APPENDIX 3.3-A: AIR QUALITY AND GREENHOUSE GASES TECHNICAL REPORT

California High-Speed Rail Authority

San Francisco to San Jose Project Section

Air Quality and Greenhouse Gases Technical Report

December 2019

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

°F	degrees Fahrenheit
$\mu g/m^3$	micrograms of pollutant per cubic meter of air
μm	micron
2016 Business Plan	*Connecting and Transforming California: 2016 Business Plan*
AB	Assembly Bill
ABAG	Association of Bay Area Governments
AP-42	*Compilation of Air Pollutant Emission Factors*
Authority	California High-Speed Rail Authority
BAAQMD	Bay Area Air Quality Management District
BART	Bay Area Rapid Transit
Bay Area	San Francisco Bay Area
C.F.R.	Code of Federal Regulations
CAA	Clean Air Act
CAAQS	California ambient air quality standards
CalEEMod	California Emissions Estimator Model
Caltrans	California Department of Transportation
CAP	climate action plans
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resources Board
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CEQA Guidelines	California Environmental Quality Act Air Quality Guidelines
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CO Protocol	Transportation Project-Level Carbon Monoxide Protocol
CP	control point
DPM	diesel particulate matter
DTX	Downtown Extension
EIR	environmental impact report
EIS	environmental impact statement
EMFAC	EMission FACtors
EMU	electric multiple unit
EO	(California) Executive Order

Fed. Reg.	*Federal Register*
FHWA	Federal Highway Administration
Foundation	Bay Area Clean Air Foundation
FRA	Federal Railroad Administration
FTA	Federal Transit Authority
GHG	greenhouse gas
GIS	geographic information system
GWP	global warming potential
HAP	hazardous air pollutant
Hot Spots Act	Air Toxics "Hot Spots" Information and Assessment Act of 1987
HRA	health risk assessment
HSR	high-speed rail
I-	Interstate
IAMF	impact avoidance and minimization features
Interim Guidance	*Interim Guidance Update on Mobile Source Air Toxic Analysis in NEPA Documents*
kWh	kilowatt-hour
LMF	light maintenance facility
LOS	level of service
MMT	million metric tons
MOU	memorandum of understanding
MOVES	Motor Vehicle Emission Simulator
mph	miles per hour
MSAT	mobile source air toxic
MT	mainline track
MTC	Metropolitan Transportation Commission
MUNI	San Francisco Municipal Railway
N_2O	nitrous oxide
NAAQS	national ambient air quality standards
NEPA	National Environmental Policy Act
NO_2	nitrogen dioxide
NOA	naturally occurring asbestos
NO_X	nitrogen oxides
O_3	ozone
OCS	overhead contact system
OEHHA	Office of Environmental Health Hazard Assessment
PAH	polycyclic aromatic hydrocarbons

Pb	lead
PCEP	Peninsula Corridor Electrification Project
PCJPB	Peninsula Corridor Joint Powers Board
PM	particulate matter
PM_{10}	particulate matter 10 microns or less in diameter
$PM_{2.5}$	particulate matter 2.5 microns or less in diameter
Project Section or project	San Francisco to San Jose Project Section
ROG	reactive organic gases
RSA	resource study area
RTP	regional transportation plan
SamTrans	San Mateo County Transit District
SB	Senate Bill
SF_6	sulfur hexafluoride
SFBAAB	San Francisco Bay Area Air Basin
SFO	San Francisco International Airport
SFTC	Salesforce Transit Center
SIL	significant impact level
SIP	state implementation plan
SJVAPCD	San Joaquin Valley Air Pollution Control District
SO_2	sulfur dioxide
SO_X	sulfur oxide
SR	State Route
TAC	toxic air containment
Tanner Act	Toxic Air Contaminant Identification and Control Act
TIP	transportation improvement program
U.S.C.	United States Code
UPRR	Union Pacific Railroad
US	U.S. Highway
USEO	U.S. (Presidential) Executive Order
USEPA	U.S. Environmental Protection Agency
VMT	vehicle miles traveled
VOC	volatile organic compound

EXECUTIVE SUMMARY

The California High-Speed Rail Authority (Authority) has prepared this *San Francisco to San Jose Project Section Air Quality and Greenhouse Gases Technical Report* to support the *San Francisco to San Jose Project Section Environmental Impact Report/Environmental Impact Statement*. This technical report characterizes existing conditions and analyzes air quality and greenhouse gas (GHG) effects of two project alternatives.

Air quality and GHG are important considerations because of their effect on human health and global climate change. This technical report addresses effects resulting from construction and operation of the San Francisco to San Jose Project Section (Project Section or project). It describes relevant federal, state, regional, and local regulations and requirements; methods used for the analysis of effects; the affected environment; impact avoidance and minimization features (IAMF) that would avoid or minimize effects; and the potential effects on air quality and GHGs in the resource study area (RSA) that could result from construction and operation of the project alternatives. Emissions under all both project alternatives are analyzed at an equal level of detail to support the project-level environmental document prepared pursuant to the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA).

Summary of Effects

Air Quality

Construction of either project alternative would result in nitrogen oxide (NO_X) emissions that would exceed the Bay Area Air Quality Management District's (BAAQMD) CEQA thresholds. The project would be constructed with all feasible on-site control measures to reduce emissions and minimize effects on air quality. Fugitive dust emissions would be reduced through implementation of a dust control plan (AQ-IAMF#1: Fugitive Dust Emissions). The contractor would use low-volatile organic compound (VOC) paints to limit the emissions of VOCs, which contribute to ozone (O_3) formation (AQ-IAMF#2: Selection of Coatings). Exhaust-related pollutants would be reduced through use of renewable diesel fuel, Tier 4 off-road engines, and model year 2010 or newer on-road engines, as required by AQ-IAMF#3: Renewable Diesel, AQ-IAMF#4: Reduce Criteria Exhaust Emissions from Construction Equipment, and AQ-IAMF#5: Reduce Criteria Exhaust Emissions from On-Road Construction Equipment. However, even with application of IAMFs, exceedances of air district thresholds would still occur. The Authority would implement mitigation measures to offset the remaining construction effects on air quality resources. Specifically, AQ-MM#1: Offset Project Construction Emissions in the San Francisco Bay Area Air Basin would offset NO_X emissions, as applicable, to levels below air district thresholds or net zero (as required by the General Conformity Rule).

Within the BAAQMD, either project alternative would result in comparable levels of emissions. Construction emissions under Alternative B would be somewhat greater than under Alternative A primarily because Alternative B would include construction of the passing tracks.

Construction activities would not generate annual emissions greater than the federal general conformity thresholds. Construction activities would generate maximum daily emissions greater than the BAAQMD significance threshold for NO_X under both project alternatives, and greater than the BAAQMD significance threshold for VOC under Alternative B. Construction activities would not by themselves lead to new exceedances of the California ambient air quality standards (CAAQS) or national ambient air quality standards (NAAQS). However, under either alternative, construction activities would contribute to existing violations of the 1- to 24-hour and annual CAAQS for particulate matter 10 microns or less in diameter (PM_{10}) where background concentrations already exceed the CAAQS. Construction activities would not lead to exceedances of BAAQMD health risk thresholds. Project features would minimize air quality effects (AQ-IAMF#1 through AQ-IAMF#5), although construction emissions would still contribute to existing violations of the ambient air quality standards. These project design features represent all best available on-site controls to reduce construction emissions, and no mitigation is available.

Long-term operation of the project would result in a decrease in all criteria pollutant emissions when compared to 2015 existing conditions and 2029 and 2040 No Project conditions. These patterns apply to all ridership scenarios and alternatives and would be beneficial to the San Francisco Bay Area Air Basin (SFBAAB) in meeting their criteria pollutant attainment goals. Regionally and locally, additional vehicle traffic at the expanded stations and new light maintenance facility (LMF) would not result in carbon monoxide (CO) or particulate matter (PM) hot spots. Similarly, displaced vehicle miles traveled (VMT) would reduce regional mobile source air toxics (MSAT) throughout the RSA. While localized MSATs near stations and the LMF may slightly increase because of additional passenger traffic, long-term emissions would be substantially reduced because of implementation of state and national vehicle and fuel regulations.

The project would reposition existing Caltrain and Union Pacific Railroad (UPRR) tracks within the railroad right-of-way under either alternative. Shifting existing tracks that carry freight trains would increase long-term toxic air contaminant (TAC) concentrations at certain receptor locations and would result in corresponding decreases at other locations. Likewise, additional generators at the Millbrae Station and the Brisbane LMF under both project alternatives would increase long-term TAC concentrations from generator testing and routine maintenance. Analysis of TAC concentrations from freight trains on shifted tracks and additional generators indicates that neither source would result in long-term cancer or noncancer health risks in excess of established thresholds.

A portion of the project would be located within an area that can contain naturally occurring asbestos (NOA). However, the design-build contractor would prepare a construction management plan that outlines practices for avoiding and minimizing NOA. Construction contractors would also be required to comply with the Asbestos Airborne Toxic Control Measure for Construction and Grading Operations (BAAQMD 2002), which requires implementation of dust control measures to limit the potential for airborne asbestos. Asbestos-containing materials and lead-based paint may be found during demolition activities, and would be addressed through compliance with all National Emission Standards for Hazardous Air Pollutants regulations (40 Code of Federal Regulations Parts 61 and 63). Although odors may be generated during construction and operation, they would not be substantial and are not expected to result in nuisance complaints.

Greenhouse Gases

Long-term operation of the project would result in a net reduction of regional and statewide GHG emissions when compared to 2015 existing conditions and 2029 and 2040 No Project conditions. Construction-related emissions would be less than 0.05 percent of the total annual statewide GHG emissions. Total amortized GHG construction emissions for the project are estimated to be 7,201 metric tons of carbon dioxide equivalent (CO_2e) per year under Alternative A and 8,303 metric tons CO_2e per year under Alternative B. The increase in GHG emissions generated during construction would be offset in approximately 1 to 2 months by net GHG reductions during operations because of reduced car and aircraft trips in Northern California and statewide. Accordingly, implementation of the project would result in a net decrease in GHG emissions that would be beneficial to the RSA and State of California and would help meet local and statewide GHG reduction goals.

1 INTRODUCTION

This report presents the air quality and greenhouse gas (GHG) technical evaluation for the California High-Speed Rail (HSR) San Francisco to San Jose Project Section (Project Section or project), prepared in support of environmental reviews required under the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA). The resource assessment presented in this analysis is consistent with the *California High Speed Rail Project EIR/EIS Environmental Methodology Guidelines Version 5.09,* adopted in April 2017 (Authority and FRA 2017), as well as the following technical guidance manuals:

- Bay Area Air Quality Management District's (BAAQMD) *California Environmental Quality Act Air Quality Guidelines* (BAAQMD 2017a)
- Federal Highway Administration's (FHWA) Memorandum*: Updated Interim Guidance on Mobile Source Air Toxic Analysis in NEPA Documents* (FHWA 2016)
- Office of Environmental Health Hazard Assessment's (OEHHA) *The Air Toxics Hot Spots Program Risk Assessment Guidelines: Guidance Manual for Preparation of Health Risk Assessments* (OEHHA 2015)

1.1 Background of the HSR Program

The California High-Speed Rail Authority (Authority) proposes to construct, operate, and maintain an electric-powered HSR system in California, connecting the San Francisco Bay Area (Bay Area) and Central Valley to Southern California. When completed, the nearly 800-mile train system would provide new passenger rail service to more than 90 percent of the state's population. More than 200 weekday trains would serve the statewide intercity travel market. The system would be capable of operating speeds up to 220 miles per hour (mph) in certain HSR sections, with state-of-the-art safety, signaling, and automatic train control systems. The HSR System would connect and serve the state's major metropolitan areas, extending from San Francisco to Los Angeles and Anaheim in Phase 1, with extensions to Sacramento and San Diego in Phase 2.

The Authority and Federal Railroad Administration (FRA) commenced their tiered environmental planning process with the 2005 *Final Program Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the Proposed California High-Speed Train System* (Statewide Program EIR/EIS) (Authority and FRA 2005). After completion of the first-tier programmatic environmental documents,[1] the Authority and FRA began preparing second-tier project environmental evaluations for sections of the statewide HSR system. Chapter 2, San Francisco to San Jose Project Section, of this analysis provides details of the Project Section and the two project alternatives under consideration.

1.2 Organization of this Technical Report

This technical report includes the following chapters in addition to this introductory chapter:

- Chapter 2 describes the alternatives as currently proposed.
- Chapter 3, Laws, Regulations, and Orders, introduces federal, state, and local laws, regulations, and policies relevant to air quality and GHGs.
- Chapter 4, Pollutants of Concern, describes the key criteria pollutants, toxic air contaminants (TAC), and GHGs of concern for the project.

[1] Two program-level environmental documents were prepared: the Statewide Program EIR/EIS (Authority and FRA 2005) and the *Final Bay Area to Central Valley High-Speed Train Program Environmental Impact Report/Environmental Impact Statement (EIR/EIS)* (Authority and FRA 2008). These documents evaluated the impacts of proposed HSR corridors and selected the HSR sections constituting the California HSR System.

- Chapter 5, Affected Environment, discusses existing conditions, including air quality and global climate change, in the resource study area (RSA).
- Chapter 6, Methods for Evaluating Effects, describes the analytical methods and assumptions used to determine the effects of the project on air quality and GHGs.
- Chapter 7, Air Quality Effects Analysis, assesses potential effects of construction and operations of the project alternatives on ambient air quality and human health.
- Chapter 8, Global Climate Change Effects Analysis, assesses the potential effects of construction and operations of the project alternatives on GHGs and climate change.
- Chapter 9, Mitigation Measures, presents mitigation measures to reduce air quality effects.
- Chapter 10, Cumulative Effects, assesses the potential for construction and operations of the project alternatives, in combination with past, present, and reasonably foreseeable projects, to result in cumulative air quality or GHG effects.
- Chapter 11, Conformity Analysis, presents the general conformity determination for the applicant-preferred alternative consistent with Clean Air Act (CAA) 40 Code of Federal Regulations (C.F.R.) Section 93.158(c).
- Chapter 12, References, provides complete reference information for the published, online, agency, institutional, and individual sources consulted in preparation of this report.
- Chapter 13, Preparer Qualifications, presents the credentials of the staff who oversaw the preparation of this report.

Supporting information is provided in the following appendices:

- Appendix A, CalEEMod Outputs for Station and Light Maintenance Facility Operation, provides the California Emissions Estimator Model (CalEEMod) output files for the local analysis of criteria pollutants and GHG emissions from operation of the stations and LMF.
- Appendix B, CALINE4 Outputs for CO Hot-Spot Analysis, provides the CalEEMod output files for the localized carbon monoxide (CO) hot-spot analysis.
- Appendix C, Construction Emissions Assumptions, provides the construction inventory and emission factor assumptions for the analysis of criteria pollutants and GHG emissions from construction of the project.
- Appendix D, Ballast Hauling Memorandum, describes quarry selection process and scenario analysis performed for the ballast-hauling assessment.
- Appendix E, Localized Impacts from Construction, describes air dispersion modeling methods for evaluating localized air quality effects.
- Appendix F, Potential Impact from Induced Winds, provides calculations and analysis details for the induced wind analysis.
- Appendix G, Council on Environmental Quality Provisions Covering Incomplete or Unavailable Information, describes incomplete or unavailable information for mobile source air toxics (MSAT).

2 SAN FRANCISCO TO SAN JOSE PROJECT SECTION

The Project Section would provide HSR service between San Francisco and San Jose as part of the statewide HSR system. HSR stations would be located at 4th and King Street[2] in San Francisco and at Millbrae. HSR service would share tracks with Caltrain along approximately 43 miles of blended system infrastructure primarily within the existing Caltrain right-of-way. The Project Section would include a light maintenance facility (LMF) in Brisbane. Two project alternatives are evaluated in this technical report—Alternative A and Alternative B. This chapter describes the common design features of the two project alternatives, followed by descriptions of each alternative.

What does "blended" mean?

Blended refers to operating the high-speed rail trains with existing intercity and commuter and regional rail trains on common infrastructure.

2.1 Common Design Features

The project would extend along the existing Caltrain right-of-way through urban cities and communities in San Francisco, San Mateo, and Santa Clara Counties, including San Francisco, Brisbane, South San Francisco, San Bruno, Millbrae, Burlingame, San Mateo, Belmont, San Carlos, Redwood City, North Fair Oaks, Atherton, Menlo Park, Palo Alto, Mountain View, Sunnyvale, and Santa Clara. The Project Section would be comprised of the following four geographic subsections: San Francisco to South San Francisco, San Bruno to San Mateo, San Mateo to Palo Alto, and Mountain View to Santa Clara (Figure 2-1).

San Francisco to San Jose Project Subsections

- San Francisco to South San Francisco—10 miles from 4th and King Street Station in San Francisco to Linden Avenue in South San Francisco
- San Bruno to San Mateo—8 miles from Linden Avenue in South San Francisco to 9th Avenue in San Mateo
- San Mateo to Palo Alto—16 miles from 9th Avenue in San Mateo to San Antonio Road in Palo Alto
- Mountain View to Santa Clara—9 miles from San Antonio Road in Palo Alto to Scott Boulevard

Operating on the two-track system primarily within the existing Caltrain right-of-way, the project would use existing and in-progress infrastructure improvements developed by Caltrain for its Caltrain Modernization Program, including electrification of the Caltrain corridor between San Francisco and San Jose as part of the Peninsula Corridor Electrification Project (PCEP) and positive train control (PTC). These improvements would provide consistent and predictable travel between San Francisco and San Jose. The blended system would accommodate operating speeds of up to 110 mph for up to four HSR trains and six Caltrain trains per hour per direction in the peak period.

Operation of the blended system would require additional infrastructure improvements and project elements beyond the Caltrain Modernization Program to accommodate HSR service. Design elements common to both alternatives include track modifications to support higher speeds while maintaining passenger comfort; station and platform modifications to accommodate HSR trains passing through or stopping at existing stations; and modifications to the overhead contact system (OCS) (a series of wires strung above the tracks by poles) and traction power facilities installed by Caltrain as part of the PCEP. The project alternatives would implement safety improvements at existing at-grade roadway crossings and at Caltrain stations and platforms, as well as security modifications such as the installation of perimeter fencing along the right-of-way. The project would also include an LMF to accommodate planned operational needs for high-capacity rail movement and communication radio towers located at approximately 2.5-mile intervals.

[2] The 4th and King Street Station would serve as an interim station until completion of the Transbay Joint Powers Authority's proposed Downtown Extension Project (DTX). The DTX would extend the electrified peninsula rail corridor in San Francisco from the 4th and King Street Station to the Salesforce Transit Center (SFTC). HSR would utilize the track constructed for the DTX to reach the SFTC.

Source: Authority 2019a

MAY 2019

Figure 2-1 Proposed San Francisco to San Jose Project Section

2.1.1 Track and Station Modifications

Definition of Hold-Out Rule

Hold-Out Rule is the rule enforced at Caltrain stations that requires passengers to board and alight the train from between the active tracks. An oncoming train is stopped outside of the station until the passengers are clear of the active tracks.

Depending on the alternative selected, between 7 and 10 of the existing 23 Caltrain stations between 4th and King Street in San Francisco and Scott Boulevard in Santa Clara would require varying degrees of modifications to accommodate HSR trains passing through or stopping at the stations. HSR trains would stop at the 4th and King Street and Millbrae Stations, requiring dedicated HSR platforms and associated passenger services to be provided at these stations. Other stations would also be modified to accommodate track adjustments, remove the hold-out rule, and build project features such as the Brisbane LMF and passing track.

The blended system would require curve straightening, track center modifications, and superelevation[3] of existing Caltrain tracks along approximately 33 percent of the project corridor to support higher speeds of up to 110 mph. These track modifications are described under Section 2.2, Alternative A, and Section 2.3, Alternative B, and illustrated on Figures 2-8, 2-13, 2-17, 2-18, 2-19, 2-20, and 2-22. Where horizontal track modifications would be greater than 1 foot, the OCS poles and wires would require relocation. Where track modifications would occur at existing Caltrain stations, adjustments to existing platforms would be required. Track modifications at San Bruno Station and Hayward Park Station under Alternatives A and B would require modifying or realigning the existing station platforms.

Two existing Caltrain stations—Broadway and Atherton Stations—would be modified as part of the blended system improvements to remove the existing hold-out rule. As illustrated on Figure 2-2, new outboard platforms would be built at these stations to eliminate the need for passengers to cross between the tracks. The Brisbane LMF would require relocation of a station platform and pedestrian overpass at the Bayshore Station in Brisbane.

2.1.2 Safety and Security Modifications to the Right-of-Way

Consistent with FRA safety guidelines for HSR systems with operating speeds of up to 110 mph, the blended system would implement safety improvements at the at-grade crossings to create a "sealed corridor" that would reduce conflicts with automobiles and pedestrians. Safety improvements would include installing four-quadrant gates extending across all lanes of travel and median separators to channelize and regulate paths of travel. These gates would prevent drivers from traveling in opposing lanes to avoid the lowered gate arms. Pedestrian crossing gates also would be built parallel to the tracks, and aligned with the vehicular gates on either side of the roadway.

Depending on the configuration of the existing at-grade crossing, one of six different four-quadrant gate applications (illustrated on Figures 2-3 through 2-5) would be installed at each of the 38 at-grade crossings currently without four-quadrant gates along the Project Section. Table 2-1 identifies the number and locations of four-quadrant gate applications. These applications would specify the improvements at each at-grade crossing, including the number of vehicle and pedestrian gates, and the need for channelization or raised medians.

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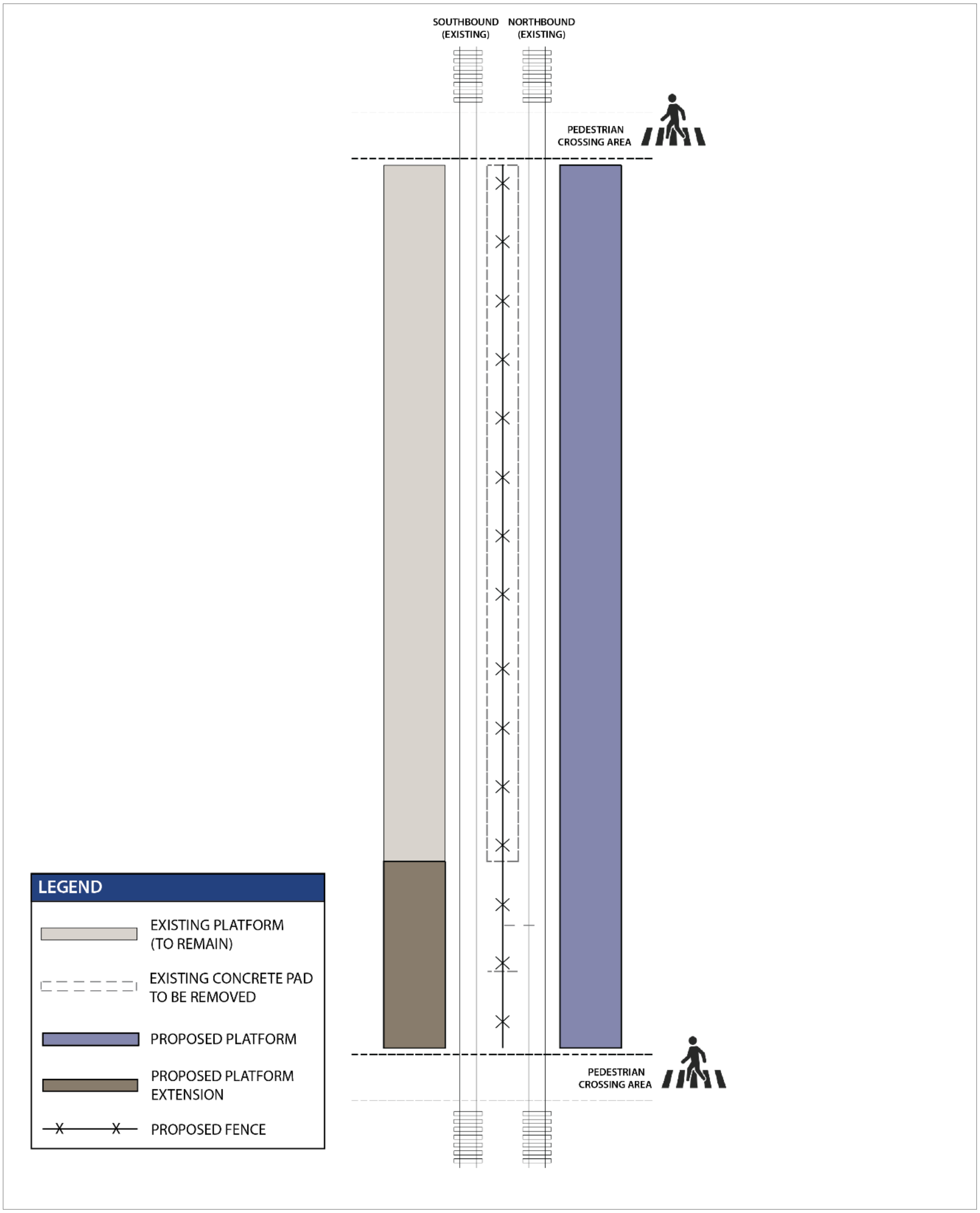
[3] *Superelevation* is the vertical distance between the height of the inner and outer rails at a curve. Superelevation is used to partially or fully counteract the centrifugal force acting radially outward on a train when it is traveling along the curve.



Source: Authority 2019a

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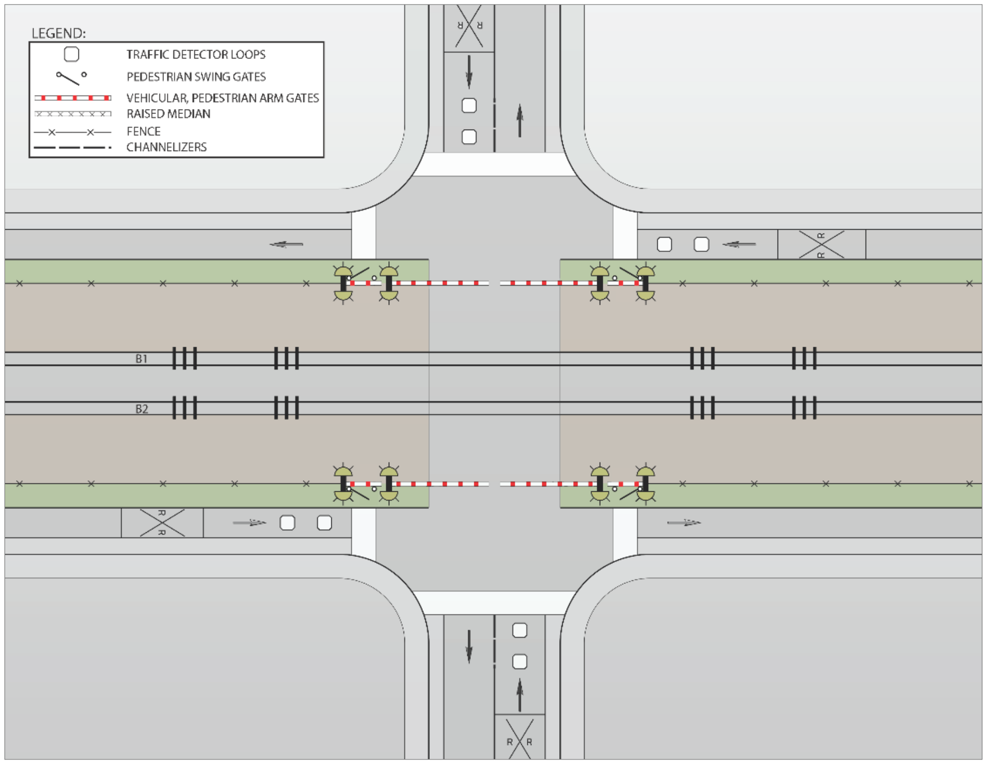
Figure 2-2 Illustration of Hold-Out Rule Stations

Option A



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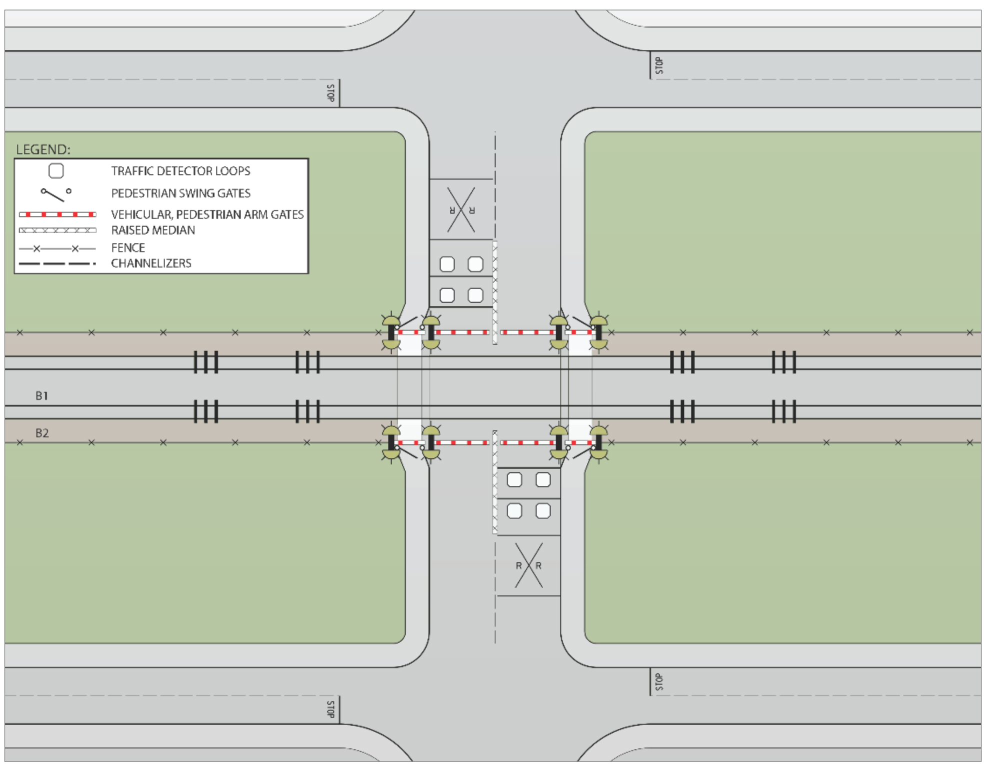

Source: Authority 2019a

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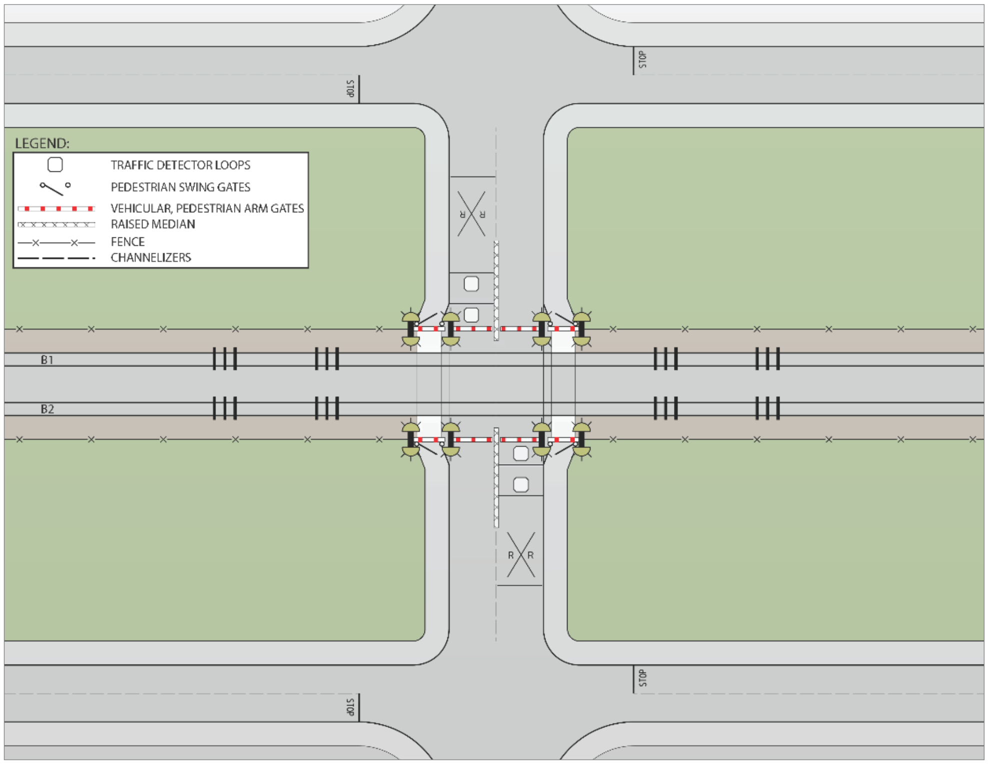
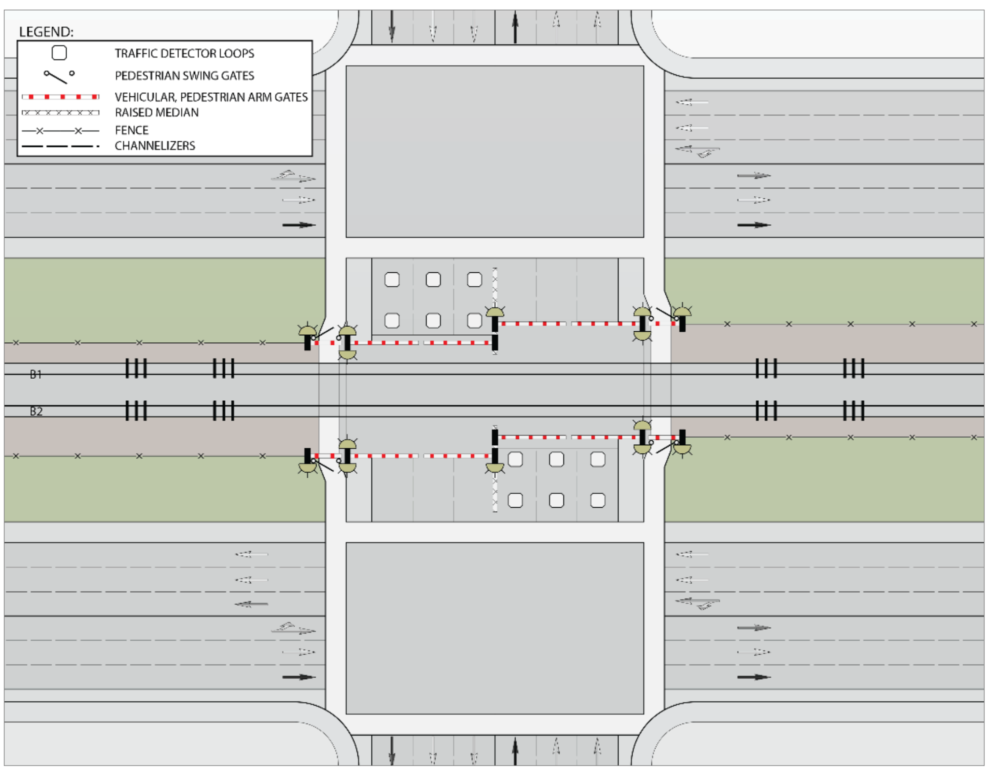
Figure 2-3 Applications of Four-Quadrant Gates (Options A and B)

Option B1



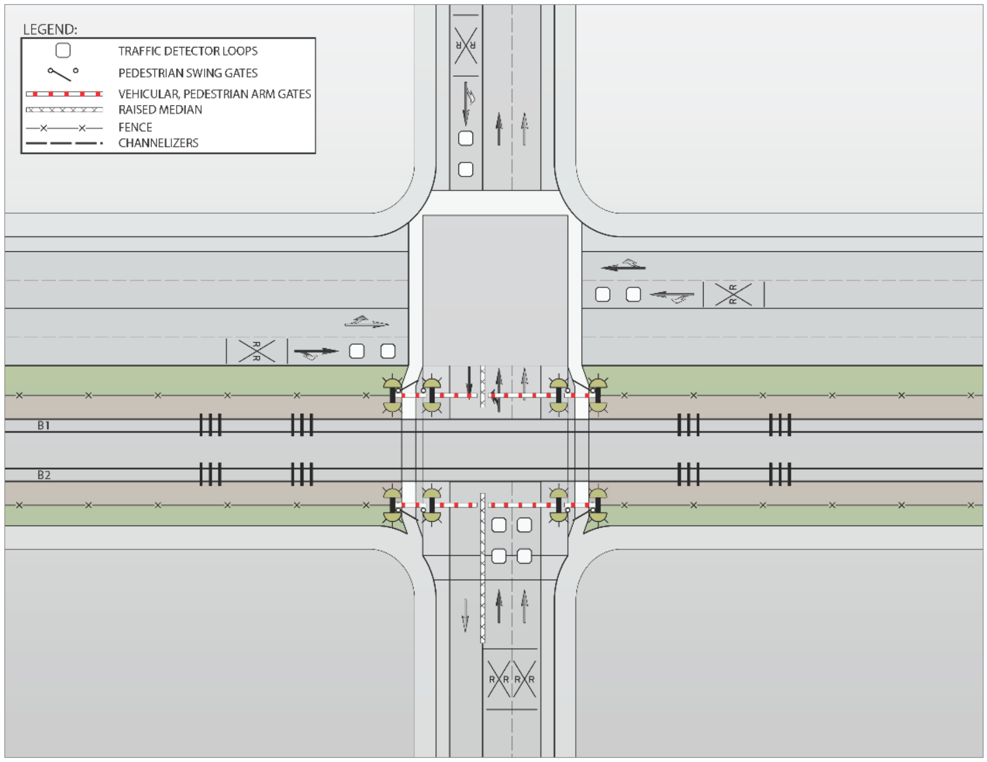
Option C



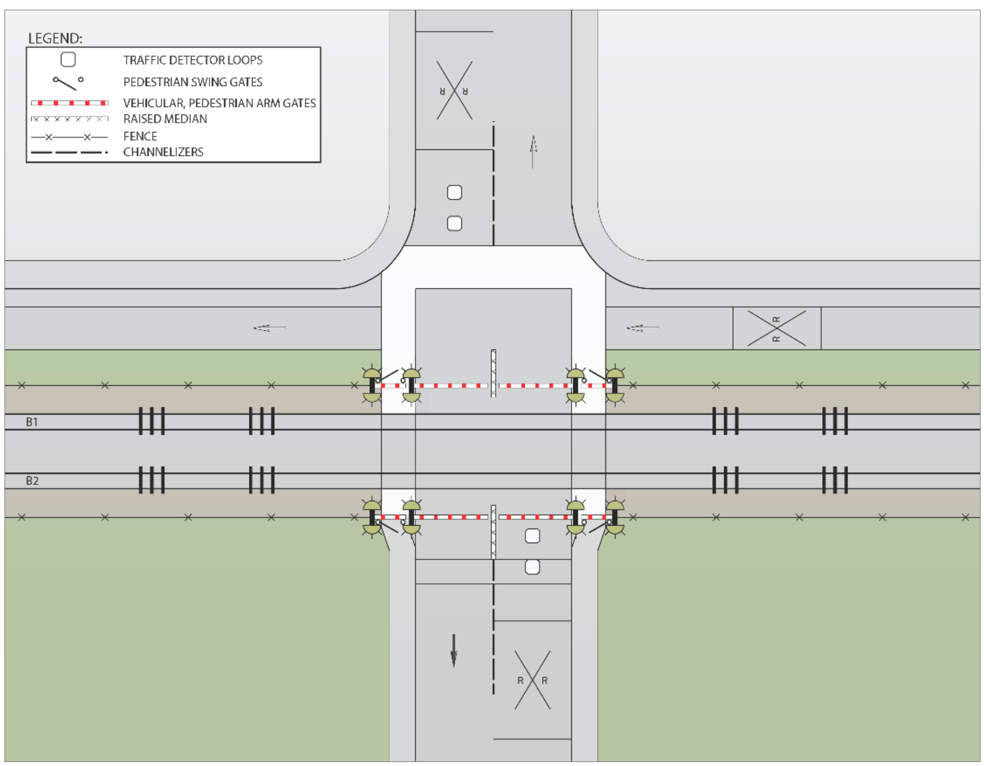
Source: Authority 2019a MAY 2019

Figure 2-4 Applications of Four-Quadrant Gates (Options B1 and C)

Option D



Option E



Source: Authority 2019a

MAY 2019

Figure 2-5 Applications of Four-Quadrant Gates (Options D and E)

Table 2-1 Number and Locations of Four-Quadrant Gate Applications within the Project Section

Application	Number of At-Grade Crossings	Location of At-Grade Crossings
A	7	Mission Bay Drive and 16th Street (San Francisco); 4th Avenue and 5th Avenue (San Mateo); Oak Grove Avenue and Ravenswood Avenue (Menlo Park); and Mary Avenue (Sunnyvale)
B	11	Center Street (Millbrae); Oak Grove Avenue, North Lane, Howard Avenue, Bayswater Avenue, and Peninsula Avenue (Burlingame); Villa Terrace and Bellevue Avenue (San Mateo); Chestnut Street (Redwood City); Encinal Avenue (Menlo Park); Alma Street (Palo Alto)
B1	2	Scott Street (San Bruno); Watkins Avenue (Atherton)
C	4	Broadway (Burlingame); Whipple Avenue (Redwood City); Rengstorff and Castro Street (Mountain View)
D	7	Linden Avenue (South San Francisco); Brewster Avenue and Broadway (Redwood City); Churchill Avenue, Meadow Drive and Charleston Road (Palo Alto); Sunnyvale Avenue (Sunnyvale)
E	7	1st Avenue, 2nd Avenue, 3rd Avenue, and 9th Avenue (San Mateo); Maple Street, Main Street (Redwood City); and Glenwood Avenue (Menlo Park)
Total	**38**	N/A

Source: Authority 2019a
N/A = not applicable

In addition to four-quadrant gates, the Authority would install fencing at the at-grade crossings and along the perimeter of the Caltrain corridor. Consistent with Caltrain's design standards, existing fencing would be extended to adjacent structures to close any gaps. Figure 2-6 depicts photographs of existing perimeter fencing of railroad rights-of-way.

SEPTEMBER 2018

Figure 2-6 Photographs of Perimeter Fencing of Right-of-Way

2.1.1 Train Control and Communication Facilities

HSR would install a radio-based communications network to maintain communications and share data between the HSR trains and the operations control center. Each communications radio tower would consist of an 8-foot by 10-foot communications equipment shelter and a 6- to 8-foot-diameter communications tower extending 100 feet above top-of-rail at approximately 2.5-mile intervals. Where possible, these facilities would be co-located at an existing Caltrain traction power substation, switching station, paralleling station, or Caltrain station as illustrated on Figure 2-7. Where communications towers cannot be co-located with other Caltrain facilities, the communications facilities would be sited in an approximately 20-foot by 15-foot fenced area near the Caltrain corridor. Some but not all of the standalone locations would have two options for environmental clearance. For the purposes of environmental clearance, some of the standalone locations have two identified site options but only one would ultimately be implemented.

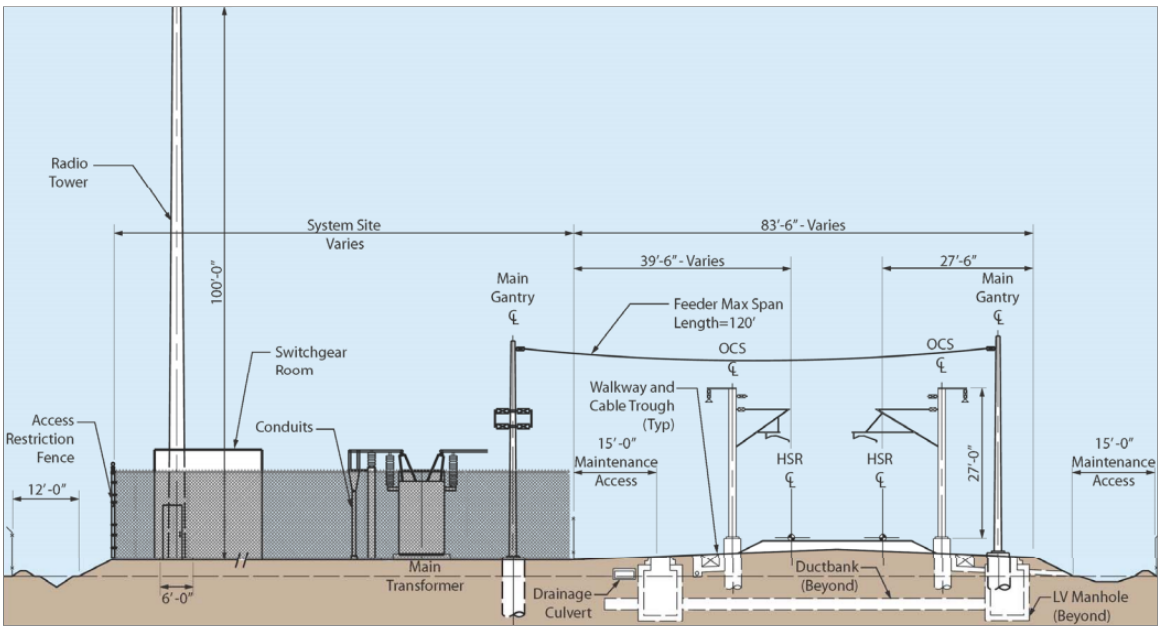


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Figure 2-7 Typical Cross Section of At-Grade Profile with an Adjacent Communications Radio Tower Co-Located with a Traction Power Substation

2.1.2 Traction Power Distribution

The blended system would use the traction power distribution system installed by Caltrain as part of the PCEP, which would install 130 to 140 single-track-miles of OCS between San Francisco and San Jose for the distribution of electric power to the trains. The OCS would consist of a series of mast poles approximately 23.5 feet higher than the top of the rail, with contact wires suspended from the mast poles. The train would have an arm, called a pantograph, to maintain contact with this wire, providing power to the train. The OCS would be powered from a 25-kilovolt, 60-Hertz, single-phase, alternating current supply system consisting of traction power substations, one switching station, and paralleling stations.[4]

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[4] Traction power substations are typically 150 feet by 200 feet in size and include transformers that step down the voltage of power provided by the utility to that needed for the OCS. Switching stations are typically 80 feet by 160 feet in size and would be installed at the midpoint between traction power substations as a phase break to ensure power supplies from each traction power substation are isolated from each other. Paralleling stations are typically 40 feet by 80 feet and would

Relocation of the OCS poles and wires installed by Caltrain as part of the PCEP would be required as part of the HSR project where track modifications would shift tracks more than 1 foot horizontally. Additionally, the project would build new OCS poles and wires for dedicated HSR infrastructure associated with the Brisbane LMF.

Beyond the infrastructure installed as part of the PCEP, HSR trains may require equipment (e.g., transformers) to handle HSR electrical loads at the PCEP traction power distribution facilities. Any additional equipment installed at these facilities would be similar in terms of size and capacity to the Caltrain equipment.

2.1.3 Light Maintenance Facility

The Project Section would include an approximately 100- to 110-acre LMF in the city of Brisbane, which would support the San Francisco terminal station operations by dispatching freshly inspected and serviced trains and crews to begin revenue service throughout the day. The LMF would also be the location for daily, monthly, and quarterly maintenance of HSR trainsets. Maintenance activities would include train washing, interior cleaning, wheel truing, testing, and inspections. These activities may occur between runs or as a pre-departure service at the start of the revenue day. Additionally, the LMF would be used as a service point for any trains in need of emergency services. Two LMF site options for the Brisbane LMF, located east and west of the mainline Caltrain tracks, are evaluated in this document as part of the two project alternatives and described in more detail in Section 2.2 and Section 2.3.

2.2 Alternative A

Alternative A would modify approximately 14.5 miles of existing Caltrain track, predominantly within the existing Caltrain right-of-way, build the East Brisbane LMF, modify seven existing stations or platforms to accommodate HSR, and install safety improvements and communication radio towers. Caltrain has several locations of four-track segments where trains can pass; no additional passing tracks would be built under Alternative A. Table 2-2 presents a summary of the alternative's design features, followed by a more detailed description by subsection.

Table 2-2 Summary of Design Features for Alternative A

Feature	Alternative A
Length of existing Caltrain track (miles)[1]	42.9
Length of modified track (miles)[1]	14.5
Length of track modification <1 ft (miles)[1]	5.1
Length of track modification >1 ft and <3 ft (miles)[1]	2.2
Length of track modification > 3 ft (miles)[1]	7.2
Length of OCS pole relocation (miles)[1, 2]	9.4
Includes additional passing tracks	No
LMF	East Brisbane
Modified stations	
Modifications to HSR stations	4th and King Street; Millbrae
Modifications to Caltrain stations due to the LMF	Bayshore (relocated)
Modifications to Caltrain stations due to track shifts	San Bruno; Hayward Park
Modifications to Caltrain stations to remove hold-out rule	Broadway; Atherton

be installed between traction power substations and switching stations to maintain the autotransformer system and system operating voltages. Traction power substations, switching stations, and paralleling stations would be equipped with circuit breakers, switching equipment, and oil-filled transformers.

Feature	Alternative A
Number of modified or new structures[3]	14
New structures	2
Modified structures	7
Replaced structures	2
Affected retaining walls	3
Number of at-grade crossings with safety modifications (e.g., four-quadrant gates, median barriers)	38
Length of new perimeter fencing (miles)[1]	7.3
Communication radio towers	20

Source: Authority 2019a
LMF = light maintenance facility
OCS = overhead contact system
[1] Lengths shown are guideway mileages, rather than the length of the northbound and southbound track.
[2] OCS pole relocations are assumed for areas with track shifts greater than 1 foot.
[3] Structures include bridges, grade separations such as pedestrian underpasses and overpasses, tunnels, retaining walls, and culverts.

2.2.1 San Francisco to South San Francisco Subsection

The San Francisco to South San Francisco Subsection would extend approximately 10 miles from the 4th and King Street Station in downtown San Francisco to Linden Avenue in South San Francisco, through the cities of San Francisco, Brisbane, and South San Francisco. The existing Caltrain track in this subsection is predominantly two-track at grade, with four two-track tunnel segments in San Francisco, and a four-track at-grade section through Brisbane. As illustrated on Figure 2-8, this alternative would modify the existing 4th and King Street and Bayshore Stations, build the East Brisbane LMF and associated track modifications, reconfigure Tunnel Avenue, install four-quadrant gates at three existing at-grade crossings, and install six communication radio towers. Additional right-of-way would be required in San Francisco and Brisbane to accommodate track modification, the East Brisbane LMF, Tunnel Avenue reconfiguration, four-quadrant gates, and communication radio towers.

Source: Authority 2019a

MAY 2019

Figure 2-8 San Francisco to South San Francisco Subsection—Alternative A

2.2.1.1 4th and King Street Station

The existing 4th and King Street Station would serve as the interim terminal station for the Project Section until the Downtown Extension (DTX) provides HSR access to the Salesforce Transit Center (SFTC). Figure 2-9 depicts the site plan for the interim station. Station improvements would include installing a booth for HSR ticketing and support services, adding HSR fare gates, and modifying existing tracks and platforms. Until the DTX can provide service to the SFTC, passengers would be required to use alternative methods of transportation to get there (e.g., San Francisco Municipal Railway [MUNI], ride-share program, or walk). Figures 2-10 and 2-11 present a cross-section view of the HSR tracks and platforms at 4th and King Street Station looking northeast.

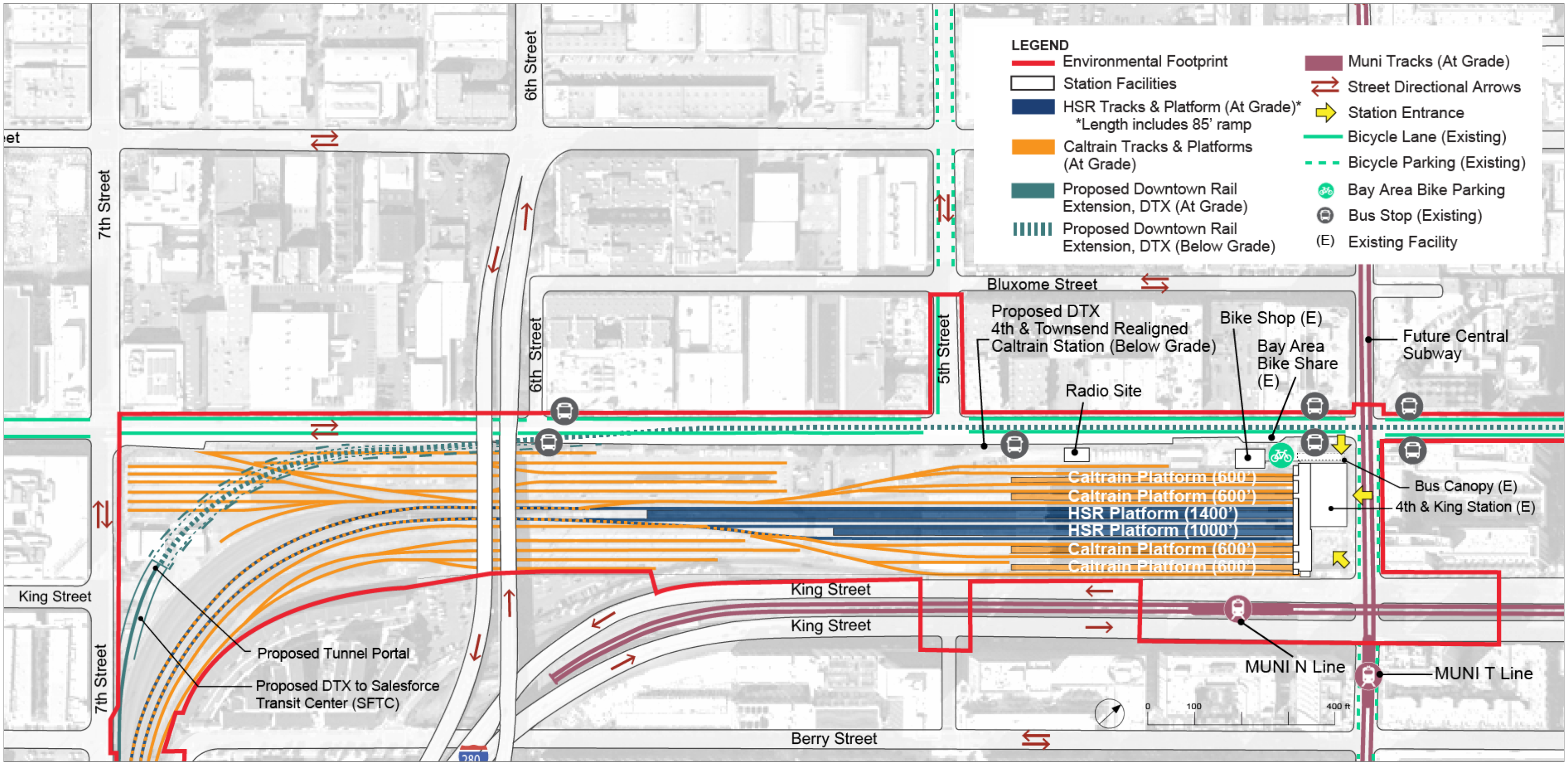
To support HSR operations, two existing Caltrain platforms in the center of the station yard would be raised and lengthened to serve four northbound and southbound HSR tracks. The HSR platforms would be approximately 4.25 feet high, with lengths of 1,000 feet for the platform on the east and 1,400 feet for the platform on the west. Ramps would be installed to provide pedestrian access from the station building to the raised platforms. Four existing Caltrain platforms, 600 feet long, would remain on either side of the HSR platforms to serve eight Caltrain tracks.

2.2.1.2 East Brisbane Light Maintenance Facility

The East Brisbane LMF would be built south of the San Francisco tunnels on approximately 100 acres east of the Caltrain corridor. Direct HSR mainline track access would be provided along double-ended yard leads that would cross over the mainline track on an aerial flyover at the north end, with an at-grade track entering the LMF from the south. Transition tracks (approximately 1,400 feet long) would allow trains to reduce or increase speed when entering or exiting the East Brisbane LMF.

The East Brisbane LMF (Figure 2-12) would include a maintenance yard with 17 yard tracks adjacent and parallel to a maintenance building containing eight shop tracks with interior access and inspection pits for underside and truck inspections. The maintenance building would provide storage areas for reserve equipment, workshops, and office space. A power generator, sewage system, cistern, collection point, and electrical substation would be north of the maintenance building with a 400-space surface parking lot for automobiles and trucks east of the maintenance building. An access road would connect the facility to the realigned Tunnel Avenue.

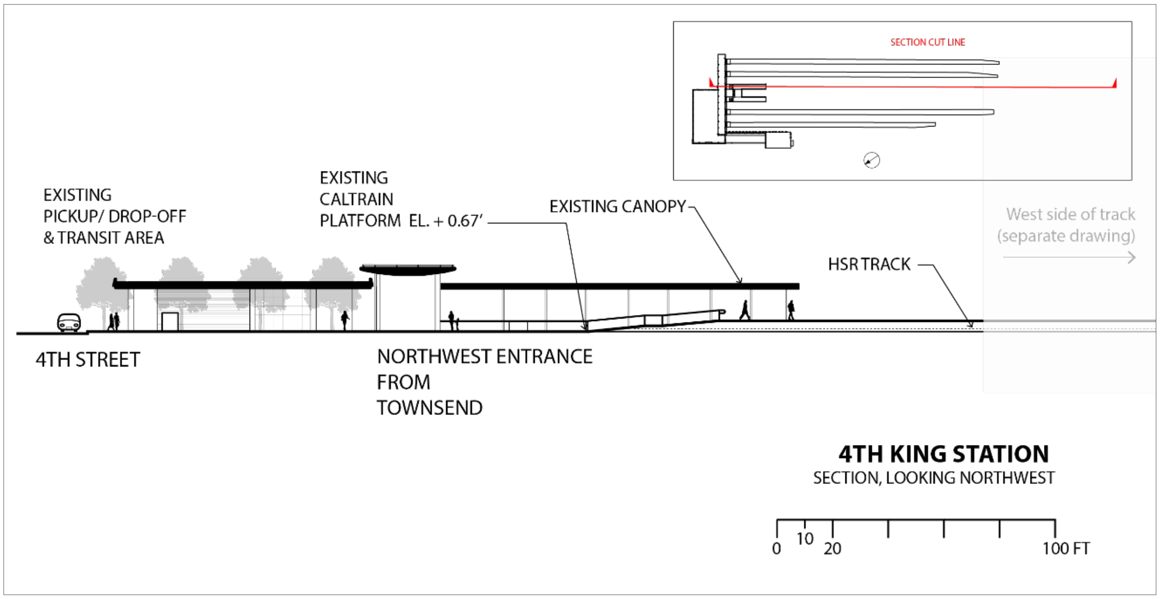
The track modifications associated with the East Brisbane LMF would require relocating the Bayshore Caltrain Station (described in Section 2.2.1.3, Track and Station Modifications), relocating the Tunnel Avenue overpass, widening the bridge crossing of Guadalupe Valley Creek in Brisbane, and relocating control point (CP) Geneva. The reconstructed Tunnel Avenue overpass would connect to Bayshore Boulevard at its intersection with Valley Drive (north of its existing connection) and would provide a roadway extension connecting Valley Drive to Old County Road. The widened Guadalupe Valley Creek Bridge would support the East Brisbane LMF lead tracks where they cross the creek. Track modification near CP Geneva could require relocating the overhead signal pole.



