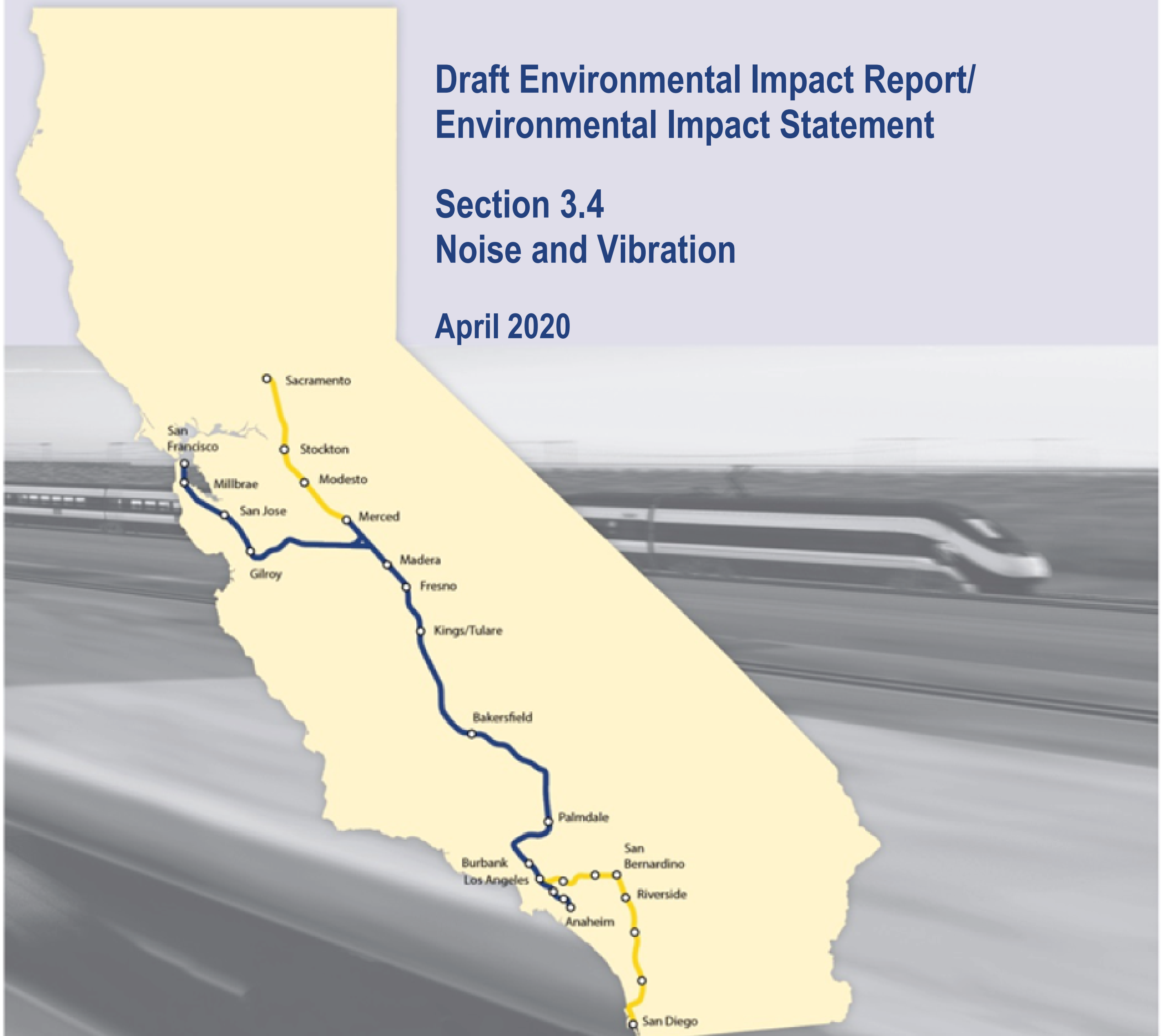
California High-Speed Rail Authority

San Jose to Merced Project Section

Draft Environmental Impact Report/ Environmental Impact Statement

Section 3.4 Noise and Vibration

April 2020



CALIFORNIA High-Speed Rail Authority

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being or have been carried out by the State of California pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated July 23, 2019, and executed by the Federal Railroad Administration and the State of California.

TABLE OF CONTENTS

Tables

Figures

Appendices

ACRONYMS AND ABBREVIATIONS

2016 Business Plan	*Connecting and Transforming California, 2016 Business Plan*
2018 Business Plan	*Connecting California, Expanding Economy, Transforming Travel, 2018 Business Plan (Final)*
ACE	Altamont Corridor Express
ATOR	above top of rail
Authority	California High-Speed Rail Authority
BART	Bay Area Rapid Transit
Bay Area	San Francisco Bay Area
C.F.R.	Code of Federal Regulations
Caltrans	California Department of Transportation
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CNEL	community noise equivalent level
dB	decibel
dBA	A-weighted decibel
EIR	environmental impact report
EIS	environmental impact statement
EMU	electric multiple unit
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FRA guidance manual	*High-Speed Ground Transportation Noise and Vibration Impact Assessment*
FTA	Federal Transit Administration
FTA guidance manual	*Transit Noise and Vibration Impact Assessment Manual*
HSR	high-speed rail
Hz	Hertz, cycles per second
I-	Interstate
IAMF	impact avoidance and minimization feature
L_{dn}	day-night sound level, dBA
L_{eq}	equivalent sound level, dBA
L_{max}	maximum sound level
L_{min}	minimum sound level
L_v	velocity level
MOWF	maintenance of way facility
mph	miles per hour

NEPA	National Environmental Policy Act
OPR	(California Governor's) Office of Planning and Research
OSHA	Occupational Safety and Health Administration
PCEP	Caltrain Peninsula Corridor Electrification Project
PG&E	Pacific Gas and Electric
PPV	peak particle velocity
project extent	San Jose to Central Valley Wye Project Extent
RMS	root-mean-square
RSA	resource study area
SEL	sound exposure level, dBA
SR	State Route
TBM	tunnel-boring machine
TPSS	traction power substation
TPF	traction power facility
U.S.C.	United States Code
US	U.S. Highway
USEPA	U.S. Environmental Protection Agency
UPRR	Union Pacific Railroad
VdB	vibration decibel(s)
VTA	Santa Clara Valley Transportation Authority

3.4 Noise and Vibration

3.4.1 Introduction

This section describes the regulatory setting, affected environment, and potential impacts related to noise and vibration in the San Jose to Central Valley Wye Project Extent (project or project extent) resource study area (RSA). The potential impacts related to noise and vibration that would result from the construction and operation of the project alternatives are evaluated and presented in accordance with applicable guidelines. Mitigation measures that would reduce the identified impacts are also described.

Noise and vibration are key elements of the environmental impact assessment for a high-speed rail (HSR) project. Increases in noise and vibration are frequently cited as among the potential impacts of most concern to residents near an HSR alignment. Project noise and vibration impacts would consist of construction-related noise and vibration impacts and HSR operational noise and vibration impacts due to trains, train horns, stations and maintenance facilities, and station and maintenance facility–related vehicular traffic.

The differences between the four project alternatives is predominantly a result of the vertical and horizontal profile of each alternative, with most of those differences occurring in the San Jose Diridon Station Approach Subsection and the Morgan Hill and Gilroy Subsection. Alternative 4 would primarily be at-grade within the existing railroad right-of-way in these subsections, which would mean more train horn noise at the at-grade crossings in addition to train engine/wheel noise at-grade. As a result, Alternative 4 would have higher noise and vibration impacts prior to mitigation than the other alternatives. Alternatives 1 and 3 would predominantly be on aerial structure. Alternative 2 would have a longer embankment profile and elevation than Alternatives 1 and 3.

Primary Noise and Vibration Impacts

- Train operations, depending on alternative, would expose between 219 (Alt. 3) and 1,186 (Alt. 4) sensitive receptors to severe noise impacts and between 834 (Alt. 3) and 1,844 (Alt. 2) sensitive receptors to moderate noise impacts in 2040 without mitigation. With noise barrier mitigation, impacts can reduce the number of sensitive receptors exposed to severe noise impact down to between 173 (Alt. 3) and 275 (Alt. 4). With noise barrier mitigation and implementation of quiet zones by local jurisdictions, the number of sensitive receptors exposed to severe noise impacts would be reduced to between 173 (Alt. 3) and 223 (Alt. 1).
- Significant traffic-related noise (greater than or equal to 3 dB increase) would occur in 2040 at 12 roadway segments near the San Jose Diridon Station, along Monterey Road, near the South Gilroy MOWF, and Downtown Gilroy Station.
- Train operations, depending on alternative, would generate between 81 (Alt. 1) and 1,203 (Alt. 4) vibration impacts, most of which would be in the Monterey Corridor.

The HSR project would result in the following changes to rail operations, all of which would affect noise and vibration conditions along the Caltrain corridor:

- Increase in the number of passenger trains—The HSR project would add an estimated 176 revenue trains per day to the Caltrain corridor (depending on location along the corridor). During the peak hour, up to 14 trains would be added.
- Change in passenger train technology—To operate a blended system efficiently, Caltrain operations would need to shift to 100 percent electric multiple unit (EMU) trains compared to only 75 percent EMUs with the Peninsula Corridor Electrification Project (PCEP). HSR would use 100 percent EMUs.
- Change in passenger train speeds—With track curve straightening, passenger service speeds would be up to 110 miles per hour (mph) for both Caltrain and HSR service with Alternative 4.
- New traction power facilities (TPF)—The project would build several new TPFs.

This analysis evaluates noise and vibration impacts associated with the four project alternatives for both the construction and operations.

Volume 2, Appendix 3.4-A, *San Jose to Merced Project Section Noise and Vibration Technical Report* (Noise and Vibration Technical Report) provides details to support this noise and vibration impact analysis. The following appendices in Volume 2 of this environmental impact report (EIR)/environmental impact statement (EIS) also provide additional details on noise and vibration:

- Appendix 2-A, Roadway Crossings, Modifications, and Closures, describes road crossings of the alignment, road relocations, and road closures resulting from construction of the project.
- Appendix 2-B, Railroad Crossings, describes railroad crossings of the project alternatives.
- Appendix 2-D, Applicable Design Standards, describes the relevant design standards for this project.
- Appendix 2-E, Project Impact Avoidance and Minimization Features, provides the list of all impact avoidance and minimization features (IAMF) incorporated into this project.
- Appendix 2-J, Regional and Local Plans and Policies, provides a list by resource of all applicable regional and local plans and policies.
- Appendix 3.4-A, Noise and Vibration Technical Report, presents the technical analysis to support this section.
- Appendix 3.4-B, Noise and Vibration Mitigation Guidelines, presents the California High-Speed Rail Authority's (Authority) noise and vibration mitigation guidelines.

The following Draft EIR/EIS resource sections present additional information related to noise and vibration in other subject areas:

- Section 3.2, Transportation—Evaluates impacts on transportation resources, including roadway and rail traffic, that would lead to changes in noise and vibration in the RSA.
- Section 3.7, Biological and Aquatic Resources—Evaluates impacts of project construction and operations on wildlife that would be affected by noise and vibration.
- Section 3.9, Geology, Soils, Seismicity, and Paleontological Resources—Evaluates areas with sensitive surrounding land uses and soil that would be affected by vibration.
- Section 3.12, Socioeconomics and Communities—Evaluates sensitive communities and residential areas that would be affected by noise and vibration.
- Section 3.13, Land Use and Development—Evaluates locations where sensitive land uses and adjacent development would be affected by noise and vibration.
- Section 3.15, Parks, Recreation, and Open Space—Evaluates adjacent parks and recreation areas that would be affected by noise and vibration.
- Section 3.17, Cultural Resources—Evaluates historic architectural resources that would be affected by noise and vibration.

3.4.1.1 Definition of Terminology

The following are definitions for noise analyzed in this Draft EIR/EIS.

Noise

Noise is discussed in terms of a "source-path-receptor" framework, as follows:

- Source—The *source* generates noise that depends on the type of source (e.g., an HSR train) and its operating characteristics (e.g., speed).
- Path—In between the source and the receptor is the *path*, where the noise is reduced by distance, intervening buildings and barriers or other features, and topography.
- Receptor—The *receptor* is the noise-sensitive land use (e.g., residence, hospital, or school, referred to as *sensitive receptors*) exposed to noise from the source.

Environmental noise impacts are assessed at the receptor. Noise criteria are established for the various types of receptors individually because not all receptors have the same noise sensitivity.

Analysts used three primary noise level descriptors (metrics) to assess noise impacts from traffic and transit projects:

- Equivalent sound level (L_{eq}) refers to a receptor's energy-averaged noise exposure from all events over a specified period (e.g., 1 minute, 1 hour, 24 hours).
- Day-night sound level (L_{dn}) refers to a receptor's energy-averaged noise exposure from all events over a 24-hour period with a penalty added for nighttime (10 p.m. to 7 a.m.) noise periods.
- Sound exposure level (SEL) refers to a receptor's noise exposure from a single noise event condensed into a 1-second duration.

The tonal character of noise is described by its frequency content. Individual frequencies or a range of frequencies are expressed in terms of the rate of fluctuation of the air pressure in cycles per seconds or Hertz (Hz). The average human ear and brain system can generally perceive noise frequencies between 20 Hz and 20,000 Hz. However, the human hearing system does not respond equally to all frequencies; it is more sensitive to mid-band frequencies (e.g., 500 to 2,000 Hz). Thus, when describing sound and its impacts on a human population, A-weighted decibel (dBA) sound pressure levels are used to account for the response of the human ear by de-emphasizing the low and very high frequency components of the sound. The A-weighted sound level correlates well with human response and is expressed in terms of a single number. Figure 3.4-1 illustrates typical A-weighted noise levels of HSR trains, as well as other indoor and outdoor noise sources. Typical A-weighted sound levels range from the 40s to the 90s (in dBA), where 40 is very quiet and 90 is very loud. On average, each A-weighted sound level increase of 10 decibels (dB) corresponds to an approximate doubling of subjective loudness.

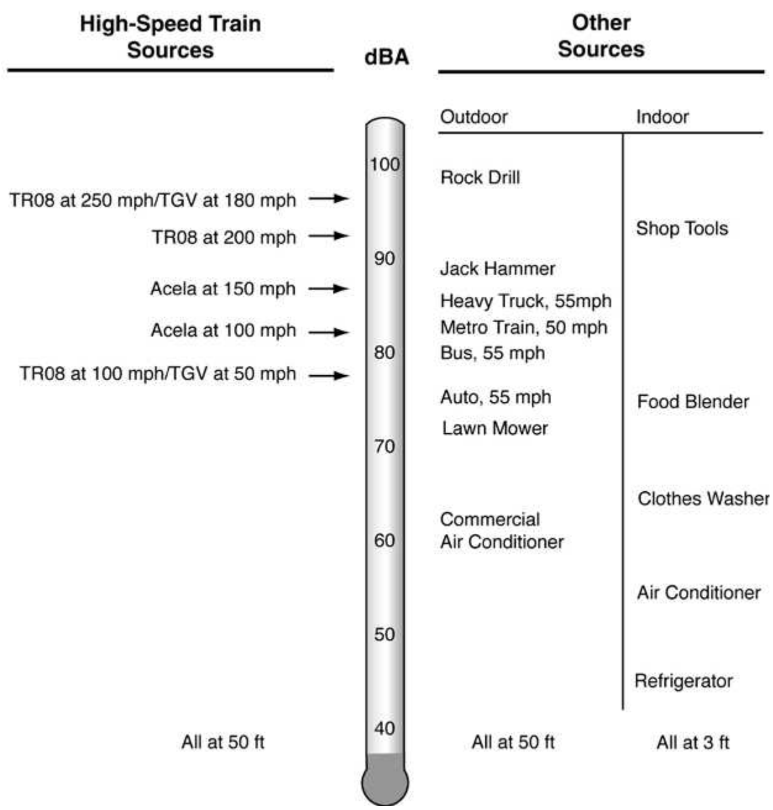


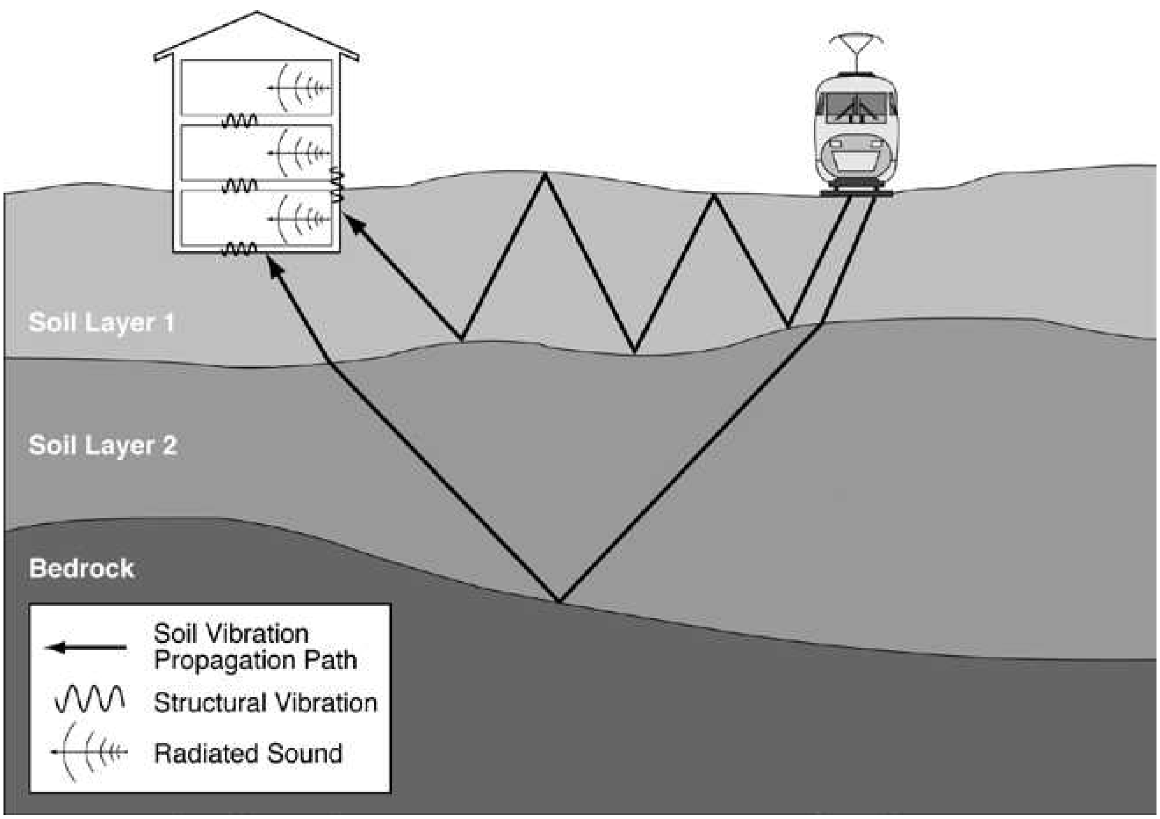
Figure 3.4-1 Typical A-Weighted Maximum Sound Levels

Vibration

Vibration is also discussed in terms of a “source-path-receptor” framework, as follows:

- Source—The *source* generates energy that causes vibration, such as the operation of construction equipment (e.g., pile driver) that could cause ground vibrations that spread through the ground and diminish in strength with distance from the source.
- Path—Once the vibration is in the ground, it propagates through the various soil and rock layers to the foundations of nearby buildings (the receptors). Ground-borne vibrations generally decline with distance, depending on the local geological conditions.
- Receptor—A *receptor* is a vibration-sensitive building (e.g., residence, hospital, or school), where the vibrations may cause perceptible shaking of the floors, walls, and ceilings, and a rumbling sound inside rooms. Not all receptors have the same vibration sensitivity. Consequently, criteria are established for the various types of receptors.

As with sound, vibration attenuates as a function of the distance between the source and the receptor. Vibration caused by trains moving along a transit structure, such as at-grade ballast and tie track, radiates energy into the adjacent soil. Buildings respond differently to ground vibration depending on the type of foundation, the mass of the building, and the building interaction with the soil. Once inside the building, vibration propagates throughout the building with some attenuation with distance from the foundation, but often with amplification from floor resonances. Figure 3.4-2 illustrates the basic concepts for rail system–generated ground vibration.



Source: FRA 2012 FEBRUARY 2019

Figure 3.4-2 Propagation of Ground-Borne Vibration into Buildings

Vibration can be described by its peak or root-mean-square (RMS) amplitudes. The RMS amplitude (expressed as vibration decibels, VdB) is useful for assessing human annoyance, while peak vibration is most often used for assessing the potential for damage to building structures. Building damage is often discussed in terms of peak velocity, or peak particle velocity (PPV). Construction vibration is assessed in terms of PPV. Volume 2, Appendix 3.4-A, provides additional details regarding noise and vibration descriptors.

Vibration is evaluated for its potential to cause damage to buildings, disrupt sensitive operations, or cause annoyance to humans in buildings. Although the threshold of human perception to vibration is approximately 65 VdB, annoyance does not usually occur until the vibration exceeds 70 VdB.

3.4.2 Laws, Regulations, and Orders

This section presents federal and state laws, regulations, and orders applicable to noise and vibration affected by the project. The Authority would implement the project in compliance with all federal and state regulations. Volume 2, Appendix 2-J, provides the regional and local plans and policies relevant to noise and vibration considered in the preparation of this analysis.

3.4.2.1 Federal

Noise Control Act of 1972 (42 U.S.C. § 4910)

The Noise Control Act of 1972 (42 United States Code [U.S.C.] § 4910) was the first comprehensive statement of national noise policy. It declared, "it is the policy of the United States to promote an environment for all Americans free from noise that jeopardizes their health or welfare." Although the act, as a funded program, was ultimately abandoned at the federal level, it served as the catalyst for comprehensive noise studies and the generation of noise assessment and mitigation policies, regulations, ordinances, standards, and guidance for many states, counties and municipal governments. For example, the noise elements of community general plans and local noise ordinances studied as part of this analysis were largely created in response to passage of the act.

Occupational Safety and Health Administration Occupational Noise Exposure (29 C.F.R. § 1910.95)

The Occupational Safety and Health Administration (OSHA) (29 Code of Federal Regulations [C.F.R.] § 1910.95) has regulated worker noise exposure to a time-weighted-average of 90 dBA over an 8-hour work shift. Areas where levels exceed 85 dBA must be designated and labeled as high-noise-level areas where hearing protection is required. This noise exposure criterion for workers would apply to project construction activities. Noise from construction activities might also elevate noise levels at nearby construction sites to levels that exceed 85 dBA and thus trigger the need for administrative or engineering controls and hearing conservation programs for worker safety, as detailed by OSHA.

Federal Railroad Administration

Noise and Vibration Impact Assessment Guidelines

The Federal Railroad Administration (FRA) provides guidance regarding the evaluation of noise and vibration impacts from construction and operations of high-speed trains in *High-Speed Ground Transportation Noise and Vibration Impact Assessment* (FRA guidance manual) (FRA 2012). The manual includes prediction methods, assessment procedures, and impact criteria for noise and vibration. Section 3.4.4.3, Methods for Impact Analysis, discusses noise and vibration impact criteria.

Railroad Noise Emission Compliance Regulations (49 C.F.R. Part 210)

FRA's Railroad Noise Emission Compliance Regulation (49 C.F.R. Part 210) prescribes minimum compliance regulations for enforcement of Noise Emission Standards for Transportation Equipment; Interstate Rail Carriers (40 C.F.R. Part 201) adopted by the U.S. Environmental Protection Agency (USEPA). New locomotives must meet the following noise standards: 70 dBA at 100 feet while stationary at idle throttle setting, 87 dBA at 100 feet while stationary at all other throttle settings, and 90 dBA at 100 feet while moving. Rail cars must meet the following noise standards: 88 dBA while moving at speeds of 45 mph or less, and 93 dBA at 100 feet while moving at speeds faster than 45 mph.

Whether or not the USEPA standard applies to high-speed trainsets, the analysis in this EIR/EIS does not assume that Authority trainsets would comply with it because the Authority is not aware of any high-speed trainsets manufactured in the world today that meet this standard at all speeds. A noise-generation standard specific to high-speed trains does exist in Europe (European TSI Standard), and a trainset manufactured to that standard complies with the USEPA standard (if applicable) generally at speeds below 190 to 200 mph. Above 200 mph, airflow over the trainset and its pantograph and related apparatus is the main source of noise, which presently known technology cannot resolve to comply with the USEPA standard (if applicable). The analysis in this EIR/EIS—both prior to mitigation and after mitigation—assumes a trainset generating noise in compliance with the European TSI standard. Because trainsets currently in manufacture and operation in Europe can meet this standard; the analysis does not assume a trainset that meets the USEPA standard. In this project section the maximum HSR speeds would be 220 mph.

Locomotive Horn Rule (49 C.F.R. Part 222 & Part 229)

FRA regulations require that engineers sound their locomotive horns while approaching public grade crossings until the lead locomotive fully occupies the crossing. In general, the regulations require locomotive engineers to begin to sound the train horn for a minimum of 15 seconds, and a maximum of 20 seconds, in advance of public grade crossings. Engineers must also sound the train horn in a standardized pattern of two long, one short and one long blast and the horn must continue to sound until the lead locomotive or train car occupies the grade crossing. Additionally, the minimum sound level for the locomotive horn is 96 dB(A), while the maximum sound level is 110 dB(A), both measured at 100 feet forward of the locomotive.FRA allows public authorities to establish a quiet zone, which is segment of a rail line, within which is situated one or a number of consecutive public road-rail crossings at which locomotive horns are not routinely sounded, provided sufficient safety measures are implemented at the crossing to prevent/minimize the potential for accidents to occur. Railroad authorities, including Caltrain, CHSRA and railroad companies (such as UPRR) cannot establish quiet zones; only local cities and counties can establish them by applying to the FRA.

At a minimum, new quiet zones must be at least one-half mile in length and contain at least one public grade crossing (i.e., a location where a public highway, road, or street crosses one or more railroad tracks at grade). Every public grade crossing in a quiet zone must be equipped at a minimum with active grade crossing warning devices consisting of flashing lights and gates.

If a public authority wants to establish a new quiet zone, it must conduct an assessment of hazards related to the crossings in the proposed zone and implement sufficient safety measures to reduce the proposed quiet zone's risk level to an acceptable level. Improvements may include: Roadway medians or channelization devices to discourage motorists from driving around a lowered crossing gate; a four-quadrant gate system to block all lanes of highway traffic; converting a two-way street into a one-way street and installing crossing gates, and permanent or temporary (nighttime) closure of the crossing to highway traffic. As an alternative, communities may also choose to silence routine locomotive horn sounding through the installation of wayside horns at public grade crossings. Wayside horns are train-activated stationary acoustic devices at grade crossings that are directed at highway traffic as a one-for-one substitute for train horns.

As described in Chapter 2, Alternatives, the project includes the following improvements in all blended service segments with at-grade crossings: fencing of the right of way; four-quadrant gates and roadway channelization at at-grade crossings, and intrusion detection and monitoring systems The installation of these features would assist local cities and counties to establish quiet zones should they decide to do so but cities or counties would need to go through the quiet zone process with the FRA first to establish such zones.

Federal Transit Administration Guidelines

The Federal Transit Administration (FTA) provides guidance regarding the evaluation of noise and vibration impacts associated with construction and operations of non-high-speed trains in *Transit Noise and Vibration Impact Assessment Manual* (FTA guidance manual) (FTA 2018). The manual includes prediction methods, assessment procedures, and impact criteria for noise and vibration. Although it was originally developed for use on public mass transit projects, the FTA guidance manual includes a method that is applicable to HSR station activities, yard and maintenance facility activities, and conventional-speed rail operations. The FTA construction noise and vibration assessment method is consistent with the FRA method. Section 3.4.4.3, Methods for Impact Analysis, discusses the noise and vibration impact criteria.

Federal Highway Administration Procedures for Abatement of Highway Traffic Noise and Construction Noise (23 C.F.R. Part 772)

The Federal Highway Administration (FHWA) stipulates procedures and criteria for noise assessment studies of highway projects (23 C.F.R. Part 772). It requires that noise abatement measures be considered on all major highway projects if the project will cause a substantial increase in traffic noise levels or if projected traffic noise levels approach or exceed the noise abatement criteria level for activities occurring on adjacent lands. These noise criteria are assigned to exterior and interior activities.

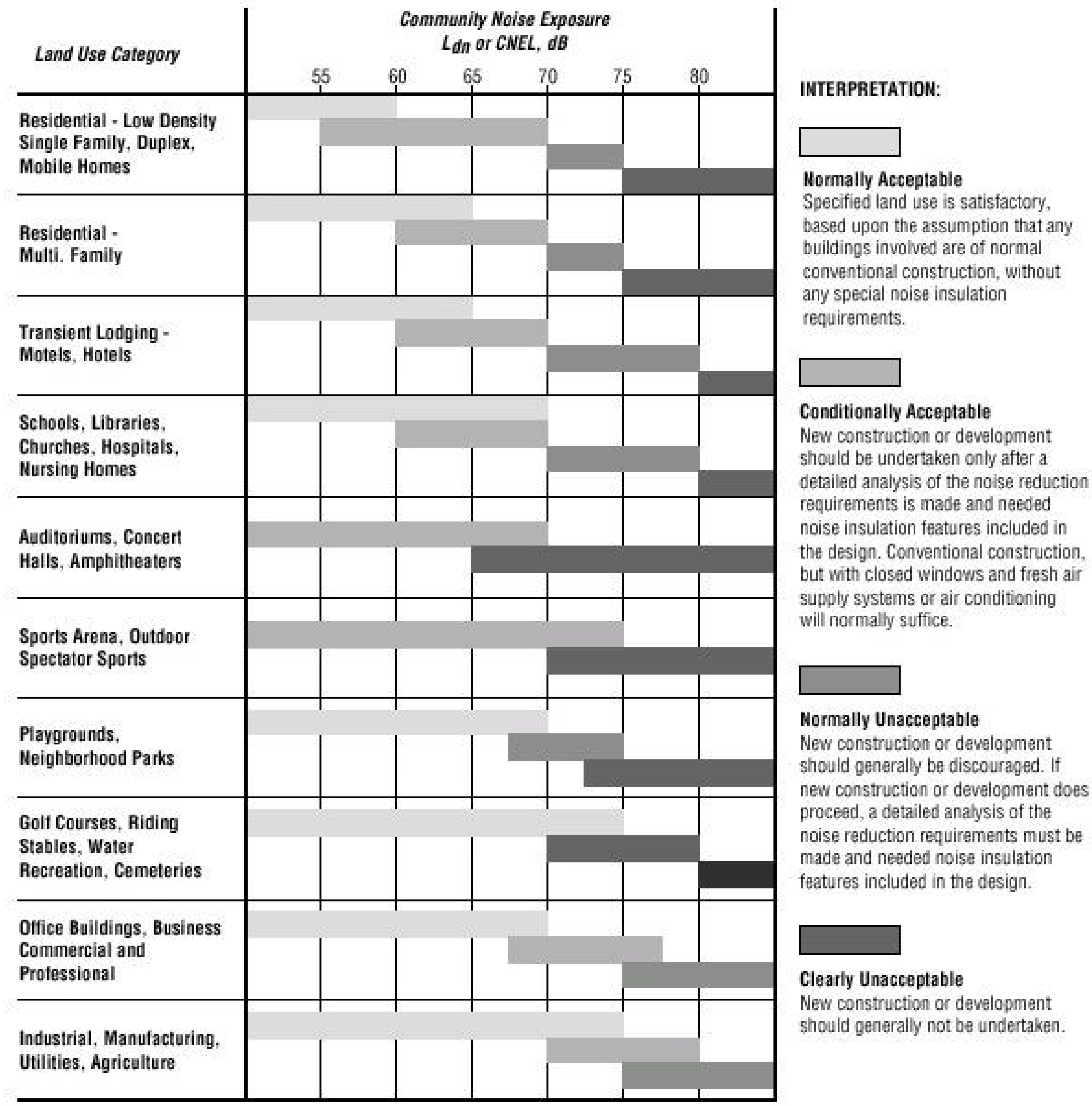
If motor vehicle traffic noise from federally funded projects is predicted to approach or exceed the noise abatement criteria during the noisiest 1-hour period, noise abatement measures must be considered, and, if determined to be reasonable and feasible, they must be incorporated as part of the project. Consistent with FHWA guidelines, the California Department of Transportation (Caltrans) defines “approach” as being within 1 dBA of the noise abatement criteria. Caltrans criteria also consider that a 12 dB increase in the noisiest 1-hour period is a significant increase as defined by the FHWA procedures.

3.4.2.2 State

General Plan Guidelines (Cal. Gov. Code § 65302(f)), Appendix C, Noise Element Guidelines

The noise element of a community’s general plan provides a basis for a comprehensive local program to control and abate environmental noise and to protect citizens from excessive exposure. The California Governor’s Office of Planning and Research (OPR) *General Plan Guidelines 2017* (OPR 2017) outlines the development of the noise element for local agencies.

Figure 3.4-3 (OPR 2017) is often adopted by city and county agencies for land use planning purposes for acoustical compatibility based on existing ambient noise levels in the community. For example, commercial land uses are considered appropriate where existing noise levels might be considered too high for residential development.



Source: OPR 2017

Figure 3.4-3 State of California Land Use Compatibility Guidelines

California Department of Transportation Traffic Noise Analysis Protocol

The Caltrans *Traffic Noise Analysis Protocol* (Caltrans 2011) establishes guidelines for evaluating traffic noise impacts along highways where frequent outdoor use areas are located and for determining reasonable and feasible noise abatement measures. These criteria are relevant to the extent that the project could result in reconstruction or reconfiguration of an existing highway or traffic lanes, or could affect traffic patterns. Under FHWA and Caltrans policies, noise abatement should be considered for transportation improvement projects when various traffic noise abatement criteria are exceeded.

California Noise Control Act (Cal. Health and Safety Code § 46010 et seq.)

The relevant legacy of the California Noise Control Act of 1973 (California [Cal.] Health and Safety Code, Division 28, Noise Control Act, § 46000 et seq.) was the development of the required content of the Noise Element of General Plans. This legislation provides guidance to local governments for preparing the required noise elements in city and county general plans, pursuant to California Government Code, Section 65302(f).

3.4.2.3 Regional and Local

Counties and cities in California prepare general plans with noise policies and ordinances according to guidelines outlined in the discussion of state regulations. In preparing the noise element, a city or county must identify local noise sources, and analyze and quantify, to the extent practicable, current and projected noise levels for various sources. These noise sources may include highways and freeways; passenger and freight railroad operations; ground rapid transit systems; commercial, general, and military aviation and airport operation; and other ground stationary noise sources, which would include HSR alignments. Noise-level contours must be mapped for these sources using the community noise equivalent level (CNEL) or the L_{dn}, and are to be used as a guide in land use decisions to minimize the exposure of community residents to excessive noise. General plans may but usually do not address ground-borne vibration.

Volume 2, Appendix 2-J, lists the regional and local policies applicable to the project. The HSR system is not subject to local general plan policies and ordinances related to noise limits or to locally based criteria concerning noise and vibration for the project alternatives.

3.4.3 Consistency with Plans and Laws

As indicated in Section 3.1.5.3, Consistency with Plans and Laws, the California Environmental Quality Act (CEQA) and Council on Environmental Quality (CEQ) regulations require a discussion of inconsistencies or conflicts between a proposed undertaking and federal, state, regional, or local plans and laws. As such, this Draft EIR/EIS describes inconsistency of the project with federal, state, regional, and local plans and laws to provide planning context.

A number of federal and state laws and implementing regulations, listed in Section 3.4.2.1, Federal, and Section 3.4.2.2, State, govern compliance with noise emission limits for construction projects and for transportation facilities. As noise and vibration assessment is highly technical, there are several published federal and state guidance documents detailing how to assess potential impacts. Consistent with the guidance, a summary of the federal and state requirements considered in this analysis follows:

- FHWA and FRA guidelines for emissions of noise from transportation sources and for the abatement of excessive noise emissions.
- OSHA regulations that provide permissible construction worker noise exposure limits.
- FTA guidelines regarding modeling noise impacts from station activities, yard and maintenance facility activities, and conventional-speed rail operations.
- The Caltrans *Traffic Noise Analysis Protocol* (Caltrans 2011), which provides a methodology for evaluating noise from roadway operations and for evaluating the effectiveness and feasibility of different sound abatement methods for operations of highway-related projects.
- FRA guidelines regarding modeling and mitigating noise and vibration from construction sources at sensitive receptors close to construction. Since FRA provides guidance for analysis, the construction analysis methods discussed in the FHWA and FTA guidelines and the Caltrans protocol were not used; however, some construction equipment reference sound levels from FHWA were used.

The Authority, as the lead agency proposing to build and operate the HSR system, is required to comply with all federal and state laws and regulations and to secure all applicable federal and state permits prior to initiating construction on the selected alternative. Therefore, there would be no inconsistencies among the project alternatives and these federal and state laws and regulations.

The Authority is a state agency and, therefore, is not required to comply with local land use and zoning regulations; however, it has endeavored to design and build the HSR system to be consistent with land use and zoning regulations. For example, the project alternatives incorporate IAMFs that would require the contractor to prepare a plan to demonstrate how construction noise levels would be maintained below applicable standards. The Authority has also adopted statewide policies that seek to reduce noise impacts associated with new sources of transportation noise (Volume 2, Appendix 3.4-B).

CEQA and CEQ regulations require the discussion of inconsistencies or conflicts between a proposed undertaking and regional or local plans and laws. Analysts reviewed 18 local plans and ordinances and 89 policies, guidelines, or goals, and determined the project alternatives would be consistent with all plans, policies, and ordinances reviewed with the exceptions noted below. Local limits are generally not placed on noise and vibration from transportation corridors; however, in some local codes there are noise limits imposed on construction noise and stationary facilities that are consistent with the applicable evaluation thresholds used in this analysis. Local land use planning guidance generally aims to develop noise-sensitive uses away from noise-intensive sources; the project evaluation thresholds also address impacts at noise-sensitive land uses.

A brief description of these inconsistencies follows:

- **Operational noise exceedances**—Although mitigation measures would reduce the project's operational noise impacts, noise impacts would not be reduced to the standards for residential, commercial, and institutional land uses established by the following general plan policies: *Envision: San José 2040 General Plan* (City of San Jose 2018), Land Use Compatibility Guidelines for Community Noise in San Jose, Table 4.
- **Codes of ordinances or zoning regulations from the City of San Jose**—Project construction would occur within a constrained operating rail corridor, and as such some trackwork and roadway work would be done at night to avoid disruption to Caltrain commuter rail operations and roadway operations. Even with the project features and mitigation measures, there would be locations where it is not technically feasible to meet the noise limits and permitted construction hours established by these local jurisdictions.

3.4.4 Methods for Evaluating Impacts

The evaluation of impacts from noise and vibration is a requirement of the National Environmental Policy Act (NEPA) and CEQA. The following sections summarize the RSAs and the methods used to analyze noise and vibration. As summarized in Section 3.4.1, Introduction, other resource sections in this Draft EIR/EIS also provide additional information related to noise and vibration.

3.4.4.1 Definition of Resource Study Area

RSAs are the geographic boundaries in which the environmental investigations specific to each resource topic were conducted. The RSAs for impacts from noise and vibration encompass the areas directly or indirectly affected by project construction and operations. Table 3.4-1 shows the separate RSAs defined for noise and vibration.

Table 3.4-1 Definition of Noise and Vibration Resource Study Areas

Type	Boundary Definition
Noise	
Construction and operations	The noise RSA extends approximately 2,500 feet from the project alternatives' centerlines and includes all sensitive receptors potentially exposed to noise impacts.
Vibration	
Construction and operations	The vibration RSA extends 275 feet from the project alternatives' centerlines and includes all sensitive receptors potentially exposed to vibration impacts.

RSA = resource study area

The noise RSA extends approximately 2,500 feet from the project alternatives' centerlines and includes all sensitive receptors potentially exposed to noise impacts. This noise RSA is larger than the maximum FRA-recommended screening distances for HSR trains shown in Table 3.4-2. The maximum FRA-recommended screening distance for a new HSR corridor is 1,300 feet in quiet suburban/rural environments with trains operational speeds greater than 170 mph; however, this assumes that there would be 50 train operations per day. Consistent with FRA methods, analysts extended the noise RSA for the project beyond the maximum FRA-recommended screening distances to reflect the frequency of train operations, which would exceed 200 trains per day based on the Authority's *Connecting and Transforming California, 2016 Business Plan* (2016 Business Plan) (Authority 2016) and its *Connecting California, Expanding Economy, Transforming Travel, 2018 Business Plan (Final)* (2018 Business Plan) (Authority 2018).

Table 3.4-2 Federal Railroad Administration Recommended Screening Distances for Evaluation of High-Speed Rail Noise Impacts[1]

Corridor Type	Existing Noise Environment	Screening Distance for Project Type and Speed Regime (feet from centerline)[2]	
		90 to 170 miles per hour	> 170 miles per hour
Railroad	Urban/noisy suburban—unobstructed	300	700
	Urban/noisy suburban—intervening buildings[3]	200	300
	Quiet suburban/rural	500	1,200
Highway	Urban/noisy suburban—unobstructed	250	600
	Urban/noisy suburban—intervening buildings[3]	200	350
	Quiet suburban/rural	400	1,100
New Rail	Urban/noisy suburban—unobstructed	350	700
	Urban/noisy suburban—intervening buildings[3]	250	350
	Quiet suburban/rural	600	1,300[4]

Source: FRA 2012

[1] Noise screening distances for Regime II (mechanical noise resulting from wheel/rail interactions and guideway vibrations) and Regime III (aerodynamic noise resulting from airflow moving past the train).

[2] Measured from centerline of guideway or rail corridor. Minimum distance is assumed 50 feet.

[3] Rows of buildings are assumed to be at 200 feet, 400 feet, 600 feet, 800 feet, and 1,000 feet parallel to the guideway.

[4] Distance was extended to 2,500 feet for analysis of the project. See discussion in text.

The project's vibration RSA extends 275 feet from the project alternatives' centerlines. This distance is consistent with FRA screening procedures and was established to identify where vibration impacts from HSR might occur. Table 3.4-3 shows the FRA-recommended screening distances for vibration assessments of various land uses. To include all potentially affected areas along the project, analysts used the highest speed and frequent event categories to establish screening distances. Typically, noise-sensitive land uses are also vibration-sensitive; hence, the analyses are closely linked and where the noise and vibration RSAs overlap, the same locations were assessed for impacts from both noise and vibration.

Table 3.4-3 Federal Railroad Administration Recommended Screening Distances for Vibration Assessments

Land Use	Train Frequency[1]	Screening Distance (feet from centerline) Train Speed	
		100 to 200 miles per hour	200 to 300 miles per hour
Residential	Frequent	220	275
	Infrequent	100	140
Institutional	Frequent	160	220
	Infrequent	70	100

Source: FRA 2012

[1] Frequent = more than 70 passbys per day; Infrequent = fewer than 70 passbys per day

The same RSAs apply to direct and indirect impacts. Direct impacts consist of increases in noise and vibration as a result of project construction or operations, while indirect impacts for noise include the project's impact on traffic patterns, which indirectly affect noise levels.

3.4.4.2 Impact Avoidance and Minimization Features

IAMFs are project features that are considered to be part of the project. They are included as applicable in each of the project alternatives for purposes of the environmental impact analysis. Appendix 2-E provides the full text of the IAMFs that are applicable to the project. NV-IAMF#1: Noise and Vibration, is applicable to the construction-phase noise and vibration analysis. This environmental impact analysis considers this IAMF as part of the project design. Within Section 3.4.6, Environmental Consequences, each impact narrative describes how this project feature is applicable and, where appropriate, effective at avoiding or minimizing potential impacts to less than significant under CEQA.

3.4.4.3 Methods for Impact Analysis

This section describes the sources and methods the Authority used to analyze potential project impacts from noise and vibration. These methods apply to both NEPA and CEQA analyses unless otherwise indicated. Section 3.1.5.4 describes the general framework for evaluating impacts under NEPA and CEQA.

This section describes the approach to establishing the existing noise and vibration conditions, identifies applicable criteria used for HSR construction and operations noise and vibration thresholds, and summarizes the process for predicting construction and operations noise and vibration levels. The noise and vibration predictions for the project alternatives were based on the "Detailed Analysis" method described in the FRA guidance manual (FRA 2012) and, where applicable, the FTA guidance manual (FTA 2018), for station activities, yard and maintenance facility activities, and conventional-speed rail operations. Operational parameters that affect the noise and vibration analyses are summarized later in this section.

Analysts evaluated the following scenarios:

- **Existing conditions**—Reflects current noise and vibration conditions based on noise measurements and calibrated noise modeling of typical community activity.
- **Construction conditions**—Reflects noise and vibration impacts expected from project construction.

- **2029 No Project conditions**—Reflects future noise and vibration conditions in 2029 for all study locations, including reasonably foreseeable land use changes and transportation network modifications.
- **2029 Plus Project conditions**—Evaluates the potential impacts of project operations in 2029 for all study locations. This scenario reflects all modifications necessary to build the project along with HSR service and ridership at stations.
- **2040 No Project conditions**—Reflects future noise and vibration conditions in 2040 for all study locations, including reasonably foreseeable land use changes and transportation network modifications.
- **2040 Plus Project conditions**—Evaluates the full potential impacts of the project in 2040 for all study locations. This analysis scenario reflects all modifications necessary to build and operate the project.

2029 Versus 2040 Analysis

- 2029 analysis—Evaluates noise and vibration impacts for 2029 for all locations.
- 2040 analysis—Evaluates noise and vibration impacts for 2040. This analysis provides a conservative analysis along the length of the Project Section. Where significant impacts are identified, feasible mitigation is considered for those conditions. The mitigation would be implemented in 2029 to anticipate later significant noise and vibration impacts.

Noise impact assessments are all conducted by comparing future conditions to existing conditions. The results reported for No Project conditions are provided for informational purposes only.

Noise

Existing Noise

Analysts established existing noise levels in the noise RSA by taking extensive field noise measurements during programs conducted in 2009, 2010, 2013, 2016, and 2017. A total of 65 measurements of ambient noise were taken in the noise RSA. Long-term noise measurements (1 to 3 days in duration) were used to characterize the existing ambient noise in the RSA. Analysts obtained the maximum sound level (L_{max}), minimum sound level (L_{min}), and L_{eq} for each hour, and used the L_{eq} to calculate the L_{dn}.

Noise Level Terminology

- L_{max} is the maximum sound level
- L_{min} is the minimum sound level
- L_{eq} is the equivalent, energy-averaged RMS noise exposure over a given period (often for 1 or more hours)
- L_{dn} is the total noise exposure over a 24-hour period (day-night sound level) with a penalty added for sounds generated between 10 p.m. and 7 a.m.

The analysts selected locations for noise measurements throughout the RSA based on the environmental conditions expected in different areas of the communities along the alignment, the type of receptors potentially affected, the proximity of the receptors to a major arterial road or freeway, and the distance of the receptors (primarily residences) to the existing Caltrain tracks. Most of the selected measurement sites between San Jose and Gilroy are representative of receptors that are directly exposed to existing noise from Caltrain and other passenger and freight trains. In Pacheco Pass and the San Joaquin Valley, most of the selected measurement sites are representative of receptors that are directly exposed to existing noise from roadways. To categorize the dominant existing noise sources in the RSA, analysts located some measurement sites adjacent to roadways along the alignment, some sites near existing rail sources, some sites near existing roadway sources, and some sites near both existing rail and roadway sources.

