The project will also include a drainage basin for stormwater runoff, as well as striping for four lanes and a center turn lane throughout the entirety of the project from the intersection of Ladd/Patterson Road and McHenry Avenue, to the intersection of East River Road and McHenry Avenue.

The project begins approximately 4.3 miles south of the City of Escalon and State Route 120, at the intersection of McHenry Avenue and Ladd Road/Patterson Road and runs north to the south abutment of the McHenry Avenue Bridge over the Stanislaus River. The widening project from Ladd Road to the south abutment of McHenry Avenue Bridge is approximately 1.9 miles in length. Stanislaus County's plan is to improve and accommodate the north to south interregional traffic between the cities of Modesto, Escalon, and to State Highway 108 by widening McHenry Avenue in its entirety from Ladd Road to East River Road. The project will also improve regional circulation, relieve existing traffic congestion, reduce traffic delay, accommodate future traffic, improve safety, promote non-motorized modes of transportation, and allow for good movement and job development for existing and future developments. The project is needed as Average Daily Traffic (ADT) (13,000 vehicles per day) counts are closely reaching capacity of the existing two-lane rural roadway.

There are existing overhead electric and communications utility lines along McHenry Avenue that will need to be relocated. Close coordination with the local utility companies will be carried out in order to coordinate the permanent relocation of these utilities.

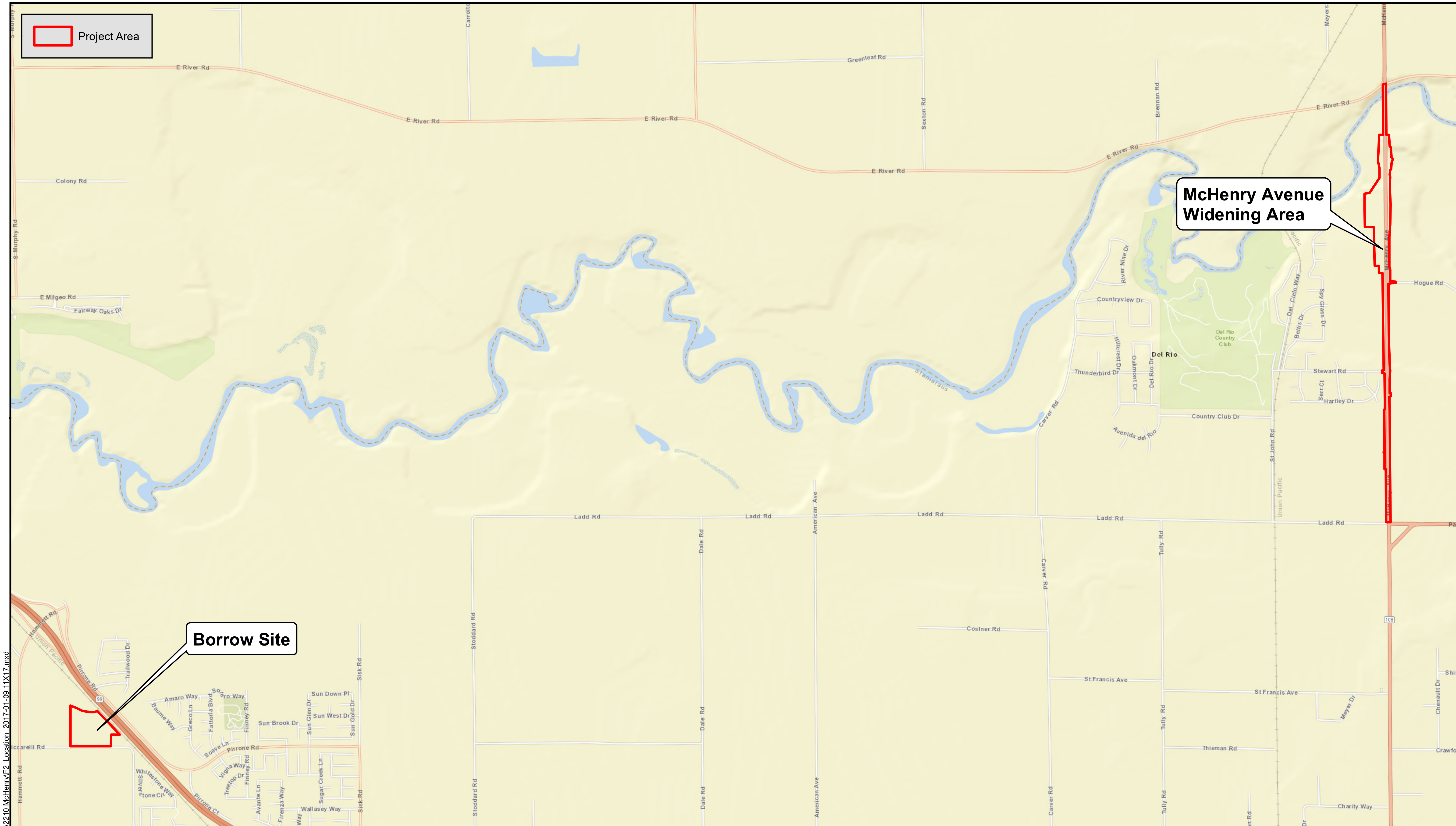
Temporary construction easements are also needed throughout the project area as construction staging would take place within County right-of-way and adjacent privately owned parcels. Permanent right-of-way acquisitions are also anticipated to accommodate the proposed roadway improvements.

The total estimated cost to implement the widening project is $13,025,000. This project is included in the Fiscal Years 2014/15 Federal Transportation Improvement Program (FTIP) and is funded through Caltrans Local Assistance.



Source: ESRI 2008; Dokken Engineering1/9/2017; Created By: adellas

FIGURE 1
Project Vicinity
STPL 5938(233)
McHenry Avenue Widening Project
Stanislaus County, California