Source: Authority 2019a

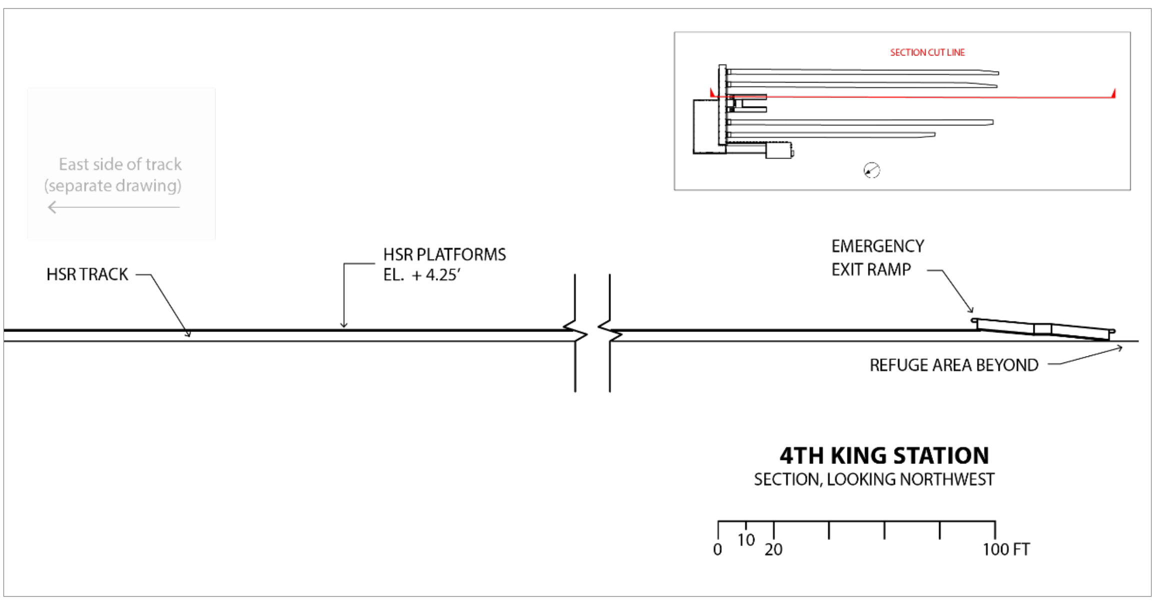
MAY 2019

Figure 2-9 4th and King Street Station Site Plan—Alternatives A and B



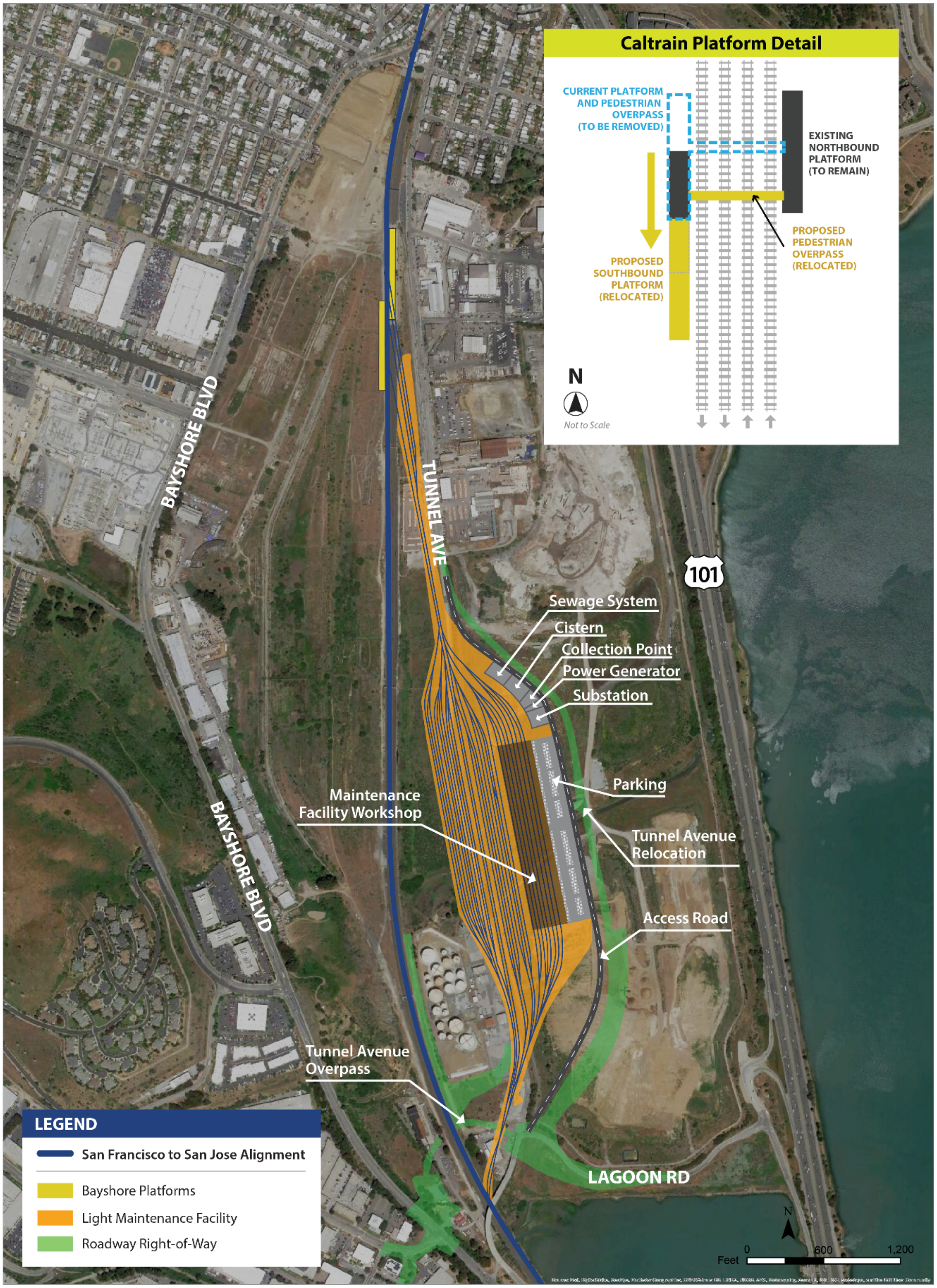
Source: Authority 2019a MAY 2019

Figure 2-10 4th and King Street Station Cross Section (Northern Portion)—Alternatives A and B



Source: Authority 2019a MAY 2019

Figure 2-11 4th and King Street Station Cross Section (Southern Portion)—Alternatives A and B



Source: Authority 2019a

MAY 2019

Figure 2-12 East Brisbane Light Maintenance Facility Layout—Alternative A

2.2.1.3 Track and Station Modifications

Track and station modifications in the San Francisco to South San Francisco Subsection (Figure 2-8) are predominantly associated with the 4th and King Street Station modifications and the East Brisbane LMF. To accommodate the realignment of the mainline tracks for the East Brisbane LMF, the Bayshore Caltrain Station and associated surface parking lot, southbound platform, and a new pedestrian overpass would be reconstructed approximately 0.2 mile south of the existing station (inset on Figure 2-12). A new pedestrian overpass would access the reconstructed station by connecting to Tunnel Avenue on the east and the planned local roadway network envisioned in the Draft Brisbane Baylands Specific Plan on the west (City of Brisbane 2011). The relocated Bayshore Caltrain Station would be closer to the planned Geneva Avenue extension, which would extend from Bayshore Boulevard to U.S. Highway (US) 101.

Track modifications not associated with the 4th and King Street Station, the approach to the 4th and King Street Station, and East Brisbane LMF would be limited to minor track shifts of less than 1 foot within the existing right-of-way in San Francisco and South San Francisco, and track modifications in South San Francisco to accommodate the planned South San Francisco Caltrain Station Improvement Project being implemented by Caltrain in coordination with the City of South San Francisco. Expected to be built by 2019, the improvement project would replace the existing South San Francisco Station platforms (which are subject to the hold-out rule) with a standard center boarding platform connected to a pedestrian underpass, to improve safety and eliminate the hold-out rule. The project would shift tracks up to 27 feet, install crash barriers at the Grand Avenue overpass, and replace columns that support the US 101 overpass with a pair of solid pier walls.

2.2.1.4 Safety and Security Modifications to the Right-of-Way

To improve safety, four-quadrant gates would be installed at three at-grade crossings in the subsection—Mission Bay Drive, 16th Street, and Linden Avenue (Figure 2-8). Table 2-1 specifies the four-quadrant gate application for each at-grade crossing, and Figures 2-3, 2-4, and 2-5 illustrate the configurations of these applications. Perimeter fencing (Figure 2-6) would be installed along the right-of-way where it does not already exist.

2.2.1.5 Train Control and Communication Facilities

There would be six communication radio towers in this subsection (Figure 2-8). Two site options are evaluated for each standalone communications radio tower, with the exception of a single site option at 4th and King Street Station and at Blanken Avenue; however, only one site would be selected for construction at each site:

- Standalone radio tower at the 4th and King Street Station in San Francisco (one site option)
- Co-located radio tower at Caltrain's Paralleling Station 1 in the Potrero Hill neighborhood of San Francisco
- Standalone radio tower in the Bayview neighborhood of San Francisco (either at Jerrold Avenue or Newcomb Avenue)
- Standalone radio tower at Blanken Avenue in Brisbane (one site option)
- Standalone radio tower in Brisbane adjacent to Bayshore Boulevard (two site options)
- Co-located radio tower at Caltrain's Traction Power Substation 1 in South San Francisco

2.2.2 San Bruno to San Mateo Subsection

The San Bruno to San Mateo Subsection would extend approximately 8 miles from Linden Avenue in South San Francisco to Ninth Avenue in San Mateo through South San Francisco, San Bruno, Millbrae, Burlingame, and San Mateo. The existing Caltrain track in this subsection is predominantly two-track at grade on retained fill with a three-track at-grade section south of the Millbrae Caltrain Station. As illustrated on Figure 2-13, this alternative would modify the existing San Bruno, Millbrae, and Broadway Caltrain Stations; modify track; install four-quadrant gates at 16 existing at-grade crossings; and install three communication radio towers. Additional right-of-way would be required in Millbrae, Burlingame, and San Mateo associated with communication radio towers, the Millbrae Station modifications to accommodate HSR service, track modifications, roadway relocations, and four-quadrant gates.

2.2.2.1 Millbrae Station

New HSR infrastructure would be constructed at the existing Millbrae Bay Area Rapid Transit (BART)/Caltrain Intermodal Station. As illustrated on Figure 2-14, new HSR station facilities on the west side of the existing Caltrain corridor would include a new station entrance hall with ticketing and support services along El Camino Real. The station area design provides intermodal connectivity with Caltrain and BART via an overhead pedestrian crossing that would extend from the new station entrance over the extension of California Drive, connecting to the existing station concourse with vertical circulation elements (stairs, escalators and elevators) providing access to HSR, Caltrain, and BART platforms.

The primary access to the Millbrae HSR Station is intended to be by transit (Caltrain, BART, San Mateo County Transit District [SamTrans]), bicycles, walking and vehicle pick-up and drop-off. Pick-up and drop-off facilities for vehicles would accommodate shuttles, taxis, car sharing, network transportation services and private vehicles.

Enhanced automobile access would be provided on the west side of the station through the extension of California Drive to Victoria Avenue. Curbside passenger pick-up and drop-off facilities west of the station would be located along the new extension of California Drive and El Camino Real; facilities east of the station would be located on the first level of the BART parking structure. Replacement parking for displaced Caltrain and BART parking would be provided at four surface parking lots on the west side of the alignment, with a fifth parking area at Murchison Drive with 37 parking spots for HSR passengers. HSR passengers desiring to drive and park would be able to use available long-term commercial parking located off-site or at the San Francisco International Airport (SFO) and arrive at the station by shuttle.

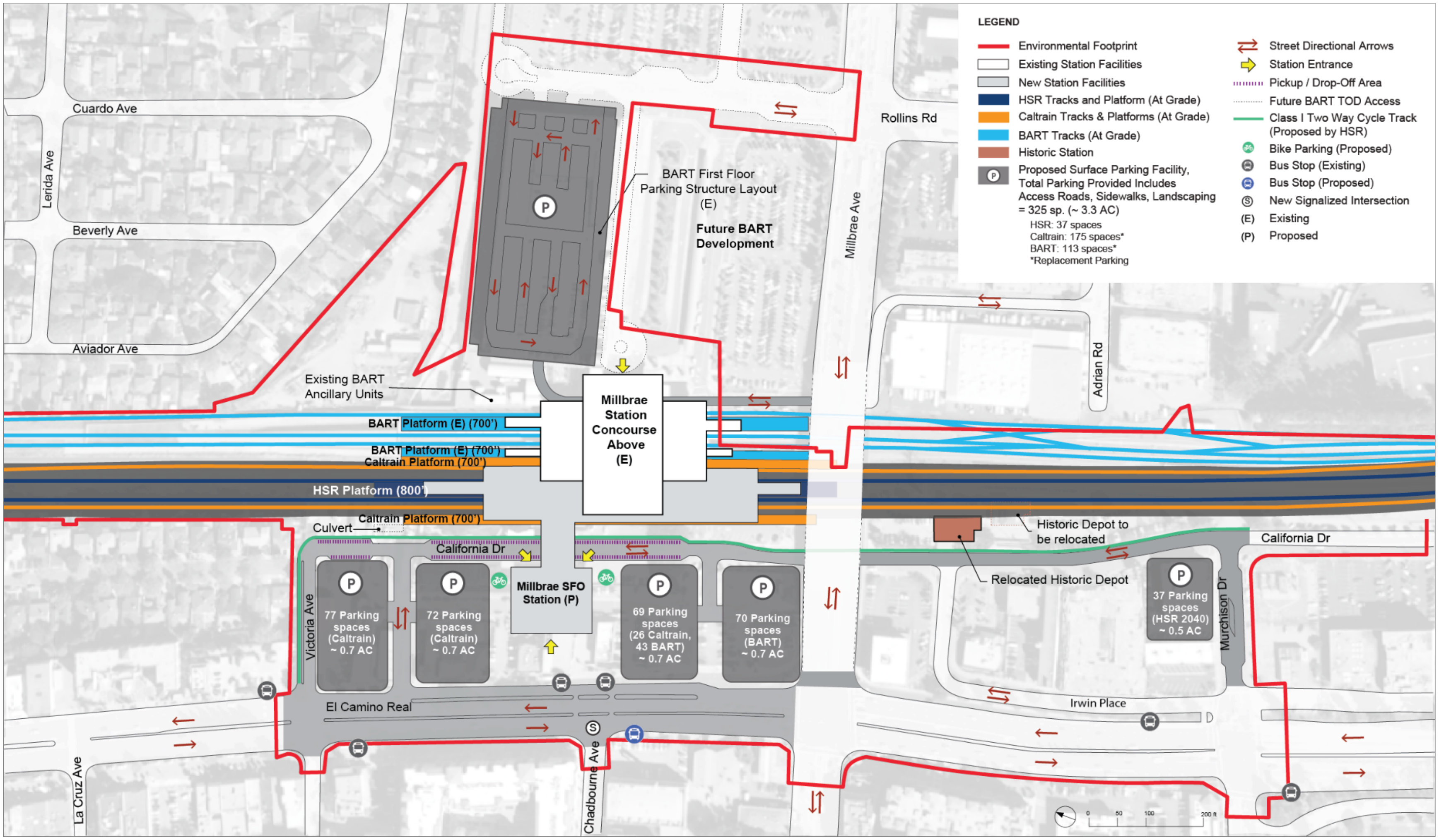
The SamTrans bus stops would be located along El Camino Real at the new signalized intersection and pedestrian crossings at Chadbourne Avenue, with direct access to the station. A new dedicated bike path would provide west side bicycle access to the station. Figures 2-15 and 2-16 illustrate cross-section views of the Millbrae Station looking south.

Track modifications extending approximately 1 mile north and south of the station would require additional right-of-way along the west side of the Caltrain corridor and modification of existing Caltrain tracks, station platforms, and structures. Constructing two new tracks would require widening the Hillcrest Boulevard underpass north of the Millbrae Station. At the station, the existing BART tracks and platforms and the easternmost Caltrain track (mainline track [MT]1) and platform would remain unchanged. The westernmost Caltrain track (MT2) would be shifted west by up to 40 feet for construction of two new tracks serving an 800-foot-long center HSR platform and a new Caltrain MT2 outboard platform. The historic Southern Pacific Depot/Millbrae Station (previously relocated to accommodate station improvements) and associated surface parking along California Drive would be relocated to accommodate these track modifications.

Source: Authority 2019a

MAY 2019

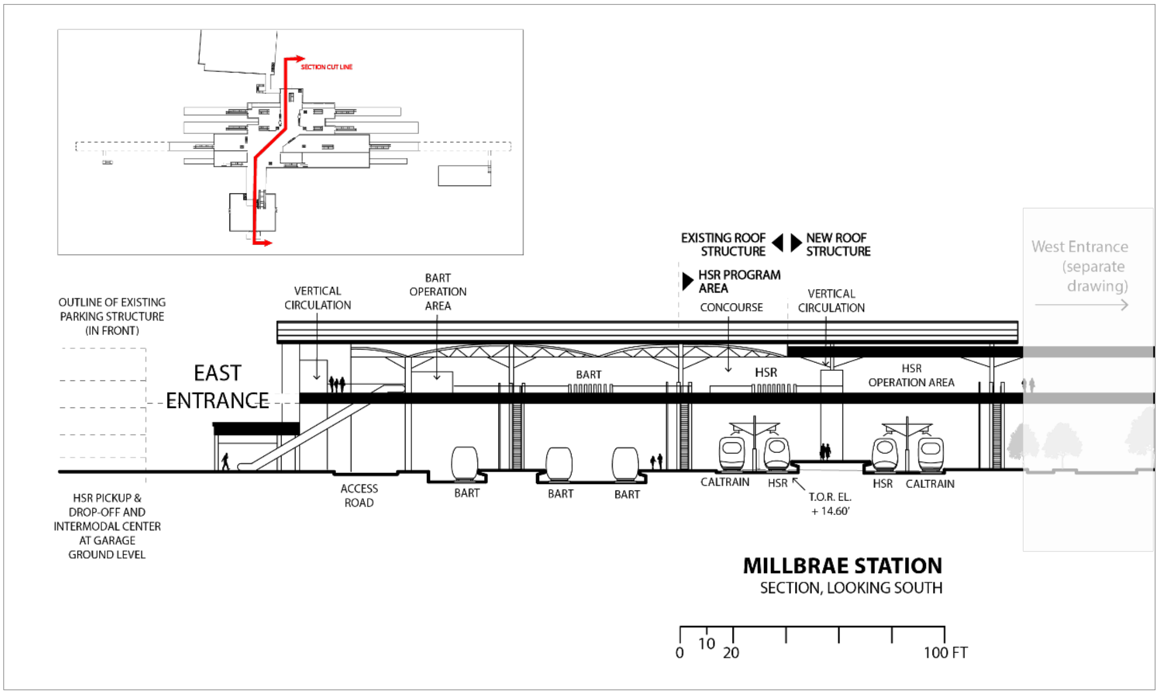
Figure 2-13 San Bruno to San Mateo Subsection—Alternatives A and B



Source: Authority 2019a

MAY 2019

Figure 2-14 Millbrae Station Site Plan—Alternatives A and B



Source: Authority 2019a

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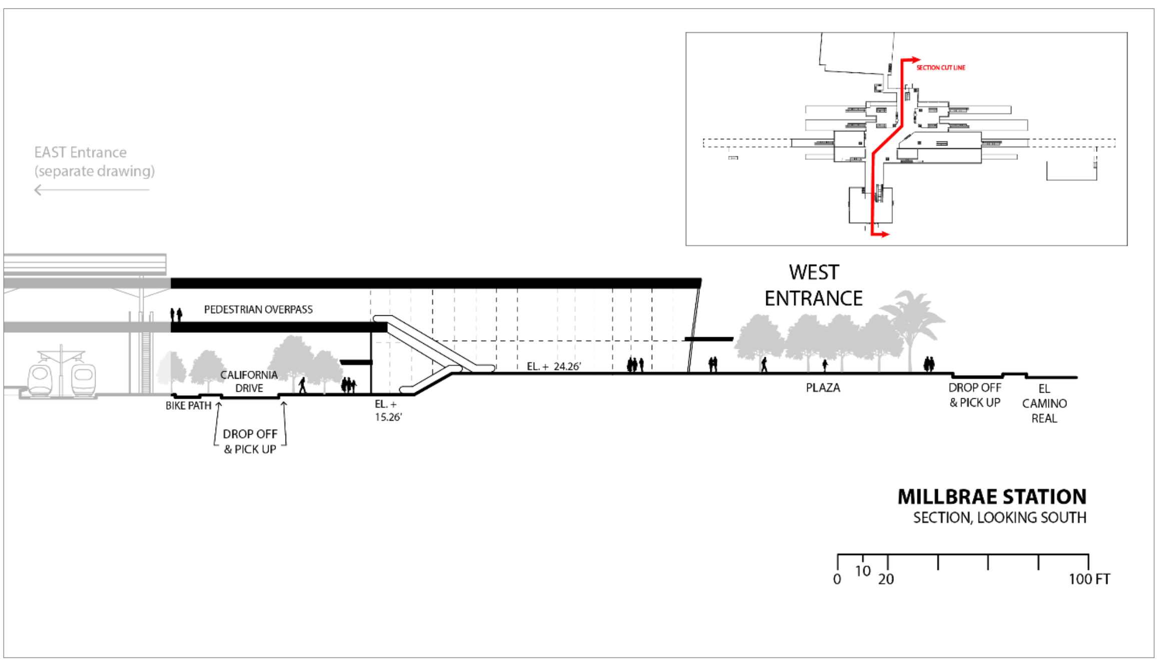
Figure 2-15 Millbrae Station Cross Section (East Entrance)—Alternatives A and B



Source: Authority 2019a

MAY 2019

Figure 2-16 Millbrae Station Cross Section (West Entrance)—Alternatives A and B

2.2.2.2 Track and Station Modifications

Track and station modifications in this subsection include curve straightening near the San Bruno Station, platform modifications at the Broadway Station to eliminate the hold-out rule, and several minor track shifts in San Bruno and San Mateo. The curve straightening at the San Bruno Station would require an extension of the existing platforms approximately 145 feet south, and relocation of the existing stairs/ramps from the northern to southern side of the northbound platform. The Euclid Avenue pedestrian underpass, just north of the San Bruno Station, would be widened to support the realigned tracks, and the concrete retaining wall along the east side would be modified to accommodate the realigned tracks. Safety-related modifications would be made to the Broadway Station, including platform upgrades that would eliminate the hold-out rule by adding a second outboard platform to serve the northbound track and extending the southbound platform (Figure 2-2). The southbound platform extension would affect the station's surface parking along California Drive, and minor track shifts south of the Broadway Station would require widening of the Sanchez Creek and Mills Creek Culverts.

2.2.2.3 Safety and Security Modifications to the Right-of-Way

To improve safety four-quadrant gates and channelizers would be installed at 16 at-grade crossings: Scott Street, Center Street, Broadway, Oak Grove Avenue, North Lane, Howard Avenue, Bayswater Avenue, Peninsula Avenue, Villa Terrace, Bellevue Avenue, First Avenue, Second Avenue, Third Avenue, Fourth Avenue, Fifth Avenue, and Ninth Avenue. As illustrated on Figure 2-13, most of these crossings are in Burlingame and San Mateo. Table 2-1 specifies the four-quadrant gate application for each at-grade crossing, and Figures 2-3, 2-4, and 2-5 illustrate the configurations of these applications. Perimeter fencing (Figure 2-6) would be installed along the right-of-way where it does not already exist.

2.2.2.4 Train Control and Communication Facilities

Three communication radio towers would be built in the subsection. Locations of these facilities—a new standalone radio tower near SFO (at either San Marco Avenue or Santa Lucia Avenue), a co-located radio tower at Paralleling Station 3 in Burlingame, and a new standalone radio tower in San Mateo near Cypress or 2nd Avenue—are illustrated on Figure 2-13. Two site options are evaluated for each standalone communications radio tower; however, only one site would be selected for construction.

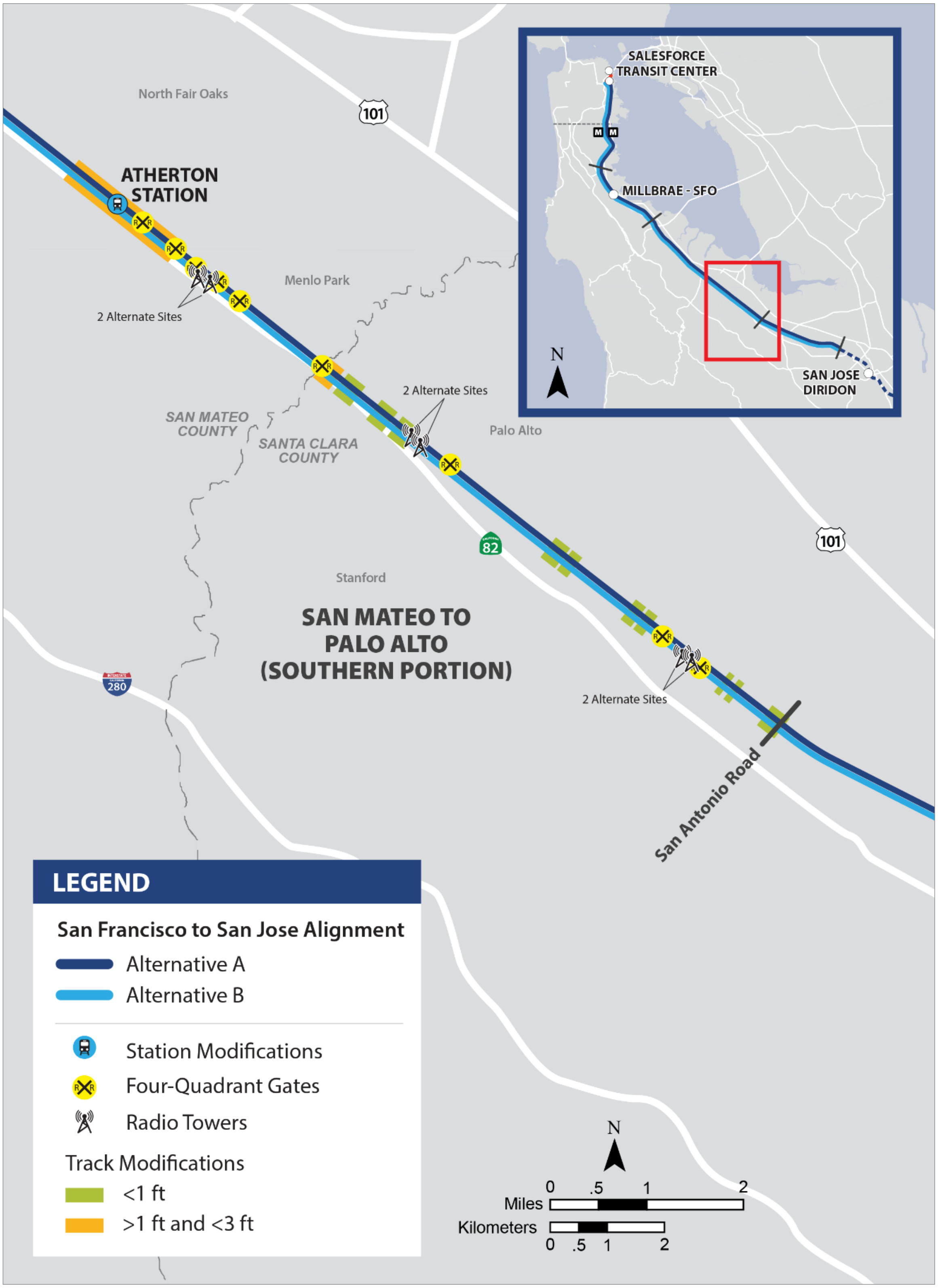
2.2.3 San Mateo to Palo Alto Subsection

The San Mateo to Palo Alto Subsection would extend approximately 16 miles from Ninth Avenue in San Mateo to San Antonio Road in Palo Alto through San Mateo, Belmont, San Carlos, Redwood City, Atherton, Menlo Park, and the northern portion of Palo Alto. The existing Caltrain track in this subsection is predominantly two-track at grade on retained fill. As illustrated on Figures 2-17 and 2-18, this alternative would modify platforms at the existing Hayward Park and Atherton Stations, modify tracks, install four-quadrant gates at 15 existing at-grade crossings, and install 7 communication radio towers. Minor amounts of additional right-of-way would be required in San Mateo, Belmont, San Carlos, Redwood City, Menlo Park, and Palo Alto for the siting of four-quadrant gates and communication radio towers.

Source: Authority 2019a

MAY 2019

Figure 2-17 San Mateo to Palo Alto Subsection (Northern Portion)—Alternative A



Source: Authority 2019a

MAY 2019

Figure 2-18 San Mateo to Palo Alto Subsection (Southern Portion)—Alternatives A and B

2.2.3.1 Track and Station Modifications

Track and station modifications in this subsection (Figures 2-17 and 2-18) consist of curve straightening predominantly in San Mateo, Belmont, San Carlos, and Palo Alto, platform modifications at the Hayward Park Station to accommodate curve straightening, and platform modifications at the Atherton Station to remove the hold-out rule by extending the southbound platform and adding a second outboard platform to serve the northbound track. In several locations, these track modifications would result in modifications to existing Caltrain structures; track shifts south of Ralston Street in Belmont and north of Holly Street in San Carlos would require the modifying the existing retaining walls along the west side of the Caltrain corridor to accommodate the shifted track. The HSR project would be compatible with Caltrain and the City of San Mateo's planned 25th Avenue Grade-Separation Project. This grade-separation project, expected to be built by 2020, would elevate the existing at-grade track between State Route (SR) 92 and Hillsdale Boulevard to provide a grade-separated undercrossing of 25th Avenue, build new east-west crossings under the track corridor at 28th and 31st Avenues, and relocate Hillsdale Station. No design changes to the 25th Avenue Grade-Separation Project are expected to result from the blended system.

2.2.3.2 Safety and Security Modifications to the Right-of-Way

To improve safety four-quadrant gates and median barriers would be installed at 15 at-grade crossings: Whipple Avenue, Brewster Avenue, Broadway, Maple Street, Main Street, Chestnut Street, Watkins Avenue, Encinal Avenue, Glenwood Avenue, Oak Grove Avenue, Ravenswood Avenue, Alma Street, Churchill Avenue, Meadow Drive, and West Charleston Road. As illustrated on Figures 2-17 and 2-18, most of these crossings are in Redwood City, Menlo Park, and Palo Alto. Table 2-1 specifies the four-quadrant gate application that would be applicable to each at-grade crossing, and Figures 2-3, 2-4, and 2-5 illustrate the configurations for these applications. Perimeter fencing would be installed along the right-of-way where it does not already exist (Figure 2-6).

2.2.3.3 Train Control and Communication Facilities

Seven communication radio towers would be built (Figures 2-17 and 2-18). Two site options are evaluated for each standalone communications radio tower; however, only one site would be selected for construction at each location:

- Co-located radio tower at Caltrain's Paralleling Station 4 south in San Mateo
- Standalone radio tower near the Belmont Station (either Middle Road or Ralston Avenue)
- Standalone radio tower in San Carlos (either near El Camino Real/Central Avenue or Center Street)
- Co-located radio tower at Caltrain's Switching Station 1, Option 2 in Redwood City
- Standalone radio tower in Menlo Park (either at Derby Lane or Ravenswood Avenue)
- Standalone radio tower in Palo Alto north of Embarcadero Road
- Standalone radio tower in Palo Alto north of West Charleston Road

2.2.4 Mountain View to Santa Clara Subsection

The Mountain View to Santa Clara Subsection would extend approximately 9 miles from San Antonio Road in Palo Alto to Scott Boulevard in Santa Clara through Palo Alto (southern portion), Mountain View, Sunnyvale, and Santa Clara. The existing Caltrain track in this subsection is predominantly two-track at grade (except for the four-track section from North Fair Oaks to north of Bowers Avenue) and there are no major project features in this subsection. As illustrated on Figure 2-19, this alternative would make minor track modifications, install four-quadrant gates at four at-grade crossings, and install four communication radio towers. Minor amounts of additional right-of-way would be required in Palo Alto, Mountain View, Sunnyvale, and Santa Clara for communication radio towers.

2.2.4.1 Track and Station Modifications

Minor track shifts of less than 1 foot would be required in several locations in Mountain View, Sunnyvale, and Santa Clara. The largest track shift in this subsection would be a shift of 2.5 feet near Bowers Avenue in Santa Clara. None of these track shifts would require modifying existing Caltrain structures or stations.

2.2.4.2 Safety and Security Modifications to the Right-of-Way

To improve safety, four-quadrant gates and median barriers would be installed at four at-grade crossings in Mountain View and Sunnyvale: Rengstorff Avenue, Castro Street, Mary Avenue, and Sunnyvale Avenue (Figure 2-19). Table 2-1 specifies the four-quadrant gate application for each at-grade crossing, and Figures 2-3, 2-4, and 2-5 illustrate the configurations of these applications. Perimeter fencing would be installed along the right-of-way where it does not already exist.

2.2.4.3 Train Control and Communication Facilities

Four communication radio towers would be installed (Figure 2-19). Two site options are evaluated for each standalone communications radio tower; however, only one site would be selected for construction at each location:

- Standalone radio tower in Mountain View
- Standalone radio tower in Sunnyvale east of SR 237
- Co-located radio tower at Caltrain's Paralleling Station 6 near the Sunnyvale Station
- Standalone radio tower in Sunnyvale east of County Road G2

Source: Authority 2019a MAY 2019

Figure 2-19 Mountain View to Santa Clara Subsection—Alternatives A and B

2.3 Alternative B

Alternative B would modify approximately 17.4 miles of existing Caltrain track, predominantly within the existing Caltrain right-of-way, build the West Brisbane LMF and a four-track passing track, modify 10 existing stations or platforms to accommodate HSR, and install safety improvements and communication radio towers. Table 2-3 summarizes the alternative's design features, followed by a more detailed description by subsection.

Table 2-3 Summary of Design Features for Alternative B

Feature	Alternative B
Length of existing Caltrain track (miles)[1]	42.9
Length of modified track (miles)[1]	17.4
Length of track modification <1 ft (miles)[1]	4.3
Length of track modification >1 ft and <3 ft (miles)[1]	1.9
Length of track modification > 3 ft (miles)[1]	11.2
Length of OCS pole relocation (miles)[1, 2]	13.1
Includes additional passing tracks	Yes
LMF	West Brisbane
Modified stations	
Modifications to HSR stations	4th and King Street; Millbrae
Modifications to Caltrain stations due to the LMF	Bayshore (relocated)
Modifications to Caltrain stations due to the passing tracks	Hayward Park; Hillsdale; Belmont; San Carlos (relocated)
Modifications to Caltrain stations due to track shifts	San Bruno
Modifications to Caltrain stations to remove hold-out rule	Broadway; Atherton
Number of modified or new structures[3]	35
New structures	3
Modified structures	18
Replaced structures	7
Affected retaining walls	7
Number of at-grade crossings with safety modifications (e.g., four-quadrant gates, median barriers)	38
Length of new perimeter fencing	8.7
Communication radio towers	20

Source: Authority 2019a
LMF = light maintenance facility
OCS = overhead contact system
[1] Lengths shown are guideway mileages.
[2] OCS pole relocations are assumed for areas with track shifts greater than 1 foot.
[3] Structures include bridges, grade separations such as pedestrian underpasses and overpasses, tunnels, retaining walls, and culverts.

2.3.1 San Francisco to South San Francisco Subsection

The Alternative B characteristics in this subsection would be predominantly the same as those described for Alternative A in Section 2.2.1, San Francisco to South San Francisco Subsection. Siting the LMF on the west side of the Caltrain corridor (West Brisbane LMF) would require different track, roadway, and Bayshore Station modifications than described for Alternative A. Locations of track modifications, safety and security improvements, and communication radio towers in this subsection are illustrated on Figure 2-20.

Source: Authority 2019a

MAY 2019

Figure 2-20 San Francisco to South San Francisco Subsection—Alternative B

2.3.1.1 West Brisbane Light Maintenance Facility

The West Brisbane LMF would be built south of the San Francisco Caltrain tunnels on approximately 110 acres west of the Caltrain corridor. Direct mainline track access would be along double-ended yard leads that would cross over the mainline track on aerial flyover and would enable north and south movements. The four existing mainline tracks would be shifted west by up to 16.5 feet, and new yard leads connecting to the West Brisbane LMF would be constructed east and west of the existing tracks. The yard leads east of the existing tracks would cross over the realigned four-track alignment on an aerial flyover to avoid train operations on the mainline track, converging with the yard leads on the west side of the track alignment. Transition tracks (approximately 1,400 feet long) would allow trains to reduce or increase speed when entering or exiting the LMF.

The West Brisbane LMF (Figure 2-21) would include a maintenance yard with 17 yard tracks parallel to a runaround track and a maintenance building with shop tracks. A power generator, sewage system, cistern, collection point, and an electrical substation would be located north of the maintenance building. A 400-space surface parking lot would be provided west of the maintenance building with truck and vehicle access to Industrial Way, which parallels and connects to Bayshore Boulevard.

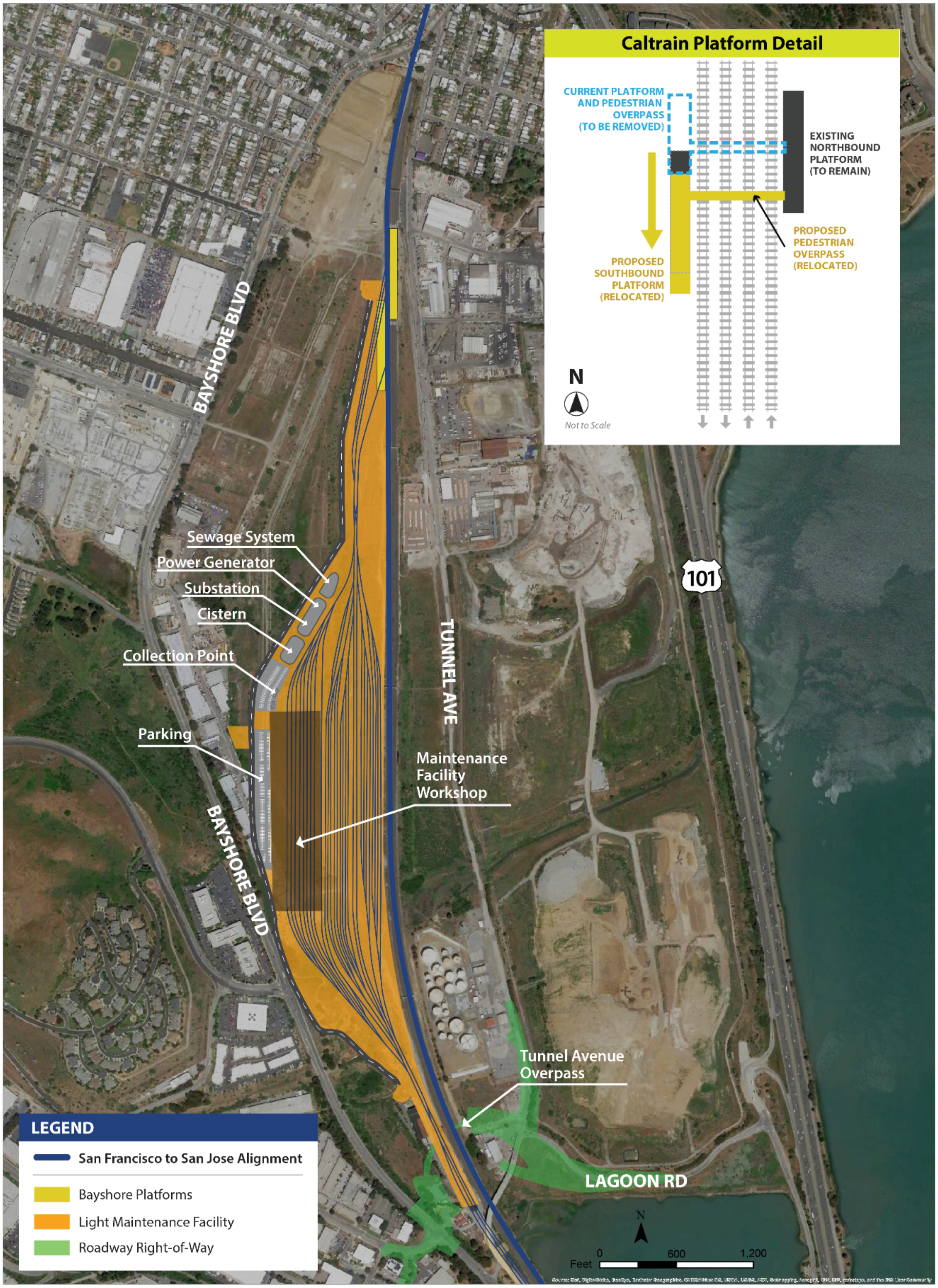
Track modifications associated with the West Brisbane LMF would require relocating the Tunnel Avenue overpass, widening the bridge crossing Guadalupe Valley Creek in Brisbane, relocating CP Geneva at its intersection with Valley Drive, and providing a roadway extension connecting Valley Drive to Old County Road. The widened Guadalupe Valley Creek Bridge would support the West Brisbane LMF lead tracks where they cross the creek. Track modification near CP Geneva could require relocating the overhead signal pole.

2.3.1.2 Track and Station Modifications

Track and station modifications in the San Francisco to South San Francisco Subsection for Alternative B (Figure 2-20) would predominantly be associated with the West Brisbane LMF. The realignment of the mainline tracks for the West Brisbane LMF would require relocation of the Bayshore Caltrain Station and removal of the existing Bayshore Station pedestrian overpass. The Bayshore Caltrain Station and associated surface parking lot, southbound platform, and a new pedestrian overpass would be reconstructed approximately 0.2 mile south of the existing station (inset on Figure 2-21). The new pedestrian overpass would provide access to the reconstructed station by connecting to Tunnel Avenue on the east and the planned local roadway network envisioned in the *Draft Brisbane Baylands Specific Plan* on the west (City of Brisbane 2011). The Bayshore Caltrain Station would be closer to the planned future Geneva Avenue extension, which would extend from Bayshore Boulevard to US 101.

2.3.2 San Bruno to San Mateo Subsection

The characteristics of the San Bruno to San Mateo Subsection of Alternative B would be the same as those described for Alternative A in Section 2.2.2, San Bruno to San Mateo Subsection. The track and station modifications, safety and security improvements, Millbrae Station, and communication radio towers in this subsection are illustrated on Figure 2-13.



Source: Authority 2019a

MAY 2019

Figure 2-21 West Brisbane Light Maintenance Facility Layout

2.3.3 San Mateo to Palo Alto Subsection

In the San Mateo to Palo Alto Subsection, Alternative B would build a passing track through San Mateo and San Carlos and modify the Hayward Park, Hillsdale, Belmont and San Carlos Stations to accommodate the additional passing tracks. As illustrated on Figures 2-18 and 2-22, this alternative would modify existing track, install four-quadrant gates at 15 existing at-grade crossings, and install 7 communication radio towers. The platforms at the existing Atherton Station would be modified to eliminate the hold-out rule. While the northern portion of this subsection (Figure 2-22) differs from Alternative A because of the passing tracks and associated track and station modifications, the characteristics of the southern portion of the San Mateo to Palo Alto Subsection would be the same as those described for Alternative A in Section 2.2.3, San Mateo to Palo Alto Subsection (Figure 2-18). Additional right-of-way would be required in San Mateo, Belmont, San Carlos, Redwood City, Menlo Park, and Palo Alto associated with four-quadrant gates, communication radio towers, passing tracks, and the reconfiguration or relocation of existing Caltrain stations.

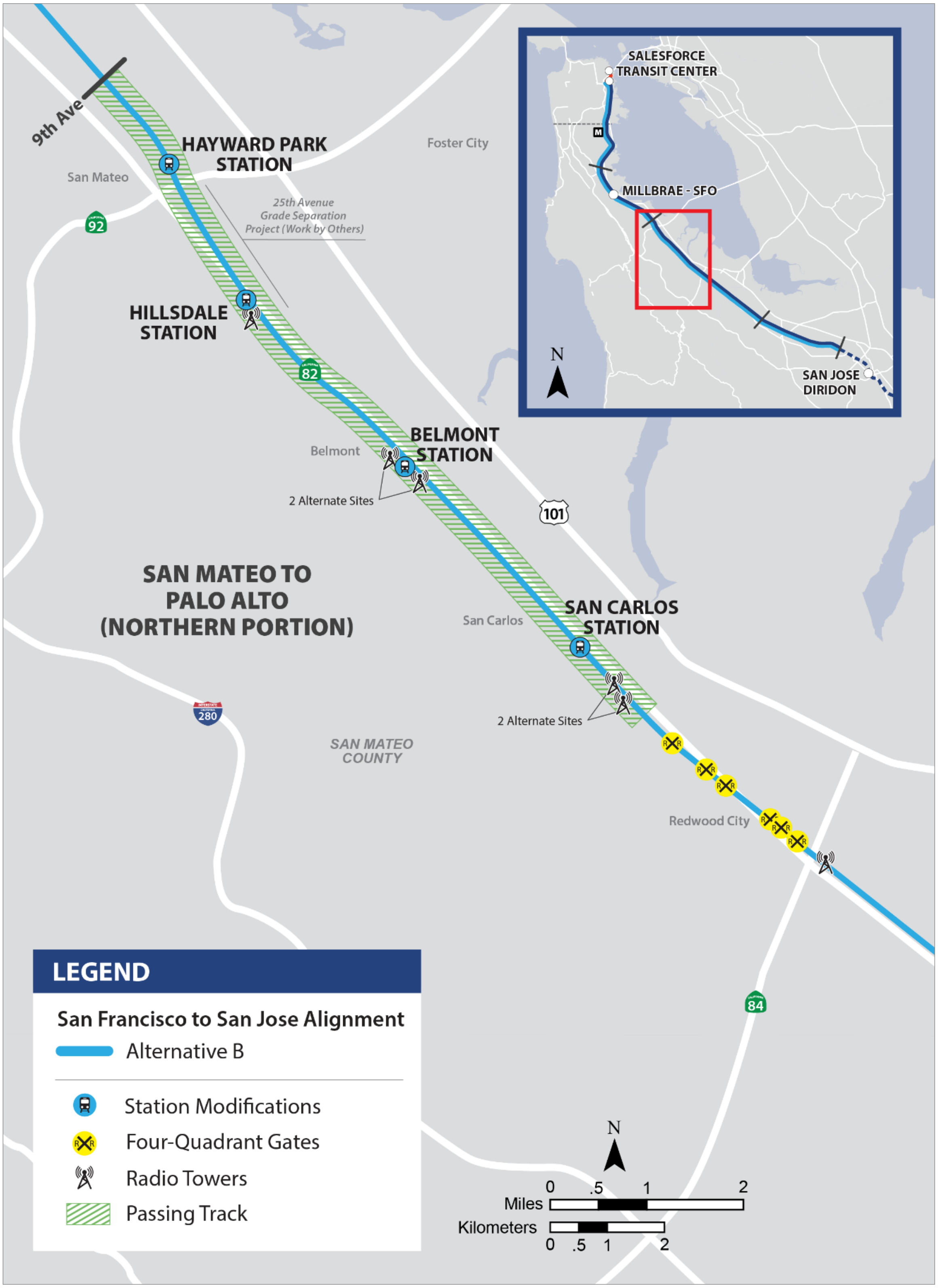
2.3.3.1 Passing Tracks

The approximately 6-mile-long passing track would extend through San Mateo, Belmont, San Carlos, and into the northern portion of Redwood City. South of Ninth Avenue in San Mateo, the two-track alignment would diverge to four tracks continuing at grade and on retained fill. The existing tracks would be realigned predominantly within the existing right-of-way to accommodate the new four-track configuration. Additional right-of-way would be required in some areas with particularly narrow existing rights-of-way or where curve straightening would be necessary to achieve higher speeds.

25th Avenue Grade Separation Project

This grade-separation project, which is being undertaken by Caltrain in coordination with the City of San Mateo, would elevate the existing at-grade track between State Route 92 and Hillsdale Boulevard to provide a grade-separated undercrossing of 25th Avenue, build new east-west crossings under the track corridor at 28th and 31st Avenues, and relocate the Hillsdale Station. Construction is expected to be completed in 2020.

Beginning in Hayward Park north of the SR 92 crossing, the tracks on retained fill would be shifted up to 46 feet, requiring acquisition of additional right-of-way. New outboard platforms, a pedestrian underpass at the Hayward Park Caltrain Station, and a new structure south of the SR 92 overpass would be built to carry the reconfigured four-tracks over the Borel Creek Culvert. South of the Hayward Park Station, the passing tracks would use the infrastructure installed by the planned 25th Avenue Grade Separation Project (see text box). A new retaining wall would be installed between SR 92 and Hillsdale Boulevard to match the elevation of the 25th Avenue Grade Separation Project, along with new bridge structures for the two new tracks at Borel Creek and 25th, 28th, and 31st Avenues. Additionally, a northbound Hillsdale Station platform would be built, eliminating some existing parking at the Hillsdale Station. At Hillsdale Boulevard, the existing underpass structure would be widened to accommodate the realigned tracks, along with widening of the existing Laurel Creek underpass to the south.



Source: Authority 2019a

MAY 2019

Figure 2-22 San Mateo to Palo Alto Subsection (Northern Portion)—Alternative B

South of Hillsdale Boulevard, the passing tracks would ascend to a four-track aerial viaduct. Between Hillsdale Boulevard and Whipple Avenue, the following structures or facilities would be replaced or rebuilt: CP Ralston tie-in points, Belmont Station platforms, and San Carlos Station and platforms. The Belmont Station and platforms would be reconstructed to accommodate the new four-track configuration. The San Carlos Station and platforms would be relocated approximately 2,260 feet south of their currently location to Arroyo Avenue and a pedestrian underpass would be constructed. The following structures would be removed and replaced or modified: 42nd Avenue underpass, Belmont Caltrain Station pedestrian underpass, Ralston Avenue underpass, Harbor Boulevard underpass, F Street pedestrian underpass, Holly Street and San Carlos Station pedestrian underpass, Arroyo Avenue pedestrian underpass, Brittan Avenue, and Howard Avenue. South of Howard Avenue, Alternative B would descend to grade and converge back to a two-track configuration.

2.3.3.2 Track and Station Modifications

The track and station modifications under Alternative B would vary from those described for Alternative A in Section 2.2.3 in the northern portion of the subsection between Ninth Avenue in San Mateo and Whipple Avenue in Redwood City. In this portion of the subsection, the addition of two passing tracks would result in modifications to the existing Hayward Park, Hillsdale, Belmont, and San Carlos Caltrain Stations. Alternative B would modify and realign station platforms at the Hayward Park Caltrain Station, build new platforms at the Hillsdale and Belmont Caltrain Stations, and relocate the San Carlos Caltrain Station approximately 2,260 feet south of its existing location (Figure 2-23).

South of Whipple Avenue, the track and station modifications in the southern portion of this subsection would be the same as those described for Alternative A. Safety-related modifications would be made to the Atherton Station, including platform upgrades that would eliminate the hold-out rule by extending the southbound platform and adding a second outboard platform to serve the northbound track (Figure 2-2).

2.3.4 Mountain View to Santa Clara Subsection

The characteristics of the Mountain View to Santa Clara Subsection under Alternative B would be the same as those described for Alternative A. The locations for track modifications, safety and security improvements, and communication radio towers within this subsection are illustrated on Figure 2-19.

Source: Authority 2019a MAY 2019

Figure 2-23 San Carlos Station Relocation—Alternative B

2.4 Impact Avoidance and Minimization Features

The Authority has developed impact avoidance and minimization features (IAMF) as standard practices, actions, and design features that are incorporated into the project. The description of each IAMF details the means and effectiveness of the feature in addressing affected resources, as well as the environmental benefits of implementing the measure. Table 2-4 shows complete descriptions of all IAMFs related to air quality and GHGs.

Table 2-4 Air Quality and Greenhouse Gas Impact Avoidance and Minimization Features

IAMF	Description
AQ-IAMF#1: Fugitive Dust Emissions	During construction, the contractor would employ the following measures to minimize and control fugitive dust emissions. The contractor would prepare a fugitive dust control plan for each distinct construction segment. At a minimum, the plan would describe how each measure would be employed and identify an individual responsible for ensuring implementation. At a minimum, the plan would address the following components unless alternative measures are approved by the applicable air quality management district. ▪ Cover all vehicle loads transported on public roads to limit visible dust emissions, and maintain at least 6 inches of freeboard space from the top of the container or truck bed. ▪ Clean all trucks and equipment before exiting the construction site using an appropriate cleaning station that does not allow runoff to leave the site or mud to be carried on tires off the site. ▪ Water exposed surfaces and unpaved roads at a minimum three times daily with adequate volume to result in wetting the top 1 inch of soil while avoiding overland flow. Rain events may sufficiently wet the top 1 inch of soil to alleviate the need to manually apply water. ▪ Limit vehicle travel speed on unpaved roads to 15 mph. ▪ Suspend any dust-generating activities when average wind speed exceeds 25 mph. ▪ Stabilize all disturbed areas, including storage piles that are not being used on a daily basis for construction purposes, by using water, a chemical stabilizer/suppressant, or hydro mulch or by covering with a tarp or other suitable cover or vegetative ground cover. In areas adjacent to organic farms, the Authority would use nonchemical means of dust suppression. ▪ Stabilize all on-site unpaved roads and off-site unpaved access roads using water or a chemical stabilizer/suppressant. In areas adjacent to organic farms, the Authority would use nonchemical means of dust suppression. ▪ Apply water to or presoak all areas where land clearing, grubbing, scraping, excavation, land leveling, grading, cut-and-fill, and demolition activities are carried out. ▪ For buildings up to six stories tall, wet all exterior surfaces of buildings during demolition. ▪ Limit or expeditiously remove the accumulation of mud or dirt from adjacent public streets at a minimum of once daily, using a vacuum type sweeper. ▪ After the addition of materials to or the removal of materials from the surface or outdoor storage piles, apply sufficient water or a chemical stabilizer/suppressant.
AQ-IAMF#2: Selection of Coatings	During construction, the contractor would use: ▪ Low-VOC paint that contains less than 10 percent of VOC contents (VOC, 10%). ▪ Super-compliant or Clean Air paint that has a lower VOC content than that required by Bay Area Air Quality Management District Regulation 8, Rule 3, when available. If not available, the contractor would document the lack of availability, recommend alternative measure(s) to comply with Regulation 8, Rule 3 or disclose absence of measure(s) for full compliance, and obtain concurrence from the Authority.

IAMF	Description
AQ-IAMF#3: Renewable Diesel	During construction, the contractor would use renewable diesel fuel to minimize and control exhaust emissions from all heavy-duty off-road diesel-fueled construction equipment and on-road diesel trucks. Renewable diesel must meet the most recent ASTM D975 specification for Ultra Low Sulfur Diesel and have a carbon intensity no greater than 50 percent of diesel with the lowest carbon intensity among petroleum diesel fuels sold in California. The contractor would provide the Authority with monthly and annual reports, through the EMMA system, of renewable diesel purchase records and equipment and vehicle fuel consumption. Exemptions to use traditional diesel can be made where renewable diesel is not available from suppliers within 200 miles of the project site. The construction contract must identify the quantity of traditional diesel purchased and fully document the availability and price of renewable diesel to meet project demand.
AQ-IAMF#4: Reduce Criteria Exhaust Emissions from Construction Equipment	Prior to issuance of construction contracts, the Authority would incorporate the following construction equipment exhaust emissions requirements into the contract specifications: ▪ All heavy-duty off-road construction diesel equipment used during the construction phase would meet Tier 4 engine requirements. ▪ A copy of each unit's certified tier specification and any required CARB or air pollution control district operating permit would be made available to the Authority at the time of mobilization of each piece of equipment. ▪ The contractor would keep a written record (supported by equipment-hour meters where available) of equipment usage during project construction for each piece of equipment. ▪ The contractor would provide the Authority with monthly reports of equipment operating hours (through the EMMA system) and annual reports documenting compliance.
AQ-IAMF#5: Reduce Criteria Exhaust Emissions from On-Road Construction Equipment	Prior to issuance of construction contracts, the Authority would incorporate the following material-hauling truck fleet mix requirements into the contract specifications: ▪ All on-road trucks used to haul construction materials, including fill, ballast, rail ties, and steel, would consist of an average fleet mix of equipment model year 2010 or newer, but no less than the average fleet mix for the current calendar year as set forth in the CARB's EMFAC2014 database. ▪ The contractor would provide documentation to the Authority of efforts to secure such a fleet mix. ▪ The contractor would keep a written record of equipment usage during project construction for each piece of equipment and provide the Authority with monthly reports of VMT (through EMMA) and annual reports documenting compliance

ASTM = American Society for Testing and Materials
Authority = California High Speed Rail Authority
CARB = California Air Resources Board
EMMA = Environmental Mitigation Management and Assessment
mph = miles per hour
USEPA = U.S. Environmental Protection Agency
VMT = vehicle miles traveled
VOC = volatile organic compound

3 LAWS, REGULATIONS, AND ORDERS

This chapter provides a summary of federal, state, and local laws, regulations, and orders that regulate air quality and GHG and that apply to the Project Section.

Air pollution is a general term that refers to one or more chemical substances that degrade the quality of the atmosphere. Air pollutants degrade the atmosphere by reducing visibility, damaging property, and combining to form smog. Air pollutants result in effects on humans by reducing the productivity or vigor of crops or natural vegetation, and by reducing human or animal health. *Air quality* describes the amount of air pollution to which the public is exposed.

The U.S. Environmental Protection Agency (USEPA) is responsible for establishing the national ambient air quality standards (NAAQS), enforcing the CAA (42 United States Code [U.S.C.] § 7401), and regulating transportation-related emission sources, such as aircraft, ships, and certain types of locomotives, under the exclusive authority of the federal government. The USEPA also establishes vehicular emission standards, including those for vehicles sold in states other than California. Automobiles sold in California must meet stricter emission standards established by the California Air Resources Board (CARB).

3.1 Federal

3.1.1 Clean Air Act (42 U.S.C. § 7401) and National Ambient Air Quality Standards

The CAA defines nonattainment areas as geographic regions designated as not meeting one or more of the NAAQS, which are standards that the USEPA has established for six major air pollutants, known as criteria pollutants. It requires that a state implementation plan (SIP) be prepared for each nonattainment area and a maintenance plan be prepared for each former nonattainment area that subsequently demonstrates compliance with the standards. A SIP is a compilation of a state's air quality control plans and rules, approved by the USEPA. Section 176(c) of the CAA provides that federal agencies cannot engage, support, or provide financial assistance for licensing, permitting, or approving any project unless the project conforms to the applicable SIP. The state's and USEPA's goals are to eliminate or reduce the severity and number of violations of the NAAQS and to achieve expeditious attainment of these standards.

The six major criteria pollutants subject to the NAAQS are ozone (O_3), particulate matter (PM) (PM_{10} is PM 10 microns or less in diameter, and $PM_{2.5}$ is PM 2.5 microns or less in diameter), CO, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead (Pb) (Table 3-1). The California ambient air quality standards (CAAQS) are statewide standards established by the CARB that are generally more stringent than the NAAQS and incorporate additional standards for sulfates, hydrogen sulfide, vinyl chloride, and visibility-reducing particles. California's regulations are discussed in more detail in Section 3.2, State.

Chapter 4 summarizes state and federal standards by pollutant. Chapter 4 also shows the standards for each pollutant by averaging time and the method of measurement. The primary standards are intended to protect public health. The secondary standards are intended to protect the nation's welfare and account for air pollutant effects on soil, water, visibility, materials, vegetation, and other aspects of the general welfare.