Analysts used the field noise measurement data to validate an existing noise spreadsheet model based on the FTA guidance manual (FTA 2018) methodology. This validated model, which incorporates existing train operations, horn, and traffic noise, was then used to calculate existing ambient noise levels at all receptors. Volume 2, Appendix 3.4-A, provides additional information on this modeling approach.

Impact Criteria

Construction

The FRA guidance manual (FRA 2012) includes construction noise assessment criteria as shown in Table 3.4-4. Analysts used an 8-hour L_{eq} and a 30-day average noise exposure L_{dn} to assess impacts, a 30-day average L_{dn} to assess impacts in residential areas, and a 30-day average 24-hour L_{eq} to assess impacts in commercial and industrial areas. The noise emission levels of the construction equipment, utilization factor, hours of operation, and location of equipment are used to calculate 8-hour and 30-day average noise exposures. FRA assessment criteria are used throughout the RSA.

Table 3.4-4 Federal Railroad Administration Detailed Assessment Criteria for Construction Noise

Land Use	8-Hour L_{eq} (dBA)		L_{dn} / L_{eq} (dBA) 30-Day Average
	Day	Night	
Residential	80	70	75
Commercial	85	85	80[1]
Industrial	90	90	85[1]

Source: FRA 2012
[1] 24-hour L_{eq}, not L_{dn}
L_{eq} = equivalent sound level
L_{dn} = day-night sound level
dBA = A-weighted decibel

Operations

For the HSR system, analysts used noise impact criteria adopted by FRA (FRA 2012) to assess the contribution of noise from project construction and operations to the existing environment, along with noise impact criteria adopted by FTA (FTA 2018) to assess the contribution of noise from conventional-speed rail operations and stationary facilities. These guidelines establish methods for analyzing and assessing noise and vibration impacts. The FRA noise impact criteria are based on maintaining a noise environment considered acceptable for land uses where noise may have an impact. Land use also factors into the determination of impact; while impacts on industrial uses are not considered, places where people sleep or where quiet is an integral component of the land use require evaluation to determine if noise impact would occur and if mitigation is appropriate. Table 3.4-5 shows the three land use categories used by the FRA.

FRA noise impact criteria for human annoyance are based on the comparison of existing outdoor noise levels and future outdoor noise levels from the project. The FRA noise impact criteria specify a comparison of future with existing noise levels, because comparison of a projection with an existing condition is more reflective of an impact than a comparison of two projections. Noise-level increases are categorized as no impact, moderate impact, or severe impact. Moderate and severe impacts are defined as follows:

- **Moderate impact**—In this range of noise impact, the change in noise level is noticeable to most people, but may not be sufficient to cause strong, adverse reactions from the community. Project-specific factors would be considered to determine the magnitude of impact and the need for mitigation, including the number of affected noise-sensitive sites, the existing level of noise exposure, and the costs associated with mitigation.
- **Severe impact**—Project-generated noise in the severe impact range can be expected to cause a substantial percentage of people to be highly annoyed by the new noise levels. It is FRA policy to implement noise mitigation for sensitive receptors experiencing severe impacts unless there are truly extenuating circumstances that prevent implementation.

Table 3.4-5 Federal Railroad Administration Land Use Categories for Noise Exposure

Land Use Category	Noise Metric (dBA)	Land Use Category[1, 2]
1	Outdoor $L_{eq}(h)$[3]	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as national historic landmarks with significant outdoor use. Also included are recording studios and concert halls.
2	Outdoor L_{dn}	Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor $L_{eq}(h)$[1]	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches, where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, and museums can be considered to be in this category. Certain historical sites, parks, campgrounds, and recreational facilities are also included.

Source: FRA 2012

[1] Parks are only considered to be noise sensitive if the park is used in a manner that is noise sensitive; active outdoor land uses, for example, such as pedestrian and bike paths, are not considered noise sensitive.

[2] Historic sites and properties protected under Section 4(f) of the U.S. Department of Transportation Act and Section 106 of the National Historic Preservation Act are not intrinsically noise-sensitive; inclusion in noise-sensitive land use categories is dependent upon land use activities (e.g., if outdoor interpretation is a critical component of a historic site, then the site would be included in Category 1).

[3] L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity.

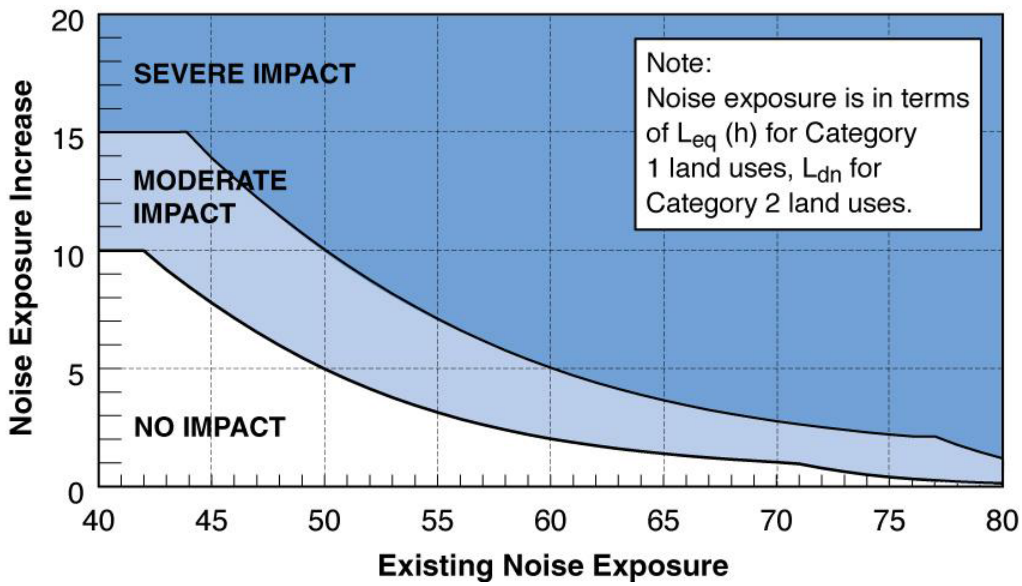
dBA = A-weighted decibel

L_{dn} = day-night sound level

$L_{eq(h)}$ = hourly equivalent sound level

The FRA criteria are presented in terms of relative levels for evaluating the total future noise exposure increases, or increases in cumulative noise exposure, from the project alternatives. If the existing noise were dominated by a source that changed because of the project, it would be incorrect to add the project noise to the existing noise. Therefore, the relative form of the noise criteria must be used for projects involving proposed changes to an existing rail transit system, such as a shift in the location or profile of existing passenger or freight tracks or a change in the vehicle technology. Figure 3.4-4 illustrates the relative form of the criteria as they apply to Category 1 and 2 land uses and Figure 3.4-5 illustrates the criteria as they apply to Category 3 land uses. These criteria are based on the increase of the existing ambient noise level associated with project operations and can be used to evaluate the project in combination with other new planned projects (i.e., cumulative impact). These criteria are applied to the outside of building locations at noise-sensitive areas.

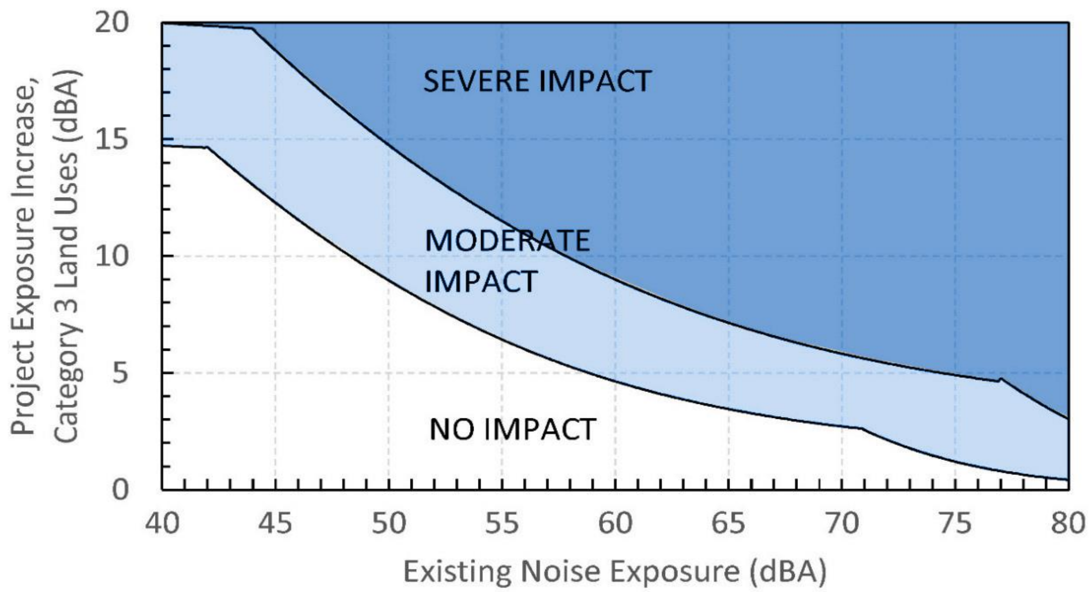
To determine the severity of a noise impact, analysts determine the land use category (Table 3.4-5), apply the appropriate noise metric (L_{dn} or L_{eq}), determine the existing exterior noise exposure for each receptor or group of similar receptors, and then determine project noise exposure or the cumulative noise exposure associated with the project alternatives and other projects using the data illustrated on Figure 3.4-4 and Figure 3.4-5.



Source: FRA 2012

FEBRUARY 2019

Figure 3.4-4 Allowable Increase in Cumulative Noise Levels (Land Use Categories 1 and 2)



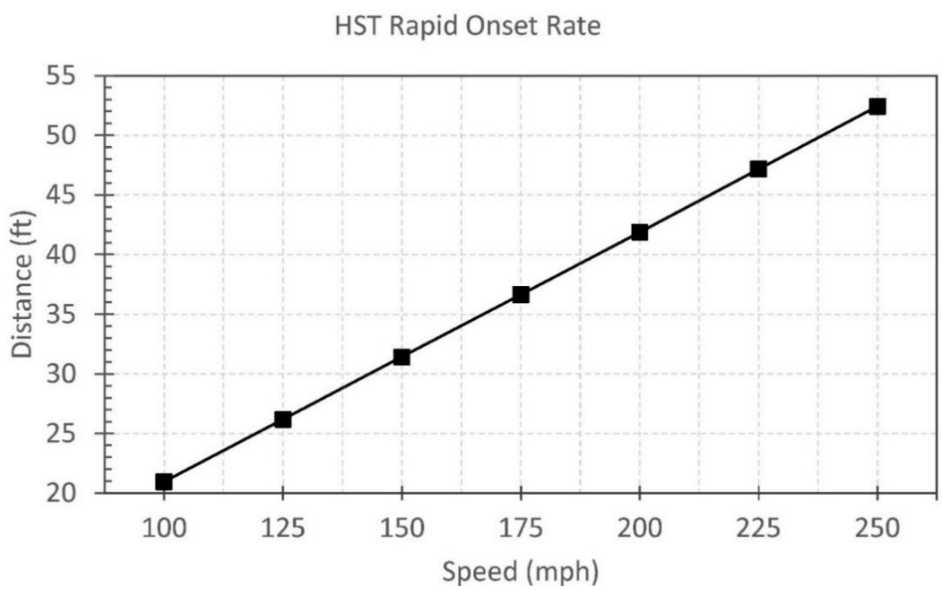
Source: FRA 2012

FEBRUARY 2019

Figure 3.4-5 Allowable Increase in Cumulative Noise Levels (Land Use Category 3)

Consider a hypothetical residential property (Category 2) that has an existing noise exposure of L_{dn} 60 dBA. The noise exposure resulting from the project plus regional growth and other planned projects could result in a project noise level exposure of L_{dn} 65 dBA. Combining the project noise with the existing noise level[1] would result in a total combined noise exposure of L_{dn} 66 dBA or a potential increase of 6 dBA over the existing noise level. Volume 2, Appendix 3.4-A, provides further details. Using Figure 3.4-4, one would start with the horizontal axis at 60 dBA for the existing condition to draw a vertical line, and then draw a horizontal line from 6 dBA on the left-hand axis. The intersection of these two lines determines the severity of impact. In this hypothetical example, the intersection of these two lines would fall in the severe impact range.

An additional environmental concern for project operations is the rapid rise in sound level that can occur for trains traveling at very high speeds. Under certain conditions, a rapid rise of sound level can result in a startle effect, particularly for a receptor near the tracks. The rate at which train sound levels increase is referred to as the *onset rate* and is a function of train speed and distance from the tracks. Research has found that a sudden increase in sound (i.e., a rapid onset rate) can result in greater annoyance than sounds of similar levels that vary less rapidly or are steady. When onset rates exceed about 30 dB/second, people tend to be startled or surprised by the sudden onset of the sound. Figure 3.4-6 illustrates the potential for startle as a function of train speed and distance from the train.



Source: FRA 2012

FEBRUARY 2019

Figure 3.4-6 Distance from Tracks within which Startle Can Occur for HSR

The FRA guidance manual (FRA 2012) states that the understanding of startle effects to date is partially based on using U.S. Air Force research for sudden onset of noise from aircraft. The guidance describes a number of unresolved issues regarding application of the U.S. Air Force research to determine the startle effects of high-speed rail, such as the scheduled nature, lower sound levels, and lower onset rates of train passbys compared to military aircraft flights. The FRA guidance further states that without better definition of the application of results of noise from aircraft overflights to noise from high-speed rail passbys, it is appropriate to consider startle effects as “additional information” included in high-speed rail impact assessments as opposed to being included in the calculation of noise exposure itself. The FRA guidance does not provide a

---

[1] Decibels are added logarithmically; 10 times the logarithm of 2 is 3 dB, so that 60+60 = 63 dB. Adding a smaller number to a larger number raises the latter by no more than 3 dB. Thus, 60+65 = 66 in decibels

threshold in the form of an "onset rate that could be considered significant enough to cause startle on a regular basis." Thus, the 30 dB/second onset rate described above is considered indicative of when startle can occur, but is not considered a significance threshold for determining when startle would occur on a regular basis.

The FRA guidance manual (FRA 2012) also addresses potential impacts on livestock animals (cattle, other livestock, and poultry). The land use along the project corridor changes from urban and suburban to rural farmland, including some areas with domestic and wild animals. Table 3.4-6 shows noise exposure limits for screening.

Table 3.4-6 Interim Criteria for High-Speed Rail Train Noise Impacts on Livestock

Animal Category	Class	Noise Metric	Noise Level (dBA)
Livestock	Mammals (livestock)	SEL	100
	Birds (poultry)	SEL	100

Source: FRA 2012
dBA = A-weighted decibel
SEL = Sound Exposure Level

Prediction Methods

Construction Noise

Analysts assessed construction noise impacts according to the method described in the FRA guidance manual (FRA 2012). Construction noise estimates are always approximate because of the lack of specific information available at the time of the environmental analysis. The contractor would make decisions about the procedures and equipment to be used. Project designers try to minimize constraints on how construction would be performed and which equipment would be used to facilitate cost-effective construction. Nevertheless, estimated construction scenarios for typical railroad construction projects allow a quantitative construction noise assessment by comparing the predicted noise levels with impact criteria appropriate for the construction stage. The methods include the following data:

- Noise emissions from equipment expected to be used by contractors during typical construction activity types
- Usage scenarios for how the equipment would be operated
- Estimated site layouts of equipment along the right-of-way
- Relationship of the construction operations to nearby noise-sensitive receptors

Project construction would also necessitate Pacific Gas and Electric (PG&E) network upgrades. The construction noise impact assessment for these upgrades follows the same methods as the typical construction noise activities. Analysts identified construction scenarios specific to the PG&E upgrades along with equipment expected to be used by contractors. It is anticipated that helicopters would be used for the PG&E upgrades; therefore, the analysis specifically accounts for the noise from helicopter movements and hovering over construction sites.

Operations Noise

The method to assess operations noise impacts is consistent with the detailed analysis approach established in the FRA guidance manual (FRA 2012). For noise from stations, yard and maintenance facilities, and noise from conventional railroad noise sources, the noise analysis is consistent with the methods outlined in the FTA guidance manual (FTA 2018). This section describes the methods for assessing potential noise impacts from train operations under the No Project Alternative and project alternatives in 2029 and 2040; horn noise; impacts associated with the rapid onset of passing HSR trains; and noise impacts of stations, maintenance facilities, and vehicular traffic. These analyses take into account the existing noise conditions, which include airport, highway, railroad, and industrial sources.

Train horn noise is an important feature of the project in areas that would not be fully grade separated, particularly between Scott Boulevard and south of downtown Gilroy where existing train operations sound warning horns approaching at-grade crossings and Caltrain passenger stations, and with Alternative 4, which includes blended HSR service with Caltrain service. Existing Caltrain locomotives feature horns at 16 feet above top of rail (ATOR) that produce a maximum sound level of 96 dBA at 100 feet from the track. Future Caltrain EMUs will feature horns mounted at 3 feet ATOR with a maximum sound level of 96 dBA at 100 feet from the track. Freight trains feature horns at 16 feet ATOR with a maximum sound level of 107 dBA at 100 feet from the track. Future HSR trains would feature horns mounted at 7 feet ATOR with a maximum sound level of 96 dBA at 100 feet from the track. Volume 2, Appendix 3.4-A, contains additional information about train horns.

The analysis of project operations in 2029 and 2040 assumes HSR service for Phase 1, which would connect San Francisco with Los Angeles via the Central Valley. Train service would include revenue service trains and nonrevenue services trains with daily trips to and from the proposed maintenance of way facility (MOWF) near Gilroy. Table 3.4-7 shows the number of daily HSR trains for various portions of the project extent. The number of daily trains would be the same under all four project alternatives. Volume 2, Appendix 3.4-A, provides a detailed discussion of assumptions used for vehicle technology, train lengths, track configurations, and design speeds.

Table 3.4-7 Assumed 2029 and 2040 Project Operations for Noise Impact Assessment

Segment	Total Number of HSR Trains (Both Directions) - 2029			Total Number of HSR Trains (Both Directions) - 2040		
	Daytime[1]	Nighttime[2]	Peak Hour (Approximate)	Daytime[1]	Nighttime[2]	Peak Hour (Approximate)
Scott Boulevard to San Jose Diridon Station	40	8	4	108	26	8
San Jose Diridon Station to Gilroy Station	40	8	4	148	28	14
Gilroy Station to Gilroy MOWF	40	8	4	148	28	14
Gilroy MOWF to San Joaquin Valley	40	8	4	148	28	14

LMF = light maintenance facility
MOWF = maintenance of way facility
[1] Daytime is defined as the period between 7:00 a.m. and 10:00 p.m.
[2] Nighttime is defined as the period between 10:00 p.m. and 7:00 a.m.

Analysts developed noise predictions based on the noise source reference levels for the specific vehicle technology proposed for the HSR system provided in the FRA guidance manual (FRA 2012) for a very high-speed EMU train. The noise source reference levels for very high-speed EMU trains are included in Table 4-6 of Volume 2, Appendix 3.4-A, Noise and Vibration Technical Report and in Table 5-2 of the FRA guidance manual (FRA 2012). Noise predictions accounted for the proposed operations schedule, ground propagation attenuation impacts, cross-sectional geometry of the trackway and superstructure (e.g., elevated guideway), and shielding provided by existing noise barriers and intervening rows of buildings. Analysts adjusted predicted noise levels to account for increases in localized noise because of special trackwork, such as crossovers or turnouts, or from insulated joints. Standard frogs (rail hardware where tracks cross one another) in crossovers and turnouts typically cause a localized increase in noise from train operations. Alternatives 1, 2, and 3 would use special trackwork, such as movable-point frogs, to avoid significant gaps in the rail running surface. Any insulated joints would be low-impact joints. Therefore, any increases in localized noise because of special trackwork with Alternatives 1, 2, and 3 would likely be small and would not change overall impacts on sensitive receptors. Alternative 4 would use the same type of special trackwork as currently exists in the corridor. All special trackwork frogs in the San Jose to Central Valley Wye Project Extent for Alternative 4 were assumed to be standard frogs.

The analysis of project operations in 2029 and 2040 also evaluates the planned changes in Caltrain train operations for blended service under Alternative 4 between San Jose and Gilroy based on methods described in the FTA guidance manual for conventional-speed railroads. PCEP will electrify the Caltrain Corridor between San Francisco and Tamien Station in San Jose, convert approximately 75 percent of diesel-locomotive hauled coaches to EMUs, and increase service to six trains per peak hour per direction (PCJPB 2015). These changes to Caltrain service would change the existing noise environment in the RSA from the Tamien Station north; therefore, the Caltrain PCEP is evaluated as part of the analysis of HSR project operations in 2029 and 2040. In addition, with Alternative 4, Caltrain operations between Tamien Station and Gilroy would change in several ways because of blended service. First, all Caltrain service between Tamien Station and Gilroy would be with EMUs instead of diesel-locomotive–hauled coaches. Second, Caltrain service would increase from three trains northward in the morning and three trains southward in the evening to six trains northward in the morning and six trains southward in the morning. This increase in service is due to the need to institute skip-stop service in order to facilitate efficient blended operations, while at the same time allowing for the same number of overall daily Caltrain service at the stations between Tamien Station and Gilroy.

Analysts also evaluated changes in horn noise associated with project operations. Construction of dedicated HSR infrastructure with Alternative 1 would eliminate one existing at-grade railway crossing at Bloomfield Avenue in Gilroy, eliminating horn noise at that location. Alternative 2 would be predominantly located on an embankment in or adjacent to the existing Caltrain/Union Pacific Railroad (UPRR) railway, which would eliminate 33 existing at-grade crossings where trains currently sound warning horns (Volume 2, Appendix 3.4-A, specifies these locations). Alternatives 3 and 4 would not eliminate any existing at-grade crossings, so trains would continue to sound warning horns as they approach at-grade crossings and passenger stations. Alternative 4, HSR trains would sound horns as they approach at-grade crossings and passenger stations. To assess changes in horn noise associated with the project alternatives, analysts used existing field noise measurements of passenger and freight trains and applied the horn noise model (FRA 2000) to receptors within 0.25 mile of locations where horns must be sounded. The analysts set the noise from the HSR train horn at the same level as the Caltrain horn where HSR would operate on Caltrain tracks (Alternative 4). Analysts also accounted for crossing bells near existing at-grade crossings in the noise measurement program, and modeled this based on the methods in the FTA guidance manual (FTA 2018).

In addition to predicting noise levels associated with train operations, analysts evaluated noise impacts associated with other noise sources including HSR passbys, station noise, maintenance facility noise, and vehicle traffic noise. A brief overview of the methods for each of these evaluations is as follows (Volume 2, Appendix 3.4-A, provides additional details):

- **Startle and annoyance from rapid onset of HSR passbys—**Analysts used an onset rate of 30 dBA per second and the FRA impact criteria illustrated on Figure 3.4-4 to establish distances from the track centerlines within which startle effects would likely be experienced. Analysts compared these distances from the outermost track centerline to the location of sensitive receptors beyond the access-restricted right-of-way to identify receptors that would experience startle and annoyance from the rapid onset of HSR passbys.
- **Station noise—**Analysts assessed the impacts of station noise associated with train movements and vehicular traffic on nearby noise-sensitive receptors according to methods summarized in Section 5.2 of the FRA guidance manual (HSR train operations) and Section 4.4 of the FTA guidance manual (parking facilities) (FRA 2012; FTA 2018). Noise levels associated with HSR train operations were modeled based on the train operating

schedules, equipment type, speed profile, and track configuration. Analysts used the station plan layouts and number of planned parking spaces to predict the noise exposure from the parking facilities at nearby noise-sensitive receptors. A reference SEL of 92 dBA at 50 feet distance corresponding to 1,000 cars in a peak activity hour (derived from the FTA guidance manual Section 4.4) was used to predict the additional noise from the parking lots at each of the HSR stations. Analysts tabulated the predicted noise levels from HSR trains at the stations and from the parking facilities along with the existing ambient noise exposures, and determined levels of impact (no impact, moderate impact, or severe impact) by comparing the existing and projected noise exposure to the impact criteria illustrated on Figure 3.4-3 and Figure 3.4-4.

- **Maintenance facility noise—**Analysts used the methods in Section 4.4 of the FTA guidance manual (FTA 2018) to predict noise exposure from the MOWF near Gilroy. A reference SEL of 118 dBA at 50 feet distance corresponding to 20 train movements in a peak-activity hour was used to predict noise from the facility. Analysts used the planned MOWF layouts and number of movements per day to calculate noise exposure at nearby noise-sensitive receptors. Analysts then combined the predicted noise levels from the MOWF with the project operations noise predictions and compared this to the impact criteria.
- **Vehicle traffic noise—**Analysts assessed changes in noise levels resulting from increased vehicle traffic volumes near the HSR stations and MOWF. Daily traffic volumes for roadway segments near the HSR stations and MOWFs for each project alternative were compared to existing traffic volumes. Consistent with FRA guidance (FRA 2012), traffic growth factors under the No Project Alternative and the project alternatives were calculated to assess noise levels. At locations where the growth factors for a project alternative resulted in a 3 dB or greater increase in noise (equivalent to a doubling of traffic volumes), analysts evaluated the increase in traffic volume that would be related to the project. Volume 2, Appendix 3.4-A, provides additional information regarding this analysis.
- **Traction power substation noise—**In addition to the noise generated by other project operations, noise would also be generated by electrical traction power facilities (substations, switching stations, and paralleling stations). Traction power substations (TPSS) would each encompass approximately 32,000 square feet (200 feet by 160 feet) at approximately 30-mile intervals, and include two 115/50 kilovolt or 230/50 kilovolt single-phase transformers at 60 megavolt amperes. The traction power switching stations would be required at approximately 15-mile intervals, midway between the TPSSs, would encompass approximately 14,400 square feet (160 by 90 feet), and would contain two (10 to 60 megavolt amperes) transformers. Traction power paralleling stations would be required at approximately 5-mile intervals between the traction power switching stations and the TPSSs, would encompass approximately 9,600 square feet (120 by 80 feet), and would contain one or two (10 to 60 megavolt amperes) transformers.

  FRA guidance does not have its own analysis techniques for traction power facilities because these facilities are not unique to HSR systems. Instead, they reference the FTA method. Thus, FTA reference levels were used to calculate the total project noise level at the receptors identified within the screening distance. The FTA reference SEL for substations is 99 dBA at 50 feet, which equates to an L_{dn} of 70 dBA at 50 feet (assuming continuous 24-hour usage).

Vibration

Existing Vibration

Analysts selected measurement sites to capture overall ground vibration as well as spectral components (frequency content of the ground vibration) of the train passbys, which are influenced by local soil conditions and input forces unique to different types of trains. Sites with a high potential for vibration impacts were prioritized, and because Caltrain train vibration is the dominant existing source of ground vibration in most of the project extent, the vibration survey focused on obtaining ground vibration measurements during Caltrain passbys at typical setback distances of the sensitive receptors from the nearest track. Analysts measured the existing vibration levels at 14 locations in the vibration RSA.

Results of the ambient vibration survey indicate existing overall vibration levels throughout the corridor varied based on the Caltrain speed and the degree of variability in soil vibration attenuation characteristics. Analysts used these factors in the selection of field vibration propagation testing locations for testing that was performed for the detailed vibration analysis.

Impact Criteria

Construction

The construction vibration assessment is based on the FRA guidance manual (FRA 2012), which covers potential impacts on buildings and potential annoyance to building occupants. Table 3.4-8 shows the FRA guidelines for vibration damage criteria from construction activity. These limits were used to identify areas that should be addressed during engineering design of the project.

Table 3.4-8 Federal Railroad Administration Construction Vibration Damage Criteria

Building Category	PPV (in/sec)	Approximate L_v[1]
I. Reinforced-concrete, steel or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Nonengineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90

Source: FRA 2012
[1] RMS VdB re: 1 microinch per second.
in/sec = inches per second
L_v = velocity level
PPV = peak particle velocity
RMS = root-mean-square
VdB = vibration decibel

To analyze temporary annoyances to building occupants during the nighttime period or interference with vibration-sensitive equipment inside special-use buildings during construction, FRA recommends using the long-term operations vibration criteria for a general assessment.

Operations

Vibration impact levels are determined by the type of land-uses affected, the number of daily vibration events, and the type of analysis being conducted (i.e., ground-borne vibration or ground-borne noise). FRA provides guidelines to assess the human response to different levels of ground-borne noise and vibration, as shown in Table 3.4-9. Ground-borne noise and vibration levels represent the vibration during a train passby (RMS vibration level of an event). The guidelines provide additional criteria for special-use buildings that are sensitive to ground-borne noise and vibration, as shown in Table 3.4-10. Analysts considered the number of daily train events (more than 70 trains per day indicates that HSR service would be considered a frequent event), and applied the criteria in Table 3.4-9 and Table 3.4-10 to occupied spaces in potentially affected buildings (i.e., receptors). Ground-borne vibration is assessed at the building façade; ground-borne noise is assessed inside buildings.

For most train operations, airborne noise is significantly louder than ground-borne noise, and ground-borne noise is not perceived separately from the airborne noise. Therefore, analysts evaluated airborne noise to assess at-grade or aerial portions of the alignment and ground-borne noise to assess portions of the alignment in tunnel.

Table 3.4-9 Ground-Borne Vibration and Ground-Borne Vibration Impact Criteria for General Assessment

Land Use Category	Ground-Borne Vibration Impact Levels (VdB re: 1 µin/sec)			Ground-Borne Vibration Impact Levels (dB re: 20 µPa)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category 1: Buildings where vibration would interfere with interior operations	65 VdB[4]	65 VdB[4]	65 VdB[4]	N/A[5]	N/A[5]	N/A[5]
Category 2: Residences and buildings where people normally sleep	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

Source: FRA 2012
[1] *Frequent Events* is defined as more than 70 vibration events of the same kind per day.
[2] *Occasional Events* is defined as between 30 and 70 vibration events of the same kind per day.
[3] *Infrequent Events* is defined as fewer than 30 vibration events of the same kind per day.
[4] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research would require detailed evaluation to define the acceptable vibration levels. Making sure vibration levels in a building are low often requires special design of the heating, ventilation, and air-conditioning systems and stiffened floors.
[5] Vibration-sensitive equipment is not sensitive to ground-borne noise.
µin/sec = microinch per second
µPa = micro-Pascal
dB = decibel
dBA = A-weighted decibel
N/A = not applicable
VdB = vibration decibels

Table 3.4-10 Ground-Borne Vibration and Ground-Borne Noise Impact Criteria for Special Use Buildings

Land Use Category	Ground-Borne Vibration Impact Levels (VdB re: 1 µin/sec)		Ground-Borne Noise Impact Levels (dB re: 20 µPa)	
	Frequent Events[1]	Infrequent Events[2]	Frequent Events[1]	Infrequent Events[2]
Concert halls	65 VdB	65 VdB	25 dBA	25 dBA
TV studios	65 VdB	65 VdB	25 dBA	25 dBA
Recording studios	65 VdB	65 VdB	25 dBA	25 dBA
Auditoriums	72 VdB	80 VdB	30 dBA	38 dBA
Theaters	72 VdB	80 VdB	35 dBA	43 dBA

Source: FRA 2012
[1] *Frequent Events* is defined as more than 70 vibration events per day.
[2] *Occasional or Infrequent Events* is defined as fewer than 70 vibration events per day.
VdB = vibration decibels
µin/sec = microinch per second
dB = decibel
µPa = micro-Pascal
dBA = A-weighted decibel

The analysts applied additional vibration criteria where the project would be located in the existing rail corridor from San Jose to Gilroy. When there are existing significant sources of vibration (e.g., trains) at locations affected by the project, existing vibration levels were factored into the assessment. FRA provides guidance on how to apply the vibration impact criteria based on the number of daily train operations and the degree to which existing railroad tracks would be relocated. Volume 2, Appendix 3.4-A, Noise and Vibration Technical Report, summarizes how vibration impact criteria are applied in existing rail corridors based on train frequency; each of these types of existing rail corridors is present in a portion of the project extent. Analysts separately compared the project's vibration levels to the criteria listed in Table 3.4-9 and Table 3.4-10. Appendix 3.4-A in Volume 2 provides more information on this analysis.

Prediction Methods

Construction Vibration

Analysts assessed construction vibration impacts in accordance with Chapter 10 of the FRA guidance manual (FRA 2012) for quantitative construction vibration assessments. HSR construction activity scenarios were developed to estimate construction vibration quantitatively, comparing the predicted ground-borne vibration levels with appropriate construction stage impact criteria. The quantitative construction vibration analysis was conducted where there would be a potential for blasting, pile driving, vibratory compaction, demolition, or excavation near vibration-sensitive structures. Criteria for annoyance (Table 3.4-9 and Table 3.4-10) and damage (Table 3.4-8) were applied to determine the impacts from construction vibration. Analysts used the following information to assess the construction vibration levels:

- Vibration source levels from equipment expected to be used by contractors
- Estimated site layouts of equipment along the right-of-way
- Distance from the construction activities to nearby vibration-sensitive receptors

Operations Vibration

The FRA guidance manual (FRA 2012) provides three levels of analysis: screening, general assessment, and detailed analysis. The screening analysis was used to determine the RSA for conducting the detailed analysis of operational vibration. For this analysis, analysts evaluated residential locations within 275 feet and institutional locations within 220 feet of the alternatives' centerlines.

Ground-borne noise is generated when interior building surfaces such as floors, walls, and ceilings vibrate because of ground-borne vibration (e.g., from trains). Ground-borne noise is commonly described as the "rumble" from a subway train. The prediction of such noise is directly related to the prediction of vibration inside a building.

The FRA criteria for assessing ground-borne vibration from shared corridors require that the vibration levels resulting from the relocated existing tracks be compared to the existing vibration levels. Thus, analysts prepared separate analyses to predict ground-borne vibration from project operations and from existing and future Caltrain operations. This analysis was conducted using the FRA's prediction model for ground-borne vibration, which is an empirical modeling approach that is described in detail in Volume 2, Appendix 3.4-A.

In accordance with FRA guidance, vibration levels from HSR on an aerial structure were assumed to be 10 VdB less than vibration from at-grade or embankment track. Appendix 3.4-A in Volume 2 details the modeling inputs and assumptions used for this assessment.

As with the noise analysis, analysts adjusted predicted vibration levels to account for increases in localized noise because of special trackwork, such as crossovers or turnouts, or from insulated joints. Standard frogs in crossovers and turnouts typically cause a localized increase in vibration from train operations. Alternatives 1, 2, and 3 would use special trackwork, such as movable-point frogs, to avoid significant gaps in the rail running surface. Any insulated joints would be low-impact joints. Therefore, any increases in localized vibration because of special trackwork under Alternatives 1, 2, and 3 would likely be small and would not change overall impacts on sensitive receptors. Alternative 4 would use the same type of special trackwork as currently exists in the corridor. All special trackwork frogs under Alternative 4 were assumed to be standard frogs.

3.4.4.4 Method for Evaluating Impacts under NEPA

The CEQ NEPA regulations (40 C.F.R. Parts 1500–1508) provide the basis for evaluating project impacts (described in Section 3.1.5.4). As described in Section 1508.27 of these regulations, the criteria of context and intensity are considered together when determining the severity of the change introduced by the project.

- **Context**—For this analysis, the context for noise impacts is the background noise and sensitivity of receptors. Rural residential has less noise and fewer receptors versus urban residential near existing noise emitters, such as railroads and freeways. For vibration analysis, the context is the existing land use.
- **Intensity**—For this analysis, intensity is determined by assessing the degree to which construction and operations of the project would change noise and vibration levels, using FRA guidelines (see impact criteria for noise and vibration in Section 3.4.4.3, Methods for Impact Analysis). These guidelines contain criteria for determining whether project-generated noise or vibration would result in an impact and of what severity.

3.4.4.5 Method for Determining Significance under CEQA

CEQA requires an EIR to identify the significant environmental impacts of a project (CEQA Guidelines § 15126). One of the primary differences between NEPA and CEQA is that CEQA requires a threshold-based impact analysis. Significant impacts are determined by evaluating whether project impacts would exceed the significance threshold established for the resource (as presented in Section 3.1.5.4). By contrast, under NEPA, significance is used to determine whether an EIS will be required; NEPA requires a federal lead agency to prepare an EIS when the proposed federal action (project) as a whole has the potential to “significantly affect the quality of the human environment.” Accordingly, Section 3.4.9, CEQA Significance Conclusions, summarizes the significance of the environmental impacts on noise and vibration for each project alternative. The Authority uses the following thresholds to determine if a significant impact from noise and vibration would occur as a result of the project. A significant impact is one that would:[2]

- Generate a substantial temporary or permanent increase in ambient noise levels in excess of severe impact standards for a severe impact established by FRA for high-speed ground transportation and by FTA for transit projects.
- Generate excessive ground-borne vibration or ground-borne noise levels.

As discussed in Section 3.4.4.4, Method for Determining Significance under NEPA, the analysis relies on noise and vibration standards developed by FTA and FRA to determine whether the project would result in significant noise or vibration impacts. These standards are derived primarily from the FRA guidelines in *High-Speed Ground Transportation Noise and Vibration Impact Assessment* (FRA 2012), which is based on the FTA *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018). The noise impact criteria established in these documents is based on the level of human annoyance, and were developed to apply to a wide variety of surface transportation modes and to respond to the varying sensitivities of communities to projects under different background noise conditions. The vibration standards address both human reaction to vibration as well as the potential for physical damage. The FRA standards were developed specifically for assessing noise and vibration impacts caused by high-speed rail projects, and the FTA standards were developed for rail projects and their associated stationary facilities. Accordingly, these standards serve as appropriate thresholds for determining whether the project would result in significant noise or vibration impacts.

For determining the significance of impacts related to traffic noise, the analysis relies in part on criteria that are included in FHWA’s *Procedures for Abatement of Highway Traffic Noise and*

[2] Appendix G of the CEQA Guidelines includes a criterion related to exposing people associated with the project to excessive noise associated with an airport. This project does not include any residential or commercial development near airports. As such, this criterion does not apply and is not included in this analysis.

Construction Noise (23 C.F.R. Part 772), which are implemented by Caltrans through its *Traffic Noise Analysis Protocol* (Caltrans 2011). These criteria are based on the level of human perception or annoyance and consider various types of land uses. Although the FHWA regulations only apply to projects funded or approved by FHWA, the criteria in these regulations are regularly considered in assessing noise impacts associated with motor vehicles. Moreover, the Caltrans *Traffic Noise Analysis Protocol* provides policy guidance for assessing traffic noise impacts as well as noise abatement criteria. Therefore, the criteria provided in these documents serve as appropriate thresholds for determining whether traffic noise would result in a significant impact.

Section 3.4.4.3, Methods for Impact Analysis, describes the federal noise standards and impact criteria used to determine the significance of noise impacts.

3.4.5 Affected Environment

3.4.5.1 Noise

This section summarizes the noise measurement results and describes the noise-sensitive land uses in the RSA. Section 3.4.4.3 provides a summary of the existing noise model used to identify the existing ambient noise conditions at all noise-sensitive receptors in the RSA.

Noise Measurement Results

A total of 65 measurements of ambient noise were conducted in the noise RSA. Analysts measured ambient noise at 11 locations in the San Jose Diridon Approach Subsection, 10 locations in the Monterey Corridor Subsection, 36 locations in the Morgan Hill and Gilroy Subsection, 2 locations in the Pacheco Pass Subsection, and 6 locations in the San Joaquin Valley Subsection. These measurement locations are mapped in Volume 2, Appendix 3.4-A.

Table 3.4-11 shows the results of the ambient noise measurements conducted between 2009 and 2017.[3] The major noise source for much of the RSA is existing rail corridors. In some locations, the project alignment deviates from existing rail corridors and extends through rural areas in a new transportation right-of-way, while in other areas the alignment is adjacent to major highways where the existing noise environment is dominated by traffic noise. Analysts used the measurement results in Table 3.4-11 to validate the existing noise spreadsheet model and predict existing noise levels at all noise-sensitive locations throughout the project. Appendix B of the Noise and Vibration Technical Report, which is provided in Appendix 3.4-A in Volume 2 of this document, contains measurement site photos and plots of ambient noise measurement results.

Table 3.4-11 Ambient Noise Measurement Results

Site	Location	Land Use	Date Deployed	Average L_{dn}[1] (dBA)	Loudest Hour L_{eq} (dBA)
San Jose Diridon Station Approach Subsection					
N76[2]	2079 Main Street, San Jose	Residential	5/3/2016	63	65
N77[2]	1315 De Altura Commons, San Jose	Residential	10/16/2009	65	64
N78[2]	726 Emory Street, San Jose	Residential	3/5/2010	64	65
N79	(adjacent to) 109 Laurel Grove Avenue, San Jose	Residential	5/10/2016	67	70
N80	421 Illinois Avenue, San Jose	Residential	10/12/2010	68	69

3 The noise analysis includes noise measurements conducted in 2009 and 2010 by the Authority's contractors for the *Draft San Jose to Merced Project Section Noise and Vibration Technical Report* (Authority 2011) and the *San Francisco to San Jose Project Section Noise and Vibration Technical Report* (Authority and FRA 2014); noise measurements conducted in 2013 as part of the *Caltrain Peninsula Corridor Electrification Project Noise and Vibration Technical Report* (Wilson Ihrig 2014); and noise measurements conducted in 2016 and 2017 as part of this assessment.

Site	Location	Land Use	Date Deployed	Average L_{dn}[1] (dBA)	Loudest Hour L_{eq} (dBA)
N81	663 Delmas Avenue, San Jose	Residential	5/6/2016	61	63
N82	827 Harliss Avenue, San Jose	Residential	10/12/2010	63	62
N83	(adjacent to) 974 McLellan Avenue, San Jose	Residential	5/17/2016	66	63
N84	1197 Lick Avenue, San Jose	Residential	11/11/2014	77	77
N139	782 Auzerais Avenue, San Jose	Residential	5/20/2013	82	81
N140	748 Illinois Avenue, San Jose	Residential	5/20/2013	71	68
Monterey Corridor Subsection					
N85	2320 Canoas Garden Avenue (Lot 608), San Jose	Residential	10/11/2010	67	67
N86	Communications Hill Drive, San Jose	Residential	5/17/2016	61	62
N87	3200 Monterey Road, Clarion Inn, San Jose	Residential	5/17/2016	79	77
N88	4406 Pinon Place, San Jose	Residential	10/13/2010	67	66
N89	23 Park Groton Place, San Jose	Residential	10/12/2010	68	63
N90	4635 Rotherhaven Way, San Jose	Residential	5/12/2016	77	77
N91	510 Saddle Brook Drive (Lot A), San Jose	Residential	5/12/2016	67	67
N92	5272 Waterfall Court, San Jose	Residential	10/19/2010	67	66
N93	60 Foxwell Place, San Jose	Residential	5/10/2016	74	75
N94	5919 Southwind Drive, San Jose	Residential	10/13/2010	73	76
Morgan Hill and Gilroy Subsection					
Along Monterey Road through Downtown Gilroy					
N95	6908 Sessions Drive, San Jose	Residential	10/13/2010	59	58
N96	6998 Sessions Drive, San Jose	Residential	5/10/2016	72	72
N97	7307 Urshan Way San Jose	Residential	10/14/2010	60	58
N98	7465 Pegasus Court San Jose	Residential	1/17/2011	61	59
N99	8470 Monterey Road, San Jose	Residential	1/18/2011	61	62
N100	586 Monterey Road, Morgan Hill	Residential	5/10/2016	81	81
N101	(adjacent to) 19271 Saffron Drive, Morgan Hill	Residential	5/9/2016	73	76
N103	19260 Monterey Road, Morgan Hill	Residential	10/18/2010	71	71
N104	157 Bender Circle, Morgan Hill	Residential	5/3/2016	68	69
N106	95 E Central Avenue, Morgan Hill	Residential	10/18/2010	66	66
N108	16250 Railroad Avenue, Morgan Hill	Residential	6/22/2010	68	68
N111	14542 Crowner Avenue, San Martin	Residential	5/12/2016	62	66
N113	13455 Monterey Road, San Martin	Residential	10/19/2010	69	69
N114	13150 Depot Road, San Martin	Residential	5/3/2016	64	67
N115	12675 Sycamore Avenue, San Martin	Residential	5/9/2016	67	66
N118	110 Jacob Way, Gilroy	Residential	6/22/2010	74	70
N120	325 Denio Avenue, Gilroy	Residential	10/21/2010	56	56
N121	25 Denio Avenue, Gilroy	Residential	10/20/2010	68	68

Site	Location	Land Use	Date Deployed	Average L_{dn}[1] (dBA)	Loudest Hour L_{eq} (dBA)
N122	70 Cohansey Avenue, Gilroy	Residential	10/20/2010	60	61
N124	(adjacent to) 120 Sarafina Way, Gilroy	Residential	5/9/2016	68	70
N125	111 Martin Street, Gilroy	Residential	10/20/2010	58	65
N126	7250 Alexander Street, Gilroy	Residential	2/14/2017	59	64
N129	1230 Bloomfield, Gilroy	Residential	5/3/2016	71	74
N130	8247 Lovers Lane, Hollister	Residential	5/6/2016	61	66
US 101 through Morgan Hill					
N102	(adjacent to) 19490 Vista De Lomas, Morgan Hill	Residential	5/9/2016	69	67
N105	17905 Condit, Morgan Hill	Residential	5/13/2016	66	68
N107	877 English Walnut Court, Morgan Hill	Residential	10/19/2010	69	69
N109	15450 Murphy Avenue, Morgan Hill	Residential	10/18/2010	57	60
N110	14916 Llagas Avenue, Morgan Hill	Residential	12/19/2016	70	68
N112	14150 Murphy Avenue, San Martin	Residential	10/18/2010	62	62
East Gilroy					
N116	11460 Rothe Avenue, Gilroy	Residential	10/20/2010	56	59
N117	405 Lena Avenue, Gilroy	Residential	10/21/2010	62	58
N119	695 Rucker Avenue, Gilroy	Residential	5/6/2016	68	69
N123	8415 Marcella Avenue, Gilroy	Residential	12/19/2016	66	65
N127	6780 Holsclaw Road, Gilroy	Residential	5/6/2016	67	66
N128	1975 CA-152, Gilroy	Residential	2/14/2017	82	65
Pacheco Pass Subsection					
N131	210 Walnut Avenue, Hollister	Residential	11/17/2010	58	54
N132	Pacheco Pass Highway	Residential	5/13/2016	82	79
San Joaquin Valley Subsection					
N133	28263 Fahey Road, Los Banos	Residential	5/20/2016	65	67
N134	(adjacent to) 24334 Henry Miller Avenue, Los Banos	Residential	5/20/2016	74	72
N135	(adjacent to) 21534 Henry Miller Avenue, Los Banos	Residential	5/20/2016	79	79
N136	(adjacent to) 18827 Henry Miller Road, Los Banos	Residential	5/20/2016	73	72
N137	13893 Henry Miller Road, Los Banos	Residential	11/15/2010	65	67
N138	12051 Carlucci Road, Los Banos	Residential	5/20/2016	67	71

Sources: Authority 2011; Authority and FRA 2014; Wilson Ihrig 2014

[1] The L_{dn} was calculated from the average hourly L_{eq} values collected over the entire measurement period.

