APPENDIX 3.8-B: SUMMARY OF HYDRAULIC MODELING

ACRONYMS AND ABBREVIATIONS

cfs	cubic feet per second
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Maps
FIS	flood insurance study
HEC-RAS	Hydrologic Engineering Center's River Analysis System
HSR	high-speed rail
I-	Interstate
NAVD 88	North American Vertical Datum of 1988
NGVD 29	National Geodetic Vertical Datum of 1929
Project Section or project	San Francisco to San Jose Project Section
SCVWD	Santa Clara Valley Water District
SR	State Route
UPRR	Union Pacific Railroad
US	U.S. Highway
USACE	U.S. Army Corps of Engineers

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1 INTRODUCTION

Since publication of the Draft Environmental Impact Report (EIR)/Environmental Impact Statement (EIS), the following substantive changes have been made to this appendix:

- Revisions were made to correct the number of aquatic resources within the project footprint of the two project alternatives.
- The reference to Santa Clara Valley Water District (SCVWD) in Section 2, Overview of Hydraulic Modeling for Project Alternatives, was deleted.
- Table 15 was corrected.
- The figure and figure caption for Figure 15 were revised for clarity.
- Section 3.12, Guadalupe River and Tributaries, was revised to remove discussion of a portion of the HSR alignment that is in the San Jose to Merced Project Section and was erroneously included for the San Francisco to San Jose Project Section.
- Section 3.12.2, Overview of Hydraulic Model, was revised to expand the description of the one-dimensional and two-dimensional components of the SCVWD's Hydrologic Engineering Centers River Analysis Program (HEC-RAS) model. A discussion of the simplified SCVWD model was also added.
- Section 3.12.3, Water Surface Elevations—Main Channel, was revised to state that the outputs from the hydraulic analysis for Alternative A showed that the proposed high-speed rail (HSR) bridge immediately upstream of the existing railroad bridge would not raise the 100- year flood profile of Guadalupe River main channel. Table 4-19 was revised to reflect these results.
- Four additional figures (Figures 21 through 24) were added to address Valley Water's comments on the Draft EIR/EIS.

There are floodplains and regulatory floodways delineated by the Federal Emergency Management Agency (FEMA) on Flood Insurance Rate Maps (FIRM) within the San Francisco to San Jose Project Section (Project Section or project). This appendix provides detailed descriptions of the floodplains present within the project footprint and the hydraulic analysis performed for those floodplains. The content of the appendix is organized as follows:

- Chapter 1, Introduction, describes and depicts the floodplains present within the project footprint. These floodplains are listed in Table 1, defined in Table 2, and illustrated on Figures 1 through 9.
- Chapter 2, Overview of Hydraulic Modeling for Project Alternatives, provides overview of the hydraulic analysis, including a brief discussion of the methods used for hydraulic analyses, existing 100-year flows of waterways in the project footprint, and a summary of the existing and proposed hydraulic conditions.
- Chapter 3, Existing and Proposed Condition Hydraulic Analysis, describes the hydraulic analyses performed for floodplains within the project footprint. Sections for each modeled waterbody provide a brief summary of the watershed, the upstream and downstream limits of the hydraulic model, and the hydraulic analysis outputs for the existing and proposed conditions.

Table 1 Floodplains in the Project Footprint

Floodplain ID	In Alt. A	In Alt. B[1]	Flood Zone	BFE[2] (feet)	Depth[3] (feet)	FEMA-Designated Floodway	County	Managing Agency	FEMA FIRM Panel(s)
San Francisco to South San Francisco Subsection									
Islais Creek	Yes	Yes	AE	10	N/A	No	San Francisco	SF	0602980232A
Visitacion Creek	Yes	No	A	N/A	N/A	No	San Mateo	SMCFCD	06081C0035F
Guadalupe Valley Creek	Yes	Yes	A	N/A	N/A	No	San Mateo	SMCFCD	06081C0035F
Brisbane Lagoon	Yes	Yes	AE	10	N/A	No	San Mateo	SMCFCD	06081C0035E, 06081C0042F
Isolated Floodplain	Yes	Yes	A	N/A	N/A	No	San Mateo	SMCFCD	06081C0035E, 06081C0042F
Oyster Point Channel	Yes	Yes	AE	10	N/A	No	San Mateo	SMCFCD	06081C0042F
Colma Creek 1	Yes	Yes	A	N/A	N/A	No	San Mateo	SMCFCD	06081C0043F
Colma Creek 2	Yes	Yes	AE	12	N/A	No	San Mateo	SMCFCD	06081C0043F
San Bruno to San Mateo Subsection									
Highline Creek Tributary 1	Yes	Yes	AH	17	N/A	No	San Mateo	SMCFCD	06081C0132F
Highline Creek Tributary 2	Yes	Yes	AH	16	N/A	No	San Mateo	SMCFCD	06081C0132F
Highline Creek Tributary 3	Yes	Yes	AE	10	N/A	No	San Francisco	SF	06081C0132E
Highline Creek Tributary 4	Yes	Yes	AE	10	N/A	No	San Mateo	SMCFCD	06081C0132F
Highline Creek Tributary 5	Yes	Yes	AH	11	N/A	No	San Mateo	SMCFCD	06081C0132F
Highline Creek	Yes	Yes	AE	10	N/A	No	San Mateo	SMCFCD	06081C0132F
El Portal Canal	Yes	Yes	A	N/A	N/A	No	San Mateo	SMCFCD	06081C0132F
Mills Creek	Yes	Yes	A	N/A	N/A	No	San Mateo	SMCFCD	06081C0132F
Mills/Easton Creek	Yes	Yes	AH	14	N/A	No	San Mateo	SMCFCD	06081C0153F
Easton Creek 1	Yes	Yes	A	N/A	N/A	No	San Mateo	SMCFCD	06081C0153F
Easton Creek 2	Yes	Yes	AE	10	N/A	No	San Mateo	SMCFCD	06081C0153F
Sanchez Creek	Yes	Yes	AH	16	N/A	No	San Mateo	SMCFCD	06081C0153F
San Mateo Creek	Yes	Yes	AE	22	N/A	No	San Mateo	SMCFCD	06081C0154G

Floodplain ID	In Alt. A	In Alt. B[1]	Flood Zone	BFE[2] (feet)	Depth[3] (feet)	FEMA-Designated Floodway	County	Managing Agency	FEMA FIRM Panel(s)
San Mateo to Palo Alto Subsection									
Borel Creek	Yes	Yes	AH	12	N/A	No	San Mateo	SMCFCD	06081C0166F
Laurel Creek 1	Yes	Yes	AH	23	N/A	No	San Mateo	SMCFCD	06081C0166F
Laurel Creek 2	Yes	Yes	AO	N/A	1	No	San Mateo	SMCFCD	06081C0166F
Laurel Creek 3	No	Yes	AE	28	N/A	No	San Mateo	SMCFCD	06081C0166F
Belmont Creek	No	Yes	A	N/A	N/A	No	San Mateo	SMCFCD	06081C0169G
Pulgas Creek 1	No	Yes	AE	17	N/A	No	San Mateo	SMCFCD	06081C0169G
Pulgas Creek 2	No	Yes	AO	N/A	1	No	San Mateo	SMCFCD	06081C0169G
Cordilleras Creek 1	Yes	Yes	AO	N/A	2	No	San Mateo	SMCFCD	06081C0301F
Cordilleras Creek 2	Yes	Yes	AE	23	N/A	No	San Mateo	SMCFCD	06081C0301F
Cordilleras Creek 3	Yes	Yes	AO	N/A	1	No	San Mateo	SMCFCD	06081C0282E, 06081C0301F
Cordilleras Creek 4	Yes	Yes	A	N/A	N/A	No	San Mateo	SMCFCD	06081C0301F
Redwood Creek	Yes	Yes	A	N/A	N/A	No	San Mateo	SMCFCD	06081C0301F
San Francisquito Creek	Yes	Yes	A	N/A	N/A	No	San Mateo, Santa Clara	SFCJPA, SMCFCD, SCVWD	06081C0308E
Matadero Creek	Yes	Yes	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0017H
Barron Creek	Yes	Yes	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0017H
Adobe Creek	Yes	Yes	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0036H
Mountain View to Santa Clara Subsection									
Permanente Creek	Yes	Yes	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0039H
Stevens Creek	Yes	Yes	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0039H
Calabazas Creek 1	Yes	Yes	AO	N/A	1-1.5	No	Santa Clara	SCVWD	06085C0226H
Calabazas Creek 2	Yes	Yes	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0226H
San Tomas Aquino Creek 1	Yes	Yes	AE	46	N/A	No	Santa Clara	SCVWD	06085C0227H
San Tomas Aquino Creek 2[4]	Yes	Yes	AO	N/A	1	No	Santa Clara	SCVWD	06085C0227H

Floodplain ID	In Alt. A	In Alt. B[1]	Flood Zone	BFE[2] (feet)	Depth[3] (feet)	FEMA-Designated Floodway	County	Managing Agency	FEMA FIRM Panel(s)
San Jose Diridon Station Approach Subsection									
San Tomas Aquino Creek 2[4]	Yes	Yes	AO	N/A	1	No	Santa Clara	SCVWD	06085C0227H
Isolated Floodplain 1	Yes	Yes	AH	65	N/A	No	Santa Clara	SCVWD	06085C0227H, 06085C0231H
Isolated Floodplain 2	Yes	Yes	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0231H
Isolated Floodplain 3	Yes	Yes	AH	63	N/A	No	Santa Clara	SCVWD	06085C0231H
Isolated Floodplain 4	Yes	Yes	AO	N/A	1	No	Santa Clara	SCVWD	06085C0233H
Isolated Floodplain 5	Yes	Yes	AO	N/A	1	No	Santa Clara	SCVWD	06085C0234H
Los Gatos Creek	Yes	Yes	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0234H
Guadalupe River 1	Yes	Yes	AH	97	N/A	No	Santa Clara	SCVWD	06085C0234H
Guadalupe River 2	Yes	Yes	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0234H
Guadalupe River 3	Yes	Yes	AO	N/A	2	No	Santa Clara	SCVWD	06085C0234H
Guadalupe River 4	Yes	Yes	AO	N/A	1	No	Santa Clara	SCVWD	06085C0234H
Guadalupe River 5	Yes	Yes	AO	N/A	2	No	Santa Clara	SCVWD	06085C0234H, 06085C0242H
Guadalupe River 6	Yes	Yes	AH	115-117	N/A	No	Santa Clara	SCVWD	06085C0234H, 06085C0242H

Sources: Authority 2019a, 2019b; FEMA 2014, 2019a, 2019b
Alt. = Alternative
BFE = base flood elevation
FEMA = Federal Emergency Management Agency
FIRM = Flood Insurance Rate Map
I- = Interstate
ID = Identifier
N/A = not applicable
SCVWD = Santa Clara Valley Water District
SF = City and County of San Francisco
SFCJPA = San Francisquito Creek Joint Powers Authority
SMCFCD = San Mateo County Flood Control District
[1] Results are the same for Alternative B (Viaduct to I-880) and Alternative B (Viaduct to Scott Boulevard).
[2] BFEs are provided for Zones AE and AH.
[3] *Depth* refers to the average depth of a Zone AO floodplain.
[4] The San Tomas Aquino Creek 2 floodplain intersects both the Mountain View to Santa Clara Subsection and the San Jose Diridon Station Approach Subsection.

Table 2 FEMA Flood Hazard Zones

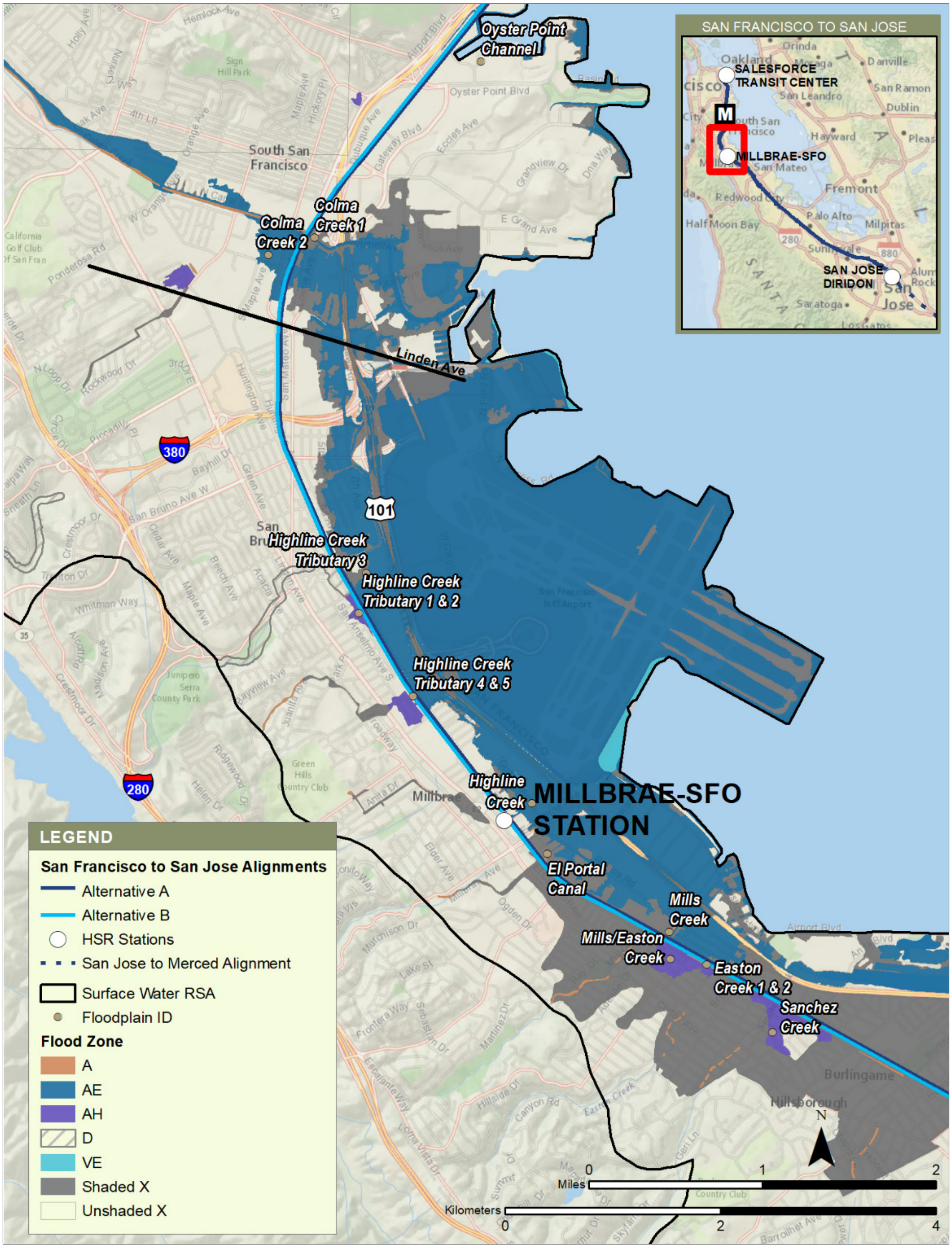
Zone	Flood Hazard
High-Risk Areas	
A	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or BFEs are shown within these zones.
AE	The base floodplain where BFEs are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones.
AH	Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. BFEs derived from detailed analyses are shown at selected intervals within these zones.
AO	River or stream flood-hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. Average flood depths derived from detailed analyses are shown within these zones.
Moderate- to Low-Risk Areas	
X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods.
X (unshaded)	Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level.
Coastal Areas	
V	Areas within 100-year coastal floodplains that have additional hazards associated with storm surges and waves. Approximate hydraulic analyses are performed for these areas, so BFEs are known.
VE	Areas within 100-year coastal floodplains that have additional hazards associated with storm surges and waves. Detailed hydraulic analyses are performed for these areas.
Undetermined Risk Areas	
D	Areas with possible, but undetermined, flood risks. No analysis of flood hazards has been performed in these zones.