Table 3-1 State and Federal Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards [1]		National Standards [2]		
		Concentration [3]	Method [4]	Primary [3,5]	Secondary [3,6]	Method [7]
Ozone (O_3)[8]	1 hour	0.09 ppm (180 µg/m^3)	Ultraviolet photometry	—	Same as primary standard	Ultraviolet photometry
	8 hour	0.070 ppm (137 µg/m^3)		0.070 ppm (137 µg/m^3)		
Respirable particulate matter (PM_{10})[9]	24 hour	50 µg/m^3	Gravimetric or Beta Attenuation	150 µg/m^3	Same as primary standard	Inertial separation and gravimetric analysis
	Annual arithmetic mean	20 µg/m^3		—		
Fine particulate matter ($PM_{2.5}$)[9]	24 hour	—	—	35 µg/m^3	Same as primary standard	Inertial separation and gravimetric analysis
	Annual arithmetic mean	12 µg/m^3	Gravimetric or Beta Attenuation	12.0 µg/m^3	15 µg/m^3	
Carbon monoxide (CO)	1 hour	20 ppm (23 mg/m^3)	Non-dispersive infrared photometry	35 ppm (40 mg/m^3)	—	Non-dispersive infrared photometry
	8 hour	9.0 ppm (10 mg/m^3)		9 ppm (10 mg/m^3)	—	
	8 hour (Lake Tahoe)	6 ppm (7 mg/m^3)		—	—	
Nitrogen dioxide (NO_2)[10]	1 hour	0.18 ppm (339 µg/m^3)	Gas phase chemiluminescence	100 ppb (188 µg/m^3)	—	Gas phase chemiluminescence
	Annual arithmetic mean	0.030 ppm (57 µg/m^3)		0.053 ppm (100 µg/m^3)	Same as primary standard	
Sulfur dioxide (SO_2)[11]	1 hour	0.25 ppm (655 µg/m^3)	Ultraviolet fluorescence	75 ppb (196 µg/m^3)	—	Ultraviolet fluorescence; spectrophotometry (pararosaniline method)
	3 hour	—		—	0.5 ppm (1300 µg/m^3)	
	24 hour	0.04 ppm (105 µg/m3)		0.14 ppm (for certain areas)[11]	—	
	Annual arithmetic mean	—		0.030 ppm (for certain areas)[11]	—	

Pollutant	Averaging Time	California Standards [1]		National Standards [2]		
		Concentration [3]	Method [4]	Primary [3,5]	Secondary [3,6]	Method [7]
Lead (Pb)[12,13]	30 day average	1.5 µg/m³	Atomic absorption	—	—	High Volume Sampler and Atomic Absorption
	Calendar Quarter	—		1.5 µg/m³ (for certain areas)[12]	Same as Primary Standard	
	Rolling 3-Month Average	—		0.15 µg/m³		
Visibility-reducing particles[14]	8 hour	See footnote 14	Beta attenuation and transmittance through filter tape	No national standards		
Sulfates	24 Hour	25 µg/m³	Ion Chromatography			
Hydrogen sulfide	1 hour	0.03 ppm (42 µg/m³)	Ultraviolet fluorescence			
Vinyl chloride[12]	24 hour	0.01 ppm (26 µg/m³)	Gas chromatography			

Source: CARB 2016a
°C = degrees Celsius
µg/m³ = micrograms of pollutant per cubic meter of air
CAAQS = California ambient air quality standards
CARB = California Air Resources Board
mg/m³ = milligrams of pollutant per cubic meter of air
NAAQS = national ambient air quality standards
ppb = parts per billion
ppm = parts per million
TAC = toxic air contaminants
USEPA = U.S. Environmental Protection Agency
— = no standard
[1] California standards for O_3, CO (except 8-hour Lake Tahoe), sulfur dioxide (1 and 24 hour), nitrogen dioxide, and particulate matter (PM_{10}, $PM_{2.5}$, and visibility-reducing particles) are values that are not to be exceeded. All others are not to be equaled or exceeded. CAAQS are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations
[2] National standards (other than O_3, PM, and those based on annual arithmetic mean) are not to be exceeded more than once per year. The O_3 standard is attained when the fourth highest 8-hour concentration measured at each site in a year, averaged over 3 years, is equal to or less than the standard. For PM_{10}, the 24-hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 µg/m³ is equal to or less than 1. For $PM_{2.5}$, the 24-hour standard is attained when 98 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. Contact the USEPA for further clarification and current national policies.
[3] Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.
[4] Any equivalent measurement method which can be shown to the satisfaction of the CARB to give equivalent results at or near the level of the air quality standard may be used.
[5] National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.
[6] National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated effects of a pollutant.
[7] Reference method as described by the USEPA. An "equivalent method" of measurement may be used but must have a "consistent relationship to the reference method" and must be approved by the USEPA.
[8] On October 1, 2015, the national 8-hour O_3 primary and secondary standards were decreased from 0.075 to 0.070 ppm.

[9] On December 14, 2012, the national annual $PM_{2.5}$ primary standard was decreased from 15 µg/m^3 to 12.0 µg/m^3. The existing national 24-hour $PM_{2.5}$ standards (primary and secondary) were retained at 35 µg/m^3, as was the annual secondary standard of 15 µg/m^3. The existing 24-hour PM_{10} standards (primary and secondary) of 150 µg/m^3 also were retained. The form of the annual primary and secondary standards is the annual mean, averaged over 3 years.
[10] To attain the 1-hour national standard, the 3-year average of the annual 98th percentile of the 1-hour daily maximum concentrations at each site must not exceed 100 ppb. Note that the national 1-hour standard is in units of ppb. California standards are in units of ppm. To directly compare the national 1-hour standard to the California standards, the units can be converted from ppb to ppm. In this case, the national standard of 100 ppb is identical to 0.100 ppm.
[11] On June 2, 2010, a new 1-hour SO_2 standard was established and the existing 24-hour and annual primary standards were revoked. To attain the 1-hour national standard, the 3-year average of the annual 99th percentile of the 1-hour daily maximum concentrations at each site must not exceed 75 ppb. The 1971 SO_2 national standards (24-hour and annual) remain in effect until 1 year after an area is designated for the 2010 standard, except that in areas designated nonattainment for the 1971 standards, the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standards are approved. Note that the 1-hour national standard is in units of ppb. California standards are in units of ppm. To directly compare the 1-hour national standard to the California standard, the units can be converted to ppm. In this case, the national standard of 75 ppb is identical to 0.075 ppm.
[12] The CARB has identified Pb and vinyl chloride as TAC with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.
[13] The national standard for Pb was revised on October 15, 2008, to a rolling 3-month average. The 1978 Pb standard (1.5 µg/m^3 as a quarterly average) remains in effect until 1 year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.
[14] In 1989, the CARB converted both the general statewide 10-mile visibility standard and the Lake Tahoe 30-mile visibility standard to instrumental equivalents, which are “extinction of 0.23 per kilometer” and “extinction of 0.07 per kilometer” for the statewide and Lake Tahoe Air Basin standards, respectively.

3.1.2 Conformity Rule

Pursuant to CAA Section 176(c) requirements, the USEPA promulgated 40 C.F.R. Part 51, Subpart W and 40 C.F.R. Part 93B, Determining Conformity of General Federal Actions to State or Federal Implementation Plans (§ 63214) (November 30, 1993) as amended; 75 *Federal Register* (Fed. Reg.) 17253 (April 5, 2010). These regulations, commonly referred to as the General Conformity Rule, apply to all federal actions, including FRA actions on the HSR System. Federal actions that are excluded from review (e.g., stationary emission sources that hold permits under the federal New Source Review program) or related to transportation plans, programs, and projects under the Federal Highway Act (Title 23 U.S.C.) or the Federal Transit Act (Title 49 U.S.C.) are not subject to general conformity. Transportation actions under Title 23 or Title 49 are subject to transportation conformity (40 C.F.R. Part 51T and 40 C.F.R. Part 93A). 40 C.F.R. Part 51, Subpart W, applies in states that have an approved SIP revision adopting the General Conformity Rule.

The General Conformity Rule is used to determine if federal actions meet the requirements of the CAA and the applicable SIP by ensuring that air emissions related to the action do not result in the following outcomes:

- Cause or contribute to new violations of a NAAQS
- Increase the frequency or severity of any existing violation of a NAAQS
- Delay timely attainment of a NAAQS or interim emission reduction

A conformity determination under the General Conformity Rule is required if the federal agency determines that all of the following criteria apply:

- The action will occur in a nonattainment or maintenance area
- One or more specific exemptions do not apply to the action
- The action is not included in the federal agency's "presumed to conform" list[5]
- The emissions from the proposed action are not within the approved emissions budget for an applicable facility
- The total direct and indirect emissions[6] of a pollutant (or its precursors) are at or above the *de minimis* levels established in the General Conformity Rule (40 C.F.R. § 93.153(b)).

Conformity regulatory criteria are listed in 40 C.F.R. Section 93.158. The evaluation of direct and indirect emissions is performed by comparing the change in annual emissions attributable to the project to the applicable *de minimis* emissions level. An action would be determined to conform to the applicable SIP if, for each pollutant that exceeds the *de minimis* emissions level in 40 C.F.R. Section 93.153(b), or otherwise requires a conformity determination because of the total of direct and indirect emissions from the action, the action meets the requirements of 40 C.F.R. Section 93.158(c).

In addition, federal activities may not cause or contribute to new violations of air quality standards, exacerbate existing violations, or interfere with timely attainment or required interim emissions reductions toward attainment. The project is subject to review under the General Conformity Rule.

[5] Category of activities designated by a federal agency as having emissions below *de minimis* levels or otherwise do not interfere with the applicable SIP or the attainment and maintenance of the NAAQS.

[6] As defined in the General Conformity Rule (40 C.F.R. § 93.152), "*direct emissions* means those emissions of a criteria pollutant or its precursors that are caused or initiated by the federal action and originate in a nonattainment or maintenance area and occur at the same time and place as the action and are reasonably foreseeable." "*Indirect emissions* means those emissions of a criteria pollutant or its precursors (1) that are caused or initiated by the federal action and originate in the same nonattainment or maintenance area but occur at a different time or place as the action; (2) that are reasonably foreseeable; (3) that the agency can practically control; and (4) for which the agency has continuing program responsibility."

3.1.3 Mobile Source Air Toxics/Hazardous Air Pollutants

In addition to the NAAQS criteria pollutants, the USEPA regulates MSATs. MSATs are compounds emitted from highway vehicles and nonroad equipment that are known or suspected to cause cancer or other serious health and environmental effects. MSATs are a subset of USEPA-designated hazardous air pollutants (HAP). In February 2007, the USEPA finalized a rule (Control of Hazardous Air Pollutants from Mobile Sources, February 9, 2007) to reduce emissions of HAPs from mobile sources. The rule limits the benzene content of gasoline and reduces toxic emissions from passenger vehicles and portable fuel containers (e.g., hand-held gas cans). The USEPA estimates that in 2030 this rule would reduce total emissions of MSATs by 330,000 tons and volatile organic compound (VOC) emissions (precursors to O_3 and $PM_{2.5}$) by more than 1 million tons. The latest revision to this rule, which added specific benzene control technologies, occurred in October 2008. No NAAQS or CAAQS exist for MSATs. Specifically, the USEPA has not established NAAQS or provided ambient standards for HAPs.

On October 18, 2016, the FHWA released *Updated Interim Guidance on Mobile Source Air Toxic Analysis in NEPA Documents,* which superseded the February 2006 interim guidelines. The FHWA's guidance advises when and how to analyze MSATs in the NEPA environmental review process for highways and other transportation-related projects. This guidance was followed to define the MSAT analysis for the project.

By 2010, the USEPA's existing programs had reduced MSATs by more than 1 million tons from 1999 levels (USEPA 2015a). In addition to controlling pollutants such as hydrocarbons, PM, and nitrogen oxides (NO_X), recent USEPA regulations controlling emissions from highway vehicles and nonroad equipment will result in large reductions in toxic emissions to the air. The USEPA is developing programs that would provide additional benefits (further controls) for small non-road gasoline engines, diesel locomotives, and marine engines. Several USEPA programs reduce risk in communities. These programs include Clean School Bus USA, the Voluntary Diesel Retrofit Program, Best Workplaces for Commuters, and the National Clean Diesel Campaign.

3.1.4 Federal Greenhouse Gas Regulations and Guidance

Climate change and GHG emission reductions are a concern at the federal level. Laws, regulations, plans, and policies address global climate change issues. This section summarizes key federal regulations relevant to the project.

In *Massachusetts v. U.S. Environmental Protection Agency, et al.*, 549 U.S. 497 (2007), the United States Supreme Court ruled that GHGs fit within the CAA's definition of air pollutants and that the USEPA has the authority to regulate GHGs.

On September 22, 2009, the USEPA published the Final Rule that requires mandatory reporting of GHG emissions from large sources in the U.S. The rule amends CAA Regulations under 40 C.F.R. Parts 86, 87, 89, 90, and 94 and provides a new section, Part 98. The USEPA uses the reports to collect accurate and comprehensive emissions data that can inform future policy decisions. Facilities that emit 25,000 metric tons or more per year of GHG emissions must submit annual reports to the USEPA under Subpart C of the final rule. The final rule covers the GHGs carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride (SF_6), and other fluorinated gases, including nitrogen trifluoride and hydrofluorinated ethers. This is not a transportation-related regulation. However, the methodology developed as part of this regulation is helpful in identifying potential GHG emissions.

On October 5, 2009, President Obama signed U.S. Presidential Executive Order (USEO) 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*. USEO 13514 requires federal agencies to set a 2020 GHG emission-reduction target within 90 days, increase energy efficiency, reduce fleet petroleum consumption, conserve water, reduce waste, support sustainable communities, and leverage federal purchasing power to promote environmentally responsible products and technologies. On December 7, 2009, the *Final Endangerment and Cause or Contribute Findings for Greenhouse Gases* under Section 202(a) of the CAA went into effect. The endangerment finding states that current and projected concentrations of the six key well-mixed GHGs in the atmosphere—CO_2, CH_4, N_2O, hydrofluorocarbons, perfluorocarbons, and SF_6—threaten the public health and welfare of current and future generations. Furthermore, it states that the combined emissions of these well-mixed GHGs from new motor vehicles and new motor vehicle engines contribute to the GHG pollution that threatens public health and welfare (USEPA 2015b).

Based on the endangerment finding, the USEPA revised vehicle emission standards under the CAA. On September 15, 2011, the USEPA and the National Highway Traffic Safety Administration (NHTSA)issued a final rule of *Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles* (76 Fed. Reg. 7106). This final rule is tailored to each of three regulatory categories of heavy-duty vehicles—combination tractors, heavy-duty pickup trucks and vans, and vocational vehicles—and applies to model years 2014–2018. The USEPA and NHTSA estimated that the new standards in this rule will reduce CO_2 emissions by approximately 270 million metric tons (MMT) and save 530 million barrels of oil over the life of vehicles sold during the 2014–2018 model years. The USEPA and NHTSA signed Phase 2 of these standards on August 16, 2016, which apply to model years 2019–2027 medium- and heavy-duty vehicles. The USEPA and NHTSA have determined that the Phase 2 standards would lower CO_2 emissions by approximately 1.1 billion metric tons and save up to 2 billion barrels of oil over the life of vehicles regulated under the program (USEPA 2016a).

The USEPA and NHTSA issued a joint final rulemaking to update the Corporate Average Fuel Economy fuel standards on October 15, 2012 (77 Fed. Reg. 62623), requiring substantial improvements in fuel economy and reductions in GHG emissions for all light-duty vehicles sold in the United States. The new standards apply to new passenger cars, light-duty trucks, and medium-duty passenger vehicles, covering model years 2017–2025. The USEPA GHG standards require that these vehicles meet an estimated combined average emissions level of 163 grams of CO_2 per mile in model year 2025, which would be equivalent to 54.5 miles per gallon if the automotive industry were to meet this CO_2 level entirely through fuel economy improvements.

To further California's support of the national program to regulate emissions, the CARB submitted a proposal that would allow automobile manufacturer compliance with the USEPA's requirements to show compliance with California's requirements for the same model years. The Final Rulemaking Package was filed on December 6, 2012, and the final rulemaking became effective December 31, 2012. In July 2016, the USEPA, NHTSA, and CARB released a mid-term evaluation of the October 2012 final rule in a draft technical assessment report (USEPA et al. 2016). The draft technical assessment report makes the following conclusions:

- A wider range of technologies exists for manufacturers to meet the model year 2022–2025 standards, and at costs that are similar or lower, than those projected in the 2012 rule.
- Advanced gasoline vehicle technologies will continue to be the predominant technologies, with modest levels of strong hybridization and very low levels of full electrification (plug-in vehicles) needed to meet the standards.
- The car/truck mix reflects updated consumer trends that are informed by a range of factors including economic growth, gasoline prices, and other macro-economic trends. However, as the standards were designed to yield improvements across the light-duty vehicle fleet, irrespective of consumer choice, updated trends are fully accommodated by the footprint-based standards.
- On August 2, 2018, the NHTSA and USEPA proposed to amend the fuel efficiency standards for passenger cars and light trucks and establish new standards covering model years 2021 through 2026 by maintaining the current model year 2020 standards through 2026 (Safer Affordable Fuel-Efficient Vehicles Rule). On September 19, 2019, USEPA and NHTSA issued a final action on the One National Program Rule, which is considered to be the first part of the Safer Affordable Fuel-Efficient Vehicles Rule and a precursor to the proposed fuel efficiency standards. The One National Program Rule enables USEPA and NHTSA to issue nationwide uniform fuel economy and GHG vehicle

standards, specifically by (1) clarifying that federal law preempts state and local tailpipe GHG standards, (2) affirming NHTSA's statutory authority to set nationally applicable fuel economy standards, and (3) withdrawing California's CAA preemption waiver to set state-specific standards.

USEPA and NHTSA published their decisions to withdraw California's waiver and finalize regulatory text related to the preemption on September 27, 2019 (84 Fed. Reg. 51310). The agencies also announced that they will publish the second part of the Safer Affordable Fuel-Efficient Vehicles Rule (i.e., the standards) in October 2019. California, 22 other states, the District of Columbia, and two cities filed suit against the proposed One National Program Rule on September 20, 2019 *(California et al. v. United States Department of Transportation et al.*, 1:19-cv-02826). The lawsuit requests "permanent injunction prohibiting Defendants from implementing or relying on the Preemption Regulation." The fate of the One National Program Rule and Safer Affordable Fuel-Efficient Vehicles Rule remains uncertain in the face of pending litigation.

The White House Council on Environmental Quality (CEQ) released final guidance regarding the consideration of GHGs in NEPA documents for federal actions in August 2016 (CEQ 2016). On April 25, 2017, CEQ withdrew the final guidance pursuant to USEO 13783, but noted "the withdrawal of the guidance does not change any law, regulation, or other legally binding requirement (82 Fed. Reg. 16576)." CEQ released new draft guidance on June 26, 2019, which, if finalized, would replace the withdrawn August 2016 guidance (84 Fed. Reg. 30097). The June 2019 guidance directs federal agencies to analyze the direct, indirect, and cumulative impacts of a proposed action's GHG emissions, when doing so is practicable and not overly speculative, as well as consider the impacts of climate change on the project.

3.2 State

3.2.1 California Clean Air Act and California Ambient Air Quality Standards

The California Clean Air Act requires that nonattainment areas achieve and maintain the health-based CAAQS by the earliest practicable date. The act is administered by the CARB at the state level and by local air quality management districts at the regional level. The air districts are required to develop plans and control programs for attaining the state standards.

The CARB is responsible for ensuring implementation of the California Clean Air Act, meeting state requirements of the federal CAA, and establishing the CAAQS. The CARB is also responsible for setting emission standards for vehicles sold in California and for other emission sources, such as consumer products and certain off-road equipment. The CARB also establishes passenger vehicle fuel specifications.

3.2.2 Mobile Source Air Toxics/Toxic Air Contaminants

California regulates TACs (equivalent to the federal HAPs) primarily through the Toxic Air Contaminant Identification and Control Act (Tanner Act) and the Air Toxics "Hot Spots" Information and Assessment Act of 1987 (Hot Spots Act). The Tanner Act created California's program to reduce exposure to air toxics. The Hot Spots Act supplements the Tanner Act by requiring a statewide air toxics inventory, notification of people exposed to a significant health risk, and facility plans to reduce these risks.

In August 1998, the CARB identified diesel particulate matter (DPM) from diesel-fueled engines as a TAC. In September 2000, the CARB approved a comprehensive diesel risk reduction plan to reduce emissions from both new and existing diesel-fueled engines and vehicles. The goal of the plan was to reduce DPM (respirable particulate matter) emissions and the associated health risk by 75 percent in 2010 and by 85 percent by 2020. The plan identifies 14 measures that target new and existing on-road vehicles (e.g., heavy-duty trucks and buses), off-road equipment (e.g., graders, tractors, forklifts, sweepers, and boats), portable equipment (e.g., pumps), and stationary engines (e.g., stand-by power generators).

The CARB has adopted regulations to reduce emissions from both on-road and off-road heavy-duty diesel vehicles (e.g., equipment used in construction). These regulations, known as airborne toxic control measures, reduce the idling of school buses and other commercial vehicles, control DPM, and limit the emissions of ocean-going vessels in California waters. The regulations also include measures to control emissions of air toxics from stationary sources. The California Toxics Inventory, developed by interpolating from CARB estimates of total organic gases and PM, provides emissions estimates by stationary, area-wide, on-road mobile, off-road mobile, and natural sources (CARB 2016b).

3.2.3 California Greenhouse Gas Regulations and Guidance

California has taken proactive steps, briefly described in this section, to address the issues associated with GHG emissions and climate change.

3.2.3.1 Assembly Bill 1493

With the passage of Assembly Bill (AB) 1493 in 2002, California launched an innovative and proactive approach to dealing with GHG emissions and climate change at the state level. AB 1493 requires the CARB to develop and implement regulations to reduce automobile and light-truck GHG emissions. These stricter emissions standards were designed to apply to automobiles and light trucks beginning with the model year 2009. Although litigation challenged these regulations and the USEPA initially denied California's related request for a waiver, the waiver request was granted (CARB 2015).

3.2.3.2 Executive Order S-3-05

On June 1, 2005, Governor Arnold Schwarzenegger signed California Executive Order (EO) S-3-05. The goal of this EO was to reduce California's GHG emissions to (1) 2000 levels by 2010; (2) 1990 levels by 2020; and (3) 80 percent below the 1990 levels by 2050. EO S-3-05 also calls for the California Environmental Protection Agency to prepare biennial science reports on the potential impact of continued global warming on certain sectors of the California economy. As a result of the scientific analysis presented in these biennial reports, a comprehensive climate adaptation strategy was released in December 2009 following extensive interagency coordination and stakeholder input. The latest of these reports, Climate Action Team Biennial Report, was published in December 2010 (California Environmental Protection Agency [Cal-EPA] 2010).

3.2.3.3 Assembly Bill 32

One goal of EO S-03-05 was further reinforced by AB 32 (Chapter 488, Statutes of 2006), the Global Warming Solutions Act of 2006, which requires the state to reduce GHG emissions to 1990 levels by 2020. AB 32 mandates that the CARB create a plan that includes market mechanisms and implement rules to achieve "real, quantifiable, cost-effective reductions of GHGs." Separately, Governor Schwarzenegger signed EO S-20-06, which directs state agencies to begin implementing AB 32, including the recommendations made by the State's Climate Action Team.

The following are specific requirements of AB 32:

- The CARB will prepare and approve a scoping plan for achieving the maximum technologically feasible and cost-effective reductions in GHG emissions from sources or categories of sources of GHGs by 2020 (Cal. Health and Safety Code § 38561). The scoping plan, approved by the CARB on December 12, 2008, and updated in 2014 and 2017, provides the outline for future actions to reduce GHG emissions in California via regulations, market mechanisms, and other measures. The scoping plan includes the implementation of the HSR system as a GHG reduction measure, estimating a 2020 reduction of 1 MMT of CO_2 equivalent (CO_2e).
- The CARB will identify the statewide level of GHG in 1990 to serve as the emissions limit to be achieved by 2020 (Cal. Health and Safety Code § 38550). In December 2007, the CARB approved the 2020 emission limit of 427 MMT of CO_2e of GHG.
- The CARB will adopt a regulation requiring the mandatory reporting of GHG emissions (Cal. Health and Safety Code § 38530). In December 2007, the CARB adopted a

regulation requiring the largest industrial sources to report and verify their GHG emissions. The reporting regulation serves as a solid foundation to determine GHG emissions and track future changes in emission levels.

3.2.3.4 Executive Order S-01-07

With EO S-01-07, Governor Schwarzenegger set forth the low carbon fuel standard for California in 2007. Under this EO, the carbon intensity of California's transportation fuels is to be reduced by at least 10 percent by 2020 (Office of the Governor 2007).

3.2.3.5 California Environmental Quality Act Guidelines Amendments to Address Greenhouse Gas Emissions

The State CEQA Guidelines amendments of December 30, 2009, specifically require lead agencies to address GHG emissions in determining the significance of environmental effects caused by a project, and to consider feasible means to mitigate the significant effects of GHG emissions. The following provisions of the State CEQA Guidelines amendments pertain to addressing GHG emissions (California Natural Resources Agency 2009).

- A lead agency may consider the following when assessing the significance of effects from GHG emissions:
  - The extent to which the project may increase or reduce GHG emissions as compared to the existing environmental setting
  - Whether the project emissions exceed a threshold of significance that the lead agency determines applies to the project
  - The extent to which the project complies with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of GHG emissions
- When an agency makes a statement of overriding considerations, the agency may consider adverse environmental effects in the context of region-wide or statewide environmental benefits.
- Lead agencies will consider feasible means of mitigating GHG emissions that may include, but not be limited to, the following:
  - Measures in an existing plan or mitigation program for the reduction of emissions that are required as part of the lead agency's decision.
  - Reductions in emissions resulting from a project through implementation of project features, project design, or other measures.
  - Off-site measures, including offsets.
  - Measures that sequester GHGs
- In the case of the adoption of a plan (e.g., general plan, long-range development plan, or GHG reduction plan), mitigation may include specific measures that may be implemented on a project-by-project basis. Mitigation may also incorporate specific measures or policies found in an adopted ordinance or regulation that reduces the cumulative effect of emissions.

3.2.3.6 Senate Bill 375

Senate Bill (SB) 375, signed into law by Governor Schwarzenegger on September 30, 2008, became effective January 1, 2009. This law requires the state's 18 metropolitan planning organizations to develop the sustainable communities strategies as part of their regional transportation plans (RTP) through integrated land use and transportation planning, and to demonstrate an ability to attain the GHG emissions reduction targets that the CARB established for the region by 2020 and 2035. This would be accomplished through either the financially constrained sustainable communities strategies as part of the RTP or an unconstrained alternative planning strategy. If regions develop integrated land use, housing, and transportation plans that meet the SB 375 targets, new projects in these regions can be relieved of certain CEQA review requirements.

In accordance with SB 375, the CARB appointed the Regional Targets Advisory Committee on January 23, 2009, to provide recommendations on factors to be considered and methodologies to be used in the CARB's target setting process. The Regional Targets Advisory Committee was required to provide its recommendations in a report to the CARB by September 30, 2009, to include any relevant issues such as data needs, modeling techniques, growth forecasts, jobs-housing balance, interregional travel, various land use/transportation issues affecting GHG emissions, and overall issues relating to setting these targets. The CARB adopted final targets on September 23, 2010. The CARB must update the regional targets every 8 years (or 4 years if it so chooses) consistent with each metropolitan planning organization's update of its RTP. The targets were last revised in March 2018.

3.2.3.7 Executive Order B-30-15

Governor Jerry Brown signed EO B-30-15 on April 29, 2015. This EO establishes a GHG reduction target of 40 percent below 1990 levels by 2030 in the state. As of July 2016, California was on track to meet or exceed the target of reducing GHG to 1990 levels by 2020, which was previously established in the California Global Warming Solutions Act of 2006 (AB 32). The state's new emission reduction target will make it possible to reach its overall goal of reducing emissions 80 percent under 1990 levels by 2050 (Office of the Governor 2015). EO B-30-15 established a medium-term goal for 2030 of reducing GHG emissions by 40 percent below 1990 levels and requires the CARB to update its current AB 32 Scoping Plan to identify measures to meet the 2030 target. The EO B-30-15 supports EO S-3-05, but currently is only binding on state agencies.

3.2.3.8 Senate Bill 32 and Assembly Bill 197

SB 32 requires the CARB to verify that statewide GHG emissions are reduced to at least 40 percent below the 1990 level by 2030, consistent with the target set forth in EO B-30-15. AB 197 creates requirements to form the Joint Legislative Committee on Climate Change Policies, requires the CARB to prioritize direct emission reductions and consider social costs when adopting regulations to reduce GHG emissions beyond the 2020 statewide limit, requires the CARB to prepare reports on sources of GHGs and other pollutants, establishes 6-year terms for voting members of the CARB, and adds two legislators as nonvoting members of the CARB. Both bills were signed by Governor Brown on September 8, 2016. CARB adopted a 2017 Scoping Plan update to assess pathways to meet the SB 32 goal.

3.2.3.9 Senate Bill 100

The state's existing renewables portfolio standard requires all retail sellers to procure a minimum quantity of electricity products from eligible renewable energy resources so that the total kilowatt-hours of those products sold to their retail end-use customers achieve 25 percent of retail sales by December 31, 2016 (achieved), 33 percent by December 31, 2020, 40 percent by December 31, 2024, 45 percent by December 31, 2027, and 50 percent by December 31, 2030. SB 100 revises and extends these renewable resource targets to 50 percent by December 31, 2026, 60 percent December 31, 2030, and 100 percent by December 31, 2045.

3.2.3.10 Executive Order B-55-18

EO B-55-18 acknowledges the environmental, community, and public health risks posed by future climate change. It further recognizes the climate stabilization goal adopted by 194 states and the European Union under the Paris Agreement. While the United States was not party to the agreement, California is committed to meeting the Paris Agreement goals and going beyond them wherever possible. Based on the worldwide scientific agreement that carbon neutrality must be achieved by midcentury, EO B-55-18 establishes a new state goal to achieve carbon neutrality as soon as possible and no later than 2045, and to achieve and maintain net negative emissions thereafter. The EO charges the CARB with developing a framework for implementing and tracking progress towards these goals. EO B-55-18 extends EO S-3-05 but is only binding on state agencies.

3.2.4 California Asbestos Control Measures

The CARB has adopted two airborne toxic control measures for controlling naturally occurring asbestos (NOA): the *Asbestos Airborne Toxic Control Measure for Surfacing Applications* (BAAQMD 2015) and the *Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations* (BAAQMD 2002). While the USEPA is responsible for enforcing regulations relating to asbestos renovations and demolitions, it can delegate this authority to state and local agencies. The CARB and local air districts have been delegated authority to enforce the Federal National Emission Standards for HAPs regulations for asbestos.

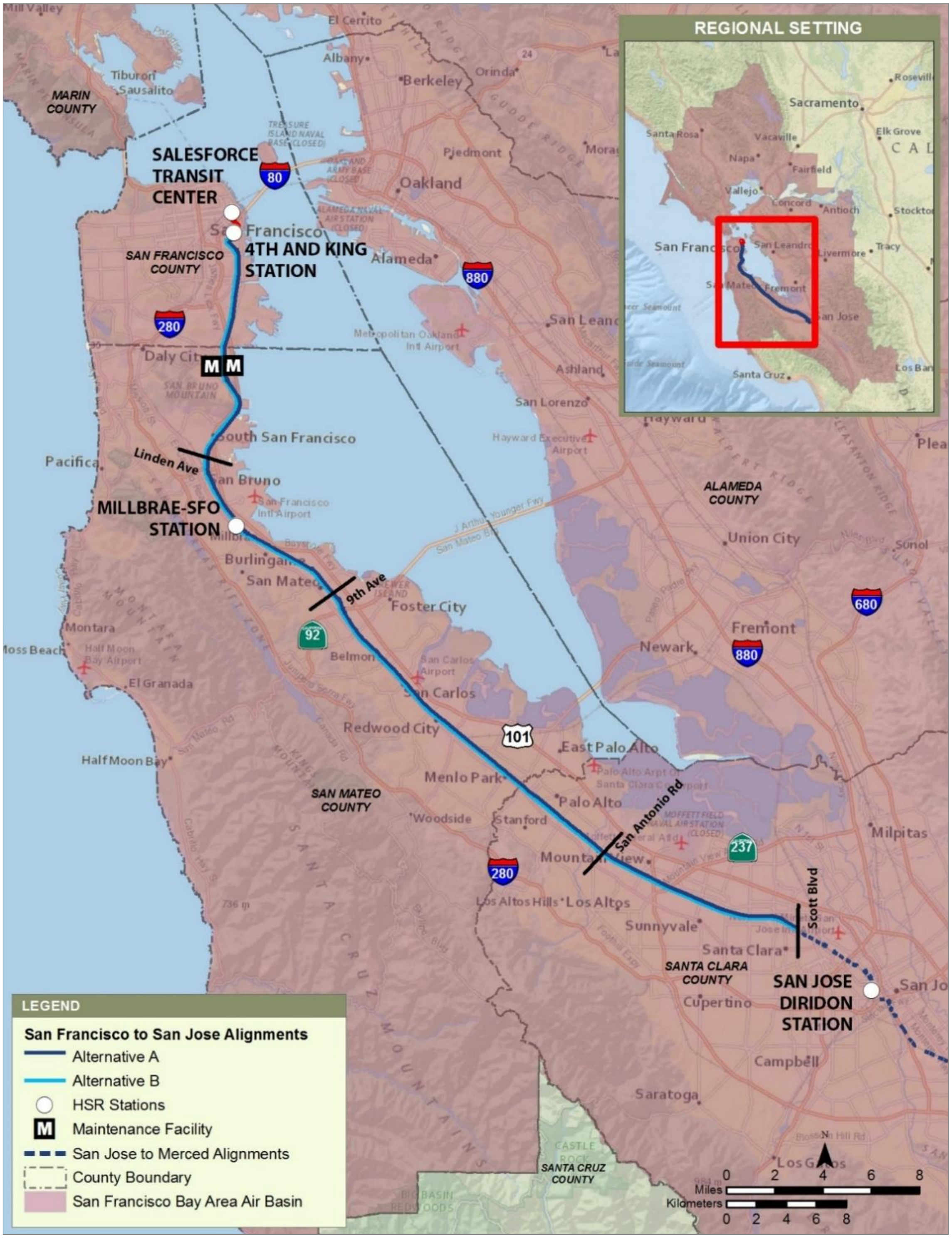
3.3 Regional and Local

3.3.1 Bay Area Air Quality Management District

The project is located in the San Francisco Bay Area Air Basin (SFBAAB), which is under the jurisdiction of the BAAQMD (Figure 3-1). The BAAQMD is responsible for the following actions:

- Implementing air quality regulations, including developing plans and control measures for stationary sources of air pollution to meet the NAAQS and CAAQS.
- Implementing permit programs for the construction, modification, and operation of sources of air pollution.
- Coordinating with local transportation planning agencies on mobile emissions inventory development, transportation control measure development and implementation, and transportation conformity.
- Enforcing air pollution statutes and regulations governing stationary sources. With CARB oversight, the BAAQMD also administers local regulations.

The BAAQMD has local air quality jurisdiction over projects in the SFBAAB. BAAQMD has adopted advisory emission thresholds to assist CEQA lead agencies in determining the level of significance of a project's emissions, which are outlined in its *California Environmental Quality Act Air Quality Guidelines* (CEQA Guidelines) (BAAQMD 2017a). The BAAQMD CEQA Guidelines outline advisory thresholds for stationary source and land use development projects. BAAQMD has also adopted air quality plans to improve air quality, protect public health, and protect the climate.



Source: Authority 2019b

MARCH 2019

Figure 3-1 Regional Air Quality Resource Study Area

The project may be subject to the following district rules. This list of rules may not be all-encompassing because additional BAAQMD rules may apply to the project as specific components are identified. There are also local city and county policies that pertain to air quality and climate change. The policies of the general plans focus on managing sources of air pollutants through mixed-use and transit- and pedestrian-friendly neighborhoods.[7]

- **Regulation 2, Rule 2 (New Source Review)**—This regulation contains requirements for best available control technology and emission offsets.
- **Regulation 2, Rule 5 (New Source Review of Toxic Air Contaminates)**—This regulation outlines guidance for evaluating TAC emissions and their potential health risks.
- **Regulation 6, Rule 1 (Particulate Matter)**—This regulation restricts emissions of PM darker than No. 1 on the Ringlemann Chart to less than 3 minutes in any 1 hour.
- **Regulation 7 (Odorous Substances)**—This regulation establishes general odor limitations on odorous substances and specific emission limitations on certain odorous compounds.
- **Regulation 8, Rule 3 (Architectural Coatings)**—This regulation limits the quantity of reactive organic gases (ROG) in architectural coatings.
- **Regulation 9, Rule 6 (Nitrogen Oxides Emission from Natural Gas-Fired Boilers and Water Heaters)**—This regulation limits emissions of NO_X generated by natural gas–fired boilers.
- **Regulation 9, Rule 8 (Stationary Internal Combustion Engines)**—This regulation limits emissions of NO_X and CO from stationary internal combustion engines of more than 50 horsepower.
- **Regulation 11, Rule 2 (Asbestos Demolition, Renovation, and Manufacturing)**—This rule controls emissions of asbestos to the atmosphere during demolition, renovation, milling, and manufacturing and establishes appropriate waste disposal procedures.

3.3.2 Metropolitan Transportation Commission

The Metropolitan Transportation Commission (MTC) serves as both the state-designated regional transportation agency and as the federally designated metropolitan planning organization for the Bay Area. Thus, it is responsible for regularly updating the RTP, a comprehensive blueprint for the development of mass transit, highway, airport, seaport, railroad, bicycle, and pedestrian facilities. The MTC also screens requests from local agencies for state and federal grants for transportation projects to determine their compatibility with the plan.

3.3.3 Association of Bay Area Governments

The Association of Bay Area Governments (ABAG) serves as a regional planning body for the Bay Area. ABAG, MTC, and BAAQMD work closely to develop long-range plans that improve the environment and standard of living through a series of measures that link land use, transportation, and air quality. ABAG is responsible for maintaining the state-mandated sustainable communities strategies, which links land use, transportation planning, and state funding. ABAG also develops demographic, economic, and project analyses for the region. ABAG also develops earthquake preparedness plans and green business development strategies, and leads the San Francisco Bay Trail planning program and the San Francisco Estuary Project.

[7] Additional details regarding the applicable rules can be found at the BAAQMD website, http://www.baaqmd.gov/rules-and-compliance/current-rules.

3.3.4 Air Quality Plans

3.3.4.1 State Implementation Plan

Federal clean air laws require areas with unhealthy levels of O_3, inhalable PM, CO, NO_2, and SO_2 to develop SIPs. SIPs are comprehensive plans that describe how an area will attain NAAQS. The 1990 amendments to the federal CAA set deadlines for attainment based on the severity of an area's air pollution problem.

SIPs are not single documents. They are a compilation of new and previously submitted plans, programs (such as monitoring, modeling, or permitting), district rules, state regulations, and federal controls. Many of California's SIPs rely on the same core set of control strategies, including emission standards for cars and heavy trucks, fuel regulations, and limits on emissions from consumer products. State law makes the CARB the lead agency for all purposes related to SIPs. Local air districts and other agencies, such as the Bureau of Automotive Repair and the Department of Pesticide Regulation, prepare SIP elements and submit them to the CARB for review and approval. The CARB forwards SIP revisions to the USEPA for approval and publication in the Fed. Reg. 40 C.F.R. Section 52.220 lists all of the items that are included in the California SIP. At any one time, several California submittals are pending USEPA approval.

The following are the relevant regional SIP and air quality plans for the SFBAAB:

- 2001 San Francisco Bay Area Ozone Attainment Plan for the 1-Hour National Ozone Standard (BAAQMD 2001)
- 2017 Clean Air Plan: Spare the Air, Cool the Climate (BAAQMD 2017b)

3.3.4.2 Transportation Plans and Programs

An RTP is a long-range plan that includes both long- and short-range strategies and actions that lead to the development of an integrated multimodal transportation system to address future transportation demand. Projects subject to transportation conformity are analyzed for air quality conformity with the SIP as components of RTPs and transportation improvement programs (TIP). RTPs address a region's growth, transportation goals, objectives, and policies for the next 25 years and identify the actions necessary to achieve those goals. TIPs provide a comprehensive listing of all surface transportation projects that are to receive federal funding, are subject to a federally required action, or are considered regionally significant for air quality conformity purposes. RTPs and TIPs relevant to the project are discussed in this section.

In the Bay Area, the MTC is responsible for preparing RTPs and TIPs. On July 26, 2017, the MTC adopted the latest RTP for the area, *Plan Bay Area 2040*, which specifies how approximately $303 billion in anticipated federal, state, and local transportation funds will be spent in the nine-county Bay Area during the next 25 years (ABAG and MTC 2017).

The TIP includes improvements for transit; local roadway, state highway, bicycle, and pedestrian facilities; and other regionally significant, locally funded transportation projects in the nine-county Bay Area. The MTC prepares and adopts the TIP every 2 years. The current 2019 TIP covers fiscal years 2018–19 through 2021–22. It contains 500 projects totaling about $13.2 billion over a 4-year period.

The MTC prepares a transportation air quality conformity analysis when it amends or updates its long-range RTP or adds or deletes regionally significant nonexempt projects into the TIP. In 2018, a conformity analysis was finalized for the *Plan Bay Area 2040* and the 2019 TIP in accordance with USEPA transportation conformity regulations and the Bay Area Conformity SIP (Bay Area Air Quality Conformity Protocol).

3.3.4.3 Regional and Local Air Quality Policies

Table 3-2 outlines the policies related to air quality and GHG from regional and local plans that were considered in the preparation of this analysis. Relevant policies from some of the RTPs are included in this table.

Table 3-2 Regional and Local Plans and Policies

Plans and Policies	Summary
Regional	
Plan Bay Area 2040 (2017)	The Association of Bay Area Governments and the Metropolitan Transportation Commission adopted *Plan Bay Area 2040* as the Bay Area's long-term regional transportation and land use blueprint in July 2017. The following targets are relevant to the project: ▪ Target #1: Reduce per-capita CO_2 emissions from cars and light-duty trucks by 15 percent. ▪ Target #3: Reduce adverse health impacts associated with air quality, road safety, and physical inactivity by 10 percent.
City and County of San Francisco	
City of San Francisco General Plan (1996, 2004)	The City and County of San Francisco adopted the *San Francisco General Plan* in 1996, with partial updates to the Environmental Protection Element in 2004. The following goals and objectives are relevant to the project: ▪ Air Quality Objective 1.1: Cooperate with regional agencies to promote air quality improvement in San Francisco which, in turn, will contribute to air quality improvements at the regional level. ▪ Air Quality Objective 1.3: Support and encourage implementation of stationary control measures established by the State. ▪ Air Quality Objective 4.3: Minimize exposure of San Francisco's population, especially children and the elderly, to air pollutants. ▪ Air Quality Objective 5.1: Continue policies to minimize particulate matter emissions during road and building construction and demolition. ▪ Air Quality Objective 5.2: Encourage the use of building and other construction materials and methods which generate minimum amounts of particulate matter during construction as well as demolition. ▪ Air Quality Objective 6.1: Encourage emission reduction through energy conservation to improve air quality. ▪ Environmental Protection Element, Air Quality Objective 4.1: Support and comply with objectives, policies, and air quality standards of BAAQMD. ▪ Environmental Protection Element, Air Quality Objective 4.3: Encourage greater use of mass transit in the downtown area and restrict the use of motor vehicles where such use would impair air quality. ▪ Environmental Protection Element, Energy Objective 15.1: Increase the use of transportation alternatives to the automobile.
Transit Center District Plan- A subarea Plan of the Downtown Plan (2012)	The City of San Francisco adopted the *Transit Center District Plan- A subarea Plan of the Downtown Plan* in 2012. The following objective is relevant to the project: ▪ Objective 4.7: The District's transportation system will further sustainability goals. Advance the goals of the City's Climate Action Plan, by reducing greenhouse gas emissions generated by vehicular transportation.
San Mateo County	
San Mateo County General Plan (2013)	The County of San Mateo adopted the *San Mateo County General Plan* in 1986, and updated the goals and policies in 2013. The following goals are relevant to the project: ▪ Goal 12.10: Balance and attempt to minimize adverse environmental impacts resulting from transportation system improvements in the County. ▪ Goal 12.11: Promote the development of energy-conserving transportation systems in the County.

Plans and Policies	Summary
	In 2013, the County of San Mateo added to the general plan the Energy and Climate Change Element. The following goals and policies are relevant to the project: ▪ Goal 1: Promote and implement policies and programs to reduce community-wide GHG emissions. ▪ Policy 1.2: Evaluate the GHG emissions impacts of development projects as part of plan review. ▪ Policy 10.1: Encourage the location and design of new development, remodels, or expansions to anticipate and mitigate climate change risks.
North Fair Oaks Community Plan (2011)	The County of San Mateo last updated the *North Fair Oaks Community Plan* in 2011. The following goals and policies are relevant to the project: ▪ Goal 5.21: Ensure that North Fair Oaks has clean, healthy air and water. ▪ Policy 21A: Reduce the impact of direct, indirect and cumulative impacts of stationary and non-stationary sources of pollution such as heavy industry, railroads, diesel trucks and nearby roadways. ▪ Policy 21B: Ensure that sensitive uses such as schools, childcare centers, parks and playgrounds, housing and community gathering places are protected from adverse impacts of emissions wherever and to the greatest extent possible. ▪ Policy 21F: Support regional, state and national initiatives and programs to reduce GHG emissions and air quality impacts locally.
City of Brisbane	
City of Brisbane General Plan (1994, 2019)	The City of Brisbane adopted the *City of Brisbane General Plan* in 1994 and amended the Community Health and Safety Element in 2019. The following policies and programs are relevant to the project: ▪ Policy 142: Continue to support vehicle trip-reduction programs to conserve non-renewable fuels. Community Health and Safety ▪ Policy 193: As a part of land use development analysis, consider the impacts on air resources that will be generated by a project through mobile sources. ▪ Program 193b: In conjunction with land use development applications and CEQA review, evaluate whether a proposal may have a significant effect on air quality because of mobile emissions. Require environmental impact analysis and mitigation plans and monitoring, as appropriate. ▪ Policy 199: Encourage County and regional transportation agencies to improve transit and transportation systems in ways that reduce mobile source emissions. ▪ Program 202b: Require that demolition and construction projects conform to BAAQMD recommended dust control measures. ▪ Policy 203: Consider issues of stationary emission in land use planning and project review. ▪ Program 203a: As part of land use planning, establish buffer zones between sensitive receptors and significant emissions sources, including uses that cause offensive odors or dust.

Plans and Policies	Summary
City of South San Francisco	
South San Francisco General Plan (2014)	The City of South San Francisco adopted the *South San Francisco General Plan* in 1999 and amended it in 2014. The following policies are relevant to the project: ▪ Policy 4.2-G-10: Make efficient use of existing transportation facilities and, through the arrangement of land uses, improved alternate modes, and enhanced integration of various transportation systems serving South San Francisco, strive to reduce the total VMT. ▪ Policy 7.3-G-1: Continue to work toward improving air quality and meeting all national and State ambient air quality standards and by reducing the generation of air pollutants both from stationary and mobile sources, where feasible. ▪ Policy 7.3.G-2: Mitigate the community of South San Francisco's impact on climate change by reducing GHG emissions consistent with state guidance. ▪ Policy 7.3-G-3: Reduce energy use in the built environment. ▪ Policy 7.3-G-4: Encourage land use and transportation strategies that promote use of alternatives to the automobile for transportation, including bicycling, bus transit, and carpooling. ▪ Policy 7.3-G-6: Minimize conflicts between sensitive receptors and emissions generators by distancing them from one another. ▪ Policy 7.3-I-1: Cooperate with BAAQMD to achieve emissions reductions for nonattainment pollutants and their precursors, including carbon monoxide, ozone, and PM_{10}, by implementation of air pollution control measures as required by State and federal statutes. ▪ Policy 7.3-I-2: Use the City's development review process and CEQA regulations to evaluate and mitigate the local and cumulative effects of new development on air quality and GHG emissions. ▪ Policy 7.3-I-3: Adopt the standard construction dust abatement measures included in BAAQMD's CEQA Guidelines.
City of San Bruno	
San Bruno General Plan (2009)	The City of San Bruno adopted the *San Bruno General Plan* in 2009. The following policies are relevant to the project: ▪ Policy ERC-26: Require dust abatement actions for all new construction and redevelopment projects. ▪ Policy ERC-32: Coordinate air quality planning efforts with local, regional, and State agencies. Support BAAQMD's efforts to monitor and control air pollutants from stationary sources. ▪ Policy ERC-33: Require all large construction projects to mitigate diesel exhaust emissions through use of alternate fuels and control devices. ▪ Policy ERC-34: Require that adequate buffer distances be provided between odor sources and sensitive receptors, such as schools, hospitals, and community centers. ▪ Policy HS-28: Require that lead-based paint and asbestos surveys be conducted by qualified personnel prior to structural demolition or renovation, in buildings constructed prior to 1980. ▪ Policy HS-29: Require abatement of lead-based paint and asbestos prior to structural renovation and demolition, and compliance with all State, federal, Occupational Safety and Health Administration, BAAQMD, and San Mateo County Health, Environmental Health Division rules and regulations.

<table>
<tr><th>Plans and Policies</th><th>Summary</th></tr>
<tr><td colspan="2">City of Millbrae</td></tr>
<tr><td>City of Millbrae's General Plan Update (1998)</td><td>The City of Millbrae adopted the General Plan Update in 1998. The following policies are relevant to the project:
▪ Policy PC6.5: Air Quality. Strive to achieve federal and state air quality standards by managing locally generated pollutants, coordinating with other jurisdictions, and implementing measures to reduce automobile trips in Millbrae and the region. Require that local project Environmental Impact Reports meet the air quality analysis criteria set forth by BAAQMD.
▪ Policy PC6.6: Air Pollution Sensitive Land Uses. To the extent feasible, separate air pollution sensitive land uses from sources of air pollution.
▪ Policy PC6.7: Agency Coordination in Air Quality Improvements. Coordinate review of large projects with local, regional and state agencies to improve air quality.
▪ Policy PC6.18: Energy Conservation. Promote energy conservation in new and existing development and encourage use of alternative energy sources, including passive heating and cooling, by allowing variances to site or building requirements (i.e., setbacks, lot coverage, building height, etc.) where consistent with public health and safety.
▪ Policy PCIP-19: Air Quality Strategies. Implement trip reduction and energy conservation measures, including jobs/housing balance and Transportation Systems Management programs as identified in the Land Use, Circulation and Housing Elements; and coordinate with regional and state agencies and other jurisdictions in enhancing air quality.</td></tr>
<tr><td>Millbrae Station Area Specific Plan (2016)</td><td>The City of Millbrae adopted the Millbrae Station Area Specific Plan in 2016. The following policies are relevant to the project:
▪ Policy P-IMP 10: Require applicants for new development to prepare a technical assessment evaluating potential project construction-related air quality impacts in conformance with current BAAQMD methodology.
▪ Policy P-IMP 11: Require applicants for new development to prepare and implement construction management plans to control construction-related impacts from fugitive dust, emissions, noise, and traffic. Project construction management plans shall include, but are not limited to, the following:
○ Current BAAQMD basic control measures for fugitive dust control in addition to other feasible measures that may be identified in project-level technical air quality assessments, when required;
○ A list of all construction equipment to be used during construction that identifies the make, model, and number of each piece of equipment;
○ Location of construction staging areas for materials, equipment, and vehicles;
○ Identification of haul routes for movement of construction vehicles that would minimize impacts on vehicular and pedestrian traffic, circulation, and or haul routes so that any damage and debris attributable to the haul trucks can be identified and corrected by the project sponsors; safety; and provision for monitoring surface streets used
○ Provisions for pedestrian and bicycle circulation through the congestion zone;
▪ Policy P-UTIL 10: Incorporate energy conserving design and equipment into new development in order to promote energy conservation</td></tr>
</table>

Plans and Policies	Summary
City of Burlingame	
Envision Burlingame General Plan (2019)	The *Envision Burlingame General Plan* was adopted in January 2019. The following goals and policies are relevant to the project: ▪ Policy HP-2.3: GHG Reduction Targets. Work to achieve GHG emissions reductions locally that are consistent with the targets established by AB 32 (California Global Warming Solutions Act of 2006) and subsequent supporting legislation. ▪ Policy HP-2.11: Innovative Technologies. Encourage the advancement of emerging technologies and innovations around energy, waste, water, and transportation Support local green technology businesses. Explore demonstration project opportunities. ▪ Policy HP-3.1: Regional Air Quality Standards. Support regional policies and efforts to improve air quality, and participate in regional planning efforts with BAAQMD to meet or exceed air quality standards. ▪ Policy HP-3.2: Local Air Quality Standards. Work with local businesses, industries, and developers to reduce the impact of stationary and mobile sources of pollution. Ensure that new development does not create cumulative net increases in air pollution, and require TDM Techniques when air quality impacts are unavoidable. ▪ Policy HP-3.4: Air Pollution Reduction. Support regional efforts to improve air quality, reduce auto use, expand infrastructure for alternative transportation, and reduce traffic congestion. Focus efforts to reduce truck idling to two minutes or fewer in industrial and warehouse districts along Rollins Road and the Inner Bayshore. ▪ Policy HP-3.7: Proximity to Sensitive Locations. Avoid locating stationary and mobile sources of air pollution near sensitive uses such as residences, schools, childcare facilities, healthcare facilities, and senior living facilities. Where adjacencies exist, include site planning and building features that minimize potential conflicts and impacts. ▪ Policy HP-3.11: Dust Abatement. Require dust abatement actions for all new construction and redevelopment projects. ▪ Policy HP-3.12: Construction Best Practices. Require construction projects to implement BAAQMD's Best Practices for Construction to reduce pollution from dust and exhaust as feasible. ▪ Goal M-5: Implement TDM strategies that reduce overall vehicle trips and encourage the use of transportation modes that reduce VMT and GHG emissions. ▪ Goal M-7: Use parking management strategies that promote parking availability, housing affordability, congestion management, and improved air quality. ▪ Goal M-8: Achieve air quality, sustainability, and GHG emission reduction objectives through technology upgrades and improved management of Burlingame's streets. ▪ Policy M-8.2: Vehicle Trip Reduction. Support vehicle trip reduction strategies, including building safer and more inviting active transportation networks, supporting connections to high frequency and regional transit, implementing TDM programs, and integrating land use and transportation decisions. ▪ Policy IF-1.3: Neighborhood Compatibility. Ensure that public facilities and infrastructure are located, designed, and maintained so that noise, light, glare, or odors associated with these facilities will not adversely affect nearby land uses, particularly residential areas. Require these facilities to use building and landscaping materials that are compatible with or screen them from neighboring properties.
Burlingame Downtown Specific Plan (2018)	The City of Burlingame adopted the *Burlingame Downtown Specific Plan* in 2010 and amended it in 2018. The following goal is relevant to the project: ▪ Goal D-5: Explore ways of promoting green design in the downtown area; promote design that decreases the carbon footprint.

Plans and Policies	Summary
North Burlingame/Rollins Road Specific Plan (2007)	The City of Burlingame adopted the *North Burlingame/Rollins Road Specific Plan* in 2004, with amendments in 2007. The following policy is relevant to the project: ▪ E-3: Encourage development design that facilitates safe pedestrian activity in conjunction with efficient vehicular circulation on city streets.
City of San Mateo	
A Vision of San Mateo in 2030 (2015)	The City of San Mateo last updated the Circulation and Urban Design Elements of *A Vision of San Mateo in 2030* in 2015. The following policies are relevant to the project: Circulation ▪ Policy C 6.5: Transit Oriented Development Areas (TOD). Concentrate future development near rail transit stations in the City's designated TOD areas by collaborating with partners to provide incentives for development and TDM within TOD areas, and encouraging developments within TOD Areas to maximize population and employment within allowable zoning limits, consistent with direction from the City's CAP. Urban Design ▪ Policy UD 2.14: Sustainable Design and Building Construction. Require new development and building alterations to conform with the City's CAP and subsequent City Council adopted goals, policies, and standards pertaining to sustainable building design and construction.
San Mateo Downtown Area Plan (2009)	The City of San Mateo adopted the *San Mateo Downtown Area Plan* in 2009. The following policy is relevant to the project: ▪ VIII. 4 Support Sustainable Transportation Initiatives. Implement Downtown Area Plan policies calling for use of TDM measures, establishment of a Transportation Management Association, and other measures to reduce vehicle trips and encourage transit use and promote bicycle and pedestrian accessibility.
San Mateo Rail Corridor Transit Oriented Development Plan (2005)	The City of San Mateo adopted the *San Mateo Rail Corridor Transit Oriented Development Plan* in 2005. The following objective is relevant to the project: ▪ Objective (F): Manage Traffic and Encourage Alternatives to Driving
Hillsdale Station Area Plan (2011)	The City of San Mateo adopted the *Hillsdale Station Area Plan* in 2011. The following goal is relevant to the project: ▪ Goal TRA-5: Provide a safe, functional and coherent system of pedestrian and bicycle-friendly facilities that support the use of alternative travel modes and directly connect the Station Area to nearby residential, retail, office, and mixed-use developments.
City of Belmont	
Belmont General Plan (2017)	The City of Belmont adopted the *Belmont General Plan* in 2017. The following goals, actions, and polices are relevant to the project: ▪ Goal 5.10: Reduce emissions of ozone-producing pollutants and particulate matter to improve regional air quality and protect the health of Belmont and Bay Area residents. ▪ Policy 5.10-1: Coordinate air quality planning efforts with other local, regional, and State agencies. ▪ Policy 5.10-2: Require that new development with sensitive uses that is located adjacent to sources of TAC be designed to minimize any potential health risks. ▪ Policy 5.10-3: Ensure that construction and grading activities minimize short-term impacts to air quality by employing appropriate mitigation measures and best practices.

Plans and Policies	Summary
	▪ Action 5.10-3.a: Require applicants proposing new development projects within the Planning Area to require their contractors, as a condition of contract, to reduce construction-related GHG emissions by implementing BAAQMD's recommended best management practices, including (but not limited to) the following measures (based on BAAQMD's (2011) CEQA Guidelines): ○ Use local building materials of at least 10 percent (sourced from within 100 miles of the planning area). ○ Recycle and reuse at least 50 percent of construction waste or demolition materials. ▪ Policy 5.10-4: Support land use, transportation management, infrastructure, and environmental planning programs that reduce vehicle emissions and improve air quality. ▪ Policy 5.10-6: Ensure compliance with the most current Bay Area Clean Air Plan by implementing the Plan's recommended Transportation Control Measures. See Policy 3.2.3. ▪ Goal 5.11: Reduce emissions of GHG to 15 percent below the 2005 baseline levels by 2020 and to 50 percent below the 2005 baseline levels by 2035. ▪ Action 5.11-2a: Support local actions that will reduce motor vehicle use, support alternative forms of transportation, improve energy efficiency, require energy conservation in new construction, and manage energy in public buildings, in accordance with State law. ▪ Policy 5.11-4: Support and participate in regional efforts to reduce GHG emissions and implement adaptation strategies.
Belmont Village Specific Plan (2017)	The City of Belmont adopted the *Belmont Village Specific Plan* in 2017. The following policy is relevant to the project: ▪ Policy 6.4-3. Require proponents of projects within 100 feet of existing hazardous materials case sites or TAC stationary sources, or 300 feet of gas stations or perc dry cleaners, to investigate ○ 1) the site's health risk, ○ 2) applicable Air District risk standards, ○ 3) use compatibility at the location in question (some kinds of uses might be at lower risk than others), and ○ 4) potential feasible design-related risk mitigation measures. If the investigation results show that the health risk exceeds the Air District standards for TACs, require project proponents to include design-related risk mitigation measures, such as upgraded ventilation systems with high efficiency filters (air filters rated at a minimum efficiency reporting value 13 or higher) or equivalent mechanisms, to minimize health risks for future residents. Existing stationary TAC sources are mapped in Figure 6-5 of the Belmont Village Specific Plan; however, project proponents are expected to check Air District databases for the latest data on stationary TAC sources and risk standards. Project proponents must provide evidence to the City of consultation with the Air District and the Regional Water Quality Control Board in making refinements to project designs to reduce applicable hazardous materials and/or TAC risk.