[2] Includes existing noise from nearby airport.

dBA = A-weighted decibel

L_{dn} = day-night sound level

L_{eq} = equivalent sound level, dBA

US = U.S. Highway

San Jose Diridon Station Approach Subsection

In San Jose, the noise RSA follows the Caltrain right-of-way through moderately dense urban areas with mixed land use. The ambient L_{dn} in the San Jose Diridon Station Approach Subsection ranges from 61 dBA to 82 dBA.

North of San Jose Diridon Station, the land use on the east side of the existing rail alignment is primarily industrial, while the western side is mainly residential. The closest residence is approximately 50 feet from the existing railway line. Bellarmine College Preparatory School campus is on the western side of the RSA. The closest Bellarmine school buildings are more than 350 feet from the existing railway line.[4] At San Jose Diridon Station, there are multifamily buildings along the entire west side of the station facing the existing tracks and platforms. Templo La Hermosa church is on the eastern side of the station, beyond the parking lots approximately 550 feet from the station.

South of San Jose Diridon Station, land uses in the noise RSA include transportation rights-of-way associated with Interstate (I-) 280 and State Route (SR) 87, residential neighborhoods, and some commercial/industrial areas. The San Jose Fire Department Bureau of Field Operations campus is just south of San Jose Diridon Station on the east side of the RSA.[5] Gardner Elementary School is approximately 275 feet south of I-280 on the south side of the RSA.

In this subsection, the alignment is in a heavily used rail corridor with 92 daily weekday Caltrain passenger trains currently operating between San Francisco and San Jose Diridon Station, and 40 daily Caltrain trains operating between San Jose Diridon Station and Tamien Station. Between two and nine freight trains run along the route per day. Fourteen Capital Corridor and eight Altamont Corridor Express (ACE) trains run along the alignment daily between De La Cruz Boulevard and San Jose Diridon Station. ACE trains continue to travel south to Tamien Station to access the layover facility. Amtrak Coast Starlight trains pass through this subsection twice daily. Santa Clara Valley Transportation Authority (VTA) light rail trains run along the center of SR 87. Other noise sources include traffic on I-880, SR 87, I-280, local roads, as well as aircraft activities associated with Norman Y. Mineta San Jose International Airport.

Monterey Corridor Subsection

The ambient L_{dn} in the Monterey Corridor Subsection ranges from 61 dBA to 79 dBA. South of West Alma Avenue, the noise RSA extends along SR 87 until south of Almaden Expressway, where it turns east toward Monterey Road following the UPRR right-of-way. Land uses along the Monterey Corridor Subsection include primarily single-family residential neighborhoods and some commercial/industrial areas. Toward the southern end of the subsection, land uses include scattered single-family homes and farms.

The closest residence is approximately 30 feet from the existing railway line, near Skyway Drive, where backyards of single-family homes abut the right-of-way. An Elk’s Lodge on West Alma Avenue is approximately 180 feet from SR 87 on the west side of the RSA. On the east side of the RSA near West Alma Avenue, a recording studio is approximately 350 feet from the existing railway and behind some intervening commercial buildings. The School of the Blues music school is on Monterey Road, approximately 190 feet from the existing railway line. Other institutional land uses include Edenvale Branch Library and four places of worship.

---

[4] Outdoor sports fields associated with Bellarmine College Preparatory School are located adjacent to the existing railway line, but are not considered noise-sensitive uses by the FRA guidance manual (FRA 2012).

[5] Fire stations contain sleeping accommodations and are considered sensitive noise receptors at all times of day and night.

Sources of existing noise include traffic on SR 87, Monterey Road (near Capitol Caltrain Station), SR 85, and local roads, as well as the existing rail traffic. South of Tamien Station, the daily rail traffic consists of six Caltrain passenger trains, two Amtrak passenger trains, and approximately four freight trains per day. Santa Clara VTA light rail trains also run along the center of SR 87.

Morgan Hill and Gilroy Subsection

In this subsection, the noise RSA diverges to follow the different project alignments.

Along Monterey Road through Downtown Gilroy

The ambient L_{dn} along this portion of the Morgan Hill and Gilroy Subsection ranges from 56 dBA to 81 dBA, depending on the location. The noise RSA extends along the single UPRR track from Bernal Way into downtown Gilroy. It continues past the Gilroy Caltrain Station, along UPRR south of downtown, and then turns east toward the Pacheco Pass Highway near Bloomfield Avenue. Land uses include farms with scattered single-family homes, and residential neighborhoods and commercial areas in Morgan Hill and San Martin. In south San Jose between Bernal Way and Metcalf Road, the closest residences to the existing railway line are a row of single-family homes approximately 40 feet away with backyards abutting the right-of-way. Three hotels are within 200 feet of the existing railway line. The closest school is approximately 145 feet from the existing railway line. The closest place of worship is approximately 150 feet from the existing railway line. In downtown Morgan Hill, the Morgan Hill Community Center outdoor amphitheater is approximately 500 feet from the existing railway line and the South Valley Civic Theatre and Community Playhouse is more than 600 feet from the railway line.

In the downtown Gilroy area, land uses include a mix of residential neighborhoods and commercial/industrial areas. South of downtown, land uses include farms with scattered single-family homes. The closest residential building to the existing railway line is approximately 50 feet from UPRR track on Monterey Road and Lewis Street. The closest school is Gilroy Preparatory School, which is approximately 145 feet from the existing railway line. Pintello Comedy Theater is approximately 365 feet from the existing railway line and the District Theater Live Music Venue is 50 feet from the railway line.

Sources of existing noise include traffic on Monterey Road and local roads, as well as the rail traffic along UPRR consisting of six Caltrain passenger trains, two Amtrak passenger trains, and approximately four freight trains per day. Caltrain trains stop at the existing Gilroy station, which is a terminal station. Amtrak and freight trains continue to operate south of Gilroy. Farming and industrial activities south of Metcalf Road also contribute to existing noise levels, as do aircraft activities associated with South County Airport and Frazier Lake Airpark.

Adjacent to US 101 through Morgan Hill

The ambient L_{dn} along this portion of the Morgan Hill and Gilroy Subsection ranged from 57 dBA to 70 dBA. Land uses include farms with scattered single-family homes, and residential neighborhoods and commercial areas in Morgan Hill near El Camino Real/U.S. Highway (US) 101. For most of this noise RSA, the noise environment is dominated by US 101 and local street traffic. At connection points on both ends, some receptors are exposed to the rail traffic along UPRR (six Caltrain passenger trains, two Amtrak passenger trains, and approximately four freight trains per day). Farming activities south of Morgan Hill also contribute to existing noise levels.

East Gilroy

The ambient L_{dn} along this portion of the Morgan Hill and Gilroy Subsection ranged from 56 dBA to 82 dBA. Land uses include farms with scattered single-family homes. For most of this RSA, rural traffic dominates the noise environment. At the connection point, some receptors are exposed to the rail traffic along UPRR (six Caltrain passenger trains, two Amtrak passenger trains, and approximately four freight trains per day). Other noise sources include aircraft activities associated with Frazier Lake Airpark and farming activities.

Pacheco Pass Subsection

The ambient L_{dn} along this subsection ranges from 58 dBA to 82 dBA. Land uses in this subsection are quite different from the rest of the project extent. Most of the RSA consists of open spaces, including the Cottonwood Creek Wildlife Area, with some scattered single-family residences. The noise environment is dominated by SR 152 and rural traffic. Most of the alignment in this subsection is in a tunnel.

San Joaquin Valley Subsection

The ambient L_{dn} along this subsection ranges from 65 dBA to 79 dBA. The RSA passes Santa Nella Road/I-5 then follows Henry Miller Road to Carlucci Road. Land uses include farms with scattered single-family homes and one elementary school. For most of the San Joaquin Valley Subsection, there are no existing rail noise sources and rural traffic dominates the noise environment. In Volta, a freight railroad line crosses the RSA. One single-family residence is within 200 feet of the freight railway line. Sources of existing noise include traffic along Henry Miller Road and other local roadways as well as farming activities.

Noise Measurement and Modeling Discussion

To validate the existing noise model, analysts compared the existing noise spreadsheet model results to the measured noise levels at the locations of the noise monitors. The comparison of the existing noise model results to the measured noise levels at the measurement locations (Volume 2, Appendix 3.4-A) indicate that the existing noise model is in close agreement with the field noise measurement data. Analysts used the existing noise model to predict ambient noise levels at all sensitive receptors, typically at the building facades, in the RSA.

3.4.5.2 Vibration

This section summarizes the locations and results of vibration measurements by project subsection. It also describes the vibration-sensitive land uses and sources of existing vibration in the RSA.

Vibration Measurement Results

Analysts conducted measurements of the existing vibration levels associated with train passbys at 14 sites in the RSA. These measurements were made in the vertical direction. Table 3.4-12 shows the results of the existing vibration measurements conducted between 2009 and 2016, which are organized by subsection.[6] The locations of the vibration measurement sites are illustrated in Volume 2, Appendix 3.4-A. At each site, ground-borne vibration levels were recorded at multiple distances from the tracks. These distances from the track centerline where the vibration levels were measured are reported in Table 3.4-12. The results include the range of maximum overall ground-borne vibration levels for each type of train passby based on distance from the track. Higher vibration levels occur closer to the existing tracks and the vibration levels decrease with distance from the track.

[6] The vibration analysis includes vibration measurements conducted in 2009 and 2010 by the Authority's contractors for unpublished noise and vibration technical studies; vibration measurements conducted in 2013 that are included in the *Caltrain Peninsula Corridor Electrification Project Noise and Vibration Technical Report* (Wilson Ihrig 2014); and vibration measurements conducted in 2016 as part of this assessment.

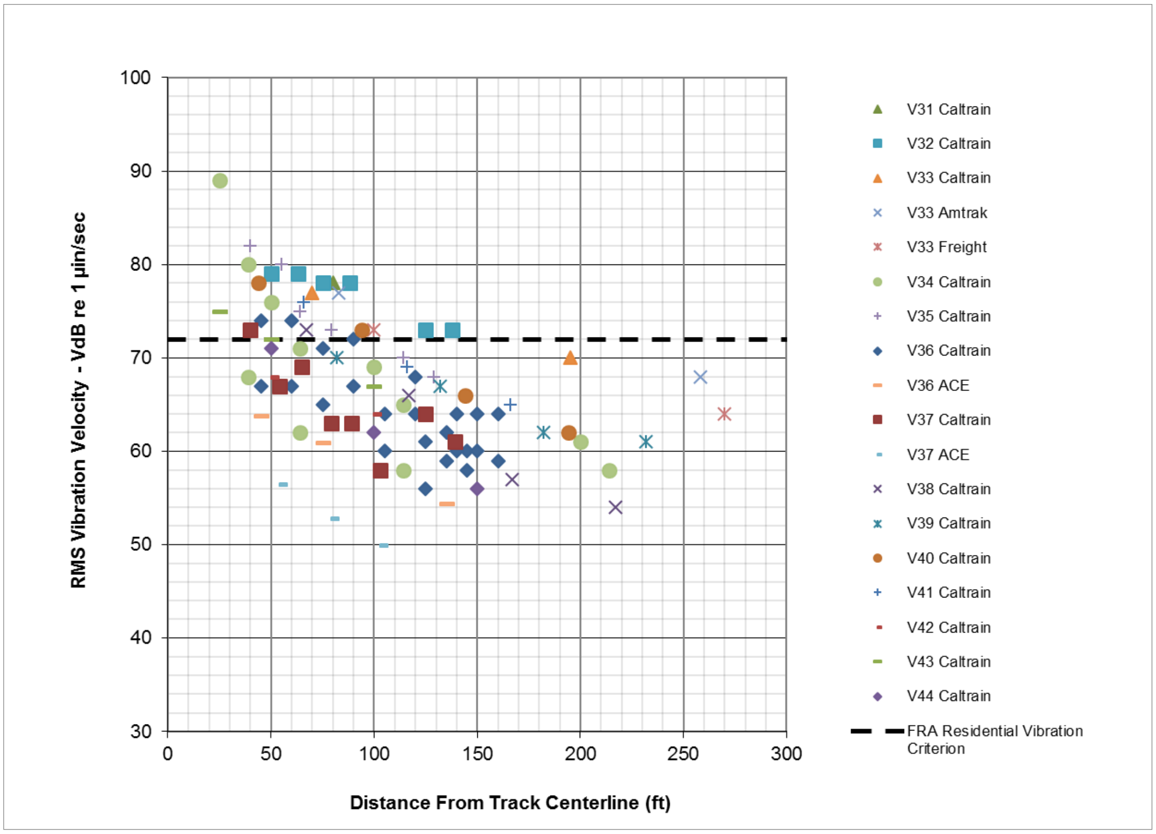
Table 3.4-12 Existing Vibration Measurement Locations

Site	Location	Date	Distance from track (feet)	Overall Vibration Level (VdB)	Source
San Jose Diridon Station Approach Subsection					
V31	2075 Main Street, Santa Clara	10/20/2009	80 – 125	78 – 73	Caltrain
V32	890 Newhall Street, San Jose	7/1/2016	50 – 138	79 – 73	Caltrain
V33	855 McKendrie Street, San Jose	3/10/2010	70 – 195	77 – 70	Caltrain
			83 – 258	77 – 68	Amtrak
			100 – 270	73 – 64	Freight
V34	782 Auzerais Avenue, San Jose	5/29/2013	25 – 214	89 – 58	Caltrain
V35	704 Harrison Street, San Jose	7/1/2016	40 – 114	83 – 70	Caltrain
V36	Jerome Street & Willis Avenue, San Jose	7/28/2016	105 – 160	68 – 56	Caltrain
			45 – 150	74 – 59	Caltrain
			45 – 135	64 – 54	ACE
V37	Fuller Avenue & Delmas Avenue, San Jose	5/31/2016	40 – 139	73 – 58	Caltrain
			54 – 103	56 – 50	ACE
Monterey Corridor Subsection					
V38	Pomme Court & Olive Hill Drive, San Jose	6/01/2016	67 – 217	73 – 54	Caltrain
V39	Hayes Avenue & Endicott Boulevard, San Jose	5/17/2016	82 – 232	70 – 61	Caltrain
Morgan Hill and Gilroy Subsection					
V40	Old Monterey Road & Paloma Drive, Morgan Hill	5/18/2016	44 – 194	78 – 62	Caltrain
V41	East Middle Avenue & Crowner Avenue, San Martin	5/18/2016	66 – 166	76 – 65	Caltrain
V42	Depot Street & North Street, San Martin	7/21/2016	25 – 100	75 – 64	Caltrain
V43	Depot Street & South Street, San Martin	7/21/2016	25 – 100	75 – 67	Caltrain
V44	Railroad Street & Lewis Street, Gilroy	5/18/2016	50 – 150	71 – 56	Caltrain

VdB = vibration decibels
ACE = Altamont Corridor Express

Figure 3.4-7 illustrates the general attenuation with distance and the range of measured vibration (Volume 2, Appendix 3.4-A, provides more details).

FRA notes that typical outdoor sources of perceptible ground-borne vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. If the roadway is smooth, the vibration from traffic is rarely perceptible (FRA 2012). For most of the project, the dominant existing vibration source is train traffic. Vibration from traffic is only mentioned if the levels are comparable to 72 VdB. In subsections where the vibration RSA diverges from the existing railroad right-of-way, there are no significant existing sources of vibration. The vibration-sensitive land uses in the RSA are generally located where the vibration RSA is adjacent to existing rail rights-of-way and, therefore, where analysts conducted existing ambient vibration measurements.



FEBRUARY 2019

Figure 3.4-7 Existing Vibration Measurement Levels

The measurements show that the vibration levels decrease with distance, which varies at each site as a function of distance from the track, the train type, and train speed. At most sites, the overall vibration levels exceeded the FRA residential criterion at locations less than 50 feet from the track and at some sites up to approximately 100 feet from the track.

As discussed in Section 3.4.4.3, Methods for Impact Analysis, analysts also conducted vibration propagation measurements at 10 locations to assist in the prediction of ground-borne vibration levels from project operations. The vibration propagation measurements are site-specific tests that quantify the efficiency of vibration propagation through the soil at specific locations. One borehole vibration propagation test was also conducted in the RSA during previous work in 2010. Volume 2, Appendix 3.4-A, and Table 3.4-13 shows the vibration propagation measurement locations.

Table 3.4-13 Vibration Propagation Measurement Locations

Site	Location	Date	Test Type	Depth (feet)[1]
San Jose Diridon Station Approach				
VP19	Main Street & Washington Street, Santa Clara	3/25/2010	Borehole	50, 60, 70
VP20	855 McKendrie Street, San Jose	3/10/2010	Surface	0
VP21	Jerome Street & Willis Avenue, San Jose	7/28/2016	Surface	0
Monterey Corridor Subsection				
VP22	Hayes Avenue & Endicott Boulevard, San Jose	5/17/2016	Surface	0
Morgan Hill and Gilroy				
VP23	Old Monterey Road & Paloma Drive, Morgan Hill	5/18/2016	Surface	0
VP24	Seymour Avenue & East Middle Avenue, San Martin	7/22/2016	Surface	0
VP25	Depot Street & North Avenue, San Martin	7/21/2016	Surface	0
VP26	Depot Street & Spring Street, San Martin	5/18/2016	Surface	0
VP27	Alexander Street & East Eighth Street, Gilroy	5/19/2016	Surface	0
Pacheco Pass				
	N/A[2]			
San Joaquin Valley				
VP28	Volta Road & Henry Miller Road, Los Banos	5/24/2016	Surface	0

[1] At site # VP19, vibration propagation was measured at multiple borehole depths.
[2] No vibration propagation measurements were conducted in the Pacheco Pass Subsection because no sensitive receptors are near the project.
N/A = not applicable

San Jose Diridon Station Approach Subsection

The sensitive land uses in the vibration RSA in this subsection are the same as those described in the noise RSA for this subsection. Existing vibration in this portion of the RSA is dominated by a number of existing rail operations that share the alignment. This alignment is a heavily used rail corridor with 92 daily weekday Caltrain passenger trains currently operating between San Francisco and San Jose Diridon Station. Forty daily Caltrain trains operate through to Tamien Station. Approximately two to nine freight trains run along the route per day. Fourteen Capital Corridor and eight ACE trains run along the alignment daily between De La Cruz Boulevard and San Jose Diridon Station. ACE trains continue to travel south to Tamien Station to access the layover facility. Amtrak Coast Starlight trains pass through the section twice daily. Santa Clara VTA light rail trains run along the center of SR 87.

Vibration from Caltrain trains was measured at three sites north of San Jose Diridon Station. Overall ground-borne vibration levels from Caltrain measured at the closest positions ranged from 79 VdB to 78 VdB at 50 and 80 feet, respectively, from the tracks. The vibration levels from Amtrak trains measured at McKendrie Street in San Jose were similar to Caltrain trains. Vibration levels from freight train operations measured at this site ranged from 73 VdB (at 100 feet) to 64 VdB (at 270 feet).

Vibration from Caltrain trains was measured at three sites south of San Jose Diridon Station. Overall vibration levels from Caltrain at the closest positions ranged from 83 VdB (at 40 feet) to 68 VdB (at 105 feet). Vibration levels from ACE trains at Jerome Street and Willis Avenue were lower than Caltrain trains.

Monterey Corridor Subsection

Sources of existing vibration include traffic on SR 87 and Monterey Road, as well as the existing rail traffic along UPRR. South of the Tamien Station, the daily rail traffic consists of six Caltrain passenger trains, two Amtrak trains, and approximately four freight trains per day. VTA light rail also runs along the center of SR 87.

Vibration from Caltrain trains was measured at Pomme Court and Olive Hill Drive in San Jose. Overall vibration levels from Caltrain ranged from 73 VdB (at 67 feet) to 54 VdB (at 217 feet) from the tracks. Vibration from Caltrain trains was also measured at Hayes Avenue and Endicott Boulevard in San Jose. Overall vibration levels ranged from 70 VdB to 61 VdB at 82 feet and 232 feet, respectively, from the tracks.

Morgan Hill and Gilroy Subsection

Along Monterey Road through Downtown Gilroy

Sources of existing vibration include existing rail traffic along UPRR (six Caltrain passenger trains, two Amtrak passenger trains, and approximately four freight trains per day). Caltrain trains stop at the existing Gilroy station, which is where Caltrain service terminates. Amtrak and freight trains continue to operate south of Gilroy.

Analysts measured vibrations from Caltrain trains at five sites from Morgan Hill to Gilroy. Overall ground-borne vibration levels from Caltrain measured at the closest positions ranged from 78 VdB at 44 feet to 71 VdB at 50 feet from the tracks. Levels at the farthest measured distances ranged from 67 VdB (at 100 feet) to 56 VdB (at 150 feet).

Adjacent to US 101 through Morgan Hill

For most of this RSA, there are no existing rail vibration sources and the existing low-level vibration environment is primarily caused by traffic on US 101 and local streets. At connection points on both ends, some receptors are exposed to the existing rail traffic along UPRR (Caltrain passenger trains, two Amtrak passenger trains, and approximately four freight trains per day).

East Gilroy

For most of this RSA, there are no existing rail vibration sources and the existing low-level vibration environment is primarily from traffic on rural streets. At the connection point, some receptors are exposed to the existing rail traffic along UPRR (Caltrain passenger trains, two Amtrak passenger trains, and approximately four freight trains per day).

Pacheco Pass Subsection

For most of this RSA, there are no existing rail vibration sources and the existing low-level vibration environment is primarily from traffic on SR 152 and rural streets. The RSA passes through two portions of the Cottonwood Creek Wildlife Area, which is an outdoor land use. Vibration impact criteria have not been established for animals. Therefore, analysts conducted no vibration propagation measurements in the Pacheco Pass Subsection.

San Joaquin Valley Subsection

The vibration RSA passes Santa Nella Road/I-5 then follows Henry Miller Road to Carlucci Road. Land uses include farms with scattered single-family homes and one elementary school. For most of the San Joaquin Valley Subsection, there are no existing rail vibration sources and the existing low-level vibration environment is primarily from traffic on rural streets. In Volta, a freight railroad line crosses the RSA. One single-family residence is within 200 feet of the existing freight railway line and the RSA.

3.4.6 Environmental Consequences

3.4.6.1 Overview

This section discusses the potential noise and vibration impacts of project construction and operations on sensitive receptors and structures. The analysis evaluates construction noise and vibration, and noise and vibration associated with train operations, passenger stations, MOWFs, and traction power facilities under the 2029 No Project, 2029 Plus Project, 2040 No Project, and

2040 Plus Project conditions. It also evaluates the potential for human annoyance from the rapid onset of noise from HSR passbys, indirect noise impacts associated with changes in vehicular traffic as a result of project operations, and the potential for noise impacts on livestock near the right-of-way.

The evaluation of vibration impacts focuses on the temporary exposure of sensitive receptors and buildings to construction-related vibration, temporary and permanent exposure of buildings to construction-related vibration damage, and the permanent exposures of sensitive receptors to vibration associated with project operations.

The Authority incorporated an IAMF (NV-IAMF#1) into the project to minimize construction-related noise and vibration impacts. The IAMF would require the contractor to prepare and submit to the Authority prior to construction a noise and vibration technical memorandum documenting how the FTA and FRA guidelines for minimizing construction noise and vibration impacts would be employed when work is conducted within 1,000 feet of sensitive receptors. This IAMF is described in detail in Volume 2, Appendix 2-E, Project Impact Avoidance and Minimization Measures.

3.4.6.2 Noise

Construction and operations of the project alternatives would result in temporary and permanent impacts from noise. At any one receptor, construction activities would occur over the course of a few days to up to 2 or 4 weeks for many project activities, such as utility relocation, grading, excavation, minor trackwork, demolition, and installation of four-quadrant gates and perimeter fencing. Some activities would occur for a longer period of time, such as construction of new tracks and stations. All these activities would temporarily increase noise levels. Project operations would increase noise levels due to operations of HSR trains, station noise from HSR train movement and parking, MOWF noise, and noise from changes in vehicle traffic patterns.

No Project Conditions

The San Francisco Bay Area (Bay Area) and San Joaquin Valley populations are expected to grow through 2040 (Section 2.6.1.1, Projections Used in Planning), with the San Joaquin Valley population projected to grow at a higher rate than any other region in California. Development in the Bay Area and San Joaquin Valley to accommodate the population increase would continue under the No Project Alternative and result in associated direct and indirect impacts. The No Project Alternative considers the impacts of conditions forecasted by current land use and transportation plans in the project vicinity, including planned improvements to the highway, aviation, conventional passenger rail, freight rail, and port systems through the 2040 planning horizon. Without the project, the forecasted population growth would increase pressure to expand highway and airport capacities. The Authority estimates that additional highway and airport projects (up to 4,300 highway lane miles, 115 airport gates, and 4 airport runways) would be needed to achieve equivalent capacity and relieve the increased pressure (Authority 2012b). Planned and other reasonably foreseeable projects anticipated to be built by 2040 include residential, commercial, industrial, recreational, and transportation projects. A full list of anticipated future development projects is provided in Volume 2 in Appendix 3.18-A, Cumulative Plans and Nontransportation Projects List, and Appendix 3.18-B, Cumulative Transportation Projects List.

As described in Section 3.4.5, Affected Environment, much of the RSA currently experiences noise from passenger and freight rail traffic as well as roadway traffic. Highway improvement projects, such as the widening of US 101 and SR 152, as well as new or expanded residential and commercial developments would increase existing traffic levels and associated noise in the RSA. An increase in freight and passenger train movement to accommodate growth and the introduction of several new planned passenger rail services in the RSA—the Coast Daylight, the Transportation Agency for Monterey County Salinas Rail Extension, and the Bay Area Rapid Transit (BART) Silicon Valley Santa Clara Extension—would further increase transportation noise in the RSA (see Volume 2, Appendix 3.4-A for daily train operations under existing conditions, as well as the 2029 and 2040 No Project train operations). The approved Caltrain PCEP would electrify the Caltrain Corridor between San Francisco and the Tamien Station in San Jose, convert approximately 75 percent of diesel locomotive-hauled coaches to EMUs, and increase service to six trains per peak hour per direction under the No Project Alternative between San Jose and San Francisco (but would not change service levels between Gilroy and San Jose). Overall, increases in noise levels under the No Project Alternative are not anticipated to exceed 3 dBA, which would only occur with a doubling of all current freeway and rail traffic.

Planned development and transportation projects that would occur as part of the No Project Alternative would likely include project features and mitigation to reduce impacts on noise. Future developments planned under the No Project Alternative would require individual environmental review, including an analysis of noise impacts on sensitive receptors, which would be analyzed under state and federal highway noise criteria. Any increases in noise would be regulated by local general plans and noise and vibration ordinances. It would be the responsibility of the affected jurisdiction to establish consistency with local regulations and ordinances aimed at avoiding or reducing permanent increases in noise levels.

Project Impacts

Construction Impacts

Project construction would involve demolition of existing structures; clearing and grubbing; handling, storing, hauling, excavating, and placing fill; pile driving; and construction of aerial structures, bridges, road modifications, utility upgrades and relocations, HSR electrical systems, and railbeds. Section 2.11, Construction Plan, describes construction activities.

Impact NV#1: Temporary Exposure of Sensitive Receptors to Construction Noise

The project would include construction of new tracks and stations, utility relocation, grading, excavation, trackwork, demolition, and installation of systems components. Some of these construction activities would occur in residential areas and at other noise-sensitive land uses within several hundred feet of the alignment. The potential for noise impacts would be greatest near pavement breaking and close to nighttime construction work. Construction noise varies with the process used, layout of the sites, and the type and condition of the equipment used. The noisiest pieces of equipment determine the maximum sound levels from construction activities.

Temporary noise impacts would result from activities associated with construction, modification, and relocation of existing tracks, stations, and platforms; modification of existing roadways and structures; construction of the MOWF; construction of new tracks and viaduct installation of four-quadrant gates at the at-grade crossings and perimeter fencing at the edge of the right-of-way; utility relocation; site preparation including demolition, excavation, and grading; and installation of systems components. Construction noise varies with the construction method, layout of the sites, and the type and condition of the equipment used. The noisiest pieces of equipment determine the maximum sound levels from construction activities, which are evaluated on an L_{eq} basis over an 8-hour construction period.

The duration and intensity of construction activities would vary by location and project component. Minor track shifts within the existing Caltrain corridor (Alternative 4) would be performed by “on-track” equipment that would operate along the existing Caltrain tracks as it adjusts track alignment and ballast; this would be expected to last no more than several days at any given location. Generally, about 600 feet of trackwork would be completed within a few days. Installing four-quadrant gates at existing at-grade crossings would occur over a period of 2 to 4 weeks; radio towers would take 3 to 6 months. The construction of several major project components would, however, occur over several years—expanding the existing San Jose Diridon Station would take approximately 2 years, while the aerial San Jose Diridon Station under Alternative 1 and 3 would take 3 to 4 years. Building the MOWF would take 1 year.

While most of these construction activities would occur mostly within the right-of-way and primarily during daytime hours during the week, work at turnouts, temporary passing tracks, track and overhead contact system pole relocation, and some roadway realignments would require weekend and nighttime construction work. Track realignments of less than 10 feet would be done at night or on weekends, and speed restrictions would be imposed until the track realignment is completed. For realignments of more than 10 feet, a parallel track would be built first and then connected to the existing track. Temporary track closure for reconnecting tracks would occur at night or on weekends and would have a duration of 1 to 2 days each. There might also be temporary nighttime construction work associated with the modification of underpasses in the vicinity of the passing tracks.

The potential for noise impacts would be greatest where noise-sensitive land uses are near major construction activities with a long duration (e.g., MOWF, passing tracks, viaduct, station modifications) and nighttime construction activities (e.g., temporary passing tracks, parallel tracks, and roadway realignment).

The alternatives include project features (IAMFs) to avoid or minimize potential impacts from construction and operations. NV-IAMF#1 would require the contractor to prepare and submit to the Authority prior to construction a noise and vibration technical memorandum documenting how the FRA guidelines for minimizing construction noise and vibration impacts would be employed when work is being conducted within 1,000 feet of sensitive receptors. Typical construction practices contained in the FRA guidance manual (FRA 2012) for minimizing construction noise and vibration impacts include the following:

- Build noise barriers, such as temporary walls or piles on excavated material, between noisy activities and noise-sensitive resources.
- Route truck traffic away from residential streets where possible.
- Build walled enclosures around especially noisy activities or around clusters of noisy equipment.
- Combine noisy operations so that they occur in the same period.
- Phase demolition, earthmoving, and ground-impacting operations so as not to occur in the same period.
- Avoid impact pile driving where possible in vibration-sensitive areas.

Application of the FRA guidelines would minimize temporary construction impacts on sensitive receptors. However, based on the analysis summarized below, there is still the potential for adverse impacts from construction noise where sensitive receptors are within 774 feet of HSR nighttime construction activity or are within 245 feet of HSR daytime construction activity.

Table 3.4-14 shows key differences among the project alternatives that would determine how construction noise affects the communities.

Table 3.4-14 Differences among Alternatives

Subsection	Alternative 1	Alternative 2	Alternative 3	Alternative 4
San Jose Diridon Station Approach	Aerial/interchange touchdown at I-880	Aerial/interchange touchdown at Scott	Same as Alternative 2	At grade, right-of-way blended
Monterey Corridor	Aerial	Embankment	Aerial	At grade, right-of-way blended
Morgan Hill and Gilroy	Aerial	Embankment/ at grade	Far east aerial would avoid downtown Gilroy and Morgan Hill	At grade, right-of-way blended
Pacheco Pass	Mostly tunnel			
San Joaquin Valley	Aerial/embankment			

Source: Authority 2019a

Analysts identified five typical types of construction activities that would be used during project construction, and evaluated the noisiest pieces of equipment required for each activity. Applying the typical maximum sound levels of each piece of equipment and its utilization factor, analysts calculated the total 8-hour L_{eq} and the distance at which the L_{eq} would reach the noise impact criteria shown in Table 3.4-4.

Table 3.4-15 shows the result of this analysis. For typical track construction scenarios, the residential nighttime 8-hour L_{eq} criterion of 70 dBA would potentially be exceeded up to 374 feet from the clear-and-grub construction activity, and as far away as 774 feet from the concrete pour aerial structure activity. For the PG&E upgrade construction scenarios, the residential nighttime 8-hour L_{eq} criterion of 70 dBA would be exceeded up to 158 feet from the haul material construction activity and as far away as 522 feet from the conductor installation construction activity. These distances identified in Table 3.4-15 would be applicable to all four project alternatives because the same types and duration of construction activities would apply to all four alternatives.

Table 3.4-15 Construction Activity Noise Levels

Construction Activity	Equipment Type	Total 8-Hour L_{eq} (dBA) at 50 feet	Distance to 70 dBA[1] Residential Nighttime Criterion (feet)	Distance to 80 dBA[1] Residential Daytime Criterion (feet)	Distance to 85 dBA[1] Commercial Criterion (feet)	Distance to 90 dBA[1] Industrial Criterion (feet)
Track Construction						
Clear and grub	Dump truck, water truck, rubber-tired dozer, loader, crane	87	374	118	66	37
Grading	Scraper, grader, crushing equipment, dump truck, rubber-tired dozer, excavator, loader, water truck	90	515	163	92	51
Concrete pour aerial structure	Transit mix truck, crane, drill rig, dump truck, flatbed truck, loader, forklift, pump, water truck	94	774	245	138	77
Ballast compaction	Loader, crushing equipment, water truck, dump truck	89	425	134	76	42
Track installation	Crushing equipment, plate compactor, dump truck, grader, scraper, water truck	91	585	185	104	59
PG&E Network Upgrades Construction						
Site preparation	Backhoe, small bulldozer, truck with trailer, water truck, light-duty pickup truck, sweeper/scrubber, plate compactor, motor grader	87	362	114	64	36

Construction Activity	Equipment Type	Total 8-Hour L_{eq} (dBA) at 50 feet	Distance to 70 dBA[1] Residential Nighttime Criterion (feet)	Distance to 80 dBA[1] Residential Daytime Criterion (feet)	Distance to 85 dBA[1] Commercial Criterion (feet)	Distance to 90 dBA[1] Industrial Criterion (feet)
Auger holes	Water truck, pickup truck, line truck with auger attachment	82	202	64	36	20
Haul material	Line truck with trailer	80	158	50	28	16
Tower installation	Crane, helicopter, vacuum trailer, rough terrain forklift, pump, bucket truck	90	483	153	86	48
Conductor installation	Line truck with reel, pickup trucks, line truck with bucket/crane, line truck with conductor puller, line truck with conductor tensioner, helicopter, cement and mortar mixer, dump truck	90	522	165	93	52

[1] Distances for this analysis assume that all pieces of equipment are at the center of the construction site.
L_{eq} = equivalent sound level
dBA = A-weighted decibel
PG&E = Pacific Gas and Electric

As described in Section 3.4.5.1, Noise, sensitive receptors are close to the project alignment in the San Jose Diridon Station Approach, Monterey Corridor, and Morgan Hill and Gilroy Subsections. The closest residential sensitive receptors in these subsections are within 30 to 40 feet of the right-of-way, well within the distances where exceedances of the FRA noise guidelines would occur for typical track construction activities. Sensitive receptors located closer to the construction activities than the distances reported in Table 3.4-15 would experience temporary increases in noise levels in exceedance of the FRA noise impact criteria for a duration of up to 1.5 years at any given location.

For the Monterey Corridor and Morgan Hill and Gilroy Subsections, construction of the viaduct structure (Alternatives 1 and 3) would have a larger criterion distance than the embankment and at-grade track options (Alternatives 2 and 4, respectively) because of the height of the structure and the concrete pumps. For the San Jose Diridon Approach Subsection, the aerial viaduct (Alternatives 1, 2, and 3) would similarly have a larger criterion distance than Alternative 4. Nighttime construction would be required under Alternative 4 to minimize disruption of existing passenger rail services.

CEQA Conclusion

The impact under CEQA would be significant for all four project alternatives because project construction would temporarily and substantially increase ambient noise levels in the noise RSA above levels without project construction, and the noise increase would be in exceedance of FRA guidelines for some receptors proximate to the construction activities—for example, at residences the criteria is 70 dBA for nighttime construction and 80 dBA for daytime construction. The alternatives would incorporate NV-IAMF#1 to minimize noise impacts by requiring compliance with FRA guidelines for minimizing construction noise and vibration impacts when work is conducted within 1,000 feet of sensitive receptors. However, even with NV-IAMF#1, some sensitive receptors would be exposed to construction noise levels that exceed FRA guidelines. Mitigation to address this impact is identified in Section 3.4.9, CEQA Significance Conclusions. Section 3.4.7, Mitigation Measures, describes the mitigation in detail.

Operations Impacts

Project operations would involve scheduled train travel along the HSR tracks through the RSA between stations and to and from the MOWF near Gilroy. Operations would generate additional traffic volumes near the stations and maintenance facilities associated with passengers and employees.

Impact NV#2: Intermittent Permanent Exposure of Sensitive Receptors to Noise from Train Operations

Under the 2029 and 2040 No Project conditions, changes in noise levels would be associated with the Caltrain PCEP. The 2029 and 2040 Plus Project conditions evaluate changes in noise associated with combined implementation of the Caltrain PCEP and the project.

Table 3.4-16 shows the results of 2029 No Project and 2029 Plus Project conditions noise impact assessments. Alternative 1 would result in 47 severe impacts and 307 moderate impacts, Alternative 2 would result in 38 severe impacts and 596 moderate impacts,[7] Alternative 3 would result in 34 severe impacts and 224 moderate impacts, and Alternative 4 would result in 191 severe impacts and 989 moderate impacts. Alternative 4 would have the most severe and moderate operations noise impacts, followed by Alternative 2, Alternative 1, and Alternative 3.

Table 3.4-16 Summary of 2029 No Project and 2029 Plus Project Noise Impacts

Subsection	Land Use Category[1]	No Project		Alternative 1		Alternative 2		Alternative 3		Alternative 4	
		Mod	Sev	Mod	Sev	Mod	Sev	Mod	Sev	Mod	Sev
San Jose Diridon Station Approach	2	0	0	1	3	11	0	11	0	69	53
	1, 3	0	0	0	0	0	0	0	0	0	0
Monterey Corridor	2	0	0	61	4	25	4	61	4	254	7
	1, 3	0	0	0	0	0	0	0	0	0	0
Morgan Hill and Gilroy	2	0	0	158	14	473	8	66	4	577	105
	1, 3	0	0	1	0	1	0	0	0	3	0
Pacheco Pass	2	0	0	8	1	8	1	8	1	8	1
	1, 3	0	0	0	0	0	0	0	0	0	0
San Joaquin Valley	2	0	0	78	25	78	25	78	25	78	25
	1, 3	0	0	0	0	0	0	0	0	0	0
Subtotal	**2**	**0**	**0**	**306**	**47**	**595**	**38**	**224**	**34**	**986**	**191**
	1, 3	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**3**	**0**
Total	**1, 2, 3**	**0**	**0**	**307**	**47**	**596**	**38**	**224**	**34**	**989**	**191**

[1] FRA Land Use Categories are summarized in Table 3.4-5. Land Use Category 1 = Areas where quiet is an essential element to the land use; Category 2 = Residential; Category 3 = Institutional use and passive-use parks.
Mod = moderate
Sev = severe

[7] The Skyway Drive Variants A and B under Alternative 2 would result in no measurable differences in noise impacts on sensitive receptors.

The difference in operations noise impacts between the four project alternatives is predominantly a result of the vertical and horizontal profile of each alternative. The greatest difference among the alternatives occurs in the Morgan Hill and Gilroy Subsection. Many Alternative 4 noise impacts would result from HSR train horns. Alternative 2 would have a longer embankment profile than Alternatives 1 and 3, which are predominantly on aerial structures. Although the aerial structures of Alternatives 1 and 3 would be much higher in the air (which can sometimes lead to higher sound levels because of less ground attenuation), the design of the aerial structures include a 3-foot-high parapet wall that functions as a short noise barrier. This parapet wall would reduce the noise levels from the propulsion and wheel-rail subsources under Alternatives 1 and 3, resulting in fewer noise impacts compared to Alternatives 2 and 4. The horizontal alignment near Gilroy further differentiates the noise and vibration impacts among the four project alternatives. Alternatives 1, 2, and 4 would extend through downtown Gilroy, while Alternative 3 would extend east of Gilroy through rural agricultural lands that are sparsely populated and have fewer sensitive receptors.

Table 3.4-17 shows the results of the 2040 No Project and 2040 Plus Project conditions noise impact assessment. Alternative 1 would result in 334 severe impacts and 1,200 moderate impacts; Alternative 2 would result in 752 severe impacts and 1,844 moderate impacts; Alternative 3 would result in 219 severe impacts and 834 moderate impacts; and Alternative 4 would result in 1,186 severe impacts and 1,639 moderate impacts. The most noise impacts would occur under Alternative 4, followed by Alternative 2, Alternative 1, and Alternative 3. The results of the 2040 Plus Project noise impact assessment indicate significantly more noise impacts relative to those of the 2029 Plus Project noise impact assessment due to increased operations.

Table 3.4-17 Summary of 2040 No Project and 2040 Plus Project Noise Impacts

Subsection	Land Use Category[1]	No Project		Alternative 1		Alternative 2		Alternative 3		Alternative 4	
		Mod	Sev	Mod	Sev	Mod	Sev	Mod	Sev	Mod	Sev
San Jose Diridon Station Approach	2	0	0	117	20	73	0	73	0	221	124
	1, 3	0	0	1	0	0	0	0	0	1	0
Monterey Corridor	2	0	0	225	46	326	46	225	46	235	280
	1, 3	0	0	1	0	1	0	1	0	3	0
Morgan Hill and Gilroy	2	0	0	815	160	1,399	598	498	65	1,132	673
	1, 3	0	0	4	0	8	0	0	0	10	1
Pacheco Pass	2	0	0	4	9	4	9	4	9	4	9
	1, 3	0	0	0	0	0	0	0	0	0	0
San Joaquin Valley	2	0	0	32	99	32	99	32	99	32	99
	1, 3	0	0	1	0	1	0	1	0	1	0
Subtotal	**2**	**0**	**0**	**1,193**	**334**	**1,834**	**752**	**832**	**219**	**1,624**	**1,185**
	1, 3	**0**	**0**	**7**	**0**	**10**	**0**	**2**	**0**	**15**	**1**
Total	**1,2,3**	**0**	**0**	**1,200**	**334**	**1,844**	**752**	**834**	**219**	**1,639**	**1,186**

[1] FRA Land Use Categories are summarized in Table 3.4-5. Land Use Category 1 = Areas where quiet is an essential element to the land use; Category 2 = Residential; Category 3 = Institutional use and passive-use parks.
Mod = moderate
Sev = severe

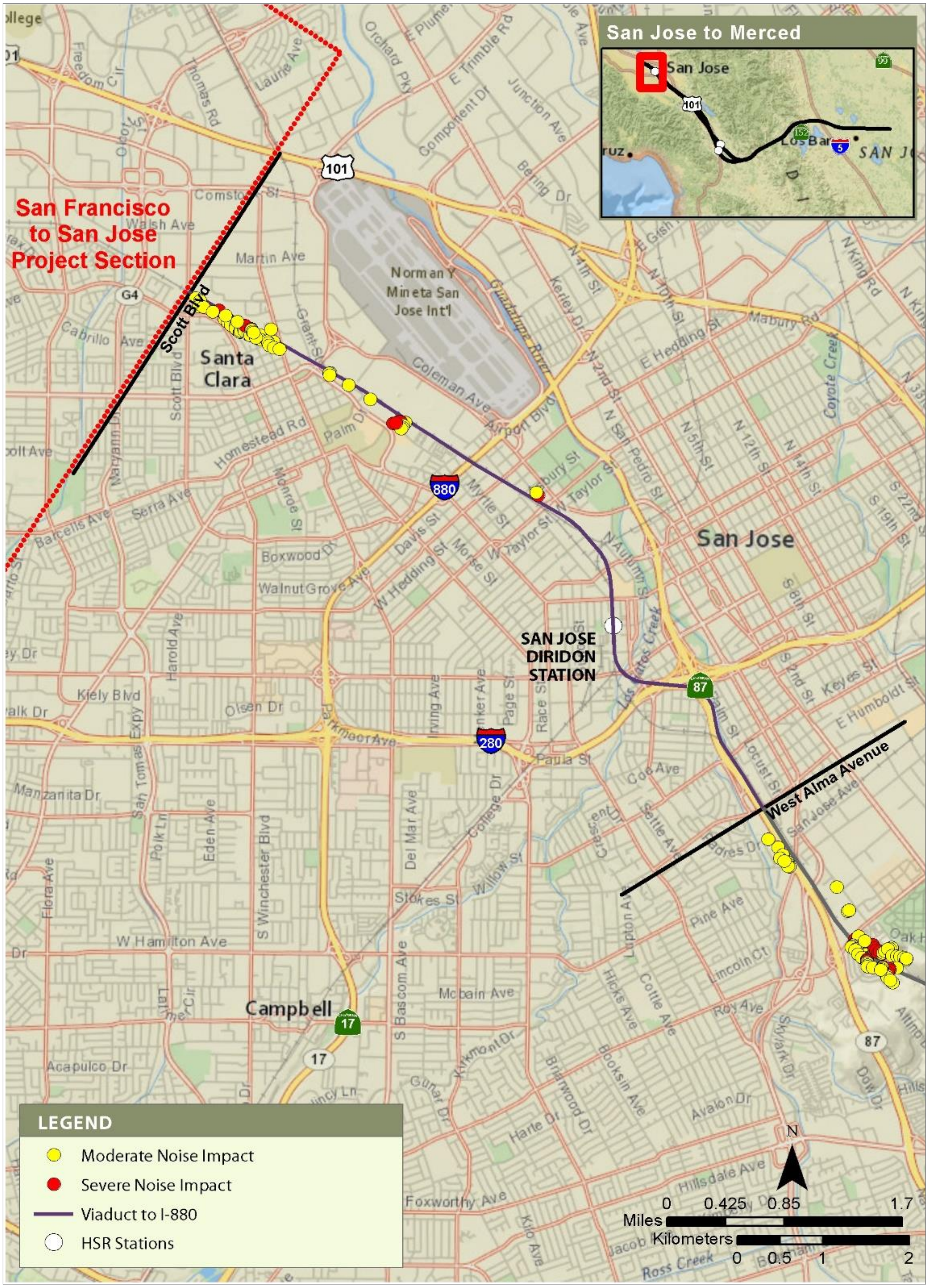
Figure 3.4 8 through Figure 3.4 21 illustrate the 2040 Plus Project noise impact locations for each project alternative. For the San Jose Diridon Station Approach Subsection, the Monterey Corridor Subsection, and the Morgan Hill and Gilroy Subsection, the noise impact locations for Alternative 1 are illustrated on Figure 3.4-8 through Figure 3.4-10. For the Pacheco Pass and San Joaquin Valley Subsections, the noise impact locations are the same for the four project alternatives and are illustrated on Figure 3.4-11 and Figure 3.4-12. Noise impact locations for the San Jose Diridon Station Approach, the Monterey Corridor, and the Morgan Hill and Gilroy Subsections for Alternative 2 are illustrated on Figure 3.4-13 through Figure 3.4-15; noise impact locations for these three subsections for Alternative 3 are illustrated on Figure 3.4-16 through Figure 3.4-18; and noise impact locations for these three subsections for Alternative 4 are illustrated on Figure 3.4-19 through Figure 3.4-21. Each red dot indicates a cluster of receptors predicted to have severe impacts and each yellow dot indicates a cluster of receptors predicted to have moderate impacts for the 2040 Plus Project condition.