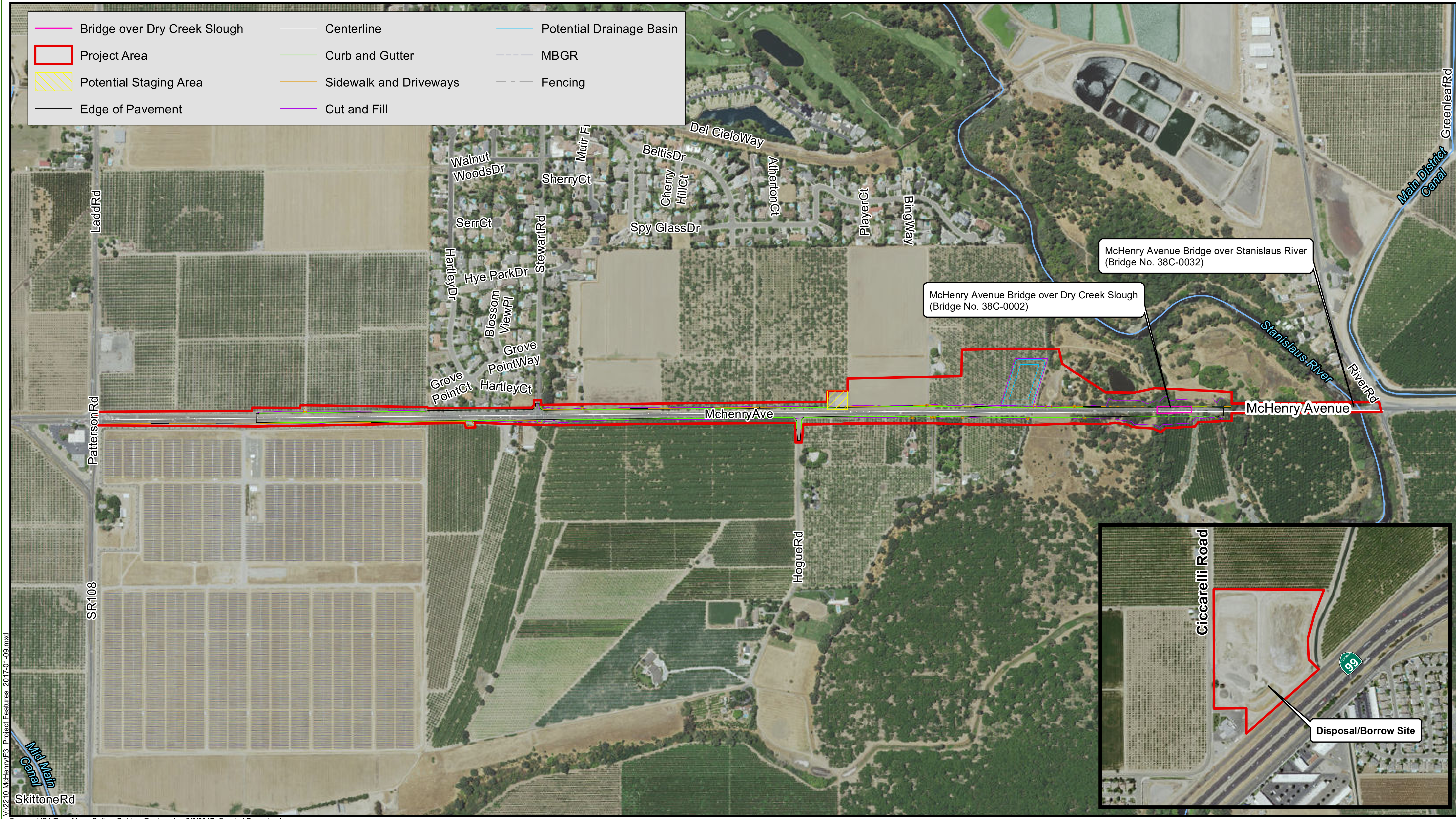


V:\2210 McHenry\F2_Location_2017-01-09 11X17.mxd

Source: ESRI Street Map Online; Dokken Engineering 1/9/2017; Created By: brianm

0 0.5 1 Miles

FIGURE 2
Project Location
STPL 5938(233)
McHenry Avenue Widening Project
Stanislaus County, California



Source: USA Topo Maps Online; Dokken Engineering 2/8/2017; Created By: astorck

0 500 1,000 2,000 3,000 Feet

FIGURE 3
Project Features
STPL 5938(233)
McHenry Avenue Widening Project
Stanislaus County, California

Chapter 3. Fundamentals of Traffic Noise

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

3.1. Sound, Noise, and Acoustics

Sound can be described as the mechanical energy of a vibrating object transmitted by pressure waves through a liquid or gaseous medium (e.g., air) to a hearing organ, such as a human ear. Noise is defined as loud, unexpected, or annoying sound.

In the science of acoustics, the fundamental model consists of a sound (or noise) source, a receiver, and the propagation path between the two. The loudness of the noise source and the obstructions or atmospheric factors affecting the propagation path to the receiver determines the noise level and characteristics of the noise perceived by the receiver. The field of acoustics deals primarily with the propagation and control of sound.

3.2. Frequency

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

3.3. Sound Pressure Levels and Decibels

The amplitude of pressure waves generated by a sound source determines the loudness of that source. Sound pressure amplitude is measured in micro-Pascals (µPa). One µPa 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 µPa. Because of this huge range of values, sound is rarely expressed in terms of µPa. 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 µPa.

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 approximately 3 dB higher than one source under the same conditions (10log[2]). 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 approximately 73 dB. Under the decibel scale, three sources of equal loudness together produce a sound level approximately 5 dB louder than one source (10log[3]).

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 1,000-8,000 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 average human hearing when listening to most ordinary sounds. When we make judgments regarding the relative loudness or annoyance of a given sound, these judgments generally correlate well with A-weighted sound levels. Other weighting networks have been devised to address high noise levels or other special acoustical characteristics (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 Noise	Noise Level (dBA)	Common Indoor Noise
	— 110 —	Rock band (noise to some, music to others)
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 in neighboring room
Quiet urban nighttime	**— 40 —**	Theater, large conference room (background)
Quiet suburban nighttime		
	— 30 —	Library
Quiet rural nighttime		Bedroom at night
	— 20 —	
		Broadcast/recording studio
	— 10 —	
Lowest threshold of human hearing	**— 0 —**	Lowest threshold of human hearing

Source: Caltrans 1998.

3.6. Human Response to Changes in Noise Levels

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

3.7. Noise Descriptors

Noise in our daily environment fluctuates over time. Some fluctuations are minor, but 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 one-hour, A-weighted equivalent sound level (L_{eq}[h]) is the energy-average of A-weighted sound levels occurring during a one-hour period, and is the basis for noise abatement criteria (NAC) used by Caltrans and FHWA.

- **Percentile-Exceeded Sound Level (L_n):** L_n represents the sound level exceeded for a given percentage (n) of a specified period (e.g., L_{10} is the sound level exceeded 10 percent of the time, and L_{90} is the sound level exceeded 90 percent 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 (10 p.m.-7 a.m.).

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

3.8. Sound Propagation

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

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 this 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.

Ground Absorption

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

Atmospheric Effects

Receivers located downwind from a source can be exposed to increased noise levels relative to calm conditions, whereas locations upwind can have reduced 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.

Shielding by Natural or Man-Made Features

A large object or sound wall in the path between a noise source and a receiver can substantially attenuate noise levels at the receiver. The amount of attenuation provided by shielding depends on the size of the object and the frequency content of the noise. Natural terrain features (e.g., hills and dense woods) and man-made features (e.g., buildings and walls) can substantially reduce noise levels. Walls are often constructed between a source and a receiver specifically to reduce noise. A sound wall that breaks the line of sight between a source and a receiver will typically result in at least 5 dB of noise reduction. Taller sound walls provide increased noise reduction. Vegetation between the highway and receiver is rarely effective in reducing noise unless it is sufficiently dense.

Chapter 4. Federal Regulations and State Policies

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

4.1. Federal Regulations

23 CFR 772

Title 23, Part 772 of the Code of Federal Regulations 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, the physical alteration of an existing highway where there is either a substantial horizontal or substantial vertical alteration, or other activities discussed below. 23 CFR 772 specifically defines a Type I project as a project that involves:

1. The construction of a highway on a new location; or

2. The physical alteration of an existing highway where there is either:

   A. Substantial horizontal alteration. A project that halves the distance between the traffic noise source and the closest receiver between the existing condition to the future build condition, or

   B. Substantial vertical alteration. A project that removes shielding, thereby exposing the line-of-sight between the receiver and the traffic noise source. This is done by altering either the vertical alignment of the highway or the topography between the highway traffic noise source and the receiver; or

3. 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; or

4. The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or

5. The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or

6. Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or

7. The new addition or substantial alteration of a weigh station, rest stop, ride-share lot, or toll plaza.

If a project is determined to be a Type I project under this definition, the entire project area as defined in the environmental document is a Type I project. This project proposes to add an interchange; therefore it is considered a Type I project.

A Type II project involves construction of noise abatement on an existing highway with no changes to highway capacity or alignment. This project is not a Type II project.

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. This project is not a Type III project.

Under 23 CFR 772.13, noise abatement must be considered and evaluated for feasibility and reasonableness 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 adopting the NEPA Categorical Exclusion (CE), Finding of No Significant Impact (FONSI), or Record of Decision (ROD). This process involves identification of noise abatement measures that are feasible, reasonable, and likely to be incorporated into the project, as well as noise impacts for which no noise abatement measures are feasible and reasonable.

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 when a predicted noise level substantially exceeds the existing noise level (a "substantial" noise increase). Noise levels are expressed in terms of A-weighted decibels (dBA) and the one-hour equivalent sound level (Leq[h]).

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 land use in a given area.

Table 4-1. Activity Categories and Noise Abatement Criteria

Activity Category	Activity L_{eq} [h][1]	Evaluation Location	Description of Activities
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[2]	67	Exterior	Residential.
C[2]	67	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, schools, and television studios.
E	72	Exterior	Hotels, motels, offices, restaurant/bars, and other developed lands, properties, or activities not included in A-D or F.
F[3]			Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G[3]			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.

[3] No NAC (reporting use only)

Predicted exterior traffic noise levels at land uses in Activity Categories listed in Table 4-1 are used to determine whether traffic noise impacts are predicted to occur. In determining traffic noise impacts for these Activity Categories, primary consideration is given to exterior areas where frequent human use occurs that would benefit from a lowered noise level. In general, an area of frequent human use is an area where people are exposed to traffic noise for an extended period of time on a regular basis.