Plans and Policies	Summary
City of San Carlos	
San Carlos 2030 General Plan (2009)	The City of San Carlos adopted the *San Carlos 2030 General Plan* in 2009. The following policies, goals, and actions are relevant to the project: ▪ Policy LU-8.18: Encourage "green building" practices in new development and redevelopment, such as those that make a building more energy efficient and reduce its effect on human health and the environment through better siting, design, construction, maintenance and operation. ▪ Goal EM-6: Support atmospheric conditions that are clean, healthful, provides maximum visibility and meets air quality standards. ▪ Policy EM-6.1: Support and comply with the BAAQMD, State and federal standards and policies that improve air quality in the Bay Area. ▪ Policy EM-6.2: Support and encourage commercial uses to adopt environmentally friendly technologies and to reduce the release of pollutants. ▪ Policy EM-6.3: Support the reduction of emission of particulates from wood burning appliances, construction activity, automobiles, trucks and other sources. ▪ Policy EM-6.4: Implement BAAQMD guidelines that establish minimum screening or buffer distances between emission sources and sensitive receptors. Exceptions may be made for projects that do not meet the distance requirements, but can be determined compatible with adjacent uses through a project-specific study that determines potential health risk. Mitigation measures shall be required to reduce these risk to acceptable levels. ▪ Policy EM-6.5: Consider potential impacts form land uses that may emit pollution and/or odors when locating air pollution sources near sensitive receptors. Air pollution sources could include freeways, industrial uses, hazardous material storage, waste disposal/transfer stations and other similar uses. ▪ Policy EM-6.6: BAAQMD recommended measures to reduce PM_{10} and exhaust emissions associated with construction shall be applied to new development in San Carlos. ▪ Action EM-6.1: Require review by appropriate agencies of development applications that may create potential air quality impacts to assure compliance with relevant regulations. ▪ Policy EM-7.1: Take appropriate action to address climate change and reduce GHG emissions. ▪ Policy EM-7.3: Participate in regional, State and federal efforts to reduce GHG emissions and mitigate the impacts resulting from climate change. ▪ Policy EM-7.4: Utilize the expertise of regional, State and federal agencies when developing, revising and implementing GHG reduction strategies. ▪ Policy EM-7.5: Support GHG emission reduction measures and climate change resiliency strategies that are cost effective and help create an environmentally sustainable, livable and equitable community. The cost of implementation to the City and the private sector shall be considered prior to the adoption of any GHG reduction strategy. ▪ Policy EM-7.7: Collaborate with stakeholders and volunteers in the formulation and implementation of GHG reduction strategies. ▪ Goal EM-9: Reduce energy consumed citywide. ▪ Policy CSS-4.6: Prohibit land uses and development which emit odors, particulates, light glare, or other environmentally-sensitive contaminants from being located within proximity of schools, community centers, senior homes and other sensitive receptors. Sensitive receptors shall be prohibited from locating in the proximity of environmentally sensitive contaminants.

Plans and Policies	Summary
City of Redwood City	
Redwood City General Plan (2010)	The City of Redwood City adopted the *Redwood City General Plan* in 2010. The following goals and policies are relevant to the project: ▪ Policy BE-25.1: Accommodate and encourage alternative transportation modes to achieve Redwood City's mobility goals and reduce vehicle trip generation and VMT. ▪ Policy BE-28.2: Support attractive and pedestrian-friendly railroad track grade-separated crossings and other appropriate measures to mitigate potential noise, air pollution, safety, and traffic impacts of increased Caltrain service and new high-speed rail service. ▪ Goal PS-1: Maintain good local air quality, and reduce the local contributions of airborne pollutants to the air basin. ▪ Policy PS-1.2: Minimize vehicle emissions by reducing automobile use and encouraging alternative means of transportation. ▪ Policy PS-1.3: Pursue efforts to reduce air pollution and GHG emissions by promoting the use of renewable energy (e.g., solar, wind, and hydroelectric power), and implement effective energy conservation and efficiency measures. ▪ Policy PS-1.4: Integrate air quality planning with land use, economic development, and transportation planning. ▪ Policy PS-1.5: Require projects that generate potentially significant levels of air pollutants to incorporate the most effective air quality mitigation into project design, as feasible. ▪ Goal PS-2: Minimize the potential impacts from land uses that may pollute proximate to sensitive receptors. ▪ Policy PS-2.5: Encourage the development and/or implementation of new technologies that address or mitigate pollutant emissions at the Port, transportation facilities, and industrial use locations. ▪ Policy PS-3.1: Support programs that increase ridesharing, reduce pollutants generated by vehicle use, and meet the transportation control measures recommended by BAAQMD in the most recent Clean Air Plan. ▪ Policy PS-3.2: Support programs that decrease vehicle emissions by increasing the number of housing units located near jobs and transit, and encouraging commuting via transit, walking, and bicycling; thereby decreasing VMT. ▪ Goal PS-4: Promote efficient management and use of energy resources to help minimize GHG emissions. ▪ Goal PS-5: Mitigate against and adapt to climate change. ▪ Policy PS-5.2: Strive to reduce per capita GHG emissions and total municipal GHG emissions to 15 percent below 2005 levels by 2020. ▪ Policy PS-5.3: Reduce GHG emissions and adapt to climate change with efforts in the following areas. Major mitigation and adaptation strategies will include: - Energy. Incentivize renewable energy installation, facilitate green technology and business, and reduce community-wide energy consumption. - Land Use. Encourage investment and development in Downtown, transit-oriented development, compact development, infill development, and a mix of uses. Discourage development on land vulnerable to flooding from sea level rise where potential impacts cannot be adequately addressed. - Transportation. Enhance bicycling and walking infrastructure, and support public transit, including Caltrain, rapid rail, streetcars, and public bus service.

Plans and Policies	Summary
	- Buildings. Educate developers regarding the City's Green Building Ordinance, and develop an assessment of green building techniques as a formal stage of City design review. Consider strategies to encourage energy and water conservation retrofits in existing buildings. Adaptation strategies will also include increased water efficiency in buildings. - Waste. Increase composting, recycling, and efforts to reduce waste generation, focusing especially on large commercial and industrial waste producers. - Ecology. Plant trees and more vegetation, and endeavor to preserve open space. Major climate adaptation strategies will include native and drought-resistant planting and preservation of open space buffers near floodplains that may be affected by sea level rise. - Government Operations. Develop green procurement plans and seek energy savings in operations and maintenance of City facilities. - Communication and Programs. Develop or support energy- or climate change-themed publications and workshops, facilitate energy audits for residents, and establish partnerships to reduce GHG emissions.
City of Menlo Park	
City of Menlo Park General Plan (2013, 2016)	The City of Menlo Park adopted the *City of Menlo Park General Plan* in 2016. The following goals and policies are relevant to the proposed project: ▪ Policy CIRC-2.15: Regional Transportation Improvements. Work with neighboring jurisdictions and appropriate agencies to coordinate transportation planning efforts and to identify and secure adequate funding for regional transportation improvements to improve transportation options and reduce congestion in Menlo Park and adjacent communities. ▪ Goal CIRC-3: Increase mobility options to reduce traffic congestion, GHG emissions, and commute travel time. ▪ Policy CIRC-3.1: VMT. Support development and transportation improvements that help reduce per service population (or other efficiency metric) VMT. ▪ Policy CIRC-3.2: GHG Emissions. Support development, transportation improvements, and emerging vehicle technology that help reduce per capita (or other efficiency metric) GHG emissions. ▪ Policy CIRC-3.3: Emerging Transportation Technology. Support efforts to fund emerging technological transportation advancements, including connected and autonomous vehicles, emergency vehicle pre-emption, sharing technology, electric vehicle technology, electric bikes and scooters, and innovative transit options. ▪ Policy CIRC-4.1: Global GHG Emissions. Encourage the safer and more widespread use of nearly zero-emission modes, such as walking and biking, and lower emission modes like transit, to reduce GHG emissions. ▪ Policy CIRC-4.2: Local Air Pollution. Promote non-motorized transportation to reduce exposure to local air pollution, thereby reducing risks of respiratory diseases, other chronic illnesses, and premature death. ▪ Policy OSC4.2: Sustainable Building. Promote and/or establish environmentally sustainable building practices or standards in new development that would conserve water and energy, prevent stormwater pollution, reduce landfilled waste, and reduce fossil fuel consumption from transportation and energy activities. ▪ Policy OSC5.1: Air and Water Quality Standards. Continue to apply standards and policies established by BAAQMD, San Mateo Countywide Water Pollution Prevention Program, and City of Menlo Park CAP through the CEQA process and other means as applicable.

Plans and Policies	Summary
	▪ Policy OSC5.2: Development in Industrial Areas. Evaluate development projects in industrial areas for impacts to air and water resources in relation to truck traffic, hazardous materials use and production-level manufacturing per CEQA and require measures to mitigate potential impacts to less than significant levels.
Santa Clara County	
Santa Clara County General Plan (1994)	Santa Clara County adopted the *Santa Clara County General Plan* in 1994. The following policies are relevant to the project: ▪ Policy C-TR 11: Santa Clara County shall participate in updating and implementing the Congestion Management Plan, the provisions of which as set forth by law: a. establish priority for air quality goals and objectives and development of alternatives to automobile travel; and b. allow additional road capacity to be created only when all feasible automobile travel demand measures have been implemented. ▪ Policy C-RC 80: Sub-regional/countywide planning for Santa Clara County should place major emphasis on the inter-related goals, strategies and policies for improving energy efficiency in transportation, air quality, and reducing traffic congestion.
City of Palo Alto	
Palo Alto Comprehensive Plan 2030 (2017)	The Palo Alto City Council adopted the *Palo Alto Comprehensive Plan 2030* in 2017. The following goals, policies, and programs are relevant to the project: ▪ Policy N-5.1: Support regional, State, and federal programs that improve air quality in the Bay Area because of its critical importance to a healthy Palo Alto. ▪ Policy N-5.3: Reduce emissions of particulates from manufacturing, dry cleaning, construction activity, grading, wood burning, landscape maintenance, including leaf blowers and other sources. ▪ Policy N-5.4: All potential sources of odor and/or TACs shall be adequately buffered, or mechanically or otherwise mitigated to avoid odor and toxic impacts that violate relevant human health standards. ▪ Policy N-5.5: Support BAAQMD in its efforts to achieve compliance with existing air quality regulations by continuing to require development applicants to comply with BAAQMD construction emissions control measures and health risk assessment requirements. ▪ Goal N-8: Actively support regional efforts to reduce our contribution to climate change while adapting to the effects of climate change on land uses and city services. ▪ Policy N-8.1: Take action to achieve target reductions in GHG emission levels from City operations and the community activity of 80 percent below 1990 levels by 2030. ▪ Program N8.1.1: Participate in cooperative planning with regional and local public agencies, including on the Sustainable Communities Strategy, on issues related to climate change, such as GHG reduction, water supply reliability, sea level rise, fire protection services, emergency medical services and emergency response planning. ▪ Goal T-1: Create a sustainable transportation system, complemented by a mix of land uses, that emphasizes walking, bicycling, use of public transportation, and other methods to reduce GHG emissions and the use of single occupancy motor vehicles. ▪ Policy T-1.3: Reduce GHG and pollutant emissions associated with transportation by reducing VMT and per-mile emissions through increasing transit options, supporting biking and walking, and the use of zero-emission vehicle technologies to meet City and State goals for GHG reductions by 2030.

<table>
<tr><th>Plans and Policies</th><th>Summary</th></tr>
<tr><td colspan="2">City of Mountain View</td></tr>
<tr><td>Mountain View 2030 General Plan (2012)</td><td>The City of Mountain View adopted the Mountain View 2030 General Plan in 2012. The following goals and policies are relevant to the project:
▪ Policy INC 12.2: Emissions reduction strategies. Develop cost-effective strategies for reducing GHG emissions.
▪ Policy INC 13.3: Coordinating efforts. Support regional and local efforts and programs to reduce energy use.
▪ Policy INC 20.2: Collaboration. Participate in state and regional planning efforts to improve air quality.
▪ Policy INC 20.3: Pollution-reduction technologies. Encourage the use of non-fossil fuels and other pollution-reduction technologies in transportation, machinery and industrial processes.
▪ Policy INC 20.6: Air quality standards. Protect the public and construction workers from construction exhaust and particulate emissions.
▪ Policy INC 20.7: Protect sensitive receptors. Protect the public from substantial pollutant concentrations.
▪ Policy INC 20.8: Offensive odors. Protect residents from offensive odors.
▪ Goal MOB-9: Achievement of state and regional air quality and GHG emission reduction targets.
▪ Policy MOB 9.2: Reduced VMT. Support development and transportation improvements that help reduce GHG emissions by reducing per capita VMT.</td></tr>
<tr><td colspan="2">City of Sunnyvale</td></tr>
<tr><td>Sunnyvale General Plan (2011, 2017)</td><td>The Sunnyvale General Plan was adopted in July 2011, and the Land Use and Transportation chapter was updated in April 2017. The following policies are relevant to the project:
▪ Policy LT-1.11c: Consider potential climate change impacts when preparing local planning documents and processes.
▪ Policy LT-2.2: Reduce GHG emissions that affect climate and the environment though land use and transportation planning and development.
▪ Goal EM-11: Improved Air Quality. Improve Sunnyvale’s air quality and reduce the exposure of its citizens to air pollutants.
▪ Policy EM-11.1: The City should actively participate in regional air quality planning.
▪ Policy EM-11.5: Reduce automobile emissions through traffic and transportation improvements.
▪ Policy EM-11.6: Contribute to a reduction in Regional VMT.</td></tr>
</table>

Plans and Policies	Summary
City of Santa Clara	
City of Santa Clara 2010–2035 General Plan (2010)	The City of Santa Clara adopted the *City of Santa Clara 2010–2035 General Plan* in 2010. The following policies are relevant to the project: ▪ 5.10.2-P1: Support alternative transportation modes and efficient parking mechanisms to improve air quality. ▪ 5.10.2-P2: Encourage development patterns that reduce VMT and air pollution. ▪ 5.10.2-P3: Encourage implementation of technological advances that minimize public health hazards and reduce the generation of air pollutants. ▪ 5.10.2-P4: Encourage measures to reduce GHG emissions to reach 30 percent below 1990 levels by 2020. ▪ 5.10.2-P6: Require “Best Management Practices” for construction dust abatement. ▪ 5.8.1-P4: Expand transportation options and improve alternate modes that reduce GHG emissions. ▪ 5.10.3-P15: Explore opportunities for alternative energy “fueling stations” and promote participation in shuttle services that use new technology vehicles to reduce GHG emissions.

Sources: ABAG and MTC 2017; City and County of San Francisco 1996, 2004, 2012; City of Belmont 2017a, 2017b; City of Brisbane 1994, 2019; City of Burlingame 2007, 2018, 2019; City of Menlo Park 2013, 2016; City of Millbrae 1998, 2016; City of Mountain View 2012; City of Palo Alto 2017; City of Redwood City 2010; City of San Bruno 2009; City of San Carlos 2009; City of San Mateo 2005, 2009, 2011, 2015a, 2015b; City of Santa Clara 2010; City of South San Francisco 2014; City of Sunnyvale 2011, 2017; County of San Mateo 2011, 2013a, 2013b; County of Santa Clara 1994

AB = (California) Assembly Bill
BAAQMD = Bay Area Air Quality Management District
CAP = Climate Action Plan
CEQA = California Environmental Quality Act
CO_2 = carbon dioxide
GHG = greenhouse gas
PM_{10} = particulate matter 10 micrometers or less in diameter
TAC = toxic air contaminant
TDM = transportation demand management
TOD = transit oriented development
VMT = vehicle miles traveled

3.3.5 Climate Action Plans

A number of cities in the Bay Area have adopted or are in the process of developing climate action plans (CAP), GHG reduction plans, or equivalent documents aimed at reducing local GHG emissions. Jurisdictions with adopted or in-development CAPs or GHG reduction plans for either municipal operations, community activities, or both include the City and County of San Francisco, the Cities of South San Francisco, Burlingame, Millbrae, Belmont, San Carlos, Redwood City, Atherton, Menlo Park, Palo Alto, Mountain View, Sunnyvale, and Santa Clara, and San Mateo County and Santa Clara County (California Governor’s Office of Planning and Research 2014; Sustainable San Mateo 2013). These plans all call for reductions in GHG emissions below current levels and actions to reduce vehicle miles traveled (VMT) and associated transportation emissions. All plans include increased transit service as a key strategy in reducing local GHG emissions.

4 POLLUTANTS OF CONCERN

Three general classes of air pollutants are of concern for the project—criteria pollutants, TACs, and GHGs. Criteria pollutants are those pollutants for which the USEPA and the State of California have set ambient air quality standards. (For analysis purposes, these pollutants include chemical precursors of compounds for which ambient standards have been set.) TACs of concern for the project are nine MSATs identified by the USEPA as having significant contributions from mobile sources—acetaldehyde, acrolein, benzene, 1,3-butadiene, DPM and diesel exhaust organic gases, ethylbenzene, formaldehyde, naphthalene, and polycyclic organic matter. GHGs are gaseous compounds that limit the transmission of radiated heat from the Earth's surface to the atmosphere. GHGs include CO_2, CH_4, N_2O, hydrofluorocarbons, perfluorocarbons, SF_6, and other fluorinated gases, including nitrogen trifluoride and hydrofluoroether.

4.1 Criteria Pollutants

Criteria pollutants are pollutants for which federal and state ambient air quality standards have been established to protect public health and welfare (Chapter 3). The sources of these pollutants, their effects on human health and the nation's welfare, and their final deposition in the atmosphere vary considerably. The following sections provide a brief description of each criteria pollutant.

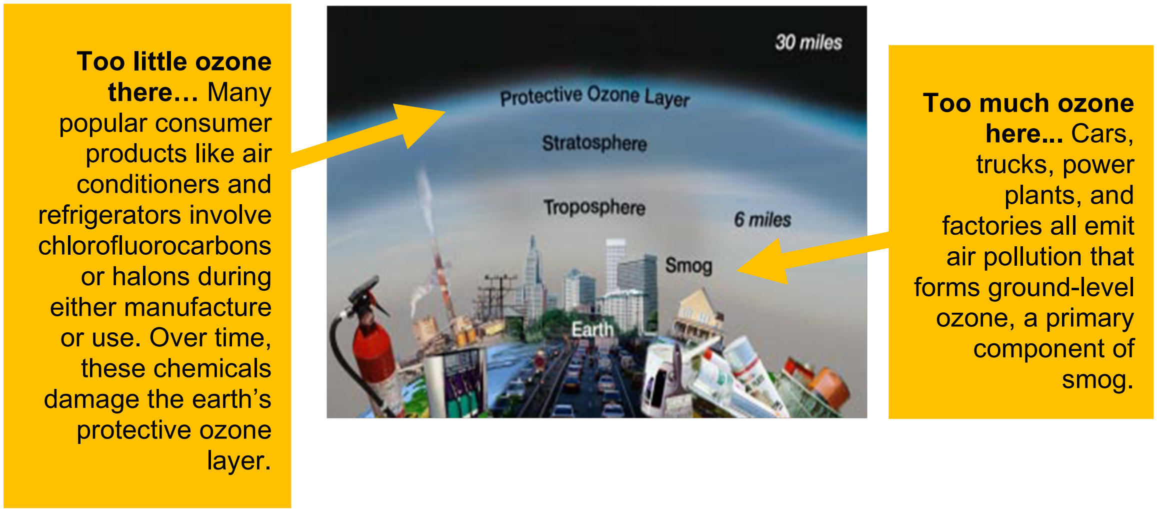
4.1.1 Ozone

O_3 is a colorless toxic gas. As illustrated on Figure 4-1, O_3 is found in both the Earth's upper and lower atmosphere. In the upper atmosphere, O_3 is a naturally occurring gas that helps to prevent the sun's harmful ultraviolet rays from reaching the Earth. Substantial O_3 formation generally requires a stable atmosphere with strong sunlight; therefore, high levels of O_3 are generally a concern in the summer.

Definition of O_3

O_3 is a colorless toxic gas found in the Earth's upper and lower atmospheric levels. In the upper atmosphere, O_3 is naturally occurring and helps to prevent the sun's harmful ultraviolet rays from reaching the earth. In the lower atmosphere, O_3 is human-made. Although O_3 is not directly emitted, it forms in the lower atmosphere through a chemical reaction between hydrocarbons and oxides of nitrogen, also referred to as VOC and NO_X, which are emitted from industrial sources and from automobiles.

In the lower atmosphere, O_3 is largely human-generated. Although O_3 is not directly emitted, it forms in the lower atmosphere through a chemical reaction between certain hydrocarbons, referred to as VOCs and NO_X, which are emitted from industrial sources and motor vehicles. Hydrocarbons are compounds composed primarily of hydrogen and carbon atoms. Total organic gas and ROGs are the two classes of hydrocarbons that the CARB inventories. ROGs have relatively high photochemical reactivity. The major source of ROGs is the incomplete combustion of fossil fuel in internal combustion engines. Other sources of ROGs include evaporative emissions associated with paints and solvents, application of asphalt paving, and household consumer products. ROGs do not directly cause effects on human health, but they cause effects by reactions of ROGs to form secondary pollutants. ROGs are also transformed into organic aerosols in the atmosphere, contributing to higher levels of fine PM and lower visibility. The CARB uses the term *ROG* for air quality analysis and defines it the same as the federal term VOC. In this analysis, ROG is assumed equivalent to VOC.



Source: USEPA 2003

Figure 4-1 Ozone in the Atmosphere

O_3 is the main ingredient of smog. Ground-level O_3 causes health problems because it irritates the mucous membranes, damages lung tissue, reduces lung function, and sensitizes the lungs to other irritants. O_3-related health effects also include respiratory symptoms, aggravation of asthma, increased hospital and emergency room visits, increased asthma medication usage, and a variety of other respiratory-related effects. There is also evidence that short-term exposure to O_3 directly or indirectly contributes to cardiopulmonary-related mortality. In addition, O_3 can damage vegetation by inhibiting its growth. Because O_3 is not directly emitted, potential O_3 effects are assessed by examining the changes in VOC and NO_X emissions for the project on regional and statewide levels.

4.1.2 Particulate Matter

PM pollution is composed of solid particles or liquid droplets that are small enough to remain suspended in the air. In general, PM pollution can include dust, soot, and smoke, which can be irritating, but usually are not toxic. It can also include salts, acids, and metals. However, PM pollution can include substances that are highly toxic. Of particular concern are those particles that have diameters equal to or smaller than 10 microns (µm) (PM_{10})—about 1/7 the thickness of a human hair—or 2.5 µm ($PM_{2.5}$), approximately 1/28 the thickness of a human hair (Figure 4-2). PM can be emitted directly from a source or can form when gases emitted undergo chemical reactions in the atmosphere.

Definition of PM_{10} and $PM_{2.5}$

PM_{10} refers to PM 10 microns or less in diameter, about 1/7th the thickness of a human hair. PM pollution consists of small liquid and solid particles floating in the air, which can include smoke, soot, dust, salts, acids, and metals.

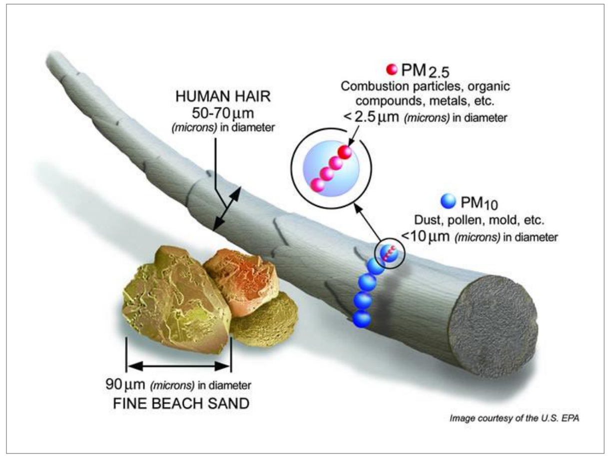
PM also forms when gases emitted from motor vehicles undergo chemical reactions in the atmosphere.

$PM_{2.5}$ is a subset of PM_{10} and refers to particulates that are 2.5 microns or less in diameter, roughly 1/28th the diameter of a human hair.

Major sources of PM_{10} include motor vehicles; wood-burning stoves and fireplaces; dust from construction, landfills, and agriculture; wildfires and brush/waste burning; industrial sources; windblown dust from open lands; and atmospheric chemical and photochemical reactions. These suspended particulates produce haze and reduce visibility.

A small portion of PM is the product of fuel combustion processes. However, the combustion of fossil fuels (by motor vehicles, power generation, and industrial facilities) accounts for a significant portion of $PM_{2.5}$ pollution. $PM_{2.5}$ also results from fuel combustion in residential fireplaces and wood stoves. In addition, $PM_{2.5}$ can be formed in the atmosphere from gases such as SO_2, NO_X, and VOCs.

The main health effect of airborne PM is on the respiratory system. Both PM_{10} and $PM_{2.5}$ can penetrate the human respiratory system's natural defenses and damage the respiratory tract when inhaled. Both tend to collect in the upper portion of the respiratory system, but $PM_{2.5}$ or smaller particles can penetrate deeper into the lungs and damage lung tissues. The effects of PM_{10} and $PM_{2.5}$ emissions for the project are examined on a localized (i.e., microscale) basis, on a regional basis, and on a statewide basis.



Source: USEPA 2015c

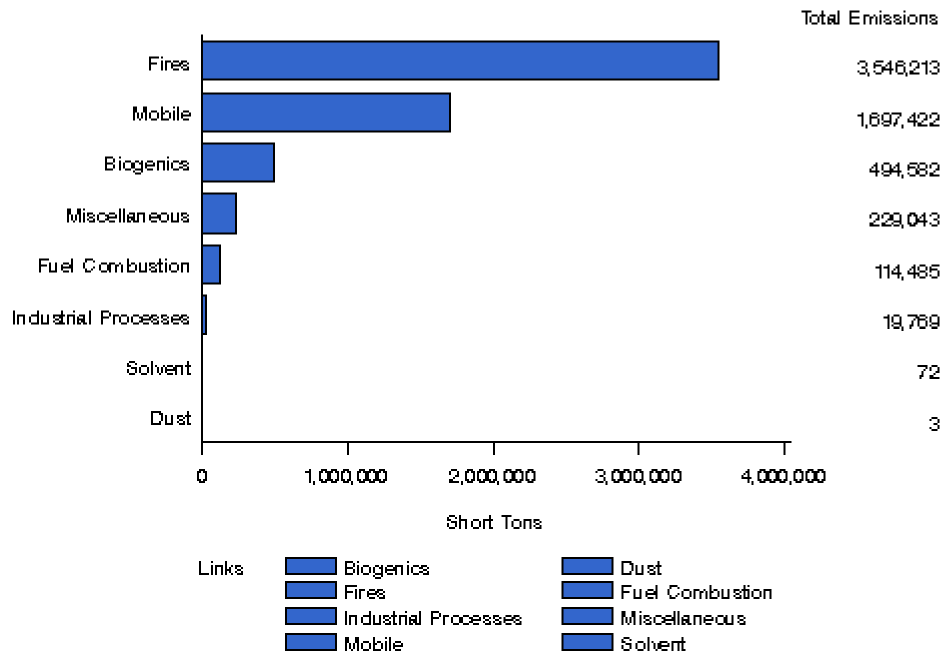
Figure 4-2
Relative Particulate Matter Size

4.1.3 Carbon Monoxide

CO is a colorless gas that interferes with the transfer of oxygen in the bloodstream to the brain. CO is emitted almost exclusively from the incomplete combustion of fossil fuels. As illustrated on Figure 4-3, on-road motor-vehicle exhaust is the primary source of human-caused CO in California. In cities, 85 to 95 percent of all CO emissions may come from motor-vehicle exhaust. Prolonged exposure to high levels of CO can cause headaches, drowsiness, loss of equilibrium, and heart disease. CO levels are generally highest in the colder months when inversion conditions (i.e., warmer air traps colder air near the ground) are more frequent. CO concentrations can vary greatly over relatively short distances. Relatively high concentrations of CO are typically found near congested intersections, along heavily used roadways carrying slow-moving traffic, and in areas where atmospheric dispersion is inhibited by urban street canyon conditions. The effects of CO emissions for the project are examined on a localized (i.e., microscale) basis, on a regional basis, and on a statewide basis.

Definition of CO

CO is a colorless gas that interferes with the transfer of oxygen to the brain. CO emits almost exclusively from the incomplete combustion of fossil fuels. On-road motor-vehicle exhaust is the primary source of CO.



Source: USEPA 2017

Figure 4-3 Sources of Carbon Monoxide in California (2014)

4.1.4 Nitrogen Dioxide

NO_2 is a brownish gas that irritates the lungs. It can cause breathing difficulties at high concentrations. NO_2 is one of a group of highly reactive gases known as oxides of nitrogen, or NO_X. NO_2 can be emitted directly or formed through a reaction between nitric oxide emissions and atmospheric oxygen. NO_2 also contributes to the formation of PM_{10}. At atmospheric concentrations, NO_2 is only potentially irritating. At high concentrations, the result is a brownish-red cast to the atmosphere and reduced visibility. There is some indication of a relationship between NO_2 and chronic (long-term) pulmonary fibrosis. Localized effects of NO_2 are analyzed relevant to the NAAQS and CAAQS.

4.1.5 Lead

Pb is a stable element that persists and accumulates in the environment and in animals. Its principal effects on humans are on the blood-forming, nervous, and renal systems. Pb levels from mobile sources in the urban environment have decreased significantly because of the federally mandated switch to Pb-free gasoline, and they are expected to continue to decrease. An analysis of the effects of Pb emissions from transportation projects is therefore not warranted and has not been conducted for the project.

4.1.6 Sulfur Dioxide

SO_2 is a gas produced by combustion of high-sulfur fuels. The main sources of SO_2 are coal and oil used in power stations, industry, and domestic heating. Industrial chemical manufacturing is another source of SO_2. SO_2 is an irritant that attacks the throat and lungs. It can cause acute respiratory symptoms and diminished ventilator function in children. SO_2 can also cause plant leaves to turn yellow and can corrode iron and steel. Although heavy-duty diesel vehicles emit SO_2, USEPA regulations have greatly decreased the sulfur content of diesel fuel and gasoline in recent years. Transportation sources contribute only a small fraction of total SO_2 emissions, and the USEPA and other regulatory agencies do not consider transportation sources to be significant sources of this pollutant. Nevertheless, consistent with applicable air district guidance, the effects of changes in SO_2 emissions for the project are examined on regional and statewide levels.

4.2 Toxic and Noncriteria Pollutants

A TAC is defined by California law as an air pollutant that “may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health.” The USEPA uses the term HAP in a similar sense. Controlling air toxic emissions became a national priority with the passage of the CAA, in which Congress mandated that the USEPA regulate 188 air toxics, also known as HAPs. TACs can be emitted from stationary and mobile sources. The effects of TACs and other noncriteria pollutants for the project are examined on a local level.

4.2.1 Asbestos

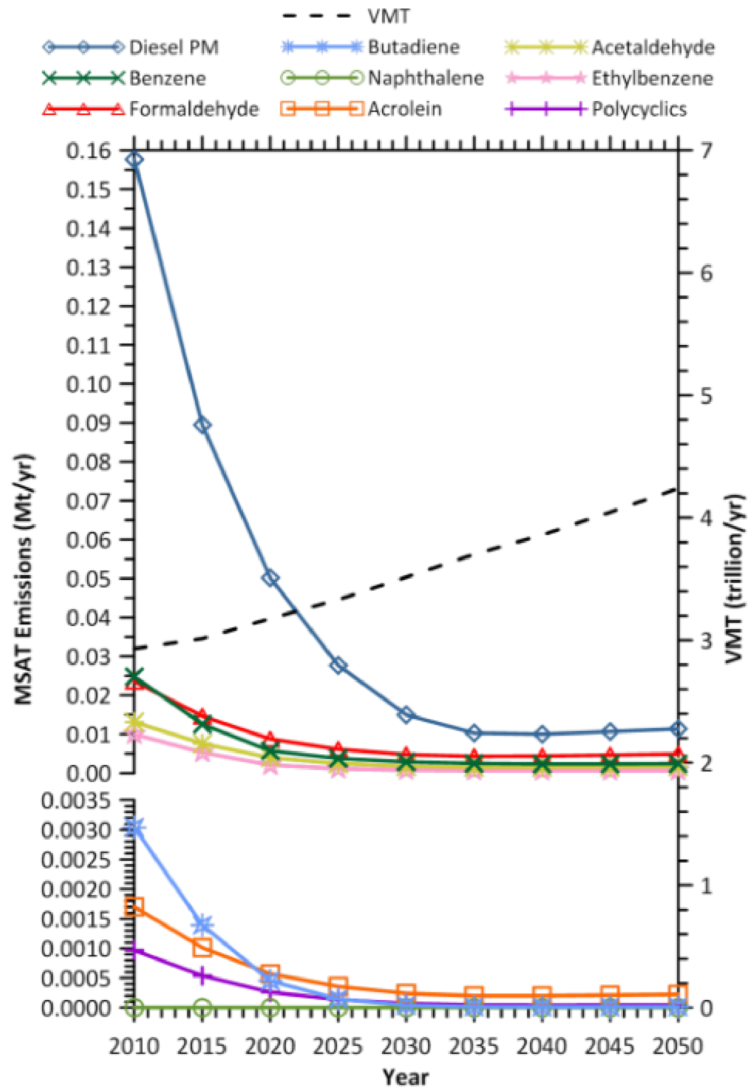
Asbestos deposits from vehicle brake wear may be present on surfaces and in the ambient air along the HSR alignment. In addition, asbestos-containing materials may have been used in constructing buildings that would be demolished. Asbestos minerals (NOA) occur in rocks and soil as the result of natural geologic processes, often in veins near earthquake faults in the coastal ranges and foothills of the Sierra Nevada and in other areas of California. NOA most commonly occurs in ultramafic rock (igneous and metamorphic rock with low silica content) that has undergone partial or complete alteration to serpentine rock (or serpentinite) and often contains chrysotile asbestos. In addition, another form of asbestos, tremolite, is associated with ultramafic rock, particularly near geologic faults.

Natural weathering or human disturbance can break NOA down to microscopic fibers, easily suspended in air. When inhaled, these thin fibers irritate tissues and resist the body’s natural defenses. Chronic inhalation exposure to asbestos in humans can lead to asbestosis, which is a diffuse fibrous scarring of the lungs. Symptoms of asbestosis include shortness of breath, difficulty in breathing, and coughing. Asbestosis is a progressive disease (the severity of symptoms tends to increase with time, even after the exposure has stopped). In severe cases, this disease can lead to death caused by impairment of respiratory function. A large number of occupational studies have reported that exposure to asbestos by inhalation can cause lung cancer and mesothelioma, which is a rare cancer of the membranes lining the abdominal cavity and surrounding internal organs. The USEPA considers asbestos to be a human carcinogen (a cancer-causing agent) (USEPA 2000). The effects of asbestos for the project are examined on regional and local levels.

4.2.2 Mobile Source Air Toxics

The USEPA has assessed an expansive list of air toxics in its 2007 Rule on the Control of Hazardous Air Pollutants from Mobile Sources and identified a group of 93 compounds emitted from mobile sources that are listed in its Integrated Risk Information System.

Under the 2007 rule, the USEPA sets standards on fuel composition, vehicle exhaust emissions, and evaporative losses from portable containers. Using USEPA’s Motor Vehicle Emission Simulator (MOVES) 2014a model, as shown on Figure 4-4, the FHWA estimates that even if VMT increases by 45 percent from 2010 to 2050 as forecast, a combined reduction of 91 percent in the total annual emissions for the priority MSAT is projected for the same period.



Source: FHWA 2016

Trends for specific locations may be different, depending on locally derived information representing vehicle miles traveled, vehicle speeds, vehicle mix, fuels, emission-control programs, meteorology, and other factors.

Figure 4-4 Projected National Mobile Source Air Toxics Emission Trends (2010–2050) for Vehicles Operating on Roadways, Based on USEPA's MOVES2014a Model Assessment (USEPA 2015d)

The USEPA identified nine compounds (MSATs) with significant contributions from mobile sources that are among the national- and regional-scale cancer risk drivers from its National Air Toxics Assessment (USEPA 2015d). These are acrolein, benzene, 1,3-butadiene, acetaldehyde, DPM, ethylbenzene, formaldehyde, naphthalene, and polycyclic organic matter. While the FHWA considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future USEPA rules. CARB and BAAQMD recognize 21 substances as TACs, including four of the USEPA MSATs: benzene, 1,3-butadiene, DPM, and formaldehyde. The BAAQMD (2017a) considers DPM as the surrogate for total diesel exhaust including organic gases. CARB and BAAQMD have not defined a list of TACs specific to mobile sources, but both agencies recognize DPM as a primary pollutant of concern for mobile sources. The effects of

MSATs for the project are examined on a regional and local level. The following paragraphs describe these MSATs (Authority and FRA 2012).

Acrolein is a colorless-to-yellow liquid that burns easily, is readily volatilized, and has a disagreeable odor. It is present as a product of incomplete combustion in the exhausts of stationary equipment (e.g., boilers and heaters) and mobile sources. It is also a secondary pollutant formed through the photochemical reaction of VOCs and NO_X in the atmosphere. Acrolein is considered to have high acute toxicity, and it causes upper respiratory tract irritation and congestion in humans. The major effects from chronic (long-term) inhalation exposure to acrolein in humans consist of general respiratory congestion and eye, nose, and throat irritation. No information is available on the reproductive, developmental, or carcinogenic effects of acrolein in humans. The USEPA considers acrolein data inadequate for an assessment of human carcinogenic potential.

Benzene is a volatile, colorless, highly flammable liquid with a sweet odor. Most of the benzene in ambient air is from incomplete combustion of fossil fuels and evaporation from gasoline service stations. Acute inhalation exposure to benzene causes neurological symptoms, such as drowsiness, dizziness, headaches, and unconsciousness in humans. Chronic inhalation of certain levels of benzene causes disorders in the blood in humans. Benzene specifically affects bone marrow (the tissues that produce blood cells). Aplastic anemia, excessive bleeding, and damage to the immune system (by changes in blood levels of antibodies and loss of white blood cells) may develop. Available human data on the developmental effects of benzene are inconclusive because of concomitant exposure to other chemicals, inadequate sample size, and lack of quantitative exposure data. The USEPA has classified benzene as a known human carcinogen by inhalation.

1,3-butadiene is a colorless gas with a mild gasoline-like odor. Sources of 1,3-butadiene released into the air include motor vehicle exhaust, manufacturing and processing facilities, forest fires or other combustion, and cigarette smoke. Acute exposure to 1,3-butadiene by inhalation in humans results in irritation of the eyes, nasal passages, throat, and lungs. Neurological effects, such as blurred vision, fatigue, headache, and vertigo, have also been reported at very high exposure levels. One epidemiological study reported that chronic exposure to 1,3-butadiene by inhalation resulted in an increase in cardiovascular diseases, such as rheumatic and arteriosclerotic heart diseases. Other human studies have reported effects on blood (ATSDR 2012). No information is available on reproductive or developmental effects of 1,3-butadiene in humans. The USEPA has classified 1,3-butadiene as a probable human carcinogen by inhalation.

Acetaldehyde is mainly used as an intermediate in the synthesis of other chemicals. It is may be formed in the body from the breakdown of ethanol. Acute (short-term) exposure to acetaldehyde results in effects including irritation of the eyes, skin, and respiratory tract. Symptoms of chronic (long-term) intoxication of acetaldehyde resemble those of alcoholism. Acetaldehyde is considered a probable human carcinogen.

DPM/diesel exhaust organic gases are a complex mixture of hundreds of constituents in either gaseous or particle form. Gaseous components of diesel exhaust include CO_2, oxygen, nitrogen, water vapor, CO, nitrogen compounds, sulfur compounds, and numerous low-molecular-weight hydrocarbons. Among the gaseous hydrocarbon components of diesel exhaust that are individually known to be of toxicological relevance are several carbonyls (e.g., formaldehyde, acetaldehyde, acrolein), benzene, 1,3-butadiene, and polycyclic aromatic hydrocarbons (PAH) and nitro-PAHs. DPM is composed of a center core of elemental carbon and adsorbed organic compounds, as well as small amounts of sulfate, nitrate, metals, and other trace elements. DPM consists primarily of $PM_{2.5}$, including a subgroup with a large number of particles having a diameter less than 0.1 µm. Collectively, these particles have a large surface area, which makes them an excellent medium for adsorbing organic compounds. Also, their small size makes them highly respirable and able to reach the deep lung. Several potentially toxicologically relevant organic compounds, including PAHs, nitro-PAHs, and oxidized PAH derivatives, are on the particles. Diesel exhaust is emitted from on-road mobile sources such as automobiles and trucks and from off-road mobile sources (e.g., diesel locomotives, marine vessels, and construction equipment). DPM is directly emitted from diesel engines (primary PM) and can be formed from the gaseous compounds emitted by diesel engines (secondary PM).

Acute or short-term (e.g., episodic) exposure to diesel exhaust can cause acute irritation (e.g., eye, throat, and bronchial), neurophysiological symptoms (e.g., lightheadedness and nausea), and respiratory symptoms (e.g., cough and phlegm). Evidence also exists for an exacerbation of allergenic responses to known allergens and asthma-like symptoms (USEPA 2002). Information from the available human studies is inadequate for a definitive evaluation of possible noncancer health effects from chronic exposure to diesel exhaust. However, based on extensive animal evidence, diesel exhaust is judged to pose a chronic respiratory hazard to humans. The USEPA has determined that diesel exhaust is “likely to be carcinogenic to humans by inhalation” and that this hazard applies to environmental exposures (USEPA 2002).

Ethylbenzene is mainly used in the manufacture of styrene. Acute (short-term) exposure to ethylbenzene results in respiratory effects, such as throat irritation and chest constriction, irritation of the eyes, and neurological effects such as dizziness. Chronic (long-term) exposure to ethylbenzene by inhalation has shown conflicting results regarding its effects on the blood. Animal studies have reported effects on the blood, liver, and kidneys from chronic inhalation exposure to ethylbenzene.

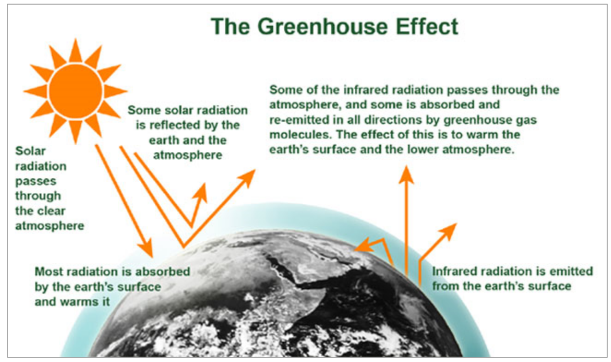
Formaldehyde is a colorless gas with a pungent, suffocating odor at room temperature. The major emission sources of formaldehyde appear to be power plants, manufacturing facilities, incinerators, and automobile exhaust. However, most of the formaldehyde in ambient air is a result of secondary formation through photochemical reactions of VOCs and NO_X. The major toxic effects caused by acute formaldehyde exposure by inhalation are eye, nose, and throat irritation and effects on the nasal cavity. Other effects from exposure to high levels of formaldehyde in humans are coughing, wheezing, chest pains, and bronchitis. Chronic exposure to formaldehyde by inhalation in humans has been associated with respiratory symptoms and eye, nose, and throat irritation. The USEPA considers formaldehyde to be a probable human carcinogen.

Naphthalene is used in mothballs and in the production of phthalic anhydride, a chemical compound used in industrial processes that can cause health effects in humans. Acute (short-term) exposure of humans to naphthalene by inhalation, ingestion, and dermal contact is associated with hemolytic anemia, damage to the liver, and neurological damage. Cataracts have also been reported in workers acutely exposed to naphthalene by inhalation and ingestion. Chronic (long-term) exposure of workers and rodents to naphthalene reportedly causes cataracts and damage to the retina. Hemolytic anemia has been reported in infants born to mothers who sniffed and ingested naphthalene (as mothballs) during pregnancy. Available data are inadequate to establish a causal relationship between exposure to naphthalene and cancer in humans. The USEPA has classified naphthalene as a possible human carcinogen.

Polycyclic organic matter defines a broad class of compounds that includes PAHs, of which benzo[a]pyrene is a member. Polycyclic organic matter compounds are formed primarily by combustion and are present in the atmosphere in particulate form. Sources of air emissions are diverse and include cigarette smoke, vehicle exhaust, home heating, laying tar, and grilling meat. Cancer is the major concern from exposure to polycyclic organic matter. Epidemiologic studies have reported an increase in lung cancer in humans exposed to coke oven emissions, roofing tar emissions, and cigarette smoke; all of these mixtures contain polycyclic organic matter compounds (USEPA 2016b). Animal studies have reported respiratory tract tumors from inhalation exposure to benzo[a]pyrene and forestomach tumors, leukemia, and lung tumors from oral exposure to benzo[a]pyrene. The USEPA has classified seven PAHs (benzo[a]pyrene, benz[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene) as probable human carcinogens.

4.3 Greenhouse Gases

Gases that trap heat in the atmosphere, or GHGs, are necessary to life, because they keep the planet's surface warmer than it otherwise would be. This is referred to as the *greenhouse effect* (Figure 4-5). As concentrations of GHGs increase, however, the Earth's temperature increases. According to National Oceanic and Atmospheric Administration and National Aeronautics and Space Administration data, the Earth's average surface (land and ocean) temperature has increased by 1.6 degrees Fahrenheit (°F) in the last 100 years (NOAA 2018). According to the USEPA, eight of the top 10 warmest years on record for the United States have occurred since 1998, and 2012 and 2015 were the two warmest years on record. Most of the warming in recent decades is very likely the result of human activities. Other aspects of the climate are also changing, such as rainfall patterns, snow and ice cover, and sea level (USEPA 2016c).



Source: USEPA 2015f

Figure 4-5 The Greenhouse Effect

Some GHGs, such as CO_2, occur naturally and are emitted into the atmosphere through natural processes and human activities. Other GHGs (e.g., fluorinated gases) are created and emitted solely through human activities. GHGs differ in their ability to trap heat. For example, 1 ton of emissions of CO_2 has a different effect than 1 ton of emissions of CH_4. To compare emissions of different GHGs, a weighting factor called global warming potential (GWP) is used. To use a GWP, the heat-trapping ability of 1 metric ton (1,000 kilograms) of CO_2 is taken as the standard, and emissions are expressed in terms of CO_2e. The GWP of CO_2 is 1, the GWP of CH_4 is 25, the GWP of N_2O is 298, and the GWP for SF_6 is 22,800 (CARB 2017). The following are the principal GHGs that enter the atmosphere because of human activities.

- **CO_2**—CO_2 enters the atmosphere from the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees, and wood products and as a result of other chemical reactions (e.g., manufacture of cement). CO_2 is also removed from the atmosphere (or sequestered) when it is absorbed by plants as part of the biological carbon cycle.
- **CH_4**—CH_4 is emitted during the production and transport of coal, natural gas, and oil. CH_4 emissions also result from livestock and other agricultural practices and from the decay of organic waste in municipal solid waste landfills.
- **N_2O**—N_2O is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.
- **Fluorinated gases**—Hydrofluorocarbons, perfluorocarbons, and SF_6 are synthetic, powerful GHGs that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for O_3-depleting substances (e.g., chlorofluorocarbons, hydrochlorofluorocarbons, and halons). These gases are typically emitted in smaller quantities but, because they are potent GHGs, they are sometimes referred to as high GWP gases.

Because of the global nature of GHG emissions, GHGs are examined for the project on the statewide and regional level. Effects of locally emitted GHGs are felt cumulatively and worldwide.

5 AFFECTED ENVIRONMENT

This chapter summarizes existing air quality and GHG conditions along the project corridor. Air quality is affected by both the rate and location of pollutant emissions and by meteorological conditions that influence movement and dispersal of pollutants. Atmospheric conditions, such as wind speed, wind direction, and air temperature gradients, along with local topography, provide the link between air pollutant emissions and air quality.

5.1 Meteorology and Climate

California is divided into 15 air basins based on geographic features that create distinctive regional climates. The Project Section is in the SFBAAB. Local meteorological conditions vary greatly throughout the Bay Area because of topography and elevation as well as proximity to local water bodies. The project would traverse two unique and different meteorological zones within the SFBAAB: the San Francisco Peninsula, and the Santa Clara Valley. These two areas are described in the following sections, based on information provided by BAAQMD (BAAQMD 2017a).

5.1.1 San Francisco Peninsula

The San Francisco Peninsula region extends from the Golden Gate to northwest of San Jose, bounded by the San Francisco Bay on the east, and the Pacific Ocean on the west. The Santa Cruz Mountains run up the center of the peninsula, with elevations exceeding 2,000 feet at the southern end, decreasing to 500 feet in South San Francisco. Coastal towns experience a high incidence of cool, foggy weather in the summer. Cities in the southeastern peninsula experience warmer temperatures and fewer foggy days because the marine layer is blocked by the ridgeline to the west. San Francisco lies at the northern end of the peninsula. Because most of San Francisco's topography is below 200 feet, marine air flows easily across most of the city, making the climate cool and windy.

The blocking effect of the Santa Cruz Mountains results in variations in summertime maximum temperatures in different parts of the Peninsula. For example, in coastal areas and San Francisco the mean maximum summer temperatures are about 65°F, while in Redwood City the mean maximum summer temperatures are about 81°F to 83°F. Mean minimum temperatures during the winter months range from about 36°F to 44°F on the eastern side of the peninsula and average 40°F to 43°F on the coast.

Two important gaps in the Santa Cruz Mountains occur on the peninsula. The larger of the two is the San Bruno Gap, extending from Fort Funston on the ocean to the San Francisco International Airport. Because the gap is oriented in the same northwest to southeast direction as the prevailing winds, and because the elevations along the gap are less than 200 feet, marine air is easily able to penetrate into the bay. The other gap is the Crystal Springs Gap, between Half Moon Bay and San Carlos. As the sea breeze strengthens on summer afternoons, the gap permits maritime air to pass across the mountains, and its cooling effect is commonly felt from San Mateo to Redwood City.

Annual average wind speeds range from 5 to 10 mph throughout the peninsula, with higher wind speeds usually found along the coast. Winds on the eastern side of the peninsula are often high in certain areas, such as near the San Bruno Gap and the Crystal Springs Gap. The prevailing winds along the peninsula's coast are from the west, although individual sites can show significant differences. For example, Fort Funston in western San Francisco has a southwest wind pattern, while Pillar Point in San Mateo County has a northwest wind pattern. On the east side of the mountains, winds are generally from the west, although wind patterns in this area are often influenced greatly by local topographic features.

At the northern end of the peninsula in San Francisco, pollutant emissions are high, especially from motor vehicle congestion. Localized pollutants, such as CO, can build up in urban canyons. Urban canyons are created when streets divide dense blocks of structures, especially skyscrapers, which can inhibit air circulation at the ground level. In most other areas, winds are generally fast enough to carry the pollutants away before they can accumulate. Air pollution potential is highest along the southeastern portion of the peninsula, where the high winds and fog of the marine layer are obstructed, resulting in accumulated concentrations of pollutants. Pollutant transport from upwind sites is common. In the southeastern portion of the peninsula, air pollutant emissions are relatively high because of motor vehicle traffic as well as stationary sources (BAAQMD 2017a).

5.1.2 Santa Clara Valley

The Santa Clara Valley is bounded by San Francisco Bay to the north and by mountains to the east, south, and west. Temperatures are warm on summer days and cool on summer nights, and winter temperatures are mild. At the northern end of the valley, mean maximum temperatures are 79°F to 82°F during the summer and 55°F to 59°F during the winter, and mean minimum temperatures range from 55°F to 59°F in the summer to 39°F to 43°F in the winter. Further inland, where the moderating effect of the bay is not as strong, temperature extremes are greater. For example, in San Martin, 27 miles south of San Jose International Airport, temperatures can be more than 10°F warmer on summer afternoons and more than 10°F cooler on winter nights.

Winds in the valley are greatly influenced by the terrain, resulting in a prevailing flow that roughly parallels the valley's northwest-southeast axis. A north-northwesterly sea breeze flows through the valley during the afternoon and early evening, and a light south-southeasterly drainage flow occurs during the late evening and early morning. In the summer, the southern end of the valley sometimes becomes a convergence zone; air flowing from Monterey Bay moves northward into the southern end of the valley and meets the prevailing north-northwesterly winds. Wind speeds are greatest in the spring and summer and weakest in the fall and winter. Nighttime and early morning hours frequently have calm winds in all seasons, while summer afternoons and evenings are quite breezy. Strong winds are rare, associated mostly with the occasional winter storm.

The air pollution potential of the Santa Clara Valley is high. High summer temperatures, stable air, and mountains surrounding the valley combine to promote O_3 formation. In addition to the many local sources of pollution, O_3 precursors from San Francisco, San Mateo, and Alameda Counties are carried by prevailing winds to the Santa Clara Valley. The valley tends to channel pollutants to the southeast. On summer days with low-level inversions, O_3 can be recirculated by southerly drainage flows in the late evening and early morning and by prevailing northwesterlies in the afternoon. A similar recirculation pattern occurs in the winter, affecting levels of CO and PM. This movement of the air up and down the valley significantly increases the effects of pollutants (BAAQMD 2017a).

5.2 Ambient Air Quality

The existing air quality conditions in the project vicinity can be characterized by regional measurement data. The CARB and various air districts operate air quality monitoring stations throughout California to measure pollutant concentrations. The BAAQMD operates air quality monitoring stations throughout the SFBAAB, including seven stations in or around the Bay Area: San Francisco, San Carlos Airport, Redwood City, Palo Alto Airport, San Jose—Jackson Street, San Jose—Knox Avenue, and Reid-Hillview Airport. Each station monitors different pollutants of concern. The San Jose—Knox Avenue station and the three airport stations are special-purpose monitors sited to measure the effects of specific nearby emission sources. Emissions near these stations are not representative of conditions along the peninsula corridor (BAAQMD 2016a). For the purposes of this analysis, three stations were selected to represent conditions along the corridor: San Francisco—Arkansas Street, Redwood City—Barron Avenue, and San Jose—Jackson Street. Each of the selected stations, illustrated on Figure 5-1, monitors ozone, CO, NO_X, PM_{10} (except at Redwood City), and $PM_{2.5}$.

Figure 5-1 Air Quality Monitoring Station Locations

Table 5-1 shows the results of ambient monitoring at the three stations for the most recent 3 years of available data. Between 2015 and 2017, measured CO and NO_2 concentrations did not exceed any federal or state standards at any of the three monitoring locations. However, the state standards for PM_{10} were exceeded, as was the federal standard for 24-hour $PM_{2.5}$. The federal and state ozone standards were exceeded at Redwood City—Barron Avenue and San Jose—Jackson Street. The state 24-hour and annual standards for PM_{10} were exceeded at San Francisco—Arkansas Street and San Jose—Jackson Street. The federal standard for 24-hour $PM_{2.5}$ was exceeded at all three sites. The most frequent exceedances occurred at San Jose.

5.3 Attainment Status

Local monitoring data (Table 5-1) are used to designate areas as nonattainment, maintenance, attainment, or unclassified for the NAAQS and CAAQS. The four designations are further defined as follows:

- **Nonattainment**—Assigned to areas where monitored pollutant concentrations consistently violate the standard in question.
- **Maintenance**—Assigned to areas where monitored pollutant concentrations exceeded the standard in question in the past but are no longer in violation of that standard.
- **Attainment**—Assigned to areas where pollutant concentrations meet the standard in question over a designated period of time.
- **Unclassified**—Assigned to areas where data are insufficient to determine whether a pollutant is violating the standard in question.

Table 5-2 shows the attainment status of portions of the SFBAAB in the project corridor with regard to the NAAQS and CAAQS.

Table 5-1 Ambient Criteria Pollutant Concentrations at Air Quality Monitoring Stations in the Project Vicinity

Pollutant and Standards	San Francisco—Arkansas Street			Redwood City—Barron Avenue			San Jose—Jackson Street		
	2015	2016	2017	2015	2016	2017	2015	2016	2017
Ozone (O_3)									
Maximum 1-hour concentration (ppm)	0.085	0.070	0.087	0.086	0.075	0.115	0.094	0.087	0.121
Maximum 8-hour concentration (ppm)	0.067	0.057	0.054	0.071	0.060	0.086	0.081	0.066	0.088
Number of days standard exceeded[1]									
CAAQS 1-hour (>0.09 ppm)	0	0	0	0	0	2	0	0	3
NAAQS 8-hour (>0.070 ppm)	0	0	0	1	0	2	2	0	4
CAAQS 8-hour (>0.070 ppm)	0	0	0	1	0	2	2	0	4
Carbon Monoxide (CO)									
Maximum 8-hour concentration (ppm)	1.3	1.1	1.4	1.6	1.1	1.4	1.8	1.4	1.8
Maximum 1-hour concentration (ppm)	1.8	1.7	2.5	3.4	2.2	2.8	2.4	1.9	2.1
Number of days standard exceeded[1]									
NAAQS 8-hour (≥9 ppm)	0	0	0	0	0	0	0	0	0
CAAQS 8-hour (≥9.0 ppm)	0	0	0	0	0	0	0	0	0
NAAQS 1-hour (≥35 ppm)	0	0	0	0	0	0	0	0	0
CAAQS 1-hour (≥20 ppm)	0	0	0	0	0	0	0	0	0
Nitrogen Dioxide (NO_2)									
National maximum 1-hour concentration, 98th percentile (ppm)	0.0532	0.0507	0.0586	0.0403	0.0396	0.0462	0.0493	0.0511	0.0675
State maximum 1-hour concentration (ppm)	0.070	0.058	0.073	0.047	0.045	0.067	0.049	0.051	0.067
State annual average concentration (ppm)	0.012	0.010	0.011	0.010	0.009	0.010	0.012	0.011	N/A
Number of days standard exceeded									
NAAQS 1-hour (98th percentile>0.100 ppm)	0	0	0	0	0	0	0	0	0
CAAQS 1-hour (0.18 ppm)	0	0	0	0	0	0	0	0	0

Pollutant and Standards	San Francisco—Arkansas Street			Redwood City—Barron Avenue			San Jose—Jackson Street		
	2015	2016	2017	2015	2016	2017	2015	2016	2017
Annual standard exceeded?									
NAAQS Annual (>0.053 ppm)	No	No	No	No	No	No	No	No	No
CAAQS Annual (>0.030 ppm)	No	No	No	No	No	No	No	No	No
Particulate Matter (PM_{10})[2]									
National[3] maximum 24-hour concentration (μg/m³)	44.7	35.7	75.9	N/A	N/A	N/A	58.8	40.0	69.4
National[3] second-highest 24-hour concentration (μg/m³)	38.2	27.9	52.7	N/A	N/A	N/A	47.2	35.2	67.3
State[4] maximum 24-hour concentration (μg/m³)	47.0	29.0	77.0	N/A	N/A	N/A	58.0	41.0	69.8
State[4] second-highest 24-hour concentration (μg/m³)	39.0	28.0	53.0	N/A	N/A	N/A	49.3	37.5	67.6
National annual average concentration (μg/m³)	9.8	8.8	11.0	N/A	N/A	N/A	21.3	17.5	20.7
State annual average concentration (μg/m³)[5]	N/A	N/A	22.1	N/A	N/A	N/A	21.9	18.3	21.3
Number of days standard exceeded[1]									
N/AAQS 24-hour (>150 μg/m³)[6]	0	0	0	N/A	N/A	N/A	0	0	0
CAAQS 24-hour (>50 μg/m³)[6]	N/A	N/A	2	N/A	N/A	N/A	3	0	19
Annual standard exceeded?									
CAAQS Annual (>20 μg/m³)	N/A	N/A	Yes	N/A	N/A	N/A	Yes	No	Yes
Particulate Matter ($PM_{2.5}$)									
National[3] maximum 24-hour concentration (μg/m³)	35.4	19.6	49.9	34.6	19.5	60.8	49.4	22.6	49.7
National[3] second-highest 24-hour concentration (μg/m³)	34.3	19.3	49.7	26.0	18.4	57.7	37.0	21.8	46.5
State[4] maximum 24-hour concentration (μg/m³)	35.4	19.6	49.9	34.6	19.5	60.8	49.4	22.7	49.7
State[4] second-highest 24-hour concentration (μg/m³)	34.3	19.3	49.7	26.0	18.4	57.7	37.0	21.8	46.5
National annual average concentration (μg/m³)	7.9	7.5	9.7	6.0	8.3	9.0	9.9	8.3	9.5
State annual average concentration (μg/m³)[5]	7.9	N/A	9.7	6.0	N/A	9.1	10.6	8.4	N/A
Number of days standard exceeded[1]									

Pollutant and Standards	San Francisco—Arkansas Street			Redwood City—Barron Avenue			San Jose—Jackson Street		
	2015	2016	2017	2015	2016	2017	2015	2016	2017
NAAQS 24-hour (>35 µg/m^3)	0	0	7	0	0	6	2	0	6
Annual standard exceeded?									
NAAQS Annual (>12.0 µg/m^3)	No	No	No	No	No	No	No	No	No
CAAQS Annual (>12 µg/m^3)	No	N/A	No	No	N/A	No	No	No	No
Sulfur Dioxide (SO_2)									
No data available	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Sources: CARB 2018a; USEPA 2018a
µg/m^3 = micrograms of pollutant per cubic meter of air
CAAQS = California ambient air quality standards
N/A = not applicable or there was insufficient or no data available to determine the value
NAAQS = national ambient air quality standards
ppm = parts per million
> = greater than
≥ = greater than or equal to
[1] An exceedance of a standard is not necessarily a violation because of the regulatory definition of a violation.
[2] National statistics are based on standard conditions data. In addition, national statistics are based on samplers using federal reference or equivalent methods.
[3] State statistics are based on local conditions data.
[4] Measurements usually are collected every 6 days.
[5] State criteria for data sufficiently complete for calculating valid annual averages are more stringent than the national criteria.
[6] Mathematical estimate of how many days' concentrations would have been measured as higher than the level of the standard had each day been monitored. Values have been rounded.