Source: FEMA 2003
BFE = base flood elevation
FIRM = Flood Insurance Rate Map

Sources: Authority 2019a; FEMA 2019a, 2019b

JULY 2019

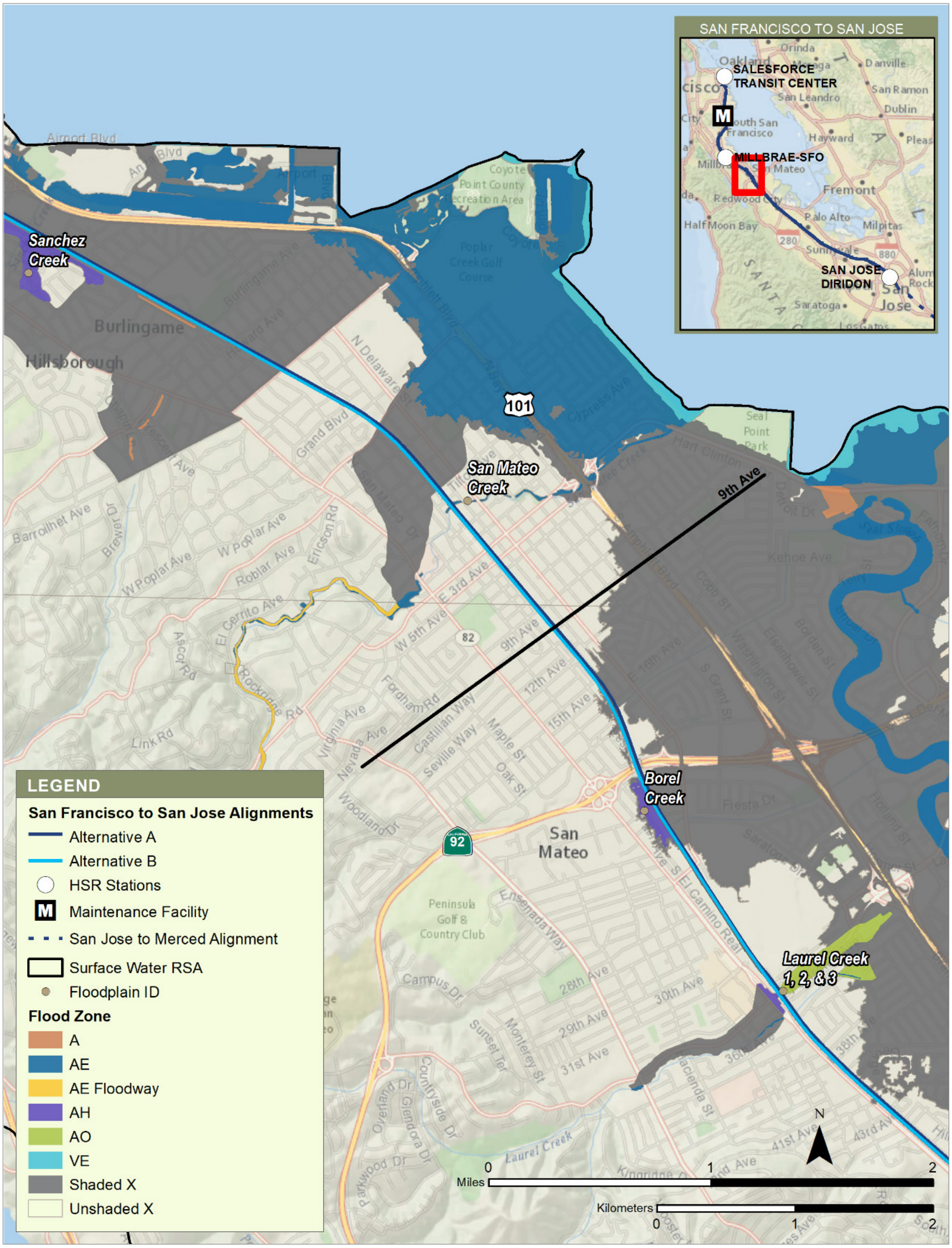
Figure 1 Floodplains, San Francisco to South San Francisco Subsection



Sources: Authority 2019a; FEMA 2019a, 2019b

JULY 2019

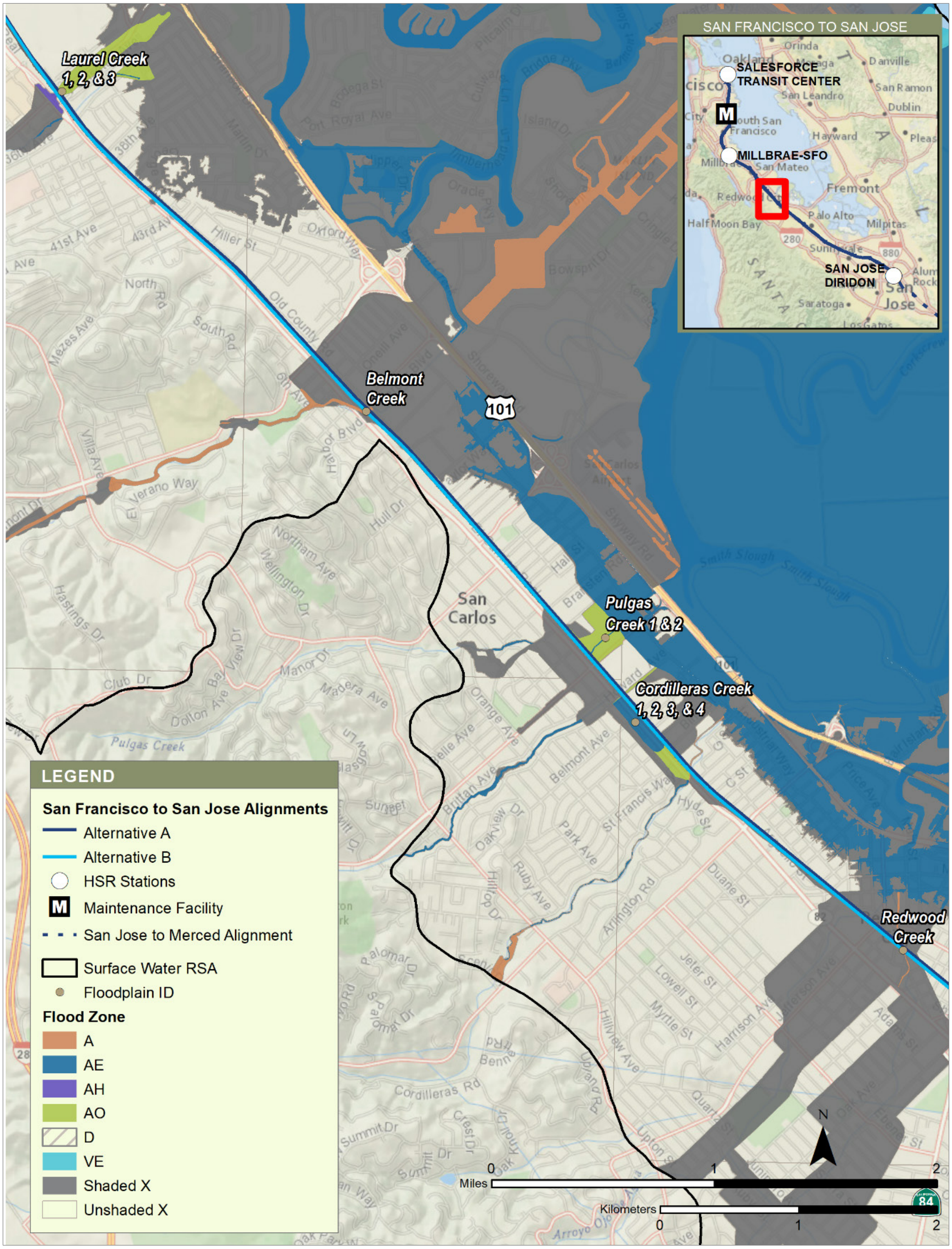
Figure 2 Floodplains, San Francisco to South San Francisco and San Bruno to San Mateo Subsections



Sources: Authority 2019a; FEMA 2019b

MAY 2019

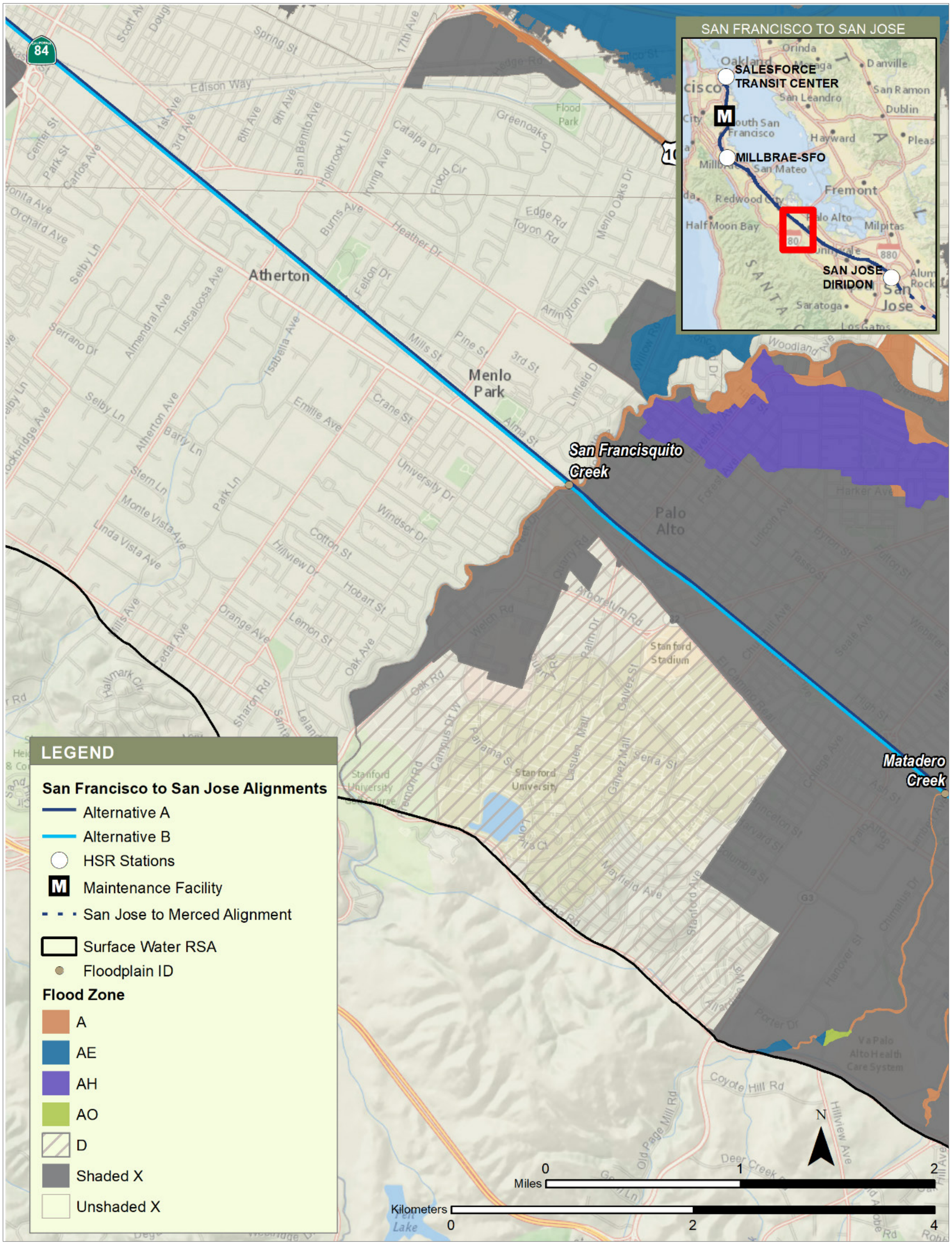
Figure 3 Floodplains, San Bruno to San Mateo and San Mateo to Palo Alto Subsections



Sources: Authority 2019a; FEMA 2019b

MAY 2019

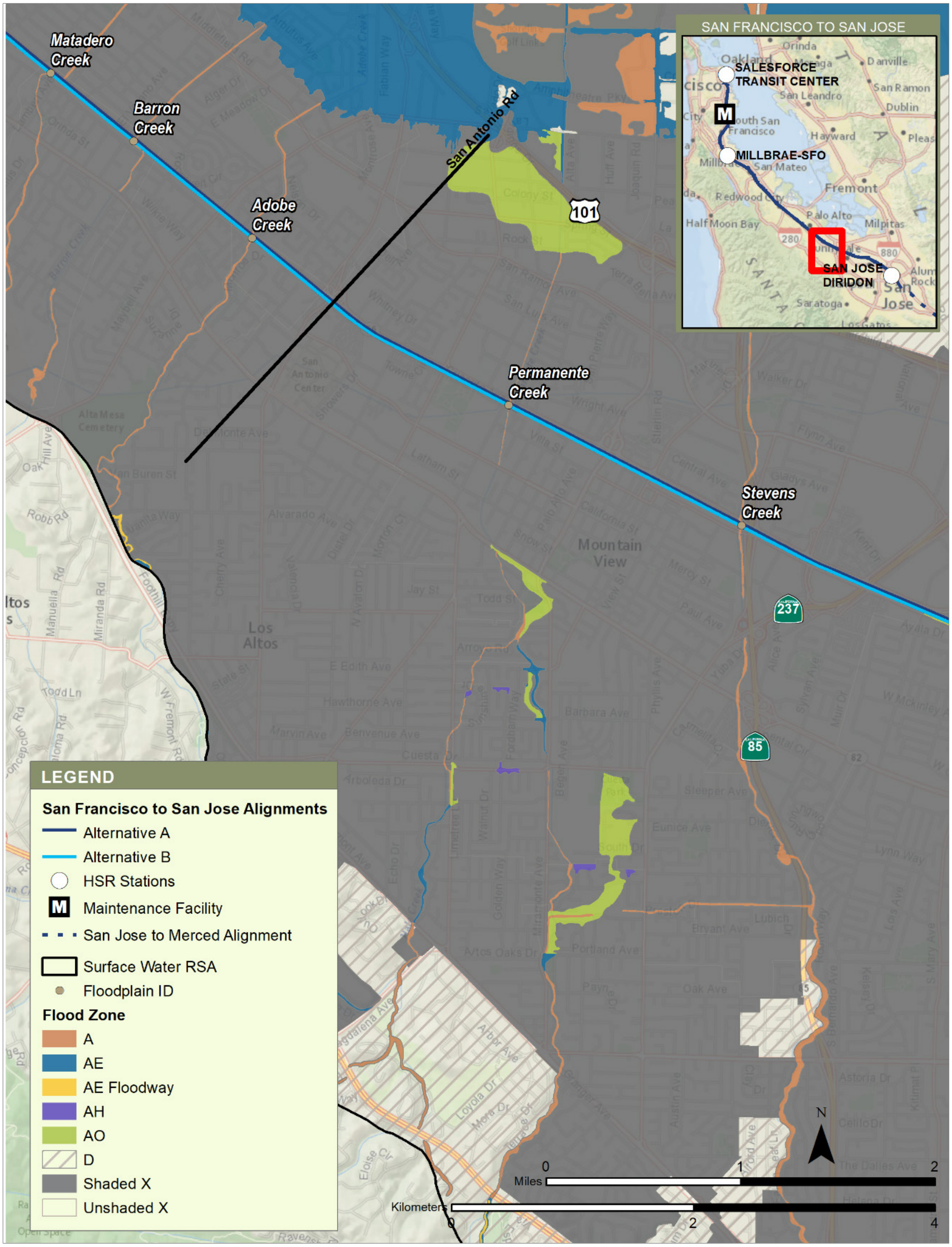
Figure 4 Floodplains, San Mateo to Palo Alto Subsection (Part 1 of 2)