As an example, the parking lot of a place of worship is not considered to be an area of frequent human use that would benefit from a lowered noise level because people only spend a few minutes there getting in and out of their cars, and there would be no benefit from a lowered noise level. However, if outdoor worship services are held at this location, this would be an area where people are exposed to noise for an extended period of time and where the ability to hear is important. This would then be considered an area of frequent human use that would benefit from a lowered noise level.

Other examples are outdoor seating areas at restaurants or outdoor use areas at hotels, if those are areas where people spend an extended period of time on a regular basis. One practical indicator for determining frequent human use is the presence of existing facilities that invite human use such as benches, barbeque facilities, covered group picnic areas, and uncovered picnic tables.

4.2. State Regulations and Policies

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. In California, a noise level is considered to approach the NAC for a given activity category if it is within 1 dBA of the NAC. In California, a substantial noise increase is considered to occur when the project's predicted worst-hour design year noise level exceeds the existing worst-hour noise level by 12 dBA or more. The use of 12 dB was established in California many years ago and is based on the concept that a 10 dB increase generally is perceived as a doubling of loudness. A collective decision by Caltrans staff, which was approved by FHWA, was made to use 12 dB.

The Technical Noise Supplement (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.

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 other noise-sensitive spaces. This requirement does not replace the "approach or exceed" NAC 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 classroom noise level generated from freeway and non-freeway 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.

There are no schools within the vicinity of the proposed project area.

Chapter 5. Study Methods and Procedures

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

A review of aerial photography and a detailed field investigation were conducted to identify land uses that could be subject to traffic and construction noise impacts from the proposed project. Specifically, land uses in the project area were categorized by land use Activity Category as defined in Table 4-1 and outdoor activity areas were noted. As stated in 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 primarily focuses on locations with defined outdoor activity areas, such as single-family residential backyards.

Identified Land Uses within Project Study Area

Developed and undeveloped land uses in the project vicinity were identified through inspection of aerial photography and a detailed field investigation. Within each land use category, sensitive receivers were then identified. Land uses in the project vicinity include low density residences agricultural uses, and undeveloped land zoned for Planned Development but not currently permitted for development. These land uses are shown in Figure 4.

The generalized land use data and location of particular sensitive receivers were the basis for the selection of representative analysis sites. A total of twenty-five (25) receiver locations were modeled to represent existing conditions in the project vicinity. Three (3) receivers were utilized to assist with model calibration. These modeled receiver locations are shown on Figure 5.

Extent of Frequent Human Use at Land Uses in Project Area

As noted previously in this NSR, in determining traffic noise impacts, primary consideration is given to exterior areas where frequent human use occurs that would benefit from a lowered noise level. In general, an area of frequent human use is an area where people are exposed to traffic noise for an extended period of time on a regular basis.

For this project, exterior areas where frequent human use occurs that would benefit from a lowered noise level are limited primarily to outdoor activity areas of individual residences, such as back yards or patios. No areas were identified for other uses located within the project study area.

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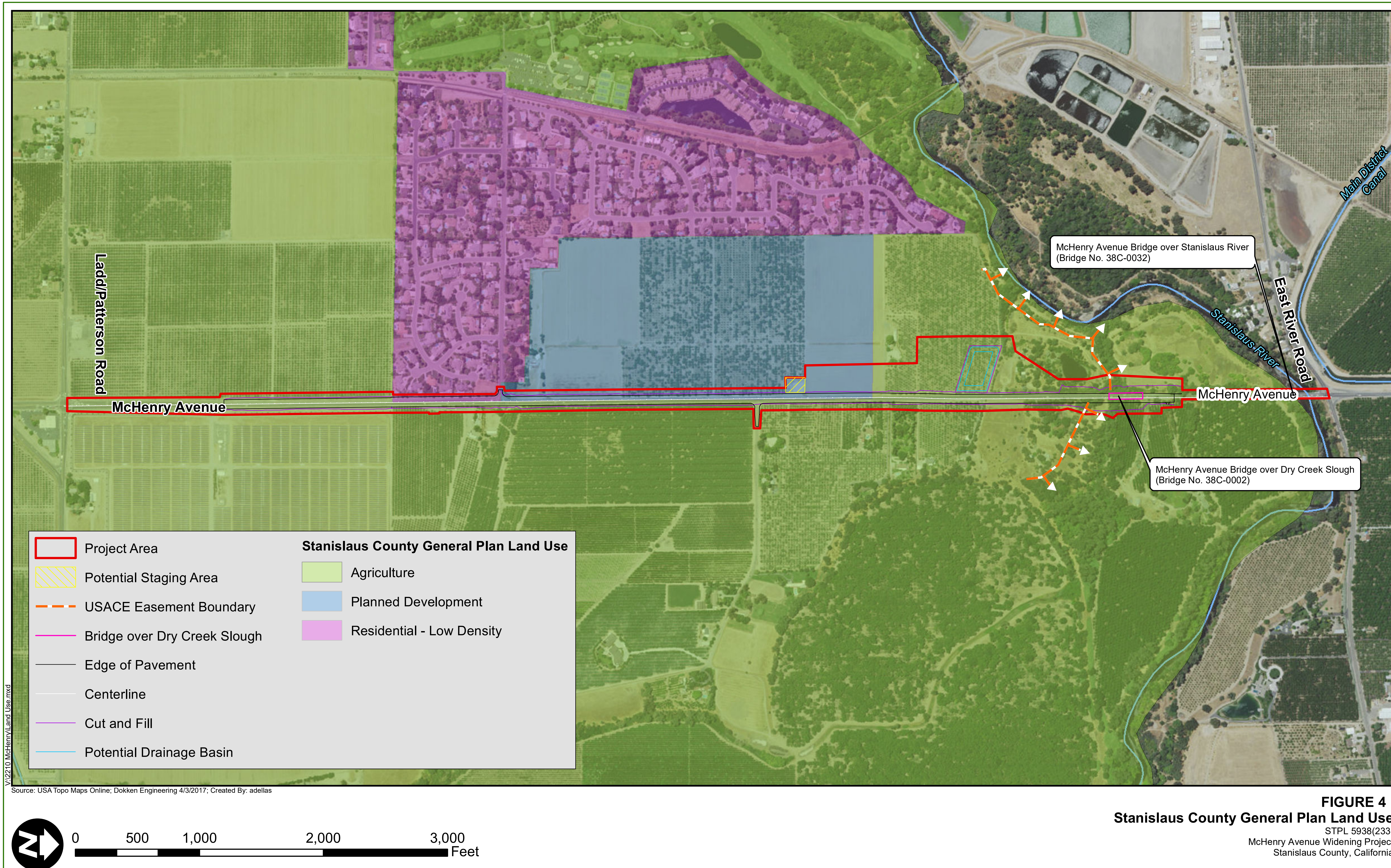

FIGURE 4
Stanislaus County General Plan Land Use
STPL 5938(233)
McHenry Avenue Widening Project
Stanislaus County, California

V:\2210 McHenry\Noise\McHenry Noise TNM 10192016.mxd

Source: USA Topo Maps Online; Dokken Engineering 4/10/2017; Created By: kchen

0 1,000 2,000 Feet

FIGURE 5
Noise Receptor Locations
STPL 5938(233)
McHenry Avenue Widening Project
Stanislaus County, California

Geometry of the Project Area Relative to Existing/Planned Land Use

The topography of the project area is relatively flat throughout the proposed project right of way.