Table 5-2 Federal and State Attainment Status in the San Francisco Bay Area Air Basin

Pollutant	Federal Designation (Classification)	State Designation
Ozone (O_3)	Nonattainment (marginal)	Nonattainment
Particulate matter (PM_{10})	Attainment/unclassified	Nonattainment
Particulate matter ($PM_{2.5}$)	Nonattainment (moderate)	Nonattainment
Carbon monoxide (CO)	Attainment	Attainment
Nitrogen dioxide (NO_2)	Attainment/unclassified	Attainment
Sulfur dioxide (SO_2)	Attainment/unclassified	Attainment

Sources: CARB 2017; USEPA 2018b

5.4 Emissions Inventory

An emissions inventory is an accounting of the total emissions from all sources in a particular geographic area over a specified period. Emission inventories are used in air quality planning and can provide a general indication of existing air quality in an area.

5.4.1 Criteria Pollutants

The CARB maintains an annual emission inventory for each county and air basin in the state. The inventory for the SFBAAB is composed of data submitted to the CARB by the BAAQMD, plus estimates for certain source categories, which are provided by CARB staff. The 2015 air pollutant inventory data for the SFBAAB is shown in Table 5-3.

In the SFBAAB, mobile source emissions account for 947 tons per day (85 percent) and 216 tons per day (79 percent) of the basin's CO and NO_X emission inventory, respectively. Area-wide sources account for more than 177 tons per day (87 percent) and 131 tons per day (22 percent) of the basin's PM and total organic gas emissions, respectively, and stationary sources account for 21 tons per day (89 percent) of the basin's sulfur oxide (SO_X) emissions.

Table 5-3 Estimated Annual Average Emissions for the San Francisco Bay Area Air Basin (2015 tons per day)

Source Category	TOG	ROG	CO	NO_X	SO_X	PM	PM_{10}	$PM_{2.5}$
Stationary Sources								
Fuel combustion	18.8	4.2	27.6	33.4	9.4	1.3	1.3	1.3
Waste disposal	193.3	3.2	1.9	1.1	0.5	–	–	–
Cleaning and surface coatings	38.8	27.3	0	0	0	–	–	–
Petroleum production and marketing	72.9	15.1	0.9	0.6	2.1	–	–	–
Industrial processes	13.9	11.4	2.2	4.3	8.8	9.2	4.9	1.6
Total stationary sources	337.7	61.1	32.6	39.6	20.8	10.6	6.3	2.9
Stationary sources percentage of total	58%	26%	3%	15%	89%	5%	5%	7%
Area-Wide Sources								
Solvent evaporation	66.5	56.6	–	–	–	–	–	–
Miscellaneous processes	64.2	15	128.4	16.4	0.5	176.6	96.5	31.7
Total area-wide sources	130.7	71.6	128.4	16.4	0.5	176.6	96.5	31.7
Area-wide sources percentage of total	22%	30%	12%	6%	2%	87%	81%	72%
Mobile Sources								
On-road motor vehicles	62.7	57.8	546.8	126.8	1	12.1	11.9	5.6
Other mobile sources	50.4	45.6	399.8	88.8	1.3	4.2	4.1	3.8
Total mobile sources	113.2	103.3	946.6	215.6	2.3	16.3	16	9.4
Mobile sources percentage of total	19%	44%	85%	79%	10%	8%	13%	21%
Grand total (all sources)	**581.6**	**236.1**	**1,107.5**	**271.6**	**23.5**	**203.4**	**118.8**	**44**

Source: CARB 2013
– = not applicable or data not available
CO = carbon monoxide
NO_X = nitrogen oxide
PM = particulate matter
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
ROG = reactive organic gases
SO_X = sulfur oxide
TOG = total organic gases

5.4.2 Statewide Greenhouse Gas Emissions

The CARB maintains a statewide emissions inventory of GHGs, shown in Table 5-4. In 2016, the largest contributor to GHG emissions was the transportation sector (41 percent). This sector includes emissions from on-road vehicles, interstate aviation, waterborne vessels, and rail operations. The next largest contributor to emissions was the industrial sector (23 percent), followed by electricity generation (16 percent, including in-state and imports).

Table 5-4 California Greenhouse Gas Inventory (2016)

Sector	Emissions (million metric tons CO_2e)	Percent of Inventory
Transportation	174	41%
Industrial	100	23%
Electricity generation (in-state)	43	10%
Electricity generation (imports)	26	6%
Agriculture & forestry	34	8%
Residential	28	7%
Commercial	23	5%
Not specified	1	<1%
Total	**429**	**100%**

Source: CARB 2018b
CO_2e = carbon dioxide equivalent
< = less than

5.5 Sensitive Receptors

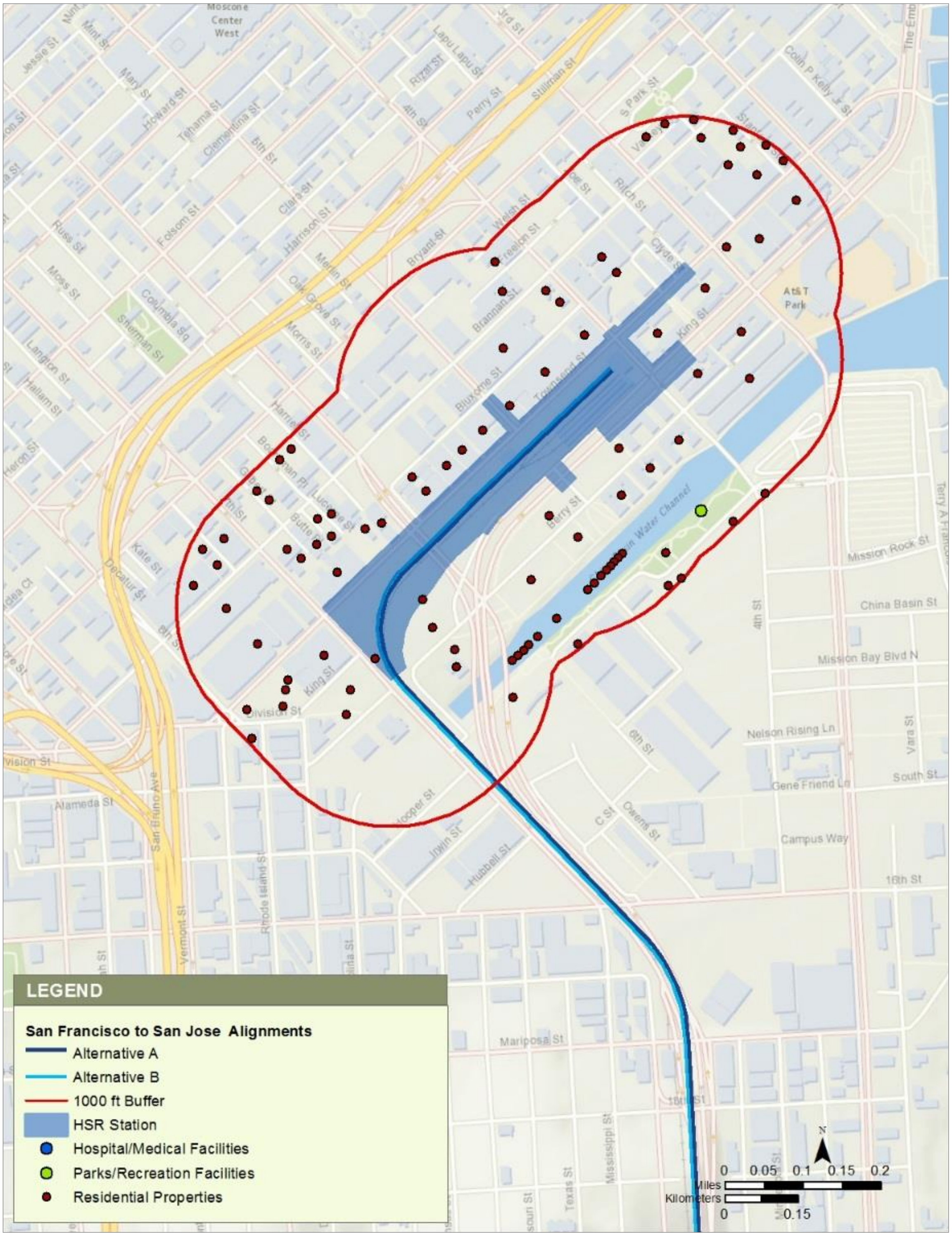
Sensitive receptors are people who have an increased sensitivity to air pollution or environmental contaminants. Sensitive receptor locations include schools, parks and playgrounds, day care centers, nursing homes, and hospitals. Residences are also considered sensitive land uses because people can be exposed to pollutants for extended periods. Recreational areas are considered moderately sensitive to poor air quality because vigorous exercise associated with recreation places a high demand on the human respiratory function.

Analyses performed by the CARB indicate that providing a separation of at least 1,000 feet from diesel sources and high-traffic areas would substantially reduce exposure to air contaminants and decrease asthma symptoms in children (Cal-EPA and CARB 2005). Sensitive receptors located within 1,000 feet of the 4th and King Street and Millbrae Stations, the East Brisbane LMF site, and the West Brisbane LMF site, are listed in Table 5-5 and illustrated on Figures 5-2 through 5-5. Residential land uses are the most common sensitive receptors in the RSA. Other sensitive receptors in the RSA include schools, hospitals, convalescent homes, and recreational areas.

Table 5-5 Sensitive Receptors within 1,000 Feet of the 4th and King Street and Millbrae Stations and the East and West Brisbane LMF

Receptor	Distance from Facility[1,2] (feet)
4th and King Street Station	
Nearest residential receptor	56
San Francisco Tennis Club	234
Mission Creek Park	917
Millbrae Station	
Nearest residential receptor	10
Burlingame Health Care Center	10
Medical offices, 1860 El Camino Real	155
Medical and dental offices, 1840 El Camino Real	191
Mills-Peninsula Medical Center	448
Magnolia of Millbrae	844
Bayside Manor Park	979
Brisbane LMF	
Nearest residential receptor	76
Brisbane Community Park	0[3]
Brisbane Lagoon	0
Brisbane Skate Park and Basketball Courts	0
Brisbane City Hall Dog Park	240
Old Quarry Road Park and Trail	374
Little Hollywood Park	590
San Bruno Mountain State and County Park	Alternative A: >1,000 Alternative B: 607
Visitacion Valley Community Center	686

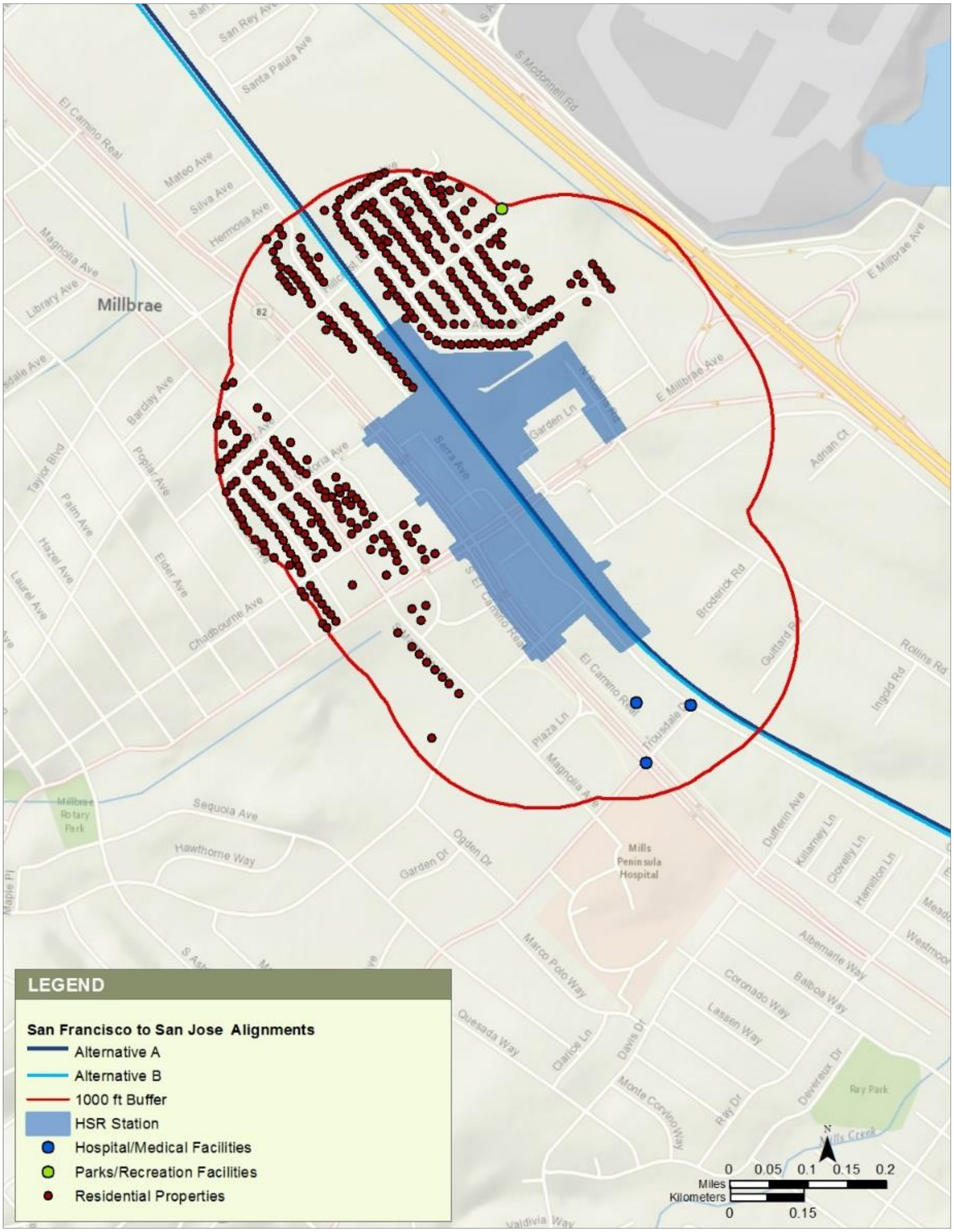
Sources: Authority 2019b; California Protected Areas Database (CPAD) 2016
> = greater than
[1] Distances are measured from the facility site perimeter. Distances from facility buildings are greater.
[2] Distances apply to both alternatives unless noted otherwise.
[3] Zero values indicate that the receptor abuts the LMF site perimeter.



Sources: Authority 2019a; CPAD 2016

JANUARY 2019

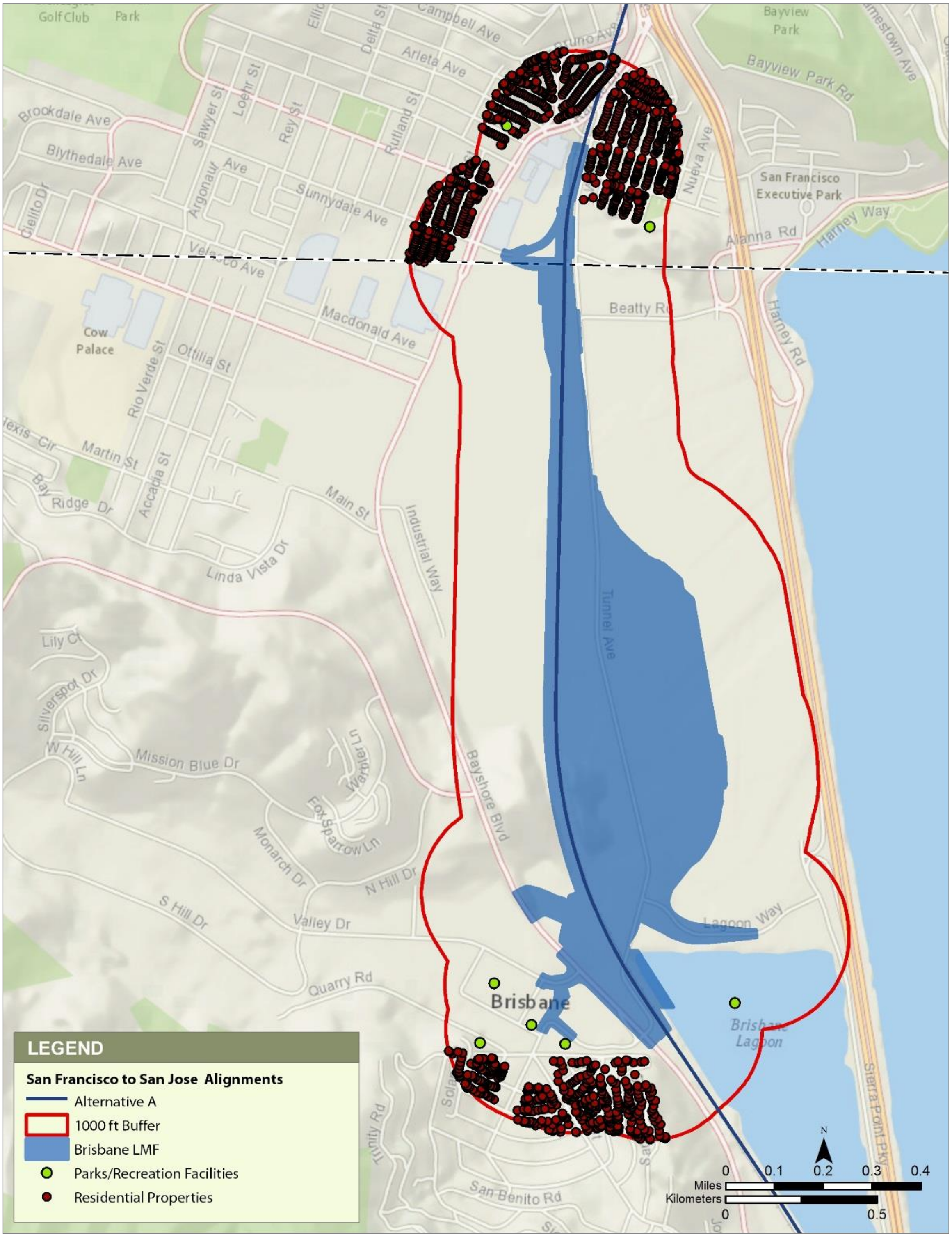
Figure 5-2 Sensitive Receptors within 1,000 Feet of the 4th and King Street Station



Sources: Authority 2019a; CPAD 2016

JANUARY 2019

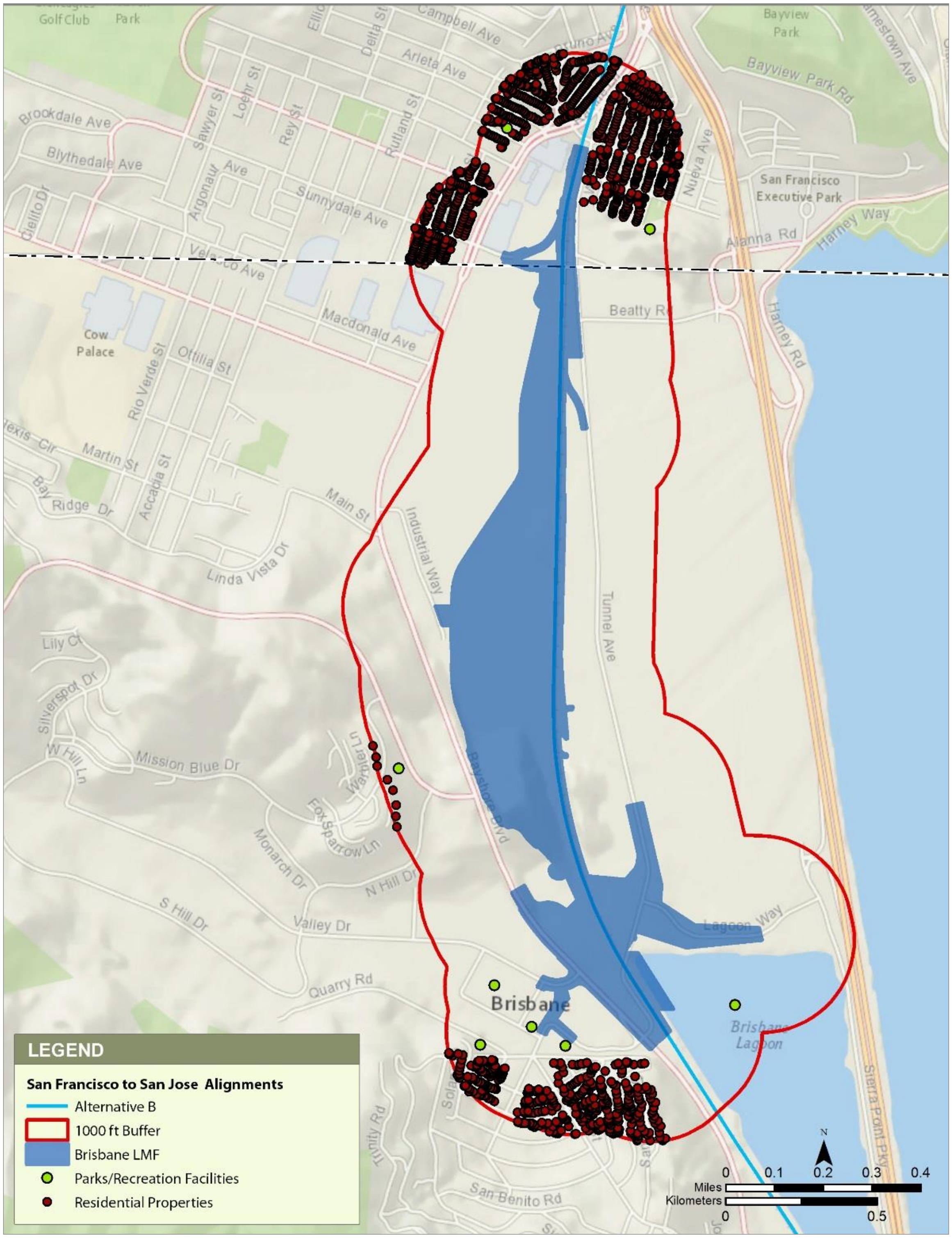
Figure 5-3 Sensitive Receptors within 1,000 Feet of the Millbrae Station



Sources: Authority 2019a; CPAD 2016

SEPTEMBER 2019

Figure 5-4 Sensitive Receptors within 1,000 Feet of the East Brisbane LMF (Alternative A)



Sources: Authority 2019a; CPAD 2016

SEPTEMBER 2019

Figure 5-5 Sensitive Receptors within 1,000 Feet of the West Brisbane LMF (Alternative B)

6 METHODS FOR EVALUATING EFFECTS

This chapter discusses the methods used to determine the air quality and global climate change effects of the construction and operations of the project. The discussion includes the existing physical conditions that were assumed in the analysis.

Air quality analysts used the year 2015 to represent existing conditions for this analysis (2015 existing conditions). The project would be constructed and in operation by 2029, and the full Phase 1 of the statewide HSR system would be operational by 2040. The existing background conditions (e.g., background traffic volumes, trip distribution, and vehicle emissions) of 2015 would change over the 25-year span to full operations in 2040. Changes to the transportation network over the next 25 years will result from funded transportation projects programmed to be constructed by 2040. The buildout of local development plans will affect background traffic volumes. Changes in vehicle emissions over the next 25 years will result from application of updated and more stringent vehicle emissions standards, as well as changing background traffic and VMT. Given these anticipated changes in background conditions over the life of the project from 2015 existing conditions, the project's air quality operations effects are evaluated against both 2015 existing conditions and background conditions (i.e., No Project conditions) as they are expected to be in 2040 (when the full Phase 1 of the statewide HSR system is in operation). The 4th and King Street Station is evaluated in 2029, the opening year of the project, because it will no longer be in use by 2040.

Temporary transportation-related effects, such as those from temporary road closures during construction, are evaluated only against 2015 existing conditions. Construction of the project alone could reconfigure the existing roadway network, permanently redirecting existing traffic and causing traffic effects at intersections and road segments that receive the redirected traffic.

6.1 Definition of Resource Study Area

The RSA is the area in which all environmental investigations specific to air quality and global climate change are conducted to determine the resource characteristics and potential effects of the project. The RSA for air quality and global climate change comprises the state, the regional air basin (the SFBAAB), and the local study areas (areas immediately adjacent to construction activities). Each of these components of the RSA is described in the following subsections.

6.1.1 Statewide

Analysts identified a statewide RSA to evaluate potential changes in GHG/global climate change and air quality from large-scale, nonlocalized factors. Such factors include HSR power requirements, changes in air traffic, and project conformance with the SIP.

6.1.2 Regional

The project would potentially affect regional air pollutant concentrations in the SFBAAB, which contains the entire Project Section. The SFBAAB comprises all of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, and Santa Clara Counties, the southern portion of Sonoma County, and the southwestern portion of Solano County. The SFBAAB is defined by the mountains of the Coast Ranges to the east and west (averaging 3,000 feet in elevation). The Bay Area is California's second largest metropolitan region.

6.1.3 Local

Local RSAs are areas of potential major air emission activities, including areas where construction would occur along the project alignment and near construction staging areas. Local RSAs are generally defined as areas within 1,000 feet of the project footprints or construction staging areas. CARB analyses indicate that providing a separation of 1,000 feet from diesel sources and high-traffic areas substantially reduces DPM concentrations, public exposure, and asthma symptoms in children (Cal-EPA and CARB 2005). Accordingly, the area extending from the tracks out to 1,000 feet from the project right-of-way is defined as the local RSA.

6.2 Statewide and Regional Operations Emissions Calculations

The emission burden analysis of a project determines a project's overall effect on air quality levels. The project would affect long-distance, city-to-city travel along freeways and highways throughout the state, as well as long-distance, city-to-city aircraft takeoffs and landings. The HSR system would also affect electrical demand throughout the state. Analysts calculated criteria pollutant and GHG operations emissions for two ridership scenarios: a medium ridership scenario and a high ridership scenario. Analysts developed these two scenarios for three different years: 2015 existing conditions, 2029 Project conditions (opening), and 2040 Project conditions (Phase 1 of the HSR system horizon 2040). Both scenarios are based on the level of ridership as presented in *Connecting and Transforming California: 2016 Business Plan* (2016 Business Plan) (Authority 2016).[8] Two ridership scenarios are shown for the No Project conditions because these scenarios assume different background conditions. For example, forecast trends in demographics and travel costs can influence ridership for any HSR scenario. The medium scenario was developed using the "most likely" values of all inputs to the HSR ridership forecasting model, while the high scenario used inputs that were set at values that result in ridership at the 75th percentile of the range considered in the ridership risk analysis. The 2016 Business Plan provides additional detail on the travel forecasts and risk analysis. The tables in the effects analysis therefore present two values for operations emissions for each pollutant, corresponding to these two scenarios.

6.2.1 On-Road Vehicles

Analysts evaluated on-road vehicle emissions using average daily VMT estimates and associated average daily speed estimates for each affected county. Analysts estimated emission factors using the CARB emission factor program, EMission FACtors (EMFAC) 2017 (CARB 2018c), which accounts for existing regulations that would reduce emissions, such as the Pavley Clean Car Standards. Parameters were set in the program for each county to reflect conditions within each county and statewide parameters to reflect travel through each county. The analysis was conducted for the following modeling years:

- Existing Year (2015)
- Opening Year (2029)
- Horizon Year (2040)

To determine overall pollutant burdens generated by on-road vehicles, analysts multiplied the estimated VMT by the applicable pollutant's emission factors, which are based on speed, vehicle mix, and analysis year. The difference between emissions with the project and without the project represents the effects of the project.

6.2.2 Trains

The entire HSR system, including the project, would use electric multiple unit (EMU) trains, with the power distributed through the OCS. Accordingly, the HSR system would not produce direct emissions from combustion of fossil fuels and associated emissions. However, trains traveling at high velocities, such as those associated with the HSR system, create sideways turbulence and rear wake (also known as induced wind), which re-suspend particulates from the surface surrounding the track, resulting in fugitive dust. Analysts used the USEPA (2006a) method for estimating emissions from wind erosion. They assumed a friction velocity of 0.62 foot per second to re-suspend soils and that a HSR train passing at 220 mph could re-suspend soil particles out

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[8] The Authority Board adopted the 2018 Business Plan on May 15, 2018. The 2018 Business Plan assumes an opening year of 2033 for Phase 1 and presents different ridership forecasts for 2029 and 2040 than were assumed in this technical report. Under the 2018 Business Plan ridership forecasts, the project would achieve the same benefits described in this section, but they would occur at different times and may be less than presented in Chapter 7, Air Quality Effects Analysis, and Chapter 8, Global Climate Change Effects Analysis. Nonetheless, the HSR system ultimately affords a more energy-efficient choice for personal travel that will help alleviate highway congestion, provide greater capacity for goods movement, and reduce criteria pollutant and GHG emissions.

to approximately 10 feet from the train (San Joaquin Valley Air Pollution Control District [SJVAPCD] 1996).

6.2.3 Aircraft

Analysts used the Federal Aviation Administration's Aviation Environmental Design Tool to estimate aircraft emissions. This tool estimates the emissions from the aircraft engines for all phases of aircraft ground and airborne operation, based on specified numbers of landing and take-off cycles. Along with emissions from the aircraft, emissions generated from associated ground-maintenance requirements are included. Analysts calculated aircraft GHG emissions by using the fuel consumption factors and emission factors from the CARB's 2000–2014 *Greenhouse Gas Emissions Inventory Technical Support Document* and the accompanying appendix. The emission factor includes both landing and take-off and cruise operations (formula: aircraft emissions per flight = fuel consumption × emission factor; aircraft emissions = flights removed × aircraft emissions per flight). Analysts calculated average aircraft emissions based on the profile of intrastate aircraft currently servicing the San Francisco to Los Angeles corridor. Analysts estimated the number of air trips removed attributable to the project through the travel demand modeling analysis conducted for the project, based on the ridership estimates presented in the 2016 Business Plan (Authority 2016).

6.2.4 Power Plants

Analysts conservatively estimated the electrical demands caused by propulsion of the trains and the trains at terminal stations and in storage depots and LMF as part of the project design. Analysts derived average emission factors for each kilowatt-hour (kWh) required from CARB statewide emission inventories of electrical and cogeneration facilities data along with USEPA eGRID2016 electrical generation data. The energy estimates used in this analysis for the propulsion of the HSR include the use of regenerative brake power.

The HSR system is currently analyzed as if it would be powered by the state's current electric grid. This is a conservative assumption because of the state requirement that an increasing fraction of electricity (60 percent by 2030) generated for the state's power portfolio come from renewable energy sources. As such, the emissions generated for the HSR system are expected to be lower in the future than the emissions estimated for this analysis. Furthermore, under the 2013 Policy Directive POLI-PLAN-03, the Authority has adopted a goal to purchase 100 percent of the HSR system's power from renewable energy sources.

6.3 Local Operations Emissions Calculations

The following sections discuss the methods used to estimate operations emissions from the train stations and LMF and evaluate the project's effect on ambient air quality conditions and human health. The health risk assessment (HRA) focuses on the key localized pollutants of concern, which are CO, PM, and MSATs.

6.3.1 Stations

The project includes modifications to the existing 4th and King Street and Millbrae Stations. Improvements to 4th and King Street Station would include the installation of a booth in the existing station for HSR ticketing and support services, HSR fare gates, and modifications to existing tracks and platforms to accommodate HSR service.

At Millbrae Station, new HSR station facilities would include a station house area for ticketing and support services and an indoor station room for passengers. A new overhead crossing would extend the existing station concourse to the new HSR tracks and platforms located on the west side of the station. Automobile access and curbside pick-up and drop-off areas would be improved and additional surface parking would be provided.

Emissions associated with the operation of the stations would primarily result from area and stationary sources, electricity and water consumption, waste generation, emergency generator testing, and vehicle traffic. The methods used to evaluate each of these sources are described in the following subsections.

Because the 4th and King Street and Millbrae Stations are existing facilities, emissions were analyzed under both 2015 existing conditions and 2029 and 2040 Project conditions. The difference between existing and project conditions represents the net effect of the project.

6.3.1.1 Area Sources

Analysts calculated the criteria pollutant and GHG emissions from area sources using CalEEMod. Emissions were based on the land use data, entered as the size of the station buildings (square feet). The CalEEMod output files and the activity data details used to develop the estimates are summarized in Appendix A.

6.3.1.2 Natural Gas

Analysts calculated criteria pollutant and GHG emissions from natural gas consumption for water and space heating based on the building square footage, existing gas consumption rates, and CalEEMod. The existing gas consumption rate (0.05 therm/square foot/year) for the San Jose Diridon Station was assumed to be representative of the rates at the 4th and King Street and Millbrae Stations and was used in the calculations.

6.3.1.3 Indirect Electricity

Stations generate indirect emissions from purchased electricity consumed for facility lighting. It is expected that the power used by HSR stations would be much less than the power used by train operations; however, the indirect emissions from power consumption have been included in the overall emission estimates.

Analysts calculated indirect GHG emissions from purchased electricity consumed by HSR stations based on the building square footage, existing electricity consumption rates, and CalEEMod. The existing electricity usage rate (28 kWh/square foot/year) for the San Jose Diridon Station was assumed to be representative of the rates at the 4th and King Street and Millbrae Stations and was used in the calculations.

6.3.1.4 Indirect Water and Wastewater

Stations generate indirect GHG emissions from purchased water consumed for facility restrooms, drinking fountains, landscaping, and other miscellaneous uses. Analysts calculated indirect GHG emissions from purchased water consumed by the HSR stations based on the building square footage, existing water consumption rates, and CalEEMod. The existing water consumption rate (89 gallons/square foot/year) for the San Jose Diridon Station was assumed to be representative of the rates at the 4th and King Street and Millbrae Stations and was used in the calculations.

6.3.1.5 Indirect Solid Waste

Stations generate indirect GHG emissions from solid waste disposal. Waste generation rates at existing stations were not available. Accordingly, analysts calculated indirect GHGs from solid waste generation using CalEEMod defaults.

6.3.1.6 Emergency Generators

The 4th and King Street and Millbrae Stations currently have emergency generators that are used in the event of a power outage. An additional generator would be installed at the Millbrae Station. Analysts assumed that the emergency generators would be Tier 4, 800-kilowatt generators. Usage of each of the proposed emergency generators would occur for up to 50 hours per year for periodic testing, consistent with CARB's Airborne Toxic Control Measure for Stationary Compression Ignition Engines and Section 330.3 of BAAQMD Regulation 9, Rule 8. Analysts modeled emissions using CalEEMod.

6.3.1.7 Vehicle Traffic

Passengers

Mobile source emissions would occur from passengers accessing the stations. Passengers would be expected to arrive at the 4th and King Street and Millbrae Stations by car, shuttle/bus, and intercity/regional rail.[9] The numbers of daily passengers visiting the 4th and King Street and Millbrae Stations are shown in Table 6-1. As a conservative estimate, passenger traffic was expected to occur 7 days per week.

Table 6-1 Daily Passengers at HSR Stations

Mode of Access	4th and King Street Station	Millbrae Station
By car[1] (auto trips)		
Existing		
2016 without HSR	2,954	9,172
2016 with HSR	6,524	13,662
Future without HSR		
2029	3,108	N/A
2040	N/A	10,355
Future with HSR		
2029	6,678	N/A
2040	N/A	14,845
By shuttle (passenger trips with and without HSR)[2]		
2029	0	N/A
2040	N/A	870
By bus/regional rail/intercity rail (passenger trips with and without HSR)[2]		
2029	5,710	N/A
2040	N/A	5,220

HSR = high-speed rail
N/A = not applicable
[1] Represents boarding and alighting passengers. Each passenger was therefore assumed to represent one vehicle trip (one to the station and one from the station)
[2] The Project conditions are the same as the No Project conditions. This is because all transit agencies have long-range expansion plans that include increased demand from HSR.

Analysts estimated vehicular exhaust emissions from passengers arriving via car using CalEEMod assuming a mix of light-duty automobiles and light-duty trucks. Connecting bus service would be provided primarily by SamTrans and MUNI. Connecting rail service includes Caltrain and BART. All agencies have long-range expansion plans that include increased demand from HSR. These plans outline anticipated service and vehicle needs commensurate with the expected demand on their respective travel modes. Because increases in light rail and bus service are captured in Caltrain, BART, SamTrans, and MUNI long-range plans and associated environmental analyses, mass emissions generated by these modes are not included in the air quality or GHG assessment for the project.

[9] Bicycling and walking trips have been excluded from the table and analysis since they would not produce emissions.

Employees

Analysts calculated emissions from employee traffic using CalEEMod based on weighted average vehicle emission factors for light-duty automobiles and light-duty trucks. The existing ratio of station area to employee trips (600 square feet/employee car trip) for the San Jose Diridon Station was assumed representative of the ratios at the 4th and King Street and Millbrae Stations and was used in the calculations. As a conservative estimate, employee traffic was expected to occur 7 days per week. Analysts assumed that each employee would make one round trip per day. The estimated total of daily employee round trips is 19 at the 4th and King Street Station and 42 at the Millbrae Station.

6.3.2 Light Maintenance Facility

One LMF would be constructed in Brisbane either east of the alignment (Alternative A) or west of the alignment (Alternative B). Activities performed at the Brisbane LMF would consist of cleaning and servicing between runs, pre-departure inspections and testing, monthly and quarterly inspection and maintenance, train wash and wheel defect detection, and motor vehicles accessing the facility.

Emissions from activities at the Brisbane LMF are expected to be low because the facility would not include activities typically associated with higher emissions (e.g., body shop, paint booth, storage tanks, extensive welding). Analysts used CalEEMod to estimate building operation emissions, assuming default conditions for the *general light industrial* land use category (Appendix A). Analysts assumed that there would be an average of 20 truck trips to the LMF per day and that the trucks would travel 120 miles round trip. Truck activity would include delivery of supplies, materials, and chemicals, and removal of refuse from the site. There would be 150 employees at the LMF. The emission outputs are provided in Appendix A.

The Brisbane LMF would have a diesel-fueled emergency generator. Analysts assessed the potential health effects of DPM emissions from the generator in accordance with BAAQMD guidance. BAAQMD considers the zone of influence for potential health effects from exposure to DPM to be 1,000 feet from the emission source. Because emissions dissipate as a function of distance, health risks beyond 1,000 feet would be minimal. There are no sensitive receptors within 1,000 feet of the potential generator locations at the East Brisbane LMF site (Alternative A) or the West Brisbane LMF site (Alternative B).

6.3.3 Microscale Carbon Monoxide Hot Spot Analysis

Traffic around the 4th and King Street and Millbrae Stations and affected by roadway-rail at-grade crossings may contribute to localized increases in CO concentrations, known as CO hot spots. The BAAQMD has adopted screening criteria that provide a conservative indication of whether project-generated traffic would cause a potential CO hot spot. The air district established that if the screening criteria are met, a quantitative analysis through site-specific dispersion modeling of project-related CO concentrations would not be necessary, and the project would not cause localized exceedances of CO CAAQS. BAAQMD developed the screening criteria based on local dispersion modeling. The criteria provide a conservative estimate for the maximum number of vehicles that can be added to an intersection without an exceedance of the CO CAAQS. The BAAQMD CO screening criteria are as follows:

- Project traffic would not increase traffic volumes at affected intersections to more than 44,000 vehicles per hour.
- Project traffic would not increase traffic volumes at affected intersections to more than 24,000 vehicles per hour where vertical and/or horizontal mixing is substantially limited (e.g., tunnel, parking garage, bridge underpass, natural or urban street canyon, below-grade roadway).
- The project is consistent with an applicable congestion management program established by the county congestion management agency for designated roads or highways, RTP, and local congestion management agency plans.

The intersection analysis included all intersections affected by station traffic and near at-grade crossings. Traffic data presented in the *San Francisco to San Jose Project Section Transportation Technical Report* (Authority 2019c) indicate that no intersections in the local RSA would have volumes of more than 24,000 vehicles per hour but some intersections do not meet the BAAQMD criterion that the project be consistent with an applicable congestion management program. To determine consistency, analysts evaluated the level of service (LOS) at each intersection. Intersections that would have an LOS that is better than the established LOS standard in the applicable congestion management program under 2040 Plus Project conditions were considered to be consistent with the congestion management program. Intersections that would have an LOS that is equal to or worse than the established LOS standard in the applicable congestion management program under 2040 Plus Project conditions were considered to be potentially not consistent with the congestion management program, and therefore were considered for further analysis.

The potential for CO hot spots was evaluated using the California Department of Transportation (Caltrans) Institute of Transportation Studies *Transportation Project-Level Carbon Monoxide Protocol* (CO Protocol) (Garza et al. 1997). The CO Protocol details a step-by-step procedure to determine whether project-related CO concentrations have a potential to generate new air quality violations, worsen existing violations, or delay attainment of CAAQS or NAAQS for CO. Additional details of the modeling are described in the following subsections.

6.3.3.1 Intersection Selection

Twenty intersections along the Caltrain corridor between San Francisco and Santa Clara would have an existing or predicted LOS in 2040 equal to or worse than the established congestion management program LOS standards. Analysts ranked these intersections by their total peak-hour traffic volumes and anticipated delay. The five intersections with the highest traffic volumes and worst congestion were selected for CO modeling. Analyzing these intersections provides a conservative assessment of potential CO effects because CO concentrations at all other intersections would be lower than those estimated for the selected intersections.

The following intersections were included in the 2040 analysis:

- Bayshore Boulevard/Geneva Avenue (Brisbane)
- El Camino Real (SR 82)/Millbrae Avenue (Millbrae)
- El Camino Real (SR 82)/Palo Alto Avenue–Sand Hill Road (Palo Alto)
- Central Expressway/Rengstorff Avenue (Mountain View)
- Central Expressway/Moffett Boulevard–Castro Street (Mountain View)

Analysts also performed a microscale CO hot-spot analysis at five intersections near the 4th and King Street Station separately for 2029 because this station would no longer be in use by 2040. The following five intersections with the highest traffic volumes and worst congestion near the 4th and King Street Station in 2029 were selected for CO modeling:

- Fourth Street/King Street
- Fifth Street/King Street/Interstate (I-) 280 Ramps
- Owens Street/16th Street
- Fifth Street/Bryant Street
- Third Street/16th Street

6.3.3.2 Receptor Locations

Receptors for the intersection analyses were identified in accordance with CO Protocol (Garza et al. 1997). All receptors were located at a height of 6 feet. Receptors for the intersection analysis were located 10 feet from the roadway so they were not within the mixing zone of the travel lanes and were spaced at 0, 82, and 164 feet from the intersection for both the 1-hour and 8-hour analyses (Garza et al. 1997). Analysts assumed that the public could access these locations whether or not sidewalks exist at the receptor location.

6.3.3.3 Emission Model

Analysts estimated vehicular emissions using EMFAC2017 (CARB 2018c), which is a mobile source emission estimator program that provides current and future estimates of emissions from highway motor vehicles. Consistent with the traffic analysis and the anticipated design year of the project, CO emission factors are based on 2029 and 2040 vehicle mixes for projected conditions in San Francisco, San Mateo, and Santa Clara Counties. The CARB designed EMFAC2017 to address a wide variety of air pollution modeling needs, and the program incorporates fleet-specific emission rates, realistic driving patterns, separation of start and running emissions, correction factors for engine deterioration, and annual fleet compositions.

6.3.3.4 Dispersion Model

Mobile source dispersion models are the basic analytical tools used to estimate CO concentrations expected under given traffic, roadway geometry, and meteorological conditions. The mathematical expressions and formulations that constitute the various models attempt to describe as closely as possible a complex physical phenomenon. Analysts used Caltrans' CALINE4 dispersion model to estimate pollutant concentrations near roadway intersections.

CALINE4 is a Gaussian model recommended in the Caltrans CO Protocol (Garza et al. 1997). Gaussian models assume that the dispersion of pollutants downwind of a pollution source follow a normal distribution around the center of the pollution source. The model is described in *CALINE4—A Dispersion Model for Predicting Air Pollutant Concentration near Roadways, FHWA/CA/TL-84/15* (Caltrans 1989) The analysis of roadway CO effects followed the CO Protocol. The CALINE4 output files are provided in Appendix B.

6.3.3.5 Meteorological Conditions

The transport and concentration of pollutants emitted from motor vehicles are influenced by three principal meteorological factors: wind direction, wind speed, and the temperature profile of the atmosphere. Analysts chose the values for these parameters to maximize pollutant concentrations at each prediction site (i.e., to establish a conservative worst-case situation).

- **Wind direction**—Maximum CO concentrations are normally found when the wind is assumed to blow approximately parallel to a single roadway adjacent to the receptor location. However, at complex intersections, it is difficult to predict which wind angle would result in maximum concentrations. Therefore, at each receptor location, analysts used the approximate wind angle that would result in maximum pollutant concentrations in the analysis. All wind angles from 0° to 360° were considered.
- **Wind speed**—CO concentrations are greatest at low wind speeds. A conservative wind speed of 1 mph was used to predict CO concentrations during peak traffic periods.
- **Temperature and profile of the atmosphere**—Analysts chose an ambient temperature based on the CO Protocol (Garza et al. 1997) recommendation for the local RSA. Winter low temperatures of 41°F were assumed based on the average temperature in December over an approximately 30-year period (based on Western Regional Climate Center data accessed in February 2017). A mixing height (the height in the atmosphere to which pollutants rise) of 1,000 feet was assumed. Atmospheric stability class G (very stable) conditions were assumed, as recommended in Table B.11 of the CO Protocol.

Analysts based the selection of these meteorological parameters on recommendations from the CO Protocol (Garza et al. 1997) and the USEPA (1992) guidelines. These data were found to be the most representative of the conditions in the RSA.

6.3.3.6 Persistence Factor

Analysts obtained peak 8-hour concentrations of CO by multiplying the highest peak-hour CO estimates by a persistence factor. The persistence factor accounts for the following characteristics:

- Over an 8-hour period (as distinct from a single hour), vehicle volumes will fluctuate downward from the peak hour.
- Vehicle speeds may vary over an 8-hour period compared to a single hour.
- Meteorological conditions, including wind speed and wind direction, will vary compared with the conservative assumptions used for the single hour.

Analysts used a persistence factor of 0.7 in this analysis, which is recommended in the CO Protocol (Garza et al. 1997).

6.3.3.7 Background Concentrations

Analysts added background CO concentrations based on local air quality monitoring data (2015 to 2017) to project-level results to account for sources of CO not included in the modeling. Background concentrations for 2029 and 2040 No Project conditions were assumed the same as those for the current year. Actual 1- and 8-hour background concentrations in future years would likely be lower than concentrations used in the CO modeling analysis because the CO emissions and concentrations are decreasing because of continuing improvements in engine technology and the retirement of older, higher-emitting vehicles.

6.3.3.8 Traffic Information

Analysts derived traffic data for the air quality analysis from traffic counts and other information developed as part of an overall traffic analysis for the project (Authority 2019c). The microscale CO analysis was performed based on data from this analysis for the afternoon-evening peak traffic period. This is the period when maximum traffic volumes occur on most streets and the greatest traffic and air quality effects of the project are expected.

6.3.4 Particulate Matter (PM_{10} and $PM_{2.5}$) Hot-Spot Analysis

PM hot spots may be created by localized increases in vehicle or rail traffic, particularly when that traffic consists of a significant number of diesel-powered vehicles. Redistributing or moving vehicle or rail traffic would also increase PM concentrations at certain locations and result in corresponding decreases in other locations. This section discusses methods for evaluating potential PM hot spots from changes in on-road vehicle and freight rail traffic.

6.3.4.1 On-Road Vehicles

Although the project is not subject to transportation conformity, portions of the local RSA are classified as nonattainment for the federal $PM_{2.5}$ standards. Consequently, analysts conducted a hot-spot analysis following the USEPA's 2015 *Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* (USEPA 2015e). The analysis focused on potential air quality concerns under NEPA from the project's effects on roads and followed the recommended practice in the USEPA's Final Rule regarding the localized or hot-spot analysis of $PM_{2.5}$ and PM_{10} (40 C.F.R. Part 93, issued March 10, 2006).

The USEPA specifies in 40 C.F.R. Section 93.123(b)(1) that only "projects of air quality concern" are required to undergo a $PM_{2.5}$ and PM_{10} hot-spot analysis. The USEPA defines projects of air quality concern as certain highway and transit projects that involve significant levels of diesel traffic, or any other project identified by the $PM_{2.5}$ SIP as a localized air quality concern. Table 6-2 shows project types that require a $PM_{2.5}$ or PM_{10} hot-spot analysis, as defined by Section 93.123(b)(1) of the Conformity Rule.

Table 6-2 Projects of Air Quality Concerns as Defined by Section 93.123(b)(1) of the Transportation Conformity Rule

Section 93.123(b)(1) Subsection	Type of Project
i	New highway projects that have a significant number of diesel vehicles and expanded highway projects that have a significant increase in the number of diesel vehicles.
ii	Projects affecting intersections that are at LOS D, E, or F with a significant number of diesel vehicles, or those that will change to LOS D, E, or F because of increased traffic volumes from a significant number of diesel vehicles related to the project.
iii	New bus and rail terminals and transfer points that have a significant number of diesel vehicles congregating at a single location.
iv	Expanded bus and rail terminals and transfer points that significantly increase the number of diesel vehicles congregating at a single location.
v	Projects in or affecting locations, areas, or categories of sites that are identified in the $PM_{2.5}$ or PM_{10} applicable implementation plan or implementation plan submission, as appropriate, as sites of violation or possible violation.

LOS = level of service
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter

The following projects are examples of what would be classified as projects of air quality concern, as defined by 40 C.F.R. Section 93.123(b)(1):

- A project on a new highway or expressway that serves a significant volume of diesel truck traffic, such as facilities with greater than 125,000 annual average daily traffic where 8 percent or more of such annual average daily traffic is diesel truck traffic.
- New exit ramps and other highway facility improvements to connect a highway or expressway to a major freight, bus, or intermodal terminal.
- Expansion of an existing highway or other facility that affects a congested intersection (operating at LOS D, E, or F) that has a significant increase in the number of diesel trucks.
- Similar highway projects that involve a significant increase in the number of diesel transit buses or diesel trucks.
- A major new bus or intermodal terminal that is considered to be a “regionally significant project” under 40 C.F.R. Section 93.101.[10]
- An existing bus or intermodal terminal that has a large vehicle fleet where the number of diesel buses increases by 50 percent or more, as measured by bus arrivals.

6.3.4.2 Shifting of Tracks Carrying Freight Trains

The existing Caltrain tracks also are used by Union Pacific Railroad (UPRR) freight trains that are pulled by diesel locomotives. Construction of the project would shift existing tracks used by UPRR freight trains by up to 63 feet laterally, depending on the location (though not all track shifts would

[10] 40 C.F.R. Section 93.101 defines a “regionally significant project” as “a transportation project (other than an exempt project) that is on a facility which serves regional transportation needs (such as access to and from the area outside of the region, major activity centers in the region, major planned developments such as new retail malls, sports complexes, etc., or transportation terminals as well as most terminals themselves) and would normally be included in the modeling of a metropolitan area’s transportation network, including at a minimum all principal arterial highways and all fixed guideway transit facilities that offer an alternative to regional highway travel.”

occur near sensitive receptors). Neither UPRR service nor associated emissions from diesel locomotive operation would be affected by the proposed track shifts, relative to 2015 existing conditions. Although the source of PM emissions would shift commensurate with the lateral track shift, the amount of emissions, and therefore the potential for the project to result in new or worsened PM hot spots under the USEPA definition of projects of air quality concern, would not change. Accordingly, analysts did not conduct a PM hot-spot analysis for freight trains on the shifted tracks because there would be no effect under the USEPA definition of projects of air quality concern. Potential changes in receptor exposure to DPM and $PM_{2.5}$ are analyzed further, as described in Section 6.3.6.1, Shifting of Tracks Carrying Freight Trains.

6.3.5 Mobile Source Air Toxics Analysis

On February 3, 2006, the FHWA released *Interim Guidance on Air Toxic Analysis in NEPA Documents*. This guidance was superseded on September 30, 2009, by the FHWA's *Interim Guidance Update on Mobile Source Air Toxic Analysis in NEPA Documents* (Interim Guidance), and was most recently updated on October 18, 2016 (FHWA 2016). The updated Interim Guidance advises on when and how to analyze MSATs in the NEPA process for highway projects. This guidance is interim because MSAT science is still evolving, but is used in the analysis of potential effects based on guidance provided by the Authority. As the science progresses, the FHWA is expected to update the guidance.

A qualitative analysis provides a basis for identifying and comparing the potential differences in MSAT emissions, if any, between the project alternatives. The Interim Guidance groups projects into the following tier categories.

- **Tier 1**—No analysis for projects without any potential for meaningful MSAT effects.
- **Tier 2**—Qualitative analysis for projects with low potential MSAT effects.
- **Tier 3**—Quantitative analysis to differentiate alternatives for projects with higher potential MSAT effects.

The project would reduce regional VMT, traffic congestion, and aircraft operations, resulting in a reduction in MSAT emissions. The level of effects from regional MSAT emissions therefore corresponds to FHWA's Tier 1. Accordingly, analysts noted changes to regional MSAT emissions but did not perform quantitative or qualitative analyses of the project alternatives, consistent with FHWA's Interim Guidance.

Changes in vehicle activity could result in localized MSAT increases. The potential level of effects from these circumstances corresponds to FHWA's Tier 2. Accordingly, analysts used a qualitative analysis to provide a basis for identifying and comparing the potential differences in local MSAT emissions, if any, between the project alternatives. The qualitative assessment is derived, in part, from *A Methodology for Evaluating Mobile Source Air Toxic Emissions among Transportation Project Alternatives* (FHWA 2011).

6.3.6 Operations Health Risk Assessment

6.3.6.1 Shifting of Tracks Carrying Freight Trains

Construction of the project would shift existing tracks used by UPRR freight trains within the railroad right-of-way. Shifting existing tracks used by freight trains would change the distances from the freight trains to certain receptor locations, which would increase TAC concentrations at certain receptor locations and would result in corresponding decreases at other locations. Because diesel-related exhaust, specifically DPM, is considered a carcinogenic TAC by the CARB, a human HRA was conducted to assess the risk (i.e., cancer risks and chronic and acute risks) associated with changes in track positions. Table 6-3 shows the shifted track segments included in the analysis and summarizes the distances to the nearest receptor under 2015 existing conditions and with the track shifts.

Table 6-3 Shifted Tracks and Distances to Nearest Sensitive Receptors

General Location	Description of Maximum Track Shift Relative to Receptor Locations[1]	Distance to Nearest Receptor[1] (feet)			Reduction in Distance (feet)
		Receptor Number	Existing Alignment	Shifted Alignment	
Brisbane	Track would be shifted westward, closer to residential receptors near San Francisco Avenue/Santa Clara Street.	1	300	275	25
Brisbane	Track would be shifted westward, closer to residential receptors (mobile home park) west of Bayshore Boulevard.	2	350	346	4
South San Francisco	Track would be shifted westward, closer to residential receptors along Airport Boulevard near Second Lane.	3	250	223	27
San Bruno	Track would be shifted eastward, closer to residential receptors along Montgomery Avenue.	4	45	19	26
San Bruno	Track would be shifted westward, closer to residential receptors along San Antonio Avenue.	5	160	159	1.2
San Bruno	Track would be shifted westward, closer to residential receptors along Hemlock Avenue.	6	70	29	41
San Bruno	Track would be shifted westward, closer to residential receptors along California Drive south of Dufferin Avenue.	7	130	106	24
San Mateo	Alternative A only: Track would be shifted westward, closer to residential receptors east of South B Street near 16th Avenue.	8	45	24	21
	Alternative B only: The receptors east of South B Street near 16th Avenue would be taken for the project, and the new nearest receptors would be west of South B Street.	9	115	71	44
San Mateo	Alternative B only: Tracks would be shifted outward. Track shifted westward would move closer to residential receptors along East 20th Avenue.	10	175	169	6
San Mateo	Alternative B only: Tracks would be shifted outward. Track shifted eastward would move closer to residential receptors along Pacific Boulevard.	11	70	43	27
San Mateo	Alternative B only: Track would be shifted westward, closer to residential receptors (senior apartments) along El Camino Real near West 39th Avenue.	12	230	193	37

General Location	Description of Maximum Track Shift Relative to Receptor Locations[1]	Distance to Nearest Receptor[1] (feet) Receptor Number	Existing Alignment	Shifted Alignment	Reduction in Distance (feet)
San Mateo	Alternative B only: Track would be shifted eastward, closer to residential receptors along El Camino Real near Mountain View Avenue.	13	100	97	3
Belmont	Track would be shifted westward, closer to residential receptors along El Camino Real near Middle Road.	14	170	165	5
Belmont	Alternative A only: Track would be shifted westward, closer to residential receptors along El Camino Real near O'Neill Avenue.	15	180	170	10
	Alternative B only: Track would be shifted eastward, closer to residential receptors on east side of Old County Road.	16	160	122	38
Belmont	Alternative B only: Track would be shifted eastward, closer to residential receptors between the tracks and Old County Road.	17	190	152	38
San Carlos	Alternative A only: Track would be shifted westward, closer to residential receptors along El Camino Real near Inverness Drive.	18	25	23	2
San Carlos	Alternative B only: Track would be shifted eastward, closer to residential receptors along Old County Road near Inverness Drive.	19	75	53	22
San Carlos	Alternative B only: Track would be shifted westward, closer to residential receptors along El Camino Real near Holly Street.	20	25	13	12
San Carlos	Alternative B only: Track would be shifted eastward, closer to residential receptors along Old County Road near Hall Street.	21	80	68	12
San Carlos	Alternative B only: Track would be shifted westward, closer to residential receptors (apartments) along El Camino Real near Morse Boulevard.	22	185	147	38

General Location	Description of Maximum Track Shift Relative to Receptor Locations[1]	Distance to Nearest Receptor[1] (feet)			Reduction in Distance (feet)
		Receptor Number	Existing Alignment	Shifted Alignment	
San Carlos	Alternative B only: Track would be shifted eastward, closer to residential receptors along Stafford Street near E Street.	23	80	75	5
Palo Alto	Track would be shifted westward, closer to El Camino Park.	24	12	10	2
Santa Clara	Track would be shifted westward, closer to residential receptors south of Bracher Park.	25	38	37	1

[1] Descriptions and distances apply to both Alternatives A and B unless noted otherwise.

The BAAQMD maintains an inventory of health risks associated with stationary sources, roadway, and rail sources within the SFBAAB (Winkel 2018). The inventory was used to characterize the net effect of health risks associated with moving operations-related diesel locomotive emissions closer to existing sensitive receptors located near the new and shifted tracks. BAAQMD's inventory is based on rail volumes and emission factors in 2015. There were approximately four freight train trips per day between San Francisco and Santa Clara during this time, and freight volumes are anticipated to grow by 4 percent per year (Peninsula Corridor Joint Powers Board [PCJPB] 2015). On the other hand, locomotive emission factors are anticipated to decrease over time as older, higher-emitting locomotives are retired and replaced with newer, lower-emitting ones. Emission rates specific to UPRR are not available; however, data from USEPA (2009) indicate that national average freight emissions of PM_{10} are expected to decline by 75 percent between 2015 and 2040, or by roughly 3 percent per year on average. Analysts used the annual growth in freight and decrease in PM_{10} emissions to adjust the 2015 risks from BAAQMD's inventory to be representative of conditions in 2022, which is a conservative assumption of the earliest year that operation on the shifted tracks could occur. The scaling factor for 2022 is weighted to account for a 30-year exposure duration (2022–2052), consistent with OEHHA (2015) guidance.