Sources: Authority 2019a; FEMA 2014, 2019b

MAY 2019

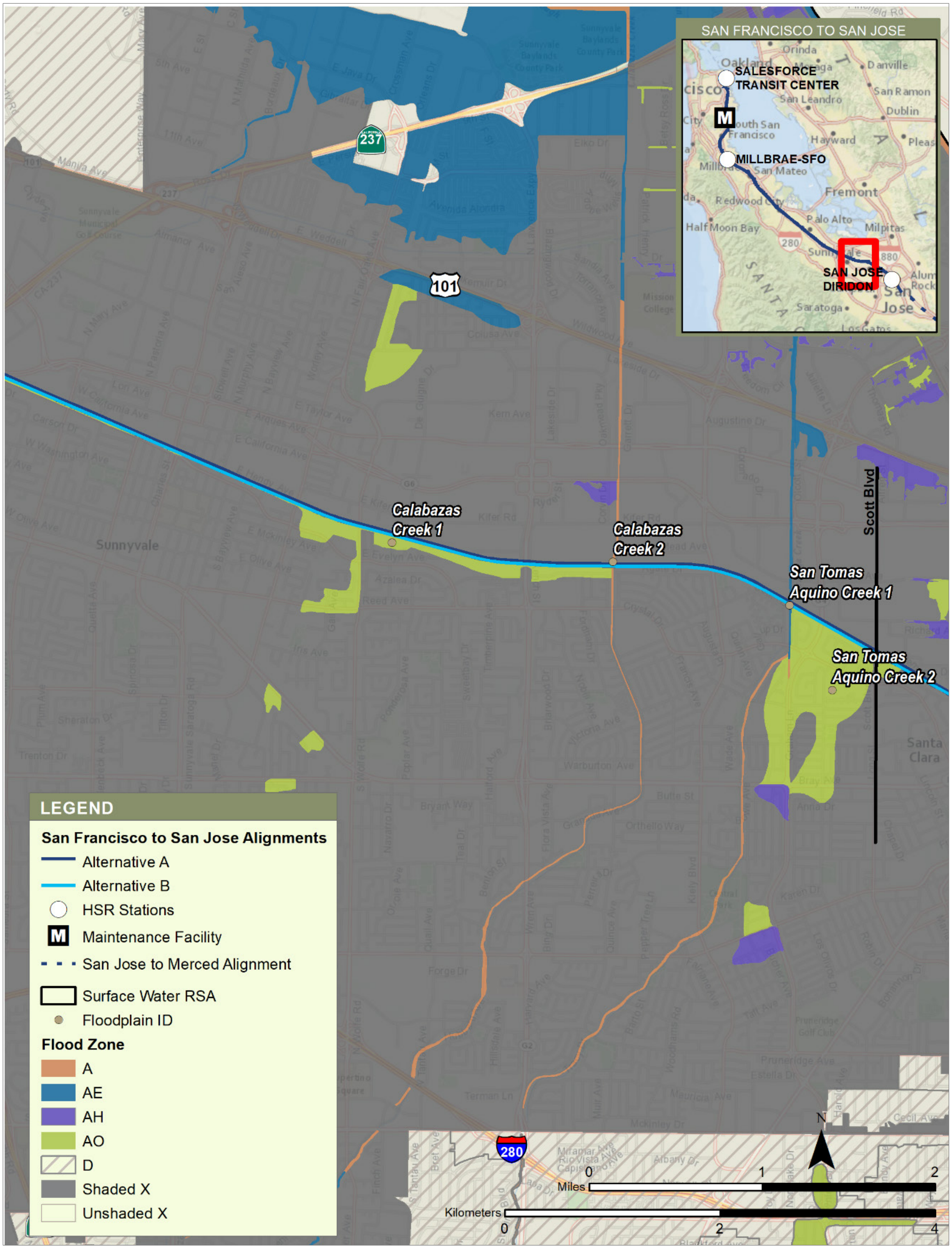
Figure 5 Floodplains, San Mateo to Palo Alto Subsection (Part 2 of 2)



Sources: Authority 2019a; FEMA 2014

MAY 2019

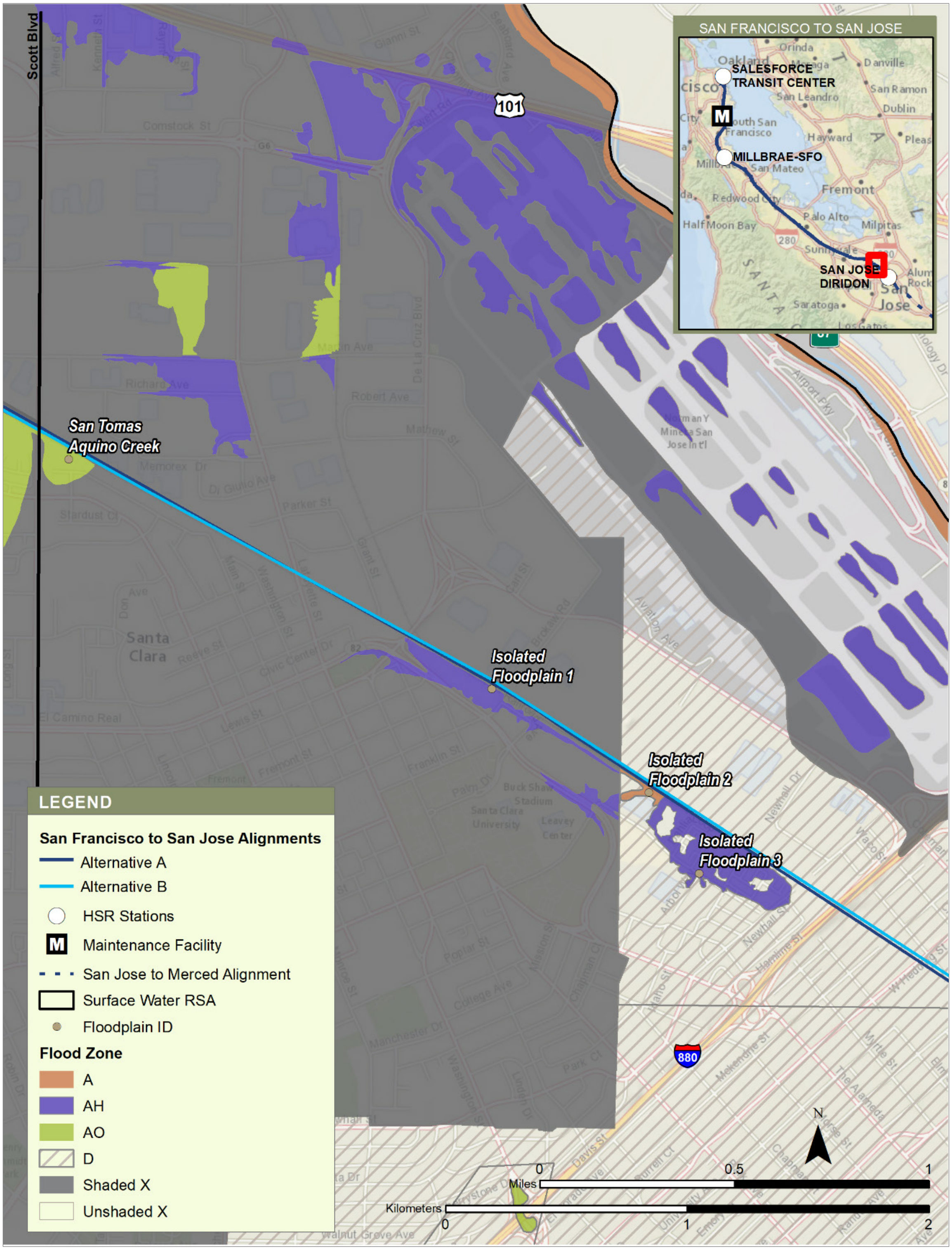
Figure 6 Floodplains, San Mateo to Palo Alto and Mountain View to Santa Clara Subsections



Sources: Authority 2019a, 2019b; FEMA 2014

MAY 2019

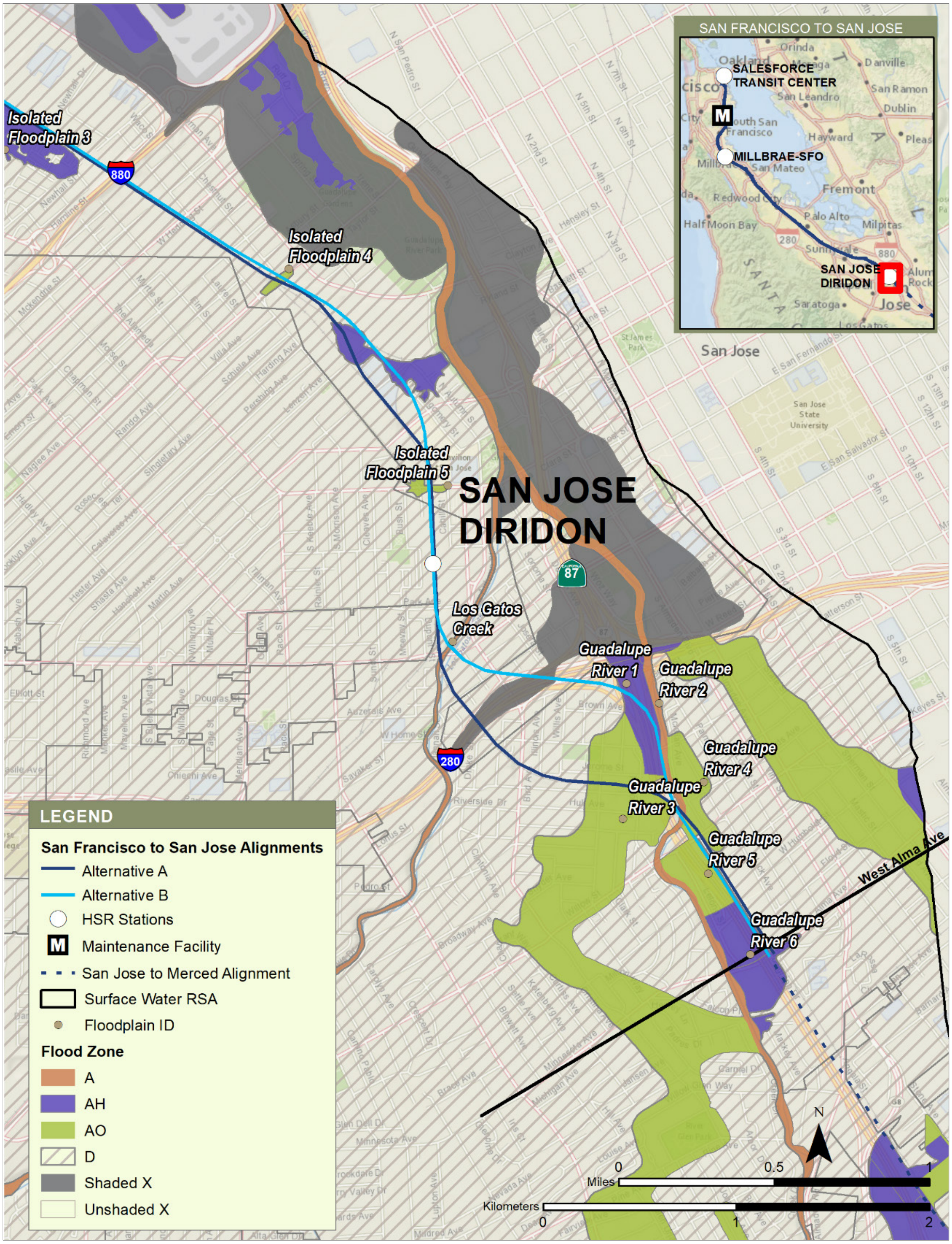
Figure 7 Floodplains, Mountain View to Santa Clara Subsection



Sources: Authority 2019b; FEMA 2014

MAY 2019

Figure 8 Floodplains, San Jose Diridon Station Approach Subsection (Part 1 of 2)



Sources: Authority 2019b; FEMA 2014

MAY 2019

Figure 9 Floodplains, San Jose Diridon Station Approach Subsection (Part 2 of 2)

2 OVERVIEW OF HYDRAULIC MODELING FOR PROJECT ALTERNATIVES

There are 68 streams, wetlands, lagoons, creeks, ditches, and constructed basins in the project footprint of Alternative A, and 69 in the project footprint of Alternative B (both viaduct options). Out of these waterbodies, existing hydraulic models of the following 12 waterbodies were available from San Mateo County Department of Public Works and Santa Clara Valley Water District (SCVWD)—Colma Creek, San Francisquito Creek, Matadero Creek, Barron Creek, Adobe Creek, Permanente Creek, Stevens Creek, Sunnyvale East Channel, Calabazas Creek, San Tomas Aquino Creek, Los Gatos Creek, and Guadalupe River. Except for Los Gatos Creek and Guadalupe River, the project is not proposing to make changes to hydraulic structures within any of these waterbodies (Table 3).

The hydraulic analyses of Los Gatos Creek and Guadalupe River were performed for both existing and proposed conditions. The hydraulic analyses of the remaining waterbodies with available hydraulic models were only performed to determine the performance of the existing hydraulic structures within the project footprint for the existing condition. The HEC-RAS program, developed by the U.S. Army Corps of Engineers (USACE), was used to perform the hydraulic analyses. For the existing condition hydraulic analyses, no changes were made to the input parameters assigned in the provided hydraulic models except for the inflows and downstream controls.

The hydraulic analyses of the waterway crossings were performed using the peak 100-year flows, as specified in Technical Memorandum 2.6.5, *Hydraulics and Hydrology Design Guidelines* (Authority 2011). The peak 100-year flows available in the FEMA flood insurance study (FIS) for San Mateo County, California, and Incorporated Areas (last revised on April 5, 2019); FEMA FIS for Santa Clara County and Incorporated Areas (last revised on February 19, 2014); the SCVWD *Permanente Creek Flood Protection Project Conform Hydraulic Design Report*; and design peak flows included in the hydraulic models obtained from the SCVWD (on November 21 and 22, 2016; July 24, 2018; and December 13, 2018); were selected as the inflows in the hydraulic model (Table 3). If peak flow rates were available from more than one source, the higher peak flow rate was selected, unless otherwise noted.

The outputs of the existing and proposed condition hydraulic analysis are summarized in Table 4. The following sections discuss the detailed analysis and background information of each waterway. The existing condition hydraulic analysis showed Colma Creek and San Tomas Aquino Creek do not have capacity to convey the 100-year flow upstream of the existing railroad bridge crossing and the railroad bridge/culvert over the creek is under pressure. The existing bridges/culverts for Matadero Creek, Adobe Creek, Stevens Creek, and Calabazas Creek would be under pressure during the 100-year storm event.

For the remaining waterbodies within the project footprint, there are no existing hydraulic models available from San Mateo County Department of Public Works or FEMA. Hydraulic analyses for these waterbodies would be performed when certain information, such as topographic survey, becomes available. The results of these analyses would be documented in a Flood Protection Plan (HYD-IAMF#2: Flood Protection). Refer to Appendix 3.8-A, List of Aquatic Resources Crossed, for a table that lists the aquatic resources within the project footprints by subsection and alternative.

Table 3 100-Year Flow Rates from the Hydraulic Modeling

Waterbody	Flow Rate (cubic feet per second)	Source of Flow Rate used in Hydraulic Analysis	Alternative A: Changes to Existing Hydraulic Structures and/or New Hydraulic Structures (Yes/No)?	Alternative B[1]: Changes to Existing Hydraulic Structures and/or New Hydraulic Structures (Yes/No)?
Colma Creek	5,000	FEMA 2019	No	No
San Francisquito Creek	8,070	FEMA 2014	No	No
Matadero Creek	2,000	FEMA 2014	No	No
Barron Creek	250	FEMA 2014	No	No
Adobe Creek	2,654	SCVWD 2016a	No	No
Permanente Creek	1,176	SCVWD 2016a	No	No
Stevens Creek	7,360	FEMA 2014	No	No
East Sunnyvale Channel	740	SCVWD 2016a	No	No
Calabazas Creek	3,100	SCVWD 2016a	No	No
San Tomas Aquino Creek	9,100	FEMA 2014	No	No
Los Gatos Creek	7,900[2]	SCVWD 2018a	No	Yes
Guadalupe River	6,920[2]	SCVWD 2018b	Yes	Yes

Sources: FEMA 2014, 2019b; SCVWD 2008, 2016a, 2018a, 2018b
FEMA = Federal Emergency Management Agency
I- = Interstate
SCVWD = Santa Clara Valley Water District
[1] Results are the same for Alternative B (Viaduct to I-880) and Alternative B (Viaduct to Scott Boulevard).
[2] The flow rate in this table is peak flow rate of waterbodies at the project location.

Table 4 Summary of Existing and Proposed Condition Hydraulic Analysis

Waterbody	100-year Flood Flow Contained in the Upstream Channel (Yes/No)?	Condition of the Existing Bridge/Culvert During 100-Year Storm Event	Condition of the Proposed Bridge/Culvert During 100-Year Storm Event
Colma Creek	No	No Freeboard, Surcharged	N/A
San Francisquito Creek	Yes	With Freeboard	N/A
Matadero Creek	Yes	No Freeboard, Surcharged	N/A
Barron Creek	Yes	With Freeboard	N/A
Adobe Creek	Yes	No Freeboard, Surcharged	N/A
Permanente Creek	Yes	With Freeboard	N/A
Stevens Creek	Yes	No Freeboard, Surcharged	N/A
East Sunnyvale Channel	Yes	With Freeboard	N/A
Calabazas Creek	Yes	No Freeboard, Surcharged	N/A
San Tomas Aquino Creek	No	No Freeboard, Surcharged	N/A
Los Gatos Creek	No	No Freeboard, Overtopped	N/A (Alternative A) With Freeboard (Alternative B)
Guadalupe River	No	With Freeboard	With Freeboard (Alternative A) With Freeboard (Alternative B)

Sources: County of San Mateo 2013; SCVWD 2016a, 2016c, 2018a, 2018b
N/A = not applicable

3 EXISTING AND PROPOSED CONDITION HYDRAULIC ANALYSIS

3.1 Colma Creek

3.1.1 Existing Condition

Colma Creek is one of the largest creeks on the San Francisco Peninsula, and it is within the Colma Creek watershed. Colma Creek drains the southern slopes of San Bruno Mountain, parts of Daly City, Colma, and San Bruno, and South San Francisco. Of the historical 7.5 miles of creek channel, 0.5 mile is natural, 2 miles are buried in storm drains, and 5 miles are engineered channels. At the existing railroad bridge crossing, Colma Creek is an engineered channel (Oakland Museum of California 2007). According to aerial imagery, hydraulic structures in the vicinity of the existing railroad bridge are Linden Avenue Bridge, approximately 450 feet upstream, and San Mateo Avenue Bridge, approximately 450 feet downstream.