5.2. Field Measurement Equipment and Procedures

Short-term noise measurements were taken at pertinent locations within the proposed project area to help determine proper shielding and background noise levels. Measurements were taken in accordance with the procedures cited in the TeNS document (Caltrans, 2013). All short-term field measurements were 15 minutes in duration and noise levels are in terms of A-weighted decibel equivalent sound level. The following is a brief description of the measurement procedures utilized during field monitoring:

- Microphones were placed 5 feet above the ground elevation for all locations.
- Sound level meters were calibrated before and after each measurement.
- Following the calibration of equipment, a windscreen was placed over the microphone.
- Frequency weighting was set on “A” and slow response.
- Results of the noise measurements were recorded on field data sheets.
- During the noise measurements, any excessive noise contamination such as barking dogs, lawn mowers, and/or aircraft fly-overs were noted.
- Wind speed, temperature, humidity, and weather conditions were observed and documented.
- The following instruments were used for field noise measurements:
- Sound Level Meter – A Larson Davis (LD) 824 System Type 1 sound level meter was used to measure existing noise levels. This sound level meter and its microphone conform to the Institute of Electronic and Electric Engineers and the American National Standards Institute standards for Type 1 instruments.
- Microphone System – LD Model 2560 1.27-centimeter (0.5-inch) pressure microphone; LD Model 900 microphone preamplifier.
- Acoustic Field Calibrator – LD Model CAL250 Precision Acoustic Calibrator.
- Nikon Coolpix AW120

Short-Term Measurements

Three (3) short-term measurements were conducted using a Larson Davis Model 824 Type 1 sound level meter. Measurements were taken over a 15-minute period at each site. Short-term monitoring was conducted at land uses. The short-term measurement locations are identified in Figure 4.

Traffic on adjacent roadways were classified and counted during each short-term noise measurement. Vehicles were classified as automobiles, medium-duty trucks, or heavy-duty trucks. Automobiles are vehicles with two axles and four tires that are designed primarily to carry passengers. Small vans and light trucks are included in this category. Medium-duty trucks included all cargo vehicles with two axles and six tires. Heavy-duty trucks include all vehicles with three or more axles.

5.3. Traffic Noise Level Prediction Methods

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

The existing traffic volume counts during field measurements, measured vehicle speeds, and measured noise levels were used to calibrate TNM 2.5 under existing roadway conditions. The existing traffic noise levels were calculated using the traffic volumes provided in the project's McHenry Avenue Widening Project Traffic Analysis Report (Dokken Engineering, 2016) and posted travel speeds. PM peak hour traffic volumes were utilized because PM volumes were higher than AM volumes.

To validate the accuracy of field noise measurements results, TNM 2.5 was used to compare measured noise levels to modeled noise levels at field measurement locations. For each location, traffic volumes counted during a 15-minute period during the short-term measurements were normalized to one hour volumes. These normalized volumes were assigned to the corresponding proposed project area roadways to simulate the noise source strength during the actual measurement period. Modeled and measured noise levels were then compared to determine if a correction factor (K-factor) would need to be applied to any monitoring location.

5.4. Process for Evaluating Noise Abatement

Traffic noise impacts are considered to occur at receiver locations where predicted design year noise levels are at least 12 dBA greater than existing noise levels, or where predicted design year noise levels approach or exceed the NAC for the applicable activity category, largely Category B, residential, and Category C, hospitals and schools. 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 dBA at impacted receiver locations is predicted for implementation of the abatement measures. Other factors that affect feasibility include topography, access requirements for driveways and ramps, presence of local cross streets, utility conflicts, other noise sources in the area, and safety considerations. In addition, sound walls should be designed to intercept the line-of-sight from the exhaust stack of a truck to the first tier of receivers, as required by the Highway Design Manual, Chapter 1100 (Caltrans, September 2006).

After a particular sound wall is found to meet the minimum noise reduction goal of 5 dB at an impacted receiver, overall reasonableness of the noise abatement must be determined. The overall reasonableness of noise abatement is determined by considering factors such as the noise reduction design goal, the cost of noise abatement and the viewpoints of benefited receivers (including property owners and residents). Caltrans' acoustical design goal states that a sound wall must be predicted to provide at least 7 dB of noise reduction at one or more benefited receivers. For a wall to be considered reasonable, the 7 dB design goal must be achieved at one or more benefited receivers. This design goal applies to any receiver and is not limited to impacted receivers. The design goal only applies to sound wall design considerations and is not meant to be associated with the increase in noise from a project. Once the noise abatement criteria is triggered by a receiver approaching or exceeding its respective NAC, the design goal guides the noise abatement evaluation by permitting for the greatest noise reduction within allowable cost limits for all receivers near the proposed sound wall.

Cost considerations for determining noise abatement reasonableness are evaluated by comparing reasonableness allowances and projected abatement costs. The Protocol defines the procedure for assessing reasonableness of sound walls from a cost perspective. A cost-per-residence allowance is calculated for each benefited residence (i.e., residences that receive at least 5 dBA of noise reduction from a sound wall). The cost allowance is $80,000 per benefited residence. Total allowances are calculated by multiplying the cost-per-residence by the number of benefited residences. The engineer's cost estimate for a given proposed noise abatement measure is compared to the total reasonableness allowance for all benefited receivers. If the engineer's cost estimate is less than the total reasonable allowance, then the sound wall is considered to be reasonable from a cost perspective.

Chapter 6. Existing Noise Environment

6.1. Existing Land Uses

A general reconnaissance of the proposed project area was performed within the project limits to identify noise-sensitive land uses. Field visits, aerial and Microstation mapping provided by the project Engineer, street views in Google Maps and field photographs of the project area were used to identify noise-sensitive land uses. Single-family residences were identified along north and southbound McHenry Avenue where outdoor frequent human use would occur as shown in Figure 4. These land use types fall into NAC Activity Category B for the residences. The FHWA and Caltrans NAC for Activity Category B is 67 dBA L_{eq}(h).

As required by the Protocol, although all developed land uses are evaluated in this analysis, noise abatement is only considered for areas of frequent human use that would benefit from a lowered noise level. Accordingly, this impact analysis focuses on locations with defined outdoor activity areas, such as residential backyards.

Receivers NR-1 through NR-16 represent a community of single family residences located southwest of the intersection of Stewart Road and McHenry Avenue where the noise from McHenry Avenue is the dominant noise source. Receivers NR-1 through NR-15 are shielded by an existing 7 foot sound wall located along the McHenry Avenue right of way. Receivers NR-17 through NR-21 and NR-23 represent large-lot single-family residences located near McHenry Avenue. The dominant noise source for these receivers is traffic traveling on McHenry Avenue. NR-24 is an undeveloped parcel used for agricultural purposes. NR-25 is an undeveloped parcel zoned for Planned Developed, but not currently permitted for development. All of the receivers are located within the County of Stanislaus.

6.2. Noise Measurement Results

The existing noise environment of the project area was characterized by conducting three (3) short-term noise measurements at representative noise-sensitive receiver locations.

Short-Term Noise Level Measurement Results

Short-term monitoring was conducted at four (4) locations in October 2016 using Larson David Model 824 Type 1 sound level meters. Measurements were taken for a duration of 15-minutes at each site. Short-term monitoring was conducted at or adjacent to Activity

Category B land uses. The short-term measurement locations are identified in Figure 4. Noise measurement field monitoring forms are located in Appendix C.

Table 6-1 summarizes the results of the short-term noise monitoring conducted in the project area. Table 6-2 describes the physical locations of the noise monitoring sites. These short-term noise measurements were used to calibrate the noise model and to calculate the noise levels at all modeled sensitive receivers in the project area.

During the short-term measurements, field staff attended each meter. During the measurement period (15 minutes in duration), dominant noise sources were also identified and logged. The calibration of the meter was checked before and after the measurement using Larson-Davis Model CAL250 calibrator.

During the short-term measurements, the wind speed ranged from 4-6 mph. Temperatures remained around 82°F, with relative humidity typically 28 percent.