6.3.6.2 Diesel Buses

The 4th and King Street and Millbrae Stations would be served by diesel-powered buses, which generate TACs at idle while loading and unloading passengers. Improved bus service to the passenger rail terminals is not part of the project. The Authority assumes that bus service levels are constant into the future given that no operator has a funding plan to deliver more service. Buses operated by SamTrans and MUNI are currently a mix of diesel, diesel-electric, and electric trolleys. MUNI has committed to an all-electric bus fleet by 2035 (San Francisco Municipal Transit Authority 2018). SamTrans has committed to an all-electric bus fleet by 2033 (SamTrans 2018). Thus, diesel bus emissions associated with the 4th and King Street and Millbrae Stations are expected to decline relative to existing emissions levels, as electric buses are integrated into the fleets over time.

6.3.6.3 Emergency Generators and On-Site Equipment

The 4th and King Street and Millbrae Stations and the Brisbane LMF would have emergency generators that would be used in the event of a power outage. Section 2.3.1 from the BAAQMD's Permit Handbook indicates that "typically any stationary diesel engines over 50 horsepower will require a risk screening analysis" (BAAQMD 2016b). Explicitly, BAAQMD Regulation 2, Rule 5, Section 302 specifies that an Authority to Construct permit or Permit to Operate from the BAAQMD will be denied if any new and modified sources of TAC (which includes generators) over 50 horsepower would result in health risks in excess of 10.0 in 1 million or a hazard index of 1.0. BAAQMD Regulation 2, Rule 5, Section 302 is cited as the evidence in support of the BAAQMD's health risk thresholds in its 2011 CEQA Guidelines (BAAQMD 2017a).

The generators associated with the project would be subject to the permitting requirements specified in BAAQMD Regulation 2, Rule 5, Section 302. Based on these permitting requirements, the emergency generators would not receive a permit from the BAAQMD and would not be allowed to operate if they would result in cancer or acute hazard effects greater than the BAAQMD's health risk thresholds of significance. However, Regulation 2, Rule 5 does not address $PM_{2.5}$ concentrations or permit restrictions for facilities with emissions more than the BAAQMD's threshold of 0.3 micrograms of pollutant per cubic meter of air ($\mu g/m^3$). Accordingly, $PM_{2.5}$ exhaust concentrations from emergency generator testing were estimated using the USEPA's AERMOD dispersion model and emission data from CalEEMod.

6.4 Construction Emissions Calculations

Analysts assessed and quantified air quality effects associated with construction of the project using industry standard and accepted software tools, techniques, and emission factors. This section provides a summary of the methods. Appendix C provides a full list of assumptions.

6.4.1 Construction Activities

Analysts quantitatively estimated construction emissions for the earthwork and major civil construction activity during construction of the following components of the project:

- At grade
- Embankment (berm)

Construction activities associated with each component include demolition, excavation, utilities, roadwork, concrete forming, and ballast and rail installation. Each of these activities was taken into account to evaluate the regional and localized air quality effects during the construction phase.

6.4.2 Construction Approach

Construction likely would proceed in all subsections concurrently. Construction would occur over multiple phases between 2021 and 2025. Construction typically would occur 5 days per week with 10-hour days (250 days per year) (Scholz 2018).

Major construction activities include earthworks and excavation support; bridge and aerial structure construction; station construction; track work; railway systems construction (including traction electrification, signaling, and communications); and testing and commissioning. During peak construction periods, work is envisioned to be underway at several locations along the route, with overlapping construction of various project elements. Working hours and workers present at any time would vary, depending on the activities being performed. Pursuant to its adopted sustainability policy (Policy Directive POLI-PLAN-03), the Authority intends to build the project using sustainable methods that:

- Minimize the use of nonrenewable resources
- Minimize the effects on the natural environment
- Protect environmental diversity
- Emphasize the use of renewable resources in a sustainable manner

6.4.3 Models and Methods for Mass Emissions Modeling

Construction of the project would generate emissions of ROG, NO_X, CO, SO_X, PM_{10}, $PM_{2.5}$, CO_2, CH_4, and N_2O that could result in temporary air quality and GHG effects. Emissions would originate from off-road equipment exhaust, employee and haul truck vehicle exhaust (on-road vehicles), site grading and earth movement, demolition, paving, and architectural coating. These emissions would be temporary (i.e., limited to the construction period) and would cease when construction activities are complete.

Combustion exhaust, fugitive dust (PM_{10} and $PM_{2.5}$), and fugitive off-gassing (ROG) were estimated using a combination of emission factors and methods from CalEEMod, version 2016.3.2; the CARB's EMFAC2017 model; and the USEPA's *Compilation of Air Pollutant Emission Factors* (AP-42) based on project-specific construction data (e.g., schedule, equipment, truck volumes) provided by the project engineering team (Scholz 2018). Appendix C provides a complete list of construction assumptions, including equipment, vehicles, and quantities and the construction schedule.

- **Off-road equipment**—Emission factors for off-road construction equipment (e.g., loaders, graders, bulldozers) were obtained from the CalEEMod (version 2016.3.2) User's Guide appendix, which provides values per unit of activity (in grams per horsepower-hour) by calendar year (California Air Pollution Control Officers Association [CAPCOA] 2017). Analysts estimated criteria pollutants by multiplying the CalEEMod emission factors by the equipment inventory provided by the project engineering team.
- **On-road vehicles**—On-road vehicles (e.g., pickup trucks, flatbed trucks) would be required for material and equipment hauling, on-site crew and material movement, and employee commuting. Analysts estimated exhaust emissions from on-road vehicles using the EMFAC2017 emissions model (CARB 2018c) and activity data (miles traveled per

day) provided by the project engineering team (Scholz 2018). Emission factors for haul trucks were based on aggregated-speed emission rates for EMFAC's T7 Single vehicle category. Factors for on-site dump, water, boom, and concrete trucks were based on 5-mph emission rates for the T6 Heavy category. Factors for employee commute vehicles were based on a weighted average for all vehicle speeds for EMFAC's light-duty automobile/light-duty truck vehicle categories. Fugitive re-entrained road dust emissions were estimated using the USEPA's AP-42, Sections 13.2.1 and 13.2.2 (USEPA 2006b, 2011).

- **Site grading and earth movement**—Fugitive dust emissions from earth movement (e.g., site grading, bulldozing, and truck loading) were quantified using emission factors from CalEEMod and the USEPA (1998) AP-42 emission factor compilation. Data on the total graded acreage and quantity of cut-and-fill material were provided by the project engineering team (Scholz 2018).
- **Demolition**—Fugitive dust emissions from building demolition were based on the anticipated amount of square feet to be demolished provided by the project engineering team and calculation methods from the CalEEMod User's Guide (CAPCOA 2017).
- **Paving**—Fugitive ROG emissions associated with paving were calculated using activity data (e.g., square feet paved) provided by the project engineer and the CalEEMod default emission factor of 2.62 pounds of ROG per acre paved (Scholz 2018; CAPCOA 2017).
- **Architectural coating**—Fugitive ROG emissions associated with architectural coatings of the stations were calculated using activity data (e.g., square feet coated) provided by the project engineering team and methods contained in the CalEEMod User's Guide (Scholz 2018; CAPCOA 2017). Emissions calculations assume a ROG content of 150 grams per liter, consistent with BAAQMD's Regulation 8, Rule 3, Section 301.
- **Concrete**—CO_2 emissions generated by concrete production, cement production and transportation were calculated using emission factors from Nisbet, Marceau, and VanGeem (2002) and the Slag Cement Association (2013).

6.4.4 Ballast and Subballast Hauling

Ballast and subballast materials could be transported from multiple quarry locations. Analysts estimated emissions from ballast and subballast material hauling by trucks and locomotives based on the travel distances and transportation method (by rail or by truck) from the locations where ballast materials would be available. Analysts used heavy-duty truck emission factors (T7 Single) from EMFAC2017 to estimate emissions from haul trucks and rail emission factors from the USEPA (2009) to estimate the locomotive emissions.

6.4.5 Daily and Annual Emissions Estimates

Up to two components (at grade and embankment/berm) would be constructed, depending on the subsection and project alternative. Each component would be constructed over multiple phases between 2021 and 2025. Daily criteria pollutant and GHG emissions generated by construction of each phase were quantified using the methods described above. The daily estimates were converted to annual totals based on the detailed construction schedule for each project alternative, which was developed by the project engineering team (Scholz 2018). Maximum daily emissions, based on concurrent construction activity, were also quantified consistent with air district requirements (BAAQMD 2017a). The highest daily emissions in each construction year were selected as the peak day for analysis purposes. This approach is meant to convey a worst-case scenario based on available information and, therefore, is not necessarily representative of actual emissions that would be incurred on a daily basis throughout the construction period.

6.4.6 Project Design Features

As discussed in Section 2.4, Impact Avoidance and Minimization Features, the Authority has developed IAMFs that would avoid or minimize potential air quality effects. Because IAMFs are included as part of the project design, they are not considered mitigation and are included as part of the project construction emissions estimate. Specifically, the following emissions benefits achieved by AQ-IAMF#1 through AQ-IAMF#5 were assumed in the modeling:

- Fugitive dust reductions from earthmoving best management practices (AQ-IAMF#1) (Western Governors' Association 2006)

– PM from ground disturbance (i.e., scraping and grading activities), 61 percent
– PM from unpaved vehicle travel (i.e., re-entrained road dust), 55 percent[11]
– PM from demolition, 36 percent

- VOC reductions (93 percent) from application of architectural coatings (AQ-IAMF#2)[12]
- Criteria pollutant and GHG reductions from use of renewable diesel (AQ-IAMF#3) in all off-road diesel fueled engines (Lovegrove and Tadross 2017)

– PM, 30 percent
– CO_2e, 99 percent

- Criteria pollutant and GHG reductions from use of Tier 4 off-road engines (AQ-IAMF#4). Emissions reductions vary by pollutant and equipment type. Emissions were modeled using Tier 4 emission rates from CalEEMod.
- Criteria pollutant and GHG reductions from use of model year 2010 or newer on-road engines in heavy-duty, diesel powered trucks (AQ-IAMF#5). Emissions reductions vary by pollutant, analysis year, and air basin. Emissions were modeled using emission rates derived from the CARB's EMFAC2017 model.

6.4.7 Regulatory Control Measures

Many of the control measures required by BAAQMD rules and regulations are the same or similar to AQ-IAMF#1 and AQ-IAMF#2. Accordingly, no additional reductions from compliance with air district rules were assumed in the emissions modeling.

6.4.8 Construction Health Risk Assessment

Analysts conducted the HRA using the guidelines provided by the OEHHA (2015) for the *Air Toxics Hot Spots Program* and the HRA guidelines developed by the California Air Pollution Control Officers Association (2009). The HRA consists of three parts: (1) PM emissions inventory, (2) air dispersion modeling to evaluate off-site concentrations of DPM emissions, and (3) assessment of risks associated with predicted concentrations. The following subsections provide descriptions of each component. The quantitative HRA was only performed for construction of the HSR facilities (e.g., alignment, stations, LMF).

6.4.8.1 Particulate Matter Emissions Inventory

The emissions inventory includes PM emissions generated by heavy-duty equipment and vehicle exhaust, as well as fugitive dust from site grading and soil movement. The particulate constituent analyzed depends on the emission location and associated air district guidance. The BAAQMD (2017a) has adopted cancer and noncancer risk thresholds for DPM, as well as a separate threshold for localized $PM_{2.5}$ emissions. While DPM is a complex mixture of gases and fine

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[11] The IAMF requires watering on all unpaved access roads, which would achieve additional reductions (up to 61 percent). However, because trucks would use both access and non-access roads, and the specific miles traveled by road type is currently not known, the analysis conservatively applies the lower reduction of 45 percent to all re-entrained road dust from travel on unpaved road.

[12] Assumes an uncontrolled ROG content of 150 g/L per BAAQMD Regulation 8, Rule 3, Section 301 and a controlled ROG content of 10 g/L per AQ-IAMF#2.

particles that includes more than 40 substances listed by USEPA and CARB as HAPs, OEHHA guidance indicates that the cancer potency factor developed to evaluate cancer risks was based on total (gas and PM) diesel exhaust (OEHHA 2001). BAAQMD considers DPM as the surrogate for total diesel exhaust, with its guidance requiring that diesel $PM_{2.5}$ emissions serve as the basis for the cancer and noncancer risk calculations in the SFBAAB (Kirk 2016). BAAQMD guidance indicates that localized $PM_{2.5}$ risks should be evaluated using total $PM_{2.5}$ exhaust emissions (i.e., emissions from both diesel- and gasoline-powered equipment).

6.4.8.2 Air Dispersion Modeling

The USEPA's AERMOD dispersion model was used to quantify annual average DPM concentrations at nearby receptor locations for each subsection. The modeling approach follows, where applicable, the OEHHA and California Air Pollution Control Officers Association methods, but is also consistent with BAAQMD methods, as provided in their guidance documents and based on staff consultation (BAAQMD 2012a).

Meteorological Data

Analysts used eight representative meteorological datasets, which broadly cover the different meteorological conditions found in the RSA, in the analysis. Table 6-4 shows the assignment for the eight datasets. The most recent available 5 years of data for each station were used to conduct the analysis (Mission Bay 2008–2012; San Francisco Sewage Treatment Plant 2010–2011, 2014–2016; San Francisco Solid Waste Transfer and Recycling Center (Sanitary Fill Co.) 2004, 2007–2009; San Francisco International Airport 2011–2015; San Mateo Sewage Treatment Plant 2011–2015; San Carlos Airport 2011–2015; Moffett Field 2011–2015; San Jose International Airport 2009–2013). All locations used urban modeling options. Appendix E provides additional details on how these datasets were developed using the AERMOD meteorological preprocessor AERMET.

Table 6-4 Meteorological Datasets by Subsection

Location	Mission Bay	San Francisco STP	San Francisco SWTRC	San Francisco Int'l Airport	San Mateo STP	San Carlos Airport	Moffett Field	San Jose Int'l Airport
Subsections								
San Francisco to South San Francisco	X	X	X					
San Bruno to San Mateo				X	X			
San Mateo to Mountain View						X		
Mountain View to Santa Clara							X	X
Stations and Brisbane LMF								
4th and King Street Station	X							
Brisbane LMF			X					
Millbrae Station					X			

Sources: BAAQMD 2017c; NOAA 2017a, 2017b; WRCC 2017
Int'l = International
LMF = light maintenance facility

STP = sewer treatment plant
SWTRC = Solid Waste Transfer and Recycling Center

Source Parameters

Analysts assumed eight types of construction work areas characterize construction activities and emissions. Further details on how each type of source was modeled are shown in Table 6-5. Off-site activity, such as long-distance haul trucks for spoils removal and ballast delivery, were modeled as area sources located on both sides of the on-site segment with a width of 12 feet.

Table 6-5 AERMOD Source Parameters

Construction Work Area	Source Type	Size of Modeled Area[1]	Release Height (meters)
At-grade 2 track (on site)	Area	Actual length × from 82 to 171 feet depending on location	3 (exhaust), 0 (dust)[2]
At-grade 2 track (off site)	Area	Actual length × 12 feet	3 (exhaust), 0 (dust)[2]
At-grade 4 track (on site)	Area	Actual length × from 82 to 171 feet depending on location	3 (exhaust), 0 (dust)[2]
At-grade 4 track (off site)	Area	Actual length × 12 feet	3 (exhaust), 0 (dust)[2]
Embankment 2 track (on site)	Area	Actual length × from 43 to 171 feet depending on location	3 (exhaust), 0 (dust)[2]
Embankment 2 track (off site)	Area	Actual length × 12 feet	3 (exhaust), 0 (dust)[2]
Embankment 4 track (on site)	Area	Actual length × from 98 to 171 feet depending on location	3 (exhaust), 0 (dust)[2]
Embankment 4 track (off site)	Area	Actual length × 12 feet	3 (exhaust), 0 (dust)[2]

Source: Kirk 2016
[1] Sizes of modeled areas are shown as dimensions of length and width of the work area.
[2] Initial vertical dimension of 1 meter.

Not all subsections would have all types of construction activity. Table 6-6 shows the types of activities within each subsection. In all cases, at least one construction type was modeled for each project alternative.

Table 6-6 Construction Work Areas by Subsection and Project Alternative

Subsection/Element	At Grade[1]	Embankment[1]
San Francisco to South San Francisco (Alternatives A and B)		
2-track at grade	X	
4-track at grade	X	
San Bruno to San Mateo (Alternatives A and B)		
2-track at grade	X	
4-track at grade	X	
2-track embankment		X
San Mateo to Palo Alto (Alternative A)		
2-track at grade	X	
4-track at grade	X	

Subsection/Element	At Grade[1]	Embankment[1]
San Mateo to Palo Alto (Alternative B)		
2-track at grade	X	
4-track at grade	X	
2-track embankment		X
4-track embankment		X
Mountain View to Santa Clara (Alternatives A and B)		
2-track at grade	X	
4-track at grade	X	

[1] Air quality modeling for the embankment and at-grade sources are modeled with similar emission source characteristics. The maximum model effects are reported in Section 7.11, Other Localized Construction Effects.

Receptors

Analysts spaced receptors along the edge of each subsection. Receptor heights were all set to 1.2 meters, consistent with OEHHA (2015) guidance.

6.4.8.3 Risk Calculations

Consistent with USEPA, CARB, and air district regulatory guidance, the HRA examines cancer and noncancer (chronic)[13] exposure to the surrounding community and uses OEHHA's guidance on risk calculations (OEHHA 2015).

Cancer Risk

Cancer risk is defined as the lifetime probability (chance) of developing cancer from exposure to a carcinogen, typically expressed as the increased chance in 1 million. The default cancer risk calculation for residents and workers is based on the 95th percentile breathing rate, as recommended by the OEHHA. It also accounts for varying sensitivities to exposure based on age. This includes a higher age sensitivity factor for the first 16 years of life, 95th percentile as a breathing rate as a function of age, exposure duration, and adjustment for time spent at home.

The cancer risk occurs exclusively through the inhalation pathway and was calculated using the following equation:

$$\mathbf{Risk} = \left(\frac{C_{air} \times DBR \times ED \times EF \times Conv_1}{AT}\right) \times CPF \times ASF \times Conv_2$$

Where

Risk	=	DPM cancer risk (per million)
C_{air}	=	Concentration in the air (micrograms per cubic meter [μg/m^3]), annual average from AERMOD
DBR	=	Daily breathing rate (liters per kilogram [L/kg] body weight-day)
ED	=	Exposure duration (years)
EF	=	Exposure frequency (days/year)
$Conv_1$	=	Micrograms to milligrams (mg), liters to cubic meters ([mg/μg] * [m^3/L])
AT	=	Averaging time (days)
CPF	=	Cancer potency factor (milligrams per kilogram per day [mg/kg-day]$^{-1}$)

[13] Note that the OEHHA, CARB, and BAAQMD have not identified acute health effects from diesel exhaust. Therefore, acute health effects are not included in this analysis.

ASF = Average age sensitivity factor for resident (unitless)

$Conv_2$ = Risk per million people

Note that the cancer potency factor incorporates worst-case, health-protective assumptions. It was established using data from animal and epidemiological exposure studies and represents the increased chance or probability of developing cancer, assuming continuous lifetime exposure.

Chronic Noncancer Risk

Analysts calculated the noncancer chronic inhalation effects by dividing the annual average concentration by the reference exposure level for DPM. The reference exposure level is defined as the concentration below which no noncancer health effects are anticipated. Consistent with OEHHA (2015) guidance, a reference exposure level of 5 $\mu g/m^3$ was assumed in the calculation.

6.4.9 Other Localized Construction Effects

Analysts used the same general approach and guidance as for the HRA (see Section 6.4.8, Construction Health Risk Assessment) to evaluate localized criteria pollutant effects during construction. The analysis considers both acute (24 hours and less) and annual emissions effects of all criteria pollutants, as applicable based on the established NAAQS and CAAQS. Note that the quantitative ambient air quality analysis was only performed for construction of the HSR facilities (e.g., alignment, stations, LMF).

6.4.9.1 Annual Air Quality Effects

The pollutants of concern with established annual standards are NO_2,[14] PM_{10}, and $PM_{2.5}$. Analysts modeled off-site concentrations of these pollutants using the annual mass emissions inventory and the AERMOD dispersion model. NO_X emissions were converted to NO_2, using the Tier 2 ARM2 approach—now the USEPA-preferred approach using the default conversions of minimum of 50 percent as NO_2 at high NO_X concentrations and 90 percent as NO_2 at low NO_X concentrations.

6.4.9.2 Acute Air Quality Effects

The following pollutants of concern have established standards based on hourly or daily exposure:

- CO (1 hour and 8 hours)
- PM_{10} and $PM_{2.5}$ (24 hours)
- NO_2 (1 hour) (atmospheric conversion of NO_X to NO_2 is estimated using USEPA's regulatory default Tier 2 ARM2 approach with minimum of 20 percent as NO_2 at high NO_X concentrations and 90 percent as NO_2 at low concentration levels of NO_X)
- SO_2 (1 hour and 24 hours)

The approach to modeling the hourly and daily emissions is similar to the annual approach, but it requires an emissions inventory that represents at least a peak-hour emission rate and activities that may overlap in location and time.

Analysts developed a representative maximum emission scenario for air quality hourly and daily effects for each subsection based on maximum activity levels that could take place simultaneously. Two types of features were modeled (embankment and at grade) within each subsection to determine the maximum hourly and daily effect. This section describes each of the

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[14] NO_X is both a regional and localized pollutant. Regional effects (i.e., O_3 formation) take place over long distances and time scales and are not analyzed through a localized ambient air quality analysis. Likewise, since ROG is a regional pollutant, it is not addressed in the localized analysis. Rather, O_3 effects (through NO_X and ROG emissions) are addressed through a comparison of project emissions to the air district and federal General Conformity *de minimis* thresholds (Section 7.9, Construction Mass Emissions Analysis). Localized effects can occur from the conversion of NO_X to NO_2, and these effects are assessed through the localized NO_2 analysis to confirm that concentrations would not exceed the CAAQS or NAAQS.

major features and their concurrent major elements. The same widths for each construction feature as used in the annual modeling were assumed. However, each construction crew was assumed active over a length of 1,000 feet within a single day.

Embankment

The following activities could occur concurrently:

- Excavation (including demolition and utility relocation)
- Concrete and retaining walls
- Fill materials and panels and straps
- Ballast

Both the emissions associated with excavation and with concrete and retaining walls can take place on the same day in two adjacent 1,000-foot sections. Fill materials, panels, and straps activity cannot start until retaining walls are complete, so this major element was only modeled as concurrently taking place with the ballast in two adjacent 1,000-foot sections.

At Grade

The following activities could occur concurrently:

- Utility relocation and demolition and removal
- Track subgrade
- Ballast

These major elements, utility relocation, demolition and removal, and track subgrade, were modeled as taking place on the same day in two adjacent 1,000-foot sections. Although unlikely, it is possible for track subgrade and ballast to take place on the same day in two adjacent sections, and these activities were modeled as taking place on the same day in two adjacent 1,000-foot sections.

6.5 Asbestos, Lead-Based Paint, and Odors

Asbestos causes cancers of the lung and the lining of internal organs, as well as asbestosis and pleural disease, which inhibit lung function. The USEPA is addressing concerns about potential effects of NOA in a number of areas in California. Analysts used the *San Francisco to San Jose Project Section Geology, Soils, and Seismicity Technical Report* (Authority 2019d) to determine if NOA occurs in the local RSA. As noted in that report, NOA may be present in Potrero Point in the San Francisco to South San Francisco Subsection, as this hill is mapped as serpentinite, a metamorphosed ultramafic rock.

Pb-based paint may have been used during construction of existing structures throughout the RSA. Analysts considered whether demolition would occur and whether the project would comply with applicable standards for appropriate disposal. The odor analysis is likewise qualitative and considered the potential for receptors to be exposed to nuisance odors during construction and operations of the project.

7 AIR QUALITY EFFECTS ANALYSIS

Using the methods described in Chapter 6, this chapter evaluates and discusses the effects of the project on emissions of criteria pollutants, TACs, MSATs, odors, and asbestos generated during operations and construction.

7.1 No Project Conditions

Tables 7-1 and 7-2 show estimated criteria pollutant emissions statewide under the No Project conditions in 2015, 2029, and 2040 under the medium and high ridership scenarios, respectively. As shown in the tables, total emissions for some pollutants would decrease from 2015 to 2040 (VOC, CO, and NO_X). The decreases in these pollutant emissions are due to expected improvements in on-road vehicle engine technology, fuel efficiency, and retirement of older, higher-emitting vehicles, which would offset emissions increases from higher on-road VMT and aircraft and power plant activity. For other pollutants (SO_2, PM_{10}, and $PM_{2.5}$), total emissions would increase from 2015 to 2040. The increase in PM would occur primarily because of higher VMT, aircraft, and electricity demand brought about by population and economic growth. The increase in SO_2 would be primarily related to growth in air travel and power plant production.

Table 7-1 Estimated Statewide Emissions, No Project Conditions—Medium Ridership Scenario

Emission Source	VOC (tons/yr)	CO (tons/yr)	NO_X (tons/yr)	SO_2 (tons/yr)	PM_{10} (tons/yr)	$PM_{2.5}$ (tons/yr)
2015						
On-road vehicles	7,839	324,144	33,370	767	22,981	6,242
Aircraft	338	2,888	2,779	299	84	84
Power plants	1,893	25,767	13,476	1,609	3,189	2,880
Total statewide emissions	**10,070**	**352,800**	**49,624**	**2,675**	**26,254**	**9,206**
2029						
On-road vehicles	1,712	125,365	9,783	577	26,322	6,998
Aircraft	411	3,445	3,391	367	103	102
Power plants	2,310	34,760	14,890	1,936	3,807	3,442
Total statewide emissions	**4,434**	**163,570**	**28,064**	**2,880**	**30,232**	**10,542**
2040						
On-road vehicles	996	86,627	6,312	489	27,540	7,091
Aircraft	474	3,968	3,908	423	118	118
Power plants	2,205	45,146	20,858	3,177	3,921	3,564
Total statewide emissions	**3,675**	**135,741**	**31,077**	**4,089**	**31,580**	**10,773**

Source: Authority 2019b
CO = carbon monoxide
NO_X = nitrogen oxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound
yr = year
Sum of individual values may not equal total due to rounding.

Table 7-2 Estimated Statewide Emissions, No Project Conditions—High Ridership Scenario

Emission Source	VOC (tons/yr)	CO (tons/yr)	NO_X (tons/yr)	SO_2 (tons/yr)	PM_{10} (tons/yr)	$PM_{2.5}$ (tons/yr)
2015						
On-road vehicles	7,800	322,534	33,204	763	22,867	6,211
Aircraft	315	2,692	2,589	279	78	78
Power plants	1,893	25,767	13,476	1,609	3,189	2,880
Total statewide emissions	**10,008**	**350,993**	**49,269**	**2,651**	**26,134**	**9,170**
2029						
On-road vehicles	1,725	126,531	9,983	590	26,898	7,147
Aircraft	341	2,856	2,811	304	85	85
Power plants	2,310	34,760	14,890	1,936	3,807	3,442
Total statewide emissions	**4,377**	**164,146**	**27,684**	**2,830**	**30,789**	**10,674**
2040						
On-road vehicles	1,093	94,097	6,907	552	29,185	7,625
Aircraft	520	4,348	4,282	464	129	129
Power plants	2,579	39,173	16,080	2,104	4,082	3,686
Total statewide emissions	**4,192**	**137,618**	**27,269**	**3,120**	**33,397**	**11,440**

Source: Authority 2019b
CO = carbon monoxide
NO_X = nitrogen oxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound
yr = year
Sum of individual items may not equal total due to rounding.

7.2 Statewide and Regional Operations Emissions Analysis

Tables 7-3 and 7-4 show estimated statewide emissions for the medium ridership scenario and the high ridership scenario, respectively, with the project operating in 2015, 2029, and 2040. As shown in the tables, total emissions for some pollutants (VOC, CO, and NO_X) would decrease from 2015 to 2040. For other pollutants (SO_2, PM_{10}, $PM_{2.5}$), total emissions increase from 2015 to 2040. The estimated statewide emissions burdens with the project would be the same under either project alternative because the ridership scenarios do not vary by alternative.

Comparing Tables 7-1 and 7-2 with Tables 7-3 and 7-4 shows that emissions with the project would follow the same general trends as emissions without the project. Emissions from on-road vehicles and aircraft would decrease by a small percentage despite population and economic growth in California because of advances in engine technology. Emissions from power plants would increase because of the increase in electricity demand with the project.

Table 7-3 Estimated Statewide Emissions with the Project—Medium Ridership Scenario

Emission Source	VOC (tons/yr)	CO (tons/yr)	NO_X (tons/yr)	SO_2 (tons/yr)	PM_{10} (tons/yr)	$PM_{2.5}$ (tons/yr)
2015						
On-road vehicles	7,708	318,720	32,811	754	22,596	6,138
Aircraft	237	2,027	1,949	210	59	59
Power plants	1,908	25,983	13,584	1,622	3,215	2,904
Total statewide net emissions	**9,853**	**346,729**	**48,344**	**2,586**	**25,870**	**9,100**
2029						
On-road vehicles	1,696	124,183	9,691	571	26,074	6,932
Aircraft	346	2,900	2,855	309	86	86
Power plants	2,323	34,944	14,982	1,947	3,829	3,462
Total statewide net emissions	**4,366**	**162,027**	**27,527**	**2,827**	**29,989**	**10,480**
2040						
On-road vehicles	1,052	90,518	6,573	525	27,749	7,251
Aircraft	335	2,805	2,763	299	84	83
Power plants	2,594	39,388	16,188	2,117	4,108	3,710
Total statewide net emissions	**3,981**	**132,711**	**25,523**	**2,941**	**31,941**	**11,044**

Source: Authority 2019b
CO = carbon monoxide
NO_X = nitrogen oxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound
yr = year
Sum of individual values may not equal total due to rounding.

Table 7-4 Estimated Statewide Emissions with the Project—High Ridership Scenario

Emission Source	VOC (tons/yr)	CO (tons/yr)	NO_X (tons/yr)	SO_2 (tons/yr)	PM_{10} (tons/yr)	$PM_{2.5}$ (tons/yr)
2015						
On-road vehicles	7,620	315,076	32,436	745	22,338	6,067
Aircraft	218	1,863	1,792	193	54	54
Power plants	1,910	26,004	13,594	1,624	3,218	2,906
Total statewide net emissions	**9,747**	**342,942**	**47,822**	**2,562**	**25,610**	**9,028**
2029						
On-road vehicles	1,728	126,496	9,872	582	26,560	7,061
Aircraft	269	2,253	2,218	240	67	67
Power plants	2,325	34,962	14,991	1,948	3,831	3,464
Total statewide net emissions	**4,322**	**163,711**	**27,080**	**2,770**	**30,458**	**10,592**

Emission Source	VOC (tons/yr)	CO (tons/yr)	NO_X (tons/yr)	SO_2 (tons/yr)	PM_{10} (tons/yr)	$PM_{2.5}$ (tons/yr)
2040						
On-road vehicles	1,067	91,810	6,739	538	28,476	7,439
Aircraft	386	3,230	3,181	345	96	96
Power plants	2,596	39,409	16,198	2,118	4,111	3,712
Total statewide net emissions	**4,049**	**134,450**	**26,118**	**3,001**	**32,683**	**11,247**

Source: Authority 2019b
CO = carbon monoxide
NO_X = nitrogen oxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound
yr = year
Sum of individual values may not equal total due to rounding.

Table 7-5 summarizes the net change in emissions between the two ridership scenarios with the project (absolute emissions are shown in Tables 7-3 and 7-4) and without the project (absolute emissions are shown in Tables 7-1 and 7-2) for the 2015 existing conditions, as well as the 2029 and 2040 No Project conditions. The net change represents the incremental change in emissions because of the project. As shown in Table 7-5, the project is predicted to have a beneficial effect on (i.e., it would reduce) statewide emissions of all pollutants under both ridership scenarios compared to the 2015 existing conditions and 2029 and 2040 No Project conditions.

7.2.1 On-Road Vehicles

As shown in Table 7-6 and Table 7-7, the project is predicted to reduce regional VMT and on-road emissions, respectively, as compared to the 2015 existing conditions, as well as the 2029 and 2040 No Project conditions, under both ridership scenarios, resulting in a beneficial effect on regional air quality. The change in emissions would be the same under either project alternative because the ridership is assumed the same. Increases in gate-down time at at-grade crossings would increase vehicle idling emissions, but this increase would be more than compensated for by the reduction in regional emissions from on-road vehicles.

The HSR system is predicted to reduce statewide and regional criteria pollutant emissions associated with roadways because travelers would use HSR rather than drive. The on-road vehicle emission analysis is based on VMT changes and associated average daily speed estimates calculated for San Francisco, San Mateo, and Santa Clara Counties. Analysts obtained emission factors from EMFAC2017, using statewide parameters.

Table 7-5 Estimated Changes in Statewide Emissions, Project vs. No Project (Medium and High Ridership Scenarios)

Emission Source	VOC (tons/yr)		CO (tons/yr)		NO_X (tons/yr)		SO_2 (tons/yr)		PM_{10} (tons/yr)		$PM_{2.5}$ (tons/yr)	
	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High
Existing Plus Project Emissions Relative to 2015 Existing Conditions												
On-road vehicles	-131	-180	-5,425	-7,458	-558	-768	-13	-18	-385	-529	-104	-144
Aircraft	-101	-97	-862	-829	-829	-798	-89	-86	-25	-24	-25	-24
Power plants	15	17	215	237	108	118	13	14	26	29	23	26
Total statewide net emissions	**-217**	**-260**	**-6,071**	**-8,051**	**-1,280**	**-1,447**	**-89**	**-89**	**-384**	**-524**	**-106**	**-142**
2029 Plus Project Emissions Relative to 2029 No Project Conditions												
On-road vehicles	-16	3	-1,182	-35	-92	-111	-5	-8	-248	-338	-66	-86
Aircraft	-65	-72	-545	-602	-536	-593	-58	-64	-16	-18	-16	-18
Power plants	13	14	184	202	92	101	11	12	22	24	20	22
Total statewide net emissions	**-68**	**-55**	**-1,543**	**-435**	**-537**	**-603**	**-52**	**-59**	**-242**	**-332**	**-62**	**-82**
2040 Plus Project Emissions Relative to 2040 No Project Conditions												
On-road vehicles	-7	-27	-564	-2,287	-109	-168	-9	-13	-500	-709	-127	-185
Aircraft	-139	-134	-1,162	-1,118	-1,145	-1,101	-124	-119	-35	-33	-35	-33
Power plants	12	17	207	237	105	118	17	14	23	29	21	26
Total statewide net emissions	**-133**	**-143**	**-1,520**	**-3,168**	**-1,148**	**-1,151**	**-116**	**-118**	**-512**	**-714**	**-141**	**-193**

Source: Authority 2019b
CO = carbon monoxide
NO_X = nitrogen oxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound
yr = year
Sum of individual values may not equal total due to rounding.

Table 7-6 On-Road Vehicle Miles Traveled, Project vs. No Project (Medium and High Ridership Scenarios)

Location	No Project VMT Total Annual Traffic		Plus Project VMT Total Annual Traffic	
	Medium	High	Medium	High
2015				
San Francisco	2,394,634,887	2,389,767,863	2,377,073,629	2,367,097,723
San Mateo	4,177,229,008	4,166,580,971	4,112,265,734	4,080,540,269
Santa Clara	10,312,374,118	10,283,778,970	10,146,971,563	10,060,102,631
Regional total	**16,884,238,013**	**16,840,127,805**	**16,636,310,926**	**16,507,740,623**
2029				
San Francisco	2,530,115,205	2,549,997,470	2,519,134,696	2,535,766,744
San Mateo	4,735,476,353	4,787,272,227	4,694,356,761	4,731,650,640
Santa Clara	12,185,576,908	12,342,515,217	12,054,792,646	12,166,524,907
Regional total	**19,451,168,466**	**19,679,784,914**	**19,268,284,102**	**19,433,942,291**
2040				
San Francisco	2,720,965,133	2,750,874,429	2,696,558,412	2,719,367,359
San Mateo	4,963,026,084	5,023,200,441	4,872,739,813	4,903,620,659
Santa Clara	13,201,830,628	13,445,805,858	12,971,953,362	13,134,939,406
Regional total	**20,885,821,845**	**21,219,880,728**	**20,541,251,587**	**20,757,927,424**

Source: Authority 2019b
VMT = vehicle miles traveled
Sum of individual values may not equal total due to rounding.

Table 7-7 On-Road Vehicle Emission Changes, Project vs. No Project (Medium and High Ridership Scenarios)

Location	VOC (tons/yr)		CO (tons/yr)		NO_X (tons/yr)		SO_2 (tons/yr)		PM_{10} (tons/yr)		$PM_{2.5}$ (tons/yr)	
	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High
Existing Plus Project Emissions Relative to 2015 Existing Conditions												
San Francisco	-1	-2	-35	-46	-3	-4	0	0	-2	-3	-1	-1
San Mateo	-3	-3	-106	-140	-11	-14	0	0	-7	-10	-2	-3
Santa Clara	-7	-9	-272	-367	-27	-37	-1	-1	-19	-25	-5	-7
Total regional net emissions change	**-11**	**-14**	**-413**	**-553**	**-41**	**-55**	**-1**	**-1**	**-28**	**-37**	**-8**	**-10**
2029 Plus Project Emissions Relative to 2029 No Project Conditions												
San Francisco	0	0	-7	-10	-1	-1	0	0	-1	-2	0	0
San Mateo	0	0	-23	-31	-2	-2	0	0	-5	-6	-1	-2
Santa Clara	-1	-1	-73	-98	-5	-7	0	0	-14	-19	-4	-5
Total regional net emissions change	**-2**	**-2**	**-103**	**-138**	**-8**	**-10**	**0**	**-1**	**-20**	**-27**	**-5**	**-7**
2040 Plus Project Emissions Relative to 2040 No Project Conditions												
San Francisco	0	0	-11	-15	-1	-1	0	0	-3	-3	-1	-1
San Mateo	0	0	-33	-19	-2	-2	0	0	-10	-13	-2	-3
Santa Clara	-1	-2	-85	-121	-6	-8	0	-1	-25	-34	-7	-9
Total regional net emissions change	**-2**	**-2**	**-128**	**-154**	**-9**	**-11**	**-1**	**-1**	**-38**	**-51**	**-10**	**-13**

Source: Authority 2019b
CO = carbon monoxide
NO_X = nitrogen oxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound
yr = year
Sum of individual values may not equal total due to rounding.

7.2.2 Trains

The project would use EMU trains, with the power distributed through the OCS. The HSR system would not produce direct emissions from combustion of fossil fuels and associated emissions that could cause substantial health concerns such as asthma or other respiratory diseases. However, trains traveling at high velocities, such as those associated with the HSR system, create sideways turbulence and rear wake, which re-suspend particulates from the surface surrounding the track, resulting in fugitive dust emissions. Assuming a friction velocity of 0.62 foot per second to re-suspend soils in the RSA, an HSR train passing at 220 mph could re-suspend soil particles out to approximately 10 feet from the train (SJVAPCD 1996). Based on the USEPA method for estimating emissions from wind erosion (USEPA 2006a), the project would generate approximately 14 tons per year of PM_{10} and 2 tons per year of $PM_{2.5}$ (Section 7.2.5, Regional Operations Criteria Pollutant Emissions Summary). The maximum train speed of 110 mph in the Project Section is half the 220 mph speed assumed in the calculation. Because emissions due to induced wind decrease as train speed decreases, actual emissions would be less than calculated. Details of the analysis and calculations are provided in Appendix F. Based on this analysis, fugitive dust emissions from HSR travel are not expected to result in sufficient amounts of dust to cause health concerns.

7.2.3 Aircraft

The implementation of the project and the HSR system is predicted to reduce the number of aircraft flights at the regional airports in Northern California. Using the methods described in Section 6.2.3, Aircraft, analysts estimated emissions from aircraft takeoff and landing cycles as well as associated ground maintenance requirements. Table 7-8 shows the total number of flights with and without the project in 2015, 2029, and 2040 for both ridership scenarios.

As shown in Table 7-9, the project is predicted to reduce regional and statewide aircraft emissions compared to the 2015 existing conditions, as well as the 2029 and 2040 No Project conditions, under both ridership scenarios, resulting in a beneficial effect on regional air quality. The effect on emissions would be the same under either project alternative because ridership is assumed the same.

7.2.4 Power Plants

The project would increase electrical requirements compared to the 2015 existing conditions and 2029 and 2040 No Project conditions because the trains would be powered by electricity. Analysts conservatively estimated the statewide electrical demands from propulsion of the trains and the operation of the trains at stations and in storage depots and maintenance facilities. No single generation source for the electrical power requirements can be identified because the state's electrical grid would power the HSR system.

Table 7-10 shows the pollutant emissions relative to the 2015 existing conditions and 2029 and 2040 No Project conditions and indicates the direct effect of the project by comparing the emissions with the project to the emissions without the project. The effect on emissions would be the same under either project alternative because ridership is assumed the same.

As previously noted, the state requires an increasing fraction (60 percent by 2030) of electricity generated for the state's power portfolio to come from renewable energy sources, and the Authority has a policy goal to use 100 percent renewable energy to power the HSR system. Accordingly, the emissions generated for powering the HSR system are expected to be lower in the future compared to emission estimates used in this analysis, because the analysis conservatively assumes the current electrical generation mix of the state.

Table 7-8 Aircraft Flights, Project vs. No Project (Medium and High Ridership Scenarios)

Location	Total No Project Number of Flights (per year)		Total Project Number of Flights (per year)	
	Medium	High	Medium	High
2015				
Regional (Bay Area)	91,124	85,065	59,462	54,762
Statewide total	268,567	250,276	188,430	173,177
2029				
Regional (Bay Area)	110,664	93,895	90,004	71,250
Statewide total	329,614	273,240	277,475	215,599
2040				
Regional (Bay Area)	125,946	137,732	81,942	95,616
Statewide total	380,189	416,659	268,814	309,505

Source: Authority 2019b

Table 7-9 Aircraft Emission Changes, Project vs. No Project (Medium and High Ridership Scenarios)

Location	VOC (tons/yr)		CO (tons/yr)		NO_X (tons/yr)		SO_2 (tons/yr)		PM_{10} (tons/yr)		$PM_{2.5}$ (tons/yr)	
	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High
2015 Plus Project Emissions Relative to 2015 Existing Conditions												
Regional (Bay Area)	-40	-38	-341	-326	-328	-314	-35	-34	-10	-9	-10	-9
Total statewide net emissions	-101	-97	-862	-829	-829	-798	-89	-86	-25	-24	-25	-24
2029 Plus Project Emissions Relative to 2029 No Project Conditions												
Regional (Bay Area)	-26	-28	-216	-237	-213	-233	-23	-25	-6	-7	-6	-7
Total statewide net emissions	-65	-72	-545	-602	-536	-593	-58	-64	-16	-18	-16	-18
2040 Plus Project Emissions Relative to the 2040 No Project Conditions												
Regional (Bay Area)	-55	-53	-459	-440	-452	-433	-49	-47	-14	-13	-14	-13
Total statewide net emissions	-139	-134	-1,162	-1,118	-1,145	-1,101	-124	-119	-35	-33	-35	-33

Source: Authority 2019b
CO = carbon monoxide
NO_X = nitrogen oxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound
yr = year

Table 7-10 Power Plant Emission Changes, Project vs. No Project (Medium and High Ridership Scenarios)

Location	VOC (tons/yr)		CO (tons/yr)		NO_X (tons/yr)		SO_2 (tons/yr)		PM_{10} (tons/yr)		$PM_{2.5}$ (tons/yr)	
	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High
2015 Plus Project Emissions Relative to 2015 Existing Conditions												
Regional (Bay Area)	1	1	13	14	6	7	1	1	2	2	1	2
Statewide	15	17	215	237	108	118	13	14	26	29	23	26
2029 Plus Project Emissions Relative to 2029 No Project Conditions												
Regional (Bay Area)	1	1	11	12	6	6	1	1	1	1	1	1
Total statewide net emissions	13	14	184	202	92	101	11	12	22	24	20	22
2040 Plus Project Emissions Relative to 2040 No Project Conditions												
Regional (Bay Area)	1	1	13	14	6	7	1	1	2	2	1	2
Statewide	15	17	215	237	108	118	13	14	26	29	23	26

Source: Authority 2019b
CO = carbon monoxide
HSR = high-speed rail
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound
yr = year

7.2.5 Regional Operations Criteria Pollutant Emissions Summary

Table 7-11 through Table 7-13 show the total emission changes from project operations under the medium and high ridership scenarios for the 2015 existing conditions (Table 7-11) and 2029 and 2040 No Project conditions (Tables 7-12 and 7-13, respectively). Results include indirect emissions from regional vehicle travel, aircraft, and power plants and direct operations emissions from HSR train movement.

As shown in the tables, both project alternatives would result in a net regional decrease in emissions of all criteria pollutants. These decreases would be beneficial to the SFBAAB and help the basin meet its attainment goals for O_3 and other criteria pollutants. Lower ridership would result in fewer regional benefits, although it would still constitute a net benefit. Direct emissions of fugitive dust (PM_{10} and $PM_{2.5}$) from train movement would only occur within the project footprint; however, as discussed, these emissions would be distributed along the entire track length and are not expected to result in substantial concentrations in any one localized area.

The beneficial effects from a reduction in regional operations criteria pollutant emissions would be approximately the same under either project alternative. The decrease in indirect emissions associated with regional vehicle travel, aircraft, and power plants would be equal under either project alternative because ridership would not vary by alternative. Direct emissions, which do not depend on ridership, also would be the same under either project alternative.

Table 7-11 Regional Criteria Pollutant Emissions Changes, Project Compared to 2015 Existing Conditions (Medium and High Ridership Scenarios)

	VOC (tons/yr)		CO (tons/yr)		NO_X (tons/yr)		SO_2 (tons/yr)		PM_{10} (tons/yr)		$PM_{2.5}$ (tons/yr)	
Emission Source	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High
Indirect Emissions												
On-road vehicles	-11	-14	-413	-553	-41	-55	-1	-1	-28	-37	-8	-10
Aircraft	-40	-38	-341	-326	-328	-314	-35	-34	-10	-9	-10	-9
Power plants	1	1	13	14	6	7	1	1	2	2	1	2
Direct Emissions (fugitive dust from train movement)[1]												
Train movement									14		2	
Total Emissions[2]												
All sources	-50	-51	-740	-865	-362	-361	-35	-34	-22	-32	-14	-15

Sources: Authority 2019b; SJVAPCD 1996; USEPA 2006a
CO = carbon monoxide
NO_X = nitrogen oxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound
yr = year
Sum of individual values may not equal total due to rounding.
[1] Direct dust emissions from train movement do not depend on ridership; emissions are the same for both scenarios.
[2] Total includes indirect and direct emissions.

Table 7-12 Regional Criteria Pollutant Emissions Changes, Project Compared to 2029 No Project Conditions (Medium and High Ridership Scenarios)

Emission Source	VOC (tons/yr)		CO (tons/yr)		NO_X (tons/yr)		SO_2 (tons/yr)		PM_{10} (tons/yr)		$PM_{2.5}$ (tons/yr)	
	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High
Indirect Emissions												
On-road vehicles	-1	-2	-103	-138	-8	-10	0	-1	-20	-27	-5	-7
Aircraft	-26	-28	-216	-237	-213	-233	-23	-25	-6	-7	-6	-7
Power plants	1	1	11	12	6	6	1	1	1	1	1	1
Direct Emissions (fugitive dust from train movement)[1]												
Train movement									2		2	
Total Emissions[2]												
All sources	-27	-29	-308	-363	-215	-237	-23	-25	-23	-31	-9	-11

*Sources: Authority 2019*b; *SJVAPCD 1996; USEPA 2006a*
CO = carbon monoxide
NO_X = nitrogen oxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound
yr = year
Sum of individual values may not equal total due to rounding.
[1] Direct dust emissions from train movement do not depend on ridership; emissions are the same for both scenarios.
[2] Total includes indirect and direct emissions.

Table 7-13 Regional Criteria Pollutant Emissions Changes, Project Compared to 2040 No Project Conditions (Medium and High Ridership Scenarios)

Emission Source	VOC (tons/yr)		CO (tons/yr)		NO_X (tons/yr)		SO_2 (tons/yr)		PM_{10} (tons/yr)		$PM_{2.5}$ (tons/yr)	
	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High
Indirect Emissions												
On-road vehicles	-2	-2	-128	-154	-9	-11	-1	-1	-38	-51	-10	-13
Aircraft	-55	-53	-459	-440	-452	-433	-49	-47	-14	-13	-14	-13
Power plants	1	1	12	14	6	7	1	1	1	2	1	2
Direct Emissions (fugitive dust from train movement)[1]												
Train movement									14		2	
Total Emissions[2]												
All sources	-56	-53	-575	-579	-455	-437	-49	-47	-36	-49	-20	-23

Source: Authority 2019b; SJVAPCD 1996; USEPA 2006a
CO = carbon monoxide
NO_X = nitrogen oxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound
yr = year
Sum of individual values may not equal total due to rounding.
[1] Direct dust emissions from train movement do not depend on ridership; emissions are the same for both scenarios.
[2] Total includes indirect and direct emissions.

7.3 Local Operation Emission Sources

Operation of the 4th and King Street and Millbrae Stations and the LMF would produce criteria pollutant emissions, which were quantified. The operation of the power traction, switching, and paralleling stations serving the blended system would not result in appreciable quantities of air pollutants because site visits would be infrequent, and power usage would be limited. Therefore, emissions from the power traction, switching, and paralleling stations were not quantified.

Emissions associated with operation of the stations and Brisbane LMF are expected as a result of combustion sources used primarily for space heating and facility landscaping, energy consumption for facility lighting, minor solvent and paint usage for periodic application of architectural coatings, and employee and passenger traffic.[15] Analysts used CalEEMod to estimate these emissions from the stations and LMF, based on the square footage of the buildings and assumptions described in Chapter 6. Analysts estimated the criteria pollutant emissions for 2015, 2029, and 2040 conditions, as shown in Table 7-14. Station and LMF emissions would be similar for both project alternatives.

Table 7-14 Station and Light Maintenance Facility Operations Emissions (tons per year)

Project Component	VOC	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$
2015 Existing Conditions[1]						
4th and King Street Station	2	18	2	0	3	1
Millbrae Station	4	50	5	0	11	3
Total	6	68	7	0	14	4
2015 Existing Plus Project						
4th and King Street Station	3	40	4	0	8	2
Millbrae Station	6	75	8	0	16	4
Brisbane LMF	2	3	1	0	1	0
Total	11	118	12	0	24	7
Change with Project	**6**	**49**	**5**	**0**	**10**	**3**
2029 No Project[1]						
4th and King Street Station	1	7	1	0	4	1
2029 Plus Project						
4th and King Street Station	1	15	1	0	8	2
Change with Project	**1**	**8**	**1**	**0**	**4**	**1**
2040 No Project[1]						
Millbrae Station	2	19	2	0	12	3

[15] The Authority also may use portable electric generators during routine maintenance activities. Emissions from portable generators have not been quantified because information on the number, size, and locations of generators and the amount of use is not available.

Project Component	VOC	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$
2040 Plus Project						
Millbrae Station	3	28	2	0	17	5
Brisbane LMF	2	2	1	0	1	0
Total	5	30	3	0	18	5
Change with Project	**3**	**11**	**2**	**0**	**6**	**2**

Source: CAPCOA 2017
CO = carbon monoxide
LMF = light maintenance facility
NO_X = nitrogen oxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SO_2 = sulfur dioxide
tons/yr = tons per year
VOC = volatile organic compound
Sum of individual values may not equal total due to rounding. Values less than 0.5 have been rounded to zero.
[1] Represents emissions from the existing facilities prior to HSR improvements. The Brisbane LMF does not exist under 2015 existing conditions, and existing emissions are assumed to be zero.

7.4 Total Operations Emissions

Tables 7-15 through 7-17 show a summary of the total emission changes because of project operation for the medium and high ridership scenarios, including the indirect emissions from regional vehicle travel, aircraft, and power plants and direct project operations emissions from HSR stations, LMF, and train movements. The project would result in a net regional decrease in emissions of criteria pollutants. These decreases would be beneficial to the SFBAAB and help the basin meet its attainment goals for O_3 and particulates (PM_{10} and $PM_{2.5}$). Lower ridership would result in fewer regional benefits, although even with lower ridership, there would be a net benefit.

Either project alternative would result in a net reduction in operations emissions from the 2015 existing conditions and 2029 and 2040 No Project conditions. Indirect emissions from vehicle travel, aircraft, and power plants are based on ridership, which would not differ by alternative. Direct emissions from stations, the LMF, and train movement also would not differ by alternative.

Table 7-15 Total Regional Criteria Pollutant Emissions Changes, Project Compared to 2015 Existing Conditions (Medium and High Ridership Scenarios)

Emission Source	VOC (tons/yr)		CO (tons/yr)		NO_X (tons/yr)		SO_2 (tons/yr)		PM_{10} (tons/yr)		$PM_{2.5}$ (tons/yr)	
	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High
Indirect Emissions Change												
On-road vehicles	-11	-14	-413	-553	-41	-55	-1	-1	-28	-37	-8	-10
Aircraft	-40	-38	-341	-326	-328	-314	-35	-34	-10	-9	-10	-9
Power plants	1	1	13	14	6	7	1	1	2	2	1	2
Direct Emissions Change [1]												
Stations[2]	4		46		4		0		9		3	
Brisbane LMF	2		3		1		0		1		0	
Train movement[3]									14		2	
Total Emissions Change [4]												
Project	-43	-45	-691	-816	-357	-356	-35	-34	-12	-22	-11	-12

Sources: Authority 2019b; SJVAPCD 1996; USEPA 2006a; CAPCOA 2017
CO = carbon monoxide
NO_X = nitrogen oxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound
yr = year
Values less than 0.5 have been rounded to zero.
[1] Direct emissions do not depend on ridership; emissions are the same for both scenarios.
[2] Represents the net emissions effect of the project (i.e., the difference in station operating emissions between Existing and Existing Plus Project conditions)
[3] Train movement would only generate fugitive dust emissions.
[4] Total includes indirect and direct emissions.

Table 7-16 Total Regional Criteria Pollutant Emissions Changes, Project Compared to 2029 No Project Conditions (Medium and High Ridership Scenarios)

	VOC (tons/yr)		CO (tons/yr)		NO_X (tons/yr)		SO_2 (tons/yr)		PM_{10} (tons/yr)		$PM_{2.5}$ (tons/yr)	
Emission Source	**Medium**	**High**	**Medium**	**High**	**Medium**	**High**	**Medium**	**High**	**Medium**	**High**	**Medium**	**High**
Indirect Emissions Change												
On-road vehicles	-1	-2	-103	-128	-8	-10	0	-1	-20	-27	-5	-7
Aircraft	-26	-28	-216	-237	-213	-233	-23	-25	-6	-7	-6	-7
Power plants	1	1	11	12	6	6	1	1	1	1	1	1
Direct Emissions Change [1]												
Stations[2]	1		8		1		0		4		1	
Brisbane LMF	2		1		1		0		1		0	
Train movement[3]									14		2	
Total Emissions Change [4]												
Project	-24	-27	-298	-343	-213	-235	-23	-25	-6	-14	-7	-9

Sources: Authority 2019b; SJVAPCD 1996; USEPA 2006a; CAPCOA 2017
CO = carbon monoxide
NO_X = nitrogen oxide
PM_{10} = particulate matter 10 microns or less in diameter
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound
yr = year
Values less than 0.5 have been rounded to zero
[1] Direct emissions do not depend on ridership; emissions are the same for both scenarios.
[2] Represents the net emissions effect of the project (i.e., the difference in station operating emissions between Existing and Existing Plus Project conditions)
[3] Train movement would only generate fugitive dust emissions.
[4] Total includes indirect and direct emissions.

Table 7-17 Total Regional Criteria Pollutant Emissions Changes, Project Compared to 2040 No Project Conditions (Medium and High Ridership Scenarios)

Emission Source	VOC (tons/yr)		CO (tons/yr)		NO_X (tons/yr)		SO_2 (tons/yr)		PM_{10} (tons/yr)		$PM_{2.5}$ (tons/yr)	
	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High	Medium	High
Indirect Emissions Change												
On-road vehicles	-2	-2	-128	-154	-9	-11	-1	-1	-38	-51	-10	-13
Aircraft	-55	-53	-459	-440	-452	-433	-49	-47	-14	-13	-14	-13
Power plants	1	1	12	14	6	7	1	1	1	2	1	2
Direct Emissions Change [1]												
Stations[2]	1		9		1		0		5		1	
Brisbane LMF	2		2		1		0		1		0	
Train movement[3]									14		2	
Total Emissions Change [4]												
Project	-53	-50	-565	-569	-453	-435	-49	-47	-30	-41	-19	-20

Sources: Authority 2019b; SJVAPCD 1996; USEPA 2006a; CAPCOA 2017
CO = carbon monoxide
NO_X = nitrogen oxide
PM_{10} = particulate matter 10 microns or less in diameter
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound
yr = year
Values less than 0.5 have been rounded to zero
[1] Direct emissions do not depend on ridership; emissions are the same for both scenarios.
[2] Represents the net emissions effect of the project (i.e., the difference in station operating emissions between Existing and Existing Plus Project conditions)
[3] Train movement would only generate fugitive dust emissions.
[4] Total includes indirect and direct emissions.

7.5 Microscale Carbon Monoxide Hot-Spot Analysis

Analysts modeled CO concentrations at intersections included in the traffic analysis, as described in Section 6.3.3.3, Emission Model. For those intersections covered by congestion management plans, analysts selected for modeling the five intersections with the highest traffic volumes and the worst levels of congestion/delay for 2040 (Authority 2019c). Analysts also selected for modeling the five intersections with the highest traffic volumes and the worst levels of congestion/delay near the 4th and King Street Station for 2029 because this station will no longer be in use by 2040. The modeled CO concentrations were combined with CO background concentrations and compared with air quality standards. Results would be the same for either project alternative because projected traffic volumes would be the same for both. Table 7-18 shows the CO hot-spot analysis results and indicates that CO concentrations are not anticipated to exceed the 1- or 8-hour NAAQS and CAAQS for either project alternative.

Table 7-18 Carbon Monoxide Modeling Concentration Results

Intersection and Year	Receptor ID[1]	1-Hour Concentration[2] (ppm)		8-Hour Concentration[3] (ppm)	
		No Project	Plus Project	No Project	Plus Project
2029					
Fourth Street/King Street	21	2.9	2.9	1.9	1.9
	22	2.9	2.9	1.9	1.9
	23	2.9	2.9	1.9	1.9
	24	2.9	2.9	1.9	1.9
Fifth Street/King Street/I-280 Ramps	25	2.9	2.9	1.9	1.9
	26	2.9	2.9	1.9	1.9
	27	3.0	3.0	2.0	2.0
	28	3.0	3.0	2.0	2.0
Owens Street/16th Street	29	2.7	2.7	1.8	1.8
	30	2.6	2.6	1.7	1.7
	31	2.6	2.6	1.7	1.7
	32	2.6	2.6	1.7	1.7
Fifth Street/Bryant Street	33	2.6	2.7	1.7	1.8
	34	2.7	2.8	1.8	1.8
	35	2.7	2.7	1.8	1.8
	36	2.7	2.7	1.8	1.8
Third Street/16th Street	37	2.7	2.7	1.8	1.8
	38	2.8	2.8	1.8	1.8
	39	2.8	2.8	1.8	1.8
	40	2.6	2.6	1.7	1.7

Intersection and Year	Receptor ID[1]	1-Hour Concentration[2] (ppm)		8-Hour Concentration[3] (ppm)	
		No Project	Plus Project	No Project	Plus Project
2040					
El Camino Real (SR 82)/Millbrae Avenue	1	3.8	3.8	2.1	2.1
	2	3.7	3.7	2.0	2.0
	3	3.7	3.7	2.0	2.0
	4	3.7	3.7	2.0	2.0
El Camino Real (SR 82)/Palo Alto Avenue-Sand Hill Road	5	3.6	3.6	1.9	1.9
	6	3.7	3.7	2.0	2.0
	7	3.9	3.9	2.1	2.1
	8	3.8	3.8	2.1	2.1
Central Expressway/Rengstorff Avenue	9	3.7	3.7	2.0	2.0
	10	3.8	3.8	2.1	2.1
	11	3.7	3.7	2.0	2.0
	12	3.7	3.7	2.0	2.0
Central Expressway/Moffett Boulevard-Castro Street	13	3.7	3.7	2.0	2.0
	14	3.8	3.8	2.1	2.1
	15	3.8	3.8	2.1	2.1
	16	3.7	3.7	2.0	2.0
Bayshore Boulevard/Geneva Avenue	17	3.5	3.5	1.9	1.9
	18	3.6	3.6	1.9	1.9
	19	3.5	3.5	1.9	1.9
	20	3.8	3.8	2.1	2.1
State standard (ppm)		20	20	9	9
Federal standard (ppm)		35	35	9	9

Sources: Garza et al. 1997; Authority 2019c
Caltrans = California Department of Transportation
CO = carbon monoxide
I- = Interstate
ID = identifier
ppm = parts per million
SR = State Route
[1] Consistent with Caltrans CO Protocol (Garza et al. 1997), receptors are located 3 meters from the intersection at each of the four corners to represent the nearest location in which a receptor could potentially be located adjacent to a traveled roadway. The modeled receptors indicated do not necessarily represent actual sensitive receptors. Receptor locations are theoretical and are not reflective of actual locations illustrated on Figures 5-2 through 5-5.
[2] An average 1-hour background concentration of 2.00 ppm was assumed for 2029, based on 2015–2017 measured data at the Redwood City—Barron Avenue monitoring site (USEPA 2018a). An average 1-hour background concentration of 2.80 ppm was assumed for 2040, based on 2015–2017 measured data at the San Francisco—Arkansas Street monitoring site (USEPA 2018a).
[3] An average 8-hour background concentration of 1.27 ppm was assumed for 2029, based on 2015-2017 measured data at the Redwood City—Barron Avenue monitoring site (USEPA 2018a). An average 1-hour background concentration of 1.37 ppm was assumed for 2040, based on 2015–2017 measured data at the San Francisco—Arkansas Street monitoring site (USEPA 2018a).