The hydraulic model of Colma Creek was provided by San Mateo County Department of Public Works. The upstream and downstream limits of the hydraulic model were immediately downstream of the Orange Avenue crossing (approximately 4,300 feet upstream of existing railroad bridge) and the outfall to San Francisco Bay (approximately 6 feet downstream of existing railroad bridge), respectively. The existing three-span railroad bridge included in the hydraulic model had a soffit elevation of 11.9 feet when referenced to the North American Vertical Datum of 1988 (NAVD 88). The channel flow line elevation at the existing railroad included in the hydraulic model was approximately -1.1 feet NAVD 88. A FEMA 100-year flow of 5,000 cubic feet per second (cfs) was used for the hydraulic analysis. This 100-year flow was obtained from the FEMA FIS for San Mateo County, California, and Incorporated Areas, dated February 19, 2014.

Table 5 shows the existing condition modeling results. Under the FEMA 100-year peak flow, the existing bridge would be under pressure and would cause backwater.

Table 5 Existing Condition Hydraulic Modeling Results, Colma Creek

Project Condition	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE – Existing Condition (feet NAVD 88)
Existing	5,000	11.9	12.6

Source: County of San Mateo 2013
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

3.1.2 Proposed Condition

Proposed condition hydraulic analysis was not performed because Alternatives A and B would not modify the existing hydraulic structure in Colma Creek within the project footprint.

3.2 San Francisquito Creek

3.2.1 Existing Condition

San Francisquito Creek is the largest stream on the San Francisco Peninsula with a watershed of approximately 46 square miles, and it drains multiple jurisdictions, including San Mateo County, Santa Clara County, Palo Alto, Woodside, Portola Valley, Menlo Park, and East Palo Alto as well as Stanford University. The creek occupies a natural, meandering channel for most of its length, only being channelized from upstream of U.S. Highway (US) 101 to its mouth on San Francisco Bay (Oakland Museum of California 2005). Within the project footprint, San Francisquito Creek has a natural, open channel with modest vegetation growth at the existing railroad bridge. In addition to the railroad bridge, there is an existing pedestrian bridge located approximately 70 feet downstream of the railroad bridge and the State Route (SR) 82/El Camino Real Bridge located approximately 400 feet upstream of the railroad bridge.

The hydraulic model of San Francisquito Creek was provided by the SCVWD. The upstream and downstream limits of the hydraulic model were approximately 5,500 feet upstream of the Interstate (I-) 280 Bridge (approximately 27,800 feet upstream of existing railroad bridge) and the outfall to San Francisco Bay (approximately 27,200 feet downstream of existing railroad bridge), respectively. A FEMA 100-year flow of 8,070 cfs was used for the hydraulic analysis. This 100-year flow was obtained from FEMA FIS for Santa Clara County, California, and Incorporated Areas, dated February 19, 2014. The existing clear-span railroad bridge included in the hydraulic model had a soffit elevation of 73.5 feet NAVD 88. The channel flowline elevation at the existing railroad included in the hydraulic model was approximately 47 feet NAVD 88.

Table 6 shows the existing condition modeling results. The existing bridge would have freeboard during the 100-year storm event.

Table 6 Existing Condition Hydraulic Modeling Results, San Francisquito Creek

Project Condition	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE – Existing Condition (feet NAVD 88)
Existing	8,070	70.8	69.9

Source: SCVWD 2016a
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

3.2.2 Proposed Condition

Proposed condition hydraulic analysis was not performed because Alternatives A and B would not modify the existing hydraulic structure in San Francisquito Creek within the project footprint.

3.3 Matadero Creek

3.3.1 Existing Condition

Matadero Creek is in the Matadero Creek watershed and drains the northeastern slopes of the Santa Cruz Mountains in Los Altos Hills, Santa Clara County, and Palo Alto. At Bol Park, high flows in Matadero Creek enter a diversion channel that carries flows to the north, where they eventually are discharged back into Matadero Creek, where the channel is engineered to have a greater flood protection capacity. In addition, Matadero Creek also receives floodwaters from Barron Creek through a diversion channel (SCVWD 2012). Downstream from Alma Street, the channel has a straight alignment, lacking any significant changes in flow direction. Within the project footprint, Matadero Creek is a concrete-lined engineered channel. The channel upstream of the existing railroad crossing is box shaped, with a top width of approximately 20 feet. The channel downstream of the existing railroad bridge crossing is a trapezoidal channel with a top width of approximately 40 feet. Flood flows in Matadero Creek are conveyed in the box culvert through the existing railroad crossing.

The hydraulic model of Matadero Creek was provided by the SCVWD. The upstream and downstream limits of the hydraulic model were the Foothill Expressway crossing (approximately 12,600 feet upstream of the existing railroad bridge) and the Palo Alto flood basin (approximately 9,200 feet downstream of the existing railroad bridge), respectively. The hydraulic model referenced National Geodetic Vertical Datum of 1929 (NGVD 29). A factor of 2.85 feet was used to convert the elevation from NGVD 29 to NAVD 88 (FEMA 2014). The existing cross culvert included in the hydraulic model has a flowline elevation of 16.6 feet NAVD 88 and crown elevation of 26.1 feet NAVD 88. A FEMA 100-year flow of 2,000 cfs was used for the hydraulic analysis. This 100-year flow was obtained from the FEMA FIS for Santa Clara County, California, and Incorporated Areas, dated February 19, 2014.

Table 7 shows the existing condition modeling results. Under the FEMA 100-year peak flow, the existing cross culvert would be under pressure and would cause backwater.

Table 7 Existing Condition Hydraulic Modeling Results, Matadero Creek

Project Condition	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE – Existing Condition (feet NAVD 88)
Existing	2,000	31.6	28.1

Source: SCVWD 2016a
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

3.3.2 Proposed Condition

Proposed condition hydraulic analysis was not performed because Alternatives A and B would not modify the existing hydraulic structure in Matadero Creek within the project footprint.

3.4 Barron Creek

3.4.1 Existing Condition

Barron Creek is a relatively small creek system in Palo Alto and Los Altos Hills in the Barron Creek watershed, which is approximately 3 square miles. Barron Creek drains the northeastern slopes of the Santa Cruz Mountains. Barron Creek has been significantly modified from its original state for flood control purposes, flowing through underground storm drains or engineered channels for much of its length. In addition, a diversion channel conveys excess flows into the Matadero Creek diversion channel, and eventually into Matadero Creek downstream of El Camino Real (SCVWD 2012). Within the project footprint, Barron Creek is concrete-lined engineered channel. The channel upstream and downstream of the existing railroad crossing is a box shape with a top width of approximately 11.5 ft. The flood flows in Barron Creek are conveyed in the box culvert through the existing railroad crossing.

The hydraulic model of Barron Creek was provided by the SCVWD. The upstream and downstream limits of the hydraulic model were at Henry M. Gunn High School (approximately 7,500 feet upstream of the existing railroad bridge) and the confluence with Adobe Creek (approximately 8,600 feet downstream of the existing railroad bridge), respectively. The hydraulic model referenced NGVD 29. A factor of 2.85 feet was used to convert the elevation from NGVD 29 to NAVD 88 (FEMA 2014). The existing cross culvert included in the hydraulic model has a flowline elevation of 25.6 feet NAVD 88 and crown elevation of 31.3 feet NAVD 88. A FEMA 100-year flow of 250 cfs was used for the Barron Creek floodplain hydraulic modeling. This 100-year flow was obtained from the FEMA FIS for Santa Clara County, California, and Incorporated Areas, dated February 19, 2014.

Table 8 shows the existing condition modeling results. Under the FEMA 100-year peak flow, the existing cross culvert would have approximately 3 feet of freeboard.

Table 8 Existing Condition Hydraulic Modeling Results, Barron Creek

Project Condition	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE – Existing Condition (feet NAVD 88)
Existing	250	32.7	28.2

Source: SCVWD 2016a
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

3.4.2 Proposed Condition

Proposed condition hydraulic analysis was not performed because Alternatives A and B would not modify the existing hydraulic structure in Barron Creek within the project footprint.

3.5 Adobe Creek

3.5.1 Existing Condition

Adobe Creek originates on the northeastern slopes of the Santa Cruz Mountains in the Adobe Creek watershed and drains portions of Palo Alto, Los Altos Hills, Los Altos, and Mountain View. It has a watershed of approximately 11 square miles that includes the West, Middle, and North Forks of Adobe Creek, Moody Creek, Purisima Creek, and Robleda Creek. Within the project footprint, Adobe Creek is a concrete-lined engineered channel. The channel upstream and downstream of the existing railroad crossing is a box shape with a top width of approximately 17 ft. Flood flows in Adobe Creek are conveyed in the box culvert through the existing railroad crossing.

The hydraulic model of Adobe Creek was provided by the SCVWD. The upstream and downstream limits of the hydraulic model were at the Moody Road crossing (approximately 43,400 feet upstream of the existing railroad bridge) and downstream of the US 101 crossing (approximately 9,400 feet downstream of the existing railroad bridge), respectively. The hydraulic model referenced NGVD 29. A factor of 2.85 feet was used to convert the elevation from NGVD 29 to NAVD 88 (FEMA 2014). The existing cross culvert included in the hydraulic model has a flowline elevation of 26.6 feet NAVD 88 and crown elevation of 36.6 feet NAVD 88. The 100-year peak flow of 2,654 cfs included in the SCVWD hydraulic model was more conservative than the FEMA 100-year flow of 1,700 cfs included in the FEMA FIS for Santa Clara County, California, and Incorporated Areas, dated February 19, 2014. According to SCVWD, the Adobe Creek hydraulic model was last revised in June 2008. The higher 100-year flow rate of 2,654 cfs was used for the Adobe Creek floodplain hydraulic modeling.

Table 9 shows the existing condition modeling results. Under the SCVWD 100-year peak flow, the existing cross culvert would be under pressure and is causing backwater.

Table 9 Existing Condition Hydraulic Modeling Results, Adobe Creek

Project Condition	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE – Existing Condition (feet NAVD 88)
Existing	2,654	44.9	40.0

Source: SCVWD 2016a
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

3.5.2 Proposed Condition

Proposed condition hydraulic analysis was not performed because Alternatives A and B would not modify the existing hydraulic structure in Adobe Creek within the project footprint.

3.6 Permanente Creek

3.6.1 Existing Condition

Permanente Creek originates on the northeastern slopes of the Santa Cruz Mountains along the Montebello Ridge. It is in the Permanente Creek watershed, which drains an area of approximately 18 square miles in Palo Alto, Cupertino, Los Altos, and Mountain View. Permanente Creek has several named tributaries that include Ohlone Creek, West Branch Permanente Creek, Loyola Creek, Magdalena Creek, Hale Creek, and Summerhill Creek, of which Hale Creek is its largest. Near Eastwood Avenue, a diversion channel conveys floodwaters from Permanente Creek into Stevens Creek through an engineered channel; low flows continue down Permanente Creek (SCVWD 2012). Within the project footprint, Permanente Creek is a concrete-lined engineered channel. The channel upstream and downstream of the existing railroad crossing is a box shape with a top width of approximately 9 feet. Flood flows in Permanente Creek are carried in the box culvert through the existing railroad crossing.

The hydraulic model of Permanente Creek was provided by the SCVWD. The upstream and downstream limits of the hydraulic model were at the Villa Street crossing (approximately 600 feet upstream of the existing railroad bridge) and upstream of the US 101 crossing (approximately 6,300 feet downstream of the existing railroad bridge), respectively. The hydraulic model referenced NGVD 29. A factor of 2.85 feet was used to convert the elevation from NAVD 29 to NAVD 88 (FEMA 2014). The existing cross culvert included in the hydraulic model has a flowline elevation of 51.9 feet NAVD 88 and crown elevation of 61.9 feet NAVD 88.

According to the *Permanente Creek Flood Protection Project, Conform Hydraulic Design Report* (SCVWD 2016b), the 100-year peak flow of Permanente Creek at the existing railroad crossing is approximately 1,176 cfs. This flow rate is significantly lower than the FEMA 100-year flow of 1,600 cfs included in the FEMA FIS for Santa Clara County, California, and Incorporated Areas, dated February 19, 2014, and the flow rate of 2,300 cfs included in the *Permanente Creek Flood Protection Project Planning Study Report*, dated July 2008 (SCVWD 2008). The peak 100-year flow rate from the *Permanente Creek Flood Protection Project, Conform Hydraulic Design Report* was used for the hydraulic analysis because this flow reflects the changes in the hydrology of Permanente Creek from the Permanente Creek Flood Protection Project currently under construction as of March 2017.

Table 10 shows the existing condition modeling results. Under the SCVWD 100-year peak flow, the existing cross culvert would have sufficient capacity to pass the 100-year flow and would have freeboard. This result is consistent with the *Permanente Creek Flood Protection Project Planning Study Report*, which included the existing channel capacity of approximately 1,350 cfs at the existing railroad bridge.

Table 10 Existing Condition Hydraulic Modeling Results, Permanente Creek

Project Condition	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE – Existing Condition (feet NAVD 88)
Existing	1,176	61.5	58.0

Source: SCVWD 2016a
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

3.6.2 Proposed Condition

Proposed condition hydraulic analysis was not performed because Alternatives A and B would not modify the existing hydraulic structure in Permanente Creek within the project footprint.

3.7 Stevens Creek

3.7.1 Existing Condition

Stevens Creek is one of the larger creeks within the Project Section. It is in the Stevens Creek watershed, which drains an area of approximately 31 square miles, and begins near Skyline Boulevard in the Santa Cruz Mountains behind Montebello Ridge in the San Andreas rift valley. It has many named tributaries, including Indian Creek, Bay Creek, Indian Cabin Creek, Gold Mine Creek, Stevens Creek Branches A, B, C, and D, Swiss Creek, Montebello Creek, and Heney Creek. It also receives floodwaters from Permanente Creek through a surface diversion channel (SCVWD 2012). Within the project footprint, Stevens Creek is an unlined engineered channel with vegetation growth in the channel bank slope (SCVWD 2006). Existing hydraulic structures in the vicinity of the existing railroad bridge are Santa Clara Valley Transportation Authority's light rail bridge immediately downstream of the railroad bridge, Central Expressway eastbound and westbound bridges located immediately downstream of the light rail bridge, and Evelyn Avenue bridge located approximately 200 feet upstream of the railroad bridge.

The hydraulic model of Stevens Creek was provided by the SCVWD. The upstream and downstream limits of the hydraulic model were the Evelyn Avenue crossing (approximately 200 feet upstream of the existing railroad bridge) and the outfall to San Francisco Bay (approximately 20,800 feet downstream of the existing railroad bridge), respectively. The hydraulic model referenced NAVD 88. The existing cross culvert included in the hydraulic model has a flowline elevation of 70.0 feet NAVD 88 and crown elevation varying from 82.6 feet to 84.0 feet NAVD 88. A FEMA 100-year flow of 7,360 cfs was used for the Stevens Creek floodplain hydraulic modeling. This 100-year flow was obtained from FEMA FIS for Santa Clara County, California, and Incorporated Areas, dated February 19, 2014.

Table 11 shows the existing condition modeling results. Under the FEMA 100-year peak flow, the existing bridge does not have freeboard.

Table 11 Existing Condition Hydraulic Modeling Results, Stevens Creek

Project Condition	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE – Existing Condition (feet NAVD 88)
Existing	7,360	85.8	83.7

Source: SCVWD 2016a
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

3.7.2 Proposed Condition

Proposed condition hydraulic analysis was not performed because Alternatives A and B would not modify the existing hydraulic structure in Stevens Creek within the project footprint.

3.8 Sunnyvale East Channel

3.8.1 Existing Condition

Sunnyvale East Channel is a linear conveyance that was built to manage urban flooding issues in the 1960s. Historically, no creeks drained this portion of Santa Clara Valley. At present, Sunnyvale East Channel drains a 7.1-square-mile watershed in the urbanized flatlands of Sunnyvale and Cupertino. Sunnyvale East Channel has a straight alignment that begins flowing toward the north; it takes a slight bend to the north-northeast near Rembrandt Drive, and proceeds in the same direction until discharging into Guadalupe Slough (SCVWD 2012). Within the project footprint, Sunnyvale East Channel is a straight engineered channel. The channel upstream and downstream of the existing railroad crossing is trapezoidal with a top width varying from approximately 35 feet to 45 feet.