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

Position	Address	Land Uses	Date and Start Time	Duration (minutes)	Measured L_{eq}
ST-1/ NR-8	7001 Hartley Court	SFR	10/26/2016 4:11 PM	15	62.2
ST-2/ NR-20	7706 McHenry Avenue	SFR	10/26/2016 4:50 PM	15	59.2
ST-3/ NR-22[3]	8018 McHenry Avenue	SFR	10/26/2016 5:20 PM	15	71.5

Note:
1) Concurrent traffic counts were taken during the 15-minute short-term measurements, a breakdown of traffic by roadway and direction are provided in Appendix A.
2) Receiver location is only for model validation. Location is not representative of an area of frequent human use.
3) This noise measurement site was chosen for monitoring purposes and was not located at an outdoor use area; however, this site is representative of nearby outdoor use areas.
ST-Short term measurement identifier
dBA – decibel or A-weighted sound level

Table 6-2. Physical Location of Noise Level Measurements

Receiver ID	Location Description	Noise Sources	Comments
ST-1	Vacant lot in single-family residential community located in Hartley Court west of McHenry Avenue, along the southbound travel lanes and towards the center of the proposed project area. The elevation at this location is approximately the same as McHenry Avenue. There is an existing barrier approximately 7 feet tall at this measurement location.	Traffic on McHenry Avenue is the dominant noise source.	The SLM was placed at ground level in a vacant lot between two single-family residences near a wall shielding the lot from McHenry Avenue. The SLM was approximately 30 feet from the nearest traffic lane on McHenry Avenue.
ST-2	Single-family residence located along McHenry Avenue east of the northbound travel lanes of McHenry Avenue. This measurement site was taken in the front yard of the residence located at 7706 McHenry Avenue. The elevation at this location is approximately the same as McHenry Avenue. Thick trees and shrubbery located between the property and McHenry Avenue shield this measurement location.	Traffic on Mchenry Avenue is the dominant noise source.	The SLM was placed in the front yard of a single-family residence. The SLM was approximately 200 feet from the nearest traffic lane on McHenry Avenue.
ST-3	Single-family residence located along McHenry Avenue east of the northbound travel lanes of McHenry Avenue. This measurement site was taken in the front yard of the residence located at 8018 McHenry Avenue. The elevation at this location is approximately the same as McHenry Avenue. There is no existing barrier at this measurement location.	Traffic on Mchenry Avenue is the dominant noise source.	The SLM was placed in the front yard of a single-family residence. The SLM was approximately 50 feet from the nearest traffic lane on McHenry Avenue.

Source: Dokken Engineering, October 2016
ST-Short-term measurement identifier
SLM – sound level meter

6.3. Model Calibration

Noise measurements were conducted at three (3) locations in October 2016 while concurrent traffic volumes were recorded through the use of a video camera. These measurements were conducted to calibrate TNM 2.5. Traffic speeds were recorded by driving on the roadways immediately after a noise measurement. The traffic counts were tabulated according to three vehicles types, including automobiles, medium-duty trucks (2-axle with 6-wheels but not including pick-up trucks) and heavy-duty trucks (3 or more axles). As a general rule, the noise model is considered to be calibrated if the field measured noise levels versus the modeled noise levels (using field collected traffic data) agree within 3 dB of each other. If differences are more than 3 dB, refinement of the noise model is performed until there is agreement between the two values. If after thorough reevaluation, validation still cannot be achieved due to complex topography or other unusual circumstances, then a K-factor is added such that the measured versus modeled values agree before any predictions can be made with the model.

Table 6-4 shows the representative modeled receiver locations, measured ambient noise level, the modeled noise levels using traffic counts and measured vehicle speeds during noise monitoring. The traffic volumes that were used in the calibration process are located in Appendix A. TNM 2.5 was used to compare measured traffic noise levels to modeled noise levels at field measurement locations. Table 6-4 compares measured and modeled noise levels at each measurement location. The predicted sound levels are within 3 dB of the measured sound levels and are thus considered to be in reasonable agreement with the measured sound levels. Therefore, no calibration of the model was necessary.

Table 6-4. Comparison of Measured to Predicted Sound Levels

Measurement Position	Measured Sound Level (dBA)	Predicted Sound Level (dBA)	Measured minus Predicted (dB)
ST-1	62.2	63.3	1.1
ST-2	59.2	62.1	-2.9
ST-3	71.5	69.5	2.0

Source: *Dokken Engineering, October 2016*

6.4. Existing Noise Levels

The land uses within the project area fall into exterior FHWA NAC Activity Category B.

Three (3) short-term locations were identified within the proposed project area. A total of twenty-five (25) receiver locations with outdoor frequent human use areas were evaluated in the model. All receiver locations are shown in Figure 4. The associated NAC Activity Category for each identified land use is listed in Table B-1 of Appendix B.

Existing noise levels were estimated using existing peak hour traffic data from the McHenry Avenue Widening Project Traffic Analysis Report (Dokken Engineering, September 2016). Existing peak hour traffic was entered into TNM 2.5 with existing roadway coordinates to estimate existing peak hour traffic noise levels. The results of the existing traffic noise modeling are shown in Table 6-5. As shown in Table 6-5, existing noise levels during the noisiest hour range at sensitive receivers range from 50 to 70 dBA L_{eq}(h); no receiver locations exceed the FHWA NAC criterion of 67 dBA L_{eq}(h) .

Table 6-5. Summary of Modeled Existing Peak Hour Noise Levels

Receiver ID	Location	Type of Land Use	Number of Dwelling Units	Noise Abatement Category	Measured Noise Level, dBA L_{eq}	Modeled Existing Peak Noise Level, dBA $L_{eq}(h)$
NR-1	7099 Grove Point Court	SFR	1	B (67)	--	57.2
NR-2	7001 Grove Point Court	SFR	1	B (67)	--	62.8
NR-3	300 Hartley Drive	SFR	1	B (67)	--	56.3
NR-4	7005 Grove Point Court	SFR	1	B (67)	--	61.9
NR-5	7009 Grove Point Court	SFR	1	B (67)	--	61.6
NR-6	7000 Hartley Court	SFR	1	B (67)	--	61.9
NR-7	7004 Hartley Court	SFR	1	B (67)	--	63.3
NR-8	7008 Hartley Court	SFR	-	D (-)	62.2	63.3
NR-9	7011 Hartley Court	SFR	1	B (67)	--	58.1
NR-10	7005 Hartley Court	SFR	1	B (67)	--	57.4
NR-11	7008 Grove Pointe Way	SFR	1	B (67)	--	55.4
NR-12	200 Blossom View Place	SFR	1	B (67)	--	54.4
NR-13	7001 Hartley Court	SFR	1	B (67)	--	56.4
NR-14	7017 Grove Pointe Way	SFR	1	B (67)	--	58.1
NR-15	7021 Grove Pointe Way	SFR	1	B (67)	--	58.1
NR-16	117 Stewart Road	SFR	1	B (67)	--	61.7
NR-17	125 Hogue Road	SFR	1	B (67)	--	60.3
NR-18	7600 McHenry Avenue	SFR	1	B (67)	--	49.7
NR-19	7730 McHenry Avenue	SFR	1	B (67)	--	57.7
NR-20	7706 McHenry Avenue	SFR	1	B (67)	59.2	62.1
NR-21	7709 McHenry Avenue	SFR	1	B (67)	--	61.5
NR-22	8018 McHenry Avenue	SFR	1	B (67)	71.5	69.4
NR-23	8018 McHenry Avenue	SFR	1	B (67)	--	66.3
NR-24	7785-7893 McHenry Avenue	AG	-	D (-)	--	70.3
NR-25	7785-7893 McHenry Avenue	PD	-	D (-)	--	66.6

Source: Dokken Engineering, October 2016

Notes: -- denotes a short-term noise measurement was not taken at this receiver location.

[1] Receiver location is only for model validation. Location is not representative of an area of frequent human use.

Chapter 7. Future Noise Environment, Impacts and Considered Abatement

The noise study was conducted to determine the future traffic noise impacts at sensitive receivers along the proposed McHenry northbound and southbound lanes to be widened. Potential long-term noise impacts associated with project operations arise solely from traffic noise. Traffic noise was evaluated for future scenarios (Future 2040 No-Build and Build) as worst-case conditions for twenty-fivef (25) receiver locations with frequently used outdoor use areas associated with existing single-family residences. These land uses fall into the NAC Activity Category B. The FHWA and Caltrans NAC for these land uses is Activity Category B, 67 dBA L_{eq}(h).

The predicted future worst-case traffic noise levels for the Build Alternative were determined using traffic volumes provided in the McHenry Avenue Widening Project Transportation Analysis Report (Dokken Engineering, September 2016).

Table B-1 in Appendix B summarizes the traffic noise modeling results for the design year conditions with the No-Build and Build Alternatives. Predicted design year traffic noise levels with the proposed project are compared to Existing conditions and to design year No-Build conditions. The modeled future noise levels with the project were compared to the modeled existing peak noise levels (after calibration) from TNM 2.5 to determine whether a substantial noise increase would occur. The modeled future noise levels for the Build Alternative were also compared to the respective NAC land use Activity Category to determine whether a traffic noise impact would occur.