7.6 Particulate Matter (PM_{10} and $PM_{2.5}$) Hot-Spot Analysis

Compared to the No Project condition, the project would reduce VMT under all analysis years (2015, 2029, and 2040), resulting in PM_{10} and $PM_{2.5}$ reductions (Table 7-6 and Table 7-7). To identify and evaluate potential effects, analysts prepared a qualitative hot-spot analysis because the regional RSA is designated nonattainment for the $PM_{2.5}$ NAAQS, and the project is subject to a localized $PM_{2.5}$ hot-spot analysis. The project alternatives would not differ in PM emissions because the regional change in VMT would be the same for both alternatives.

In November 2015, the USEPA updated its *Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* (USEPA 2015e), which was used for this analysis. Although this analysis is normally associated with the Transportation Conformity Rule, the HSR system is subject to the General Conformity Rule. Notwithstanding the decision to use this analytical structure, additional analysis or associated activities required to comply with transportation conformity would be carried out only if discrete project elements become subject to those requirements. In accordance with this guidance, if a project meets one of the following criteria, it is considered a project of air quality concern, and a quantitative PM_{10}/$PM_{2.5}$ analysis is required:

- **New or expanded highway projects that have a significant number of or significant increase in number of diesel vehicles**—The project is not a new highway project, nor would it expand an existing highway beyond its current capacity. The HSR system would be electrically powered. While the project would affect traffic conditions on roadways near the stations, it would not measurably affect truck volumes on the affected roadways. Most vehicle trips entering and leaving the station location would be passenger vehicles, which are typically not diesel-powered, with the exception of delivery truck trips to support station activities. Moreover, the project would improve regional traffic conditions by reducing traffic congestion and regional VMT within the RSA and increasing vehicle speeds.
- **Projects affecting intersections that are at LOS D, E, or F with a significant number of diesel vehicles or those that will degrade to LOS D, E, or F because of increased traffic volumes from a significant number of diesel vehicles related to the project**—The project would not change the existing traffic mix at signalized intersections. Although the LMF would use diesel vehicles, daily deliveries are not expected to exceed 20 trips. In some cases, the LOS of intersections near the HSR stations would be degraded to LOS D, E, or F under the project. However, the traffic volume increases at the affected intersections would be primarily from passenger cars and transit buses used for transporting people to or from the stations. Passenger cars would be gasoline-powered. Buses operated by SamTrans and MUNI are a mix of diesel, diesel-electric, and electric trolleys. MUNI has committed to an all-electric bus fleet by 2035 (San Francisco Municipal Transit Authority 2018). SamTrans has committed to an all-electric bus fleet by 2033 (SamTrans 2018).
- **New or expanded bus and rail terminals and transfer points that have a significant number of diesel vehicles congregating at a single location**—The project would not have new or expanded bus or rail passenger terminals or transfer points that would significantly increase the number of diesel vehicles congregating at a single location. The trains used for the project would be EMUs, powered by electricity, not diesel fuel. Most vehicle trips entering and leaving the station would be passenger vehicles, which are not typically diesel-powered. Improved bus service is not part of the HSR system. The Authority assumes that bus service levels are constant into the future given that no operator has a funding plan to deliver more service. As noted, SamTrans and MUNI have plans to transition to all-electric bus fleets will also reduce diesel bus emissions over time. The Brisbane LMF may have diesel vehicles, but these would be limited to 20 or fewer haul vehicles per day.

- **Projects in or affecting locations, areas, or categories of sites that are identified in the $PM_{2.5}$- or PM_{10}-applicable implementation plan or implementation plan submission, as appropriate, as sites of violation or possible violation**—The RSA is not in an area identified as a site of violation or possible violation in the USEPA-approved SIP.

Based on these criteria, the project would not be considered a project of air quality concern as defined by 40 C.F.R. Section 93.123(b)(1) and would not likely cause violations of the $PM_{2.5}$ NAAQS during its operation. Therefore, quantitative $PM_{2.5}$ and PM_{10} hot-spot evaluations are not required. CAA 40 C.F.R. Section 93.116 requirements are therefore met without a quantitative hot-spot analysis. The project would not likely cause an effect on air quality for $PM_{2.5}$ standards because, based on these criteria, it is not a project of air quality concern.

7.7 Mobile Source Air Toxics

In accordance with the FHWA's *Updated Interim Guidance on Air Toxic Analysis in NEPA Documents,* released September 30, 2009 and updated on October 18, 2016 (FHWA 2016), the qualitative assessment presented in the following subsections is derived, in part, from an FHWA study, *A Methodology for Evaluating Mobile Source Air Toxic Emissions among Transportation Project Alternatives* (FHWA 2011). It is provided as a basis for identifying and comparing the potential differences in MSAT emissions, if any, between the project alternatives.

MSAT emissions would not differ between the project alternatives because the regional change in vehicle emissions would be the same for both alternatives. Therefore, this analysis compares the project to the 2015 existing conditions and 2029 and 2040 No Project conditions.

7.7.1 Regional Mobile Source Air Toxics

Under the project, the HSR system would use EMUs, with the power distributed to each train car via the OCS. Operation of the EMUs would not generate combustion emissions; therefore, no toxic emissions would be expected from operation of the project.

The project would decrease regional VMT and MSAT emissions relative to the 2015 existing and 2029 and 2040 No Project conditions. The availability of the HSR system would reduce the number of individual vehicle trips on a regional basis. Because the project would not substantially change the regional traffic mix, the amount of MSATs emitted from highways and other roadways within the RSA would be proportional to the VMT. Because the regional VMT estimated for the project would be less than the anticipated VMT in 2015 existing and 2029 and 2040 No Project conditions, MSAT emissions from regional vehicle traffic would be less for the project.

The project would also result in reduced traffic congestion and increased vehicle speed when compared to the 2029 and 2040 No Project conditions because more people would use the HSR system instead of driving. According to USEPA's MOVES2014a model, emissions of all priority MSATs, except DPM, decrease as speed increases. Therefore, the project would result in decreases in overall MSAT emissions as traffic congestion declines.

Even without the project, emissions in 2029 and 2040 would likely be lower than present levels because of the USEPA's national vehicle emissions control programs, which are projected to reduce annual MSAT emissions by 90 percent between 2010 and 2050. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the USEPA-projected reductions is so great (even after accounting for VMT growth relative to 2015 existing conditions) that MSAT emissions in the RSA are likely to be lower in the future in nearly all cases.

7.7.2 Local Mobile Source Air Toxics

The potential MSAT emission sources directly related to project operation would be from vehicles used at the LMF and passenger vehicles traveling to and from the train stations. Localized increases in MSAT emissions could occur near the stations because of passenger vehicles accessing the stations. Consistent with FHWA's MSAT guidance, the magnitude and the duration of potential changes in localized MSATs, and thus health consequences, cannot be reliably quantified because of incomplete or unavailable information in forecasting project-specific health effects. Although there may be differences between the project alternatives with respect to localized MSATs, USEPA's vehicle and fuel regulations, coupled with fleet turnover, will cause substantial MSAT reductions over time, thereby offsetting the increase in localized traffic associated with the project.

7.7.3 Mobile Source Air Toxics Research and Incomplete Information

Air toxics analysis is an ongoing area of research. While much work has been done to assess the overall health risk of TACs, many questions remain unanswered. In particular, considerable uncertainties are associated with the existing estimates of MSAT toxicity, as well as the acceptable risk levels. Because of these and other limitations, technical tools are not available to predict the project-specific health effects of the emission changes associated with each project alternative. Because of these limitations, Appendix G is included in this analysis in accordance with CEQ regulations (40 C.F.R. § 1502.22(b)) regarding incomplete or unavailable information.

7.8 Operations Health Risk Assessment

7.8.1 Shifting of Tracks Carrying Freight Trains

Shifting of tracks carrying freight trains to accommodate higher speeds for existing and new passenger rail has the potential to create increased inhalation health risks and exposure to $PM_{2.5}$, which may exceed local significance thresholds for cancer and noncancer hazards at receptor locations adjacent to the shifted track. Health risks to the closest receptors along the shifted track sections were estimated using the BAAQMD's rail inventory tool and the methods described in Section 6.3.6.1. Table 7-19 shows maximum estimated cancer risk, chronic health hazard, and $PM_{2.5}$ concentrations associated with the track shifts at the analyzed receptor locations. Table 7-19 shows the receptor at which the project would have the greatest effect for each project subsection.

Table 7-20 shows the incremental change in health risks between the existing, Plus Project, and No Project conditions. Existing conditions reflect the risks that would occur if the freight tracks were not shifted and exposure to emissions began in 2015. As discussed in Section 6.3.6.1, the analysis assumes conservatively that service on the shifted track could begin as early as 2022. Accordingly, emissions exposure under the shifted track scenario and No Project conditions was assumed to begin in 2022. In accordance with OEHHA (2015) guidance, inhalation exposure at residences was assumed to occur for 30 years. The parameters used for all exposure scenarios assume exposure begins in the last trimester of pregnancy and progresses through the 30-year period using varying age-specific factors and exposure duration.

As shown in Table 7-20, track shifts would generally result in decreased cancer and noncancer health risks, relative to 2015 existing conditions. These decreases occur primarily because of advancements in locomotive emissions control technology and the retirement of older, higher-emitting engines, which reduce future DPM emission rates. The reduction in future locomotive emission rates is enough to offset the increased risk associated with shifting tracks closer to existing receptors.

The comparison of risks to the No Project conditions normalizes locomotive emission rates since both conditions assume exposure begins in 2022. Accordingly, the comparison reflects the incremental project effect, exclusive of background trends. As shown in Table 7-20, relative to No Project conditions, track shifts would result in minor increases in cancer and noncancer health risks at modeled receptor locations. These increases would not exceed BAAQMD thresholds. Note that Table 7-20 only evaluates locations where freight trains would be moved closer to receptors. In many of these locations, receptors on the other side of the track would experience a corresponding health benefit as freight trains would be moved farther away from these receptors.

Table 7-19 Cancer and Noncancer Health Risks from Freight Operation on Shifted Track under Existing, No Project, and Project Conditions

Subsection and Location	Receptor No. (Table 6-3)	Cancer Risk (per million)			Chronic HI			$PM_{2.5}$ Concentration ($\mu g/m^3$)		
		Existing	No Project[1]	Project[1,2]	Existing	No Project[1]	Project[1,2]	Existing	No Project[1]	Project[1,2]
San Francisco to South San Francisco										
Near San Francisco Avenue and Santa Clara Street	1	23.50	17.16	17.92	0.01	0.01	0.01	0.05	0.03	0.03
San Bruno to San Mateo										
Near Hillcrest Boulevard and Hemlock Avenue	6	24.39	17.81	25.83	0.01	0.01	0.01	0.05	0.03	0.05
San Mateo to Palo Alto										
Near El Camino Real and Morse Boulevard	22	29.77	21.73	26.02	0.01	0.01	0.01	0.06	0.04	0.05
Mountain View to Santa Clara										
N/A[3]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Sources: BAAQMD 2012a; Winkel 2018; PCJPB 2015; OEHHA 2015
$\mu g/m^3$ = micrograms of pollutant per cubic meter of air
HI = hazard index
N/A = not applicable
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
[1] Based on freight volumes and locomotive emission rates assuming exposure begins in 2022.
[2] Represents risks to the receptor locations with the shifted tracks.
[3] No locations with both substantial track shifts and nearby receptors were identified in this subsection.

Table 7-20 Changes in Cancer and Noncancer Health Risks from Freight Operation on Shifted Track Relative to Existing and No Project Conditions

Subsection and Location	Receptor No. (Table 6-3)	Change in Exposure with the Track Shifts relative to Exposure under Existing Conditions[1]			Change in Exposure with the Track Shifts relative to Exposure under No Project Conditions[2]		
		Cancer	Chronic HI	$PM_{2.5}$ (µg/m^3)	Cancer	Chronic HI	$PM_{2.5}$ (µg/m^3)
San Francisco to South San Francisco							
Near San Francisco Avenue and Santa Clara Street	1	-5.6	<0.01	<0.01	0.8	<0.01	<0.01
San Bruno to San Mateo							
Near Hillcrest Boulevard and Hemlock Avenue	6	1.4	<0.01	<0.01	8.0	<0.01	<0.01
San Mateo to Palo Alto							
Near El Camino Real and Morse Boulevard	22	-3.7	<0.01	<0.01	4.3	<0.01	<0.01
Mountain View to Santa Clara							
N/A[3]	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BAAQMD Threshold		**10.0**	**1.0**	**0.3**	**10.0**	**1.0**	**0.3**

Sources: Winkel 2018; PCJPB 2015; OEHHA 2015
µg/m^3 = micrograms of pollutant per cubic meter of air
BAAQMD = Bay Area Air Quality Management District
HI = hazard index
N/A = not applicable
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
[1] Existing conditions reflect the risks that would occur if the freight tracks were not shifted and exposure to emissions began in 2015.
[2] No Project conditions reflect the risks that would occur if the freight tracks were not shifted and exposure to emissions began in 2022.
[3] No locations with both substantial track shifts and nearby receptors were identified in this subsection.

7.8.2 Emergency Generators

The 4th and King Street and Millbrae Stations currently have emergency generators (one at each station) for use in the event of a power outage. As noted in Section 6.3.6.3, Emergency Generators and On-Site Equipment, the project includes installation of a second fully permitted generator at Millbrae Station. The Brisbane LMF would also have a generator. Table 7-21 shows the results of modeling based on USEPA's AERMOD dispersion model and emission data from CalEEMod. Maximum $PM_{2.5}$ concentrations from operation of the emergency generators would be less than BAAQMD's health risk thresholds of significance with the project.

Table 7-21 Maximum $PM_{2.5}$ Concentrations from Operation of Emergency Generators

Generator Location/Condition	Maximum $PM_{2.5}$ Concentration (µg/m³)
2015 Existing/2029 and 2040 No Project	
4th and King Street Station	0.003
Millbrae Station	0.009
2029/2040 Plus Project	
4th and King Street Station	0.001
Millbrae Station	0.001
East Brisbane LMF (Alternative A)	0.003[1]
West Brisbane LMF (Alternative B)	0.002[1]
Project vs. Existing and No Project Conditions[2]	
4th and King Street Station	0.001
Millbrae Station	0.001
East Brisbane LMF (Alternative A)	0.003[1]
West Brisbane LMF (Alternative B)	0.002[1]
BAAQMD Threshold	**0.3**

Source: AERMOD version 18081
µg/m³ = micrograms of pollutant per cubic meter of air
LMF = light maintenance facility
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
[1] No sensitive receptors would be within 1,000 feet of the generator location.
[2] Represents the net concentration effect of the project (i.e., the difference in between the existing/no project and the project condition).

7.9 Construction Mass Emissions Analysis

7.9.1 Total Emissions

Construction activities associated with the project would result in criteria pollutant emissions. This section quantifies and analyzes mass emissions generated by construction. Construction activities expected to occur during the same calendar year are summarized based on the construction schedule presented in Appendix C. Analysts compared project emissions to the general conformity *de minimis* emission thresholds on a calendar-year basis; consequently, emissions can exceed thresholds for any calendar year in which emissions occur.

Construction emissions for the project alternatives over the entire construction period are shown in Table 7-22. The following sections present detailed tables of emissions by year for each project alternative.

Table 7-22 Total Construction-Related Project Criteria Pollutant Emissions[1]

Alternative	Emissions (Total Tons)									
					PM_{10}			$PM_{2.5}$		
	VOC	NO_X	CO	SO_2	Exhaust	Dust	Total[2]	Exhaust	Dust	Total[2]
Alternative A	16	356	478	1.9	1.7	421	423	5.5	92	97
Alternative B	18	405	546	2.2	1.9	508	510	5.7	111	116

Sources: AERMOD version 18081; CAPCOA 2017; CARB 2018c; USEPA 1998, 2006b, 2011; Scholz 2018
CO = carbon monoxide
NO_X = nitrogen oxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound
[1] Table presents total emissions in tons over the course of complete construction (2021–2025). Emissions results include implementation of AQ-IAMF#1 through AQ-IAMF#5, as described in Section 2.4, Impact Avoidance and Minimization Features.
[2] Total PM_{10} and $PM_{2.5}$ emissions consist of exhaust and fugitive dust emissions.

7.9.2 Alternative A Yearly and Daily Emissions

Table 7-23 shows emissions from Alternative A in tons per year and pounds per day. Emissions are shown for each year that construction would occur and include the major construction activities discussed in Section 6.4, Construction Emissions Calculations. Table 7-23 also shows the applicable general conformity and CEQA significance thresholds within the BAAQMD and indicates whether project construction emissions would exceed these general conformity and CEQA thresholds.

The emissions results in Table 7-23 demonstrate that construction of Alternative A would result in daily NO_X emissions that would exceed the BAAQMD's CEQA threshold. Localized effects from NO_X are evaluated based on the air dispersion modeling of ambient air concentrations. Section 7.11, Other Localized Construction Effects, presents the modeled ambient air concentrations relative to the NAAQS and CAAQS.

Project features (AQ-IAMF#1 through AQ-IAMF#5) would minimize air quality effects through application of all best available on-site controls to reduce construction emissions. However, even with these measures, exceedances of the BAAQMD NO_X threshold would still occur. NO_X emissions would be offset in the BAAQMD, as applicable, through the purchase of offsets (AQ-MM#1: Offset Project Construction Emissions in the San Francisco Bay Area Air Basin).

7.9.3 Alternative B Yearly and Daily Emissions

Table 7-24 presents emissions from Alternative B in tons per year and pounds per day. Emissions are shown for each year that construction would occur and include the major construction activities discussed in Section 6.4. Table 7-24 also shows the applicable general conformity and CEQA significance thresholds within the BAAQMD and indicates whether project construction emissions would exceed these general conformity and CEQA thresholds.

The emissions results in Table 7-24 demonstrate that construction of Alternative B would result in daily VOC and NO_X emissions that would exceed the BAAQMD's CEQA threshold. Localized effects from NO_X are evaluated based on the air dispersion modeling of ambient air concentrations. Section 7.11 presents the modeled ambient air concentrations relative to the NAAQS and CAAQS.

Project features (AQ-IAMF#1 through AQ-IAMF#5) would minimize air quality effects through application of all best available on-site controls to reduce construction emissions. However, even with these measures, exceedances of the BAAQMD VOC and NO_X thresholds would still occur. VOC and NO_X emissions would be offset in the BAAQMD, as applicable, through the purchase of offsets (AQ-MM#1).

Table 7-23 Construction-Related Criteria Pollutant Emissions under Alternative A[1]

Activities	Tons per year										Maximum Pounds per day[2]									
					PM_{10}			$PM_{2.5}$							PM_{10}			$PM_{2.5}$		
	VOC	NO_X	CO	SO_2	Exhaust	Dust	Total	Exhaust	Dust	Total[3]	VOC	NO_X	CO	SO_2	Exhaust	Dust	Total	Exhaust	Dust	Total[3]
General conformity threshold[4]	100	100	–	100	–	–	–	–	–	100	–	–	–	–	–	–	–	–	–	–
BAAQMD CEQA threshold	–	–	–	–	–	–	–	–	–	–	54	54	–	–	82	–	–	54	–	–
2021																				
Emissions	2	35	50	0	0	44	44	0	10	10	34	**677***	1,010	4	3	863	866	3	194	198
Exceeds general conformity threshold?	No	No	–	No	–	–	–	–	–	No	–	–	–	–	–	–	–	–	–	–
Exceeds CEQA threshold?	–	–	–	–	–	–	–	–	–	–	No	Yes	–	–	No	–	–	No	–	–
2022																				
Emissions	4	82	112	0	0	102	103	1	23	24	36	**694***	944	4	4	837	840	4	188	191
Exceeds general conformity threshold?	No	No	–	No	–	–	–	–	–	No	–	–	–	–	–	–	–	–	–	–
Exceeds CEQA threshold?	–	–	–	–	–	–	–	–	–	–	No	Yes	–	–	No	–	–	No	–	–
2023																				
Emissions	3	78	98	0	0	96	97	1	21	22	29	**642***	831	4	3	806	809	3	180	182
Exceeds general conformity threshold?	No	No	–	No	–	–	–	–	–	No	–	–	–	–	–	–	–	–	–	–
Exceeds CEQA threshold?	–	–	–	–	–	–	–	–	–	–	No	Yes	–	–	No	–	–	No	–	–
2024																				
Emissions	3	71	92	0	0	91	91	0	19	20	43	**981***	1,399	5	4	1,125	1,129	4	218	222
Exceeds general conformity threshold?	No	No	–	No	–	–	–	–	–	No	–	–	–	–	–	–	–	–	–	–
Exceeds CEQA threshold?	–	–	–	–	–	–	–	–	–	–	No	Yes	–	–	No	–	–	No	–	–
2025																				
Emissions	4	90	125	1	1	88	89	4	18	22	53	**1,592***	1,375	7	18	1,125	1,129	18	218	222
Exceeds general conformity threshold?	No	No	–	No	–	–	–	–	–	No	–	–	–	–	–	–	–	–	–	–
Exceeds CEQA threshold?	–	–	–	–	–	–	–	–	–	–	No	Yes	–	–	No	–	–	No	–	–

Sources: CAPCOA 2017; CARB 2018c; USEPA 1998, 2006b, 2011; Scholz 2018

BAAQMD = Bay Area Air Quality Management District
CEQA = California Environmental Quality Act
CO = carbon monoxide
IAMF = impact avoidance and minimization feature
NAAQS = national ambient air quality standards
- = no threshold
NO_X = nitrogen oxide
O_3 = ozone
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SFBAAB = San Francisco Bay Area Air Basin
SO_2 = sulfur dioxide
USEPA = U.S. Environmental Protection Agency
VOC = volatile organic compound

Values less than 0.5 are rounded to zero.
Exceedances of thresholds are **bolded with an asterisk (*)**.
[1] Emissions results include implementation of air quality IAMFs.
[2] Presents the highest emissions estimate during a single day of construction in each year, based on concurrent construction activities
[3] Total PM_{10} and $PM_{2.5}$ emissions consist of the exhaust and fugitive dust emissions. Sum of annual values may not equal total due to rounding. Sum of daily values may not equal total because the table presents maximum emissions results for each individual pollutant component. For example, the maximum PM exhaust emissions may not occur on the same day as the maximum total dust emissions.
[4] The general conformity *de minimis* thresholds for criteria pollutants are based on the federal attainment status of the project vicinity in the SFBAAB. The project vicinity is considered a marginal nonattainment area for the O_3 NAAQS and a moderate nonattainment area for the $PM_{2.5}$ NAAQS. Although the project vicinity is in attainment for SO_2, because SO_2 is a precursor for $PM_{2.5}$, the $PM_{2.5}$ general conformity *de minimis* thresholds are used.

Table 7-24 Construction-Related Criteria Pollutant Emissions under Alternative B[1]

	Tons per year										Maximum Pounds per day[2]									
					PM_{10}			$PM_{2.5}$							PM_{10}			$PM_{2.5}$		
Activities	VOC	NO_X	CO	SO_2	Exhaust	Dust	Total	Exhaust	Dust	Total[3]	VOC	NO_X	CO	SO_2	Exhaust	Dust	Total	Exhaust	Dust	Total[3]
General conformity threshold[4]	100	100	–	100	–	–	–	–	–	100	–	–	–	–	–	–	–	–	–	–
BAAQMD CEQA threshold	–	–	–	–	–	–	–	–	–	–	54	54	–	–	82	–	–	54	–	–
2021																				
Emissions	2	39	56	0	0	51	52	0	12	12	41	**812***	1,227	5	4	1,135	1,139	4	250	254
Exceeds general conformity threshold?	No	No	–	No	–	–	–	–	–	No	–	–	–	–	–	–	–	–	–	–
Exceeds CEQA threshold?	–	–	–	–	–	–	–	–	–	–	No	Yes	–	–	No	–	–	No	–	–
2022																				
Emissions	5	99	136	1	1	134	134	1	29	30	42	**811***	1,147	5	4	1,115	1,118	4	245	249
Exceeds general conformity threshold?	No	No	–	No	–	–	–	–	–	No	–	–	–	–	–	–	–	–	–	–
Exceeds CEQA threshold?	–	–	–	–	–	–	–	–	–	–	No	Yes	–	–	No	–	–	No	–	–
2023																				
Emissions	4	91	117	1	0	116	117	1	26	27	34	**758***	982	4	3	971	975	3	220	223
Exceeds general conformity threshold?	No	No	–	No	–	–	–	–	–	No	–	–	–	–	–	–	–	–	–	–
Exceeds CEQA threshold?	–	–	–	–	–	–	–	–	–	–	No	Yes	–	–	No	–	–	No	–	–
2024																				
Emissions	3	80	105	0	0	106	106	0	23	24	46	**1,070***	1,466	5	5	1,187	1,192	5	232	236
Exceeds general conformity threshold?	No	No	–	No	–	–	–	–	–	No	–	–	–	–	–	–	–	–	–	–
Exceeds CEQA threshold?	–	–	–	–	–	–	–	–	–	–	No	Yes	–	–	No	–	–	No	–	–
2025																				
Emissions	4	96	132	1	1	101	102	4	20	23	**55***	**1,645***	1,381	8	18	1,182	1,186	18	225	229
Exceeds general conformity threshold?	No	No	–	No	–	–	–	–	–	No	–	–	–	–	–	–	–	–	–	–
Exceeds CEQA threshold?	–	–	–	–	–	–	–	–	–	–	Yes	Yes	–	–	No	–	–	No	–	–

Sources: CAPCOA 2017; CARB 2018c; USEPA 1998, 2006b, 2011; Scholz 2018

BAAQMD = Bay Area Air Quality Management District
CEQA = California Environmental Quality Act
CO = carbon monoxide
IAMF = impact avoidance and minimization feature
NAAQS = national ambient air quality standards
- = no threshold
- = no threshold
NO_X = nitrogen oxide
O_3 = ozone
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SFBAAB = San Francisco Bay Area Air Basin
SO_2 = sulfur dioxide
USEPA = U.S. Environmental Protection Agency
VOC = volatile organic compound

Values less than 0.5 are rounded to zero.
Exceedances of thresholds are **bolded with an asterisk (*)**.

[1] Emissions results include implementation of air quality IAMFs.
[2] Presents the highest emissions estimate during a single day of construction in each year, based on concurrent construction activities
[3] Total PM_{10} and $PM_{2.5}$ emissions consist of the exhaust and fugitive dust emissions. Sum of annual values may not equal total due to rounding. Sum of daily values may not equal total because the table presents maximum emissions results for each individual pollutant component. For example, the maximum PM exhaust emissions may not occur on the same day as the maximum total dust emissions.
[4] The general conformity *de minimis* thresholds for criteria pollutants are based on the federal attainment status of the project vicinity in the SFBAAB. The project vicinity is considered a marginal nonattainment area for the O_3 NAAQS and a moderate nonattainment area for the $PM_{2.5}$ NAAQS. Although the project vicinity is in attainment for SO_2, because SO_2 is a precursor for $PM_{2.5}$, the $PM_{2.5}$ general conformity *de minimis* thresholds are used.

7.10 Construction Health Risk Assessment

During construction, sensitive receptors (e.g., schools, residences, and health care facilities) could be exposed to increased concentrations of TAC, such as DPM, that may present increased cancer risks and other health hazards. This section reports and identifies the health risk from the emissions generated by construction.

The analysis considers both acute and chronic non-cancer health hazards and increased cancer risk for each project alternative and subsection. Acute risks are based on the maximum hourly emissions that could occur across all calendar years. Chronic health risks are based on the maximum annual emissions from all calendar years. Cancer risk is defined as the predicted risk of cancer (unitless) over a lifetime and is expressed as chances per million persons exposed.

DPM is the primary TAC released from construction activities. The modeled DPM concentrations were used in determining the total exposure dose and associated health effect. Specific details of the air dispersion modeling and HRA are provided in Appendix E.

Table 7-25 shows the results of the HRA. The results represent the highest modeled risk at a receptor location from combined construction of all features (at grade, embankment, stations, LMF). Maximum predicted risks for each subsection are compared to the BAAQMD significance criteria. None of BAAQMD's cancer risk criteria is exceeded for either alternative. Consistent with BAAQMD guidance, Table 7-25 also presents the maximum incremental $PM_{2.5}$ concentration generated by project construction. The results in Table 7-25 include implementation of AQ-IAMF#1 through AQ-IAMF#5.

Table 7-25 Excess Cancer, Noncancer, and $PM_{2.5}$ Concentration Health Risks Associated with Project Construction in the Bay Area Air Quality Management District[1]

Subsection	Alternative A				Alternative B			
	Cancer (per million)[2]	Chronic HI[3]	Acute HI[3]	$PM_{2.5}$ (µg/m³)	Cancer (per million)[2]	Chronic HI[3]	Acute HI[3]	$PM_{2.5}$ (µg/m³))
San Francisco to South San Francisco	1.1	0.001	0.09	0.004	1.1	0.001	0.09	0.004
San Bruno to San Mateo	2.3	0.002	0.10	0.008	2.3	0.002	0.10	0.008
San Mateo to Palo Alto	1.8	0.001	0.10	0.006	3.3	0.002	0.10	0.030
Mountain View to Santa Clara	3.6	0.003	0.09	0.013	3.6	0.003	0.09	0.013
BAAQMD Risk Threshold	**10.0**	**1.0**	**1.0**	**0.3**	**10.0**	**1.0**	**1.0**	**0.3**

Sources: AERMOD version 18081; OEHHA 2015; and HARP 2 version 18159
µg/m³ = micrograms of pollutant per cubic meter of air
BAAQMD = Bay Area Air Quality Management District
HI = hazard index
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
[1] Only the highest modeled off-site risk is presented for each subsection. The reported risk includes effects from combined construction of all features (e.g., at grade, embankment, stations, LMF) in each subsection.
[2] Cancer risk represents the incremental increase in the number of cancers in a population of one million. Risks are cumulative of inhalation, dermal, soil, mother's milk, and crop pathways.
[3] HI are shown by pollutant contributions to the most affected organ system (respiratory).

7.11 Other Localized Construction Effects

Construction emissions have the potential to cause elevated criteria pollutant concentrations. These elevated concentrations may cause or contribute to exceedances of the NAAQS and CAAQS. This section reports and identifies the criteria air pollutant concentrations from the emissions generated by construction.

Analysts added the increase in pollutant concentrations associated with project construction[16] to the background concentration to estimate the ambient air pollutant concentration for comparison to the applicable NAAQS and CAAQS for all pollutants, to determine if construction would cause an ambient air quality violation. The analysis considers both the incremental project-related contribution and the total pollutant concentration; only the total pollutant concentration, which reflects the incremental project contribution plus the background concentration, is compared to the CAAQS and NAAQS. However, pre-project background concentrations of PM_{10} along portions of the project alignment already exceed the CAAQS. In such cases, the BAAQMD recommends comparing the incremental project-related increase in PM_{10} concentrations to the USEPA significant impact levels (SIL) to analyze the potential for the project to worsen existing PM_{10} violations.

The background concentration varies by location. Table 7-26 shows the background concentrations by pollutant and applicable averaging period as measured by the BAAQMD at the three representative monitoring locations (Section 5.2, Ambient Air Quality) within the RSA. The ambient air quality standards are provided for reference. Existing violations of the standards are shown in **bold with an asterisk (*)**.

Tables 7-27 through 7-30 show the difference between the 1-, 8-, and 24-hour criteria pollutant air quality standards and the project's maximum effect plus background for Alternatives A and B. (CAAQS are presented first, followed by NAAQS.) Similarly, Tables 7-31 and 7-32 show the difference between the annual criteria pollutant air quality standards and the project's maximum effect plus background for Alternatives A and B, respectively. The tables assume implementation of AQ-IAMF#1 through AQ-IAMF#5.

Tables 7-27, 7-29, 7-31, and 7-32 show that either project alternative would exceed both the 24-hour and annual CAAQS for PM_{10} because the background values already exceed the PM_{10} CAAQS. In accordance with BAAQMD guidance, analysts compared the project-related PM_{10} contributions the USEPA SILs. The 24-hour project contributions (Tables 7-27 and 7-29) would not exceed the SIL. However, the annual project contributions (Tables 7-31 and 7-32) would exceed the PM_{10} SIL at all locations along the alignment. The SIL would not be exceeded at the stations or the Brisbane LMF.

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[16] Analysts did not evaluate Pb emissions because equipment and vehicles emit only negligible quantities of Pb.

Table 7-26 Existing Background Air Quality Concentrations (2015–2017) in the Resource Study Area (μg/m³)

Pollutant	San Francisco—Arkansas Street		Redwood City—Barron Avenue		San Jose—Jackson Street	
	NAAQS	CAAQS	NAAQS	CAAQS	NAAQS	CAAQS
$PM_{2.5}$						
24-hour	26.2	N/A	23.3	N/A	26.8	N/A
Standard	*35*	N/A	*35*	N/A	*35*	N/A
Annual mean	8.2	9.7	7.7	9.0	9.2	9.9
Standard	*12.0*	*12*	*12.0*	*12*	*12.0*	*12*
PM_{10}						
24-hour	47.0	**69.0***	49.7[2]	**69.0***[2]	49.7	**69.0***
Standard	*150*	*50*	*150*	*50*	*150*	*50*
Annual mean	9.9	**22.1***[1]	19.8[2]	**21.9***[2]	19.8	**21.9***
Standard	*N/A*	*20*	*N/A*	*20*	*N/A*	*20*
NO_2						
1-hour	101.8	137.2	79.0	89.9	85.2	127.8
Standard	*188*	*339*	*188*	*339*	*188*	*339*
Annual mean	21.3	22.6	18.2	18.8	22.8	24.1
Standard	*100*	*57*	*100*	*57*	*100*	*57*
CO						
1-hour	1,986	2864	2,979	3,895	2,329	2,749
Standard	*23,000*	*23,000*	*23,000*	*23,000*	*23,000*	*23,000*
8-hour	1,337	1,604	1,489	1,833	1,757	2,062
Standard	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*	*10,000*

Pollutant	San Francisco—Arkansas Street		Redwood City—Barron Avenue		San Jose—Jackson Street	
	NAAQS	CAAQS	NAAQS	CAAQS	NAAQS	CAAQS
SO_2						
1-hour	6.1[3]	9.4[3]	6.1[3]	9.4[3]	6.1	9.4
Standard	*196*	*655*	*196*	*655*	*196*	*655*
24-hour	N/A	2.9[3]	N/A	2.9[3]	N/A	2.9
Standard	*N/A*	*105*	*N/A*	*105*	*N/A*	*105*

CAAQS = California ambient air quality standards
CO = carbon monoxide
N/A = no applicable standard
NAAQS = national ambient air quality standards
SO_2 = sulfur dioxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
Exceedances of standards are **bolded with an asterisk (*).**
[1] Data from 2015/2016 not available; used data for 2017 (CARB 2018a)
[2] Data Site: San Jose—Jackson Site (CARB 2018a)
[3] Data Site: San Jose—Jackson Site (USEPA 2018a)

Table 7-27 Criteria Pollutant Concentration Effects from Construction of Alternative A (μg/m³)[1] Compared to 1- to 24-Hour California Ambient Air Quality Standards

Construction Area	CO				NO_2		SO_2		PM_{10}		SO_2	
	Project 1-hour[2]	Total 1-hour[3]	Project 8-hour[2]	Total 8-hour[4]	Project 1-hour[2]	Total 1-hour[5]	Project 24-hour[2]	Total 24-hour[6]	Project 24-hour[2,7]	Total 24-hour[7,8]	Project 1-hour[2]	Total 1-hour[9]
San Francisco to South San Francisco Subsection												
4th and King Street Station	207	3,071	76	1,680	37	174	0.07	2.97	9.7	**78.7***	0.47	9.9
4th and King Street Station to Chavez Street (at grade)	39	2,903	17	1,621	21	158	0.02	2.92	5.3	**74.3***	0.12	9.5
Chavez Street to Salinas Avenue (at grade)	74	2,938	25	1,629	40	177	0.03	2.93	9.4	**78.4***	0.24	9.6
Salinas Avenue to Linden Avenue (at grade)	47	2,911	37	1,641	25	162	0.02	2.92	9.0	**78.0***	0.15	9.6
Brisbane LMF	150	3,014	60	1,664	32	169	0.05	2.95	**13.8***	**82.8***	0.33	9.7
Combined[10]	246	3,110	97	1,701	58	195	0.09	2.99	**22.8***	**91.8***	0.60	10.0
San Bruno to San Mateo Subsection												
Millbrae Station	181	3,045	51	1,655	29	166	0.05	2.95	6.5	**75.5***	0.37	9.8
Linden Avenue to Peninsula Avenue (at grade)	49	2,913	15	1,619	29	166	0.02	2.92	8.4	**78.4***	0.21	9.6
Linden Avenue to Peninsula Avenue (embankment)	31	2,895	10	1,614	19	156	0.02	2.92	5.7	**74.7***	0.14	9.5
Peninsula Avenue to Ninth Avenue (at grade)	73	2,937	19	1,623	47	184	0.03	2.93	8.3	**77.3***	0.33	9.7
Peninsula Avenue to Ninth Avenue (embankment)	72	2,936	19	1,623	45	182	0.03	2.93	8.5	**77.5***	0.32	9.7
Combined[10]	230	3,094	66	1,670	58	195	0.07	2.97	**14.9***	**83.9***	0.58	10.0
San Mateo to Palo Alto Subsection												
At grade	78	3,973	19	1,852	42	132	0.02	2.92	8.5	**77.5***	0.25	9.7
Embankment	28	3,923	6.9	1,840	16	106	0.01	2.91	3.3	**72.3***	0.12	9.5

Construction Area	CO				NO_2		SO_2		PM_{10}		SO_2	
	Project 1-hour[2]	Total 1-hour[3]	Project 8-hour[2]	Total 8-hour[4]	Project 1-hour[2]	Total 1-hour[5]	Project 24-hour[2]	Total 24-hour[6]	Project 24-hour[2,7]	Total 24-hour[7,8]	Project 1-hour[2]	Total 1-hour[9]
Mountain View to Santa Clara Subsection												
San Antonio Road to Lawrence Expressway (at grade)	68	2,817	18	2,080	44	172	0.21	3.11	8.2	**77.2***	0.34	9.7
Lawrence Expressway to Scott Boulevard (at grade)	18	2,767	11	2,073	11	139	0.02	2.92	5.1	**74.1***	0.09	9.5
Threshold												
SIL ($\mu g/m^3$)[7,11]	2,000	–	500	–	N/A	–	–	–	10.4	–	7.8	–
CAAQS ($\mu g/m^3$)	–	23,000	–	10,000	–	339	–	105	–	50	–	655

Sources: AERMOD version 18081; CARB 2018a
$\mu g/m^3$ = micrograms of pollutant per cubic meter of air
CAAQS = California ambient air quality standards
CO = carbon monoxide
LMF = light maintenance facility
NO_2 = nitrogen dioxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SIL = significant impact level
Exceedances of the CAAQS or the PM_{10} SIL are **bold with an asterisk (*).**
SILs for pollutants other than PM_{10} are shown for information only.
[1] Only the highest modeled concentration in the form of the standard is presented for each pollutant.
[2] Represents the maximum incremental off-site concentration in the form of the standard from project construction.
[3] A background 1-hour CO concentration of 2,864, 3,895, and 2,749 $\mu g/m^3$ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[4] A background 8-hour CO concentration of 1,604, 1,833, and 2,062 $\mu g/m^3$ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[5] A background 1-hour NO_2 concentration of 137.2, 89.9, and 127.8 $\mu g/m^3$ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[6] A background 24-hour SO_2 concentration in the form of the standard of 2.9, 2.9, 2.9 $\mu g/m^3$ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[7] Background PM_{10} concentration alone exceeds the CAAQS. Therefore, the incremental project increase in PM_{10} concentrations should be compared to the applicable SIL as recommended by the BAAQMD (Kirk 2016). SILs for pollutants other than PM_{10} are shown for information only.
[8] A background 24-hour PM_{10} concentration of 69.0, 69.0, and 69.0 $\mu g/m^3$ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[9] A background 1-hour SO_2 concentration of 9.4, 9.4 and 9.4 $\mu g/m^3$ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[10] "Combined" conservatively estimates the sum of worst-case concentrations from all features that can occur concurrently at one receptor location.
[11] USEPA SIL Guidance (USEPA 2018c).

Table 7-28 Criteria Pollutant Concentration Effects from Construction of Alternative A (µg/m³)[1] Compared to 1- to 24-Hour National Ambient Air Quality Standards

Construction Area	CO				NO_2		$PM_{2.5}$		PM_{10}		SO_2	
	Project 1-hour[2]	Total 1-hour[3]	Project 8-hour[2]	Total 8-hour[4]	Project 1-hour[2]	Total 1-hour[5]	Project 24-hour[2]	Total 24-hour[6]	Project 24-hour[2]	Total 24-hour[7]	Project 1-hour[2]	Total 1-hour[8]
San Francisco to South San Francisco Subsection												
4th and King Street Station	186	2,172	74	1,411	21	123	2.2	28	9.6	57	0.32	6.4
4th and King Street Station to Chavez Street (at grade)	39	2,025	17	1,354	18	120	0.96	27	5.3	52	0.11	6.2
Chavez Street to Salinas Avenue (at grade)	74	2,060	25	1,362	29	131	1.6	28	9.4	56	0.17	6.3
Salinas Avenue to Linden Avenue (at grade)	47	2,033	37	1,374	21	123	1.4	28	9.0	56	0.12	6.2
Brisbane LMF	140	2,126	46	1,383	17	119	2.1	28	**10.6***	58	0.23	6.3
Combined[9]	225	2,211	91	1,428	39	141	3.5	30	**19.6***	67	0.43	6.5
San Bruno to San Mateo Subsection												
Millbrae Station	146	2,132	48	1,385	15	117	1.5	28	6.2	53	0.25	6.4
Linden Avenue to Peninsula Avenue (at grade)	49	2,035	15	1,352	22	124	1.5	28	8.4	55	0.16	6.3
Linden Avenue to Peninsula Avenue (embankment)	31	2,017	9.8	1,347	14	116	0.91	27	5.7	53	0.10	6.2
Peninsula Avenue to Ninth Avenue (at grade)	73	2,059	19	1,356	30	132	1.5	28	8.3	55	0.21	6.3
Peninsula Avenue to Ninth Avenue (embankment)	72	2,058	19	1,356	30	132	1.4	28	8.5	56	0.21	6.3
Combined[9]	195	2,181	63	1,400	37	139	3.0	29	**14.6***	62	0.41	6.5
San Mateo to Palo Alto Subsection												
At grade	78	3,973	19	1,852	26.3	105	1.6	25	8.5	58.2	0.16	6.3
Embankment	28	3,923	6.9	1,840	10.1	89.1	0.5	24	3.3	53.0	0.07	6.2

Construction Area	CO				NO_2		$PM_{2.5}$		PM_{10}		SO_2	
	Project 1-hour[2]	Total 1-hour[3]	Project 8-hour[2]	Total 8-hour[4]	Project 1-hour[2]	Total 1-hour[5]	Project 24-hour[2]	Total 24-hour[6]	Project 24-hour[2]	Total 24-hour[7]	Project 1-hour[2]	Total 1-hour[8]
Mountain View to Santa Clara Subsection												
San Antonio Road to Lawrence Expressway (at grade)	68	2,397	18	1,775	33	118	1.5	28	8.2	58	0.25	6.4
Lawrence Expressway to Scott Boulevard (at grade)	18	2,347	11	1,768	9.1	94	0.92	28	5.1	55	0.07	6.2
Threshold												
SIL (µg/m³)[10,11]	2,000	–	500	–	N/A	–	1.2	–	10.4	–	7.8	–
NAAQS (µg/m³)	–	40,000	–	10,000	–	188	–	35	–	150	–	196.0

Sources: AERMOD version 18081; USEPA 2018a
µg/m³ = micrograms of pollutant per cubic meter of air
CO = carbon monoxide
LMF = light maintenance facility
NAAQS = national ambient air quality standards
NO_2 = nitrogen dioxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SIL = significant impact level
Exceedances of the NAAQS or the PM_{10} SIL are **bold with an asterisk (*).**
[1] Only the highest modeled concentration in the form of the standard is presented for each pollutant.
[2] Represents the maximum incremental off-site concentration in the form of the standard from project construction.
[3] A background 1-hour CO concentration of 1,986, 2,979, and 2,329 µg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[4] A background 8-hour CO concentration of 1,337, 1,489, and 1,757 µg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[5] A background 1-hour NO_2 concentration of 101.8, 79.0, and 85.2 µg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[6] A background 24-hour $PM_{2.5}$ concentration in the form of the standard of 26.2, 23.3, and 26.8 µg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[7] A background 24-hour PM_{10} concentration of 47.0, 49.7, and 49.7 µg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[8] A background 1-hour SO_2 concentration of 6.1, 6.1 and 6.1 µg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[9] "Combined" conservatively estimates the sum of worst-case concentrations from all features that can occur concurrently at one receptor location.
[10] USEPA SIL guidance (USEPA 2018c).
[11] Background concentrations do not exceed the NAAQS. Therefore, USEPA SILs are shown for information only.

Table 7-29 Criteria Pollutant Concentration Effects from Construction of Alternative B (µg/m³)[1] Compared to 1- to 24-Hour California Ambient Air Quality Standards

Construction Area	CO				NO_2		SO_2		PM_{10}		SO_2	
	Project 1-hour[2]	Total 1-hour[3]	Project 8-hour[2]	Total 8-hour[4]	Project 1-hour[2]	Total 1-hour[5]	Project 24-hour[2]	Total 24-hour[6]	Project 24-hour[2,7]	Total 24-hour[7,8]	Project 1-hour[2]	Total 1-hour[9]
San Francisco to South San Francisco Subsection												
4th and King Street Station	207	3,071	76	1,680	37	174	0.07	2.97	9.7	**78.7***	0.47	9.9
4th and King Street Station to Chavez Street (at grade)	39	2,903	17	1,621	21	158	0.02	2.92	5.3	**74.3***	0.12	9.5
Chavez Street to Salinas Avenue (at grade)	74	2,938	25	1,629	40	177	0.03	2.93	9.4	**78.4***	0.24	9.6
Salinas Avenue to Linden Avenue (at grade)	47	2,911	37	1,641	25	162	0.02	2.92	9.0	**78.0***	0.15	9.6
Brisbane LMF	124	2,988	54	1,658	26	163	0.05	2.95	**12.4***	**81.4***	0.27	9.7
Combined[10]	246	3,110	93	2,079	58	195	0.09	2.99	**21.4***	**90.4***	0.59	10.0
San Bruno to San Mateo Subsection												
Millbrae Station	181	3,045	51	1,655	29	166	0.05	2.95	6.5	**75.5***	0.37	9.8
Linden Avenue to Peninsula Avenue (at grade)	49	2,913	15	1,619	29	166	0.02	2.92	8.4	**78.4***	0.21	9.6
Linden Avenue to Peninsula Avenue (embankment)	31	2,895	10	1,614	19	156	0.02	2.92	5.7	**74.7***	0.14	9.5
Peninsula Avenue to Ninth Avenue (at grade)	73	2,937	19	1,623	47	184	0.03	2.93	8.3	**77.3***	0.33	9.7
Peninsula Avenue to Ninth Avenue (embankment)	72	2,936	19	1,623	45	182	0.03	2.93	8.5	**77.5***	0.32	9.7
Combined[10]	230	3,094	66	1,670	58	195	0.07	2.97	**14.9***	**83.9***	0.58	10.0
San Mateo to Palo Alto Subsection												
Embankment	42	3,937	10	1843	27	117	0.02	2.92	5.6	**74.6***	0.21	9.6
At grade	29	3,924	7.0	1,840	16	106	0.01	2.91	5.8	**74.8***	0.10	9.5

Construction Area	CO				NO_2		SO_2		PM_{10}		SO_2	
	Project 1-hour[2]	Total 1-hour[3]	Project 8-hour[2]	Total 8-hour[4]	Project 1-hour[2]	Total 1-hour[5]	Project 24-hour[2]	Total 24-hour[6]	Project 24-hour[2,7]	Total 24-hour[7,8]	Project 1-hour[2]	Total 1-hour[9]
Mountain View to Santa Clara Subsection												
San Antonio Road to Lawrence Expressway (at grade)	68	2,817	18	2,080	44	172	0.21	3.11	8.2	**77.2***	0.34	9.7
Lawrence Expressway to Scott Boulevard (at grade)	18	2,767	11	2,073	11	139	0.02	2.92	5.1	**74.1***	0.09	9.5
Threshold												
SIL (µg/m³)[7,11]	2,000	–	500	–	N/A	–	1.2	–	10.4	–	7.8	–
CAAQS (µg/m³)	–	23,000	–	10,000	–	339	–	–	–	50	–	655

Sources: AERMOD version 18081; USEPA 2018a
µg/m³ = micrograms of pollutant per cubic meter of air
CAAQS = California ambient air quality standards
CO = carbon monoxide
LMF = light maintenance facility
NO_2 = nitrogen dioxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SIL = significant impact level
Exceedances of the CAAQS or the PM_{10} SIL are **bold with an asterisk (*).**
[1] Only the highest modeled concentration in the form of the standard is presented for each pollutant.
[2] Represents the maximum incremental off-site concentration in the form of the standard from project construction.
[3] A background 1-hour CO concentration of 2,864, 3,895, and 2,749 µg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[4] A background 8-hour CO concentration of 1,604, 1,833, and 2,062 µg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[5] A background 1-hour NO_2 concentration of 137.2, 89.9, and 127.8 µg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[6] A background 24-hour SO_2 concentration in the form of the standard of 2.9, 2.9, and 2.9 µg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[7] Background PM_{10} concentration alone exceeds the CAAQS. Therefore, the incremental project increase in PM_{10} concentrations should be compared to the applicable USEPA SIL as recommended by the BAAQMD (Kirk 2016). SILs for pollutants other than PM_{10} are shown for information only.
[8] A background 24-hour PM_{10} concentration of 69.0, 69.0, and 69.0 µg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[9] A background 1-hour SO_2 concentration of 9.4, 9.4 and 9.4 µg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[10] "Combined" conservatively estimates the sum of worst-case concentrations from all features that can occur concurrently at one receptor location.
[11] USEPA SIL guidance (USEPA 2018c).

Table 7-30 Criteria Pollutant Concentration Effects from Construction of Alternative B (µg/m³)[1] Compared to 1- to 24-Hour National Ambient Air Quality Standards

Construction Area	CO				NO_2		$PM_{2.5}$		PM_{10}		SO_2	
	Project 1-hour[2]	Total 1-hour[3]	Project 8-hour[2]	Total 8-hour[4]	Project 1-hour[2]	Total 1-hour[5]	Project 24-hour[2]	Total 24-hour[6]	Project 24-hour[2]	Total 24-hour[7]	Project 1-hour[2]	Total 1-hour[8]
San Francisco to South San Francisco Subsection												
4th and King Street Station	186	2,172	74	1,411	21	123	2.2	28.4	9.6	57	0.32	6.4
4th and King Street Station to Chavez Street (at grade)	39	2,025	17	1,354	18	120	0.96	27	5.3	52	0.11	6.2
Chavez Street to Salinas Avenue (at grade)	74	2,060	25	1,362	29	131	1.6	28	9.4	56	0.17	6.3
Salinas Avenue to Linden Avenue (at grade)	47	2,033	37	1,374	21	123	1.4	28	9.0	56	0.12	6.2
Brisbane LMF	119	2,105	39	1,376	15	117	2.0	28	9.6	57	0.19	6.3
Combined[9]	225	2,211	91	1,428	39	141	3.4	30	**18.6***	66	0.43	6.5
San Bruno to San Mateo Subsection												
Millbrae Station	146	2,132	48	1,385	15	117	1.5	28	6.2	53	0.25	6.4
Linden Avenue to Peninsula Avenue (at grade)	49	2,035	15	1,352	22	124	1.5	28	8.4	55	0.16	6.3
Linden Avenue to Peninsula Avenue (embankment)	31	2,017	9.8	1,347	14	116	0.91	27	5.7	53	0.10	6.2
Peninsula Avenue to Ninth Avenue (at grade)	73	2,059	19	1,356	30	132	1.5	28	8.3	55	0.21	6.3
Peninsula Avenue to Ninth Avenue (embankment)	72	2,058	19	1,356	30	132	1.4	28	8.5	56	0.21	6.3
Combined[9]	195	2,181	63	1,400	37	139	3.0	29	**14.6***	62	0.41	6.5
San Mateo to Palo Alto Subsection												
Embankment	42	3,937	10	1843	16	95.0	1.1	24.4	5.6	55.3	0.12	6.2
At grade	29	3,924	7.0	1,840	9.8	88.8	1.2	24.5	5.8	55.5	0.06	6.2

Construction Area	CO				NO2		PM2.5		PM10		SO2	
	Project 1-hour[2]	Total 1-hour[3]	Project 8-hour[2]	Total 8-hour[4]	Project 1-hour[2]	Total 1-hour[5]	Project 24-hour[2]	Total 24-hour[6]	Project 24-hour[2]	Total 24-hour[7]	Project 1-hour[2]	Total 1-hour[8]
Mountain View to Santa Clara Subsection												
San Antonio to Lawrence Expressway (at grade)	68.	2,397	18	1,775	33	118	1.5	28	8.2	58	0.25	6.4
Lawrence Expressway to Scott Blvd (at grade)	18.	2,347	11	1,768	9.1	94	0.92	28	5.1	55	0.07	6.2
Threshold												
SIL (μg/m³)[10,11]	2,000	–	500	–	N/A	–	1.2	–	10.4	–	7.8	–
NAAQS (μg/m³)	–	40,000	–	10,000	–	188	–	35	–	150	–	196.0

Sources: AERMOD version 18081, CARB 2018a
μg/m³ = micrograms of pollutant per cubic meter of air
CO = carbon monoxide
LMF = light maintenance facility
NAAQS = national ambient air quality standards
NO_2 = nitrogen oxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SIL = significant impact level
Exceedances of the NAAQS or the PM_{10} SIL are **bold with an asterisk (*).**
[1] Only the highest modeled concentration in the form of the standard is presented for each pollutant.
[2] Represents the maximum incremental off-site concentration in the form of the standard from project construction.
[3] A background 1-hour CO concentration of 1,986, 2,979, and 2,329 μg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[4] A background 8-hour CO concentration of 1,337, 1,489, and 1,757 μg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[5] A background 1-hour NO_2 concentration of 101.8, 79.0, and 85.2 μg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[6] A background 24-hour $PM_{2.5}$ concentration in the form of the standard of 26.2, 23.3, and 26.8 μg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[7] A background 24-hour PM_{10} concentration of 47.0, 49.7, and 49.7 μg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[8] A background 1-hour SO_2 concentration of 6.1, 6.1 and 6.1 μg/m³ (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[9] "Combined" conservatively estimates the sum of worst-case concentrations from all features that can occur concurrently at one receptor location.
[10] USEPA SIL guidance (USEPA 2018c).
[11] Background concentrations do not exceed the NAAQS. Therefore, USEPA SILs are shown for information only.

Table 7-31 Criteria Pollutant Concentration Effects from Construction of Alternative A (µg/m³)[1] Compared to Annual National Ambient Air Quality Standards and California Ambient Air Quality Standards

Construction Area	NO_2 (CAAQS)		NO_2 (NAAQS)		$PM_{2.5}$ (CAAQS)		$PM_{2.5}$ (NAAQS)		PM_{10} (CAAQS)	
	Project Annual[2]	Project Annual[3]	Project Annual[2]	Total Annual[4]	Project Annual[2]	Total Annual[5]	Project Annual[2]	Total Annual[6]	Project Annual[2,7]	Total Annual[7,8]
San Francisco to South San Francisco Subsection										
4th and King Street Station	0.26	23	0.25	22	0.02	9.7	0.02	8.2	0.16	**22***
At grade	3.9	26	3.7	25	0.59	10	0.56	8.8	**3.2***	**25***
Brisbane LMF	0.31	23	0.3	22	0.08	9.8	0.07	8.3	0.26	**22***
Combined[9]	4.2	27	4.0	25	0.67	10	0.63	8.8	**3.5***	**26***
San Bruno to San Mateo Subsection										
Millbrae Station	0.19	23	0.19	22	0.02	9.7	0.01	8.2	0.10	**22***
Embankment	2.3	25	2.2	24	0.57	10	0.54	8.7	**2.7***	**25***
At grade	2.9	26	2.9	24	0.58	10	0.56	8.8	**3.1***	**25***
Combined[9]	3.1	26	3.1	24	0.60	10	0.57	8.8	**3.2***	**25***
San Mateo to Palo Alto Subsection										
Embankment	2.3	21	2.2	20	0.57	9.6	0.54	8.2	**2.8***	**25***
At grade	2.9	22	2.8	21	0.41	9.4	0.40	8.1	**2.5***	**24***
Combined[9]	2.9	22	2.8	21	0.57	9.6	0.54	8.2	**2.8***	**25***
Mountain View to Santa Clara Subsection										
At grade	4.3	28	3.9	27	0.95	11	0.85	10	**5.3***	**27***
Combined[9]	4.3	28	3.9	27	0.95	11	0.85	10	**5.3***	**27***
Threshold										
SIL (µg/m³)[7,10]	1		1		0.2		0.2		2.08	
CAAQS/NAAQS (µg/m³)	–	57	–	100	–	–	–	12	–	20

Sources: AERMOD version 18081, CARB 2018a; USEPA 2018a
µg/m³ = micrograms of pollutant per cubic meter of air
CAAQS = California ambient air quality standards

LMF = light maintenance facility
NAAQS = national ambient air quality standards
NO_2 = nitrogen dioxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SIL = significant impact level
Exceedances of the CAAQS, NAAQS, or PM_{10} SIL are **bold with an asterisk (*).**
[1] Only the highest modeled concentration in the form of the applicable standard is presented for each pollutant.
[2] Represents the maximum incremental off-site concentration in the form of the standard from project construction.
[3] A background annual NO_2 concentration in the form of the (CAAQS) standard of 22.6, 18.8 and 24.1 µg/m^3 (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[4] A background annual NO_2 concentration in the form of the (NAAQS) standard of 21.3, 18.2, and 22.8 µg/m^3 (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[5] A background annual $PM_{2.5}$ concentration in the form of the (CAAQS) standard of 9.7, 9.0, and 9.9 µg/m^3 (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[6] A background annual $PM_{2.5}$ concentration in the form of the (NAAQS) standard of 8.2, 7.7, 9.2 µg/m^3 (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[7] Background PM_{10} concentration alone exceeds the CAAQS. Therefore, the incremental project increase in PM_{10} concentrations should be compared to the applicable USEPA SIL as recommended by the BAAQMD (Kirk 2016). SILs for pollutants other than PM_{10} are shown for information only.
[8] A background annual PM_{10} concentration in the form of the (CAAQS) standard of 22.1, 21.9, and 21.9 µg/m^3 (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[9] "Combined" conservatively estimates the sum of worst-case concentrations from all features that can occur concurrently at one receptor location.
[10] USEPA SIL guidance (USEPA 2018c).