The hydraulic model of Sunnyvale East Channel was provided by the SCVWD. The upstream and downstream limits of the hydraulic model were the Evelyn Avenue crossing (approximately 12,200 feet upstream of the existing railroad bridge) and the confluence with Guadalupe Slough (approximately 18,400 feet downstream of the existing railroad bridge), respectively. The hydraulic model referenced NAVD 88. The existing cross culvert included in the hydraulic model is an 8.5-foot diameter circular culvert with a flowline elevation of 62.8 feet NAVD and crown elevation of 71.3 feet NAVD 88. The FEMA FIS for Santa Clara County, California, and Incorporated Areas, dated February 19, 2014, only provided the peak 100-year flow rate of Sunnyvale East Channel at Caribbean Drive, located approximately 15,300 feet downstream of the existing railroad crossing. The hydraulic model provided by the SCVWD used a peak 100-year flow rate of 740 cfs at the existing railroad crossing and a peak flow of 1,100 cfs at Caribbean Drive. Because of the availability of data near the existing railroad crossing, the peak 100-year flow of 740 cfs included in the SCVWD model was used for the Sunnyvale East Channel floodplain hydraulic modeling.

Table 12 shows the existing condition modeling results. Under the SCVWD 100-year peak flow, the existing circular culvert would have approximately 0.4 feet of freeboard.

Table 12 Existing Condition Hydraulic Modeling Results, Sunnyvale East Channel

Project Condition	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE – Existing Condition (feet NAVD 88)
Existing	740	77.7	70.9

Source: SCVWD 2016a
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

3.8.2 Proposed Condition

Proposed condition hydraulic analysis was not performed because Alternatives A and B would not modify the existing hydraulic structure in Sunnyvale East Channel within the project footprint.

3.9 Calabazas Creek

3.9.1 Existing Condition

Calabazas Creek is a highly modified creek system that originates on Table Mountain in the Santa Cruz Mountains. It is in the Calabazas Creek watershed, approximately 20 square miles, which includes Los Gatos, Saratoga, Cupertino, San Jose, Sunnyvale, and Santa Clara. Calabazas Creek has several unnamed tributaries, as well as named tributaries that include Prospect Creek, Rodeo Creek, Regnart Creek, El Camino Storm Drain, and Junipero Serra Channel. Within the project footprint, Calabazas Creek is a straight engineered channel. The channel upstream and downstream of the existing railroad crossing is trapezoidal with a top width of approximately 50 feet.

The hydraulic model of Calabazas Creek was provided by the SCVWD. The upstream and downstream limits of the hydraulic model were the Miller Avenue crossing (approximately 23,100 feet upstream of the existing railroad bridge) and the confluence with Guadalupe Slough (approximately 17,100 feet downstream of the existing railroad bridge), respectively. The hydraulic model referenced NGVD 29. A factor of 2.85 feet was used to convert the elevation from NGVD 29 to NAVD 88 (FEMA 2014). The existing cross culvert included in the hydraulic model has a flowline elevation of 41.1 feet NAVD 88 and crown elevation of 49.1 feet NAVD 88.

The FEMA FIS for Santa Clara County, California, and Incorporated Areas, dated February 19, 2014, contains a table with peak 100-year flows of Calabazas Creek at various locations. However, the table of peak flows for Calabazas Creek in the FIS has errors that call the accuracy of the entire table into question (i.e., the table unintentionally contains peak flows from multiple hydraulic assessments; two different peak flow rates are provided for the same location upstream of Kifer Road). Because the most current FIS mixed the inputs for multiple hydraulic analyses, the flow rate at the existing railroad crossing varied from 2,340 cfs to 4,000 cfs. Therefore, the peak 100-year flow rate of 3,100 cfs included in the SCVWD hydraulic model was used for the Calabazas Creek hydraulic analysis.

Table 13 shows the existing condition modeling results. Under the SCVWD 100-year peak flow, the existing cross culvert would be under pressure and would cause backwater.

Table 13 Existing Condition Hydraulic Modeling Results, Calabazas Creek

Project Condition	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE – Existing Condition (feet NAVD 88)
Existing	3,100	50.8	49.9

Source: SCVWD 2016a
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

3.9.2 Proposed Condition

Proposed condition hydraulic analysis was not performed because Alternatives A and B would not modify the existing hydraulic structure in Calabazas Creek within the project footprint.

3.10 San Tomas Aquino Creek

3.10.1 Existing Condition

San Tomas Aquino Creek begins in the Santa Cruz Mountains and is in the San Tomas Aquino watershed, which is approximately 27 square miles. San Tomas Aquino Creek drains Saratoga, Santa Clara, Monte Sereno, and Campbell. It has numerous tributaries, including Wildcat Creek, Vasona Creek, Vasona Canal, Smith Creek, and Sobey Creek. However, the largest of its tributaries is Saratoga Creek, which receives flow from Booker Creek, McElroy Creek, Todd Creek, Bonjetti Creek, Sanborn Creek, Aubry Creek, and Congress Springs Creek. Within the project footprint, San Tomas Aquino Creek is a straight engineered channel. The channel upstream and downstream of the existing railroad crossing is a rectangular concrete-lined channel with a top width of approximately 60 feet. San Tomas Aquino Creek Trail runs adjacent to San Tomas Aquino Creek and crosses under the existing railroad bridge.

The hydraulic model of San Tomas Aquino Creek was provided by the SCVWD. The upstream and downstream limits of the hydraulic model were the confluence with Saratoga Creek (approximately 1,500 feet upstream of the existing railroad bridge) and immediately upstream of the US 101 bridge (approximately 5,600 feet downstream of the existing railroad bridge), respectively. The hydraulic model referenced NGVD 29. A factor of 2.85 feet was used to convert the elevation from NGVD 29 to NAVD 88 (FEMA 2014). The existing bridge included in the hydraulic model has a flowline elevation of 38.4 feet NAVD 88 and a bridge soffit elevation of 51.7 feet NAVD 88. A FEMA 100-year flow of 9,100 cfs was used for the San Tomas Aquino Creek floodplain hydraulic modeling. This 100-year flow was obtained from FEMA FIS for Santa Clara County, California, and Incorporated Areas, dated February 19, 2014.

Table 14 shows the existing condition modeling results. Under the FEMA 100-year peak flow, the existing bridge would be under pressure and cause backwater.

Table 14 Existing Condition Hydraulic Modeling Results, San Tomas Aquino Creek

Project Condition	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE – Existing Condition (feet NAVD 88)
Existing	9,100	51.7	55.8

Source: SCVWD 2016c
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

3.10.2 Proposed Condition

Proposed condition hydraulic analysis was not performed because Alternatives A and B would not modify the existing hydraulic structure in San Tomas Aquino Creek within the project footprint.

3.11 Los Gatos Creek

3.11.1 Background Information

The SCVWD combined one- and two-dimensional HEC-RAS models used to perform existing and proposed condition hydraulic analyses included the hydrographs for the 100-year storm event. The hydrographs included in the hydraulic model are discussed in Section 3.11.2, Overview of Hydraulic Model. The limits of the hydraulic model are shown in Figure 10.

According to the FEMA FIRM Panel No. 60685C0234H (FEMA 2009), Los Gatos Creek in the project footprint is identified as Zone A (Figure 11). The FEMA FIRM does not show overbank flood flows in the project vicinity. The width of the Zone A measured along the alignment is approximately 130 feet for Alternative A and approximately 70 feet for Alternative B.

Alternative A would be blended and at grade, using the existing Caltrain and Union Pacific Railroad (UPRR) tracks, which were replaced in 2017. HSR trains would share the existing railroad bridge over Los Gatos Creek with Caltrain and UPRR. Modifications to the existing bridge structure would not be made under this project alternative. The project footprints for Alternative B overlap with the existing 100-year floodplain for Los Gatos Creek. However, the proposed viaduct segments supported by pier columns for Alternative B (both viaduct options) would span over Los Gatos Creek and the proposed pier columns supporting the viaduct would be built outside the limits of the existing Zone A floodplain. The track profile over Los Gatos Creek would be approximately 60 feet above the existing channel bank elevation of Los Gatos Creek and would not be in contact with the 100-year flood flow as shown in the FEMA FIRM. Accordingly, for both project alternatives, no changes are proposed inside the existing FEMA 100-year floodplain of Los Gatos Creek.

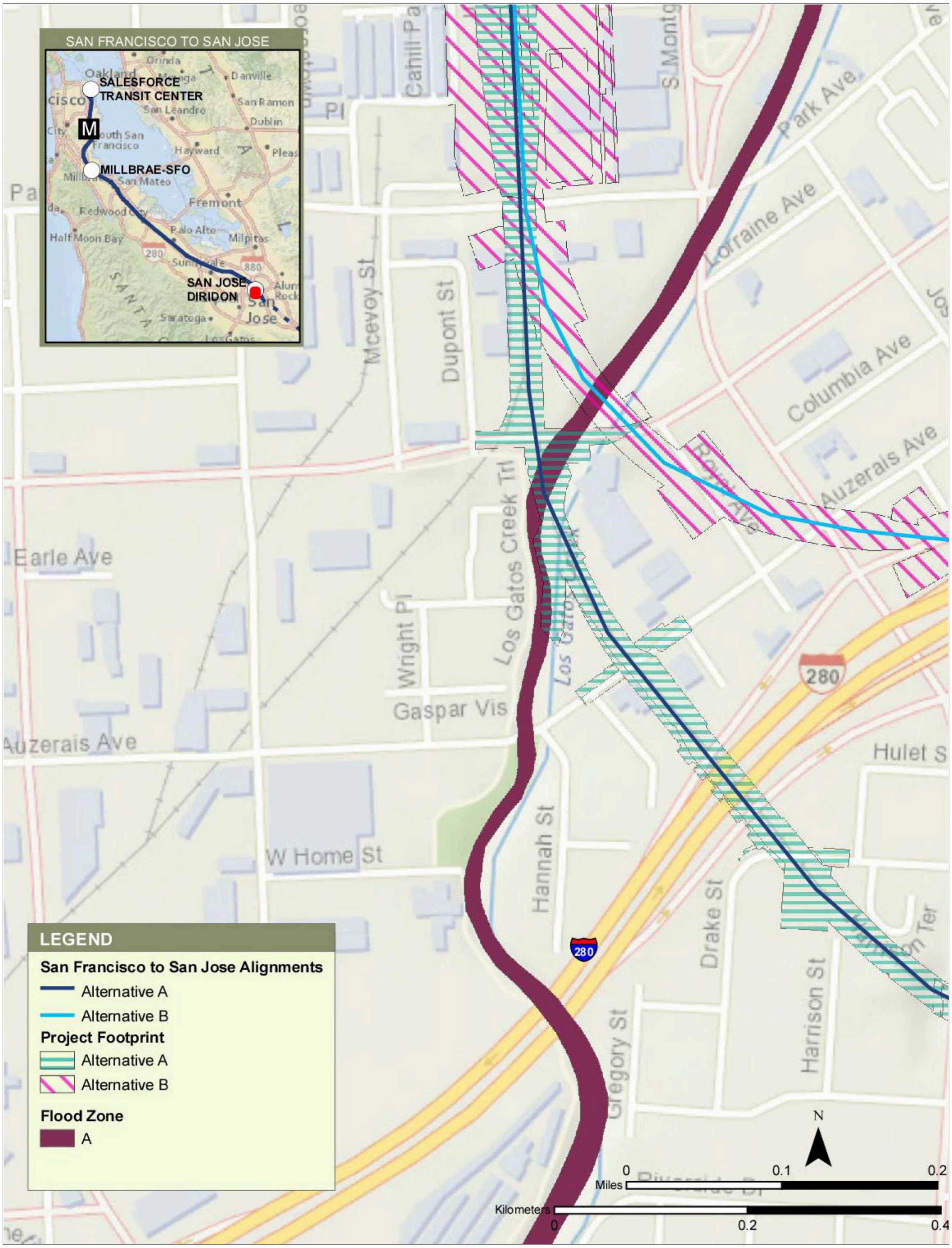
Los Gatos Creek in the project vicinity is identified as Zone A, which is assigned to floodplains determined by approximate methods. In addition, the date of the current effective FEMA FIRM (2009) is before the construction of the existing bridge in the year 2017, which would be used as the blended railroad track for HSR in Alternative A. Therefore, the hydraulic analysis using FEMA's effective hydraulic model was not performed for Los Gatos Creek.

The more recent SCVWD hydraulic model was documented in this study. Figure 10 illustrates upstream and downstream limits of the hydraulic model. Figures 12 and 13 illustrate the limits of the SCVWD hydraulic model and project footprint for Alternative A and Alternative B at Los Gatos Creek, respectively.

Sources: SCVWD 2018a; Authority 2019b

MAY 2019

Figure 10 Location and Limits of the Available Hydraulic Models: Los Gatos Creek, SCVWD Model



Sources: FEMA 2009; Authority 2019b

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Figure 11 Los Gatos Creek, FEMA FIRM Overlay with Project Footprints for Alternatives A and B

Sources: SCVWD 2018a; Authority 2019b

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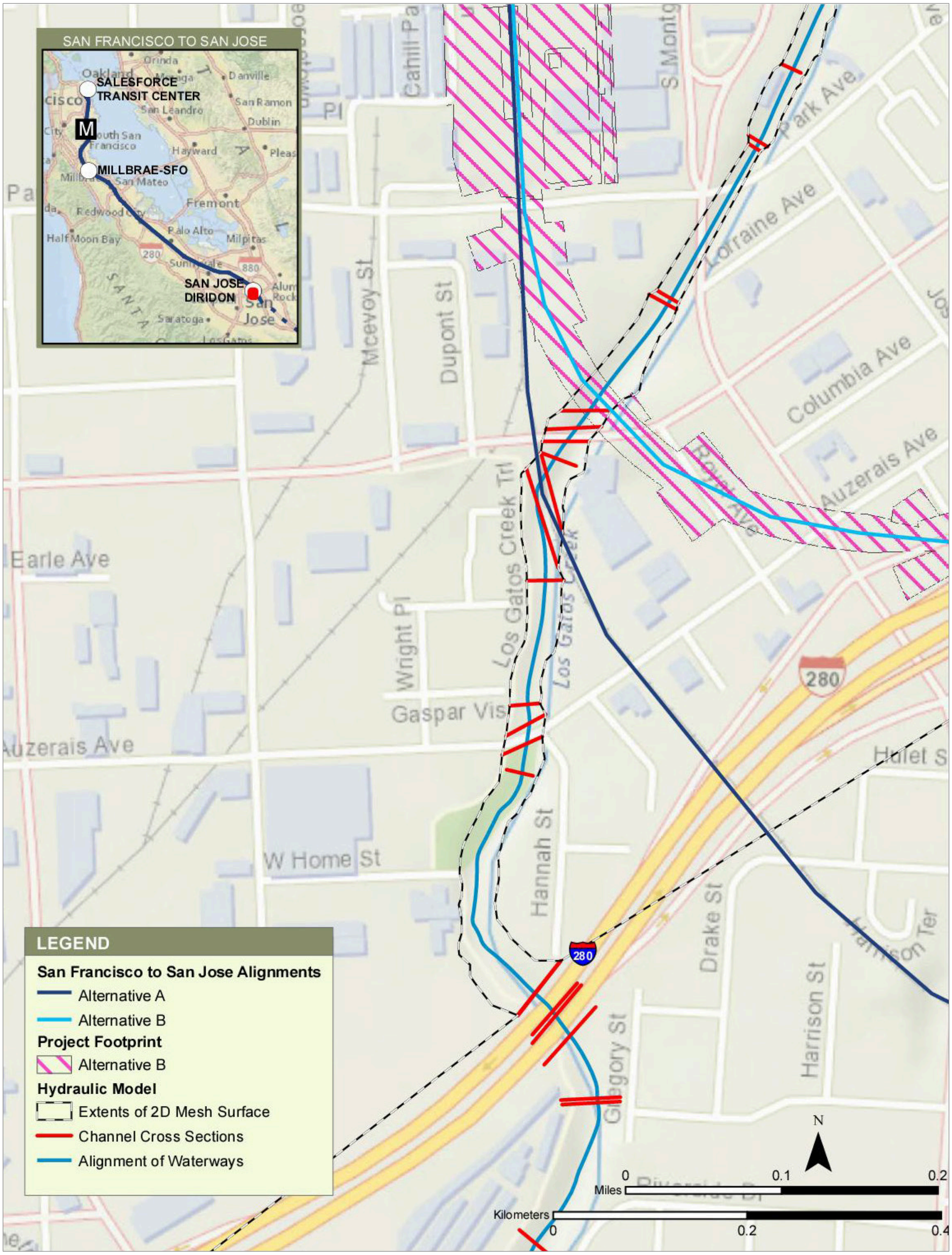
Figure 12 Los Gatos Creek, Plan View of SCVWD Hydraulic Model with Project Footprints for Alternative A



Sources: SCVWD 2018a; Authority 2019b

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Figure 13 Los Gatos Creek, Plan View of SCVWD Hydraulic Model with Project Footprints for Alternative B

3.11.2 Overview of Hydraulic Model

The upstream and downstream limits of Los Gatos Creek included in the hydraulic model were immediately downstream of Vasona Park Road Bridge in Vasona Reservoir (approximately 37,860 feet upstream of existing Caltrain/UPRR bridge over Los Gatos Creek) and confluence with Guadalupe River (approximately 4,100 feet downstream of the proposed HSR viaduct over Los Gatos Creek).