Traffic noise impacts occur when either of the following occurs: (1) if the traffic noise level at a sensitive receptor location is predicted to "approach, within 1 dBA, or exceed" the NAC, or (2) if the predicted traffic noise level is 12 dBA or more over the corresponding modeled existing peak noise level at the sensitive receptor locations analyzed. When traffic noise impacts occur, noise abatement measures must be considered.

As stated in the TeNS, modeling results are rounded up 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 L_{eq}. The difference between these two values is 0.1 dB. However, after rounding, the difference is reported as 1 dB.

7.1. Future Noise Impacts

Under No-Build conditions McHenry Avenue would not be widened. The traffic noise modeling results for the design year No-Build Alternative range from 51 to 72 dBA L_{eq}(h), as shown in Table B-1 of Appendix B. No-Build noise levels at one of the evaluated receivers approach or exceed their respective NAC Activity Category standard.

The design year traffic noise modeling results for the Build Alternative range from 52 to 74 dBA L_{eq}(h), as shown in Table B-1 of Appendix B. Noise levels from Existing to No-Build conditions are expected to increase by up to 1.6 dB. The increase in noise levels is due to the slight increases in traffic volumes from Existing to No-Build conditions. Noise levels for the design year under the Build Alternative are expected to increase by up to 2.6 dB higher than design year No-Build noise levels. Build noise levels approach or exceed their respective NAC Activity criteria at one existing residence. Therefore, a noise abatement evaluation was required.

7.2 Preliminary Noise Abatement Analysis

In accordance with 23 CFR 772, 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 sound walls;
- 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 sound walls is the only abatement that is considered to be feasible. Analysis of the various alignments is inherent in this study and is hereby taken into account. Applying traffic management measures, such as restricting truck traffic, would be fundamentally counter to the Project purpose and need. Acquisition of land for creating buffer zones would not be practical, as much of the areas where such measures would be most effective are already used by homes and businesses.

Each noise sound wall has been evaluated for feasibility based on achievable noise reduction. For each of the noise sound walls found to be acoustically feasible, reasonable cost allowances were calculated. Table B-1 in Appendix B summarizes sound wall analysis results at receiver locations.

The analysis was conducted with sound walls heights ranging from 6 to 16 feet at two foot increments. The sound walls heights and locations were evaluated to determine if a minimum 5 dB attenuation at the outdoor frequent use areas of the representative receivers could be achieved. The reason for limiting the maximum sound wall height to 16 feet above the ground line is to comply with the suggestions set forth by Highway Design Manual (Caltrans, 2007). The minimum sound walls height required to cut the line-of-sight from each receiver to the exhaust stacks of heavy trucks has been calculated for all feasible sound walls. These heights were evaluated through calculations performed by TNM 2.5.

For any noise sound walls to be considered reasonable from a cost perspective the estimated cost of the noise sound walls should be equal to or less than the total cost allowance calculated for the sound walls. Furthermore, 23 CFR 772 requires that an acoustical design goal be applied to all noise abatement. Caltrans' acoustical design goal is that sound walls must be predicted to provide at least 7 dB of noise reduction at one or more benefited receivers. For a wall to be considered reasonable, the 7 dB design goal must be achieved at one or more benefited receivers. This design goal applies to any receiver and is not limited to impacted receivers. The cost calculations of the noise sound walls should include all items appropriate and necessary for construction of the sound walls, such as traffic control, drainage modification, and retaining walls. Construction cost estimates are not provided in this NSR, but are presented in the Noise Abatement Decision Report (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 proposed project. The NADR is prepared by the proposed 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 sound walls configurations are reasonable from a cost perspective.

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

Receiver locations under the Build Alternatives show design-year noise levels would approach or exceed the NAC criterion of 67 dBA L_{eq} (h). Therefore, a noise abatement evaluation was required. Sound wall heights were evaluated in 2 foot increments ranging in height from 6 feet to 16 feet. Results of the noise abatement evaluation are presented in Tables B-1 in Appendix B for the Build Alternative.

The proposed project would not require the removal or relocation of any existing sound walls. Currently, only a white fence and approximately 100 feet of undeveloped land separate the nearest traffic from McHenry Avenue between the nearest outdoor use space at the residence at NR-23.

Evaluated Sound Wall Locations

Receivers NR-23: This receiver represents the single family residence located at 8018 McHenry Avenue to the east of northbound lanes. The addition of a 2nd northbound lane will bring traffic closer to receiver NB-23 and cause noise levels to exceed 67 dBA L_{eq}. SW-W1 was evaluated on the edge of the shoulder along northbound McHenry Avenue to shield receiver NB-23. SW-W1 was found to be feasible at a minimum height of 8 feet where SW-W1 was raised in 2 foot increments from 6 feet to 16 feet in height. In order to meet the Caltrans acoustical design goal of a 7 dB reduction, a 14 foot sound wall must be erected. A 12 foot sound wall is able to provide a 6.7 dB reduction and break the line of sight of an 11.5 foot truck stack. Table B-1 in Appendix B summarizes the results of the sound wall analysis for these receiver locations. Table 7-1 summarizes the calculated noise reductions and reasonable allowances for each sound wall height.

Table 7-1. Summary of Reasonableness Determination Data—SW-W1 Alternative

Barrier I.D.: SW-W1	**6.-Foot**	**8-Foot**	**10-Foot**	**12-Foot**	**14-Foot**	**16-Foot**
Number of Benefited Receivers	N/A	1	1	1	2	--[b]
Reasonable Allowance Per Benefited Receiver	N/A	$80,000	$80,000	$80,000	$80,000	--[b]
Total Reasonable Allowance	N/A	$80,000	$80,000	$80,000	$80,000	--[b]

Note: N/A-Not applicable. Barrier does not provide 5 dB of noise reduction.

[a] An NADR will be prepared that will identify noise barrier construction cost information and the noise barriers that are reasonable from a cost perspective.

[b] Per the Highway Design Manual, the maximum height of a noise barrier should not exceed 14 feet in height when located 15 feet or less from edge of traveled way.

Figure 5 shows the evaluated sound wall and receiver locations.

V:\2210 McHenry\Noise\F5_Proposed Sound Wall.mxd

Source: USA Topo Maps Online; Dokken Engineering 1/10/2017; Created By: kchen

FIGURE 6
Evaluated Sound Walls and Receiver Locations
STPL 5938(233)
McHenry Avenue Widening Project
Stanislaus County, California

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. Table 8-1 summarizes noise levels produced by construction equipment that is commonly used on roadway construction projects. Construction equipment is expected to generate noise levels ranging from 70 to 90 dB at a distance of 50 feet, and noise produced by construction equipment would be reduced over distance at a rate of about 6 dB per doubling of distance. To minimize the construction-generated noise, abatement measures from Standard Specification 14-8.02 “Noise Control” and SSP 14-8.02 must be followed:

- Do not exceed 86 dBA at 50 feet from the job site activities from 9 p.m. to 6 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. Construction Equipment Noise

Equipment	Maximum Noise Level (dBA at 50 feet)
Scrapers	89
Bulldozers	85
Heavy Trucks	88
Backhoe	80
Pneumatic Tools	85
Concrete Pump	82

Source: Federal Transit Administration 2006.

No adverse noise impacts from construction are anticipated because construction would be conducted in accordance with Standard Specification 14-8.02, SSP14-8.02 and applicable local noise standards. Construction noise would be short-term, intermittent, and overshadowed by local traffic noise. In addition, the local County noise ordinance, Stanislaus County Noise Control Ordinance (Chapter 10.46) would be followed. The County’s Municipal Code specifically prohibits the operation of any construction equipment that would cause a greater sound level than 75 decibels at or beyond the property line of any property between the hours of 7:00 p.m. to 7 a.m.