Implementation of the project alternatives would change the current practices regarding the sounding of train horns and crossing bells in the noise RSA. Most of the length of Alternatives 1 and 3 would be grade separated and on aerial structures. As a result, there are no locations where HSR trains would regularly sound warning horns. Alternative 1 would eliminate one existing at-grade railway crossing at Bloomfield Avenue in Gilroy, which would eliminate horn noise at that location. Alternative 2 would be predominantly located on an embankment in or adjacent to the existing Caltrain/UPRR railway, which would necessitate the elimination of 33 existing at-grade crossings where trains currently sound warning horns. The elimination of at-grade crossings associated with Alternative 2 would produce a beneficial impact because of reduced noise exposure from horns and crossing bells. Existing trains would still sound horns at Caltrain stations with Alternative 2.

Alternative 4 would be at grade at the same locations as the existing Caltrain and other passenger and freight operations. As a result, HSR trains under Alternative 4 would regularly sound warning horns at all at-grade crossings and Caltrain passenger stations.

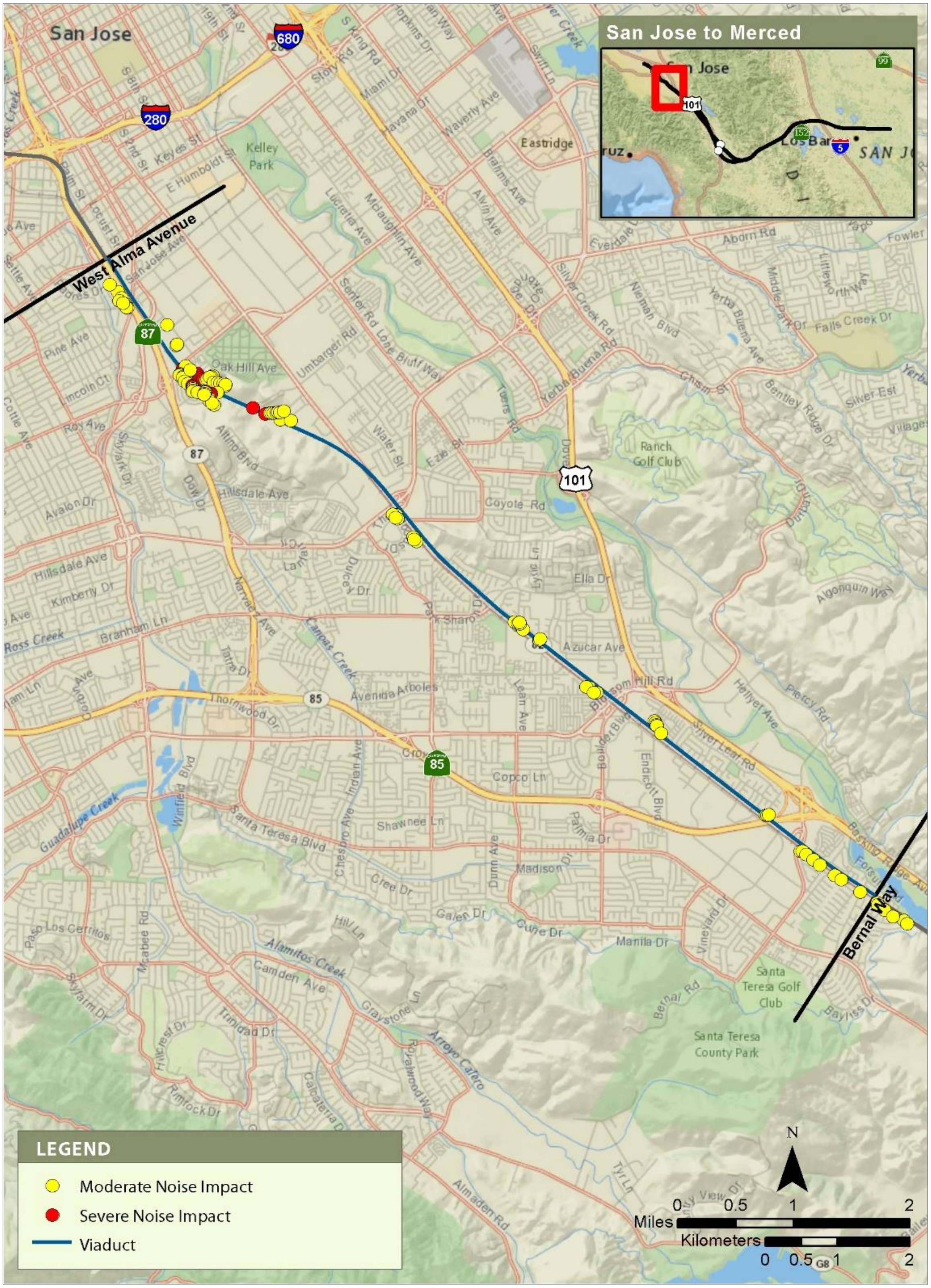
CEQA Conclusion

The impact under CEQA would be significant for all four project alternatives because operations would generate noise levels above existing ambient levels and in exceedance of FRA criteria, causing severe noise impacts at sensitive receptors. This exceedance would occur under all four project alternatives and in both the opening year and 2040, although the most noise impacts would occur in 2040, and under Alternative 4, followed by Alternative 2, Alternative 1, and Alternative 3. The difference in operational noise impacts among project alternatives would be attributed to HSR horns with Alternative 4 and would be relative to the vertical and horizontal profile of each alternative, which would vary to the greatest extent in the Morgan Hill and Gilroy Subsection. Mitigation to address this impact is identified in Section 3.4.9, CEQA Significance Conclusions. Section 3.4.7, Mitigation Measures, describes the mitigation in detail.



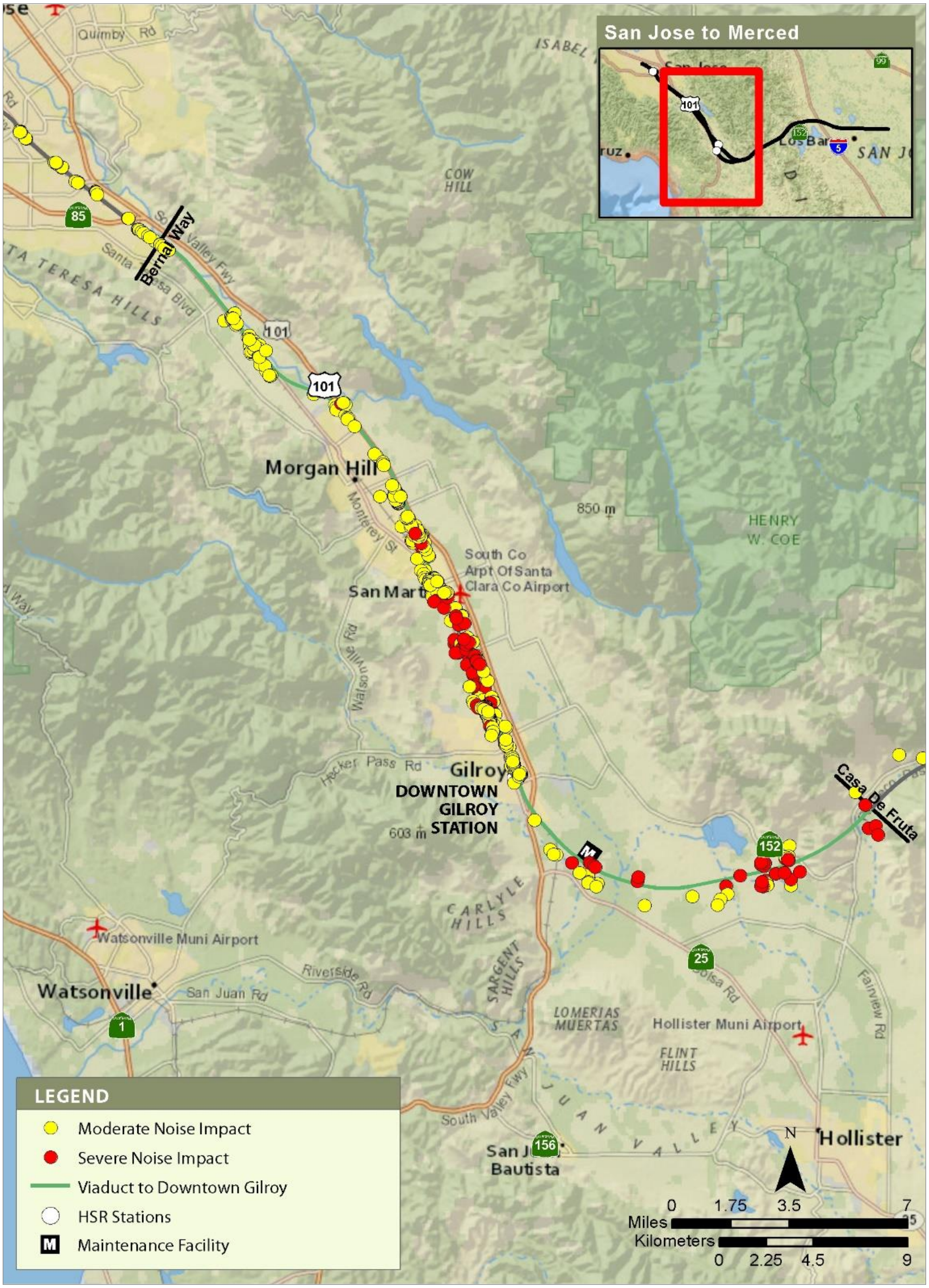
FEBRUARY 2019

Figure 3.4-8 2040 Plus Project Noise Impacts—Alternative 1 (San Jose Diridon Station Approach Subsection)



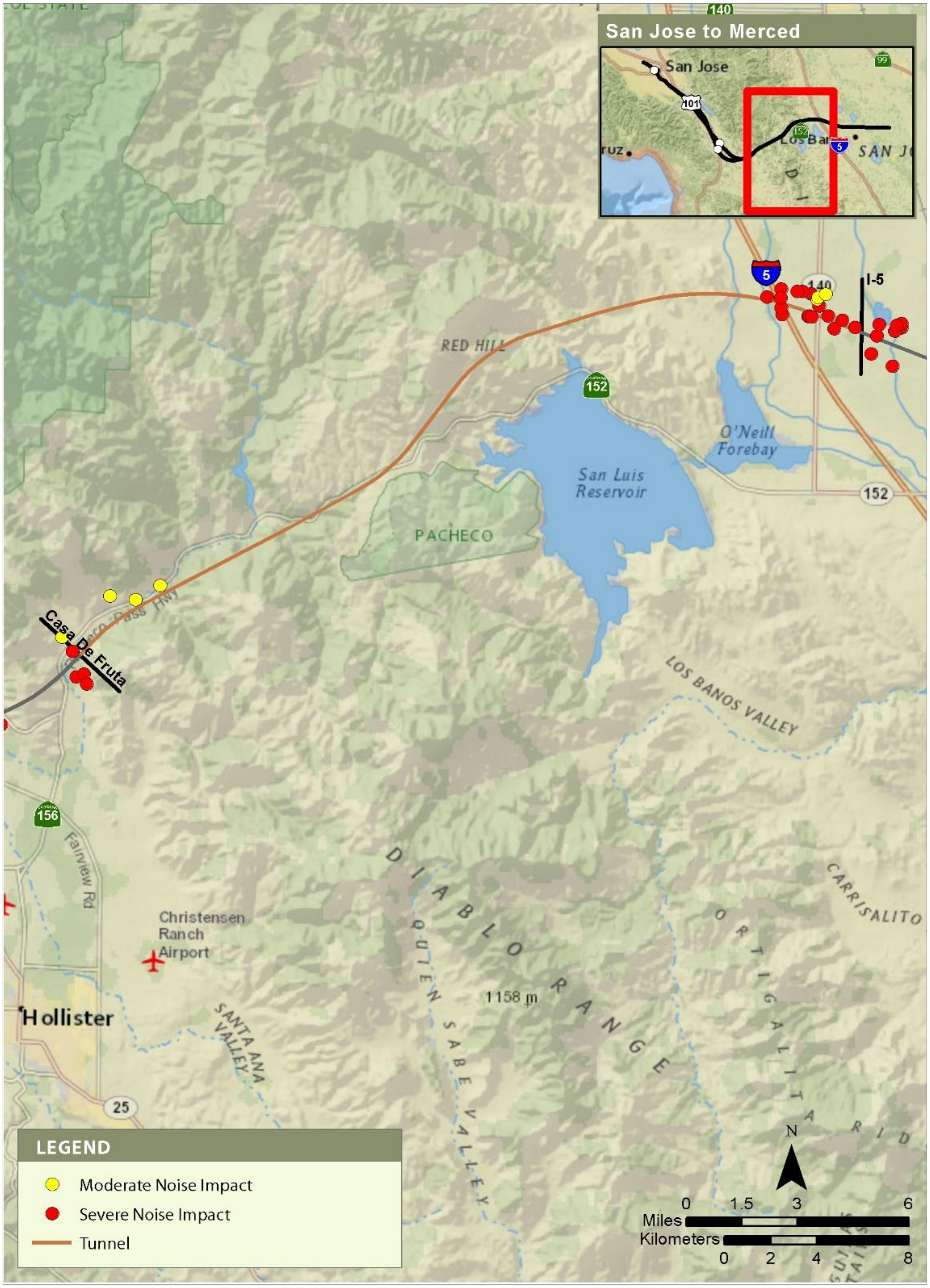
FEBRUARY 2019

Figure 3.4-9 2040 Plus Project Noise Impacts—Alternative 1 (Monterey Corridor Subsection)



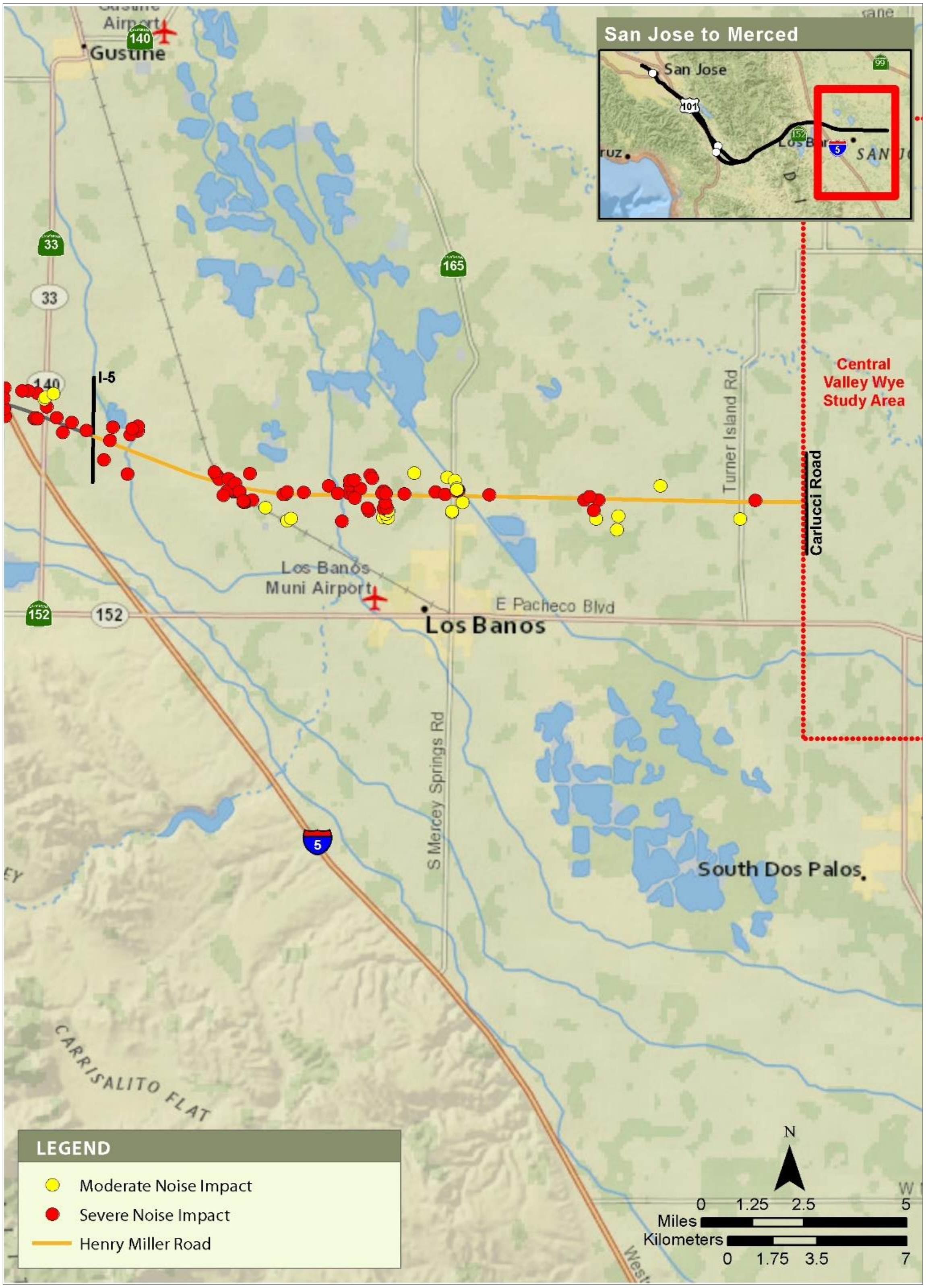
FEBRUARY 2019

Figure 3.4-10 2040 Plus Project Noise Impacts—Alternative 1 (Morgan Hill and Gilroy Subsection)



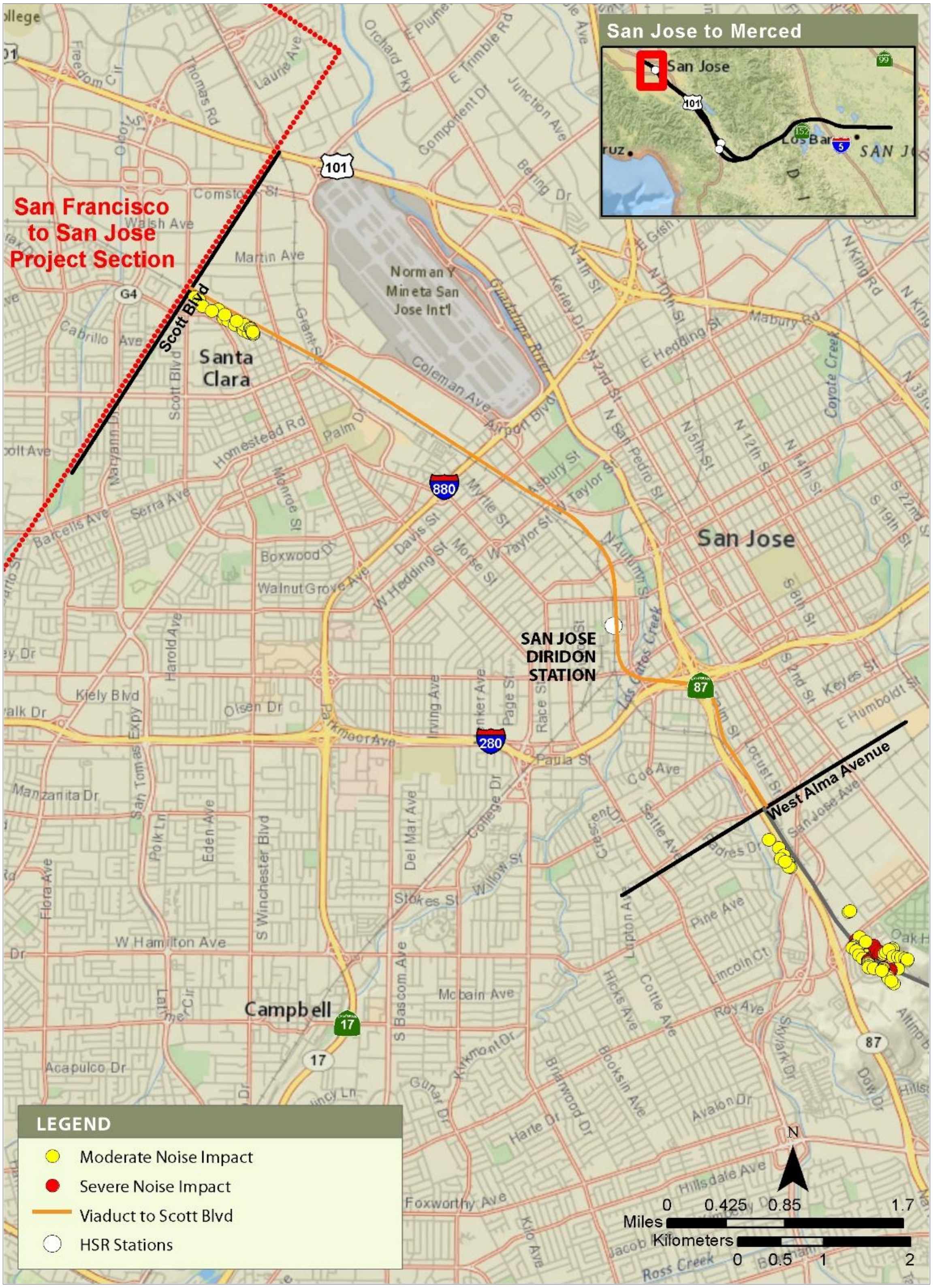
FEBRUARY 2019

Figure 3.4-11 2040 Plus Project Noise Impacts—Alternatives 1, 2, 3, and 4 (Pacheco Pass Subsection)



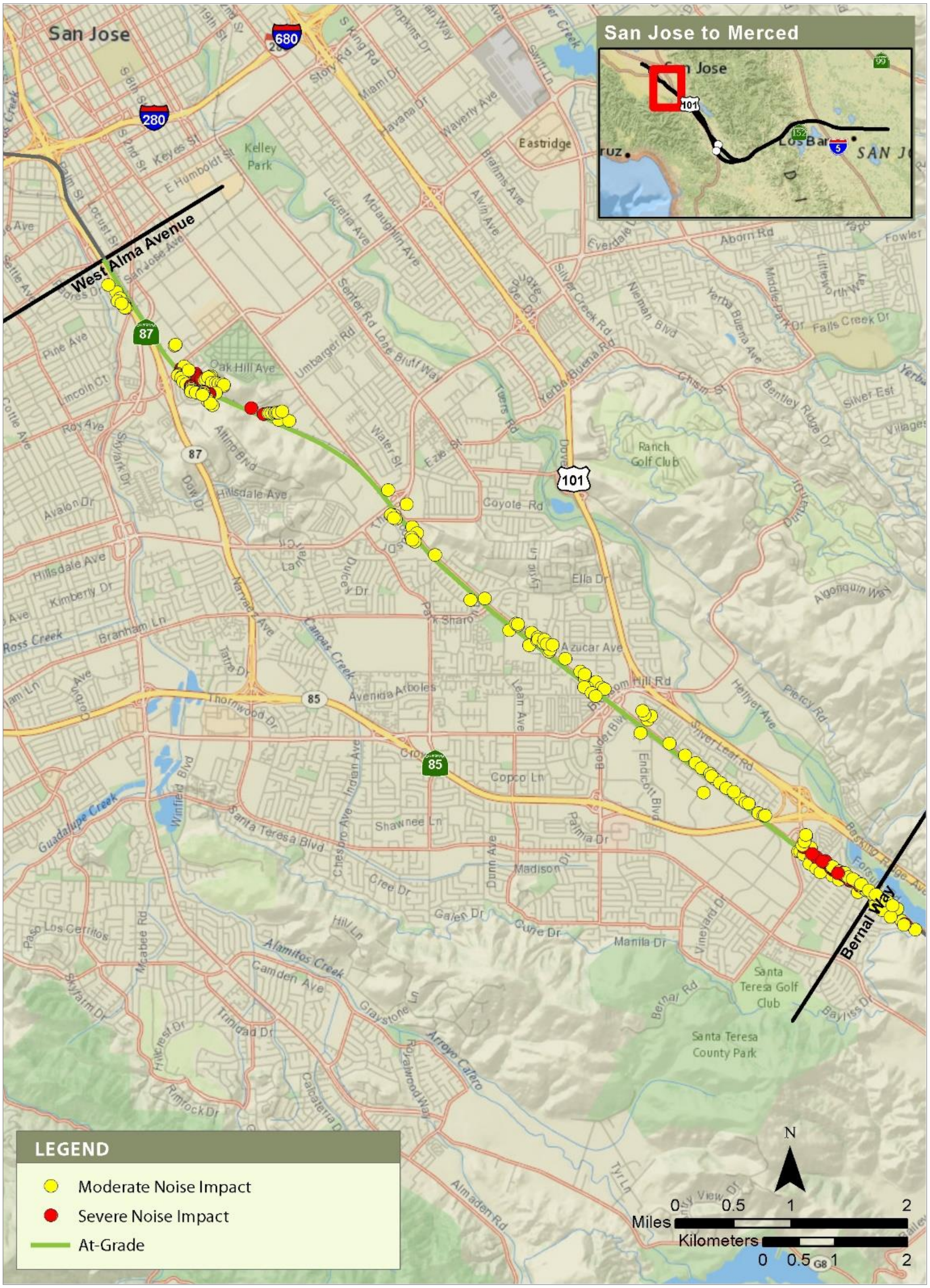
FEBRUARY 2019

Figure 3.4-12 2040 Plus Project Noise Impacts—Alternatives 1, 2, 3, and 4 (San Joaquin Valley Subsection)



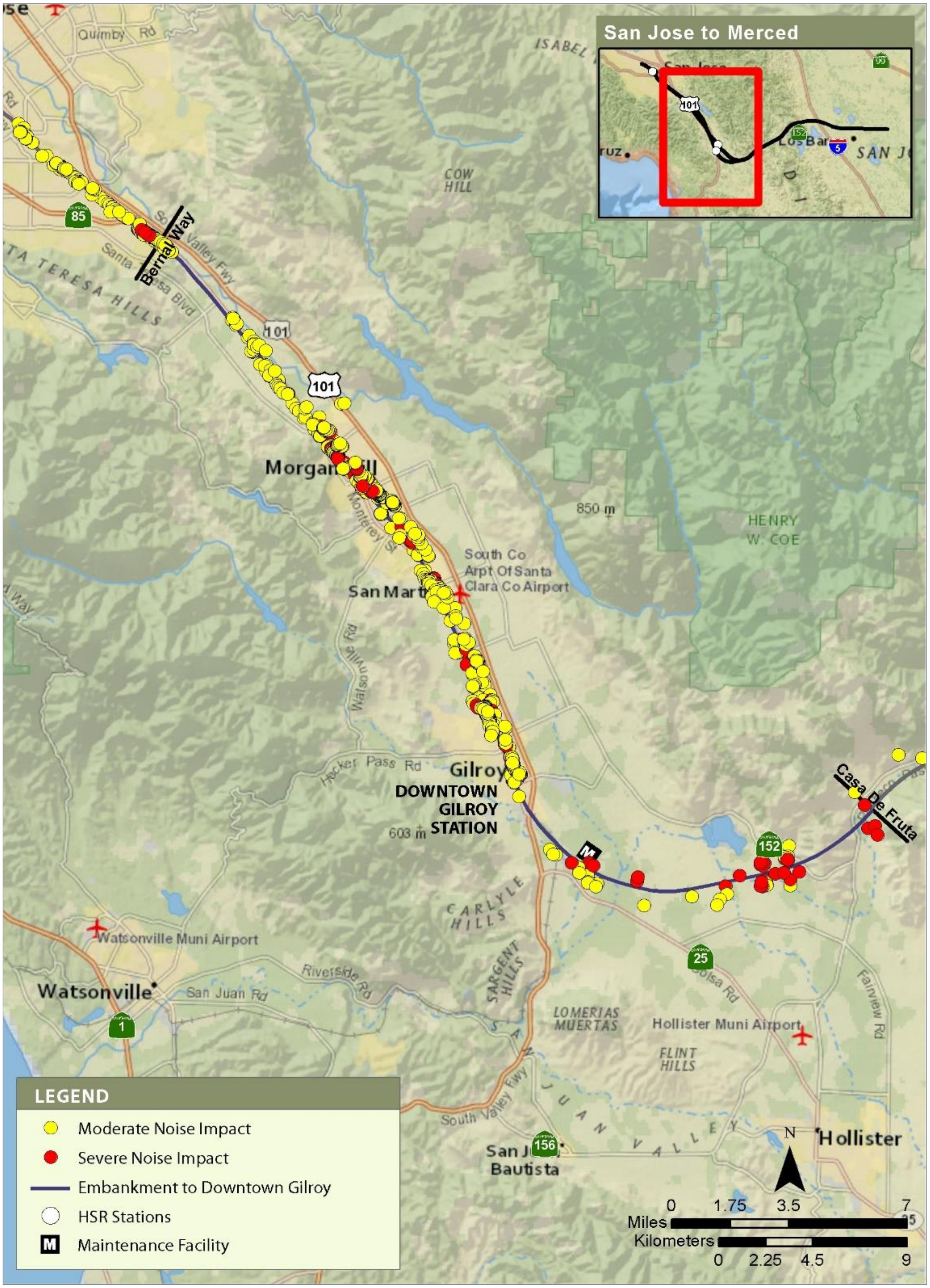
FEBRUARY 2019

Figure 3.4-13 2040 Plus Project Noise Impacts—Alternative 2 (San Jose Diridon Station Approach Subsection)



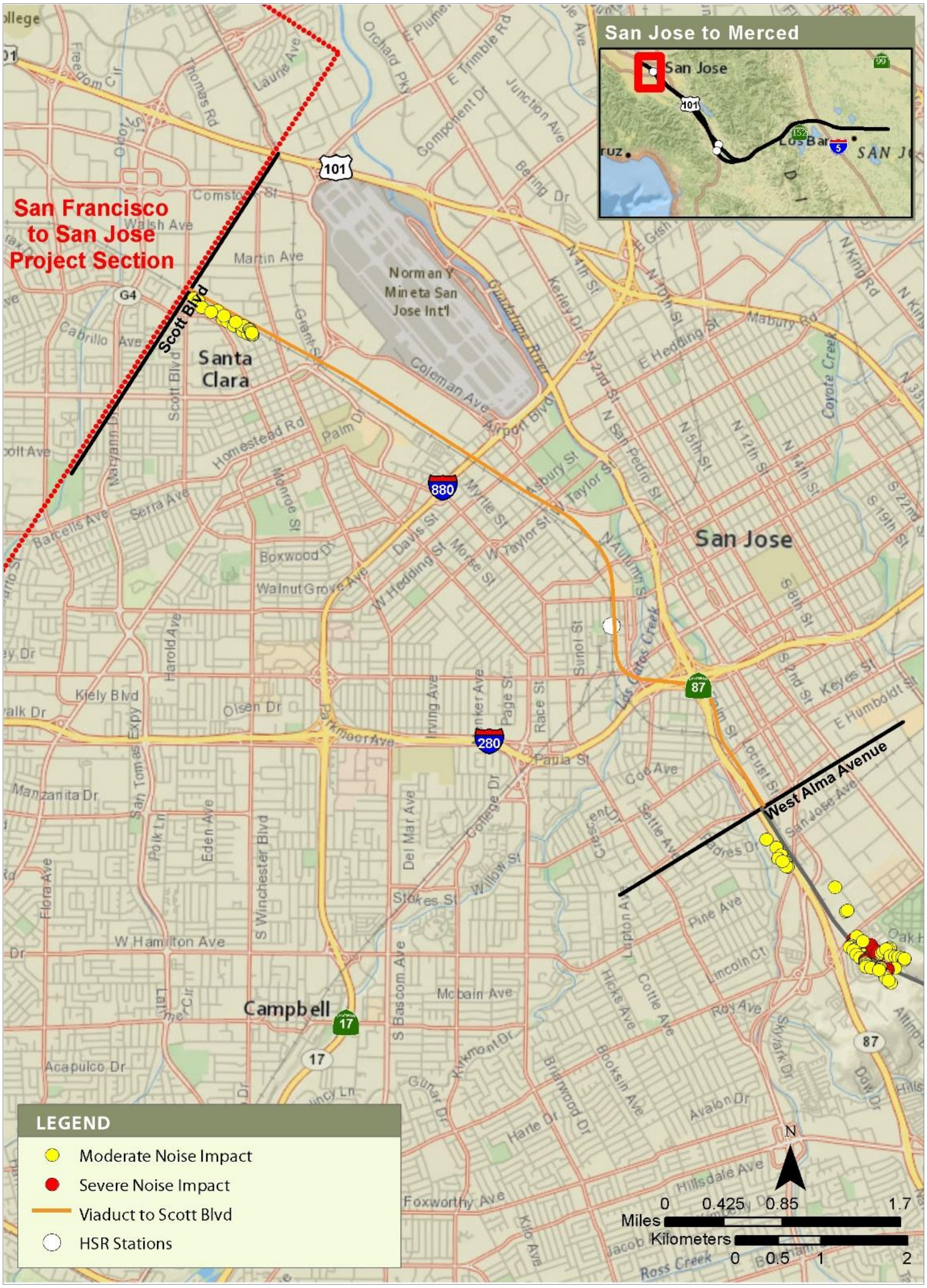
FEBRUARY 2019

Figure 3.4-14 2040 Plus Project Noise Impacts—Alternative 2 (Monterey Corridor Subsection)



FEBRUARY 2019

Figure 3.4-15 2040 Plus Project Noise Impacts—Alternative 2 (Morgan Hill and Gilroy Subsection)



FEBRUARY 2019

Figure 3.4-16 2040 Plus Project Noise Impacts—Alternative 3 (San Jose Diridon Station Approach Subsection)

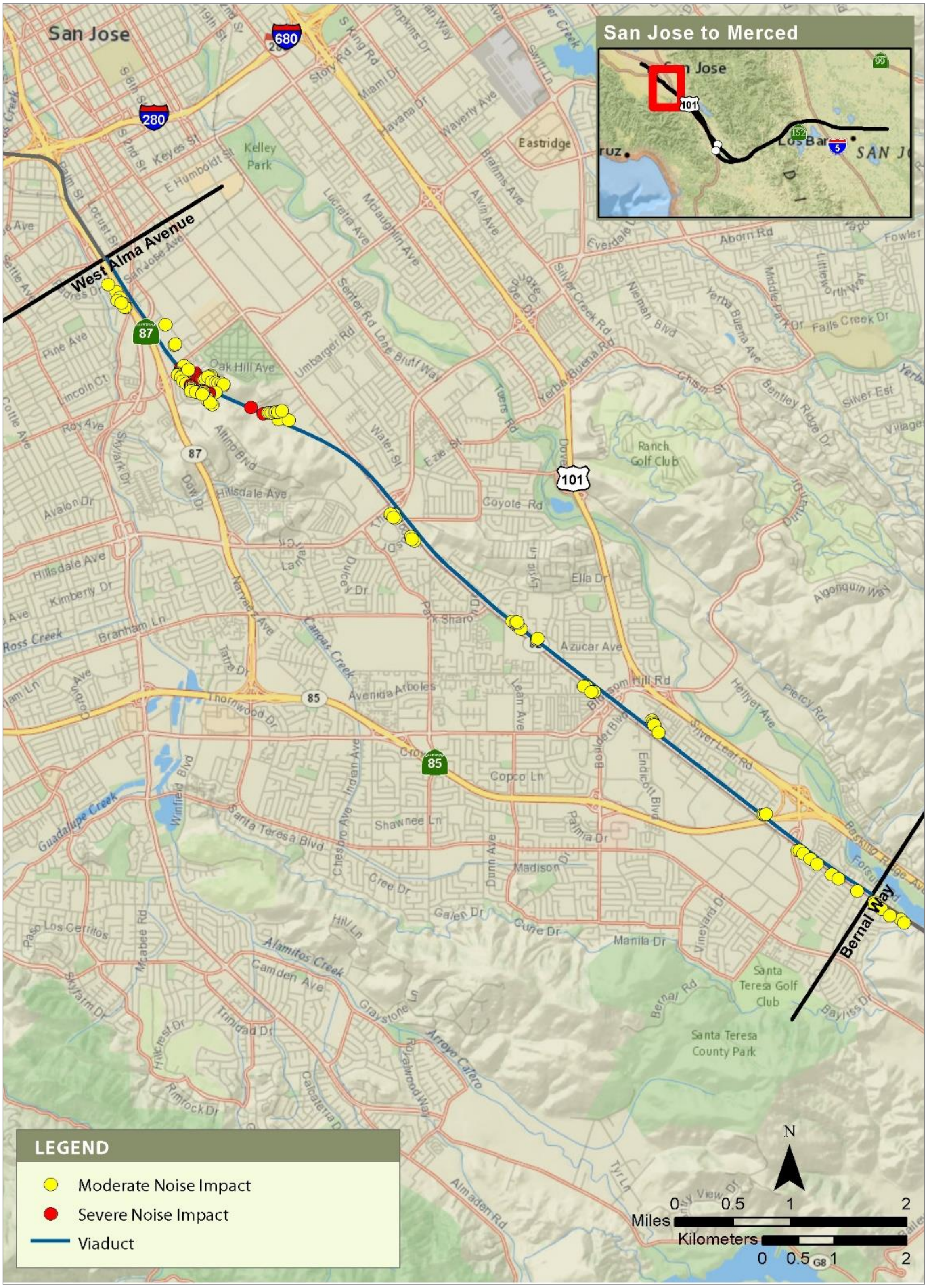
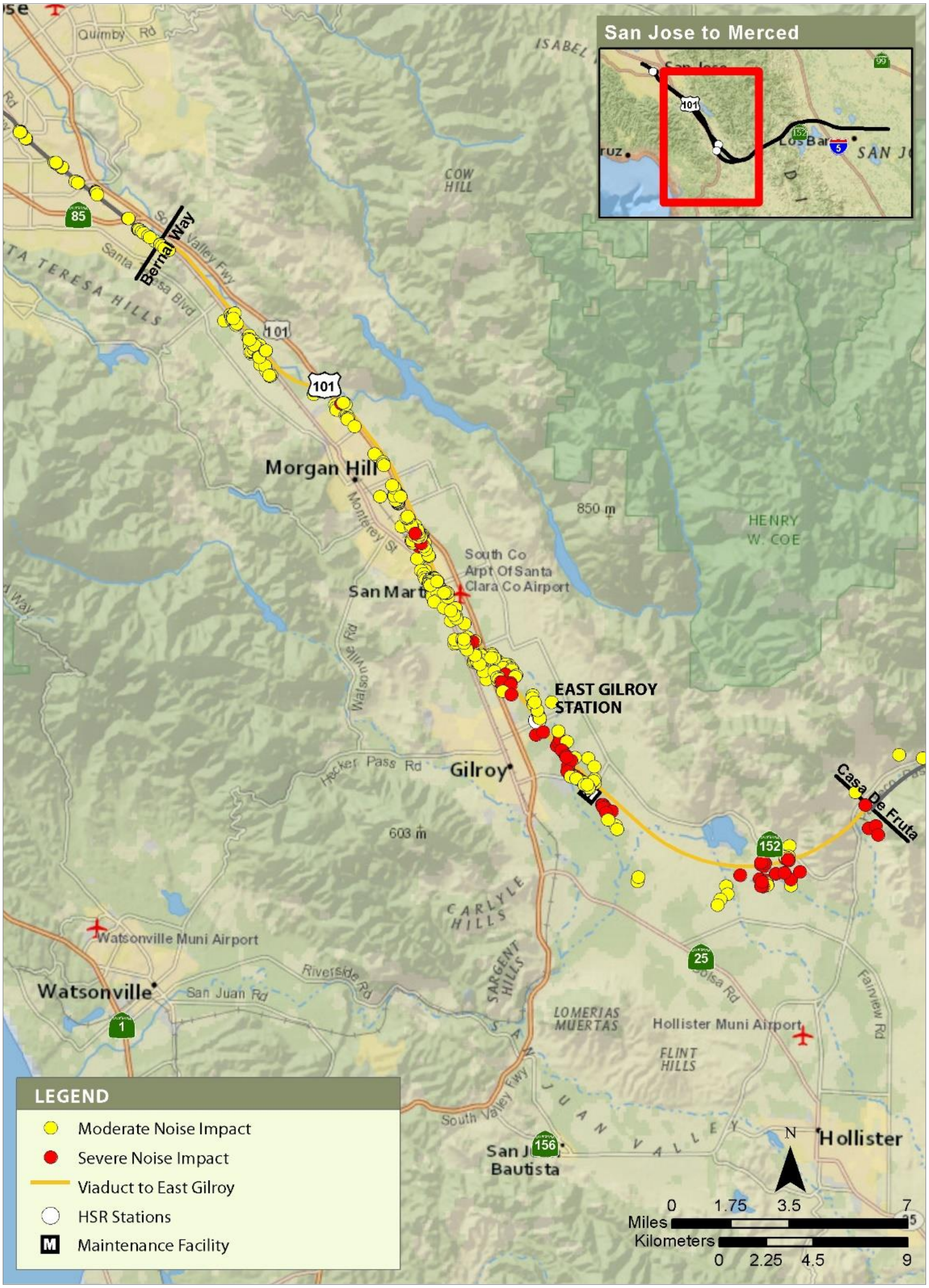


Figure 3.4-17 2040 Plus Project Noise Impacts—Alternative 3 (Monterey Corridor Subsection)

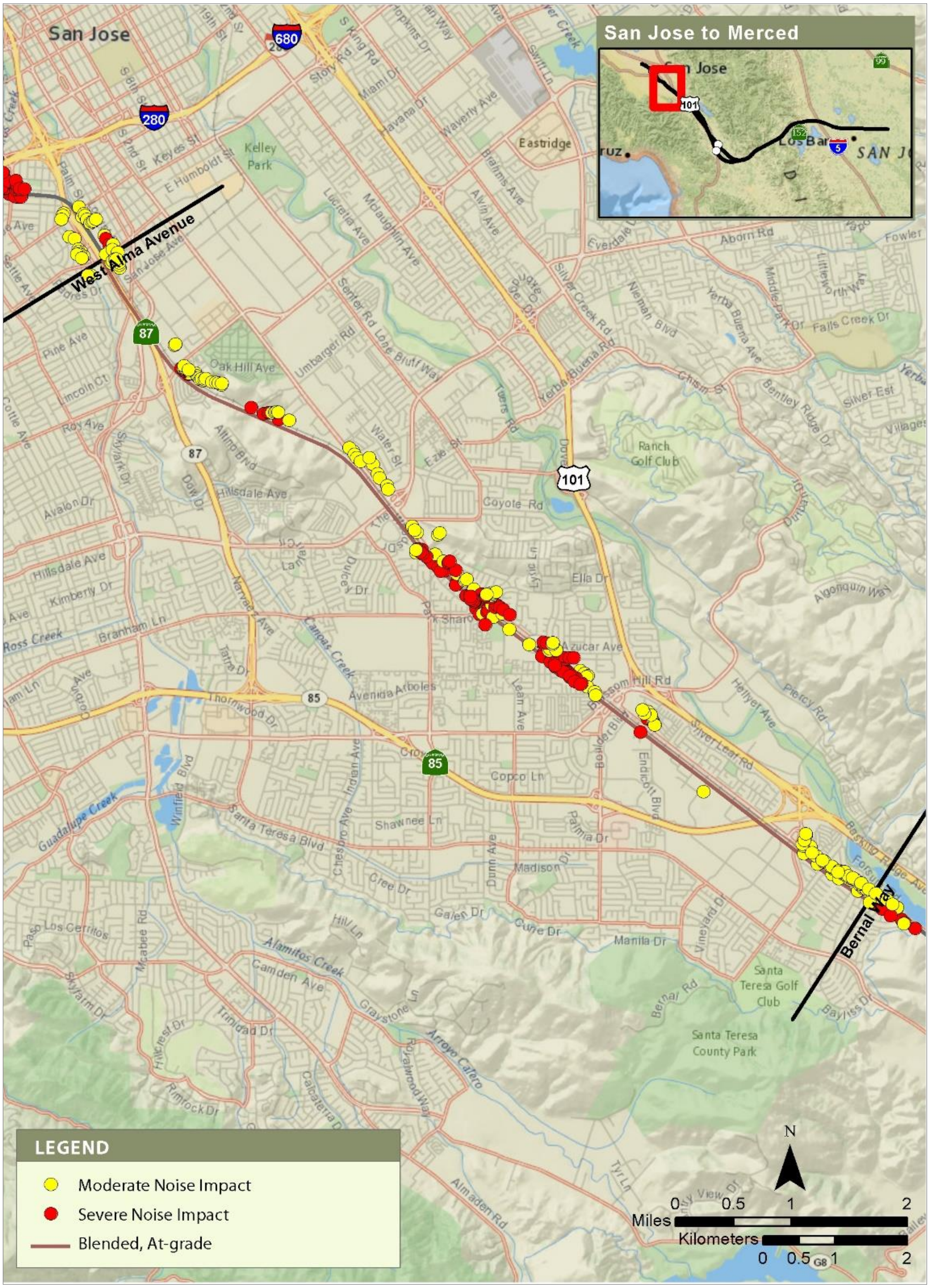


FEBRUARY 2019

Figure 3.4-18 2040 Plus Project Noise Impacts—Alternative 3 (Morgan Hill and Gilroy Subsection)

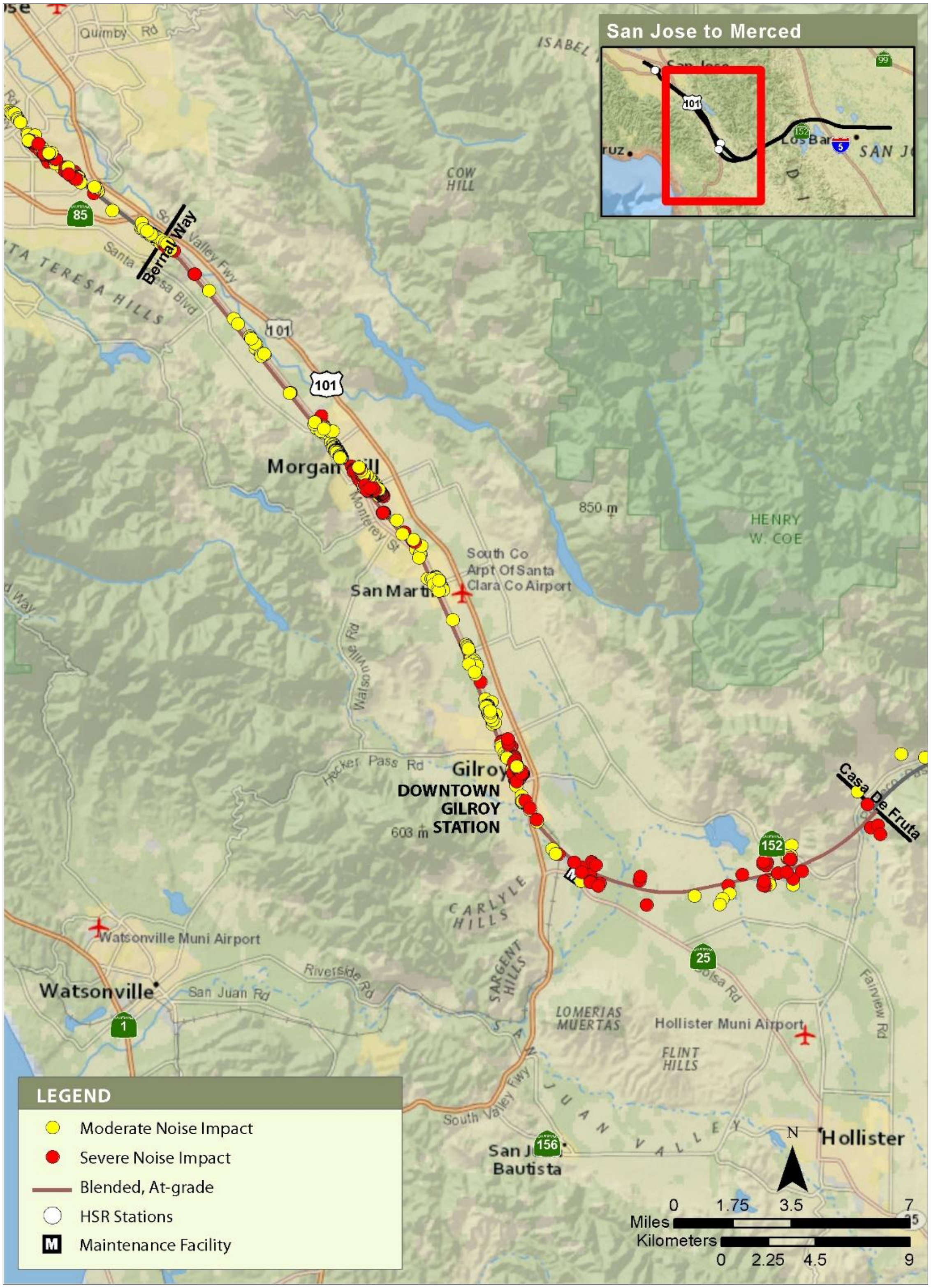
FEBRUARY 2019

Figure 3.4-19 2040 Plus Project Noise Impacts—Alternative 4 (San Jose Diridon Station Approach Subsection)



FEBRUARY 2019

Figure 3.4-20 2040 Plus Project Noise Impacts—Alternative 4 (Monterey Corridor Subsection)



FEBRUARY 2019

Figure 3.4-21 2040 Plus Project Noise Impacts—Alternative 4 (Morgan Hill and Gilroy Subsection)

Impact NV#3: Intermittent Permanent Exposure of Sensitive Receptors to Noise from HSR Passenger Station Parking

The project includes the construction of two HSR stations—one passenger station would be in San Jose adjacent to the existing San Jose Diridon Station and the other would be in Gilroy. The San Jose Diridon Station would be the same under Alternatives 1 through 3, with a variation under Alternative 4, and would remove and relocate approximately 226 parking spaces. Two station location options have been identified in Gilroy. Alternatives 1, 2, and 4 would include a Downtown Gilroy Station adjacent to the existing Gilroy Caltrain Station, while Alternative 3 would include an East Gilroy Station, which would be built in agricultural lands east of Gilroy. The Downtown Gilroy Station would have four parking areas with 1,710 total spaces, and the East Gilroy Station would have two parking areas with 1,520 total spaces.[8]

The evaluation of the noise generated from the station parking facilities determined that the San Jose Diridon Station parking facilities would result in an L_{dn} contribution of 29 dBA at nearby sensitive receptors. Near the Downtown Gilroy Station, the largest L_{dn} contribution from the parking facilities at the nearby noise receptors would be 40 dBA, while the East Gilroy Station parking facilities would have an L_{dn} contribution at the nearby noise receptors of 28 dBA. Accordingly, the additional noise from parking facilities would be substantially lower (at least 18 dB less) than the projected L_{dn} from project operations and would be nearly inaudible.