The two-dimensional mesh included in the hydraulic model used to represent the overbank flood flows, included areas roughly bounded by I-280 on the south, SR 87 on the east, West Taylor Street on the north, and The Alameda/Race Street on the west. The area of the two-dimensional mesh included in the hydraulic model is approximately 836 acres. This hydraulic model provided by the SCVWD did not provide references to vertical datum. Therefore, vertical datum were assumed to be referencing the NAVD 88. The outputs from the existing condition hydraulic analysis showed that the existing railroad bridge over Los Gatos Creek would be overtopped during the 100-year storm event.

Alternative A would not involve any improvements to the existing Los Gatos Creek bridge. Because detailed design of the removal/replacement Bird Avenue undercrossing under this alternative is not available, hydraulic analysis for Alternative A was not performed in this phase of the project.

The pier columns for Alternative B are outside of the limits of the Los Gatos Creek main channel represented in one-dimensional riverine model. The hydraulic model for Alternative B did not make any modifications to the model inputs in the one-dimensional riverine component.

The pier columns for Alternative B are within the limits of the two-dimensional mesh included in the hydraulic model, which represents the extents of the overbank flood flows from Los Gatos Creek within the model limits. The Manning's roughness coefficient of 1.0 was assigned in the footprint of the proposed piers columns for Alternative B to represent the additional obstruction from the pier columns in the overbank area.

According to SCVWD, flow hydrographs from the 2009 USACE Guadalupe Hydrology Report were used in the Los Gatos Creek HEC-RAS model (SCVWD 2018a). There were 11 locations in the hydraulic model with assigned inflows. The peak 100-year flows at each inflow location are shown in Table 15. The inflow locations in the hydraulic model are illustrated on Figure 14.

Table 15 Peak 100-year Inflows into Los Gatos Creek Hydraulic Model

Location	Distance from Existing Railroad Bridge[1]	Peak 100-year Inflow (cfs)
RS 41962.09	37,860 feet upstream	7,730
RS 36755.72	32,660 feet upstream	511
RS 30400	26,300 feet upstream	130
RS 24499.3	20,400 feet upstream	130
RS 19915.39	15,820 feet upstream	107
RS 15559.06	11,460 feet upstream	107
RS 12899.16	8,800 feet upstream	107
RS 12591.04	8,490 feet upstream	267
RS 5087.607	990 feet upstream	36
RS 3953	150 feet downstream	36
RS 3363.051	740 feet downstream	36

Source: SCVWD 2018a
cfs = cubic feet per second
RS = River Station
[1] Rounded to the nearest 10 feet.

Sources: SCVWD 2018a; Authority 2019b

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Figure 14 Inflow Locations in the SCVWD Hydraulic Model of Los Gatos Creek

3.11.3 Water Surface Elevations, Main Channel

Table 16 shows the modeling results for Alternative B. The outputs from hydraulic analysis shows the proposed pier columns for Alternative B placed in two-dimensional mesh area of the hydraulic model would not have an impact on the 100-year flood profile of Los Gatos Creek in the main channel. Because there were minimal impacts on the existing 100-year floodplain, the existing railroad bridge would remain overtopped during 100-year storm event for Alternative B (both viaduct options).

Table 16 Existing and Proposed Condition Hydraulic Modeling Results, Los Gatos Creek, Alternative B[1]

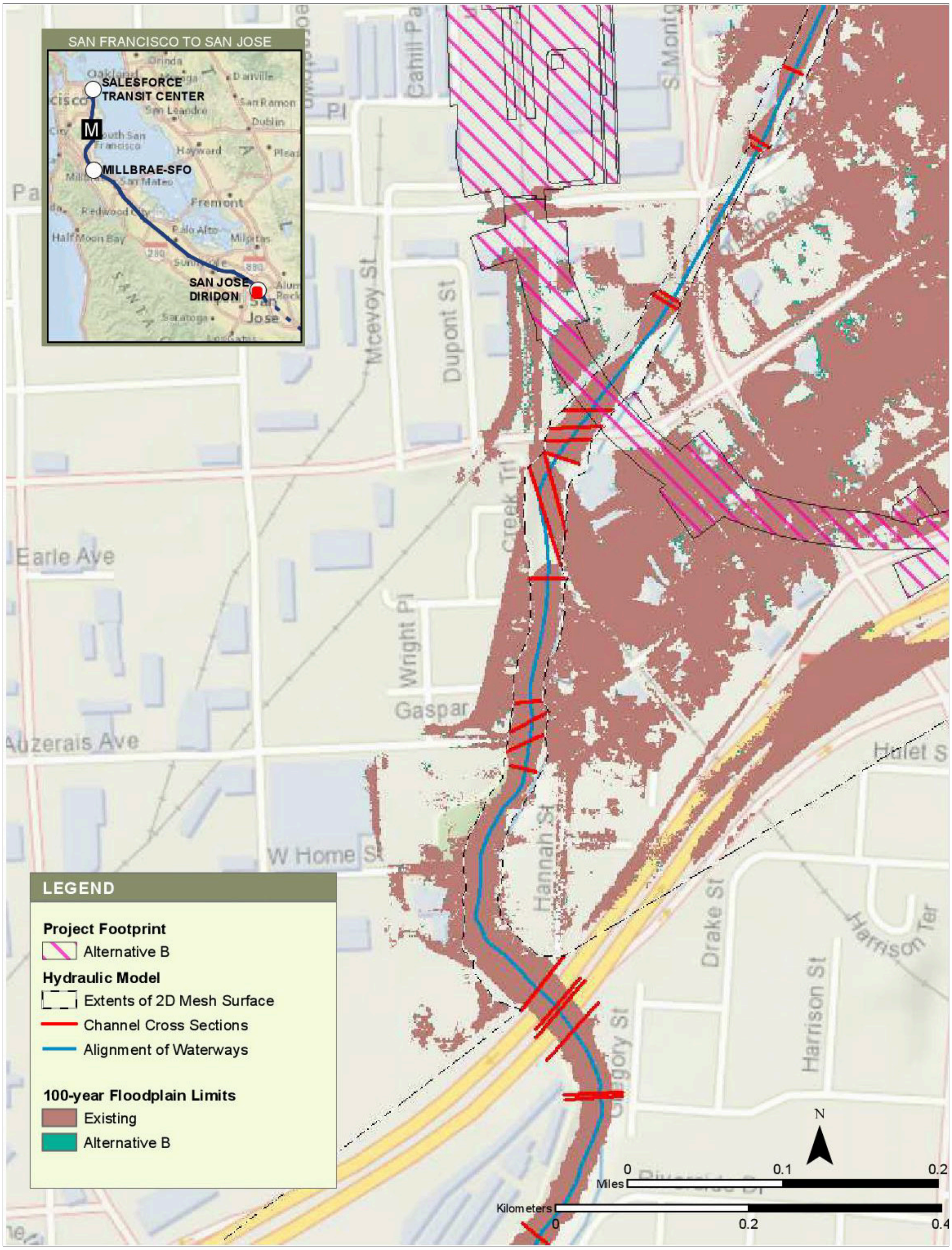
Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At confluence with Guadalupe River	7,700	81.3	78.2	78.2	0.0
At proposed HSR viaduct crossing (66+00)	7,900	99.6	99.6	99.6	0.0
At existing Railroad Bridge	7,630	98.9	101.2	101.2	0.0
At Auzerais Avenue Bridge	8,030	103.7	105.9	105.9	0.0
At I-280 Bridge	8,260	109.2	109.5	109.5	0.0

cfs = cubic feet per second
HSR = high-speed rail
I- = Interstate
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
Elevations are rounded to the nearest 0.1 foot.
Flow rate shown in this table is for flood flows remaining inside the main channel, and is rounded up to the nearest 10 cfs.
[1] Results are the same for Alternative B (Viaduct to I-880) and Alternative B (Viaduct to Scott Boulevard).

3.11.4 Water Surface Elevations, Overbank Area

The outputs from the hydraulic analysis of the existing condition and Alternative B using the SCVWD hydraulic model showed overbank flood flows from Los Gatos Creek during 100-year storm event. The proposed pier columns for Alternative B outside the main channel of Los Gatos Creek were in contact with the overbank flood flows.

The extents of the 100-year floodplain in the overbank area of the hydraulic model for the existing condition and Alternative B (both viaduct options) are illustrated on Figure 15. The proposed pier columns represented as areas with the Manning's roughness coefficient of 1.00 in the overbank areas represented by two-dimensional mesh showed no significant changes to the extents of the 100-year floodplain.



Sources: SCVWD 2018a; Authority 2019b

NOVEMBER 2020

Figure 15 Extents of 100-Year Floodplain, Existing Condition and Alternative B

3.12 Guadalupe River and Tributaries

3.12.1 Background Information

Guadalupe River runs through downtown San Jose for 3 miles from I-280 to I-880. The Guadalupe River's headwaters form in the Santa Cruz Mountains near the summit of Loma Prieta and Mount Umunhum. The river mainstem begins on the Santa Clara Valley floor at the northern end of Lake Almaden, which is fed by Los Alamitos Creek and Guadalupe Creek, just downstream of Coleman Road in San Jose. From there, it flows north 14 miles through San Jose, emptying into San Francisco Bay at Alviso Slough. Historically, Guadalupe River was even shorter, originating several miles farther north at the downstream end of a large willow swamp that is now Willow Glen.

Guadalupe River in the project vicinity would be subject to the USACE Section 404 and 408 permitting process. The FEMA Special Flood Hazard Areas in the main channel of Guadalupe River that would be subject to USACE Section 404 and 408 permitting process is Zone A.

According to the FEMA FIRM Panel No. 60685C0234H (FEMA 2009), the main channel of the Guadalupe River in the project footprint is identified as Zone A with a width of approximately 150 feet (Figure 16). The FEMA FIRM also shows overbank flood flows from Guadalupe River and tributaries that are identified as Zone AO and AH (Figure 16).

The footprints for both project alternatives are in the existing 100-year floodplain for Guadalupe River and its tributaries. Under Alternative A, HSR would share the corridor with UPRR and Caltrain and would build a new at-grade track adjacent to the existing track. Near the Guadalupe River bridge crossing, Alternative A is proposing a new single-track bridge structure over I-280, SR 87, and Guadalupe River on the south side of the existing bridge structure. The existing railroad track over I-280, SR 87, and Guadalupe River would remain. This project alternative would also remove and replace existing underpasses for Bird Avenue and Delmas Avenue. Under Alternative B (both viaduct options), a viaduct segment supported by pier columns would span the Guadalupe River and run along the top of the western channel bank. The proposed pier columns for the viaduct segment are inside FEMA Special Flood Hazard Area Zones A, AO, and AH.

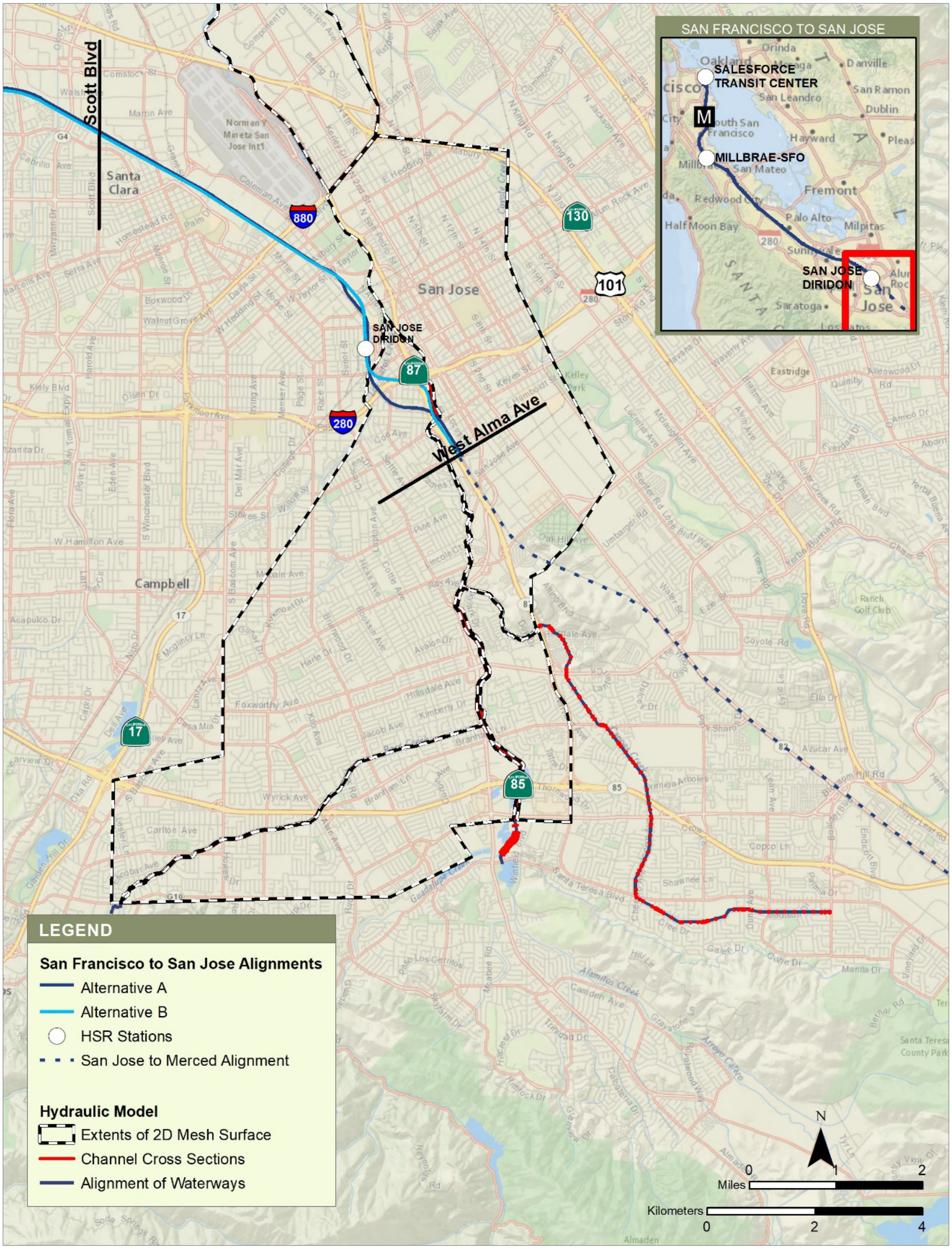
The FEMA effective hydraulic model was not available because the existing floodplain is designated as Zone A, defined as FEMA SHFA and determined by approximate methods. The hydraulic model provided by SCVWD was available for this waterbody and was used to perform hydraulic analysis to determine project's potential impacts on the existing floodplain. Figure 17 illustrates the upstream and downstream limits of the hydraulic model.

Figures 18 and 19 illustrate the limits of the SCVWD hydraulic model and project footprint for Alternatives A and B, respectively, near the existing railroad bridge over Guadalupe River. The existing and proposed conditions of the 100-year flood profile of Guadalupe River near the existing and proposed railroad bridges over Guadalupe River were compared.