The following Standard Special Provision (SSP 14-8.02) will be edited specifically for this project during the PS&E phase:

Do not exceed 86 dBA L_{max} at 50 feet from the job site activities from _____ p.m. to _____ a.m. except you may perform the following activities during the hours and for the days shown in the following table:

Noise Restriction Exceptions

Activity	Hours		Days	
	From	To	From	Through

Do not operate construction equipment or run the equipment engines from 7:00 p.m. to 7:00 a.m. or on Sundays, with the exception that you may operate equipment within the project limits during these hours to:

1. Service traffic control facilities
2. Service construction equipment

Noise Monitoring

Provide one Type 1 sound level meter and 1 acoustic calibrator to be used by the Department until Contract acceptance. Provide training by a person trained in noise monitoring to 1 Department employee designated by the Engineer. The sound level meter must be calibrated and certified by the manufacturer or other independent acoustical laboratory before delivery to the Department. Provide annual recalibration by the manufacturer or other independent acoustical laboratory. The sound level meter must be capable of taking measurements using the A-weighting network and the slow response settings. The measurement microphone must be fitted with a windscreen. The Department returns the equipment to you at Contract acceptance. Work specified in this paragraph is paid for as noise monitoring.

Chapter 9. References

Caltrans, 2013. Technical Noise Supplement. September. Sacramento, CA: Division of Environmental Analysis. Sacramento, CA. Available: (http://www.dot.ca.gov/hq/env/noise/pub/tens_complete.pdf).

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County of Stanislaus. 2010. Noise Control Ordinance. Stanislaus County. February 2, 2010. http://www.stancounty.com/bos/agenda/2010/20100202/A02.pdf

Dokken Engineering. 2016. McHenry Avenue Widening Project Traffic Analysis Report. Stanislaus County, CA. September, 2016.

Federal Highway Administration. 2006. Transit Noise and Vibration Impact Assessment. May 2006. https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FTA_Noise_and_Vibration_Manual.pdf

Federal Highway Administration. 2004. FHWA Traffic Noise Model, Version 2.5

Appendix A Traffic Data

Table A-1. Existing PM Peak Hour Traffic Volumes Used in TNM

	Segment	Number of Lanes	Total PM Peak Hour Traffic	Auto %	Total Auto	MT %	Total MT	HT %	Total HT	Speed (A/MT/HT)
McHenry Avenue	Northbound South of Stewart Road	1	750	95%	713	3%	23	2%	15	50/50/45
McHenry Avenue	Northbound North of Stewart Road	1	679	95%	645	3%	20	2%	14	50/50/45
McHenry Avenue	Southbound South of Stewart Road	1	929	95%	883	3%	28	2%	19	50/50/45
McHenry Avenue	Southbound North of Stewart Road	1	901	95%	856	3%	27	2%	18	50/50/45

Source: Dokken Engineering 2016
A = Auto, MT = medium truck, HT = heavy truck

Table A-2. 2018 No Build PM Peak Hour Traffic Volumes Used in TNM

	Segment	Number of Lanes	Total PM Peak Hour Traffic	Auto %	Total Auto	MT %	Total MT	HT %	Total HT	Speed (A/MT/HT)
McHenry Avenue	Northbound South of Stewart Road	1	760	95%	722	3%	23	2%	15	50/50/45
McHenry Avenue	Northbound North of Stewart Road	1	706	95%	671	3%	21	2%	14	50/50/45
McHenry Avenue	Southbound South of Stewart Road	1	966	95%	918	3%	29	2%	19	50/50/45
McHenry Avenue	Southbound North of Stewart Road	1	937	95%	890	3%	28	2%	19	50/50/45

Source: Dokken Engineering 2016
A = Auto, MT = medium truck, HT = heavy truck

Table A-3. 2018 Build PM Peak Hour Traffic Volumes Used in TNM

	Segment	Number of Lanes	Total PM Peak Hour Traffic	Auto %	Total Auto	MT %	Total MT	HT %	Total HT	Speed (A/MT/HT)
McHenry Avenue	Northbound South of Stewart Road	2	760	95%	722	3%	23	2%	15	50/50/45
McHenry Avenue	Northbound North of Stewart Road	2	706	95%	671	3%	21	2%	14	50/50/45
McHenry Avenue	Southbound South of Stewart Road	2	966	95%	918	3%	29	2%	19	50/50/45
McHenry Avenue	Southbound North of Stewart Road	2	937	95%	890	3%	28	2%	19	50/50/45

Source: Dokken Engineering 2016
A = Auto, MT = medium truck, HT = heavy truck

Table A-4. 2040 No Build PM Peak Hour Traffic Volumes Used in TNM

	Segment	Number of Lanes	Total PM Peak Hour Traffic	Auto %	Total Auto	MT %	Total MT	HT %	Total HT	Speed (A/MT/HT)
McHenry Avenue	Northbound South of Stewart Road	2	1052	95%	999	3%	32	2%	21	50/50/45
McHenry Avenue	Northbound North of Stewart Road	2	977	95%	928	3%	29	2%	20	50/50/45
McHenry Avenue	Southbound South of Stewart Road	2	1337	95%	1270	3%	40	2%	27	50/50/45
McHenry Avenue	Southbound North of Stewart Road	2	1297	95%	1297	3%	39	2%	26	50/50/45

Source: Dokken Engineering 2016
A = Auto, MT = medium truck, HT = heavy truck

Table A-5. 2040 Build PM Peak Hour Traffic Volumes Used in TNM

	Segment	Number of Lanes	Total PM Peak Hour Traffic	Auto %	Total Auto	MT %	Total MT	HT %	Total HT	Speed (A/MT/HT)
McHenry Avenue	Northbound South of Stewart Road	2	1052	95%	999	3%	32	2%	21	50/50/45
McHenry Avenue	Northbound North of Stewart Road	2	977	95%	928	3%	29	2%	20	50/50/45
McHenry Avenue	Southbound South of Stewart Road	2	1337	95%	1270	3%	40	2%	27	50/50/45
McHenry Avenue	Southbound North of Stewart Road	2	1297	95%	1297	3%	39	2%	26	50/50/45