CEQA Conclusion

The impact under CEQA would be less than significant for all four project alternatives because operations of HSR passenger stations would provide only a minor contribution to the overall noise generated by project operations. Because the dominant noise source at HSR passenger stations would be train operations, the minor contribution of traffic in the station parking facilities would not result in the generation of noise levels in excess of standards for a severe impact established by the FRA. Therefore, CEQA does not require mitigation.

Impact NV#4: Intermittent Permanent Exposure of Sensitive Receptors to Noise from HSR Maintenance Facilities

The project would include the operation of one MOWF near Gilroy. There are three potential location options for the MOWF—a South Gilroy MOWF (south of the Downtown Gilroy Station under Alternatives 1 and 2), an East Gilroy MOWF (south of the East Gilroy Station under Alternative 3), and a South Gilroy MOWF south of the Downtown Gilroy Station under Alternative 4, but at a different location than Alternatives 1 and 2. At all three locations, the mainline HSR tracks would be directly adjacent to the MOWF and the HSR speeds would be approximately 200 mph. Therefore, the noise from project operations would dominate noise from occasional HSR train movements into and out of the MOWF.

Analysts used preliminary layouts of the MOWFs near Gilroy to identify the approximate center of noise-producing activities at the facilities. The project operations schedule identified 24 planned HSR train movements into and out of the MOWF during the daytime and 12 movements during the nighttime. The L_{dn} contribution from these MOWF train movements was calculated at all nearby noise-sensitive receptors.

The closest identified receptor (single-family residence on Bolsa Road) to the South Gilroy MOWF under Alternatives 1 and 2 is more than 1,500 feet away. The L_{dn} contribution from the South Gilroy MOWF under Alternatives 1 and 2 at that nearest receptor would be 40 dBA, more than 20 dB less than the noise from HSR train operations at that receptor. The nearest receptors (residences on Pacheco Pass Highway in the rural residential Old Gilroy neighborhood) to the East Gilroy MOWF are approximately 800 feet away. In this neighborhood, the highest L_{dn} contribution from the MOWF would be 47 dBA, more than 20 dB less than noise from HSR train

[8] The analysis assumed that on a typical day during the three morning and afternoon peak hours, all the parking spaces would be filled once and vacated once (turned over). During the nonpeak, midday, and evening hours, the analysis assumed that a percentage of the parking space corresponding to the ridership peaking factors would turn over each hour (Authority 2008).

operations at that receptor. The nearest receptors to the Alternative 4 South Gilroy MOWF are approximately 900 feet away. In this neighborhood, the highest L_{dn} contribution from the MOWF would be 45 dBA, more than 18 dB less than noise from HSR train operations at that receptor. As a result, the additional noise from all of the MOWFs would not contribute to noise impacts on nearby sensitive receptors.

CEQA Conclusion

The impact under CEQA would be less than significant for all four project alternatives because the sound levels from the MOWFs would be substantially less than from HSR train operations. Therefore, the MOWFs would not contribute to or cause noise impacts. Therefore, CEQA does not require mitigation.

Impact NV#5: Intermittent Permanent Human Annoyance from Onset of Passing HSR Trains

Under all project alternatives, trains would reach maximum speeds of 220 mph in certain portions of the alignments with dedicated track. As shown on Figure 3.4-4, the onset rate of 30 dB/second would be experienced by receptors within 46 feet of the train when the train is operating at 220 mph and within 23 feet when the train is operating at 110 mph. For speeds between 110 mph and 220 mph, the onset rate of 30 dB/second would be experienced at distances between 23 and 46 feet from the train. For speeds less than 110 mph, the onset rate of 30 dB/second would be experienced at distances of less than 23 feet from the train.

The project's dedicated right-of-way would be a minimum of 85 feet wide. In addition, the dedicated segments are usually on viaduct or embankments instead of at-grade, which introduces additional vertical distance separation from sensitive receptors. As the distance for the startle effect for humans is 46 feet, it is expected that the distance in which startle effects would occur would be within the dedicated right-of-way. This would apply to Alternative 1 south of I-880, Alternatives 2 and 3 south of Scott Boulevard, and Alternative 4 south of Gilroy.

Under Alternative 1, blended operations would occur between Scott Boulevard and I-880, but the right-of-way is sufficiently wide that there are no noise-sensitive receptors within 23 feet of the planned track alignments.

Under Alternative 4, blended operations would occur between Scott Boulevard in Santa Clara and San Jose and Gilroy, with speeds up to 110 mph. Noise-sensitive receptors within 23 feet of the alignment would experience an onset rate of 30 dB/second. Between Scott Boulevard and the San Jose Diridon Station, there is extensive daily train traffic along the Caltrain Corridor, including Caltrain (92 daily trains), ACE (8 daily trains), Capitol Corridor (14 daily trains), Amtrak (2 daily trains), and freight (9 daily trains). Between the San Jose Diridon Station and Tamien Station, a moderate amount of daily train traffic operates along the Caltrain Corridor, including Caltrain (40 daily trains), ACE (8 daily trains), Amtrak (2 daily trains), and freight (4 daily trains). Between Tamien Station and Gilroy, there is limited existing daily train traffic along the Caltrain and UPRR corridors, including Caltrain (6 daily trains), Amtrak (2 daily trains), and freight (4 daily trains). At present, trains operate up to 79 mph in these areas.

Passengers may be on Caltrain or HSR platforms closer than 23 feet from the tracks. However, there would be advance warning of trains approaching with announcements, horns, bells, and signage, so substantial, ongoing startle effects would not occur there with train passage. The same would be true at the at-grade crossings for vehicles, bicyclists, and pedestrians under Alternative 4.

Analysts reviewed the Alternative 4 alignment between Scott Boulevard in Santa Clara and Gilroy and found that in most areas (outside of stations and at-grade crossings), there would be more than 23 feet from the outermost track to sensitive noise receptors and no startle effects would occur. Analysts identified one noise-sensitive receptors within 23 feet of the Alternative 4 tracks (receptors in properties not immediately adjacent to the railroad right-of-way would not be affected):[9]

- Morgan Hill and Gilroy Subsection
  - In Morgan Hill, one mobile home east of Wright Avenue west of the right-of-way south of Butterfield Boulevard I, is within 23 feet of the proposed southbound track.

Based on the current tunnel design, roughly half of the sound generated in the tunnel would pass out through the portal, and the other half would propagate into the interior. The effect would be a rapid rise in sound level as the train leaves the tunnel and portal, forewarned by a propagating wave ahead of the train. Depending on the shape of the portal, shape of the train nose, and blockage ratio, the rate of pressure rise associated with rapid train movement can be substantial. The pressure wave front rate of rise is reduced by friction between the moving air column and tunnel wall, so that the pressure wave does not easily develop into a shock wave. This portal noise effect has been studied theoretically and experimentally and is well understood. However, as described in Chapter 2, Alternatives, attenuation of the portal noise will be achieved with long, flared portals and low blockage ratios. In-tunnel cross-passages and vents may also be utilized to reduce pressure magnitudes and rates of rise, though passage of these vents may generate additional propagating and steepening wave fronts. These tunnel and tunnel portal design features will be used to attenuate additional noise associated with the train entering or exiting a tunnel.

CEQA Conclusion

The impact under CEQA would be less than significant under Alternatives 1, 2, and 3 between San Jose and Gilroy, and under all project alternatives from Gilroy to the San Joaquin Valley, because the area where the startle effect could occur is within the HSR right-of-way, which would be fenced off from public access. Therefore, startle of adjacent sensitive receptors would not occur, and these alternatives would not result in the generation of noise levels in excess of standards for a severe impact established by the FRA. Therefore, CEQA does not require mitigation

Under all alternatives, at Caltrain or HSR stations, passengers may be on HSR platforms closer than 23 feet from the tracks but would have advance warning of trains approaching, so substantial, ongoing startle effects would not occur. The same would be true at the at-grade crossings for vehicles, bicyclists, and pedestrians under Alternative 4.

Under Alternative 4, one sensitive noise receptor was identified less than 23 feet from the nearest track; residents at that location would be initially startled by approaching trains traveling at up to 110 mph in areas where the receptors currently experience train passbys up to 79 mph and this is considered significant because the onset noise rate would exceed the identified threshold for sudden onset noise. Mitigation to address this impact is identified in Section 3.4.9, CEQA Significance Conclusions. Section 3.4.7, Mitigation Measures, describes the mitigation in detail.

Regarding tunnel portal noise, project tunnel and portal design included in the project description will attenuate noise pressure magnitudes and rate of rise and thus impacts relative to tunnel portal noise would be less than significant.

Impact NV#6: Permanent Exposure of Sensitive Receptors to Vehicular Traffic Noise Increases

In addition to noise from project operations, analysts evaluated noise from changes in vehicle traffic volume from existing conditions compared to those associated with the project at HSR stations and MOWFs for 2029 and 2040 No Project and Plus Project conditions. Alternative 2 would eliminate a number of existing at-grade crossings, but these are not expected to increase traffic volume. Monterey Road is the only major road that would be substantially reconfigured by

[9] If residences are proposed for acquisition, they are not included in the profile of potentially affected areas because residents would not be present during operations.

the project, with a reduction of travel lanes from six to four lanes between Capitol Expressway and Blossom Hill Road.

Project operations would generate additional traffic and traffic-related noise under the 2029 Plus Project and 2040 Plus Project conditions when compared to the existing conditions. Volume 2, Appendix 3.4-A, provides the existing total average daily traffic volumes for each roadway segment under 2029 No Project and the 2029 Plus Project conditions for each project alternative, and calculates the noise increases over existing noise conditions and over the No Project Alternative. Table 3.4-18 summarizes the number of roadway segments with noise increases greater than or equal to 3 dB over existing conditions by alternative under the 2029 and 2040 Plus Project conditions.

Table 3.4-18 2029 and 2040 Plus Project Number of Roadway Segments with Traffic-Related Noise Increases More than 3 dBA above Existing Noise Conditions

Subsection and Roadway Segments	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
	2029	2040	2029	2040	2029	2040	2029	2040
San Jose Diridon Station Approach Subsection								
San Jose Roadway Segments	4	5	4	5	4	5	3	4
Monterey Corridor Subsection								
Monterey Road Segments	1	4	1	4	1	4	2	4
Morgan Hill and Gilroy Subsection								
Monterey Road Segments	1	2	1	2	1	2	1	2
Downtown Gilroy Station Roadway Segments	0	0	0	0	0	0	0	1
East Gilroy MOWF Roadway Segments	0	0	0	0	0	1	0	0
Gilroy MOWF Roadway Segments	1	1	1	1	0	0	0	1
Totals	**7**	**12**	**7**	**12**	**6**	**12**	**6**	**12**

dBA = A-weighted decibels
MOWF = maintenance of way facility

Permanent increases in traffic-related noise would be similar for all four project alternatives and would occur at roadways segments near San Jose Diridon Station, along Monterey Corridor, and near Gilroy. In 2029, seven roadway segments under Alternatives 1 and 2 and six roadway segments under Alternatives 3 and 4 have the potential for noise level increases greater than or equal to 3 dB compared to existing noise conditions. Except for one roadway segment under Alternatives 1, 2, and 4 near the South Gilroy MOWF and under Alternative 3 near the East Gilroy MOWF, these traffic-related noise increases would occur in San Jose. In 2040, project operations would result in 12 roadway segments with the potential for noise level increases greater than or equal to 3 dB; most of these traffic noise impacts would occur near the San Jose Diridon Station and along Monterey Road.

CEQA Conclusion

The impact under CEQA would be significant for all four project alternatives because increases in traffic associated with project operations would increase ambient noise levels in the project vicinity above levels existing without the project. Traffic noise level increases greater than or equal to 3 dB above existing levels would occur at roadway segments located primarily near the HSR stations and MOWFs. Seven roadway segments under Alternatives 1 and 2 and six roadway segments under Alternatives 3 and 4 would have the potential for noise level increases greater than or equal to 3 dB compared to existing noise conditions in 2029; by 2040, 12 roadway segments would have the potential for noise level increases greater than or equal to 3 dB under all four project alternatives. Mitigation to address this impact is identified in Section 3.4.9, CEQA Significance Conclusions. Section 3.4.7, Mitigation Measures, describes the mitigation in detail.

Impact NV#7: Intermittent Permanent Livestock Stress from Passing HSR Trains

The project would cross through rural, agricultural, and open space lands in southern Santa Clara, San Benito, and Merced Counties that include rangeland used by cattle and confined animal agricultural operations in the San Joaquin Valley.

The FRA guidance manual (FRA 2012) establishes an SEL of 100 dBA from a single train passby as the criterion for potential noise impacts on livestock. A noise screening assessment was conducted to determine typical and maximum distances from the proposed HSR tracks at which the limits may be exceeded.

Table 3.4-19 shows the results of the screening assessment. For HSR track at grade and on an embankment, the screening distances for potential impacts on livestock would be 15 feet from the track centerline for trains traveling at 110 mph, 25 feet from the track centerline for trains traveling at 150 mph, and 70 feet for trains traveling at 220 mph. At locations where the HSR would be on a 50-foot-high viaduct, the passby SEL of 100 dBA would not be surpassed beyond the edge of the aerial structure, approximately 15 feet from the track centerline.

Table 3.4-19 Screening Distances for Impacts on Livestock

HSR Configuration	Speed (mph)	SEL[1] (dBA)	Distance from HSR Centerline (feet)
HSR on at-grade track	110	100	15
	150	100	25
	220	100	70
HSR on 10-foot high embankment	150	100	25
	220	100	70
HSR on 50-foot high viaduct[2]	150	88	15
	220	94	15
HSR on at-grade track, sounding warning horn	110	100	65
Caltrain on at-grade track, sounding warning horn	79	100	62
Freight train on at-grade track, sounding warning horn	60	100	290

[1] The SEL represents a receptor's cumulative noise exposure from an event normalized to a 1-second interval. This noise descriptor is used to assess impacts on livestock.
[2] The aerial structure projections assume a parapet barrier on the edge of the aerial structure 3 feet above the top of the rail. The distance from the track centerline where the SEL = 100 dBA is less than 15 feet.
HSR = high-speed rail
mph = miles per hour
SEL = sound exposure level
dBA = A-weighted decibel

At locations where the HSR would sound warning horns (e.g., at HSR stations under all alternatives and at the at-grade crossings and Caltrain stations under Alternative 4), the screening distance would be approximately 285 feet from the track centerline. For reference, screening distances were also calculated and added to Table 3.4-19 for a Caltrain train and a freight train passby sounding warning horns. The screening distances are 62 feet and 290 feet, respectively.

According to the screening distance information shown in Table 3.4-19, livestock might be within the screening distance for an at-grade location or 10-foot high embankment HSR (i.e., within 70 feet of either side of the track centerline [for a total width of 140 feet]). Because fences control access to the right-of-way and the right-of-way would be a minimum of 85 feet wide, livestock would have to be within approximately 30 feet of the edge of the HSR right-of-way to experience noise impacts above the recommended threshold. Where livestock operations are adjacent to the HSR right-of-way, adverse impacts would occur within 30 feet of the HSR right-of-way.

Livestock may come within 30 feet of the right-of-way fence while foraging or trying to cross the project alignment using crossing structures for livestock. All project alternatives would cross rangeland used for cattle foraging whether on viaduct, embankment, or at grade. There are no current methods to measure the impacts on a species-by-species basis. However, in all areas that would be at-grade where the right-of-way and adjacent rangeland are used for livestock grazing, the project would expose livestock to noise levels that exceed the 100-dBA SEL threshold, which may elicit a startle, avoidance, or negative behavior by livestock. In most cases, livestock using rangeland could avoid noise stress by not foraging near the tracks. However, it is expected that because of the speed of the train and the short duration of any passbys, there would be livestock in this zone and noise impacts in this zone would be of short duration.

As described in Attachment 1 of Appendix D, High-Speed Rail Impacts on Confined Animal Agriculture Facilities of the *San Jose to Merced Project Section Community Impact Assessment* (Authority 2019b), several confined animal agriculture facilities are within 100 feet of the centerline of the project alignment in the San Joaquin Valley Subsection, and livestock animals within 30 feet of the right-of-way fence would be affected by train passbys. The figures in the Community Impact Assessment show confined animal agriculture facilities that would be affected by the alternatives. Livestock could avoid noise stress by staying away from the tracks. However, it is unlikely that livestock would have sufficient warning to move away from a passing train at speeds in excess of 200 mph, as would occur in the San Joaquin Valley Subsection. It is also unknown whether animals would choose to move. It is possible that animals in confined animal agricultural facilities may become habituated to train noise over time. While habituation has been shown as a common animal response to noise over time, there are limited studies to confirm the specific response of livestock to startle noise.[10]

Alternatives 1, 2, and 3 would be grade separated on dedicated tracks and thus no horn sounding would be necessary at any at-grade crossings or at Caltrain stations; therefore, no horn-sounding impacts on livestock would occur. Under Alternative 4, the project would sound horns at the at-grade crossings and Caltrain stations between San Jose and Gilroy. The urban areas of San Jose, Morgan Hill, Gilroy, the developed area of San Martin, and land adjacent to the Caltrain stations provide limited to no access to livestock. Thus, potential horn-sounding impacts on livestock under Alternative 4 are limited to the rural area between San Jose and Morgan Hill (e.g., Coyote Valley) and the semirural area between San Martin and Gilroy. In these two areas, livestock would be sporadically within the screening distance for an HSR train sounding the warning horn at an at-grade crossing (i.e., within 285 feet of either side of the track centerlines), similar to livestock within the screening distances for existing Caltrain and freight sounding warning horn noise at the at-grade crossings. Horn sounding in these areas would increase in frequency, but horn intensity would not increase over current levels.

---

[10] The Mineta Transportation Institute conducted a study of the effects of HSR noise on horses (Mineta Transportation Institute 2015) which concluded as follows: "…Loud noises are known to have the potential to startle horses, which may have various detrimental effects on their well-being and that of their riders. There are no precise criteria for the amount of noise required to create a startling effect, only rough estimates of the amount of noise that may startle them. Virtually no systematic research has been conducted to establish such criteria. The very few studies that seem most relevant—i.e., those that explicitly seek to address the link between noise and a response from equines—uniformly conclude that horses tend to "habituate" to regularly repeated noises. However, this response pattern appears not to have been subject to systemic testing with respect to the specific noise patterns produced by trains." The Authority evaluated the effects of noise on dairies in a 2012 white paper (Authority 2012a), which concluded as follows: "Many studies on domestic animals suggest that some species appear to adjust to some forms of sound disturbance. Conclusions from research conducted to date provide only rough estimates of threshold levels for observed animal disturbance. Cows on dairies are constantly exposed to a variety of noises from farm equipment, farm machinery, and work activities that may have habituated them to noises above the presumed threshold for response… While current research suggests minimal impact beyond 100 feet, this is not conclusive and consideration should be given to studies of cattle responses to the HST for conditions where cattle operations are within 350 feet (90 dB)."

CEQA Conclusion

The impact under CEQA would be less than significant for all four project alternatives because noise from passbys would be temporary and brief. Confined animals may also become habituated to train noise. Livestock in two areas between San Jose and Gilroy would experience additional horn soundings with Alternative 4, but the horn soundings would be similar to existing train horn noise and are not expected to result in substantial new stress compared to existing conditions. Therefore, CEQA does not require mitigation.

Impact NV#8: Permanent Exposure of Sensitive Receptors to Traction Power Facility Noise

Analysts identified potentially affected noise sensitive receptors using the screening distance of 250 feet for receptors with an unobstructed view to the facilities and 125 feet for those with intervening buildings. FTA reference levels were used to calculate the total project noise level with substations and train operations at the receptors identified within the screening distance.

Train operational noise levels were also calculated using the methodology in Section 3.4.4.3, Methods for Impact Analysis, to compare the total project noise levels with the ambient noise at the receptors and to account for both changes from project operations and the new substation or facility noise source. Table 3.4-20 shows the number of receptors potentially affected by noise. The highest noise levels from ancillary facilities would be 70 L_{dn} dBA at 110 feet, which would generate a severe noise impact at the substation facility alone. However, in combination with the train operations, the substation noise would not generate any additional impact beyond those shown in Table 3.4-16. Furthermore, this analysis is conservative because distances were based on the closest outer footprint of facility, and the specific distance to noise sources would be greater in many cases.

Table 3.4-20 Traction Power Facility Noise Analysis—Number of Affected Receptors

City	Substation Facility[1]	Land Use Category[2]	Alt 1		Alt 2		Alt 3		Alt 4	
			Mod	Sev	Mod	Sev	Mod	Sev	Mod	Sev
San Jose	Paralleling Station	2	0	0	0	0	0	0	0	30
Morgan Hill	Paralleling Station	2	0	5	0	0	0	5	0	0
Gilroy	Switching Station	2	0	0	0	0	0	0	0	2
	Paralleling Station	1 2	0	0	0	0	0 0	1 1	0	0
Hollister	Paralleling Station[3]	2	0	0	0	0	0	0	0	0
Gilroy	TPSS Site 4	2	0	1	0	1	0	1	0	1
Total			**1**	**6**	**0**	**1**	**1**	**8**	**1**	**33**

[1] Facilities not listed have no noise-sensitive receptors within 250 feet of the facility.
[2] FRA Land Use Categories are summarized in Table 3.4-5. Land Use Category 1 = Areas where quiet is an essential element to the land use; Category 2 = Residential; Category 3 = Institutional use and passive-use parks.
[3] Take: property would be acquired by the Authority; buildings not counted.
Alt = Alternative
Mod = moderate
Sev = severe
TPSS =traction power supply substation

CEQA Conclusion

The impact under CEQA would be significant for Alternative 4 and less than significant for Alternatives 1, 2, and 3 when combined with the operational train noise impacts that exceed FRA criteria. Under Alternative 4, the combined train and traction power paralleling station operations would generate severe noise impacts at 30 apartment residences in San Jose; moderate noise impacts only would occur under Alternatives 1, 2, and 3. The highest impacts would occur under Alternative 4, followed by Alternative 1 and 3, and with Alternative 2 having the fewest impacts. The difference in substation noise impacts between the project alternatives is predominantly the result of the placement of switching station or paralleling station sites near sensitive receptors; the Alternative 4 San Jose traction power paralleling station would be directly adjacent to a large multifamily apartment building. Mitigation to address this impact is identified in Section 3.4.9, CEQA Significance Conclusions. Section 3.4.7, Mitigation Measures, describes the mitigation in detail.

3.4.6.3 Vibration

Construction and operations of the project alternatives would result in temporary and permanent impacts from vibration. Construction of the new tracks, stations, and MOWFs would result in vibration impacts from blasting, pile driving, vibratory compaction, demolition, or excavation near vibration-sensitive structures. Train movement during operations of the project alternatives would increase vibration levels near the alignment right-of-way and also cause impacts.

No Project Conditions

The conditions describing the No Project Alternative are the same as those described in Section 3.4.6.2, Noise. The same planned development and transportation projects would generally result in increases in background vibration levels and could cause localized vibration impacts. Without the project alternatives, the Caltrain PCEP is assumed to use EMU vehicles in place of the current diesel locomotive-hauled coaches. The vibration analysis for the PCEP assumed that the EMU vehicle would be similar to the existing vehicles regarding vibration (Wilson Ihrig 2014). Thus, no new vibration impacts are assumed associated with PCEP without the project, because although there could be increases in other passenger or freight train operations, those operations would not be expected to cause higher vibration levels than the existing conditions.

Project Impacts

Construction Impacts

Project construction would involve demolition of existing structures, clearing and grubbing; handling, storing, hauling, excavating, and placing fill; pile driving; and construction of aerial structures, bridges, road modifications, utility upgrades and relocations, HSR electrical systems, and railbeds. Section 2.11, Construction Plan, describes construction activities.

Impact NV#9: Temporary Exposure of Sensitive Receptors and Buildings to Construction Vibration

Construction of project alternatives would require the use of equipment that would generate temporary ground-borne vibration during the 5-year construction period, with up to 2 years of continuous construction activity anticipated at any one location. The impacts from construction vibration would be the same under all project alternatives.

Human annoyance occurs when construction vibration rises above the threshold of human perception for extended periods. A threshold of 80 VdB has been used to evaluate nighttime annoyance for infrequent events at residential land use. This threshold is typically applied to most HSR construction work. For sources such as pile driving, vibratory compaction, and ongoing demolition work with jackhammers or hoe-rams, the frequent event criterion of 72 VdB has been used. Nighttime annoyance would potentially occur as far out as 300 feet from pile driving, 140 feet from vibratory compaction, and as close as 50 feet from short-duration, transient events. These activities could occur under any of the project alternatives, but are more likely to occur under Alternative 4.

Building damage occurs when construction activities produce vibration in the ground that is strong enough to potentially cause cosmetic or structural damage. Pile driving very close to buildings (within 50 feet) would potentially exceed the 0.2 inch/second PPV threshold and cause building damage at wood-framed residential buildings with plaster. For modern, reinforced concrete buildings, building damage would potentially exceed the 0.5 inch/second PPV threshold within 30 feet. Pile driving would occur on bridge retrofit structures and some aerial structure foundation support for any of the project alternatives.

Construction of bored tunnels in the Pacheco Pass Subsection would require the use of a tunnel-boring machine (TBM). Ground-borne TBM vibration is often imperceptible to humans at distances greater than 100 feet and comparable to vibration from the operation of trains. Vibration from the TBM would vary with the diameter of the tunnel being constructed; a bigger TBM would create greater vibration than a smaller TBM. At slant distances (measured along a direct line from the TBM to a receptor of interest) of less than 100 feet, the likelihood of perceptibility increases, and overall vibration levels might be expected in the range of 72 VdB to 80 VdB. In this range, a person in an occupied building could be aware of the vibration from the TBM, but because the TBM would be moving through the tunnel, the vibration may only last for approximately a day. At the residential building nearest to the project alignment in Pacheco Pass, on Whiskey Flat Road, the tunnel depth would greater than 200 feet. At that distance, it is not anticipated that vibration from the TBM would be perceptible.

Key construction differences are discussed under Impact NV#1 in Section 3.4.6.2, Noise, and Table 3.4-14. For the Morgan Hill and Gilroy Subsection, construction of the viaduct structure with cast-in-drilled-hole piles (Alternatives 1 and 2) would generally have a shorter criterion distance than the embankment and at-grade track options (Alternatives 2 and 4) because vibratory compaction would not be as widespread. For the San Jose Diridon Approach and Monterey Corridor Subsections, the aerial viaduct (Alternatives 1 and 2) similarly would have a shorter criterion distance than Alternatives 2 and 4. Nighttime construction would be required under Alternative 4 to minimize disruption with existing passenger rail services.

CEQA Conclusion

The impact under CEQA would be significant for all four project alternatives because project construction would expose persons or buildings to excessive ground-borne vibration if pile driving would occur within 50 feet of any building. The alternatives would include NV-IAMF#1 to minimize construction vibration and the potential for it to cause damage to buildings and human annoyance. However, even with NV-IAMF#1, some sensitive receptors and buildings would be exposed to ground-borne vibration that would result in nighttime annoyance (Alternative 4) or building damage (all project alternatives). Mitigation to address this impact is identified in Section 3.4.9, CEQA Significance Conclusions. Section 3.4.7, Mitigation Measures, describes the mitigation in detail.

Operations Impacts

Project operations would include trains along the Caltrain Corridor servicing passengers at the San Jose Diridon and Gilroy Stations. Trains would also run regularly to MOWFs for maintenance. Chapter 2, Alternatives, describes operations and maintenance activities.

Impact NV#10: Intermittent Permanent Exposure of Sensitive Receptors to Vibration from Operations

Potential vibration impacts from project operations were assessed for 2040. Project operations would be fewer per day in 2029 than in 2040, but the maximum operating speeds would be the same, so the maximum vibration levels would be the same for both 2029 and 2040 Plus Project conditions. Thus, the vibration impact assessment was conducted for only the 2040 Plus Project condition. Under the No Project Alternative, the Caltrain PCEP is assumed to use EMU vehicles in place of the current diesel locomotive-hauled coaches. The vibration analysis for the Caltrain PCEP assumed that the EMU vehicle would generate vibration similar to the existing vehicle (Wilson Ihrig 2014). Thus, no new vibration impacts are assumed associated with PCEP.

Table 3.4-21 summarizes the results of the vibration impact assessment by project alternative. Alternative 1 would result in 81 vibration impacts, Alternative 2 would result in 143 vibration impacts, Alternative 3 would result in 140 vibration impacts, and Alternative 4 would result in 1,203 vibration impacts. Most vibration impacts would occur within the Monterey Corridor Subsection, with the remaining vibration impacts occurring in the San Jose Diridon Station Approach and Morgan Hill and Gilroy Subsections. There are no vibration impacts in the Pacheco Pass and San Joaquin Valley Subsections under any of the project alternatives.

Table 3.4-21 2029 and 2040 Plus Project Potential Vibration Impacts

Subsection	Number of Vibration Impacts				
	Land Use Category[1]	Alternative 1	Alternative 2	Alternative 3	Alternative 4
San Jose Diridon Station Approach	2	19	78	78	201
	1, 3	0	0	0	2
Monterey Corridor	2	62	63	62	581
	1, 3	0	0	0	2
Morgan Hill and Gilroy	2	0	1	0	416
	1, 3	0	1	0	1
Pacheco Pass	2	0	0	0	0
	1, 3	0	0	0	0
San Joaquin Valley	2	0	0	0	0
	1, 3	0	0	0	0
Subtotal	**2**	**81**	**142**	**140**	**1,198**
	1, 3	**0**	**1**	**0**	**5**
Total	**1, 2, 3**	**81**	**143**	**140**	**1,203**

[1] FRA Land Use Categories are summarized in Table 3.4-5. Land Use Category 1 = areas where quiet is an essential element to the land use; Category 2 = Residential; Category 3 = Institutional use and passive-use parks.

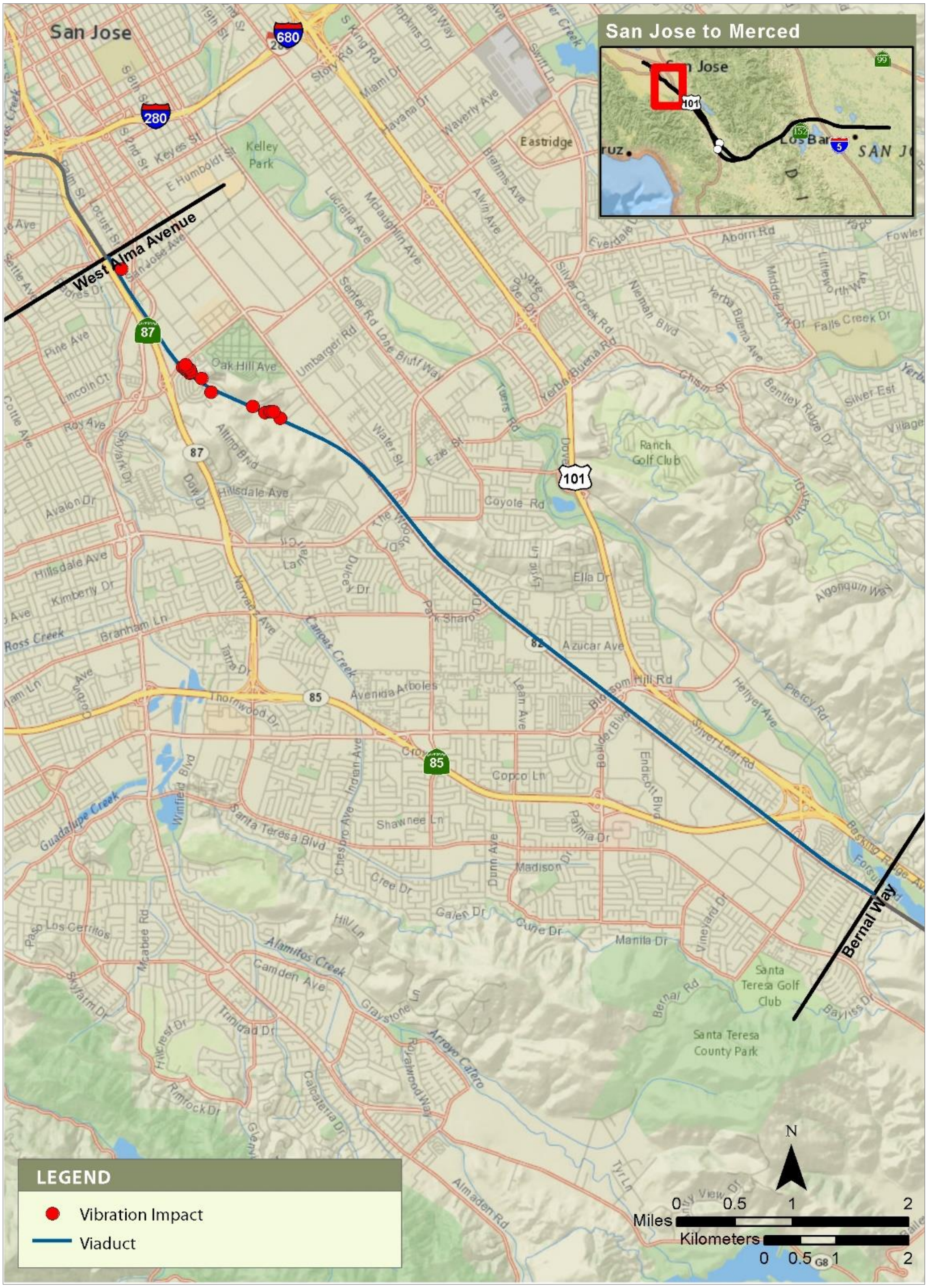
These vibration impacts are caused by both HSR train operations and, in some cases, Caltrain operations. Where the HSR project causes Caltrain and freight tracks to be shifted closer to vibration-sensitive buildings, the train operations on those closer tracks are treated as project vibration sources and compared to the impact criteria. Under Alternative 4, the project also causes Caltrain trains to operate at increased maximum speeds to accommodate blended service. Those Caltrain operations at higher speeds are treated as project vibration sources and compared to impact criteria.

The potential vibration impacts for each project alternative in the San Jose Diridon Station Approach, Monterey Corridor, and Morgan Hill and Gilroy Subsections are illustrated on Figure 3.4-22 through Figure 3.4-31. Figure 3.4-22 and Figure 3.4-23 illustrate the Alternative 1 vibration impact locations, Figure 3.4-24 through Figure 3.4-26 illustrate the Alternative 2 vibration impact locations, Figure 3.4-27 and Figure 3.4-28 show the Alternative 3 locations, and Figure 3.4-29 through Figure 3.4-31 show the Alternative 4 locations. Each red dot indicates a cluster of receptors predicted to have a potential vibration impact. There are no vibration impacts in the Pacheco Pass and San Joaquin Valley Subsections under any of the project alternatives.

In the San Jose Diridon Station Approach and Monterey Corridor Subsections, there are many vibration-sensitive locations where the existing levels exceed the residential criterion of 72 VdB. Caltrain trains are the dominant existing rail source of vibration in the RSA, because Caltrain speeds exceed those of freight trains and vibration levels increase with speed.

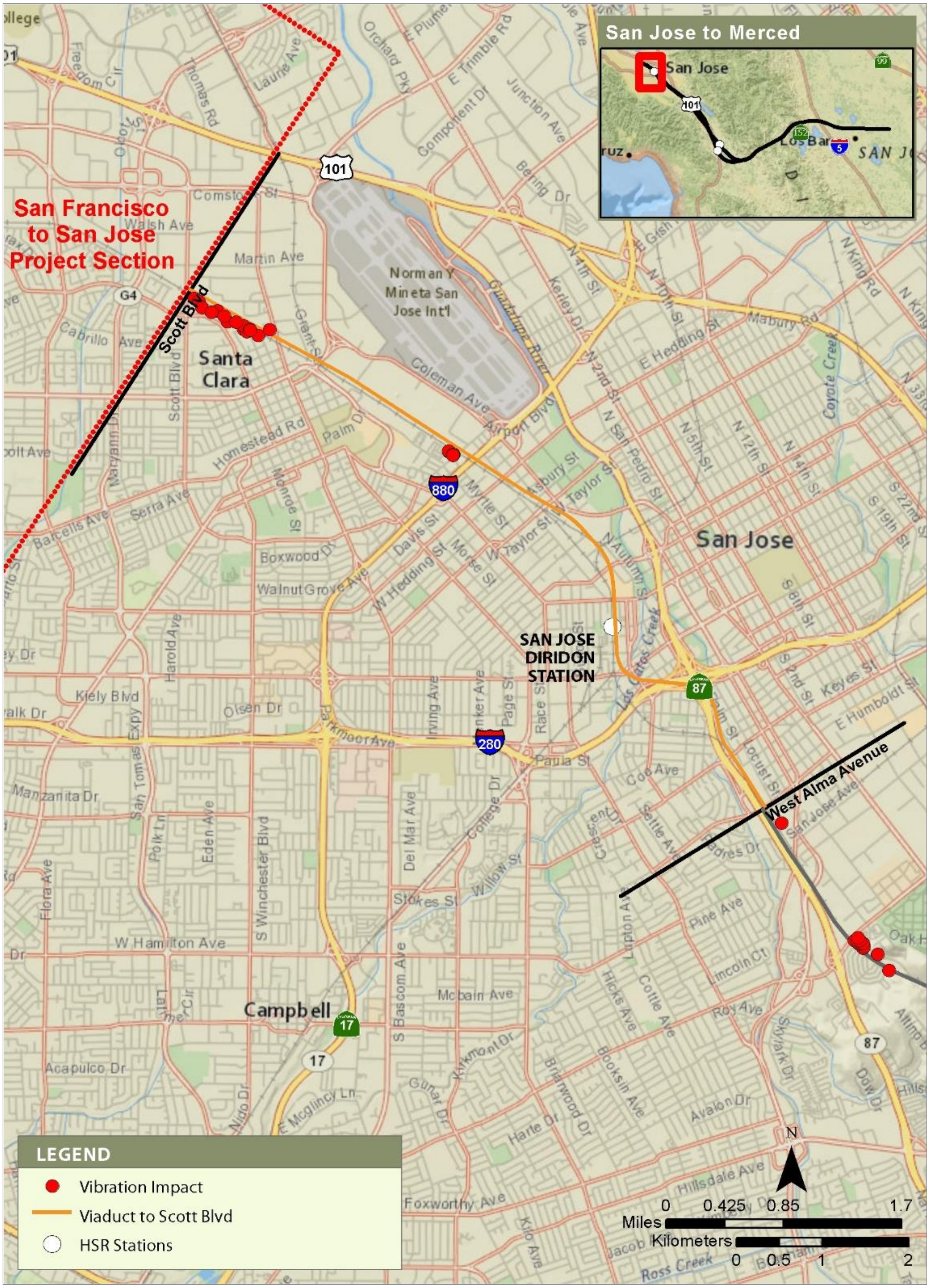
FEBRUARY 2019

Figure 3.4-22 2029 and 2040 Plus Project Vibration Impacts—Alternative 1 (San Jose Diridon Station Approach Subsection)



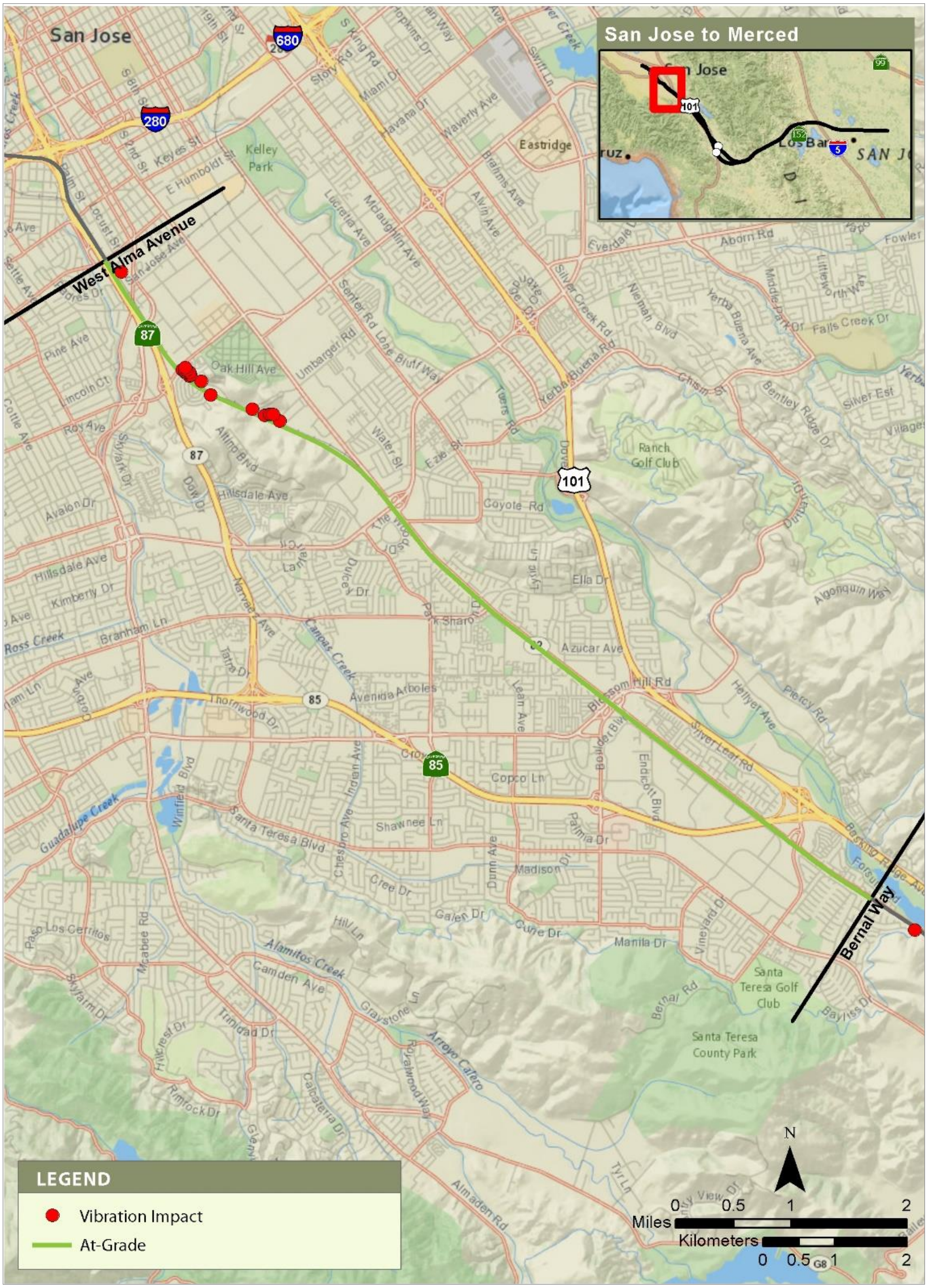
FEBRUARY 2019

Figure 3.4-23 2029 and 2040 Plus Project Vibration Impacts—Alternative 1 (Monterey Corridor Subsection)