Sources: FEMA 2009; Authority 2019b

JANUARY 2019

Figure 16 Guadalupe River, FEMA FIRM Overlay at Guadalupe River Bridge with Project Footprints for Alternatives A and B



Sources: SCVWD 2018b; Authority 2019b

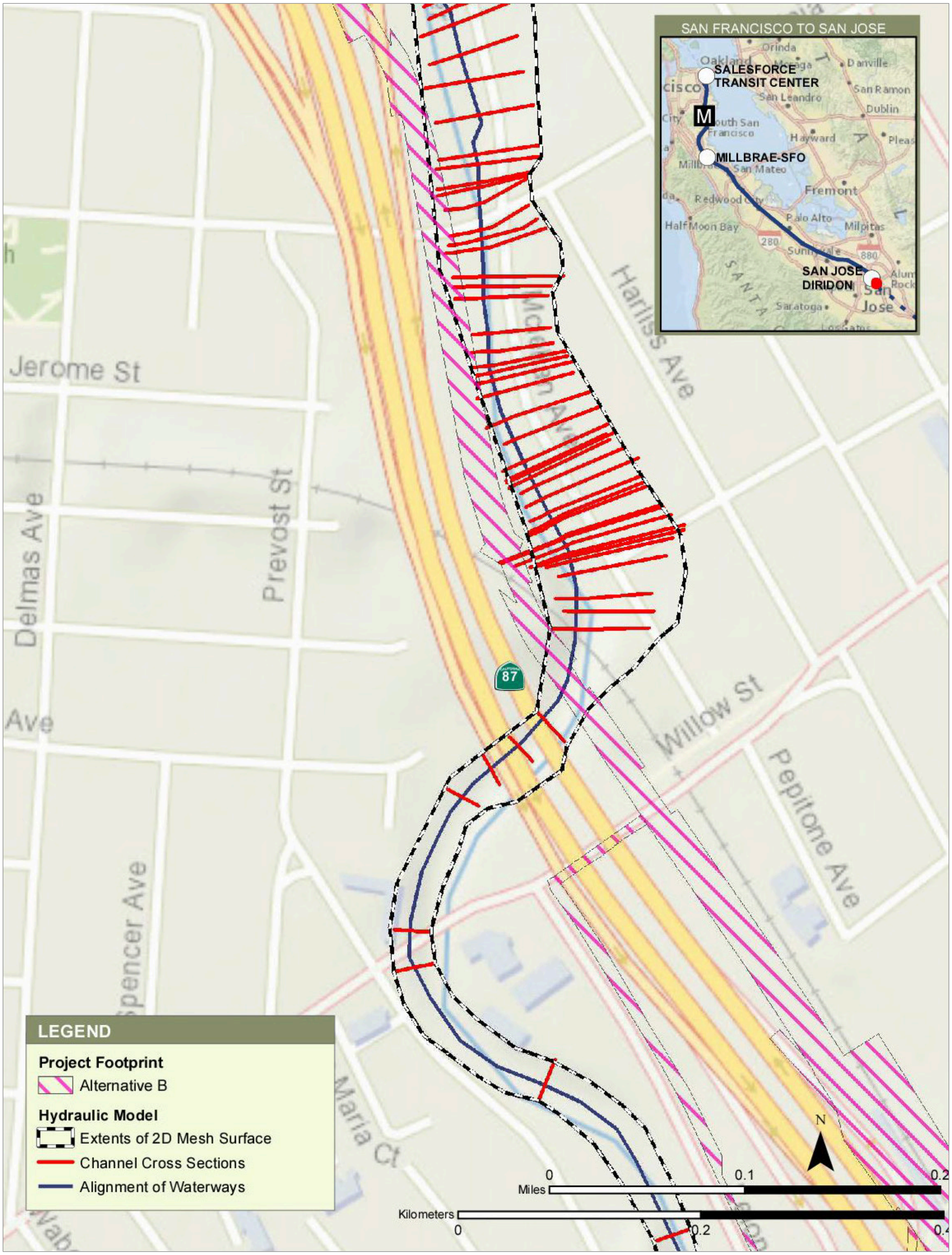
MAY 2019

Figure 17 Location and Limits of the Available Hydraulic Models: Guadalupe River and Tributaries, SCVWD Model

Sources: SCVWD 2018b; Authority 2019b

MAY 2019

Figure 18 Guadalupe River, Plan View of SCVWD Hydraulic Model at Guadalupe River mainline with Project Footprints for Alternative A



Sources: SCVWD 2018b; Authority 2019b MAY 2019

Figure 19 Guadalupe River, Plan View of SCVWD Hydraulic Model at Guadalupe River mainline with Project Footprints for Alternative B

3.12.2 Overview of Hydraulic Model

The combined one- and two-dimensional hydraulic model of Guadalupe River and its tributaries provided by SCVWD was developed using the USACE HEC-RAS. The one-dimensional component of the SCVWD's HEC-RAS model refers to the main channel of Guadalupe River and tributaries (Canoas Creek and Ross Creek) represented by a series of channel cross sections and bridge crossings. The two-dimensional component of the SCVWD's HEC-RAS model refers to the overland floodplain area of Guadalupe River and tributaries represented by the computational mesh. The length and upstream/downstream limits of the floodplains included in the hydraulic model are summarized in Table 17. The limits of the hydraulic model are illustrated on Figure 17.

Table 17 Floodplains included in Guadalupe River Hydraulic Model

Name of Floodplain	Reach Length (feet)	Location of Upstream Limit	Location of Downstream Limit
Guadalupe River	32,630	Approximately 500 feet downstream (north) of Coleman Road	Immediately upstream of I-280/SR 87 Interchange
Canoas Creek	39,000	At Cottle Road	Confluence with Guadalupe River
Ross Creek	25,920	At Blossom Hill Road	Confluence with Guadalupe River

Sources: SCVWD 2018b; Authority 2019b
I- = Interstate
SR = State Route

There were no changes to the setup of the SCVWD hydraulic model to perform the hydraulic analysis of existing condition. Based on the design of the proposed railroad bridge over Guadalupe River included in the Volume 3, Preliminary Engineering Plans (Alternative 1 Book A4, Drawing No. ST-T4001), the proposed railroad bridge over Guadalupe River crossing for Alternative A was represented in the proposed condition of the HEC-RAS model by widening the existing railroad bridge over Guadalupe River located immediately downstream of the proposed railroad bridge. The pier columns supporting the proposed viaduct segments along the Guadalupe River and at the Guadalupe River crossings for Alternative B (both viaduct options) were represented in the HEC-RAS model of the proposed condition.

The HEC-RAS model for Alternatives A and B made adjustments to the model inputs in the two-dimensional mesh to include the proposed cut and fill, proposed structures within the existing FEMA 100-year floodplain, and project features that would minimize the potential for floodplain impacts. The full setup of the hydraulic model will be revised during the design phase of this project.

In addition to the hydraulic analysis using a full model, a simplified one-dimensional hydraulic model (simplified SCVWD model), based on SCVWD's HEC-RAS model, was used for the hydraulic analysis of the Guadalupe River main channel for Alternative A at the proposed railroad bridge crossing. The simplified SCVWD model was created by removing the two-dimensional model components and one-dimensional model components representing upstream tributaries from SCVWD's model. For this hydraulic model, new additional Guadalupe River channel cross sections were added to the model at the Project location, based on the Santa Clara County LiDAR data published in October 2020 (OCM Partners 2021). The new railroad bridge with channel grading, consistent with the existing design, was incorporated into the model to replicate the proposed condition.

There were 36 locations in the hydraulic model with assigned inflows. The peak 100-year flows at each inflow location are summarized in Table 18. The inflow locations in the hydraulic model are illustrated on Figure 20.

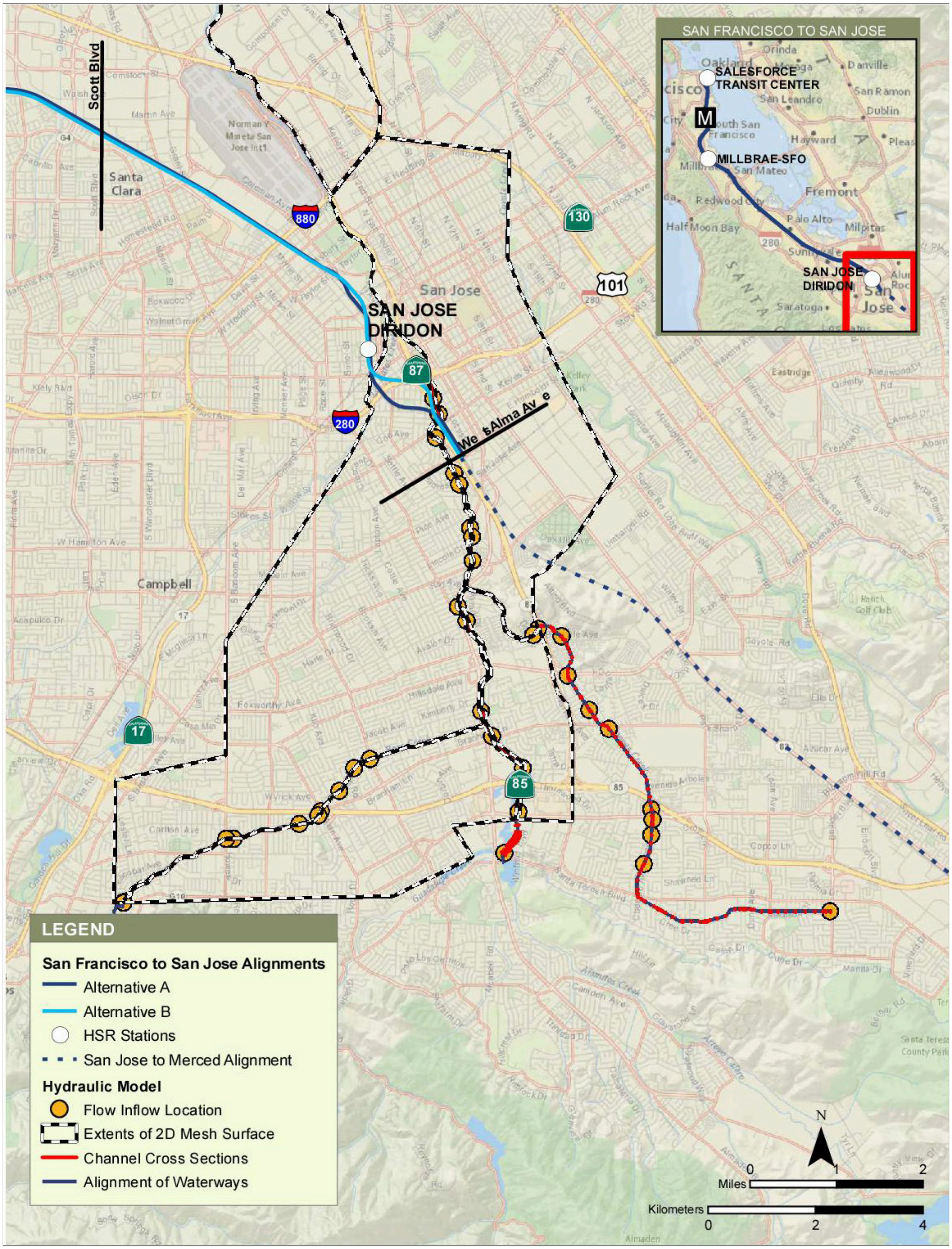
Table 18 Peak 100-Year Inflows into Guadalupe River and Tributaries Hydraulic Model

Floodplain Name	River Station in Hydraulic Model	Distance from Existing Railroad Bridge[1]	Peak Inflow (cfs)
Guadalupe River	104500	30,300 feet upstream	11,165
Guadalupe River	101450	27,250 feet upstream	137
Guadalupe River	98800	24,600 feet upstream	68
Guadalupe River	95900	21,700 feet upstream	68
Guadalupe River	94200	20,000 feet upstream	138
Guadalupe River	88000	13,800 feet upstream	275
Guadalupe River	87000	12,800 feet upstream	46
Guadalupe River	84005	9,800 feet upstream	45
Guadalupe River	82343	8,100 feet upstream	81
Guadalupe River	81773	7,570 feet upstream	45
Guadalupe River	78690	4,490 feet upstream	59
Guadalupe River	77944	3,740 feet upstream	81
Guadalupe River	75490	1,290 feet upstream	53
Guadalupe River	73691.23	500 feet downstream	105
Guadalupe River	72705.37	1,500 feet downstream	26
Canoas Creek	39008.19	46,800 feet upstream	475
Canoas Creek	38981.17	46,700 feet upstream	238
Canoas Creek	24395.26	32,220 feet upstream	93
Canoas Creek	22565.98	30,390 feet upstream	31
Canoas Creek	21618.92	29,440 feet upstream	196
Canoas Creek	21011.59	28,830 feet upstream	177
Canoas Creek	15301.56	23,120 feet upstream	177
Canoas Creek	13527.74	21,350 feet upstream	56
Canoas Creek	11053.71	18,880 feet upstream	56
Canoas Creek	8395.165	16,220 feet upstream	29
Canoas Creek	6665.77	14,490 feet upstream	36
Canoas Creek	6192.517	14,010 feet upstream	106
Ross Creek	25994.8	53010 feet upstream	1,067
Ross Creek	25951.9	52970 feet upstream	161
Ross Creek	18158.9	45180 feet upstream	80
Ross Creek	17695	44710 feet upstream	201
Ross Creek	13572.8	40590 feet upstream	187
Ross Creek	12213	39230 feet upstream	120

Floodplain Name	River Station in Hydraulic Model	Distance from Existing Railroad Bridge[1]	Peak Inflow (cfs)
Ross Creek	11906.9	38920 feet upstream	67
Ross Creek	10211.4	37230 feet upstream	67
Ross Creek	8544.6	35560 feet upstream	174
Ross Creek	7397.7	34420 feet upstream	107

Sources: SCVWD 2018b
cfs = cubic feet per second
[1] Distance from existing railroad bridge is rounded to the nearest 10 feet.

In the simplified SCVWD model of Guadalupe River for Alternative A, the single flow rate of 7,290 cfs was used for the main channel of Guadalupe River, based on the outputs from the existing condition hydraulic model at the Project location.



Sources: SCVWD 2018a; Authority 2019b

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Figure 20 Inflow Locations in the Guadalupe River and Tributaries Hydraulic Model

3.12.3 Water Surface Elevations—Main Channel

Table 19 shows the modeling results for the Guadalupe River main channel for Alternative A and Table 20 shows the modeling results for the Guadalupe River main channel for Alternative B. Table 21 shows the modeling results of the overbank floodplain of the Guadalupe River for Alternative A and Table 22 shows the modeling results for the overbank floodplain of the Guadalupe River for Alternative B. Figure 21 illustrates extents of the 100-year floodplain for Alternative A and existing conditions, and Figure 22 illustrates extents of the 100-year floodplain for Alternative B and existing conditions. Figure 23 illustrates changes to the 100-year floodplain elevation for Alternative A, and Figure 24 illustrates changes to the 100-year floodplain elevation for Alternative B.

The outputs from the hydraulic analysis for Alternative A showed that the proposed HSR bridge immediately upstream of the existing railroad bridge would not raise the 100-year flood profile of Guadalupe River main channel.

The outputs from the hydraulic analysis for Alternative B (both viaduct options) showed that pier columns supporting the viaduct near the Guadalupe River crossing would raise the 100-year flood profile inside the Guadalupe River main channel by approximately 0.1 foot or less both inside the main channel of the Guadalupe River and in the overbank floodplain near the existing railroad bridge over Guadalupe River. Project features would be required in Alternatives A and B to lower the 100-year flood profile back to the level of existing condition.

Table 19 Hydraulic Modeling Results, Guadalupe River, Alternative A

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At upstream of I-280 bridge	7,290	91.8	88.9	88.9	0.0
At West Virginia Street	7,290	99.0	93.3	93.3	0.0
Downstream of existing railroad bridge	7,290	104.0	100.3	100.3	0.0
Immediately Upstream of proposed HSR Bridge	7,290	106.6	104.1	104.1	0.0
Downstream end of SR 87 (Northbound) Bridge	7,290	107.0	104.4	104.4	0.0
Upstream end of SR 87 (Northbound) Bridge	7,290	108.0	105.1	105.1	0.0
Upstream end of SR 87 (Southbound) Bridge	7,290	108.0	105.6	105.6	0.0
At Willow Street	7,290	109.0	109.0	109.0	0.0
At upstream of I-280 bridge	7,290	91.8	88.9	88.9	0.0

cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
Elevations are rounded to the nearest 0.1 foot, unless otherwise noted.

Table 20 Hydraulic Modeling Results, Guadalupe River, Alternative B[1]

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At West Virginia Street	8,020	99.0	93.2	93.2	0.0
At downstream of existing railroad bridge	6,910	104.0	100.2	100.3	0.1
At upstream end of proposed HSR bridge	6,920	107.0	106.34	106.36	0.02
At Willow Street	7,430	109.0	109.13	109.16	0.03

cfs = cubic feet per second
HSR = high-speed rail
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
Elevations are rounded to the nearest 0.1 foot, unless otherwise noted.
[1] Results are the same for Alternative B (Viaduct to I-880) and Alternative B (Viaduct to Scott Boulevard).