Table 7-32 Criteria Pollutant Concentration Effects from Construction of Alternative B (μg/m³)[1] Annual National Ambient Air Quality Standards and California Ambient Air Quality Standards

Construction Area	NO_2 (CAAQS)		NO_2 (NAAQS)		$PM_{2.5}$ (CAAQS)		$PM_{2.5}$ (NAAQS)		PM_{10} (CAAQS)	
	Project Annual[2]	Project Annual[3]	Project Annual[2]	Total Annual[4]	Project Annual[2]	Total Annual[5]	Project Annual[2]	Total Annual[6]	Project Annual[2,7]	Total Annual[7,8]
San Francisco to South San Francisco Subsection										
4th and King Street Station	0.26	23	0.25	22	0.02	9.7	0.02	8.2	0.16	**22***
At grade	3.9	26	3.7	25	0.59	10	0.56	8.8	**3.2***	**25***
Brisbane LMF	0.31	23	0.30	22	0.08	9.8	0.07	8.3	0.26	**22***
Combined[9]	4.2	27	4.0	25	0.67	10	0.63	8.8	**3.5***	**26***
San Bruno to San Mateo Subsection										
Millbrae Station	0.19	23	0.19	22	0.02	9.7	0.01	8.2	0.10	**22***
Embankment	2.3	25	2.2	24	0.57	10	0.54	8.7	**2.7***	**25***
At grade	2.9	26	2.9	24	0.58	10	0.56	8.8	**3.1***	**25***
Combined[9]	3.1	26	3.1	24	0.60	10	0.57	8.8	**3.2***	**25***
San Mateo to Palo Alto Subsection										
Embankment	4.0	23	3.8	22	1.1	10	1.0	8.7	**6.5***	**28***
At grade	5.3	24	5.1	23	1.5	11	1.5	9.2	**10***	**32***
Combined[9]	5.3	24	5.1	23	1.5	11	1.5	9.2	**10***	**32***
Mountain View to Santa Clara Subsection										
At grade	4.3	28	3.9	27	0.95	11	0.85	10	**5.3***	**27***
Combined[9]	4.3	28	3.9	27	0.95	11	0.85	10	**5.3***	**27***
Threshold										
SIL (μg/m³)[7,10]	N/A		N/A		N/A		0.2		2.08	
CAAQS/NAAQS (μg/m³)	–	57	–	100	–	12	–	12	–	20

Sources: AERMOD version 18081; USEPA 2018a; CARB 2018a
μg/m³ = micrograms of pollutant per cubic meter of air
CAAQS = California ambient air quality standards

LMF = light maintenance facility
NAAQS = national ambient air quality standards
NO_2 = nitrogen dioxide
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SIL = significant impact level
Exceedances of CAAQS or NAAQS are **bold with an asterisk (*).**
[1] Only the highest modeled concentration in the form of the applicable standard is presented for each pollutant.
[2] Represents the maximum incremental off-site concentration in the form of the standard from project construction.
[3] A background annual NO_2 concentration in the form of the (CAAQS) standard of 22.6, 18.8 and 24.1 µg/m^3 (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[4] A background annual NO_2 concentration in the form of the (NAAQS) standard of 21.3, 18.2, and 22.8 µg/m^3 (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[5] A background annual $PM_{2.5}$ concentration in the form of the (CAAQS) standard of 9.7, 9.0, and 9.9 µg/m^3 (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[6] A background annual $PM_{2.5}$ concentration in the form of the (NAAQS) standard of 8.2, 7.7, 9.2 µg/m^3 (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[7] Background PM_{10} concentration alone exceeds the CAAQS. Therefore, the incremental project increase in PM_{10} concentrations should be compared to the applicable USEPA SIL as recommended by the BAAQMD (Kirk 2016).
[8] A background annual PM_{10} concentration in the form of the (CAAQS) standard of 22.1, 21.9, and 21.9 µg/m^3 (for the locations of San Francisco—Arkansas St., Redwood City—Barron Ave., and San Jose—Jackson St., respectively) was added to the maximum increment off-site project contribution.
[9] “Combined” conservatively estimates the sum of worst-case concentrations from all features that can occur concurrently at one receptor location.
[10] USEPA SIL guidance (USEPA 2018c).

7.12 Asbestos, Lead-Based Paint, and Odors

7.12.1 Asbestos

NOA could become airborne as a result of excavating ultramafic and metavolcanic bedrock. As noted in Section 6.5, Asbestos, Lead-Based Paint, and Odors, NOA may be present in Potrero Point, as this hill is mapped as serpentinite, a metamorphosed ultramafic rock. Construction activities near the Potrero Point serpentinite would consist of minor track modifications in the existing Caltrain corridor. No major excavation of serpentinite rock would be anticipated; therefore, the risk of exposure of construction workers and the public to airborne NOA would be limited. If NOA would be disturbed, the design-build contractor would prepare a CMP that outlines practices for avoiding and minimizing NOA. Construction contractors would also comply with the BAAQMD's *Asbestos Airborne Toxic Control Measure for Construction and Grading Operations* (BAAQMD 2002), which requires implementation of dust control measures to limit the potential for airborne asbestos.

The demolition of asbestos-containing materials is subject to the limitations of the *National Emission Standards for Hazardous Air Pollutants* (USEPA n.d.) regulations (40 C.F.R. Parts 61 and 63) and would require an asbestos inspection. The Authority would consult with the BAAQMD, as applicable, before demolition activities begin. Alternative B would require about 524,400 square feet of demolition, and therefore has greater potential to encounter and expose receptors to effects from asbestos and Pb-based paint, compared to Alternative A, which would require about 246,000 square feet of demolition. Both project alternatives would use the same construction techniques and comply with the same regulations and standards to minimize exposure to these substances.

7.12.2 Lead-Based Paint

Buildings in the RSA might be contaminated with residual Pb, which was used as a pigment and drying agent in oil-based paint until the Lead-Based Paint Poisoning Prevention Act of 1971 prohibited such use. If encountered during demolitions and relocations for either project alternative, Pb-based paint and asbestos would be handled and disposed of in accordance with applicable standards. The *San Francisco to San Jose Project Section Draft Hazardous Materials and Wastes Technical Report* discusses potential issues of Pb-based paint during construction of the project (Authority 2019e).

7.12.3 Odors

Sources of odor during project construction would include diesel exhaust from construction equipment and asphalt paving. All odors would be localized and generally confined to the immediate area surrounding the construction site. The project would use standard construction techniques, and the equipment odors would be typical of most construction sites. The equipment odors would be temporary and localized, and they would cease once construction activities have been completed. The BAAQMD has adopted rules that limit the amount of ROG emissions from cutback asphalt (Section 3.3, Regional and Local), which would also reduce construction-related odors. The potential for effects would be the same for both project alternatives because both project alternatives would use the same construction techniques and comply with the same air district rules to limit odors.

No potentially odorous emissions would be associated with train operation because the trains would be powered from the regional electrical grid. There would be some area source emissions associated with station and the Brisbane LMF operation, such as natural-gas combustion for space and water heating, landscaping equipment emissions, and minor solvent and paint use. The solvent and paint use could be odorous to sensitive receptors. However, the exposure would be similar to the exposure to odors from other commercial and industrial activities that would occur in these areas under the No Project condition.

7.13 Summary of Effects

Project features, including IAMFs, design standards, and compliance with the Authority's project design guideline technical memoranda would minimize effects on air quality. Table 7-33 summarizes the project alternatives' air quality effects.

Construction activities under either project alternative would result in daily VOC (under Alternative B) and NO_X emissions that would exceed the BAAQMD's CEQA thresholds. Temporary construction activity for either project alternative would generate criteria pollutant emissions in the SFBAAB, but the general conformity *de minimis* thresholds would not be exceeded. Construction emissions under Alternative B would be somewhat higher than under Alternative A, primarily because Alternative B includes construction of the passing tracks.

The project would be constructed with all feasible on-site control measures to reduce emissions and minimize effects on air quality. Effects associated with fugitive dust emissions would be minimized through implementation of a dust control plan (AQ-IAMF#1). The contractor would use low-VOC paints to limit the emissions of VOCs (AQ-IAMF#2). Exhaust-related pollutants would be reduced through use of renewable diesel, Tier 4 off-road engines, and model year 2010 or newer on-road engines, as required by AQ-IAMF#3 through AQ-IAMF#5. However, even with application of IAMFs, exceedances of the BAAQMD daily VOC (under Alternative B) and NO_X thresholds would still occur. The Authority would implement mitigation measures to offset the remaining construction effect on air quality resources. Specifically, AQ-MM#1 would offset VOC and NO_X emissions, as applicable, to below the BAAQMD threshold.

Construction activities would not by themselves lead to new exceedances of the CAAQS or NAAQS. However, under either project alternative, construction activities would contribute to existing exceedances of the 1- to 24-hour and annual CAAQS for PM_{10} where background concentrations already exceed the CAAQS. Construction activities would not lead to exceedances of BAAQMD health risk thresholds. Project features would minimize air quality effects (AQ-IAMF#1 through AQ-IAMF#5), although construction emissions would still contribute to existing exceedances of the ambient air quality standards.

Table 7-33 Summary of Effects

Effect	Alternative A	Alternative B
Temporary Direct and Indirect Effects on Air Quality in the SFBAAB	Temporary construction activity would generate emissions of criteria pollutants, but those emissions would be below the applicable general conformity *de minimis* thresholds. Construction-related NO_X emissions would exceed BAAQMD's threshold.	Emissions would be greater than Alternative A because of construction of passing tracks. Construction-related VOC and NO_X emissions would exceed the BAAQMD thresholds.
Temporary Direct Effects on Implementation of an Applicable Air Quality Plan	Emissions of NO_X from temporary construction activity in excess of the BAAQMD threshold could impede implementation of O_3 plans in the SFBAAB.	Emissions of VOC and NO_X from temporary construction activity in excess of the BAAQMD thresholds could impede implementation of O_3 plans in the SFBAAB.
Temporary Direct Effects on Localized Air Quality—Criteria Pollutants	Construction-related PM_{10} concentrations would contribute to existing exceedances of the PM_{10} CAAQS. Construction-related criteria pollutant concentrations would not lead to new exceedances of the CAAQS or NAAQS.	Emissions would be greater than Alternative A because of construction of passing tracks.

Effect	Alternative A	Alternative B
Temporary Direct Effects on Localized Air Quality—Exposure to Diesel Particulate Matter and $PM_{2.5}$ (Health Risk)	Temporary construction activity would not generate DPM or $PM_{2.5}$ concentrations in excess of BAAQMD health risk thresholds. The maximum increase in potential cancer risk (3.6 per million) would occur in the Mountain View to Santa Clara Subsection.	Same as Alternative A
Temporary Direct Effects on Localized Air Quality—Exposure to Asbestos and Lead-Based Paint	Project design and compliance with existing asbestos and lead-based paint handling and disposal standards would prevent exposure of sensitive receptors to substantial pollutant concentrations. There would be limited potential for exposure of sensitive receptors to asbestos or Pb-based paint associated with demolition of approximately 246,000 square feet.	Greater potential for exposure than Alternative A because of additional demolition associated with construction of passing tracks and related station modifications. There would be limited potential for exposure of sensitive receptors to asbestos or Pb-based paint associated with demolition of approximately 524,400 square feet associated with construction of passing tracks.
Temporary Direct Effects on Localized Air Quality—Exposure to Odors	There would be limited potential for odors generated by construction to affect sensitive receptors or result in nuisance complaints.	Same as Alternative A
Continuous Permanent Direct Effects on Air Quality within the SFBAAB	Long-term operation of the HSR system would reduce criteria pollutant emissions, relative to the No Project conditions, resulting in a regional and local air quality benefit. Annual reductions in regional emissions would range from 24 to 53 tons of VOC, 298 to 565 tons of CO, 213 to 453 tons of NO_X, 23 to 49 tons of SO_2, 6 to 41 tons of PM_{10}, and 7 to 20 tons of $PM_{2.5}$, depending on the year and ridership scenario.	Same as Alternative A
Continuous Permanent Direct Effects on Implementation of an Applicable Air Quality Plan	Emissions reductions from project operations would support implementation of air quality plans and attainment of regional air quality goals.	Same as Alternative A
Continuous Permanent Direct Effects on Localized Air Quality—Carbon Monoxide Hot Spots (NAAQS Compliance)	Increased station traffic would not result in localized CO hot spots or exceedances of the CO NAAQS or CAAQS.	Same as Alternative A
Continuous Permanent Direct Effects on Localized Air Quality—Exposure to Mobile Source Air Toxics	Operations of the HSR system would result in a regional MSAT reduction and benefit. Increased station traffic would have a low potential for meaningful localized MSAT effects.	Same as Alternative A

Effect	Alternative A	Alternative B
Continuous Permanent Direct Effects on Localized Air Quality—Particulate Matter Hot Spots (NAAQS Compliance)	The project is not considered a project of air quality concern, based on the descriptions as indicated in 40 C.F.R. Section 93.123(b)(1).	Same as Alternative A
Continuous Permanent Direct Effects on Localized Air Quality—Exposure to Diesel Particulate Matter and $PM_{2.5}$ (Health Risk)	Emissions of DPM and $PM_{2.5}$ from freight trains on shifted tracks, and station and LMF operation, would not expose sensitive receptors to excessive pollutant concentrations because health risks would not exceed BAAQMD's thresholds.	Same as Alternative A
Continuous Permanent Direct Effects on Localized Air Quality—Exposure to Odors	Emissions-generated odors would be very limited and would not be expected to affect a substantial number of people.	Same as Alternative A

BAAQMD = Bay Area Air Quality Management District
CAAQS = California ambient air quality standards
C.F.R. = Code of Federal Regulations
CMP = construction management plan
CO = carbon monoxide
DPM = diesel particulate matter
HSR = high-speed rail
MSAT = mobile source air toxics
NAAQS = national ambient air quality standards
NOA = naturally occurring asbestos
NO_X = nitrogen oxide
O_3 = ozone
Pb = lead
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
PM_{10} = particulate matter 10 microns or less in diameter
SFBAAB = San Francisco Bay Area Air Basin
SO_2 = sulfur dioxide
VOC = volatile organic compounds

8 GLOBAL CLIMATE CHANGE EFFECTS ANALYSIS

Using the methods described in Chapter 6, this chapter evaluates and discusses the effects of the project pertaining to global climate change and GHG.

8.1 Statewide and Regional Operations Emissions Analysis

Table 8-1 shows the statewide GHG emission changes (expressed in terms of CO_2e) that would result from the project under the medium and high ridership scenarios compared to the 2015 existing conditions and 2029 and 2040 No Project conditions. Analysts estimated the emission changes from reduced on-road VMT, reduced intrastate aircraft travel, and increased electrical demand. As Table 8-1 shows, the project is predicted to have a beneficial effect on statewide GHG emissions relative to both the 2015 existing conditions and 2029 and 2040 No Project conditions because it would result in a net reduction in GHG emissions. The estimated GHG emissions changes would be the same under either project alternative because the ridership scenarios do not vary by alternative.

Table 8-1 Estimated Statewide Greenhouse Gas Emissions Change from Project Operation—Medium and High Ridership Scenarios (Million MT CO_2e per year)

Emission Source	Change in CO_2e Emissions from HSR (Million MT/year)	
	Medium	High
Existing Plus Project Emissions Relative to 2015 Existing Conditions		
On-road vehicles	-1.1	-1.5
Aircraft	-0.7	-0.7
Power plants	0.4	0.4
Total statewide emissions	**-1.4**	**-1.7**
2029 Plus Project Emissions Relative to 2029 No Project Conditions		
On-road vehicles	-0.4	-0.3
Aircraft	-0.5	-0.5
Power plants	0.3	0.4
Total statewide emissions	**-0.6**	**-0.4**
2040 Plus Project Emissions Relative to 2040 No Project Conditions		
On-road vehicles	-0.5	-1.1
Aircraft	-1.0	-0.9
Power plants	0.4	0.4
Total statewide emissions	**-1.0**	**-1.6**

Source: Authority 2019b
CO_2e = carbon dioxide equivalent
HSR = high-speed rail
MMT = million metric tons
Sum of individual values may not equal total due to rounding.

This analysis considers the GHG effects associated with the project beyond 2020, consistent with SB 32 (Section 3.2.3.8, Senate Bill 32 and Assembly Bill 197), by assessing operations emissions for two conditions (2029 and 2040). Table 8-1 shows that the project would result in GHG reductions relative to the 2029 and 2040 No Project conditions and would help the state reach the goal established in SB 32 (40 percent below 1990 levels). Based on the 1990 emissions of 431 MMT CO_2e, the state would need to reduce emissions by 172 MMT CO_2e to achieve the SB 32 goal. The project would reduce statewide GHG emissions by 1 MMT CO_2e in the design year (2040) under the medium ridership scenario, and by 1.5 MMT CO_2e in 2040 under the high ridership scenario. These reductions correspond to an annual reduction of 0.6 to 0.9 percent of the 172 MMT CO_2e needed to achieve the SB 32 goal.

Table 8-1 also shows that the net change in emissions for 2015 existing conditions would be a decrease in GHG emissions. Despite increases in power plant emissions from the project plus all other statewide activity between 2015 and 2040, total statewide GHG emissions in 2040 would be less than the level of GHG emissions in 2015. As evident in Table 8-1, the primary factors for the net decrease in emissions are decreases in on-road vehicle emissions related to advancements in vehicle emissions technology and the retirement of older, higher-emitting vehicles. Statewide growth would increase aircraft emissions over time in the absence of the project, but the project would reduce emissions relative to the No Project conditions by diverting passengers from aircraft to HSR. Therefore, the project's effect on GHG emissions would be beneficial with respect to both 2015 existing conditions and the 2029 and 2040 No Project conditions.

8.1.1 On-Road Vehicles

The project would reduce annual roadway VMT compared to 2015 existing conditions and the 2029 and 2040 No Project conditions because travelers would use the HSR rather than drive (see Table 7-6 for VMT under No Project and Project conditions). The on-road vehicle emission analysis is based on projected VMT changes and associated average daily speed estimates, calculated based on the ridership estimates presented in the 2016 Business Plan (Authority 2016). Analysts obtained GHG emission factors from EMFAC2017, using statewide parameters.

As shown in Table 8-2, the project is predicted to decrease statewide on-road GHG emissions relative to both 2015 existing conditions and 2029 and 2040 No Project conditions. On county and regional levels, Table 8-2 also shows the project is predicted to result in a decrease in on-road GHG emissions relative to both conditions. As discussed previously, on-road vehicle emissions are expected to decrease in the future because of advancements in vehicle emissions technology and the retirement of older, higher-emitting vehicles. Therefore, the reduction in GHG emissions from on-road vehicles because of the project is demonstrated on the county, regional, and statewide levels for both conditions. Increases in gate-down time at at-grade crossings would increase vehicle idling emissions of GHGs, but this increase would be more than compensated for by the reduction in regional GHG emissions from on-road vehicles. The change in emissions would be the same under either project alternative because the ridership is assumed the same.

Table 8-2 On-Road Vehicle Greenhouse Gas Emission Changes from the Project—Medium and High Ridership Scenarios (MMT CO_2e per year)

Location	Change in CO_2e Emissions from HSR (MMT/year)	
	Medium	High
Existing Plus Project Emissions Relative to 2015 Existing Conditions		
San Francisco County	-0.01	-0.01
San Mateo County	-0.02	-0.03
Santa Clara County	-0.05	-0.07
Total regional net emissions	-0.08	-0.11
Total statewide net emissions	-1.07	-1.47

Location	Change in CO_2e Emissions from HSR (MMT/year)	
	Medium	High
2029 Plus Project Emissions Relative to 2029 No Project Conditions		
San Francisco County	0.00	0.00
San Mateo County	-0.01	-0.01
Santa Clara County	-0.03	-0.04
Total regional net emissions	-0.05	-0.05
Total statewide net emissions	-0.49	-0.27
2040 Plus Project Emissions Relative to 2040 No Project Conditions		
San Francisco County	-0.01	-0.01
San Mateo County	-0.02	-0.01
Santa Clara County	-0.04	-0.06
Total regional net emissions	-0.06	-0.07
Total statewide net emissions	-0.46	-1.11

Source: Authority 2019b
CO_2e = carbon dioxide equivalent
HSR = high-speed rail
MMT = million metric tons
Sum of individual values may not equal total due to rounding. Values less than 0.005 have been rounded to zero.

8.1.2 Trains

The project would use EMU trains, with the power distributed through the OCS. The HSR system would not produce direct GHG emissions from combustion of fossil fuels and associated emissions. Electricity-related emissions are assessed in Section 8.1.4, Power Plants.

8.1.3 Aircraft

As described in Section 6.2.3 analysts calculated aircraft emissions by using fuel consumption and emission factors, profiles of aircrafts, and number of air trips removed. Refer to Table 7-8 for the number of flights in 2015, 2029, and 2040 with and without the project. As shown in Table 8-3, the project would reduce regional (Bay Area) and statewide emissions relative to 2015 existing conditions and 2029 and 2040 No Project conditions. The change in emissions would be the same under either project alternative because the ridership is assumed the same.

Table 8-3 Aircraft Greenhouse Gas Emission Changes from the Project—Medium and High Ridership Scenarios (MMT CO_2e per year)

Location	Change in CO_2e Emissions from HSR (MMT/year)	
	Medium	High
Existing Plus Project Emissions Relative to 2015 Existing Conditions		
Regional (Bay Area)	-0.3	-0.3
Total statewide net emissions	-0.7	-0.7
2029 Plus Project Emissions Relative to 2029 No Project Conditions		
Regional (Bay Area)	-0.2	-0.2
Total statewide net emissions	-0.5	-0.5

Location	Change in CO_2e Emissions from HSR (MMT/year)	
	Medium	High
2040 Plus Project Emissions Relative to 2040 No Project Conditions		
Regional (Bay Area)	-0.4	-0.4
Total statewide net emissions	-1.0	-0.9

Source: Authority 2019b
CO_2e = carbon dioxide equivalent
HSR = high-speed rail
MMT = million metric tons
Sum of individual values may not equal total due to rounding.

8.1.4 Power Plants

The HSR system would increase electrical requirements when compared to both the 2015 existing conditions and 2029 and 2040 No Project conditions. Analysts conservatively estimated the electrical demands from propulsion of the trains and operation of the trains in storage depots and LMF. Table 8-4 shows the GHG emissions for both medium and high ridership scenarios relative to the 2015 existing conditions and 2029 and 2040 No Project conditions. Emissions would increase under both scenarios.

The state's electrical grid would power the HSR system, and, therefore, no single generation source for the electrical power requirements can be identified. As previously discussed, the state requires an increasing fraction (50 percent by 2030) of electricity generated for the state's power portfolio to come from renewable energy sources, and the Authority has a policy goal to use 100 percent renewable energy to power the HSR system. Accordingly, the GHG emissions generated for powering the HSR system are expected to be lower in the future compared to emission estimates used in this analysis, which assume the current electrical generation mix of California. As shown in Table 8-4, the HSR system's electrical requirements would increase statewide and regional indirect GHG emissions.

Table 8-4 Power Plant Greenhouse Gas Emission Changes from the Project—Medium and High Ridership Scenarios (MMT CO_2e per year)

Location	Change in CO_2e Emissions from HSR (MMT/year)	
	Medium	High
Existing Plus Project Emissions Relative to 2015 Existing Conditions		
Regional	0.02	0.02
Statewide	0.4	0.4
2029 Plus Project Emissions Relative to 2029 No Project Conditions		
Regional	0.02	0.02
Statewide	0.3	0.4
2040 Plus Project Emissions Relative to 2040 No Project Conditions		
Regional	0.03	0.02
Statewide	0.4	0.4

Source: Authority 2019b
CO_2e = carbon dioxide equivalent
HSR = high-speed rail
MMT = million metric tons

8.1.5 Regional Operations Greenhouse Gas Emissions Summary

A summary of the effects of the project on regional GHG emissions, which include the emissions from vehicles, aircraft, and power plants, is shown in Table 8-5. The project would reduce regional GHG emissions relative to 2015 existing conditions and 2029 and 2040 No Project conditions. However, this regional assessment does not account for the benefit of reductions in roadway and airplane emissions that would occur statewide. Therefore, the full benefit of the project is not reflected in the emissions at the regional level. However, as shown in Table 8-5, the project would result in a net reduction in GHG emissions statewide for both conditions. Because GHGs circulate globally, an increase at the regional level would not be adverse, given the net reduction at the state level. There would be no difference in emissions between the alternatives because ridership is assumed the same.

Table 8-5 Estimated Regional Greenhouse Gas Emissions Change from the Project—Medium and High Ridership Scenarios (MMT CO_2e per year)

Emission Source	Change in CO_2e Emissions from HSR (MMT/year)	
	Medium	High
Existing Plus Project Emissions Relative to 2015 Existing Conditions		
On-road vehicles	-0.08	-0.11
Aircraft	-0.28	-0.26
Power plants	0.02	0.02
Total regional emissions	**-0.34**	**-0.35**
2029 Plus Project Emissions Relative to 2029 No Project Conditions		
On-road vehicles	-0.04	-0.05
Aircraft	-0.18	-0.20
Power plants	0.02	0.02
Total regional emissions	**-0.20**	**-0.23**
2040 Plus Project Emissions Relative to 2040 No Project Conditions		
On-road vehicles	-0.06	-0.07
Aircraft	-0.38	-0.37
Power plants	0.03	0.02
Total regional emissions	**-0.42**	**-0.42**

Source: Authority 2019b
CO_2e = carbon dioxide equivalent
HSR = high-speed rail
MMT = million metric tons
Sum of individual values may not equal total due to rounding.

8.2 Local Operations Emissions Sources

Operation of the 4th and King Street and Millbrae Stations and the Brisbane LMF would produce GHG emissions. The operation of the power traction, switching, and paralleling stations for the blended system would not result in appreciable quantities of GHG emissions because site visits would be infrequent and power usage would be limited. Therefore, analysts did not quantify emissions from these facilities. This section therefore focuses on emissions generated by the station sites and Brisbane LMF.

8.2.1 Station Sites and Light Maintenance Facility

Emissions associated with the operation of stations and the Brisbane LMF are expected because of combustion sources used primarily for space heating and facility landscaping, energy consumption for facility lighting, water usage, waste generation, and employee and passenger traffic. Analysts used CalEEMod to estimate these emissions from the stations and LMF, based on the square footage of the buildings. The GHG emissions (expressed in terms of CO_2e) were estimated for the 2015 existing conditions and 2029 (for 4th and King Street Station) and 2040 No Project conditions and are shown in Table 8-6. The estimated GHG emissions would be the same for either project alternative.

Table 8-6 Station and Light Maintenance Facility Operations Greenhouse Gas Emissions (MT CO_2e per year)

Project Component	CO_2e
2015 Existing[1]	
4th and King Street Station	3,708
Millbrae Station	10,114
Total	13,822
Existing Plus Project	
4th and King Street Station	8,069
Millbrae Station	15,153
Brisbane LMF	2,192
Total	25,413
Change with project	**11,591**
2029 No Project[1]	
4th and King Street Station	2,385
2029 Plus Project	
4th and King Street Station	5,055
Change with Project	**2,670**
2040 No Project[1]	
Millbrae Station	6,391
2040 Plus Project	
Millbrae Station	9,220
Brisbane LMF	1,770
Total	10,990
Change with project	**4,600**

Source: CAPCOA 2017
CO_2e = carbon dioxide equivalent
LMF = light maintenance facility
MT = metric ton
[1] Represents emissions from the existing facilities prior to HSR improvements

8.3 Total Operations Emissions

Table 8-7 shows the total GHG emission changes because of project operations for the medium and high ridership scenarios, including the indirect emissions from regional vehicle travel, aircraft, and power plants and direct project operations emissions from HSR stations and Brisbane LMF under the project. The project would result in a net decrease in GHG emissions. These decreases would be beneficial to the SFBAAB and state and would help meet local and statewide GHG reduction goals. Although lower ridership would result, there would still be a net benefit. The overall change in GHG emissions would be the same under either project alternative.

Table 8-7 Total Statewide Greenhouse Gas Emissions Changes from Project Operation—Medium and High Ridership Scenarios Compared to Existing, 2029, and 2040 No Project Conditions (MMT CO_2e per year)

Emission Source	Change in CO_2e Emissions from HSR (MMT/year)	
	Medium	High
Existing Plus Project Emissions Relative to 2015 Existing Conditions		
Indirect Emissions		
On-road vehicles	-1.07	-1.47
Aircraft	-0.70	-0.67
Power plants	0.38	0.41
Direct Emissions[1]		
Stations and Brisbane LMF	0.02	0.02
Total Emissions[2]	**-1.37**	**-1.70**
2029 Plus Project Emissions Relative to 2029 No Project Conditions		
Indirect Emissions		
On-road vehicles	-0.45	-0.27
Aircraft	-0.46	-0.50
Power plants	0.32	0.35
Direct Emissions[1]		
Stations and Brisbane LMF	0.02	0.02
Total Emissions[2]	**-0.56**	**-0.40**
2040 Plus Project Emissions Relative to 2040 No Project Conditions		
Indirect Emissions		
On-road vehicles	-0.46	-1.11
Aircraft	-0.97	-0.94
Power plants	0.44	0.41
Direct Emissions[1]		
Stations and LMF	0.02	0.02
Total Emissions[2]	**-0.98**	**-1.61**

Sources: Authority 2019b; CAPCOA 2017
CO_2e = carbon dioxide equivalent
HSR = high-speed rail
MMT = million metric tons
Sum of individual values may not equal total due to rounding.
[1] Sum of station and LMF emissions. Represents the net emissions effect of the project (i.e., the difference in operating emissions between existing or No Project condition and the project condition).
[2] The total includes the indirect and direct emissions.

8.4 Construction Greenhouse Gas Emissions

GHG emissions generated from construction of the project would be temporary. However, because CO_2, once emitted, remains in the atmosphere for relatively long periods (5 to 200 years [IPCC 2007]), the climate effects of construction GHG emissions are as long-term as the climate effects of operations GHG emissions.

Table 8-8 shows construction activity emissions from the project. The analysis assumes implementation of AQ-IAMF#1 through AQ-IAMF#5. The total GHG construction emissions of the project would be less than 0.05 percent of the total annual statewide GHG emissions.[17]

Table 8-8 also shows the amortized GHG emissions during project construction activities. A 25-year project life is conservatively assumed (although the actual project life would be much longer). Total amortized GHG construction emissions for the project are estimated to be 7,201 metric tons CO_2e per year under Alternative A and 8,303 metric tons CO_2e per year under Alternative B. The increase in GHG emissions generated during construction would be offset in about 1 to 2 months, depending on the ridership scenario and alternative (because of car and aircraft trips removed in the RSA), relative to No Project conditions.

Table 8-8 Carbon Dioxide–Equivalent Construction Emissions

Year	CO_2e Emissions (MT/year)			
	Alternative A		Alternative B	
2021	20,073		22,600	
2022	44,302		54,465	
2023	41,212		48,339	
2024	35,241		40,142	
2025	39,192		42,032	
Construction Total	**180,021**		**207,579**	
Amortized GHG Emissions (averaged over 25 years[1])				
CO_2e per year for total construction	7,201		8,303	
Payback of GHG Emissions (months)[2,3]				
Ridership scenario	Medium	High	Medium	High
Payback period (Project conditions vs. 2040 No Project conditions)	2.2	1.3	2.5	1.5
Payback period (Project conditions vs. 2015 existing conditions)	1.6	1.2	1.8	1.4

Sources: CAPCOA 2017; CARB 2018c; The Climate Registry 2017; Scholz 2018
CO_2e = carbon dioxide equivalent
GHG = greenhouse gas
MT = metric tons
Emission factors for CO_2e do not account for improvements in technology over time that would reduce emissions.
[1] Project life assumed to be 25 years.
[2] Payback periods were estimated by dividing the GHG emissions during construction years by the annual GHG emission reduction during operation. See Table 8-7 for operations GHG emission-reduction data. The range in payback time represents the range of emissions changes based on the medium and high ridership scenarios.
[3] The payback period accounts for all emissions directly and indirectly generated by construction activities for which the Authority has practical control and program responsibility. Emissions generated upstream (e.g., material manufacturing) and downstream (e.g., recycling) of construction, otherwise known as "lifecycle emissions," are not included in the analysis, consistent with guidance from the California Natural Resources Agency (2018). While the origin of most raw materials is not known, and thus an emissions analysis would be speculative, construction of the project would

[17] A GHG emissions inventory for the project vicinity was not available at the time of the release of this document, so the comparison was made to the most recent CARB emissions inventory (2016), which estimated that the annual CO_2e emissions in California are about 429 MMT (CARB 2018b).

require concrete from off-site batch plants. Lifecycle emissions for cement and aggregate manufacturing, which is upstream of the concrete batching process, have been studied in various literature. These emissions would be generated upstream of construction and through activities for which the Authority has no practical control. Therefore, lifecycle emissions are not included in the table.

8.5 Summary of Effects

Project features, including IAMFS, design standards, and compliance with the Authority's project design guideline technical memoranda, would avoid or minimize effects of GHGs. Table 8-9 summarizes the project's effects associated with GHG by alternative.

Table 8-9 Summary of Effects

Effects	Alternative A	Alternative B
Temporary Direct and Indirect Effects on Global Climate Change—Greenhouse Gas Emissions	GHG emissions generated during temporary construction of 7,201 metric tons CO_2e per amortized year would be offset by reductions achieved through project operation within 1 to 2 months.	GHG emissions generated during temporary construction of 8,303 metric tons CO_2e per amortized year would be offset by reductions achieved through project operation within 1 to 2 months.
Continuous Permanent Direct and Indirect Effects on Global Climate Change—Greenhouse Gas Emissions	Long-term operation of the HSR system would reduce GHG emissions, relative to the No Project conditions, resulting in a statewide and regional GHG benefit. Statewide annual reductions would range from 0.3 Million MT CO_2e to 1.7 Million MT CO_2e, depending on the year and ridership scenario.	Same as Alternative A.

CO_2e = carbon dioxide equivalent
GHG = greenhouse gas
HSR = high-speed rail
MT = metric tons

9 MITIGATION MEASURES

This chapter presents mitigation measures the Authority would implement to address effects on air quality.

AQ-MM#1: Offset Project Construction Emissions in the San Francisco Bay Area Air Basin

Prior to issuance of construction contracts, the Authority would be required to enter into a memorandum of understanding (MOU) with the Bay Area Clean Air Foundation (Foundation), a public nonprofit and supporting organization for the BAAQMD to reduce ROG/VOC and NO_X to the required levels. The required levels in the SFBAAB are as follows:

- For emissions above the BAAQMD's daily emission thresholds (ROG/VOC and NO_X): **below the appropriate CEQA threshold levels**.

The mitigation offset fee amount would be determined at the time of mitigation to fund one or more emissions reduction projects in the SFBAAB. The Foundation would require an additional administrative fee of no less than 5 percent. The mitigation offset fee would be determined by the Authority and the Foundation based on the type of projects available at the time of mitigation. When the CEQA threshold is exceeded, these funds may be spent to reduce either ROG/VOC or NO_X emissions (O_3 precursors). If the general conformity threshold is exceeded, these funds may be spent to reduce O_3 precursors that exceed the threshold, provided this is allowed by the federal CAA provisions addressing General Conformity. This fee is intended to fund emissions reduction projects to achieve reductions, with the estimated tonnage of emissions offsets required starting in 2021. Documentation of payment would be provided to the Authority or its designated representative.

The MOU would include details regarding the annual calculation of required offsets the Authority must achieve, funds to be paid, administrative fee, and the timing of the emissions reductions projects. Acceptance of this fee by the Foundation would serve as an acknowledgment and commitment by the Foundation to undertake the following steps: (1) implement an emissions reduction project(s) within a timeframe to be determined based on the type of project(s) selected after receipt of the mitigation fee designed to achieve the emission reduction objectives; and (2) provide documentation to the Authority or its designated representative describing the project(s) funded by the mitigation fee, including the amount of emissions reduced (tons per year) within the SFBAAB from the emissions reduction project(s). To qualify under this mitigation measure, the specific emissions reduction project(s) must result in emission reductions within the SFBAAB that are real, surplus, quantifiable, enforceable, and would not otherwise be achieved through compliance with existing regulatory requirements or any other legal requirement. Pursuant to 40 C.F.R. Section 93.163(a), the necessary reductions must be achieved (contracted and delivered) by the applicable year in question. Funding would need to be received prior to contracting with participants and should allow enough time to receive and process applications to fund and implement off-site reduction projects prior to commencement of project activities being reduced. This would roughly equate to the equivalent of 1 year prior to the required mitigation; additional lead time may be necessary depending on the level of off-site emission reductions required for a specific year.

10 CUMULATIVE EFFECTS

The RSA for cumulative air quality is the SFBAAB, and the RSA for global climate change is the state and global atmosphere. Air quality and global climate change are inherently cumulative resources because criteria pollutant and GHG emissions, once emitted, mix into the atmosphere and affect a larger area than an individual project site. Thus, this cumulative analysis does not consider individual cumulative projects near the project; rather, it uses the same thresholds of significance as the project-level analysis because of the inherently cumulative nature of these resources.

10.1 Near- and Long-Term Operations

State: Even with the more stringent regulations on GHG emissions expected in the future, projected growth in California may result in cumulative increases in GHG emissions. Increased GHG emissions from past, present, and reasonably foreseeable future projects in the state would result in effects on global climate change. The project's statewide demand for electricity could result in indirect GHG emissions from power generation facilities. Although the Authority has adopted a policy to purchase renewable, clean-power energy sources, it cannot guarantee that only renewable energy is used to power the HSR system because the local power distribution network does not distribute energy based on energy sources. Therefore, GHG emissions may be associated with the provisions of energy to the HSR system. However, the project would decrease overall GHG emissions by reducing vehicle and aircraft trips and would result in a net reduction in CO_2 emissions, as described in Chapter 8. This reduction in GHG emissions would more than offset the increase in GHG emissions associated with project facilities. Therefore, the project would result in a net decrease in GHG emissions from operations.

Regional: Operation of the HSR system would help the region attain air quality standards and plans by reducing the amount of regional vehicular traffic and providing an alternative mode of transportation. Because the project would help to decrease emissions of criteria pollutants and precursors (e.g., ROG, NO_X), it would result in a net benefit to regional air quality.

Local: Cumulative CO effects would not occur because, as discussed in Section 7.5, Microscale Carbon Monoxide Hot-Spot Analysis, additional traffic created by the project would not result in CO concentrations in excess of the NAAQS or CAAQS.

Multiple sources of cumulative (existing sources and future planned) TAC emissions are located within 1,000 feet of the shifted track sections and the HSR stations, including the following sources:

- **Existing sources**—Multiple stationary, rail, and roadway sources are currently located along the alignment.
- **Planned land use development**—Land use development in the region would increase traffic levels and result in increased vehicle-related emissions along roadways, although, over time, state and federal regulations would reduce the allowed emission rates for new vehicles. Planned development may also generate additional DPM from emergency generators and truck loading bays, as well as DPM during construction of near-term improvements.
- **Passenger rail service expansion**—Caltrain, as part of the PCEP will transition from current diesel service to approximately 75 percent EMU operation in 2022. Caltrain intends to transition to an all-electric train operation by the time blended service begins with HSR operations. With all-electric service, there would be a reduction of DPM emissions associated with current Caltrain diesel operations.
- **Freight rail service expansion**—Freight rail service may also expand in the future as the economy expands. The exact amount of freight rail transport is difficult to predict. Freight levels depend on not only the overall level of economic activity but also the specific demand for bulk and oversize commodities that dominate freight carried by rail. As a conservative assessment, analysts assumed that freight would increase in the future

at a rate of 3.5 percent per annum (PCJPB 2015) rounded up to 4 percent. This rate is an informal rate that freight operators, such as UPRR, often cite.

A quantitative HRA has not been conducted to estimate future DPM-related health risks to nearby sensitive receptors from cumulative land use development because construction and operations details are not available, and those projects would be responsible for analyzing their contributions. The cumulative HRA, therefore, focuses on ambient concentrations from stationary, rail, and roadway sources.

The BAAQMD has developed Google Earth and geographic information system (GIS) raster files that identify source-specific health risks throughout the SFBAAB. Analysts used these files to screen the shifted track alignment and select one area per subsection to analyze cumulative health risks (Winkel 2018). The selected areas were chosen based on their proximity to residential receptors and the rail alignment, as well as overall density of existing sources. Where appropriate, the BAAQMD's distance multipliers were used to adjust risks from existing generators and gasoline-dispensing facilities (collectively known as the background risk). Total cumulative health risks at the representative location in each subsection were calculated by adding the background health risk sources to the health risk and hazard effects for the net change in health risk from the track shift.

Table 10-1 shows cumulative cancer risk, chronic health hazard, and $PM_{2.5}$ concentrations at representative locations of maximum effect along the shifted track sections. Cumulative $PM_{2.5}$ concentrations exceed the BAAQMD threshold but, as shown in Table 10-1, the exceedances are not due to the project. Table 10-2 shows this information for the HSR stations and Brisbane LMF. Note that the locations of maximum cumulative effects are not necessarily the same as the locations of maximum project effect.

Table 10-1 Cumulative Cancer and Noncancer Health Risks from Freight Trains on Shifted Track

Subsection and Location	Cancer (per million)	Chronic HI (unitless)	$PM_{2.5}$ (µg/m³)
San Francisco to South San Francisco Subsection			
Near San Francisco Avenue and Santa Clara Street			
Ambient[1]	23.3	<0.1	**66.0***
Project[2]	0.8	<0.1	<0.1
Total	24.1	<0.1	**66.0***
San Bruno to San Mateo Subsection			
Near Dufferin Avenue and California Drive			
Ambient[1]	42.4	<0.1	**1.1***
Project[2]	2.0	<0.1	<0.1
Total	44.4	<0.1	**1.1***
San Mateo to Palo Alto Subsection			
Near El Camino Real and O'Neill Avenue			
Ambient[1]	66.0	<0.1	**1.0***
Project[2]	4.0	<0.1	<0.1
Total	70.0	<0.1	**1.0***

Subsection and Location	Cancer (per million)	Chronic HI (unitless)	$PM_{2.5}$ (µg/m³)
Mountain View to Santa Clara Subsection			
N/A[3]	N/A	N/A	N/A
Threshold			
BAAQMD threshold[4]	100	10.0	0.8

Sources: BAAQMD 2017a, 2012b, 2012c, 2012d; Winkel 2018; PCJPB 2015; OEHHA 2015
µg/m³ = micrograms of pollutant per cubic meter of air
HI = hazard index
N/A = not applicable
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
< = less than
Sum of individual values may not equal total due to rounding.
Exceedances of threshold are **bold with an asterisk (*).**
[1] Sum of ambient risks from stationary sources, roads, and rail.
[2] Incremental change in rail risk due to track shift, relative to No Project conditions
[3] No locations with both substantial track shifts and nearby receptors were identified in this subsection.
[4] BAAQMD has adopted both project- and cumulative-level thresholds for health risks. BAAQMD's cumulative thresholds are used in this analysis.

Table 10-2 Cumulative Cancer and Noncancer Health Risks from Station and Brisbane Light Maintenance Facility Operation

Location	Risks from Station and LMF Operations vs. Existing and No Project Conditions[1]		
	Cancer (per million)	Chronic HI (unitless)	$PM_{2.5}$ (µg/m³)
Millbrae Station			
Ambient[2]	35	<0.1	0.3
Generator Operation[3]	<10 [4]	<1.0 [4]	<0.01
Total	**<45**	**<1.0**	**0.3**
West Brisbane LMF (Alternative B only)[5]			
Ambient[2]	10	<0.1	<0.1
Generator Operation[3]	<10 [4]	<1.0 [4]	<0.01
Total	**<20**	**<1.0**	**<0.1**
Threshold			
BAAQMD threshold[6]	100	10.0	0.8

Sources: BAAQMD 2017a, 2012b, 2012c, 2012d; Winkel 2018; PCJPB 2015; OEHHA 2015
µg/m³ = micrograms of pollutant per cubic meter of air
HI = hazard index
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
< = less than
Sum of individual values may not equal total due to rounding.
[1] 4th and King Street Station is not included in Table 10-2 because the project would not affect the existing emergency generator and no additional generators would be installed; therefore, there would be no project effect.
[2] Sum of ambient risks from stationary sources, roads, and rail.
[3] Maximum incremental contribution from emergency generator operation, relative to existing and No Project conditions (Table 7-21).
[4] A project-specific cancer risk and chronic health hazard assessment was not conducted because BAAQMD Regulation 2, Rule 5, Section 302, prohibits generator use if they would result in cancer or acute hazard effects in excess of BAAQMD's health risk thresholds of significance.
[5] No ambient sources were identified within 1,000 feet of the East Brisbane LMF and receptors under Alternative A. Accordingly, there would be no cumulative effect, and East Brisbane LMF has been omitted from the table.
[6] BAAQMD has adopted both project- and cumulative-level thresholds for health risks. BAAQMD's cumulative thresholds are used in this analysis.

As shown in Table 10-1, total cumulative cancer risk and the noncancer chronic hazard index at sensitive receptors located near the shifted tracks would not exceed the BAAQMD's health risk thresholds. However, total cumulative $PM_{2.5}$ concentrations would exceed the BAAQMD's $PM_{2.5}$ threshold. The exceedances are the result of existing ambient risks. The relative contribution of the track shifts to the exceedances of the $PM_{2.5}$ threshold would be less than the BAAQMD's project-level $PM_{2.5}$ threshold and minor compared to ambient $PM_{2.5}$ concentrations from existing sources.

As shown in Table 10-2, total cumulative health risks to sensitive receptors near Millbrae Station and the West Brisbane LMF would not exceed the BAAQMD's health risk thresholds. The 4th and King Street Station is not included in Table 10-2 because the project would not affect the existing emergency generator and no additional generators would be installed; therefore, there would be no project effect on health risk. Millbrae Station is relatively near San Francisco International Airport, which is not accounted for in BAAQMD's ambient risk data. The airport may contribute to ambient risks near Millbrae Station, but data are not available to quantify potential risks from the airport. Consequently, the actual ambient risks near Millbrae Station may be greater than as indicated in Table 10-2.

10.2 Construction

Air quality construction effects associated with the project would be above the BAAQMD's significance thresholds.

State: As described in Section 8.4, Construction Greenhouse Gas Emissions, construction of the project would result in a one-time increase in GHG emissions. These emissions are anticipated to be offset in 1 to 2 months of project operations because of reduced passenger vehicle travel on roadways. Based on this short offset period, overall GHG emissions (construction plus operations) would be reduced and would therefore be consistent with AB 32 and SB 32 goals.

Regional: The BAAQMD thresholds of significance may be used to evaluate criteria pollutant effects. Projects with emissions in excess of these significance thresholds would have a cumulatively considerable effect on air quality in the SFBAAB because they would not be consistent with the BAAQMD's attainment strategies and could prevent the BAAQMD from achieving attainment of state and federal standards.

As discussed in Chapter 7, project construction would result in NO_X emissions that would exceed BAAQMD's CEQA thresholds. NO_X emissions would be offset in the BAAQMD, as applicable, through the purchase of offsets (AQ-MM#1). Because AQ-MM#1 would offset NO_X emissions to below air district thresholds or net zero, construction of the project would not have a cumulatively considerable effect on NO_X.

Local: Emissions analysis at the local level includes the criteria pollutants PM_{10}, $PM_{2.5}$, NO_2, CO, SO_2, and TACs.

10.2.1 Criteria Pollutants

Construction activities would not by themselves lead to new exceedances of the CAAQS or NAAQS. However, under either project alternative, construction activities would contribute to existing violations of the 1- to 24-hour and annual CAAQS for PM_{10} where background concentrations already exceed the CAAQS. Construction activities would not contribute to new exceedances of any long-term standards.

10.2.2 Toxic Air Contaminants

Analysts performed a cumulative HRA for project construction, consistent with BAAQMD requirements, using the method described in Chapter 6 for near- and long-term operations effects. The BAAQMD's Google Earth and GIS raster files were used to screen the HSR alignment and select one 1,000-foot area per subsection to analyze cumulative health risks. Total cumulative health risks at the representative location in each subsection were calculated by adding the background health risks sources to the health risk and hazard effects for project construction. Table 10-3 summarizes cumulative cancer risk, chronic health hazard, and $PM_{2.5}$ concentrations at the maximum representative locations in the subsections.

Table 10-3 Cumulative Cancer and Noncancer Health Risks from Construction of Either of the Project Alternatives

Subsection/Source	Alternative A			Alternative B		
	Cancer	Chronic HI	$PM_{2.5}$ (µg/m³)	Cancer	Chronic HI	$PM_{2.5}$ (µg/m³)
San Francisco to South San Francisco Subsection						
Ambient	**1,355***	4.2	**66.1***	**1,355***	4.2	**66.1***
HSR construction[1]	1	<0.1	<0.1	1	<0.1	<0.1
Total[2]	**1,356***	4.2	**66.1***	**1,356***	4.2	**66.1***
San Bruno to San Mateo Subsection						
Ambient	**103***	0.5	**6.7***	**103***	0.5	**6.7***
HSR construction[1]	2	<0.1	<0.1	2	<0.1	<0.1
Total[2]	**105***	0.5	**6.7***	**105***	0.5	**6.7***
San Mateo to Palo Alto Subsection						
Ambient	**148***	0.7	**48.1***	**148***	0.7	**48.1***
HSR construction[1]	2	<0.1	<0.1	3	<0.1	<0.1
Total[2]	**150***	0.7	**48.1***	**152***	0.7	**48.1***
Mountain View to Santa Clara Subsection						
Ambient	**224***	0.2	**10.3***	**224***	0.2	**10.3***
HSR construction[1]	4	<0.1	<0.1	4	<0.1	<0.1
Total[2]	**228***	0.2	**10.3***	**228***	0.2	**10.3***
BAAQMD threshold[3]	**100**	**10.0**	**0.8**	**100**	**10.0**	**0.8**

Sources: BAAQMD 2017a, 2012b, 2012c, 2012d; Winkel 2018; PCJPB 2015; OEHHA 2015
µg/m³ = micrograms of pollutant per cubic meter of air
HI = hazard index
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
Sum of individual values may not equal total due to rounding.
Exceedances of threshold are **bold with an asterisk (*).**
[1] Presents the maximum health risk from HSR construction (see Table 7-25). Note that construction alone does not cause risks or $PM_{2.5}$ concentrations to exceed thresholds.
[2] Sum of individual values may not equal total due to rounding.
[3] BAAQMD has adopted both project- and cumulative-level thresholds for health risks. BAAQMD's cumulative thresholds are used in this analysis.

The combined effects of the electrified passenger rail service, track shifts, displacement of VMT and air travel, and motor vehicle and stationary source turnover represent the new emissions conditions to which receptors would be exposed. Although there are areas of the RSA with greater existing health risks, the addition of HSR service would achieve health risk reductions in the RSA, which also would constitute a localized air quality benefit. Nevertheless, Table 10-3 shows that total cumulative cancer risks and noncancer effects on sensitive receptors located near the project footprint would exceed the BAAQMD's cumulative thresholds. The exceedances would be the result of existing ambient sources. The project's relative contribution to the exceedances of the cumulative thresholds would be less than the BAAQMD's project-level heath thresholds and is minor compared to health risks from existing sources.

10.3 Combined Construction and Operations Cumulative Health Risk Assessment

Long-term residents residing in the same location may be exposed to project-generated emissions from multiple sources (e.g., construction, station operation, track shifts). Health risks depend on the duration receptors are exposed to the emission source. Individuals currently residing near the project corridor are exposed to a certain amount of pollution (representative of ambient risks described in Tables 10-1 through 10-3). If that individual remains in the same location during and after construction, they would be exposed to project-generated DPM during construction and then any incremental changes in project-generated DPM during operations. Analysts conservatively estimated the potential lifetime risks to long-term residents that may be present during both construction and operations. Table 10-4 shows the results of the analysis and compares the risks to BAAQMD's cumulative thresholds.

As shown in Table 10-4, total cumulative cancer risks and $PM_{2.5}$ concentrations for combined construction and operations would exceed the BAAQMD's thresholds. The exceedances are the result of existing ambient risks. The relative contribution of the combined construction and operation of the project to the exceedances of the thresholds would be less than the BAAQMD's project-level thresholds and minor compared to ambient cancer risks and $PM_{2.5}$ concentrations from existing sources.

Table 10-4 Cumulative Cancer and Noncancer Health Risks from Combined Construction and Operations

Subsection and Source	Cancer	Chronic HI	$PM_{2.5}$ (µg/m^3)
San Francisco to South San Francisco Subsection			
Ambient[1]	**1,355***	4.2	**66.1***
HSR construction	1.1	<0.1	<0.1
West Brisbane LMF (Alternative B only)[2,3]	<10	<1.0	<0.01
Track shifts[4]	0.8	<0.01	<0.1
Total	**1,367***	5.2	**66.1***
San Bruno to San Mateo Subsection			
Ambient[1]	**103***	0.5	**6.7***
HSR Construction	2.3	<0.1	<0.1
Millbrae Station operation[2]	<10	<1.0	<0.01
Track shifts[4]	2.0	<0.01	<0.1
Total	**117***	1.5	**7***
San Mateo to Palo Alto Subsection			
Ambient[1]	**148***	0.7	**48***
HSR Construction	3.3	<0.1	<0.1
Track shifts[4]	4.0	<0.01	<0.1
Total	**156***	0.7	**48***

Subsection and Source	Cancer	Chronic HI	$PM_{2.5}$ (µg/m^3)
Mountain View to Santa Clara Subsection			
Ambient[1]	**224***	0.2	10
HSR Construction	3.6	<0.1	<0.1
Track shifts[4]	N/A[5]	N/A	N/A
Total	**228***	0.2	10
Threshold			
BAAQMD Threshold[6]	100	10	0.8

Sources: Winkel 2018; AERMOD version 18081; OEHHA 2015; and HARP 2 version 18159
µg/m^3 = micrograms of pollutant per cubic meter of air
BAAQMD = Bay Area Air Quality Management District
HI = hazard index
N/A = not applicable
$PM_{2.5}$ = particulate matter 2.5 microns or less in diameter
Sum of individual values may not equal total due to rounding.
Exceedances of threshold are **bold with an asterisk (*).**
[1] Sum of existing ambient risks from stationary sources, roads, and rail
[2] Maximum incremental contribution from emergency generator operation
[3] No ambient sources were identified within 1,000 feet of the LMF and receptors under Alternative A. Accordingly, there would be no cumulative effect, and LMF Alternative A has been omitted from the table.
[4] Maximum incremental contribution from freight trains on shifted tracks.
[5] No locations with both substantial track shifts and nearby receptors were identified in this subsection.
[6] BAAQMD has adopted both project- and cumulative-level thresholds for health risks. BAAQMD's cumulative thresholds are used in this analysis.

11 CONFORMITY ANALYSIS

Projects requiring approval or funding from federal agencies that are in areas designated as nonattainment or maintenance for the NAAQS may be subject to the USEPA's General Conformity Rule. The two types of federal conformity are transportation conformity and general conformity.

Conformity refers to conforming to, or being consistent with, SIP for compliance with the CAA. The USEPA's Conformity Rule requires SIP conformity determinations on transportation plans, programs, and projects before they are approved or adopted (i.e., eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of such standards [40 C.F.R. Part 93]). Federal activities, such as federally sponsored projects, may not cause or contribute to new violations of air quality standards, exacerbate existing violations, or interfere with timely attainment or required interim emission reductions toward attainment.

Transportation conformity applies to those projects that will have FHWA or Federal Transit Authority (FTA) funding or require FHWA/FTA approval. General conformity applies to those projects that will have funding or require approval from any federal agency other than the FHWA or FTA.

The FRA and USEPA have determined that general conformity may be applicable to the project, because the project will likely require or receive one or more federal approvals or future federal construction funding. Pursuant to 23 U.S.C. Section 327 and an MOU executed by the FRA and the State of California on July 23, 2019, FRA assigned its federal environmental review responsibilities under NEPA and related statutes to the Authority under a federal program commonly known as NEPA Assignment. Accordingly, the Authority is now the NEPA lead agency. Consistent with 23 U.S.C. Section 327 and the NEPA Assignment MOU, FRA retains its obligations to make General Conformity Determinations under the CAA.

FHWA or FTA involvement is not anticipated other than incidental FHWA or FTA funding for joint-benefit components. If the FHWA or FTA funds a component of the HSR, or if a minor action is required to approve the project, such as the need for an FHWA-approved grade crossing, it is anticipated that this project element would be added to the affected area's regional transportation improvement program or RTIP for transportation conformity purposes. However, conformity of elements of the overall HSR system is addressed through application of the General Conformity Rule and requirements. Both general conformity and transportation conformity, as they relate to the project, are discussed in this chapter.

11.1 General Conformity

The USEPA has established general conformity *de minimis* thresholds (in tons per calendar year) for each criteria pollutant to determine whether projects are subject to conformity determination requirements. If the emissions generated by construction or operations of a project (on an area-wide basis) are less than these threshold values, the effects of the project are not considered to be significant, and no additional analyses are required to satisfy general conformity. If the emissions are greater than these values, compliance with the General Conformity Rule must be demonstrated by one or more of several prescribed methods.

Under federal designations, the SFBAAB is currently designated as marginal nonattainment for 8-hour O_3 and moderate nonattainment for $PM_{2.5}$. Consequently, the FRA is required to demonstrate project-level compliance with the General Conformity Rule for NO_X and VOC (O_3 precursors) $PM_{2.5}$, and SO_2 (if required as a $PM_{2.5}$ precursor) if project-related emissions of these pollutants in the SFBAAB would exceed the general conformity *de minimis* thresholds.

As shown in Section 7.4, Total Operations Emissions, the total regional emissions for all of the applicable pollutants would be lower during project operations than under No Project conditions (and would therefore not exceed the *de minimis* emission thresholds). Accordingly, only emissions generated during the construction phase need to be compared to the conformity threshold levels to determine conformity compliance. As shown in Section 7.9, Construction Mass Emissions Analysis, construction emissions would be less than the general conformity thresholds in all construction years for either project alternative. Accordingly, a general conformity determination is not required for the project.

11.2 Transportation Conformity

Transportation conformity is an analytical process required for all transportation projects funded under the Federal Highway Act or the Federal Transit Act, but it does not apply to the project. Under the 1990 CAA amendments, the U.S. Department of Transportation cannot fund, authorize, or approve federal actions to support programs or projects that are not first found to conform to the SIP for achieving the goals of the CAA requirements. Conformity with the CAA takes place at both the regional and project levels.

The project is not subject to the Transportation Conformity Rule. However, if the project requires future actions that meet the definition of a project element subject to transportation conformity, additional determinations, and associated analysis would be completed as required.

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13 PREPARER QUALIFICATIONS

Project Role	Name, Credential	Qualifications
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Project Director	Rich Walter	27 years of experience MA, International Relations/Energy, Environment, Science, and Technology, The School for Advanced International Studies, The Johns Hopkins University BA, History, Stanford University
Project Manager	Anne Winslow	8 years of experience MS, Earth Systems, Stanford University BS, Earth Systems, Stanford University
Project Coordinator	Sarah Glasgow	5 years of experience BS, Integrated Science and Technology, James Madison University
Principal, Air Quality/Climate	David Ernst	40 years of experience B.S., Engineering, Brown University, Providence, RI M.C.R.P., Environmental Policy, Harvard University, Cambridge, MA
Fellow/Technical Director, Air Quality Assessment	Edward Carr, Certified Consulting Meteorologist, 1989, No. 442	36 years of experience B.S., Meteorology, San Jose State University, M.S., Atmospheric Science, University of Washington, Seattle, WA
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Editor	Sara Wilson	22 years of experience BA, Classical Languages (Ancient Greek, Latin), University of California, Berkeley
Former Editor	Laura Cooper	25 years of experience BA, Psychology, Reed College
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