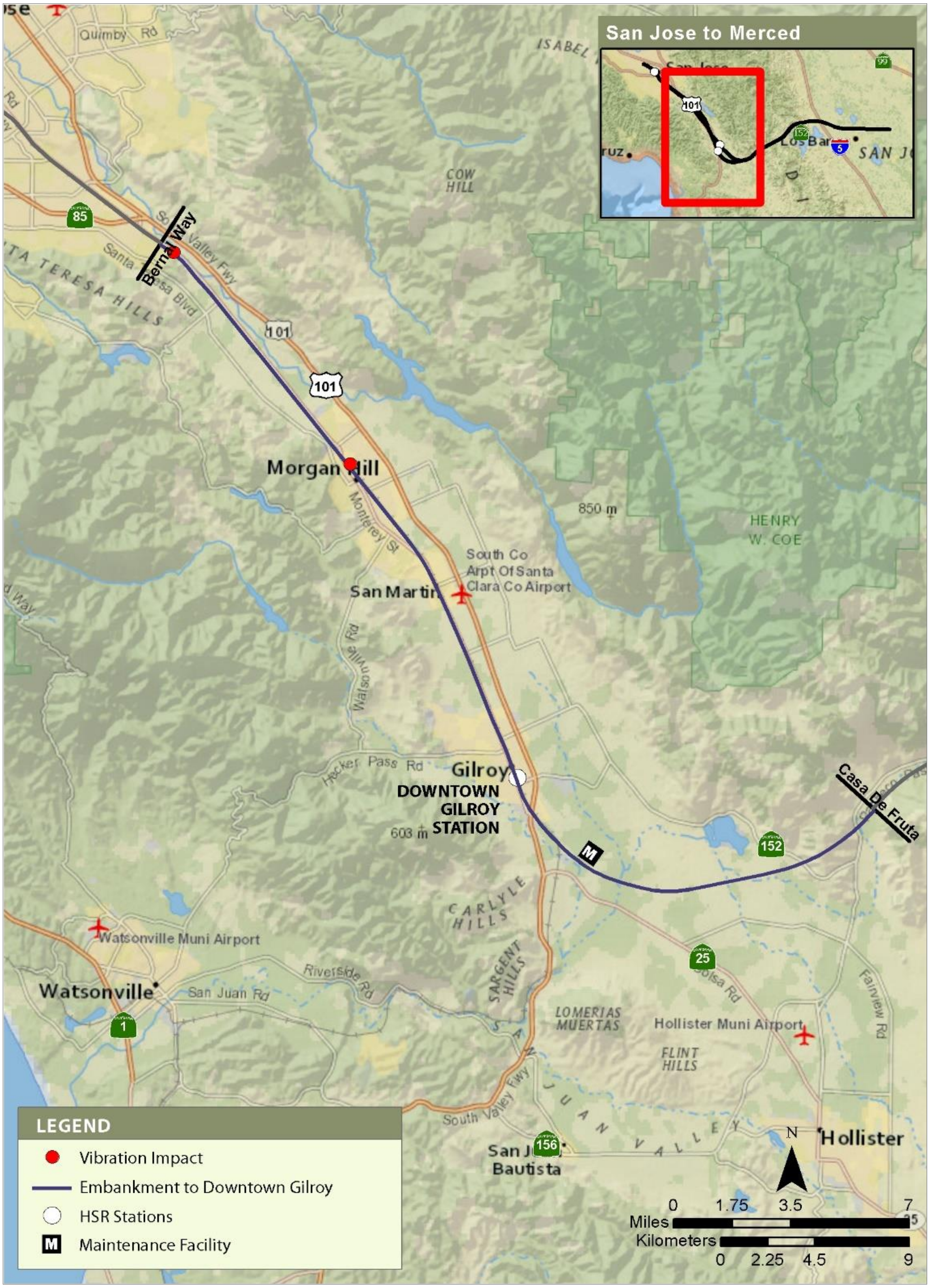
FEBRUARY 2019

Figure 3.4-24 2029 and 2040 Plus Project Vibration Impacts—Alternative 2 (San Jose Diridon Station Approach Subsection)



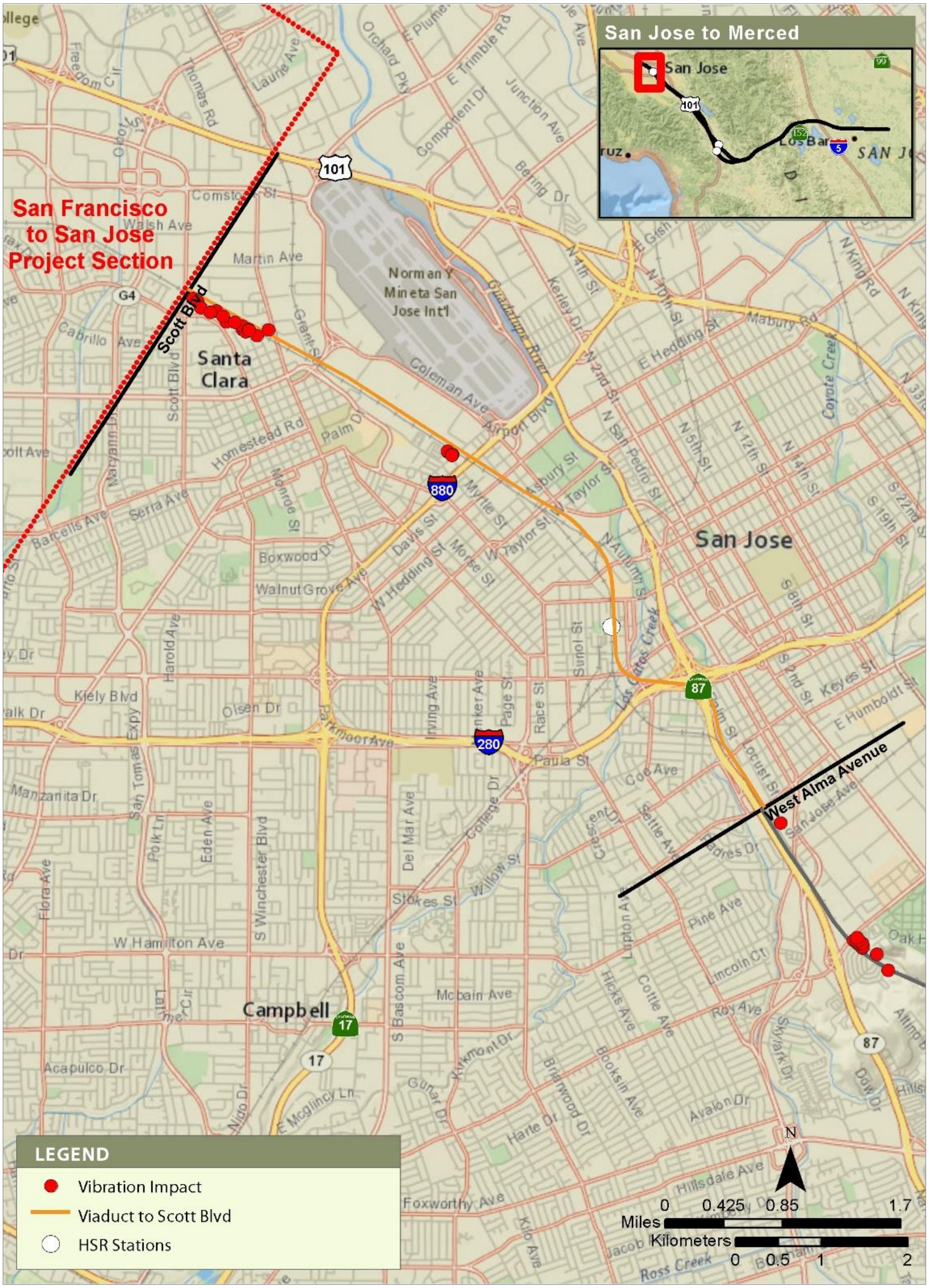
FEBRUARY 2019

Figure 3.4-25 2029 and 2040 Plus Project Vibration Impacts—Alternative 2 (Monterey Corridor Subsection)



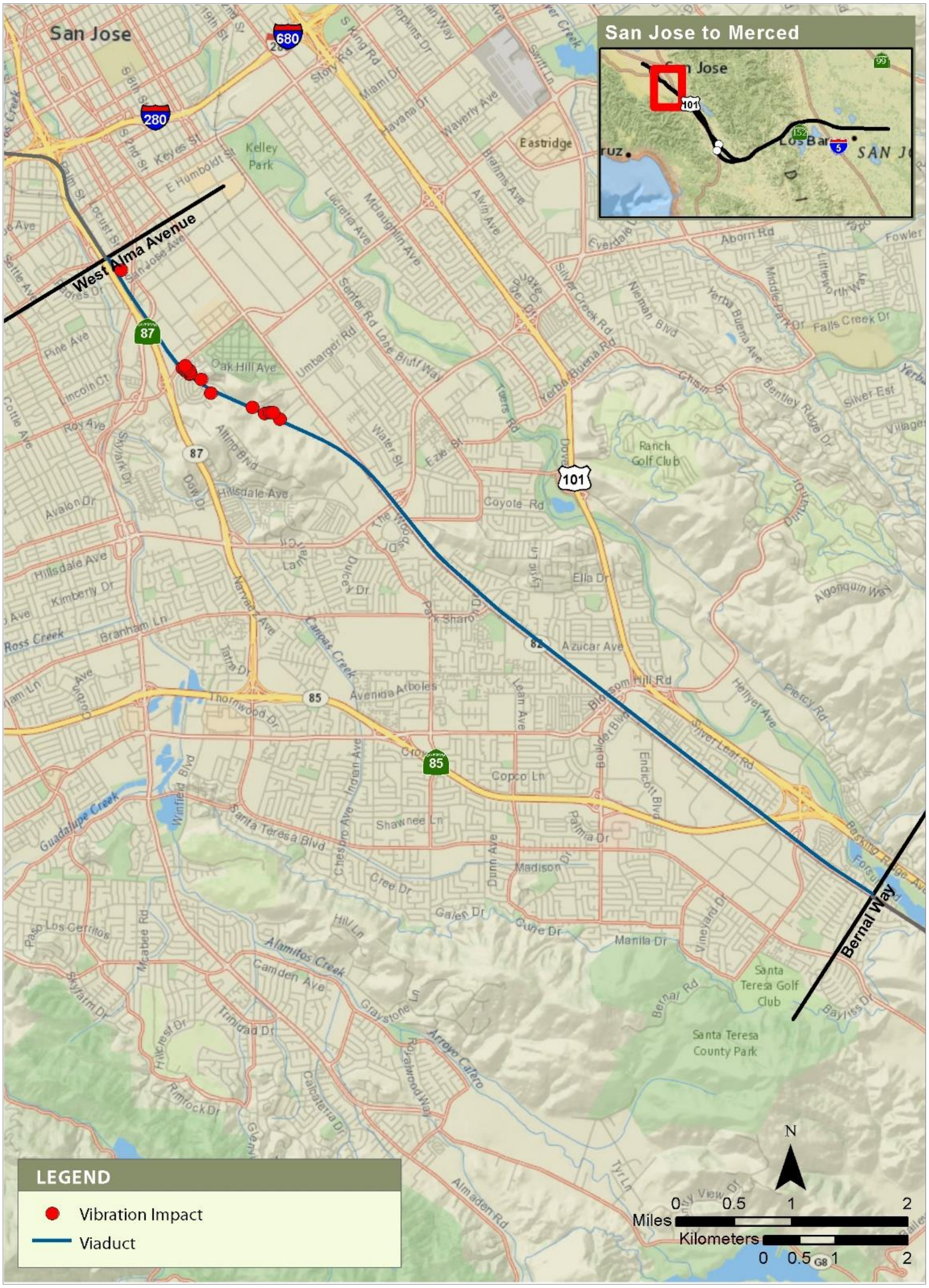
FEBRUARY 2019

Figure 3.4-26 2029 and 2040 Plus Project Vibration Impacts—Alternative 2 (Morgan Hill and Gilroy Subsection)



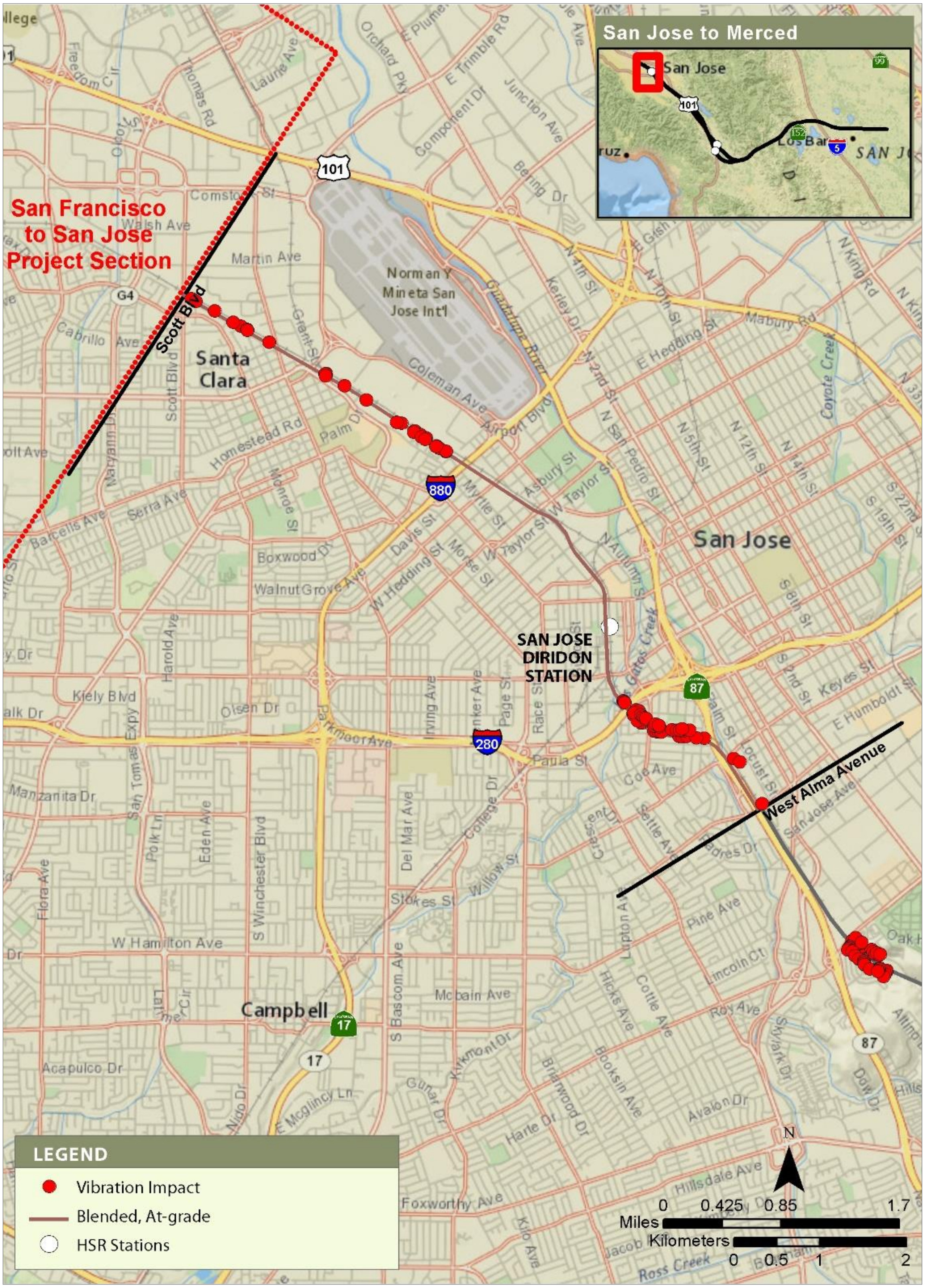
FEBRUARY 2019

Figure 3.4-27 2029 and 2040 Plus Project Vibration Impacts—Alternative 3 (San Jose Diridon Station Approach Subsection)



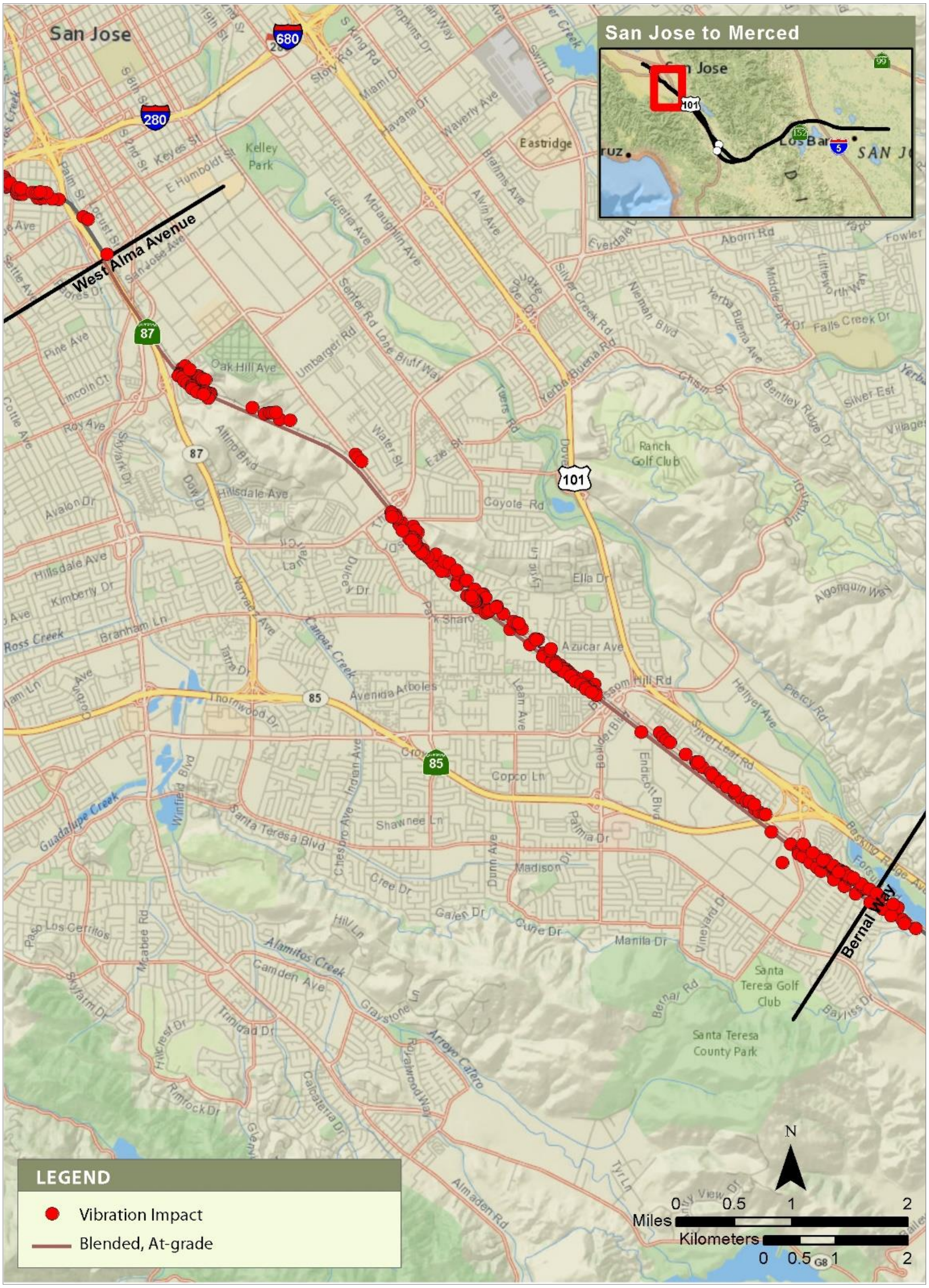
FEBRUARY 2019

Figure 3.4-28 2029 and 2040 Plus Project Vibration Impacts—Alternative 3 (Monterey Corridor Subsection)



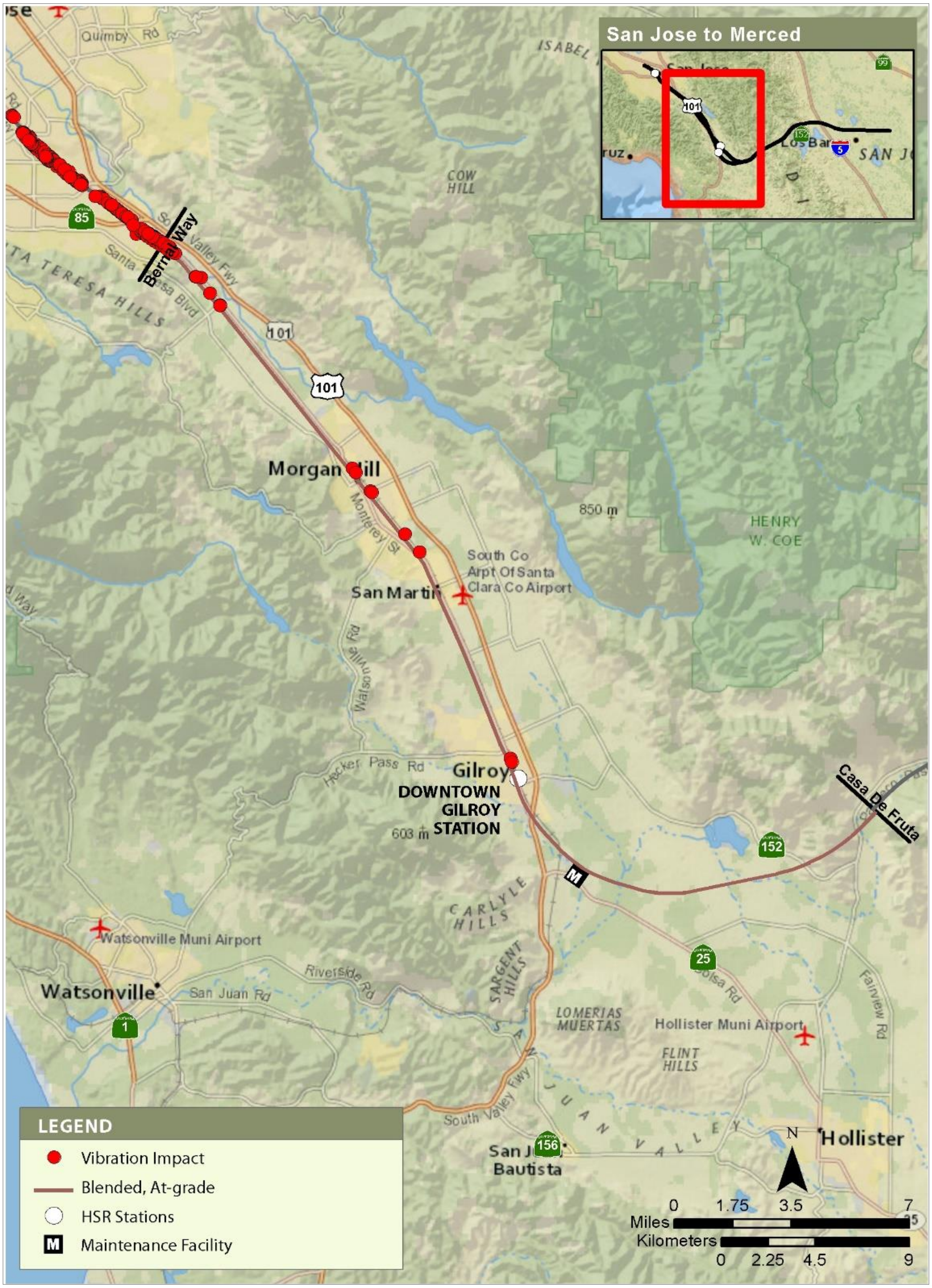
FEBRUARY 2019

Figure 3.4-29 2029 and 2040 Plus Project Vibration Impacts—Alternative 4 (San Jose Diridon Station Approach Subsection)



FEBRUARY 2019

Figure 3.4-30 2029 and 2040 Plus Project Vibration Impacts—Alternative 4 (Monterey Corridor Subsection)



FEBRUARY 2019

Figure 3.4-31 2029 and 2040 Plus Project Vibration Impacts—Alternative 4 (Morgan Hill and Gilroy Subsection)

Throughout most of the RSA, the projected vibration levels from HSR trains would be below the impact criterion and typically lower than the slower Caltrain trains. Much of Alternatives 1 and 3 would be on viaduct, and vibration levels from HSR trains on aerial structure are assumed to be 10 VdB lower than HSR trains at grade or on embankments. Even though the HSR train speeds are much higher than conventional-speed commuter rail such as Caltrain, the ground-borne vibration levels are often comparable or lower. This is likely because of the relatively low input forces from the HSR trains (the force density level[11]). To operate trains at very high speeds, the rails and wheels typically have to be in very good condition, resulting in lower vibration levels.

Under Alternative 4, HSR trains between San Jose and Gilroy would operate on tracks that are shared with Caltrain, which increases the likelihood that the rail roughness would increase with time and potentially lead to increased vibration levels. To account for this, an added engineering factor of 5 VdB has been added to the HSR vibration predictions where blended service would occur under Alternative 4.

Analysts identified four Category 1 vibration-sensitive facilities in the RSA, and potential impacts at each are described in the following paragraphs. The FRA general assessment impact criterion of 65 VdB for Category 1 vibration-sensitive facilities was used to assess impact at these buildings because it is not known what specific equipment is in the buildings, or where that sensitive equipment is located in the buildings. Therefore, the general assessment criterion is used to provide a conservative assessment of potential impact. Though the specific vibration-sensitive equipment at these facilities is not known, the projected maximum vibration level in any 1/3-octave band is provided for future reference (Volume 2, Appendix 3.4-A, provides more details).

The Great Oaks Research Park would be approximately 180 feet from the nearest HSR track in the Monterey Corridor Subsection under Alternative 4, and approximately 250 feet from the nearest HSR track under Alternatives 1, 2, and 3. The maximum projected vibration levels from HSR trains at the Great Oaks Research Park would be approximately 52 VdB under Alternatives 1 and 3, 64 VdB under Alternative 2, and 69 VdB under Alternative 4. With Alternatives 1 and 3, the maximum vibration level in any 1/3-octave band is predicted to be approximately 47 VdB. With Alternative 2, the maximum vibration in any 1/3-octave band is predicted to be approximately 58 VdB. With Alternative 2, the maximum vibration in any 1/3-octave band is predicted to be approximately 63 VdB. A vibration impact on this facility is predicted with Alternative 4, but not with the other alternatives.

Two vibration-sensitive facilities were identified in the Morgan Hill and Gilroy Subsection under Alternatives 2 and 4—Paramit Manufacturing and the Butterfield Professional Center—both between Tilton and Tennant. The Paramit Manufacturing building would be approximately 215 feet from the nearest HSR track under Alternative 2 and approximately 320 feet from the nearest HSR track under Alternative 4. The maximum projected overall vibration levels from HSR trains would be approximately 56 VdB; therefore, no vibration impact is predicted. The maximum vibration level in any 1/3-octave band is predicted to be approximately 49 VdB. The Butterfield Professional Center building is approximately 75 feet from the nearest HSR track under Alternative 2 and approximately 150 feet from the nearest HSR track under Alternative 4. The maximum projected overall vibration levels from HSR trains would be 60 VdB under Alternative 4 and 65 VdB under Alternative 2; therefore, vibration impact is predicted at the Butterfield facility under Alternative 2. The maximum vibration level in any 1/3-octave band is predicted to be approximately 59 VdB.

The St. Louise Regional Hospital would be more than 1,000 feet from the nearest HSR track under Alternative 3. The maximum projected vibration levels would be less than 50 VdB; therefore, no vibration impact is predicted.

The maximum vibration level in any 1/3-octave band is predicted to be less than 50 VdB. In the areas categorized as a heavily used rail corridor in the San Jose Diridon Station Approach

[11] The force density level is the vibration excitation force transmitted by the train into the rails, track, and ground.

Subsection, many of the receptors currently experience vibration levels greater than the criterion of 72 VdB. Because the project alternatives would more than double the number of train passby events per day, per FRA this combined condition of exceedances above 72 VdB and doubling of events would cause vibration impacts. The predicted vibration impacts in the subsections characterized as a moderately used rail corridors would be caused primarily by HSR trains on embankment that exceed the vibration impact criterion or by shifted existing rail sources that exceed the criteria, although HSR train vibration would exceed the criterion at some locations.

In the Pacheco Pass Subsection, the alignment would largely be in a tunnel. The tunnel depth would vary depending upon the terrain elevation. Near the closest sensitive buildings, the tunnel would be more than 200 feet deep and 1,000 feet away horizontally. At these large distances and depths, ground-borne vibration would be well below the impact criteria. Similarly, at the depth and distance from the tunnel to the sensitive buildings in Pacheco Pass, ground-borne noise levels are expected to be below 25 dBA, thus below the lowest impact criteria. Under Alternatives 1 and 2, there is also a planned cut-and-cover tunnel area of the alignment where it passes under US 101 in the Morgan Hill and Gilroy Subsection. At receptors in this location, the projected ground-borne noise levels are expected to be below 25 dBA, also below the lowest impact criteria.

CEQA Conclusion

The impact under CEQA would be significant for all four project alternatives because operations would generate excessive ground-borne vibration impacts at sensitive receptors in the San Jose Diridon Station Approach and Monterey Corridor Subsections. Alternative 1 would result in 81 vibration impacts, Alternative 2 would result in 143 vibration impacts, Alternative 3 would result in 140 vibration impacts, and Alternative 4 would result in 1,203 vibration impacts. The greater number of vibration impacts under Alternative 4 are due to both HSR trains operating on blended tracks that are typically at-grade and due to increased speeds of Caltrain trains under Alternative 4. Mitigation to address this impact is identified in Section 3.4.9, CEQA Significance Conclusions. Section 3.4.7, Mitigation Measures, describes the mitigation in detail.

3.4.7 Mitigation Measures

Significant impacts under CEQA would be associated with project construction and operations activities, including noise impacts from construction activity, noise impacts from project operations, noise impacts from increased project-related vehicle traffic, exposure of buildings and sensitive receptors to vibration impacts from construction, and exposure of buildings and sensitive receptors to increased vibration levels from project operations. The Authority has developed standardized mitigation measures that would be implemented to address impacts from noise and vibration generated by project construction and operations. As described in this section, the construction noise and vibration mitigation measures would reduce impacts on sensitive receptors, but would not completely avoid impacts. The operational measures would minimize operations impacts on sensitive receptors, but would not completely avoid impacts.

NV-MM#1: Construction Noise Mitigation Measures

Prior to construction (any ground-disturbing activities), the contractor would prepare a noise-monitoring program for Authority approval. The noise-monitoring program would describe how during construction the contractor would monitor construction noise to reduce noise levels to the noise limits (an 8-hour L_{eq} of 80 dBA during the day and 70 dBA at night for residential land use, 85 dBA for both day and night for commercial land use, and 90 dBA for both day and night for industrial land use) where a noise-sensitive receptor is present and wherever feasible. The contractor would be given the flexibility to reduce noise in the most efficient and cost-effective manner. This can be done by prohibiting certain noise-generating activities during nighttime hours or providing additional noise control measures to meet required noise limits. In addition, the noise-monitoring program would describe the actions required of the contractor to meet required noise limits. These actions would include the following nighttime and daytime noise control mitigation measures, as necessary:

- Install a temporary construction site noise barrier near a noise source.
- Avoid nighttime construction in residential neighborhoods.

- Locate stationary construction equipment as far as possible from noise-sensitive sites.
- Reroute construction truck traffic along roadways that would cause the least disturbance to residents.
- During nighttime work, use smart backup alarms, which automatically adjust the alarm level based on the background noise level, or switch off back-up alarms and replace with spotters.
- Use low-noise-emission equipment.
- Implement noise-deadening measures for truck loading and operations.
- Monitor and maintain equipment to meet noise limits.
- Line or cover storage bins, conveyors, and chutes with sound-deadening material.
- Use acoustic enclosures, shields, or shrouds for equipment and facilities.
- Use high-grade engine exhaust silencers and engine-casing sound insulation.
- Prohibit aboveground jackhammering and impact pile driving during nighttime hours.
- Minimize the use of generators to power equipment.
- Limit use of public address systems.
- Grade surface irregularities on construction sites.
- Use movable noise barriers at the source of the construction activity.
- Limit or avoid certain noisy activities during nighttime hours.
- To mitigate noise related to pile driving, use an auger to install the piles instead of a pile driver to reduce noise levels substantially. If pile driving is necessary, limit the time of day that the activity can occur.

The Authority would establish and maintain in operation until completion of construction a toll-free “hotline” regarding the project construction activities. The Authority would arrange for all incoming messages to be logged (with summaries of the contents of each message) and for a designated representative of the Authority to respond to hotline messages within 24 hours (excluding weekends and holidays). The Authority would make a reasonable good-faith effort to address all concerns and answer all questions, and would include on the log its responses to all callers. The Authority would make a log of the incoming messages and the Authority’s responsive actions publicly available via request on its website.

The contractor would provide the Authority with an annual report by January 31 of the following year documenting how it implemented the noise monitoring program.

This measure would have limited to no secondary environmental impacts because the temporary measures are limited to the construction zone itself and would not exacerbate any other environmental impacts of construction.

NV-MM#2: Construction Vibration Mitigation Measures

Prior to construction involving impact pile driving within 50 feet of any building, the contractor would provide the Authority with a vibration technical memorandum documenting how project pile driving criteria would be met. Upon approval of the technical memorandum by the Authority, and where a noise-sensitive receptor is present, the contractor would comply with the vibration reduction methods described in that memorandum. Potential construction vibration building damage is only anticipated from impact pile driving at very close distances to buildings. If pile driving occurs more than 50 feet from buildings, or if alternative methods such as push piling or auger piling are used, damage from construction vibration is not expected to occur. When a construction scenario has been established, the contractor would conduct pre-construction surveys at locations within 50 feet of pile driving to document the existing condition of buildings in case damage is reported during or after construction. The contractor would arrange for the repair of damaged buildings or would pay compensation to the property owner.

NV-MM#3: Implement Proposed California High-Speed Rail Project Noise Mitigation Guidelines

Various options exist to address the potentially severe noise effects from HSR operations. The Authority has developed Noise and Vibration Mitigation Guidelines for the statewide HSR system that sets forth three categories of mitigation measures to reduce or offset severe noise impacts from HSR operations: noise barriers, sound insulation, and noise easements. The guidelines also set forth an implementation approach that considers multiple factors for determining the reasonableness of noise barriers as mitigation for severe noise impacts, including structural and seismic safety, cost, number of affected receptors, and effectiveness. Noise barrier mitigation would be designed to reduce the exterior noise level from HSR operations from severe to moderate, according to the provisions of the FRA guidance manual (FRA 2012) and Figure 3.4-12.

The Noise and Vibration Mitigation Guidelines, included as Volume 2, Appendix 3.4-B, describe the following mitigation measures and approach:

- **Noise Barriers**—Prior to operation of the HSR, the Authority would install noise barriers where they can achieve between 5 and 15 dB of exterior noise reduction, depending on their height and location relative to the tracks. The primary requirements for an effective noise barrier are that the barrier must (1) be high enough and long enough to break the line-of-sight between the sound source and the receiver, (2) be of an impervious material with a minimum surface density of four pounds per square foot, and (3) not have any gaps or holes between the panels or at the bottom. Because many materials meet these requirements, aesthetics, durability, cost, and maintenance considerations usually determine the selection of materials for noise barriers. Depending on the situation, noise barriers can become visually intrusive. Typically, the noise barrier style is selected with input from the local jurisdiction to reduce the visual effect of barriers on adjacent lands uses (Authority 2014). For example, noise barriers could be solid or transparent, and made of various colors, materials, and surface treatments.

  Pursuant to the Noise and Vibration Mitigation Guidelines, recommended noise barriers must meet the following criteria to be considered a reasonable and feasible mitigation measure:

  - Achieve a minimum of 5 dB of noise reduction, which is then defined as a benefited receptor.
  - The minimum number of receptors should be at least 10.
  - The length should be at least 800 feet.
  - Must be cost-effective, defined as mitigation not exceeding $95,000 per benefited receptor.

  The maximum noise barrier height would be 14 feet for at-grade sections. Berm and berm/wall combinations are the preferred types of noise barriers where space and other environmental constraints permit. On aerial structures, the maximum noise barrier height would also be 14 feet, but barrier material would be limited by engineering weight restrictions for barriers on the structure. All noise barriers would be designed to be as low as possible to achieve a substantial noise reduction.

  Noise barriers on both aerial structures and at-grade structures would consist of solid, semitransparent, or transparent materials, as defined in *Aesthetic Options for Non-Station Structures* (Authority 2014). Figure 3.4-32 shows an example of a noise barrier that meets the Authority's typical requirements. Volume 2, Appendix 3.4-B, Noise and Mitigation Guidelines, provides additional details.

MAY 2019

Figure 3.4-32 Example of a Typical Noise Barrier

- **Install Building Sound Insulation**—If noise barriers are not proposed for receptors with severe impacts, or if proposed noise barriers do not reduce exterior sound levels to below a severe impact level, the Authority would consider providing sound insulation as a potential additional mitigation measure on a case-by-case basis. Sound insulation of residences and institutional buildings to improve outdoor-to-indoor noise reduction is a mitigation measure that can be considered when the use of noise barriers is not feasible in providing a reasonable level (5 to 7 dBA) of noise reduction. Although this approach has no effect on noise in exterior areas, it may be the best choice for sites where noise barriers are not feasible or desirable and for buildings where indoor sensitivity is of most concern. Substantial improvements in building sound insulation (on the order of 5 to 10 dBA) can often be achieved by adding an extra layer of glazing to windows, by sealing holes in exterior surfaces that act as sound leaks, and by providing forced ventilation and air conditioning so that windows do not need to be opened.
- **Noise Easements**—If a substantial noise reduction cannot be completed through installation of noise barriers or installing sound insulation, the Authority would consider acquiring a noise easement on properties with a severe impact on a case-by-case basis. An agreement between the Authority and the property owner can be established wherein the property owner releases the right to petition the Authority regarding the noise level and subsequent disruptions. This would take the form of an easement that would encompass the property boundaries to the right-of-way of the rail line. The Authority would consider this mitigation measure only in isolated cases where other mitigation is ineffective or infeasible.

Noise barriers could have secondary impacts on visual aesthetics and require tree or vegetation removal. Depending on their design, height, and location, noise barriers can become visually intrusive, blocking views or creating places for unwanted graffiti. Within the Caltrain Corridor portions of Alternative 4, noise barriers would be installed within the fenced areas of the existing Caltrain right-of-way, which is often shielded from view by fencing or landscaping (described in Section 3.16, Aesthetics and Visual Quality). Per Mitigation Measure AVQ-MM#7 (see description in Section 3.16, Aesthetics and Visual Quality), as part of the final design and construction management plan, the Authority would work with local jurisdictions to develop the appropriate noise barrier style and treatments for visually sensitive areas, to reduce the visual effect of barriers on adjacent land uses. For example, noise barriers could be solid or transparent, made of various colors, materials, and surface treatments, screened with vegetation, or treated with surface coatings to facilitate cleaning and removal of graffiti. Providing sound insulation would involve modest building retrofit activity similar to routine residential or commercial window modifications or insulation replacement and would not result in significant secondary effects.

NV-MM#4: Support Potential Implementation of Quiet Zones by Local Jurisdictions

Trains sound warning horns when approaching at-grade crossings because it is required by the FRA as a safety precaution (49 C.F.R. Parts 222 and 229). FRA does allow for the possibility of establishing horn-free Quiet Zones, which would eliminate the requirement for all trains to routinely sound their warning horns when approaching at-grade highway/rail crossings. Establishing Quiet Zones can only be legally undertaken by local jurisdictions; HSR cannot legally establish or require a Quiet Zone. However, HSR would assist local communities with this process through the installation of four-quad gates and channelization at all at-grade crossings that presently lack them, which would help cities to implement Quiet Zones, should they choose to do so. Establishing Quiet Zones would eliminate train warning horns for all trains approaching at-grade highway and rail crossings under normal, nonemergency situations.

NV-MM#5: Vehicle Noise Specification

During HSR vehicle technology procurement, the Authority would require bidders to meet the federal regulations (40 C.F.R. §§201.12/201.13) at the time of procurement for locomotives (currently a 90-dB-level standard) operating at speeds faster than 45 mph. This measure would have no secondary environmental impacts.

NV-MM#6: Special Trackwork at Crossovers, Turnouts, and Insulated Joints

Prior to construction, the contractor would provide the Authority with an HSR operations noise technical report for review and approval. The report would address minimization or elimination of rail gaps at crossovers and turnouts. Because the impacts of HSR wheels over rail gaps at turnouts increases HSR noise by approximately 6 dB over typical operations, turnouts can be a major source of noise impact. If the turnouts cannot be moved from sensitive areas, the noise technical report would recommend the use of special types of trackwork that eliminate the gap. The Authority would require the project design to follow the recommendations in the approved noise impact report.

Special trackwork would occur in the construction footprint and would not require additional right-of-way. Special trackwork would require additional construction equipment activity using equipment similar to that used to build the project and would result in similar temporary aesthetic, air quality, and noise impacts during the construction period.

NV-MM#7: Additional Noise Analysis during Final Design

Prior to construction, the contactor would provide the Authority with an HSR operations noise technical report for review and approval. If final design or final vehicle specifications result in changes to the assumptions underlying the noise technical report, the Authority would prepare necessary environmental documentation, as required by CEQA and NEPA, to reassess noise impacts and mitigation.

It would be premature to assess the specific potential secondary impacts of final design measures. Measures adopted as a result of additional noise analysis are likely to be similar to the other noise measures identified. Thus, they would likely result in similar secondary environmental impacts during their construction that may be significant.

NV-MM#8: Project Vibration Mitigation Measures

Mitigation for operations vibration impacts can take place at the source, at the sensitive receptor, or along the propagation path from the source to the sensitive receptor. Table 3.4-22 lists the mitigation procedures and their locations.

It would be premature to assess the specific potential secondary impacts of vibration measures. Special trackwork, building modifications, or other approaches adopted pursuant to this measure are likely to be similar to the other vibration-reducing measures identified. Thus, they would likely result in similar secondary environmental impacts during their construction that may be significant.

Table 3.4-22 Vibration Mitigation Procedures and Descriptions

Mitigation Procedure	Location of Mitigation	Description
Location and design of special trackwork	Source	Review crossover, turnout, and insulated joint locations during the preliminary engineering stage. When feasible, relocate special trackwork to a less vibration-sensitive area. Install spring frogs and other non-gap trackwork to eliminate gaps and help reduce vibration levels.
Vehicle suspension	Source	Employ rail vehicle with low unsprung weight, soft primary suspension, minimum metal-on-metal contact between moving parts of the truck, and smooth wheels that are perfectly round.
Special track support systems	Source	Use floating slabs, resiliently supported ties, high-resilience fasteners, and ballast mats to help reduce vibration levels from track support system.
Building modifications	Receptor	For existing buildings, if vibration-sensitive equipment is affected by train vibration, stiffen the floor upon which the vibration-sensitive equipment is located, isolate it from the remainder of the building, or both. For new buildings, support and effectively isolate the building foundation with vibration-isolating components such as springs and elastomer pads.
Buffer zones	Receptor	Negotiate a vibration easement from the affected property owners or expand rail right-of-way.

3.4.7.1 Noise Mitigation Analysis

The Authority has provided guidance regarding the implementation of noise barrier mitigation measures in Volume 2, Appendix 3.4-B. Analysts used this guidance to conduct a noise mitigation analysis to evaluate the use of noise barriers as specified in NV-MM#3 and the potential effectiveness of horn-free quiet zones that may be adopted by local jurisdictions in combination with noise barrier mitigation.

HSR train horns are not a direct source of noise impacts in the RSA under Alternatives 1, 2, and 3, but horn noise from other non-HSR trains is significant. Therefore, if use of the existing train horns could be reduced, noise levels in the project area would decrease, which would partially offset the noise increases from introducing HSR trains. Establishing Quiet Zones, which would eliminate the requirement for non-HSR trains in the RSA to routinely sound their warning horns when approaching at-grade highway/rail crossings, is a measure that would need to be undertaken by local communities, not by the Authority. Therefore, this document includes additional analysis that investigates the potential benefit provided to noise-sensitive receptors from eliminating all train horn noise in the RSA under Alternatives 1, 2, and 3. Section 3.4.9, CEQA Significance Conclusions, provides this information.

Alternative 4 would cause HSR horn noise throughout the shared Caltrain corridor from San Jose to Gilroy. Therefore, an analysis of the potential benefit that could be provided by instituting Quiet Zones is provided under Alternative 4. Section 3.4.9, CEQA Significance Conclusions, provides more information.

Noise Barriers

NV-MM#3 identifies noise barriers in the form of noise barriers as a potential mitigation measure to avoid severe noise impacts from project operations. Analysts assessed the feasibility and cost-effectiveness of using noise barriers to mitigate severe impacts from project operations based on the criteria listed in Volume 2, Appendix 3.4-B.

The Authority would examine alternatives to avoid, minimize, or mitigate severe noise impacts. If severe noise impacts cannot be avoided, then the Authority would take steps to reduce severe noise substantially through mitigation measures that are reasonable, physically feasible, practical, and cost-effective. The minimum number of receptors should be at least 10, and the length of a noise barrier should be at least 800 feet. Barrier heights up to a maximum of 14 feet for at-grade and aerial structure sections would be considered. Mitigation options for areas that require barriers over 14 feet would be studied on a case-by-case basis. The community should approve of implementation of the recommended noise barriers (75 percent of all affected parties). The cost for constructing a noise barrier along the at-grade portion of the alignment is estimated to be $70 per square foot, and the cost to build a noise barrier along the elevated portion of the alignment is estimated to be $65 per square foot. The total cost of mitigation cannot exceed $95,000 per benefitted receptor. This cost is determined by dividing the total cost of the mitigation measure by the number of noise-sensitive buildings that receive a substantial (i.e., 5 dBA or greater) outdoor noise reduction. This calculation generally limits the use of mitigation in areas that have few or isolated residential buildings. If the density of residential dwellings is insufficient to make the measure cost-effective, then other noise abatement measures, such as sound insulation [or a local noise barrier], would be considered on a case-by-case basis. If sound insulation is identified as an alternative mitigation measure, the treatment must provide a substantial increase in noise reduction (i.e., 5 dBA or greater) between the outside and inside noise levels for interior habitable rooms. Receptors that receive at least a 5 dBA noise reduction from a noise barrier are described as benefitted receptors.

Table 3.4-23 shows the proposed noise barriers found to be cost-effective for Alternative 1. The table includes the approximate start and end locations of the barriers, the length, height, and side of track. The table also shows the number of severe and moderate noise impacts that would be benefitted with each barrier, as well as the number of residual noise impacts that would remain, even though they would be behind the proposed noise barriers.

Analysts found six potential noise barriers to be cost-effective for Alternative 1. The proposed noise barriers would mitigate 107 severe impacts and 551 moderate impacts. The first two proposed noise barriers would be in the San Jose Diridon Station Approach Subsection and the next three would be in the Monterey Corridor Subsection, where the track profile is on embankment. The proposed barrier heights would range from 5 to 14 feet above the top of the rail. Three proposed noise barriers would be the same for all project alternatives. The sixth potential noise barrier for Alternative 1 would be in the Morgan Hill and Gilroy Subsection and would continue for 6,800 feet at a height of 14 feet above the top of the rail.

Table 3.4-24 shows the proposed noise barriers that were found to be cost-effective for Alternative 2. Analysts found 11 potential noise barriers to be cost-effective. The proposed noise barriers would mitigate 564 severe impacts and 1,066 moderate impacts. The first four proposed noise barriers would be in the Monterey Corridor Subsection. Barriers 1, 2, and 3 would be the same as those proposed for Alternatives 1 and 3. Barrier 4 would be in both the Monterey Corridor Subsection and the Morgan Hill and Gilroy Subsection, and the proposed height would be 14 feet above the top of the rail. Barriers 5 through 11 would be in the Morgan Hill and Gilroy Subsection and the proposed heights would range from 5 to 14 feet above the top of the rail.

Table 3.4-25 shows the proposed noise barriers found to be cost-effective for Alternative 3. Analysts found three potential noise barriers to be cost-effective. The proposed noise barriers for Alternative 3 would mitigate 51 severe impacts and 140 moderate impacts. The three proposed noise barriers would be in the Monterey Corridor Subsection and would be the same as those proposed for Alternatives 1 and 2.