Table 21 Hydraulic Modeling Results, Guadalupe River Overbank Floodplain, Alternative A

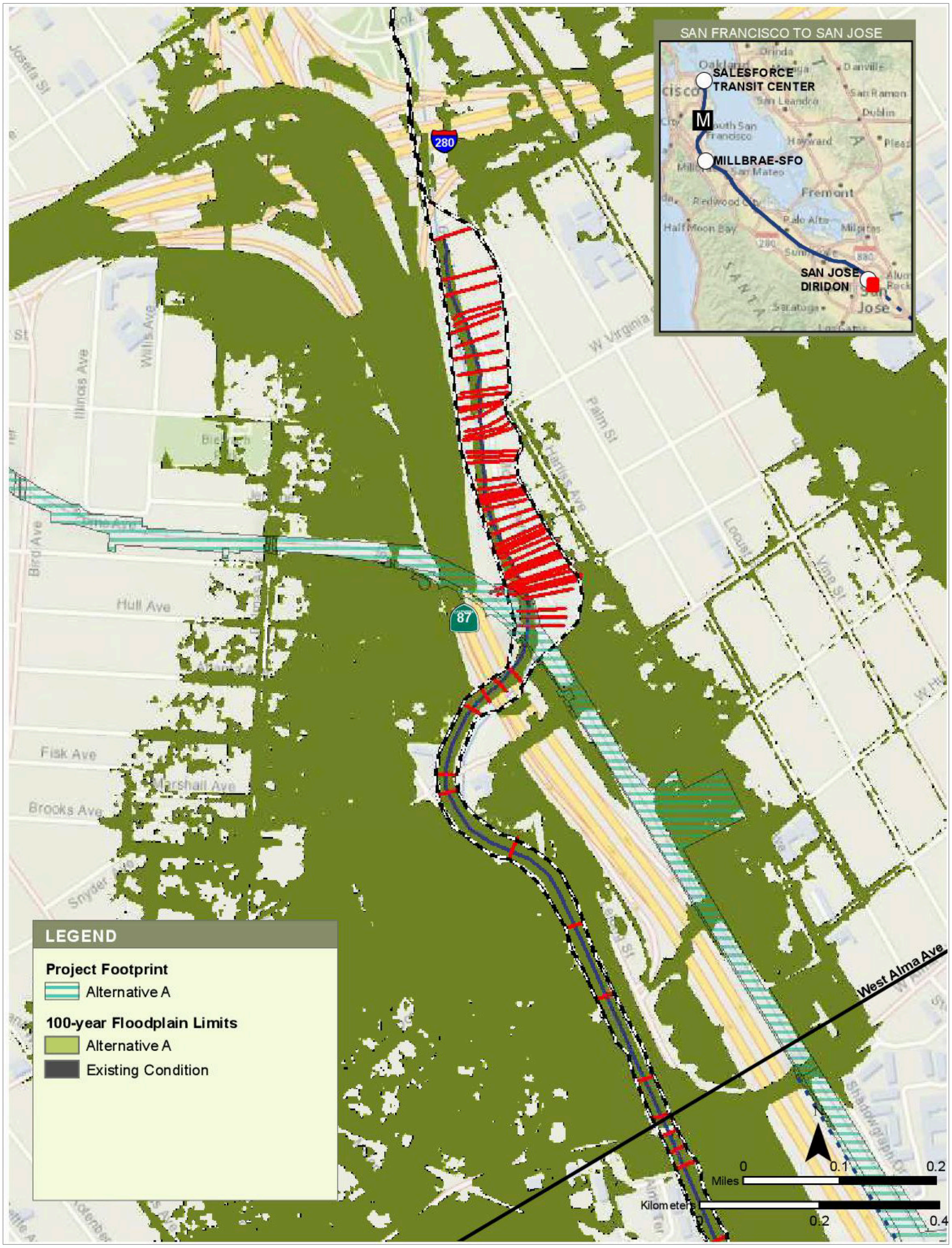
Location	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
Intersection of Prevost Street and Fuller Avenue	103.32	103.37	+0.04
Intersection of Prevost Street and Atlanta Avenue	105.94	105.97	+0.03
Intersection of Prevost Street and Willow Avenue	110.69	110.69	0.00
Intersection of Mills Court and Atlanta Avenue	106.13	106.26	+0.13
At Willow Street below Existing Railroad Bridge	108.50	108.51	+0.01

cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
Elevations are rounded to the nearest 0.1 foot, unless otherwise noted.

Table 22 Hydraulic Modeling Results, Guadalupe River Overbank Floodplain, Alternative B[1]

Location	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
Intersection of Prevost Street and Fuller Avenue	103.32	103.33	+0.01
Intersection of Prevost Street and Atlanta Avenue	105.94	105.95	+0.02
Intersection of Prevost Street and Willow Avenue	110.69	110.70	+0.01
Intersection of Mills Court and Atlanta Avenue	106.13	106.15	+0.02
At Willow Street below Existing Railroad Bridge	108.50	108.49	-0.01

cfs = cubic feet per second
HSR = high-speed rail
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
Elevations are rounded to the nearest 0.1 foot, unless otherwise noted.
[1] Results are the same for Alternative B (Viaduct to I-880) and Alternative B (Viaduct to Scott Boulevard).



Sources: SCVWD 2018b; Authority 2019b

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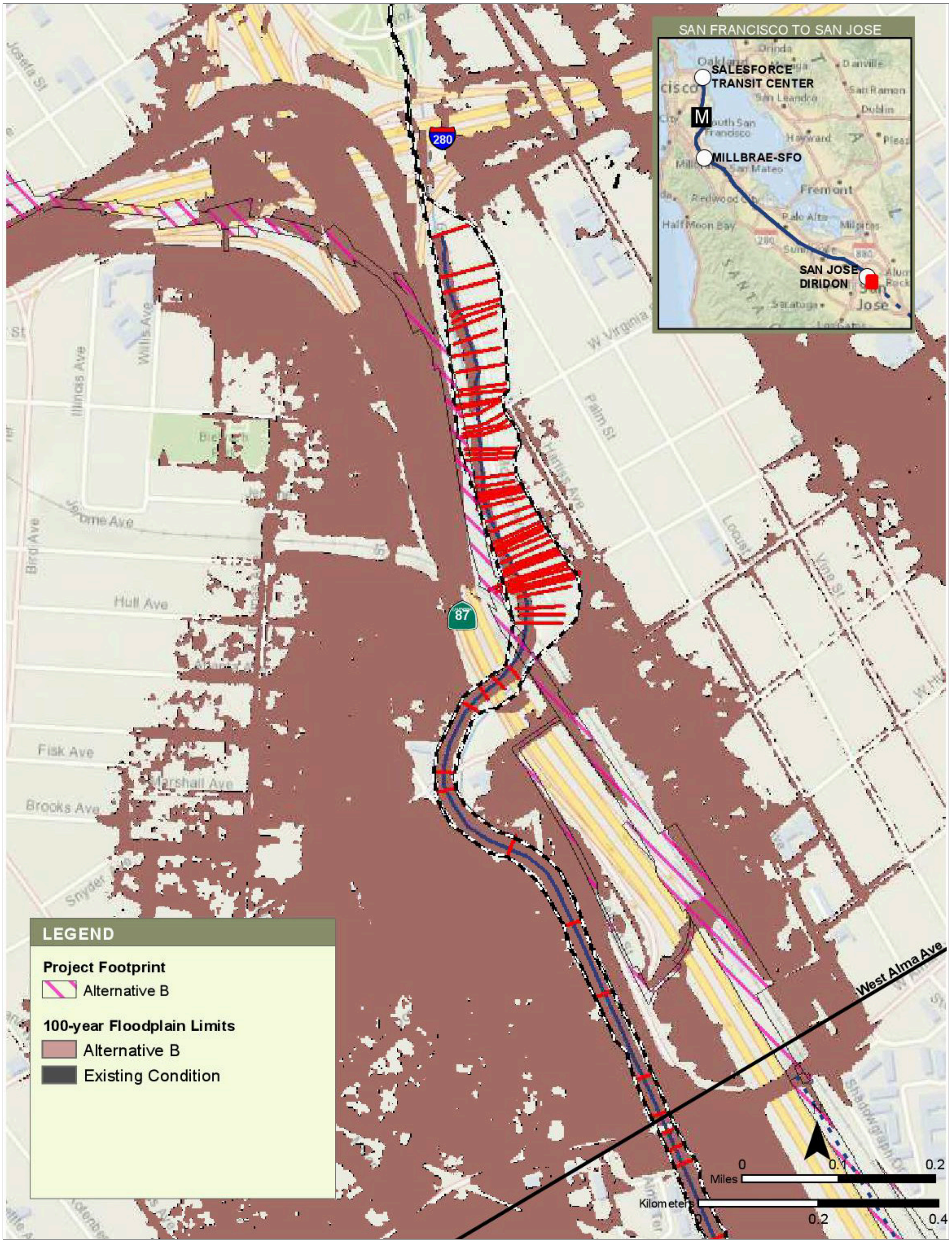
Figure 21 Guadalupe River, 100-year Floodplain Footprints from Hydraulic Analysis for Existing Condition and Alternative A



Sources: SCVWD 2018b; Authority 2019b

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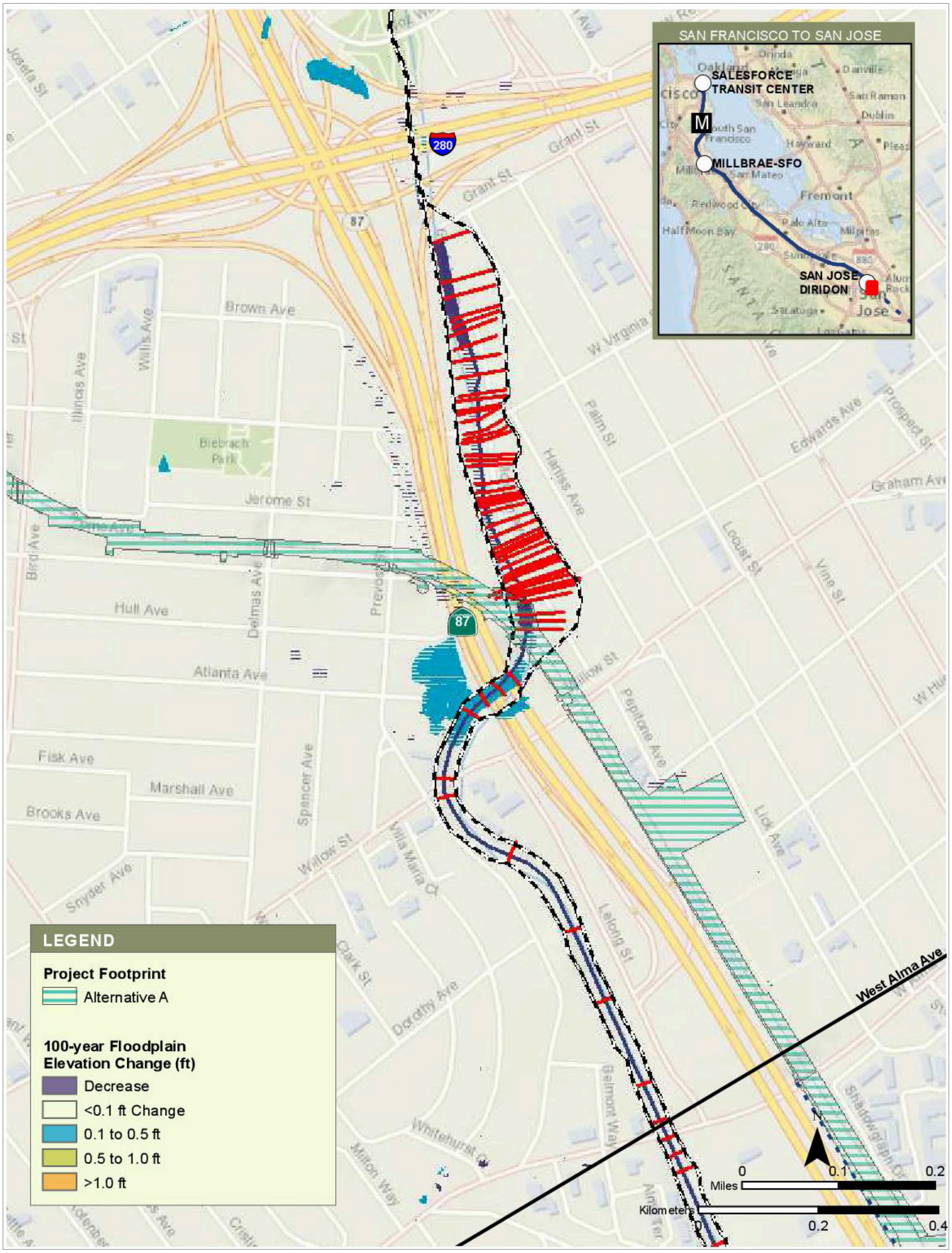
Figure 22 Guadalupe River, 100-year Floodplain Footprints from Hydraulic Analysis for Existing Condition and Alternative B



Sources: SCVWD 2018b; Authority 2019b

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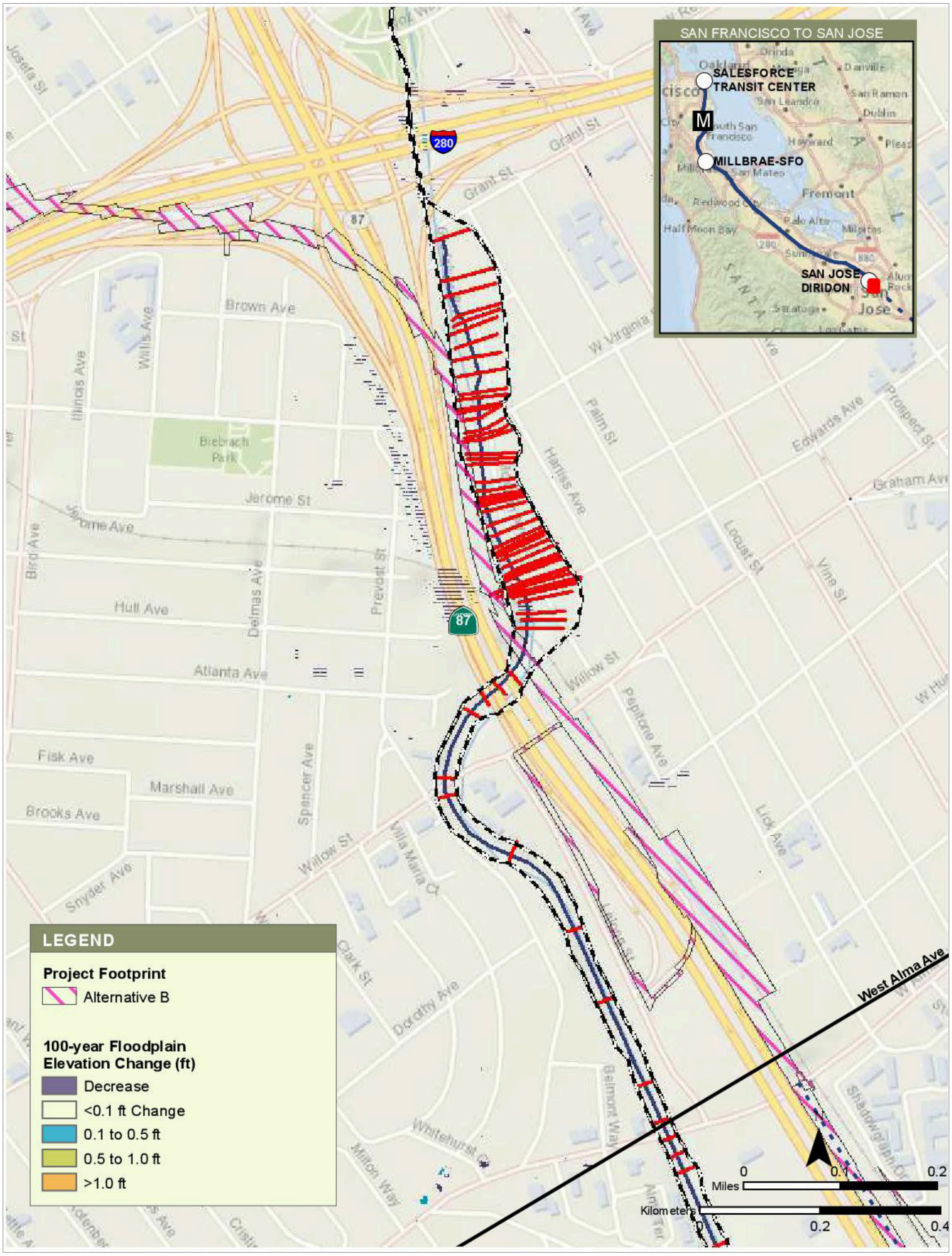
Figure 23 Guadalupe River, 100-year Floodplain Elevation Change from Existing Condition to Alternative A



Sources: SCVWD 2018b; Authority 2019b

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Figure 24 Guadalupe River, 100-year Floodplain Elevation Change from Existing Condition to Alternative B

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