Source: Dokken Engineering 2016
A = Auto, MT = medium truck, HT = heavy truck

Appendix B Predicted Future Noise Levels

Table B-1. Predicted Future Noise

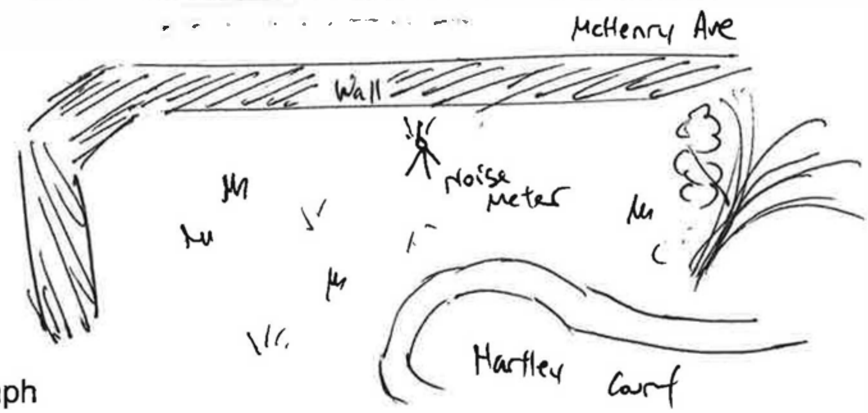
Receptor I.D.	Barrier I.D.	Number of Dwelling Units	Land Use	Address	McHenry Avenue Widening PM Peak Hour Noise Levels -Leq, dBA: Existing Exterior Noise Level Leq, dBA	2018 No Build PM Exterior Noise Level Leq, dBA	2018 Build PM Exterior Noise Level Leq, dBA	2040 No Build PM Exterior Noise Level Leq, dBA	2040 Build PM Exterior Noise Level Leq, dBA	Activity Category (NAC)	Impact Type[2]	Noise Prediction with Barrier, Barrier Insertion Loss (I.L.), and Number of Benefited Receptors (NBR) 2040: 6 feet Leq	6 feet I.L.	6 feet NBR	8 feet Leq	8 feet I.L.	8 feet NBR	10 feet Leq	10 feet I.L.	10 feet NBR	12 feet Leq	12 feet I.L.	12 feet NBR	14 feet Leq	14 feet I.L.	14 feet NBR	Barrier Feasible (5 dB I.L.)	Barrier meets Caltrans Acoustical Design Goal (7 dB I.L.)
NR-1	No Barrier	1	Residential	7099 Grove Point Court	57.2	57.3	56.8	58.7	58.5	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-2	No Barrier	1	Residential	7001 Grove Point Court	62.8	63.0	62.5	64.4	64.4	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-3	No Barrier	1	Residential	300 Hartley Drive	56.3	56.4	56.0	57.9	57.7	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-4	No Barrier	1	Residential	7005 Grove Point Court	61.9	62.0	61.5	63.5	63.4	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-5	No Barrier	1	Residential	7009 Grove Point Court	61.6	61.8	61.1	63.2	63.0	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-6	No Barrier	1	Residential	7000 Hartley Court	61.9	62.0	61.0	63.4	62.8	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-7	No Barrier	1	Residential	7004 Hartley Court	63.3	63.4	62.4	64.8	64.2	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-8	No Barrier	1	Residential	7008 Hartley Court	63.3	63.4	62.4	64.8	64.1	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-9	No Barrier	1	Residential	7011 Hartley Court	58.1	58.3	57.8	59.7	59.4	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-10	No Barrier	1	Residential	7005 Hartley Court	57.4	57.5	57.1	58.9	58.7	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-11	No Barrier	1	Residential	7008 Grove Pointe Way	55.4	55.5	55.1	57.0	56.7	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-12	No Barrier	1	Residential	200 Blossom View Place	54.4	54.5	54.2	55.9	55.8	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-13	No Barrier	1	Residential	7001 Hartley Court	56.4	56.5	56.2	57.9	57.8	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-14	No Barrier	1	Residential	7017 Grove Pointe Way	57.2	57.3	57.1	58.7	58.5	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-15	No Barrier	1	Residential	7021 Grove Pointe Way	58.1	58.2	58.1	59.6	59.4	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-16	No Barrier	1	Residential	117 Stewart Road	61.7	61.9	62.4	63.3	63.6	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-17	No Barrier	1	Residential	125 Hogue Road	60.3	60.5	61.2	61.9	62.3	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-18	No Barrier	1	Residential	7600 McHenry Avenue	49.7	49.8	50.5	51.2	51.6	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-19	No Barrier	1	Residential	7730 McHenry Avenue	57.7	57.9	58.7	59.3	59.8	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-20	No Barrier	1	Residential	7706 McHenry Avenue	62.1	62.3	63.1	63.7	64.2	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-21	No Barrier	1	Residential	7709 McHenry Avenue	61.5	61.7	61.7	63.1	62.8	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-22	No Barrier	0[6]	Residential	8018 McHenry Avenue	69.4	69.6	72.7	71.0	73.6	B (67)	None	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-23	Soundwall 1	1	Residential	8018 McHenry Avenue	66.3	66.5	67.8	67.9	68.8	B (67)	A/E	63.8	4.8	1	63.2	5.4	1	62.6	6	1	61.9	6.7	1	61.6	7	1	Y	Y
NR-24	No Barrier	0	Agricultural	7785-7893 McHenry Avenue	70.3	70.5	70.8	71.9	72.0	G (N/A)	N/A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NR-25	No Barrier	0	Planned Development[7]	7785-7893 McHenry Avenue	66.6	66.7	66.9	68.2	68.1	G (N/A)	N/A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Notes:
1. Noise levels were adjusted to existing peak hour.
2. Impact types: A/E - Future noise conditions approach (within 1 dBA) or exceed the Noise Abatement Criteria, S = substantial noise increase, when the project's predicted worst-hour design-year noise level exceeds the existing worst hour noise level by 12 dBA or more
3. I.L. = Insertion Loss
4. SFR = single-family residence, UND = Undeveloped, ASA = active sports area, MFR = multi-family residence
5. N/A - Not Applicable
6. NR-22 represents a noise measurement location a residential property that is not a sensitive outdoor use area.
7. NR-25 is not currently permitted for future development

Appendix C Field Data

Project Name and Number	McHenry Ave Widening Project 2210
Receptor Site	NM-1 / NR-8
Latitude/Longitude/Description	37°44'31.34"N 120°59'44.45"
Start Date & Time	4:11 PM 10/26/2016
End Date & Time	4:26 PM 10/26/2016
Relative Humidity (%),Temperature (degrees F), Wind Speed/Direction	Humidity 28% Wind: 6 mph Temp: 82°F
Vehicle Speeds	45-50 mph
Notes	car honk at noise meter 4:20 pm

Site Sketch (including landmarks—building corners, trees, street signs, curbs, fences)



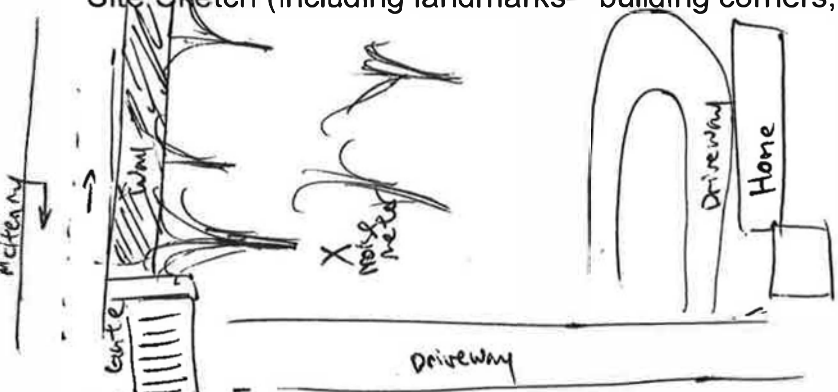
Site Photograph

Equipment	Meter Type:	Larson Davis 824
	Calibrator:	Larson Davis Cal 200
Company meter #		
Staff	Ken Chen, Laura Lawson	

Noise Field Data Sheet

Project Name and Number	McHenry Ave Widening Project 2210
Receptor Site	NM-2 / NR-19
Latitude/Longitude/Description	37°45'4"N 120°59'42"W
Start Date & Time	4:50 pm 10/26/2016
End Date & Time	5:05 pm 10/26/2016
Relative Humidity (%),Temperature (degrees F), Wind Speed/Direction	Humidity = 26% Wind = 5mph South Temp = 82°F
Vehicle Speeds	45-50 mph
Notes	

Site Sketch (including landmarks—building corners, trees, street signs, curbs, fences)

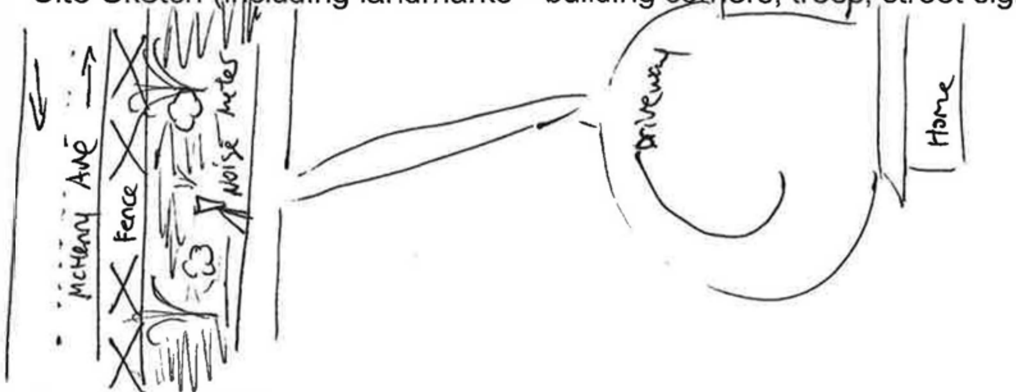


Site Photograph

Equipment	Meter Type:	Larson Davis 824
	Calibrator:	Larson Davis Cal 200
Company meter #		
Staff	Laura Lawson, Ken Chen	

Project Name and Number	McHenry Ave Widening Project 2210
Receptor Site	NM-3 / NR-22
Latitude/Longitude/Description	37°45'16.97"N 120°59'43.00"W
Start Date & Time	5:20 pm
End Date & Time	5:35 pm
Relative Humidity (%),Temperature (degrees F), Wind Speed/Direction	82°F 28% Humidity wind 4mph
Vehicle Speeds	45-50 mph
Notes	

Site Sketch (including landmarks—building corners, trees, street signs, curbs, fences)



Site Photograph

Equipment	Meter Type:	Larson Davis 824
	Calibrator:	Larson Davis Cal 200
Company meter #		
Staff	Ken Chen, Laura Lawson	