Table 3.4-26 shows the proposed noise barriers that were found to be cost-effective for Alternative 4. Analysts found 33 potential noise barriers to be cost-effective. The proposed noise barriers for Alternative 4 would mitigate 905 severe impacts and 439 moderate impacts. The first five proposed noise barriers would be in the San Jose Diridon Station Approach Subsection and the next nine would be in the Monterey Corridor Subsection; the proposed heights would range from 8 to 14 feet above the top of the rail. Barrier 15 would be in both the Monterey Corridor Subsection and the Morgan Hill and Gilroy Subsection, and the proposed height would be 8 feet above the top of the rail. Barriers 16 through 33 would be in the Morgan Hill and Gilroy Subsection. The proposed barrier heights would range from 10 to 14 feet above the top of the rail.

Table 3.4-23 Proposed Noise Barriers—Alternative 1

Barrier	City	Start Stationing	End Stationing	Length (feet)	Height (feet)	Noise Barrier Coverage (square feet)	Side of Track	Number of Severe Impacts Benefited	Number of Moderate Impacts Benefited	Number of Residual Impacts (Severe/ Moderate)
1	Santa Clara	2261+00	2302+00	4,100	8	32,800	West	13	98	0 / 0
2	Santa Clara & San Jose	2351+00	2361+00	1,000	9	9,000	West	4	7	0 / 0
3	San Jose	208+00	237+00	2,900	14	40,600	East	25	58	0 / 0
4	San Jose	208+00	236+00	2,800	5	14,000	West	23	56	0 / 0
5	San Jose	239+00	270+00	3,100	8	24,800	East	2	26	0 / 0
6	San Jose	1581+00	1649+00	6,800	14	95,200	West	40	306	0 / 28
Total								**107**	**551**	**0 / 28**

Table 3.4-24 Proposed Noise Barriers—Alternative 2

Barrier	City	Start Stationing	End Stationing	Length (feet)	Height (feet)	Noise Barrier Coverage (square feet)	Side of Track	Number of Severe Impacts Benefited	Number of Moderate Impacts Benefited	Number of Residual Impacts (Severe/ Moderate)
1	San Jose	208+00	237+00	2,900	14	40,600	East	26	58	0 / 0
2	San Jose	208+00	236+00	2,800	5	14,000	West	23	56	0 / 0
3	San Jose	239+00	270+00	3,100	8	24,800	East	2	26	0 / 0
4	San Jose	567+00	715+00	5,900	14	82,600	East	48	98	0 / 0
5	Morgan Hill	1071+00	1214+00	14,300	14	200,200	West	217	179	0 / 24
6	Morgan Hill	1072+00	1107+00	3,500	12	42,000	East	16	28	0 / 0
7	Morgan Hill	1158+00	1236+00	7,800	14	109,200	East	71	165	0 / 2
8	Morgan Hill	1289+00	1301+00	1,200	10	12,000	West	100	100	0 / 100
9	Gilroy	1581+00	1649+00	6,800	14	95,200	West	20	326	0 / 0
10	Gilroy	1656+00	1675+00	1,900	5	9,500	East	21	20	0 / 0
11	Gilroy	1705+00	1724+00	1,900	14	26,600	East	20	10	0 / 7
Total								**564**	**1,066**	**0 / 133**

Table 3.4-25 Proposed Noise Barriers—Alternative 3

Barrier	City	Start Stationing	End Stationing	Length (feet)	Height (feet)	Noise Barrier Coverage (square feet)	Side of Track	Number of Severe Impacts Benefited	Number of Moderate Impacts Benefited	Number of Residual Impacts (Severe/ Moderate)
1	San Jose	208+00	237+00	2,900	14	40,600	East	26	58	0 / 0
2	San Jose	208+00	236+00	2,800	5	14,000	West	23	56	0 / 0
3	San Jose	239+00	270+00	3,100	8	24,800	East	2	26	0 / 0
Total								**51**	**140**	**0 / 0**

Table 3.4-26 Proposed Noise Barriers without Quiet Zones—Alternative 4

Barrier	City	Start Stationing	End Stationing	Length (feet)	Height (feet)	Noise Barrier Coverage (square feet)	Side of Track	Number of Severe Impacts Benefited	Number of Moderate Impacts Benefited	Number of Residual Impacts (Severe/ Moderate)
1	Santa Clara & San Jose	2963+00	2973+00	1,000	9	9,000	West	4	0	0 / 0
2	San Jose	3105+00	3114+00	900	12	10,800	West	23	0	0 / 0
3	San Jose	3114+00	3120+00	600	10	6,000	West	11	1	0 / 2
4	San Jose	3120+00	3137+00	1,700	12	20,400	West	41	0	0 / 0
5	San Jose	3123+00	3138+00	1,500	12	18,000	East	20	0	0 / 0
6	San Jose	3246+00	3275+00	2,900	14	40,600	East	15	59	0 / 0
7	San Jose	3278+00	3309+00	3,100	8	24,800	East	22	5	0 / 0
8	San Jose	385+00	401+00	1,600	12	19,200	West	26	3	0 / 0
9	San Jose	403+00	428+00	2,500	12	30,000	West	79	0	0 / 0
10	San Jose	403+00	428+00	2,500	14	35,000	East	19	34	0 / 13
11	San Jose	430+00	458+00	2,800	12	33,600	West	17	4	0 / 0
12	San Jose	430+00	444+00	1,400	12	16,800	East	17	0	0 / 0
13	San Jose	458+00	472+00	1,400	12	16,800	West	33	0	0 / 0
14	San Jose	474+00	487+00	1,300	12	15,600	West	32	0	0 / 0
15	San Jose	644+00	677+00	3,300	8	26,400	West	49	11	0 / 0
16	Morgan Hill	1024+00	1053+00	2,900	10	29,000	West	36	47	0 / 0
17	Morgan Hill	1110+00	1132+00	2,200	10	22,000	West	22	1	0 / 0
18	Morgan Hill	1133+00	1144+00	1,100	10	11,000	West	30	1	0 / 0
19	Morgan Hill	1133+00	1157+00	2,400	12	28,800	East	63	62	0 / 0
20	Morgan Hill	1145+00	1157+00	1,200	10	12,000	West	8	10	0 / 0

Barrier	City	Start Stationing	End Stationing	Length (feet)	Height (feet)	Noise Barrier Coverage (square feet)	Side of Track	Number of Severe Impacts Benefited	Number of Moderate Impacts Benefited	Number of Residual Impacts (Severe/ Moderate)
21	Morgan Hill	1159+00	1165+00	600	10	6,000	West	30	2	0 / 0
22	Morgan Hill	1159+00	1175+00	1,600	10	16,000	East	29	38	0 / 0
23	Morgan Hill	1175+00	1185+00	1,000	14	14,000	East	14	0	0 / 2
24	Morgan Hill	1239+00	1251+00	1,200	10	12,000	West	100	100	0 / 0
25	Morgan Hill	1278+00	1290+00	1,200	10	12,000	West	14	6	0 / 0
26	Gilroy	1606+00	1618+00	1,200	10	12,000	West	37	9	0 / 0
27	Gilroy	1606+00	1627+00	2,100	10	21,000	East	42	0	0 / 1
28	Gilroy	1632+00	1643+00	1,100	10	11,000	West	2	29	0 / 0
29	Gilroy	1632+00	1643+00	1,100	12	13,200	East	21	0	0 / 0
30	Gilroy	1643+50	1654+00	1,050	10	10,500	West	2	0	0 / 0
31	Gilroy	1643+50	1654+00	1,050	14	14,700	East	23	7	0 / 0
32	Gilroy	1661+00	1668+00	700	12	8,400	West	14	0	0 / 0
33	Gilroy	1668+00	1679+00	1,100	12	13,200	West	10	10	0 / 0
Total								**905**	**439**	**0 / 18**

Figure 3.4-33 through Figure 3.4-35 illustrate the approximate locations of the potential noise barriers for Alternative 1. The approximate locations of the potential noise barriers for Alternative 2 are illustrated on Figure 3.4-36 and Figure 3.4-37. The approximate locations of the potential noise barriers for Alternative 3 are illustrated on Figure 3.4-38. The approximate locations of the potential noise barriers for Alternative 4 are illustrated on Figure 3.4-39 through Figure 3.4-41. Figure 3.4-33 through Figure 3.4-41 also show the residual noise-affected receptors that would remain with the potential noise barriers.

Horn Noise

NV-MM#4 identifies Quiet Zones as a method to reduce horn noise in the corridor. Many of the projected noise impacts under Alternative 4 would be from train warning horn noise in the RSA. Caltrain, freight, and HSR trains would sound warning horns as they approach at-grade roadway crossings and passenger stations under Alternative 4. Trains are presumed to sound horns while approaching Caltrain stations following Caltrain operating policy. Trains sound the warning horns approaching at-grade crossings because it is required by FRA as a safety precaution. FRA does allow for the possibility of establishing Quiet Zones, which would eliminate the requirement for all trains to routinely sound their warning horns when approaching at-grade highway/rail crossings. Establishing Quiet Zones is a measure that would need to be undertaken by local communities. The project includes the installation of four-quad gates at all at-grade crossings currently without them , which would help cities to implement Quiet Zones, should they choose to do so.

A noise analysis conducted for Alternative 4 examined the use of Quiet Zones in the RSA in conjunction with noise barriers. Analysts evaluated the benefit of eliminating train horn noise for all trains approaching at-grade crossings and then additionally analyzed potential noise barriers. This analysis assumed that all trains would continue to sound warning horns approaching passenger stations, consistent with Caltrain operating policy.

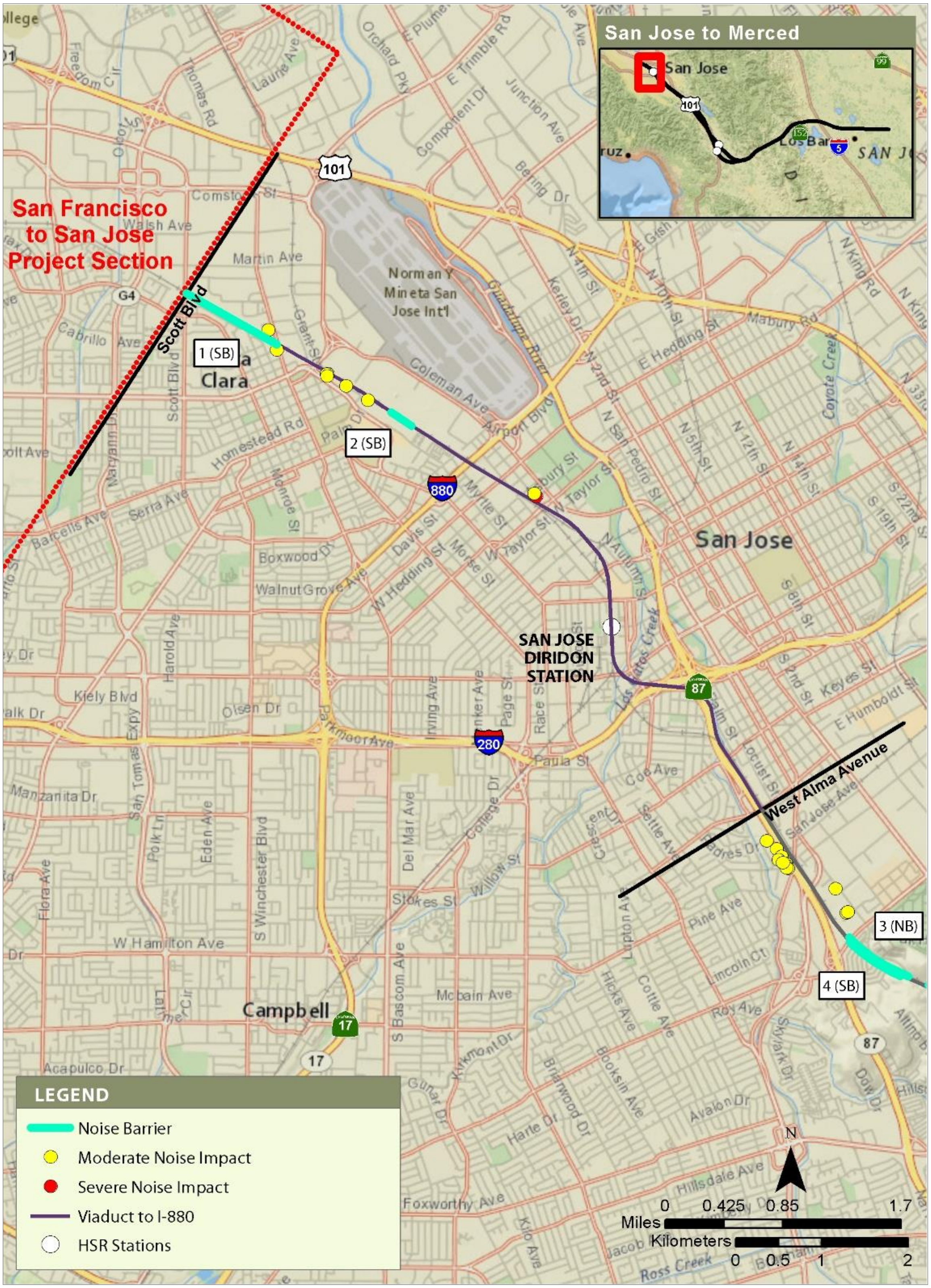
Table 3.4-27 shows the proposed noise barriers with Quiet Zones that were found to be cost-effective for Alternative 4. With Quiet Zones, analysts found eight potential noise barriers to be cost-effective for Alternative 4. With Quiet Zones in place, the proposed noise barriers would mitigate an additional 250 severe impacts and 187 moderate impacts. The first proposed noise barrier would be in the San Jose Diridon Station Approach Subsection and the next two would be located in the Monterey Corridor Subsection. Barrier 4 would be in both the Monterey Corridor Subsection and the Morgan Hill and Gilroy Subsection. The remaining four proposed noise barriers would be in the Morgan Hill and Gilroy Subsection.

Figure 3.4-42 through Figure 3.4-44 illustrate the approximate locations of the potential noise barriers with Quiet Zones under Alternative 4. These figures also illustrate the residual noise-affected receptors that would remain with the Quiet Zones and potential noise barriers.

Alternatives 1, 2, and 3 would not have HSR train horn noise; however, they would have horn noise from Caltrain, other passenger trains, and freight trains. Analysts evaluated additional noise mitigation to determine if eliminating the use of train warning horns along the project alignment would provide a benefit. Section 3.4.4.3, Methods for Impact Analysis, discusses the use of train warning horns in the RSA. Under Alternatives, 1, 2, and 3, much of the project would be in existing rail corridors with Caltrain, freight, and other passenger trains operating on separate tracks parallel to the HSR tracks.

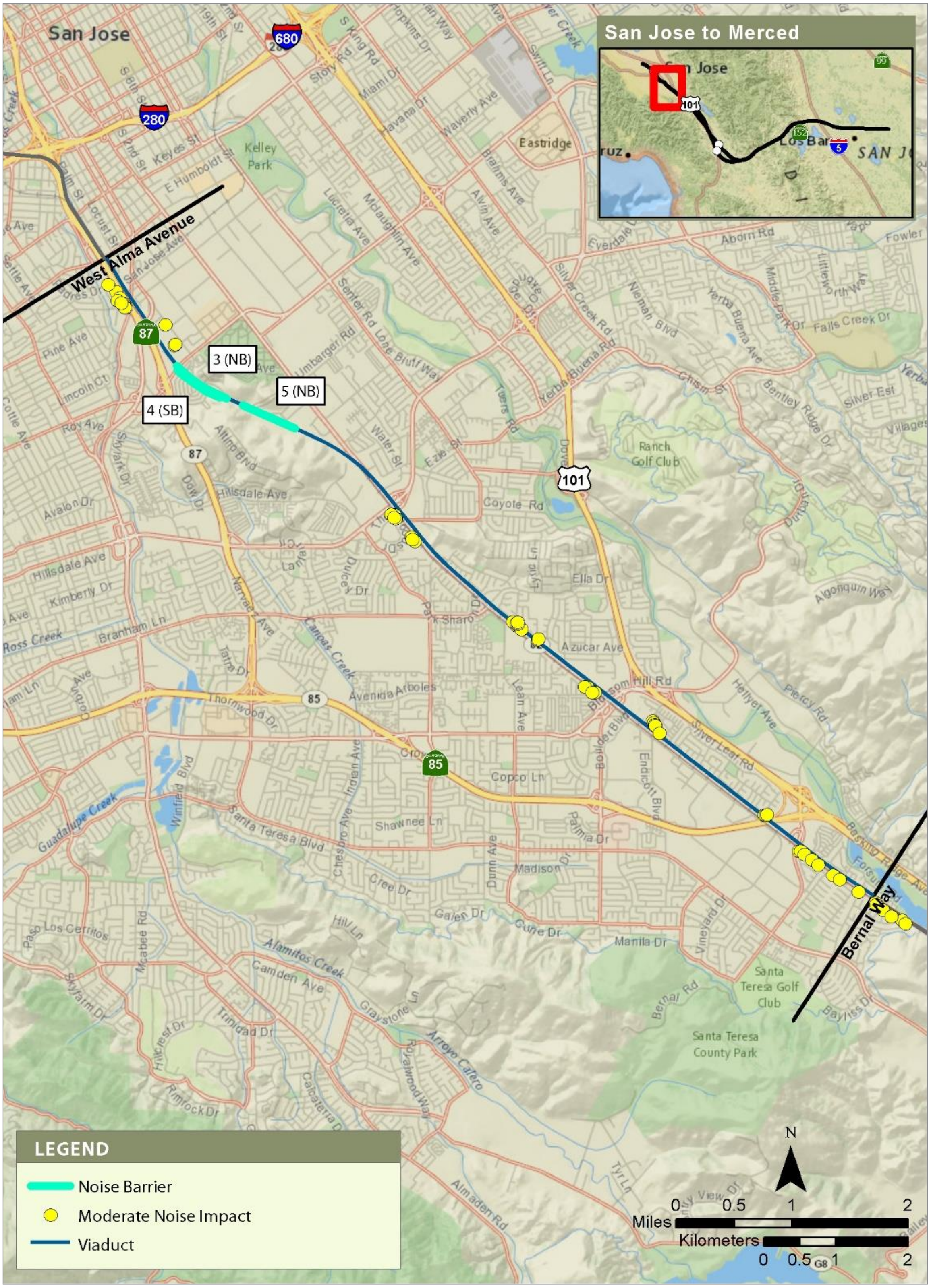
As discussed in Section 3.4.4.3, analysts based the impact assessment on a comparison of the existing noise exposure to the future total noise exposure with the project alternatives. Therefore, even though non-HSR trains would sound warning horns at grade crossings and passenger stations with or without the HSR alternatives, reducing future total noise levels by eliminating horn sounding could reduce the number of project noise impacts under Alternatives 1, 2, and 3.

The horn noise mitigation analysis for Alternatives 1, 2, and 3 calculated the future noise levels without any train horns in the RSA. Eliminating horn noise as a potential mitigation measure was analyzed in conjunction with the noise barrier analysis.



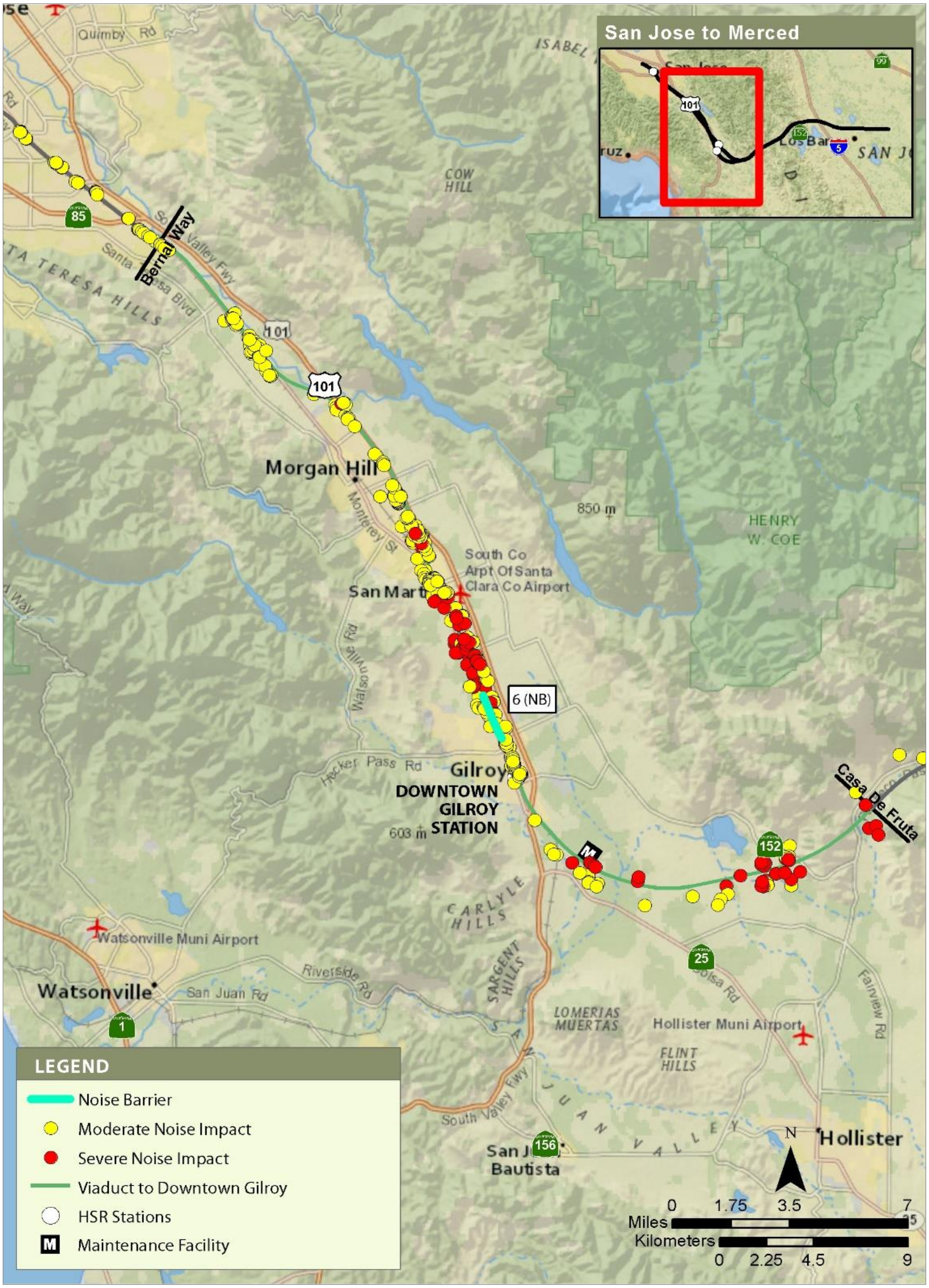
FEBRUARY 2019

Figure 3.4-33 Proposed Noise Barriers and Residual Noise Impacts—Alternative 1 (San Jose Diridon Station Approach Subsection)



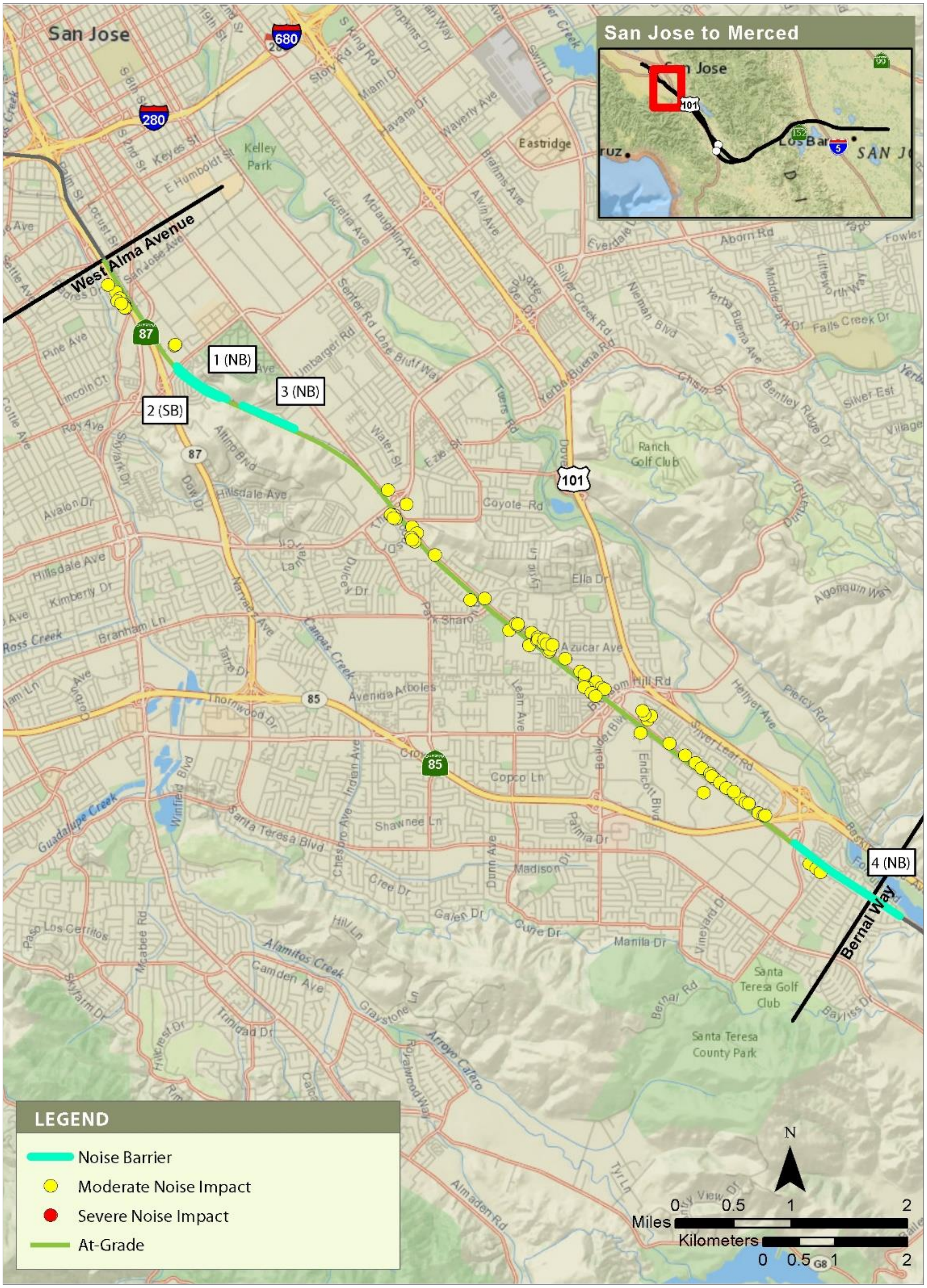
FEBRUARY 2019

Figure 3.4-34 Proposed Noise Barriers and Residual Noise Impacts—Alternative 1 (Monterey Corridor Subsection)



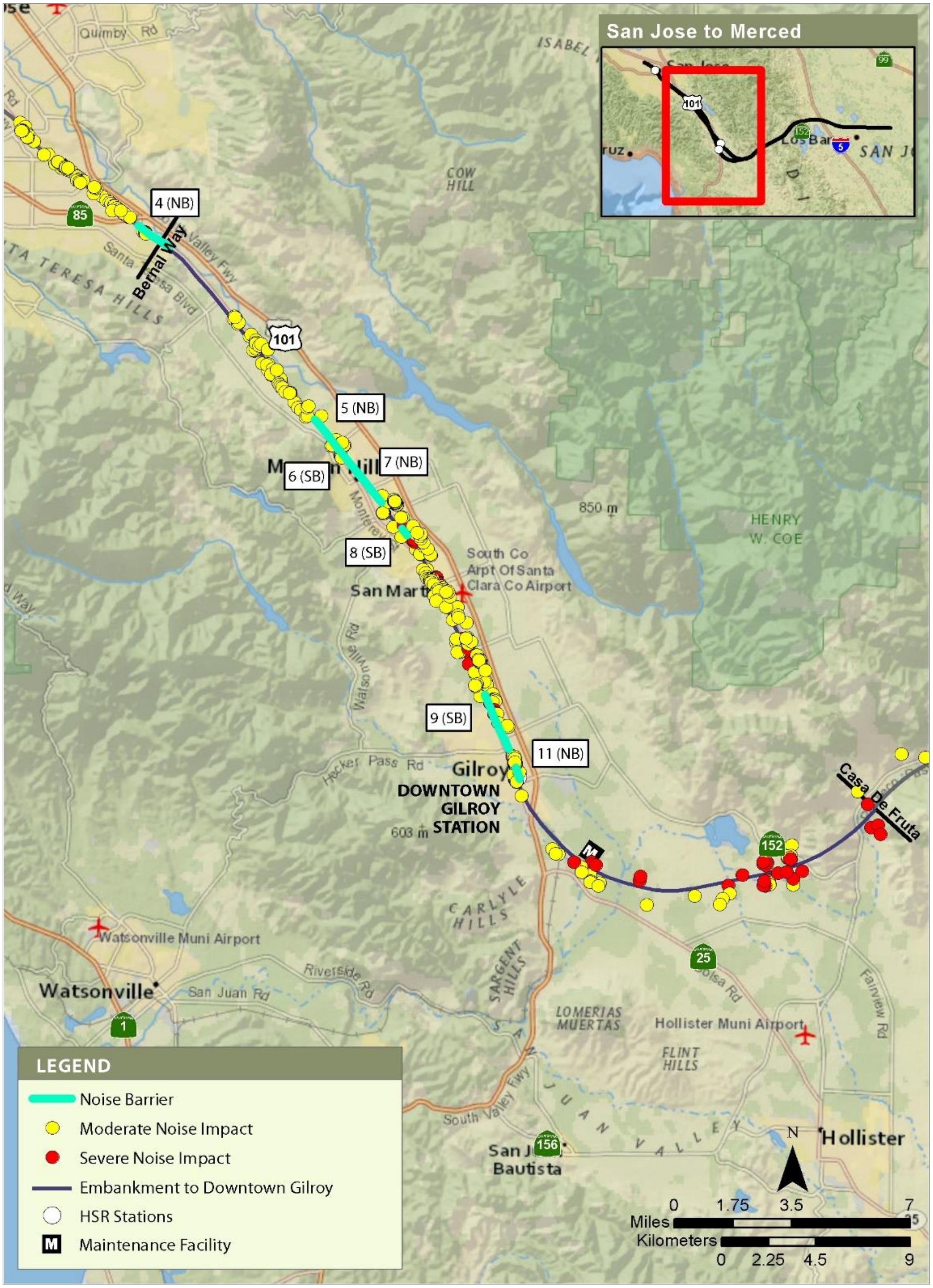
FEBRUARY 2019

Figure 3.4-35 Proposed Noise Barriers and Residual Noise Impacts—Alternative 1 (Morgan Hill and Gilroy Subsection)



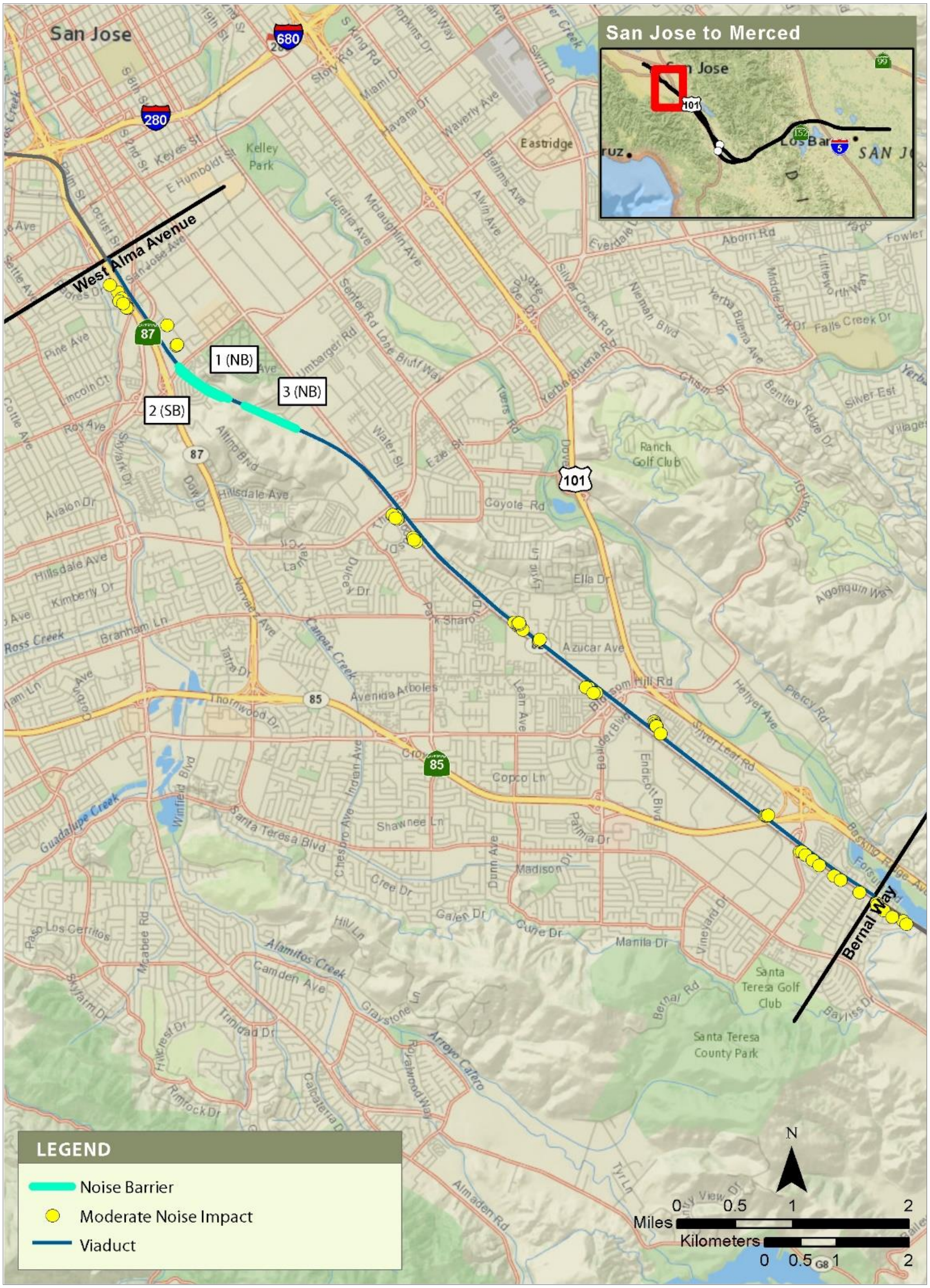
FEBRUARY 2019

Figure 3.4-36 Proposed Noise Barriers and Residual Noise Impacts—Alternative 2 (Monterey Corridor Subsection)



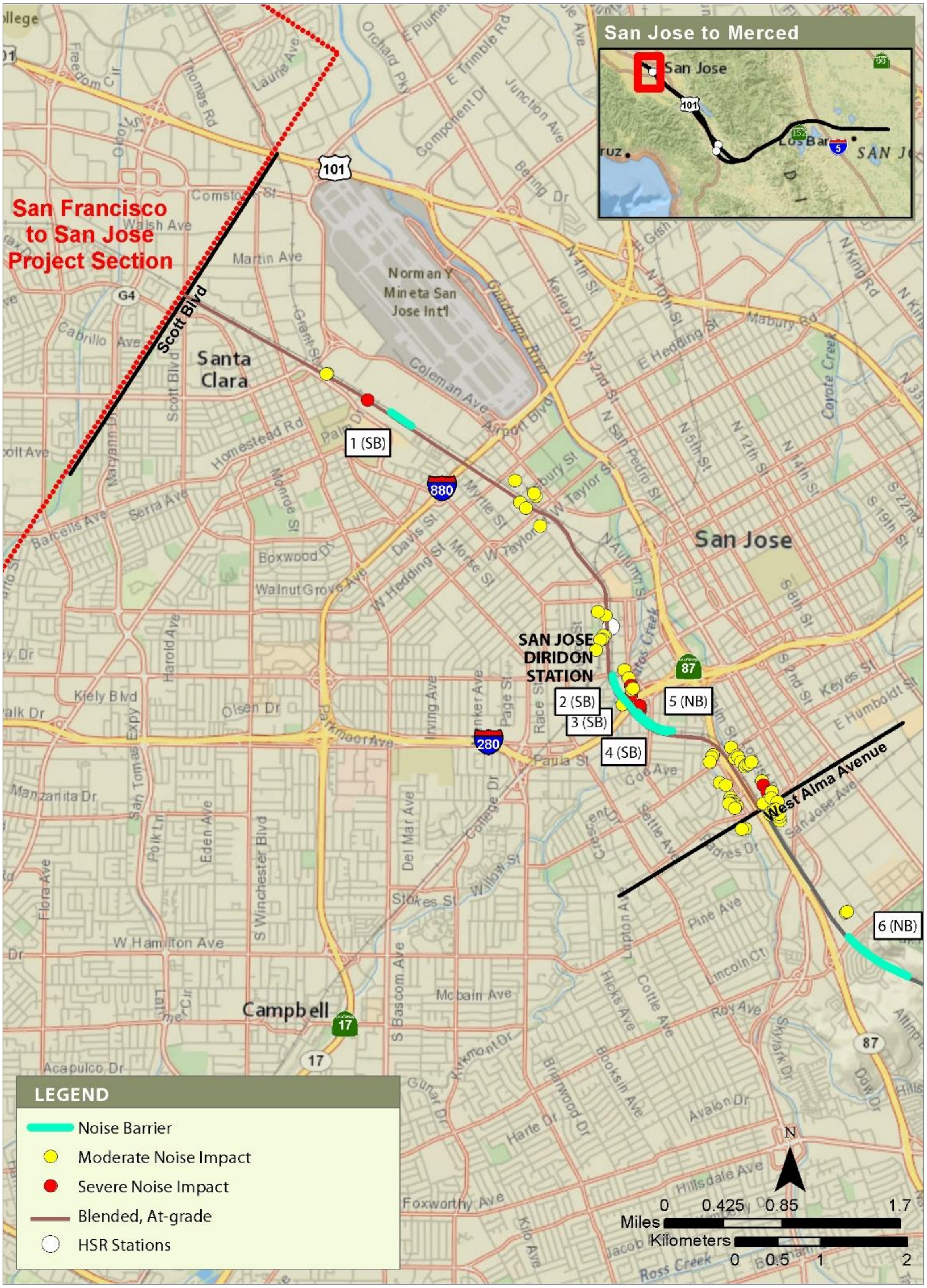
FEBRUARY 2019

Figure 3.4-37 Proposed Noise Barriers and Residual Noise Impacts—Alternative 2 (Morgan Hill and Gilroy Subsection)



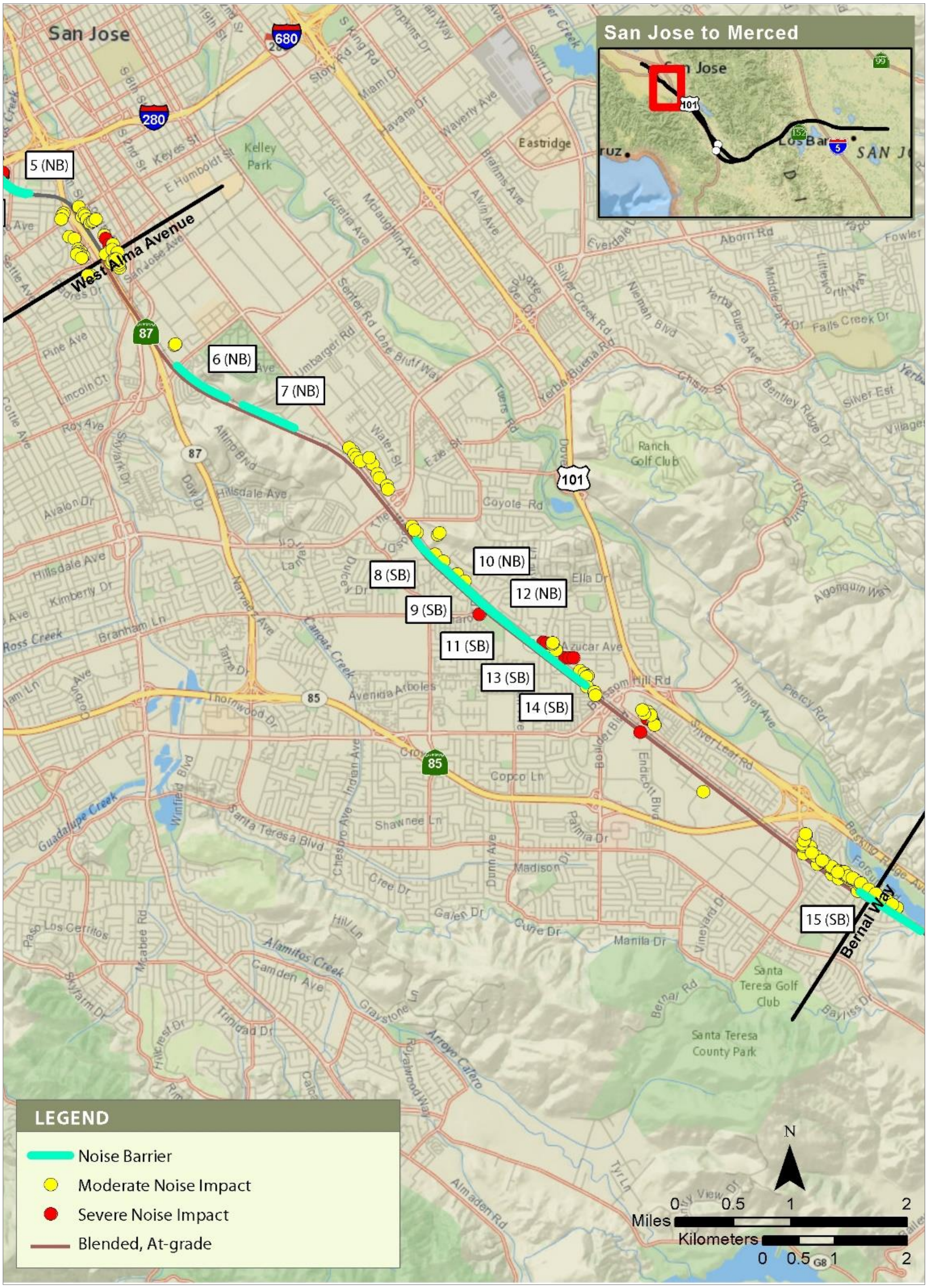
FEBRUARY 2019

Figure 3.4-38 Proposed Noise Barriers and Residual Noise Impacts—Alternative 3 (Monterey Corridor Subsection)



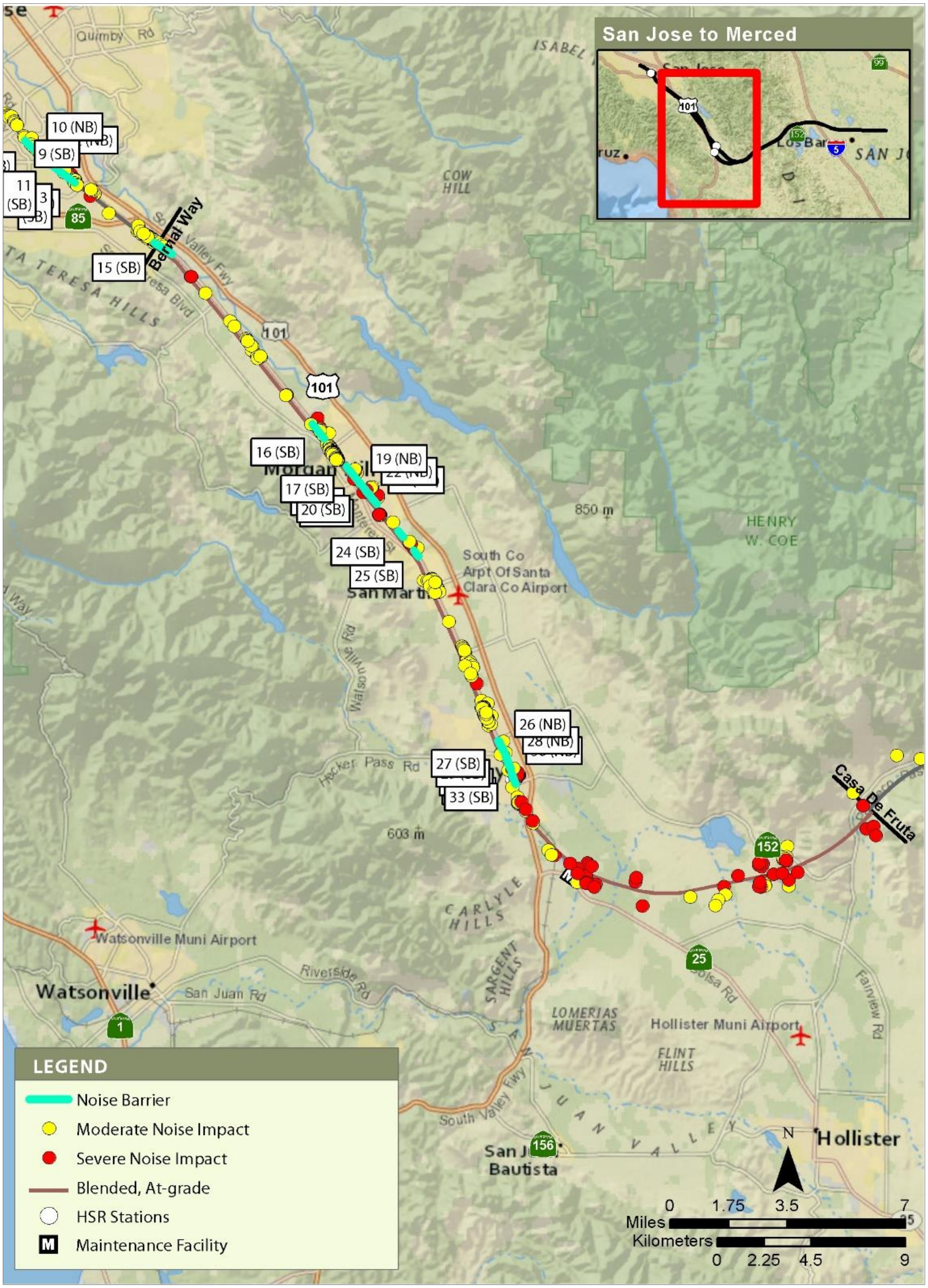
FEBRUARY 2019

Figure 3.4-39 Proposed Noise Barriers and Residual Noise Impacts—Alternative 4 (San Jose Diridon Station Approach Subsection)



FEBRUARY 2019

Figure 3.4-40 Proposed Noise Barriers and Residual Noise Impacts—Alternative 4 (Monterey Corridor Subsection)

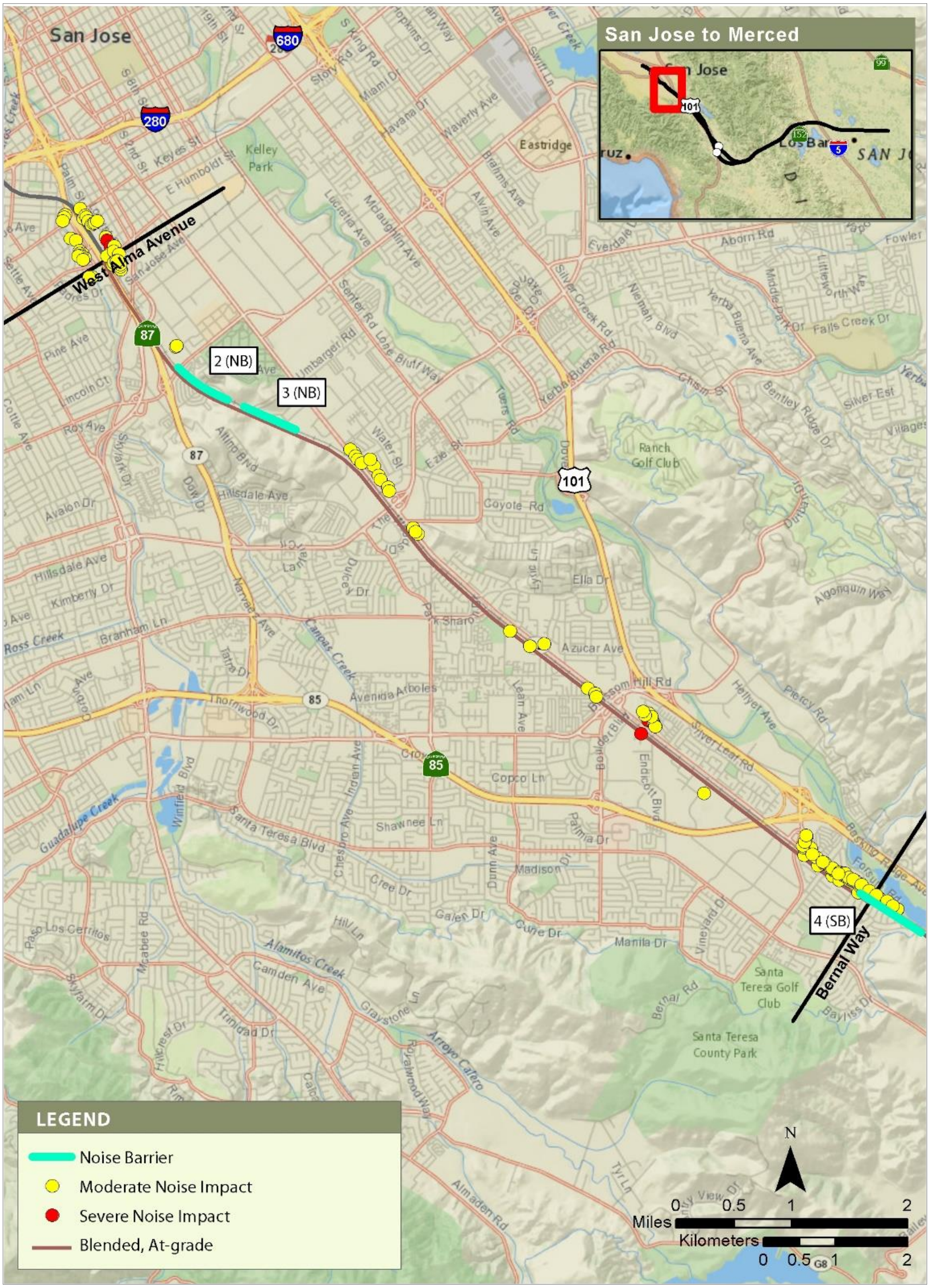


FEBRUARY 2019

Figure 3.4-41 Proposed Noise Barriers and Residual Noise Impacts—Alternative 4 (Morgan Hill and Gilroy Subsection)

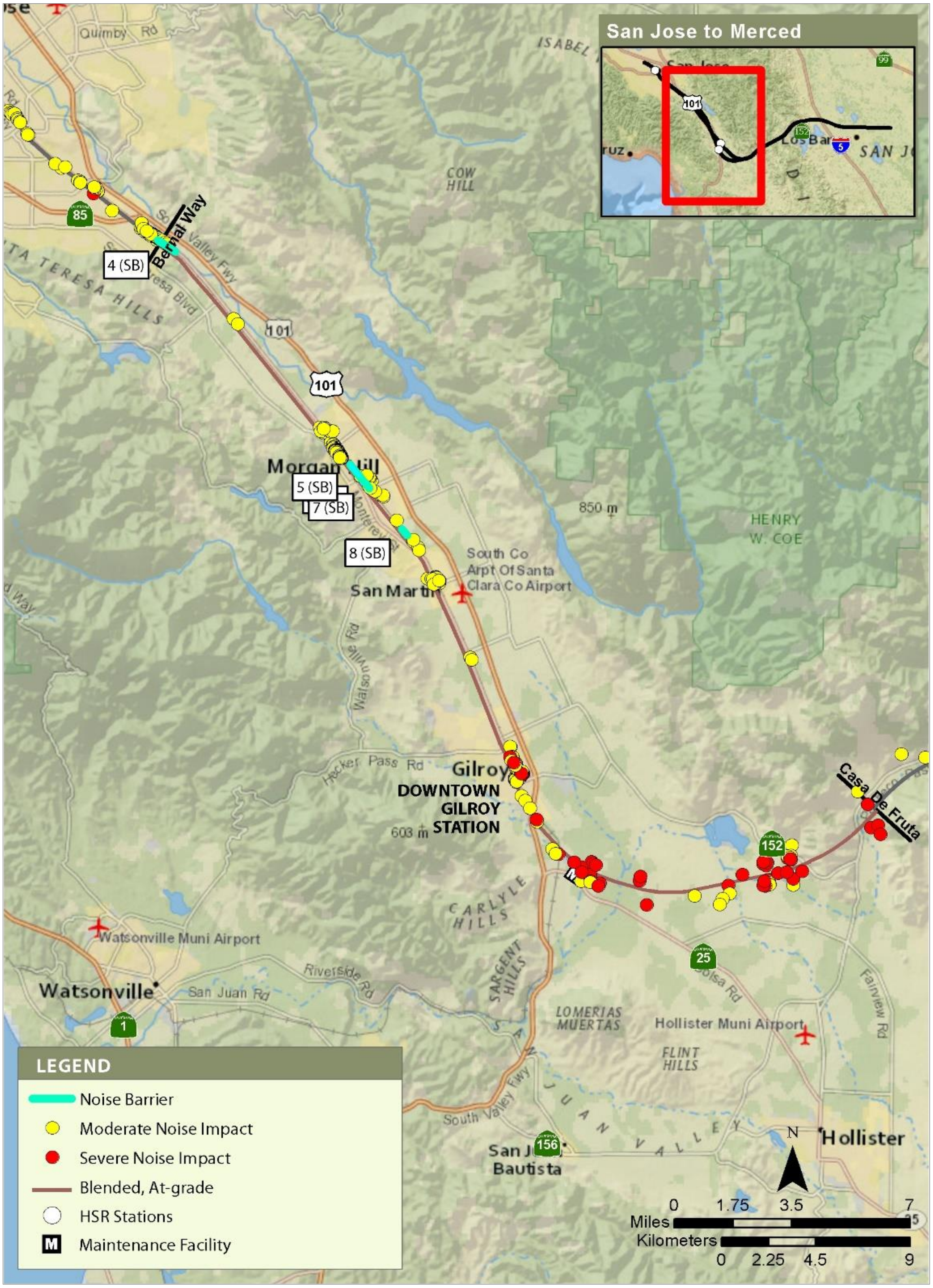
FEBRUARY 2019

Figure 3.4-42 Proposed Noise Barriers with Quiet Zones and Residual Noise Impacts—Alternative 4 (San Jose Diridon Station Approach Subsection)



FEBRUARY 2019

Figure 3.4-43 Proposed Noise Barriers with Quiet Zones and Residual Noise Impacts—Alternative 4 (Monterey Corridor Subsection)



FEBRUARY 2019

Figure 3.4-44 Proposed Noise Barriers with Quiet Zones and Residual Noise Impacts—Alternative 4 (Morgan Hill and Gilroy Subsection)

Table 3.4-27 Proposed Noise Barriers with Quiet Zones—Alternative 4

Barrier	City	Start Stationing	End Stationing	Length (feet)	Height (feet)	Noise Barrier Coverage (square feet)	Side of Track	Number of Severe Impacts Benefited	Number of Moderate Impacts Benefited	Number of Residual Impacts (Severe/ Moderate)
1	Santa Clara & San Jose	2963+00	2973+00	1,000	9	9,000	West	4	0	0 / 0
2	San Jose	3246+00	3275+00	2,900	14	40,600	East	15	59	0 / 0
3	San Jose	3278+00	3309+00	3,100	8	24,800	East	22	5	0 / 0
4	San Jose	644+00	677+00	3,300	8	26,400	West	49	11	0 / 0
5	Morgan Hill	1110+00	1132+00	2,200	10	22,000	West	22	1	0 / 0
6	Morgan Hill	1133+00	1144+00	1,100	10	11,000	West	30	1	0 / 0
7	Morgan Hill	1145+00	1157+00	1,200	10	12,000	West	8	10	0 / 0
8	Morgan Hill	1239+00	1251+00	1,200	10	12,000	West	100	100	0 / 0
Total								**250**	**187**	**0 / 0**

Summary

The analysis investigated noise impacts under each project alternative for the year 2040 for three cases: noise impacts without mitigation, residual noise impacts with noise barriers, and residual noise impacts with noise barriers and Quiet Zones. Quiet Zones, where implemented by local jurisdictions, would eliminate sounding of train horns approaching at-grade crossings. Quiet Zones would not affect HSR train noise where the HSR alignments are on grade-separated sections.

As shown in Table 3.4-28, under Alternative 1, in the San Jose Diridon Station Approach Subsection, noise barriers would mitigate 17 severe noise impacts and eliminating horn noise would not affect the number of projected noise impacts. In the Monterey Corridor Subsection, noise barriers would eliminate 46 severe noise impacts, but no additional severe noise impacts would be eliminated with Quiet Zones. In the Morgan Hill and Gilroy Subsection, noise barriers would eliminate 40 severe noise impacts and an additional 8 severe noise impacts could be eliminated with the implementation of quiet zones by local jurisdictions. In the Pacheco Pass Subsection, no noise barriers are recommended and there is no horn noise. In the San Joaquin Valley Subsection, no noise barriers are recommended and there is no horn noise.

Table 3.4-28 Noise Mitigation Effectiveness—Alternative 1[1]

Subsection	Alternative 1 Moderate and Severe Noise Impacts					
	Without Mitigation		With Noise Barriers		With Quiet Zones and Noise Barriers	
	Moderate	Severe	Moderate	Severe	Moderate	Severe
San Jose Diridon Station Approach	118	20	13	3	13	3
Monterey Corridor	226	46	85	0	84	0
Morgan Hill and Gilroy	819	160	541	120	486	112
Pacheco Pass	4	9	4	9	4	9
San Joaquin Valley	33	99	33	99	33	99
Total[1]	**1,200**	**334**	**676**	**231**	**620**	**223**

[1] The total numbers of impacts shown as benefitted in Table 3.4-23 are not the same as the difference between the numbers in this table with and without mitigation because, while mitigation would reduce noise effects, it may not eliminate them entirely. Thus, a reduced impact may still qualify as a residual moderate or severe impact.

Table 3.4-29 shows noise impacts for Alternative 2 under the same mitigation conditions. In the San Jose Diridon Station Approach Subsection, analysts found no noise barriers to be cost-effective and eliminating horn noise would not affect the number of projected noise impacts because there are no at-grade crossings. In the Monterey Corridor Subsection, noise barriers would eliminate 46 severe noise impacts, and Quiet Zones would not provide an additional benefit. In the Morgan Hill and Gilroy Subsection, noise barriers would eliminate 512 severe noise impacts, and Quiet Zones would not provide an additional benefit because all existing at-grade crossings are already eliminated with Alternative 2. In the Pacheco Pass Subsection, no noise barriers are recommended and there is no horn noise. In the San Joaquin Valley Subsection, no noise barriers are recommended and there is no horn noise.

Table 3.4-29 Noise Mitigation Effectiveness—Alternative 2

Subsection	Alternative 2 Moderate and Severe Noise Impacts					
	Without Mitigation		With Noise Barriers		With Quiet Zones and Noise Barriers	
	Moderate	Severe	Moderate	Severe	Moderate	Severe
San Jose Diridon Station Approach	73	0	73	0	73	0
Monterey Corridor	327	46	186	0	186	0
Morgan Hill and Gilroy	1,407	598	497	86	497	86
Pacheco Pass	4	9	4	9	4	9
San Joaquin Valley	33	99	33	99	33	99
Total[1]	**1,844**	**752**	**793**	**194**	**793**	**194**

[1] The total numbers of impacts shown as benefitted in Table 3.4-24 are not the same as the difference between the numbers in this table with and without mitigation because, while mitigation would reduce noise effects, it may not eliminate them entirely. Thus, a reduced impact may still qualify as a residual moderate or severe impact.

Table 3.4-30 shows noise impacts for Alternative 3 under the same mitigation conditions. In the San Jose Diridon Station Approach Subsection, no noise barriers were found to be cost-effective and eliminating horn noise would not affect the number of projected noise impacts because there are no at-grade crossings. In the Monterey Corridor Subsection, noise barriers would eliminate 46 severe noise impacts, and no additional severe noise impacts would be eliminated with Quiet Zones. In the Morgan Hill and Gilroy Subsection, no noise barriers were found to be cost-effective, and no severe noise impacts would be eliminated with Quiet Zones. In the Pacheco Pass Subsection, no noise barriers are recommended and there is no horn noise. In the San Joaquin Valley Subsection, no noise barriers are recommended and there is no horn noise.

Table 3.4-30 Noise Mitigation Effectiveness—Alternative 3[1]

Subsection	Alternative 3 Moderate and Severe Noise Impacts					
	Without Mitigation		With Noise Barriers		With Quiet Zones and Noise Barriers	
	Moderate	Severe	Moderate	Severe	Moderate	Severe
San Jose Diridon Station Approach	73	0	73	0	73	0
Monterey Corridor	226	46	85	0	65	0
Morgan Hill and Gilroy	498	65	498	65	461	65
Pacheco Pass	4	9	4	9	4	9
San Joaquin Valley	33	99	33	99	33	99
Total[1]	**834**	**219**	**693**	**173**	**636**	**173**

[1] The total numbers of impacts shown as benefitted in Table 3.4-25 are not the same as the difference between the numbers in this table with and without mitigation because while, mitigation would reduce noise effects, it may not eliminate them entirely. Thus, a reduced impact may still qualify as a residual moderate or severe impact.

Table 3.4-31 shows noise impacts for Alternative 4 under the same mitigation conditions. Under Alternative 4, Quiet Zones would eliminate HSR train horn noise at grade crossings. In the San Jose Diridon Station Approach Subsection, noise barriers would eliminate 100 severe noise impacts, and an additional 10 severe noise impacts would be eliminated with Quiet Zones. In the Monterey Corridor Subsection, noise barriers would eliminate 264 severe noise impacts, and an additional 12 severe noise impacts would be eliminated with Quiet Zones. In the Morgan Hill and Gilroy Subsection, noise barriers would eliminate 547 severe noise impacts, and an additional 74 severe noise impacts would be eliminated with Quiet Zones. In the Pacheco Pass Subsection, no noise barriers are recommended and there is no horn noise. In the San Joaquin Valley Subsection, no noise barriers are recommended and there is no horn noise.

Table 3.4-31 Noise Mitigation Effectiveness—Alternative 4[1]

Subsection	Alternative 4 Moderate and Severe Noise Impacts					
	Without Mitigation		With Noise Barriers		With Quiet Zones and Noise Barriers	
	Moderate	Severe	Moderate	Severe	Moderate	Severe
San Jose Diridon Station Approach	222	124	222	24	216	14
Monterey Corridor	238	280	129	16	86	4
Morgan Hill and Gilroy	1,142	674	805	127	587	53
Pacheco Pass	4	9	4	9	4	9
San Joaquin Valley	33	99	33	99	33	99
Total[1]	**1,639**	**1,186**	**1,193**	**275**	**926**	**179**

[1] The total numbers of impacts shown as benefited in Table 3.4-26 and Table 3.4-27 are not the same as the difference between the numbers in this table with and without mitigation because, while mitigation would reduce noise effects, it may not eliminate them entirely. Thus, a reduced impact may still qualify as a residual moderate or severe impact.

3.4.7.2 Vibration Mitigation Analysis

Operations vibration impacts would be mitigated with NV-MM#8. This mitigation measure includes various options to reduce train vibration. The specific design and implementation of this mitigation measure would be identified during final design.

As there are site-specific factors to consider, such as the speed, presence of special trackwork, soil type, and vibration propagation characteristics, further studies during the subsequent engineering phases of the project should evaluate these site-specific conditions where vibration mitigation is indicated to determine the mitigation design requirements. Such studies would include additional vibration propagation tests to narrow down the site-specific vibration estimates, and engineering evaluation of the special track support options. Vibration impacts less than 10 dB over the thresholds would be reduced to less than significant levels with mitigation. It may not be possible to fully mitigate vibration impacts that are more than 10 dB over the threshold; as a result, some vibration impacts would be potentially significant and unavoidable with mitigation.

3.4.8 Impact Summary for NEPA Comparison of Alternatives

As described in Section 3.1.5.4, the impacts of project actions under NEPA are compared to the No Project Alternative when evaluating the impact of the project alternatives on the resource. The determination of impact is based on the context and intensity of the change that would be generated by project construction and operations. Table 3.4-32 compares the project impacts by alternative, and is followed by a summary of the impacts.

Table 3.4-32 Comparison of Project Alternative Impacts for Noise and Vibration

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Noise				
Impact NV#1: Temporary Exposure of Sensitive Receptors to Construction Noise	Temporary noise impacts at noise sensitive locations would exceed the residential nighttime 8-hour L_{eq} criterion of 70 dBA for typical track construction activities up to 374 feet from the clear-and-grub construction activity and up to 774 feet from the concrete pour aerial structure activity. For the PG&E upgrades, these criteria would be exceeded as far away as 522 feet from reconductoring activity. These distances would be applicable to all four project alternatives.	Similar to Alternative 1, with fewer noise impacts in Morgan Hill, Gilroy and Monterey Corridor Subsections.	Similar to Alternative 1, without noise impacts on downtown Gilroy businesses.	Similar to Alternative 1, but no concrete pour aerial structure activity from San Jose to Gilroy. This would have more impacts in Morgan Hill.
Impact NV#2: Intermittent Permanent Exposure of Sensitive Receptors to Noise from Train Operations	Permanent noise impacts from 2029 Plus Project conditions: ▪ 307 moderate noise impacts ▪ 47 severe noise impacts Permanent noise impacts from 2040 Plus Project conditions: ▪ 1,200 moderate noise impacts ▪ 334 severe noise impacts	Permanent noise impacts from 2029 Plus Project conditions: ▪ 596 moderate noise impacts ▪ 38 severe noise impacts Permanent noise impacts from 2040 Plus Project: ▪ 1,844 moderate noise impacts ▪ 752 severe noise impacts	Permanent noise impacts from 2029 Plus Project conditions: ▪ 224 moderate noise impacts ▪ 34 severe noise impacts Permanent noise impacts from 2040 Plus Project conditions: ▪ 834 moderate noise impacts ▪ 219 severe noise impacts	Permanent noise impacts from 2029 Plus Project conditions: ▪ 989 moderate noise impacts ▪ 191 severe noise impacts Permanent noise impacts from 2040 Plus Project conditions: ▪ 1,639 moderate noise impacts ▪ 1,186 severe noise impacts
Impact NV#3: Intermittent Permanent Exposure of Sensitive Receptors to Noise from HSR Passenger Station Parking	Noise contribution from parking facilities: ▪ 29 dBA L_{dn} at San Jose Diridon Station ▪ 40 dBA L_{dn} at the Downtown Gilroy Station This additional noise would be substantially lower than noise from HSR trains.	Same as Alternative 1	Noise contribution from parking facilities: ▪ 29 dBA L_{dn} at San Jose Diridon Station ▪ 28 dBA L_{dn} at the East Gilroy Station This additional noise would be substantially lower than noise from HSR trains.	Same as Alternative 1

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Impact NV#4: Intermittent Permanent Exposure of Sensitive Receptors to Noise from HSR Maintenance Facilities	40 dBA L_{dn} contribution from train movements at the South Gilroy MOWF, which is substantially lower than the noise from operating HSR trains. No additional impact is projected.	Same as Alternative 1	47 dBA L_{dn} contribution from train movements at the East Gilroy MOWF, which is substantially lower than the noise from operating HSR trains. No additional impact is projected.	45 dBA L_{dn} contribution from train movements at the Alternative 4 South Gilroy MOWF, which is substantially lower than the noise from operating HSR trains. No additional impact is projected.
Impact NV#5: Intermittent Permanent Human Annoyance from Onset of Passing HSR Trains	Operations would not cause human annoyance from the startle effect of HSR train passbys within dedicated sections of the alignment because the threshold for sudden onset noise would occur within the right-of-way, which would be fenced to prohibit public access.	Same as Alternative 1	Same as Alternative 1	Operations would cause initial human annoyance from the startle effect of HSR train passbys at one location within 23 feet of the tracks in Morgan Hill. Effects south and east of Gilroy would be the same as Alternative 1.
Impact NV#6: Permanent Exposure of Sensitive Receptors to Vehicular Traffic Noise Increases	Roadway segments with an anticipated increase in traffic noise of ≥3 dB compared to existing conditions include: 2029 Plus Project conditions ▪ 4 segments near San Jose ▪ 2 segments along Monterey Road ▪ 1 segment near South Gilroy MOWF 2040 Plus Project conditions ▪ 5 segments near San Jose ▪ 6 segments along Monterey Road ▪ 1 segment near South Gilroy MOWF	Same as Alternative 1	Roadway segments with an anticipated increase in traffic noise of ≥3 dB compared to existing conditions include: 2029 Plus Project conditions ▪ 4 segments near San Jose ▪ 2 segments along Monterey Road 2040 Plus Project conditions ▪ 5 segments near San Jose ▪ 6 segments along Monterey Road ▪ 1 segment near East Gilroy MOWF	Roadway segments with an anticipated increase in traffic noise of ≥3 dB compared to existing conditions include: 2029 Plus Project conditions ▪ 3 segments near San Jose ▪ 3 segments along Monterey Road 2040 Plus Project conditions ▪ 4 segments near San Jose ▪ 6 segments along Monterey Road ▪ 1 segment near Downtown Gilroy Station ▪ 1 segment near South Gilroy MOWF

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Impact NV#7: Intermittent Permanent Livestock Stress from Passing HSR Trains	Livestock within 30 feet from the edge of the HSR right-of-way would experience stress associated with exposure to noise levels above the recommended thresholds.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1. Also, livestock at two locations between San Jose and Gilroy within 285 feet of edge of HSR right-of-way would experience stress associated with exposure to noise levels from sounding of HSR horns.
Impact NV#8: Permanent Exposure of Sensitive Receptors to Traction Power Facility Noise	The substation facilities would generate noise, but would not cause additional noise impacts beyond those from trains and horns.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Vibration				
Impact NV#9: Temporary Exposure of Sensitive Receptors and Buildings to Construction Vibration	Potential annoyance from nighttime vibratory methods within 300 feet of residential structures. Potential building damage from impact pile driving within 50 feet of structures. Potential perceptible vibration in occupied buildings within 100 feet of tunnel boring operations for tunnel construction.	Similar to Alternative 1 but potentially more vibratory compaction at embankments and at grade at the Monterey Corridor and Morgan Hill and Gilroy Subsections; less vibratory compaction in San Jose to Scott Blvd touchdown.	Similar to Alternative 1 in Gilroy and in Monterey Corridor Subsection, but eastern alignment in Gilroy and Morgan Hill would affect fewer structures; similar to Alternative 2 in the Monterey Corridor Subsection through San Jose.	Similar to Alternative 1 east of Gilroy; most vibratory compaction at embankments and at-grade portions of all project alternatives; construction in existing right-of-way would require more nighttime work to minimize service disruptions.
Impact NV#10: Intermittent Permanent Exposure of Sensitive Receptors to Vibration from Operations	81 permanent vibration impacts	143 permanent vibration impacts	140 permanent vibration impacts	1,203 permanent vibration impacts

≥ = greater than or equal to
dB = decibel
dBA = A-weighted decibel
HSR = high-speed rail
L_{dn} = day night sound level
Leq = equivalent sound level
MOWF = maintenance of way facility
PG&E = Pacific Gas and Electric

3.4.8.1 Construction Noise

Project construction would require the use of mechanical equipment that would generate temporary increases in noise and result in temporary construction impacts at noise-sensitive locations. For typical track construction scenarios, the residential nighttime 8-hour L_{eq} criterion of 70 dBA would potentially be exceeded up to 374 feet from the clear-and-grub construction activity and as far as 774 feet from the concrete pour aerial structure activity. For the PG&E upgrades, these criteria would be exceeded as far as 522 feet from the conductor installation construction activity. These distances would be applicable to all four project alternatives. Concrete pour aerial structure activity would not apply to Alternative 4 between San Jose and Gilroy. The Authority and its contractors would comply with FRA guidelines for minimizing noise impacts at sensitive receptors during project construction (NV-IAMF#1), but construction noise impacts would remain. Implementation of NV-MM#1, Construction Noise Mitigation Measures, would reduce these impacts. This mitigation would require the contractor to conduct construction noise monitoring. The measure provides contractors with the flexibility to implement different tools to meet FRA standards for limiting both daytime and nighttime noise during construction.

3.4.8.2 Operations Noise

Project operations would permanently increase noise levels above FRA's noise impact thresholds at sensitive receptors. Alternative 4 would have the most severe and moderate operations noise impacts, followed by Alternative 2, Alternative 1, and Alternative 3, and impacts would be greater under the 2040 Plus Project conditions due to increased HSR train operations compared to 2029. Under the 2040 Plus Project condition, there would be 334 severe noise impacts and 1,200 moderate impacts under Alternative 1; 752 severe impacts and 1,843 moderate impacts under Alternative 2; 219 severe impacts and 834 moderate impacts under Alternative 3; and 1,186 severe impacts and 1,638 moderate impacts under Alternative 4. The Authority has identified multiple mitigation measures that would reduce the number of sensitive receptors subject to moderate and severe impacts from train operations: NV-MM#3, NV-MM#4, NV-MM#5, NV-MM#6, and NV-MM#7, as described in Section 3.4.7, Mitigation Measures.

Project operations would generate traffic and associated noise at HSR stations. Near the San Jose Diridon Station, the L_{dn} contribution from the relocated parking spaces would be 29 dBA at the closest noise receptors. Near the Downtown Gilroy Station, the L_{dn} contribution from the parking facilities would be 40 dBA at the closest noise receptors. Near the East Gilroy Station, the L_{dn} contribution from the parking facilities would be 28 dBA at the closest noise receptors. The additional noise from parking facilities would be substantially lower (at least 17 dB less) than the projected L_{dn} from project operations. Therefore, no additional noise impacts from parking facilities are anticipated.

Project operations would also generate additional noise associated with train movements in and out of the MOWF near Gilroy. Under Alternatives 1 and 2, the L_{dn} contribution from the South Gilroy MOWF at that nearest receptor would be 40 dBA (more than 20 dBA less than project operations). Under Alternative 3, the L_{dn} contribution from the East Gilroy MOWF at that nearest receptor would be 47 dBA (more than 20 dBA less than project operations). Under Alternative 4, the L_{dn} contribution from the MOWF at that nearest receptor would be 45 dBA (more than 18 dBA less than project operations). Therefore, no additional noise impacts from MOWFs are anticipated.

Project construction would result in permanent changes in the local roadway network that would require some diversion and rerouting of traffic. The diversion of traffic would not be expected to affect noise levels because traffic on local roadways provides only a minor contribution to overall noise levels. Project operations would generate additional traffic and traffic-related noise under the 2029 Plus Project and 2040 Plus Project conditions. Permanent increases in traffic-related noise would be similar for all four project alternatives and would occur at roadways segments near San Jose Diridon Station, along Monterey Road, and near Gilroy. In 2029, seven roadway segments under Alternatives 1 and 2 and six roadway segments under Alternatives 3 and 4 would have the potential for noise level increases greater than or equal to 3 dB, compared to existing noise conditions. In 2040, operations of all project alternatives would result in 12 roadway segments with the potential for noise level increases greater than or equal to 3 dB. Most of these traffic noise impacts would occur near the San Jose Diridon Station and along Monterey Road. Mitigation measures NV-MM#3 and NV-MM#7 would address these impacts.

Human annoyance due to startle would be limited to areas within the project's proposed right-of-way except for one residential location with Alternative 4. Analysts also evaluated the potential for livestock animals to experience stress associated with the noise of passing trains in exceedance of FRA's recommended threshold. Where livestock operations are within approximately 30 feet of the edge of the HSR right-of-way, adverse impacts would occur. With Alternative 4, adverse impacts on livestock at two locations between San Jose and Gilroy would occur within approximately 285 feet of HSR tracks where HSR trains would sound warning horns at the at-grade crossings.

Project operations would also generate additional noise associated with TPF facilities. Under all project alternatives, the L_{dn} contribution from these facilities would not generate additional noise impact beyond the train operations noise impacts. The most combined HSR train operation and TPF impacts would occur with Alternative 4 (33 severe, 0 moderate) near the traction power paralleling stations in San Jose, Morgan Hill, and Gilroy; followed by Alternative 3 (8 severe, 1 moderate) and Alternative 1 (6 severe, 1 moderate) in Morgan Hill and Gilroy; and then Alternative 2 (1 severe, 0 moderate) in Gilroy. Mitigation measures NV-MM#3 and NV-MM#7 would address these impacts.

3.4.8.3 Construction Vibration

Project construction would cause temporary exposure of sensitive receptors and buildings to construction vibration. Building damage could occur within approximately 50 feet of pile driving. Additionally, construction of the HSR tunnels in the Pacheco Pass Subsection would cause temporary perceptible vibration in occupied buildings within approximately 100 feet of the tunnel boring machine operation. Incorporation of NV-IAMF#1 would minimize construction vibration and the potential for it to cause damage to buildings. However, even with NV-IAMF#1, some sensitive receptors would still be exposed to ground-borne vibration that could result in building damage. This impact would be addressed with NV-MM#2.

Using the frequent event criterion, annoyance from nighttime vibratory construction activities would occur as far out as 300 feet from pile driving or 140 feet from vibratory compaction. Incorporation of NV-IAMF#1 would minimize construction vibration and the potential for it to cause annoyance to occupants at vibration-sensitive land use. However, even with NV-IAMF#1, some sensitive receptors would still be exposed to ground-borne vibration that would result in annoyance during nighttime hours. The residual impact would be addressed with NV-MM#2.

3.4.8.4 Operations Vibration

Project operations would cause permanent vibration annoyance impacts at sensitive receptors. Alternative 1 would result in 81 vibration impacts, Alternative 2 would result in 143 vibration impacts, Alternative 3 would result in 140 vibration impacts, and Alternative 4 would result in 1,203 vibration impacts. Most of these vibration impacts would occur in the Monterey Corridor Subsection, with the remaining vibration impacts occurring in the San Jose Diridon Station Approach and Morgan Hill and Gilroy Subsections. NV-MM#8 would address these impacts.

3.4.9 CEQA Significance Conclusions

As described in Section 3.4.4.5, the impacts of project actions under CEQA are evaluated against thresholds to determine whether a project action would result in no impact, a less than significant impact, or a significant impact. Table 3.4-33 identifies the CEQA significance determinations for each impact discussed in Sections 3.4.6.2, Noise, and 3.4.6.3, Vibration. A summary of the significant impacts, mitigation measures, and factors supporting the significance conclusion after mitigation follows the table.

Table 3.4-33 CEQA Significance Conclusions and Mitigation Measures for Noise and Vibration

CEQA Impacts	Impact Description and CEQA Level of Significance before Mitigation	Mitigation Measure	CEQA Level of Significance after Mitigation
Noise			
Impact NV#1: Temporary Exposure of Sensitive Receptors to Construction Noise	Significant for all project alternatives. Construction activity noise would exceed FRA standards at sensitive receptors.	NV-MM#1: Construction Noise Mitigation Measures	Significant and Unavoidable for all project alternatives
Impact NV#2: Intermittent Permanent Exposure of Sensitive Receptors to Noise from Train Operations	Significant for all project alternatives. Operations noise would exceed FRA standards at sensitive receptors.	NV-MM#3: Implement Proposed California High-Speed Rail Project Noise Mitigation Guidelines NV-MM#4: Support Potential Implementation of Quiet Zones by Local Jurisdictions NV-MM#5: Vehicle Noise Specification NV-MM#6: Special Trackwork at Crossovers, Turnouts, and Insulated Joints NV-MM#7: Additional Noise Analysis during Final Design	Significant and Unavoidable for all project alternatives
Impact NV#3: Intermittent Permanent Exposure of Sensitive Receptors to Noise from HSR Passenger Station Parking	Less than significant for all project alternatives. Additional noise would be substantially lower than noise from HSR trains. No additional impact is projected.	No mitigation measures are required.	N/A
Impact NV#4: Intermittent Permanent Exposure of Sensitive Receptors to Noise from HSR Maintenance Facilities	Less than significant for all project alternatives.	No mitigation measures are required.	N/A

CEQA Impacts	Impact Description and CEQA Level of Significance before Mitigation	Mitigation Measure	CEQA Level of Significance after Mitigation
Impact NV#5: Intermittent Permanent Human Annoyance from Onset of Passing HSR Trains	Less than significant for Alternatives 1, 2 and 3. Alternative 4 would have potential to expose one residential location to sudden onset noise above the threshold level, which would be a significant impact at that location.	NV-MM#3: Implement Proposed California High-Speed Rail Project Noise Mitigation Guidelines NV-MM#7: Additional Noise Analysis during Final Design	Less than Significant.
Impact NV#6: Permanent Exposure of Sensitive Receptors to Vehicular Traffic Noise Increases	Significant for all project alternatives. Additional vehicular traffic at HSR stations and MOWFs would increase ambient noise levels in the project vicinity above levels existing without the project.	NV-MM#3: Implement Proposed California High-Speed Rail Project Noise Mitigation Guidelines NV-MM#7: Additional Noise Analysis during Final Design	Significant and Unavoidable for all project alternatives
Impact NV#7: Intermittent Permanent Livestock Animal Stress from Passing HSR Trains	Less than significant for all project alternatives. Impacts limited to within 30 feet of the edge of the HSR right-of-way for train passbys (all project alternatives). Unconfined livestock could avoid high noise levels by moving away from the track as trains approach and noise from passbys would be short. Confined animals could move away from the tracks in some cases and could become habituated to train noise. Livestock in two areas between San Jose and Gilroy would experience additional horn soundings with Alternative 4, but the horn soundings would be similar to existing train horn noise-sounding events and are not expected to result in substantial new stress compared to existing conditions.	No mitigation measures are required.	N/A
Impact NV#8: Permanent Exposure of Sensitive Receptors to Traction Power Facility Noise	Significant for all project alternatives in combination with other project noise. The substation facilities would not affect new receptors beyond those identified in Impact NV#2.	NV-MM#3: Implement Proposed California High-Speed Rail Project Noise Mitigation Guidelines NV-MM#7: Additional Noise Analysis during Final Design	Less than Significant with Mitigation

CEQA Impacts	Impact Description and CEQA Level of Significance before Mitigation	Mitigation Measure	CEQA Level of Significance after Mitigation
Vibration			
Impact NV#9: Temporary Exposure of Sensitive Receptors and Buildings to Construction Vibration	Significant for all project alternatives. Project construction could expose buildings to excessive ground-borne vibration and would exceed nighttime annoyance ground-borne vibration criterion for residential building occupants.	NV-MM#2: Construction Vibration Mitigation Measures	Less than Significant for all project alternatives
Impact NV#10: Intermittent Permanent Exposure of Sensitive Receptors to Vibration from Operations	Significant for all project alternatives. Project operations would generate excessive ground-borne vibration impacts at sensitive receptors.	NV-MM#8: Project Vibration Mitigation Measures	Significant and Unavoidable for all project alternatives

CEQA = California Environmental Quality Act
FRA = Federal Railroad Administration
HSR = high-speed rail
MOWF = maintenance of way facility
N/A = not applicable

Impact NV#1: Temporary Exposure of Sensitive Receptors to Construction Noise

There would be a significant impact under CEQA for all project alternatives because construction activities would affect sensitive receptors by temporarily and periodically substantially increasing ambient noise levels in the project vicinity. The alternatives would incorporate NV-IAMF#1 to minimize noise impacts by requiring compliance with FRA guidelines for minimizing construction noise and vibration impacts when work is conducted within 1,000 feet of sensitive receptors. However, even with NV-IAMF#1, some sensitive receptors would be exposed to construction noise that exceeds FRA guidelines. Mitigation to address this impact is included in Section 3.4.7, Mitigation Measures, and the Authority would implement NV-MM#1 to reduce the potential for construction noise impacts. This mitigation measure would require the contractor to prepare a noise-monitoring program and noise control plan prior to construction to comply with the FRA construction noise limits wherever feasible. The monitoring program would describe the actions the contractor would use to reduce noise, such as installing temporary noise barriers, avoiding nighttime construction near residential areas, and using low-noise emission equipment. Implementation of this mitigation measure would reduce construction noise levels but not always below the FRA noise standards, particularly at night and during pile driving. Therefore, the impact would be significant and unavoidable for all project alternatives.

Impact NV#2: Intermittent Permanent Exposure of Sensitive Receptors to Noise from Train Operations

There would be a significant impact under CEQA for all project alternatives because project operations would increase noise levels above existing ambient levels and in exceedance of FRA criteria, causing severe noise impacts at sensitive receptors. The number of severe impacts would vary by alternative, as summarized in Table 3.4-34, with the most noise impacts occurring under Alternative 4, followed by Alternative 2, Alternative 1, and Alternative 3.

Table 3.4-34 Noise Mitigation Effectiveness

Project Alternative	2040 Noise Impacts without Mitigation		Noise Impacts with Noise Barriers		Noise Impacts with Quiet Zones and Noise Barriers	
	Moderate	Severe	Moderate	Severe	Moderate	Severe
Alternative 1	1,200	334	676	231	620	223
Alternative 2	1,844	752	793	194	793	194
Alternative 3	834	219	693	173	636	173
Alternative 4	1,639	1,186	1,193	275	926	179

1. TPF impacts would occur at receptors already identified for HSR train operations as follows: Alternative 1: 6 severe, 1 moderate; Alternative 2: 1 severe, no moderate; Alternative 3: 8 severe, 1 moderate; Alternative 4: 33 severe, 0 moderate.
2. The total numbers of impacts shown as benefitted in Table 3.4-23 through Table 3.4-27 are not the same as the difference between the numbers in this table with and without mitigation because while mitigation would reduce noise effects, it may not eliminate them entirely. Thus, a reduced impact may still qualify as a residual moderate or severe impact.
HSR = high-speed rail
TPF = traction power facility

Mitigation to address this impact is included in Section 3.4.7, Mitigation Measures. The Authority would implement mitigation measures to minimize operations noise impacts. As part of NV-MM#3, Implement Proposed California High-Speed Rail Project Noise Mitigation Guidelines, the Authority would consider constructing noise barriers, supporting implementation of Quiet Zones where cities decide to implement them, installing sound insulation, or acquiring easements on properties severely affected by noise, based on criteria in the Authority's Noise and Vibration Mitigation Guidelines (Volume 2, Appendix 3.4-B). These measures would reduce or compensate for severe noise impacts from operations. As part of NV-MM#4, Support Potential Implementation of Quiet Zones by Local Jurisdictions, the Authority would assist local communities in establishing Quiet Zones to reduce noise impacts from train warning horns. NV-MM#5, Vehicle Noise Specification, would require HSR vehicles to meet federal regulations for noise (40 C.F.R. § 201.12) at the time of procurement. NV-MM#6, Special Trackwork at Crossovers, Turnouts, and Insulated Joints, would require the contractor to document how they minimized or eliminated rail gaps related to special trackwork, which can be a major source of noise during operations. As part of NV-MM#7, Additional Noise Analysis during Final Design, if any changes to final design or vehicle specifications change any assumptions underlying the noise analysis, the Authority would prepare the necessary environmental documentation as required by NEPA and CEQA to reassess potential impacts and mitigation. These mitigation measures would all be effective at reducing the number of severe noise impacts in the RSA; however, they would not mitigate all noise impacts. Table 3.4-34 summarizes the noise impacts that could be mitigated with noise barriers, and with a combination of noise barriers and Quiet Zones. As specified in the noise mitigation guidelines (See Appendix 3.04-B), noise barriers should be approved by 75 percent affected parties in a community; if they do not approve, then noise barriers may not be installed at certain locations. Quiet zones cannot be implemented by the Authority or any rail operators (like Caltrains); they can only be established at the initiative of a local jurisdiction. Thus, quiet zones may not be advanced where local jurisdictions do not want them to be established.

Because severe noise impacts would remain following mitigation and/or noise barriers or quiet zones would not be implemented due to the constraints noted above, the impact would be significant and unavoidable under CEQA.

For the TPF, noise barriers would be considered as part of NV-MM#3, and equipment selection and site design would be considered as part of NV-MM#7 to reduce noise from transformers and other sources within the traction power facilities.

Impact NV#5: Intermittent Permanent Human Annoyance from Onset of Passing HSR Trains

Alternative 4 would have a significant impact related to startle at one residential location in Morgan Hill where the residence is within 23 feet of the proposed track alignment. Mitigation to address this impact is included in Section 3.4.7, Mitigation Measures. The Authority would implement mitigation measures to minimize operations noise impacts. As part of NV-MM#3, Implement Proposed California High-Speed Rail Project Noise Mitigation Guidelines, the Authority would consider constructing noise barriers, installing sound insulation, or acquiring easements on properties severely affected by noise, based on criteria in the Authority's Noise and Vibration Mitigation Guidelines (Volume 2, Appendix 3.4-B). As part of NV-MM#7, additional noise analysis during final design could refine or reduce the impact by incorporating more detailed train speed, track design, and actual vehicle noise characteristics. These mitigation measures would lower the amount of resultant train noise, which would also address the severity of rapid onset of noise at the one identified significant location and, thus, this impact would be mitigated to a less than significant level.

Impact NV#6: Permanent Exposure of Sensitive Receptors to Vehicular Traffic Noise Increases

There would be a significant impact under CEQA for all project alternatives because project operations would permanently expose sensitive receptors to traffic noise increases from additional traffic near the HSR stations, MOWF, and some roadways in the Monterey Corridor Subsection. A total of seven roadway segments under Alternatives 1 and 2 and six roadway segments under Alternatives 3 and 4 would have the potential for noise level increases greater than or equal to 3 dB compared to existing noise conditions in 2029. By 2040, 12 roadway segments would have the potential for noise level increases greater than or equal to 3 dB for all four project alternatives. Mitigation to address this impact is included in Section 3.4.7, Mitigation Measures. The Authority would implement mitigation measures to minimize impacts from traffic noise increases. As part of NV-MM#3, Implement Proposed California High-Speed Rail Project Noise Mitigation Guidelines, the Authority would investigate the traffic noise impacts and ways to mitigate them by means such as noise barriers. As part of NV-MM#7, Additional Noise Analysis during Final Design, if any changes to final design or vehicle specifications change any assumptions underlying the noise analysis, the Authority would prepare the necessary environmental documentation as required by NEPA and CEQA to reassess impacts and mitigation. These mitigation measures would reduce the traffic noise impacts, but would not mitigate all traffic noise impacts. Therefore, the impact would be significant and unavoidable.

Impact NV#8: Permanent Exposure of Sensitive Receptors to Transfer Power Facility Noise

There would be a significant impact under CEQA for all project alternatives because project operations would permanently expose sensitive receptors to severe noise increase from TPF sites in San Jose, Morgan Hill, and Gilroy for the combined condition of TPF and HSR trains and other project noise. Under Alternative 4, 30 residences in a San Jose multifamily building would be exposed to a noise increase that exceeds the 2.9 dBA threshold for the TPF and the HSR trains; in Gilroy, the 3.6 dBA threshold would increase at 2 homes and the 2.8 dBA threshold would increase at 1 home. Under Alternative 3, five single-family residences in Morgan Hill would be exposed to a noise increase that exceeds the 3.4 dBA threshold; in Gilroy a school would be exposed to noise that exceeds the 2.5 dBA threshold and two homes would be exposed to noise that exceeds their respective thresholds of 2.7 and 2.8 dBA. Under Alternative 2, one Gilroy residence would be exposed to noise that exceeds the threshold of 2.8 dBA. Under Alternative 1, five single-family residences in Morgan Hill would be exposed to a noise increase that exceeds the 3.4 dBA threshold; in Gilroy, one residence would be exposed to noise that exceeds the threshold of 2.8 dBA. Mitigation to address this impact is included in Section 3.4.7, Mitigation Measures; the Authority would implement mitigation measures to minimize impacts from TPF noise. As part of NV-MM#3, Implement Proposed California High-Speed Rail Project Noise Mitigation Guidelines, the Authority would investigate the TPF noise impacts and ways to mitigate them by means such as noise barriers around the facility. As part of NV-MM#7, Additional Noise

Analysis during Final Design, additional design considerations such as equipment selection and siting would be evaluated during final design if needed to mitigate the noise. These mitigation measures would mitigate all severe noise impacts from TPF. Therefore, the impact would be less than significant with mitigation.

Impact NV#9: Temporary Exposure of Sensitive Receptors and Buildings to Construction Vibration

There would be a significant impact under CEQA for all project alternatives because construction activities would expose persons and could expose buildings to excessive ground-borne vibration from pile driving and possibly other construction activities such as vibratory compaction. Incorporation of NV-IAMF#1 would minimize construction vibration and its potential to cause damage to buildings and human annoyance. However, even with NV-IAMF#1, some sensitive receptors would be exposed to ground-borne vibration that would result in annoyance, and buildings could be exposed to vibration that exceeds the FRA vibration damage criteria. Mitigation to address this impact is included in Section 3.4.7, Mitigation Measures. The Authority would implement NV-MM#2, Construction Vibration Mitigation Measures, to minimize vibration impacts from construction. As part of this mitigation measure, the contractor would develop and implement vibration reduction methods whenever impact pile driving or other high-vibration-producing activity would occur within 50 feet of any building to meet the FRA criteria. Prior to starting pile driving and other high-vibration activity, the contractor would conduct pre-construction surveys within 50 feet of the activity to document the existing condition of buildings in case damage is reported during or after construction. The contractor would arrange for the repair of damaged buildings or would pay compensation to the property owner. These measures would avoid or offset vibration impacts from construction. Therefore, the impact would be less than significant for all project alternatives.

Impact NV#10: Intermittent Permanent Exposure of Sensitive Receptors to Vibration from Operations

There would be a significant impact under CEQA for all project alternatives because project operations would generate excessive ground-borne vibration impacts at sensitive receptors in the San Jose Diridon Station Approach and Monterey Corridor Subsections. Alternative 1 would result in 81 vibration impacts, Alternative 2 would result in 143 vibration impacts, Alternative 3 would result in 140 vibration impacts, and Alternative 4 would result in 1,203 vibration impacts. Mitigation to address this impact is included in Section 3.4.7, Mitigation Measures. The Authority would implement NV-MM#8, Project Vibration Mitigation Measures, to minimize vibration impacts from operations. There are various options to reduce train vibration, although it may not be possible in all instances to mitigate all vibration impacts. The specific design and implementation of this mitigation measure would be identified during final design. Therefore, the impact would be significant and unavoidable.

There would be no building damage impacts from project operations.